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Claim

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Introduction to CLAIM D.4.20 – Part 2:

Report on WP4 Task 2, Activity c)

Activity c) represents original studies about the effects of landscape on economic activities and society welfare. These “ad-hoc studies” in Activity c) can be seen as the logical consequence of Activity a) and b): In the ad-hoc study, the knowledge gaps in the process of local answering the project’s guiding questions, that have been detected during Activity a) and b), shall be filled.

Furthermore, the ad-hoc studies test innovative methodologies likely to be sufficient in assessing the cause chain effects between landscape and rural development development/regional competitiveness. (At this, testing of methodologies is decided on case by case by the CLAIM consortium, depending on local need (and with a view of providing, altogether a coverage of different potential methods.)

Consequently, the different CSA ad-hoc studies do not follow a common methodological approach, as the different local basic conditions and knowledge gaps determine different needs and as a variety of methods shall be tested which could be suitable to address the projects objectives.

Part 4 of D4.20 represents the basic report on the application of different methods to answer the CSA specific research questions and on the final results of the ad-hoc studies. The report is organised country by country.

Contents of D4.20 – Part 2

1 CSA1: Landscape perception and ecosystem service uses: some results from surveys and latent variable models

Authors:

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1.1 Motivation and characteristics of the ad hoc study

The main objective of the first ad hoc study is to investigate the possible relationship between the relevance attributed to some components of agricultural landscape and the behavior in ecosystem service uses.

Data were collected through two ad hoc surveys carried out in the Po Delta area from July to September 2013. The first survey had the aim to collect information from inhabitants of the area selected, which is composed by ten municipalities: Codigoro, Comacchio, Goro, Jolanda di Savoia, Lagosanto, Massa Fiscaglia, Mesola, Migliarino, Migliaro and Ostellato. The municipalities were aggregated in three areas considering different geographical location and used as one of the three variables of stratification. The other two variables used to stratify the population were gender and age class.

The second survey was addressed to collect information from tourists. The questionnaire was distributed in 3 different occasions to people on the beach of the case study municipalities, distributed in the visit centers of the Po delta Park and in all agritourisms situated in the area. Finally, 380 tourists participated by compiling themselves the questionnaire.

Both questionnaires have the same structure even if some questions were adapted to be coherent with the respondents type (residents or tourists). The first set of questions have the aim to collect information about the perceptions of aspects of agricultural landscape. For the same set of landscape elements residents answered about their relevance for agricultural and tourism sectors and for inhabitants; instead tourists answered about the influence of the landscape elements on the choice of holiday location. More specifically the elements could be classified in two groups: “strictly” landscape elements (canals and bodies of water (lakes, ponds); herons, other fowl, aquatic animals; woods and characteristic plants, hedges, wetlands and other uncultivated land; rice paddies and related fauna (amphibians, insects, etc.); protected areas in the Po Delta Park;) and “promotional” landscape elements (networks of bicycle paths; wine and flavour routes (‘Strade dei vini e dei sapori’); crops and quality local products (PGI, PDO, DOCG); celebrations and local countryside festivals).

The second part focuses on “uses” of agricultural landscape services, in particular asking about local product purchases and activities connected to landscape (walking, bird watching, cycling,..). The last part of the questionnaire deals with individual and family characteristics (age, gender, education,…).

Data collected with the ad-hoc survey were analysed using Latent class factor models (Magidson and Vermunt, 2001), a particular subclass of latent variable models separately for residents and for tourists.

1.2 Methodology

Latent variable models are statistical models that can be used to analyze data in presence of unobservable variables. These models are particularly useful when one is interested in studying theoretical constructs that cannot be directly observed (such as the relevance attributed to landscape or to promotional activities related to landscape, or willingness to use landscape services). These models can be build starting from observed variables that can be considered as indirect indicators of such construct (for example the number of landscape features that are considered relevant for the local economic activities, or the use of local agricultural products).

Latent class factor models (Magidson and Vermunt, 2001) are a particular subclass of latent variable models that are characterized by the assumption that the latent variables have an ordinal nature. Furthermore, these subclass of latent variable models allow to jointly consider more than one latent variable, and thus allow to investigate the relationships among the unobservable constructs. The commercial software Latent GOLD 4.0 (Vermunt and Magidson, 2005) can be used to estimate the parameters of these models.

1.2.1 Basic definition

Let Y_i denote the i-th observed indicators, with i=1, ..., I, with I denoting the number of observed variables. Although latent class factor models can deal with any type of observed indicators, in the following the attention is focused on either binary or ordinal indicators. In such a situation, the observed binary indicators are numerically coded by 0 or 1, and the observed ordinal indicators are coded by integer numbers ranging from 0 to S (without loss of generality, in the following ordinal indicators with the same number of categories are considered). Furthermore, it is assumed that binary indicators have a Bernoulli probability distributions and ordinal indicators have multinomial probability distributions. The key assumption of latent class factor models is that these probability distribution depend on L ordinal latent variables, with L≥1. These latent ordinal variables can have a different number of categories. For the sake of simplicity, in the following latent class factor models with two dichotomous ordinal latent variables, X_1 and X_2 are considered.

The link between each binary indicator and the latent factors is expressed using a binary logistic regression model

$$\log\left[\frac{P(Y_i=1|X_1=x_1,X_2=x_2)}{1-P(Y_i=1|X_1=x_1,X_2=x_2)}\right] = \beta_{i0} + \beta_{i1}x_1 + \beta_{i2}x_2 \quad (1)$$

x_1 and x_2 represent the numerical coding of specific levels of the two ordinal latent factors. In order to guarantee identifiability of the resulting model, these numerical coding are set equal to fixed scores. Usually, equally spaced scores between 0 and 1 are considered. In this case, x_l=0, 1, for l=1, 2.

Similarly, the link between each ordinal indicator and the latent factors is assumed to follow an adjacent-category ordinal logistic model

$$\log\left[\frac{P(Y_i=s|X_1=x_1,X_2=x_2)}{P(Y_i=(s-1)|X_1=x_1,X_2=x_2)}\right] = \beta_{i0s} + \beta_{i1}x_1 + \beta_{i2}x_2, \quad s=1,\dots,S \quad (2)$$

in equations (1) and (2), β_{i0}, β_{i0s}, β_{i1} and β_{i2} are unknown parameters that have to be estimated from an observed data set. In particular β_{i1} and βi_2 describe the strength of the relationship between Y_i and each of the two latent factors.

In order to complete the model definition, the joint distribution of the ordinal latent factors need to be specified. The simplest specification for this joint distribution can be obtained by assuming independence among latent factors. In such case, the joint distribution of the two factors in simply obtained by multiplying the two marginal distributions. In the case of dichotomous factors, these marginal distributions are modelled as follows:

$$P(X_l = 1) = \frac{\exp(\gamma_{l0})}{1+\exp(\gamma_{l0})} \quad (3)$$

Thus, for example,

$$P(X_1 = 1, X_2 = 1) \propto \exp(\gamma_{10} + \gamma_{20}) \tag{4}$$

Equations (3) and (4) can be combined to defining the following basic latent class factor model:

$$P(Y_1 = y_1, \ldots, Y_I = y_I, X_1 = x_1, X_2 = x_2) = P(X_1 = x_1, X_2 = x_2) \times \prod_{i=1}^{I} P(Y_i = y_i | X_1 = x_1, X_2 = x_2) \tag{5}$$

1.2.2 Estimation and inference

Latent class factor models are characterized by a set of unknown parameters that can be estimated using the maximum likelihood method.

Once the parameters of the model have been estimated, it is possible to compute the probability of an individual of belonging to one of the category of a latent factor, given the values of the observed indicators. For example, from Equation (5),

$$P(X_1 = 1 | Y_1 = y_1, \ldots, Y_I = y_I, X_2 = x_2) = \frac{P(Y_1 = y_1, \ldots, Y_I = y_I, X_2 = x_2, X_1 = 1)}{\sum_{x=0}^{1} P(Y_1 = y_1, \ldots, Y_I = y_I, X_2 = x_2, X_1 = x)}.$$

These probabilities can be used to assign a category of the latent factors to each individual, by resorting to the majority rule.

Hypothesis testing on the unknown parameters of latent class factor models can be performed using usual likelihood ratio tests (or, equivalently, using Wald tests, after having estimated the standard errors using the Fisher information matrix).

1.2.3 Some possible extensions of the basic model

The basic model above described can be extended in several ways. For example, it is possible to introduce the effect of *C* covariates $Z_1, \ldots, Z_C$ on the latent factor distributions given in Equation (3)

$$P(X_l = 1 | Z_1 = z_1, \ldots, Z_C = z_C) \propto \exp(\gamma_{l0} + \gamma_{l1} z_1 + \cdots + \gamma_{lC} z_C), \quad l = 1,2,$$

where $z_1, \ldots, z_C$ denote given values of the covariates and $\gamma_{l1}, \ldots, \gamma_{lC}$ are the unknown parameters that measure the intensity of the effects of the covariates on X_l, l=1,2.

Furthermore, dependence between the latent factors can be introduced by assuming that

$$P(X_1 = 1, X_2 = 1) \propto \exp(\gamma_{10} + \gamma_{20} + \gamma_{\_}),$$

where $\gamma_{.}$ is an unknown parameter that measure the strength of association between X_1 and X_2.

Restrictions on the conditional distributions of the observed indicators can also be introduced, for example by setting β_{il} equal to zero for some *i* and *l* (i=1,…,*I* and *l*=1,2), in order to let these distributions depend only on one of the two factors.

1.2.4 Model selection

Starting from a given set of observed indicators, several latent class factor models can be defined. Two latent class factor models obtained from the same data set can be compared using likelihood ratio tests or model selection criteria, such as *AIC* and *BIC*.

Likelihood ratio tests can be used only when two models are nested, that is when one of the two is obtained by imposing some restrictions on the parameters of the others. For example, nested models can be obtained by eliminating the effects of one covariate on the latent factors, or by setting to zero the association parameter between two latent factors.

Model selection criteria have to be used whenever the two model are not nested. For example, models with different number of latent factors, or models with the same latent factors but with different numbers of categories.

1.3 Results

1.3.1 Most relevant landscape features suggested by respondents

The first question in both questionnaire invited to list the main elements that characterize the agricultural landscape area in the 10 municipalities. The frequency of most cited aspects are presented in Table 1 showing that specific features of the area (intensive agricultural region, wet area as artificial canals, ponds, rivers and coastal zone) are remarked nearly the same by both residents and tourists. Obviously since these areas are mainly the location of a typical vacation along the coast that consist in doing activities on the beaches, the seaside has an higher frequency for tourists.

Table 1: Elements characterizing the agricultural landscape area (first in mind)

Elements	**Frequency of residents (N=300)**	**Frequency of tourists (N=380)**
Agricultural area, crops, fields	59 + 7 Rice paddies	9 + 7 Rice paddies
Woods ,edges, wetlands	52	43
Canals and bodies of water, Po river	45	54
Beaches, seaside	44	130
Urban area	24	16
Herons, aquatic animals	4	9
Protected areas in the Po Delta Park	2	5

Two next sections illustrate results separately for residents and for tourists.

1.3.2 Results for residents

1.3.2.1 Some descriptives

A set of elements that characterised the case study landscape have been selected and used to ask about perception of landscape aspects. In particular for each element it was asked if it could be considered as an advantage or a disadvantage or indifferent for agricultural sector (Table 2), for tourism and commercial sector (Table 3) and for inhabitants (Table 4).

All the landscape elements are mainly considered as an advantage for agricultural sector (Table 2), but the presence of aquatic animals and of wetlands have the minor percentage. About the “promotional activity” the lowest percentage of an advantage is obtained by the presence of network of bicycle path.

Table 2: Role of landscape elements on agricultural sector (%)

Elements	advantage	indifferent	disadvantage
Canals and bodies of water (lakes, ponds)	92.0	3.7	3.0
Herons, other fowl, aquatic animals	50.0	16.7	17.0
Woods and characteristic plants, hedges, wetlands and other uncultivated land	58.7	14.0	17.7
Rice paddies and related fauna (amphibians, insects, etc.)	64.0	11.0	15.7
Protected areas in the Po Delta Park	69.0	10.3	8.0
Networks of bicycle paths	58.7	22.7	8.7
Wine and flavour routes ('Strade dei vini e dei sapori')	74.7	7.3	1.3
Crops and quality local products (PGI, PDO, DOCG)	88.0	1.7	2.0
Celebrations and local countryside festivals	91.7	3.7	2.0

Considering the tourism and commercial sector, all the landscape elements are mainly considered as an advantage with one exception: the presence of "Rice paddies and related fauna" is judged more a disadvantage than an advantage (Table 3).

Table 3: Role of landscape elements on tourism and commercial sectors (%)

Elements	advantage	indifferent	disadvantage
Canals and bodies of water (lakes, ponds)	75.3	7.3	10.0
Herons, other fowl, aquatic animals	87.3	4.3	3.0
Woods and characteristic plants, hedges, wetlands and other uncultivated land	77.7	6.0	12.7
Rice paddies and related fauna (amphibians, insects, etc.)	43.3	16.0	31.0
Protected areas in the Po Delta Park	91.3	2.7	2.0
Networks of bicycle paths	94.3	1.3	1.3
Wine and flavour routes ('Strade dei vini e dei sapori')	82.0	3.3	0.3
Crops and quality local products (PGI, PDO, DOCG)	88.0	2.3	2.3
Celebrations and local countryside festivals	94.7	1.3	2.3

Table 4 shows the percentage of advantage/disadvantage perception of landscape elements for inhabitants. The only element considered mainly a disadvantage is the presence of "Rice paddies and related fauna". Instead all the other landscape aspects have a positive judgement.

Table 4: Role of landscape elements on residents (%)

Elements	advantage	indifferent	disadvantage
Canals and bodies of water (lakes, ponds)	71.7	11.7	14.3
Herons, other fowl, aquatic animals	76.0	12.0	6.0
Woods and characteristic plants, hedges, wetlands and other uncultivated land	69.7	10.7	16.3
Rice paddies and related fauna (amphibians, insects, etc.)	38.7	15.0	39.7
Protected areas in the Po Delta Park	81.3	6.7	5.3
Networks of bicycle paths	93.3	1.7	2.0
Wine and flavour routes ('Strade dei vini e dei sapori')	75.0	7.3	2.0
Crops and quality local products (PGI, PDO, DOCG)	93.0	3.0	2.3
Celebrations and local countryside festivals	84.7	5.7	1.3

The second part of the questionnaire focuses on "uses" of landscape services. We consider two blocks of activities: recreational activities in rural area in the case study area or in the Po Delta area (walking; bird watching (cycling; fishing in canals or other water bodies (not in the sea) or hunting; dining in rural guest houses ('agriturismo'); visit to Po Delta Park) and purchases of local agricultural products (rice; wine; eel and/or clams; fruit and/or vegetables).

Some recreational activities have a very low (less than once in a month or never) incidence. That is quite justifiable for specific activities for example bird watching or fishing/hunting, but it is more unexpected for "dining in rural guest houses ('agriturismo')" and for "visit to Po Delta Park" (Table 5).

Table 5: Recreational activities in rural areas by residents in 2013 (%)

Activity	**Several times in a week**	**Once or twice in a week**	**Once or twice in a month**	**Less than once in a month**	**Never**
Walking	27.0	26.0	16.0	12.3	18.7
Bird watching (observation and study of birds and fowl in natural setting)	1.3	1.7	7.3	10.3	78.7
Cycling	33.7	27.7	12.7	7.3	18.7
Fishing in canals or other water bodies (not in the sea) or hunting	2.3	4.3	4.0	4.3	84.0
Dining in rural guest houses ('agriturismo')	1.0	2.7	19.0	35.7	41.3
Visit to Po Delta Park	1.7	0.7	6.7	34.0	56.0

Table 6 illustrates purchases frequency of local products: wine is the less often bought, followed by rice.

Table 6: Purchase frequency of local products by residents (%)

	Rice	**Wine**	**Eel and/or clams**	**Fruit and/or vegetables**
Always	17.3	8.3	20.7	35.3
Often	23.7	16.3	37.3	43.3
Occasionally	24.0	18.3	29.0	13.7
Rarely	15.3	15.3	6.7	4.3
Never	16.7	40.3	6.0	2.7

The motivation of not buying agricultural local products is presented in Table 7 and in Table 8 is indicated the motivation of buying them. For all products except fruit and vegetables, the main motivation not buying them is because respondent doesn't consume such products (34% for rice; 69% for wine and 66% for eel and clams). Concerning fruit and vegetables the main reason is the cost considered too high. The main motivation for buying local products is motivated by trusting in local producers.

Table 7: Why don't you purchase quality local products? (%)

Motivation	**Rice (N=96)**	**Wine (N=167)**	**Eel and/or clams (N=38)**	**Fruit and/or vegetables (N=21)**
I don't consume such products	34.4	68.9	65.8	4.8
I don't know where to buy them	19.8	2.4	-	4.8
I don't buy them because they cost too much	11.5	3.0	21.1	19.0
I don't not trust local producers	1.0	1.8	5.3	-
I'm not interested in quality local products	28.1	18.6	5.3	61.9

Table 8: Why do you purchase quality local products? (%, max two answers)

Motivation	**Percentage**
They cost less (better value for money)	10.3
They have better flavour (they are better)	32.3
Trust in local producers	43.3
Support of local economy	20.7
Recommended by others (friends/family)	2.3
In favour of zero kilometre/zero mile philosophy	30.3
As gifts for friends/acquaintances	1.0
Other reasons	0.7

1.3.2.2 Model specification

Models with 4 latent ordinal factors were considered. As showed in Figure 1 each of these factors is related to only a subset of the observed indicators (illustrated as rectangle in the figure). In particular, factor 1 (with 2 categories) refers to awareness about the relevance of promotional activities, factor 2 (with 3 categories) accounts for awareness about the relevance of landscape features, factor 3 (with 2 categories) represents attitude to consume local products and factor 4 (with 3 categories) is related to attitude to exploit recreational services related to landscape.

In order to understand the relationships among awareness about the role of landscape and use of landscape services, all associations between pairs of factors were included in the model.

Finally, ten variables were considered as candidate covariates and their effects on the factors were included: age class, gender, income declared, labour condition, family type, years of residence, educational level, home location, area and agricultural-related occupation.

Parameters of this model were estimated using a data set composed of 295 residents, obtained by considering only residents with complete information about the indicators and the covariates.

1.3.2.3 Covariate selection

A backward elimination procedure was used to select the relevant covariates: starting from a complete model (including all covariates), each covariate was considered for elimination, obtaining 10 nested models. The p-value for the likelihood ratio tests that compare each of these nested models with the complete one were computed. The covariate whose elimination led to the largest p-value was selected and eliminated from the model if this p-value was larger than 0.05. This procedure was iterated until it was possible to find a covariate whose elimination produced a p-value larger than 0.05.

This backward elimination procedure led to the selection of 7 covariates: age class, gender, income declared, labour condition, family type, years of residence, educational level.

A null model (obtained by eliminating all the covariates from the model) was also fitted to the data.

The Table 9 shows comparisons between the model containing the selected covariates and the null and complete model. As it is possible to see, the selected model is significantly better than the null one. Furthermore, considering all the covariates does not lead to a significant improvement (the complete model is not significantly better than the selected one).

Table 9: Comparison among models

	Loglikelihood	**Parameters**	**AIC**	**BIC**	**Chisq**	**df**	**p-value**
selected covariates	-3005.66	117	6245.32	6676.69			
Null model (no covariates)	-3069.57	65	6269.14	6508.79	127.82	52	<0.001
Complete model (all covariates)	-2990.99	141	6263.99	6783.85	29.33	24	0.21

Table 10 reports the Wald test statistics and the corresponding p-value obtained by testing the significance of the specific covariate effects on each factor. As it is possible to see, no covariate affects the distributions of factor 1 (awareness about the relevance of promotional activities related to landscape), while factor 2 (awareness about the relevance of landscape features) seems to depend only on the educational level: highly educated people tends to have an higher awareness.

As far as factor 3 (attitude to consume local products) is concerned, the covariates having significant effects are age class, labour condition, family type, years of residence and (only marginally) gender. Specifically, attitude to consume local products seems to be higher for younger people, people with a job or looking for a job, couples with children, people living in the area for many years and males.

Finally, labour condition, family type, years of residence and income declared seem to significantly affects the distribution of factor 4. In particular, employed people, couples with children, people living in the area for few years and people who declared an income during the interview tends to have an higher attitude to exploit recreational services related to landscape.

Table 10: Inference on covariate effects on latent factors

	DFactor1 Promotional elements		DFactor2 Landscape elements		DFactor3 Local products		DFactor4 Recreational activities	
Covariates	**Wald**	**p-value**	**Wald**	**p-value**	**Wald**	**p-value**	**Wald**	**p-value**
age class	0.1510	0.93	3.8701	0.14	6.4808	0.039	2.3892	0.30
labour condition	0.1050	0.95	0.8256	0.66	10.7716	0.0046	6.9673	0.031
family type	2.3132	0.31	0.5834	0.75	13.3478	0.0013	5.9298	0.052
years of residence	0.7649	0.86	5.9893	0.11	17.3900	0.00059	11.1450	0.011
income declared	0.0337	0.85	0.1168	0.73	0.0833	0.77	52.436	0.022
gender	0.2195	0.64	17.761	0.18	26.408	0.10	18.808	0.17
educational level	4.2022	0.12	8.9635	0.011	1.0736	0.58	1.3018	0.52

1.3.2.4 Association among factors

The following tables summarizes the results obtained with respect to the parameters (and corresponding Wald test statistics) in the model that are related to the associations among factors. As it is possible to see, some of these parameters are not significantly different from zero, thus implying conditional independence among some factors. Note that the sign of the association parameters may take negative values because for some factors (in particular factor 1, factor 3 and factor 4) the ordinal category corresponding to the high level is the first one (and not the last one, as for factor 2).

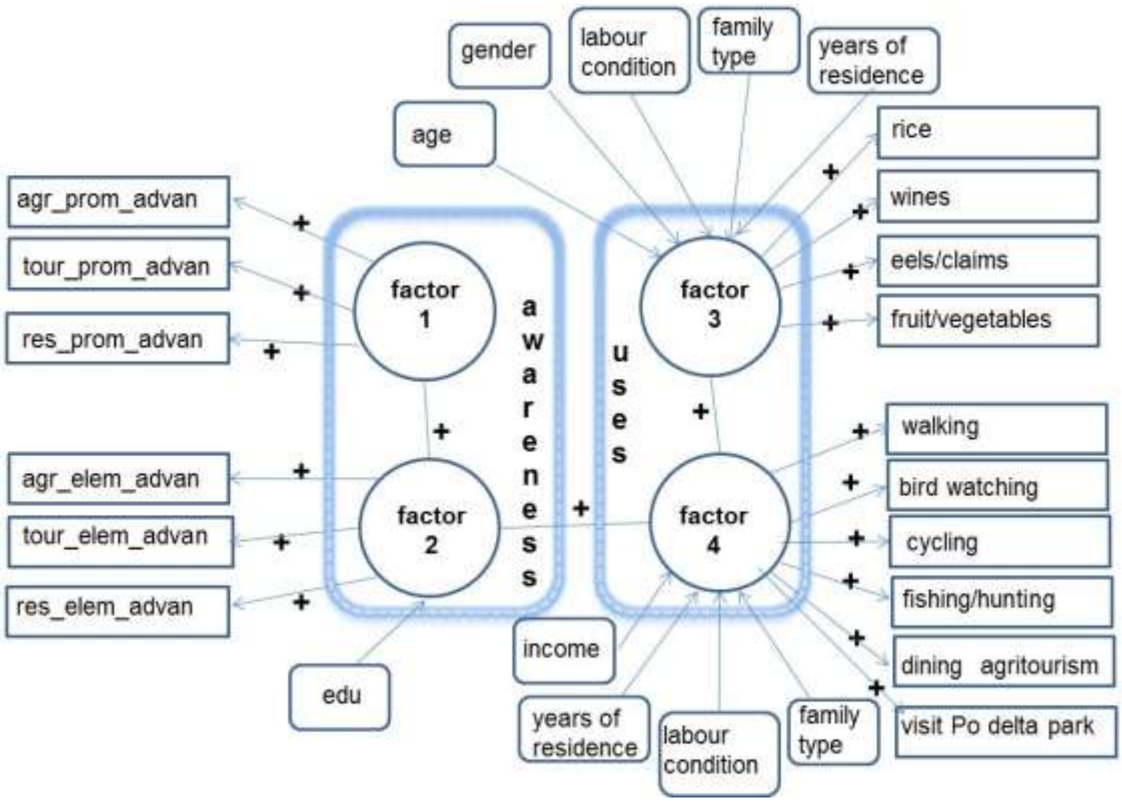
Table 11: Inference on association between latent factors

DFactors	**DFactor1**	**Wald**	**p-value**	**DFactor2**	**Wald**	**p-value**	**DFactor3**	**Wald**	**p-value**
DFactor2	-2.3400	7.9004	0.0050						
DFactor3	1.1238	0.8164	0.37	0.1881	0.0187	0.89			
DFactor4	0.4500	0.0683	0.79	-4.1141	4.7472	0.029	21.7651	11.7067	0.00062

Significant associations seem to relate factor 1 with factor 2 (high awareness about the relevance of promotional activities seems to be associated with high awareness about the relevance of landscape features), factor 2 with factor 4 (high awareness about the relevance of landscape features seems to be associated with high attitude to exploit recreational services related to landscape), and factor 3 with factor 4 (high attitude to exploit recreational services related to landscape seems to be related with high attitude to consume local products).

Figure 1 summarizes the final structure of the model showing significant associations between factors, observed variables and significant covariate effects on latent factors.

Figure 1: Structure of the model for residents



1.3.3 Results for tourists

1.3.3.1 Some descriptives

The second survey collected information from tourists that fulfilled themselves the questionnaire. We kept the same structure of the residents questions, but some adaptations were necessarily needed. In particular, we asked about the influence of landscape elements on the decision to spend vacation in the area. The set of elements includes all the previous ones ("strictly" landscape elements and "promotional" landscape elements) and add some aspects more related to the holiday issues: beaches/seaside infrastructures; lower prices/cost; celebrations and local countryside festivals; knowledge of, and ties with, the territory.

The main" attractiveness" were beaches/seaside infrastructures and knowledge of, and ties with, the territory; the less one was rice paddies & related fauna. All the "strictly" landscape elements show a small influence (Table 12).

Table 12: Influence of landscape elements on decision to spend vacation in the area (%)

Elements	very much	somewhat	not very much	not at all don't
Canals and bodies of water (lakes, ponds)	16.1	28.2	24.2	22.1
Herons, other fowl, aquatic animals	17.1	33.9	24.2	15.3
Woods and characteristic plants, hedges, wetlands and other uncultivated land	15.8	29.5	25.5	18.9
Rice paddies & related fauna (amphibians, insects, etc.)	5.3	13.7	35.5	35.0
Protected areas in the Po Delta Park	26.1	33.2	21.1	11.1
Networks of bicycle paths	15.8	28.2	25.3	21.8
Wine and flavour routes ('Strade dei vini e dei sapori')	12.1	29.2	25.0	21.3
Crops and quality local products (PGI, PDO, DOCG)	17.6	30.0	26.3	13.7
Beaches / Seaside infrastructures	48.9	30.8	8.4	6.1
Lower prices/cost	19.5	30.8	23.2	16.8
Celebrations and local countryside festivals	13.2	32.1	27.1	17.6
Knowledge of, and ties with, the territory	32.1	32.1	16.3	9.5

Quite high percentage of none recreational activity was registered. The only two activities with a significant frequency are walking and cycling. (Table 13).

Table 13: Recreational activities in rural areas or in the Po Delta park during the vacation (%)

Activity	often	occasionally	rarely	never	will do
Walking	56.3	25.5	4.2	5.8	1.3
Bird watching (observation and study of birds and fowl in natural setting)	5.5	13.9	13.9	**44.5**	4.5
Cycling	24.7	25.3	12.6	22.1	3.9
Fishing in canals or other water bodies (not in the sea) or hunting	3.2	5.3	7.4	**66.6**	1.3
Dining in rural guest houses ('agriturismo')	13.9	20.3	15.5	**33.2**	4.7
Visit to Po Delta Park	7.4	23.4	15.5	**29.5**	11.3

Purchase of local **products** during the vacation are likely for eel/clams and fruit/vegetables, but not for rice and wine (Table 14).

Table 14: Purchase possibility local products during the vacation (%)

	Rice	Wine	Eel and/or clams	Fruit and/or vegetables
Without a doubt yes	18.2	22.1	24.2	51.8
Likely Yes	14.7	17.1	19.5	17.1
Likely not	22.1	17.4	13.7	6.6
Without a doubt no	22.1	24.5	21.3	8.7

Main motivation of not buying local products is the same for tourists and residents ("I don't consume such products") recording the highest percentage for all products (Table 15).

Table 15: Why don't you purchase local products? (%)

	Rice (N=168)	Wine (N=159)	Eel and/or clams (N=133)	Fruit and/or vegetables (N=58)
I don't consume such products	34.5	59.7	73.7	13.8
I don't know where to buy them	26.8	6.3	2.3	8.6
I don't buy them because they cost too much	7.1	5.0	6.0	13.8
I don't not trust local producers	0.6	1.9	-	1.7
I'm not interested in quality local products	14.3	13.8	9.0	34.5
Other reasons	14.9	11.9	8.3	22.4

Table 16 illustrates that the most relevant reason for buying local products is because they have a better taste flavour.

Table 16: Why do you purchase quality local products? (%, max two answers)

Motivation	**Percentage**
They cost less (better value for money)	10.0
They have better taste (they are better)	35.0
Trust in local producers	25.8
Support of local economy	21.8
Recommended by others (friends/family)	4.0
In favour of zero kilometre/zero mile philosophy	21.5
As gifts for friends/acquaintances	2.9
Other reasons	1.1

1.3.3.2 Model specification

Models with 5 latent ordinal factors were considered. Each of these factors is related to only a subset of the observed indicators. In particular, factor 1 is related to the importance of promotional activities related to landscape in deciding the present holiday destination, factor 2 represents the importance of landscape features in deciding the present holiday destination, factor 3 refers to the attitude to consume local products during the present holiday, factor 4 accounts for the attitude to exploit recreational services related to landscape during the present holiday, and factor 5 is introduced in order to describe the importance of the so-called "seaside-type vacation" (a kind of vacation which is very typical along all the Emilia-Romagna coast, which, broadly speaking, consists in spending most of the holiday doing activities on the beaches) in deciding the present holiday destination. This factor states the tourist attraction for seaside and beaches. All factors have two ordered categories.

All the considered models included association parameters between each pair of factors, thus allowing to understand the relationships among the role of landscape in deciding the present holiday destination and the use of landscape services during the present holiday.

Finally, age class, gender, labour condition, family type, length of stay during the present holiday, number of previous holidays in the Delta Po area and type of interview (in a rural guest house/in a Delta Po park center/on a beach) were considered as candidate covariates for explaining the distributions of factors.

Parameters of these models were estimated using a data set composed of 336 tourists, obtained by considering only tourists with complete information about the indicators and the covariates.

1.3.3.3 Covariate selection

A backward elimination procedure was used to select the relevant covariates: starting from a complete model (including all covariates), each covariate was considered for elimination, obtaining 8 nested models. The p-values for the likelihood ratio tests that compare each of these nested models with the complete one were computed. The covariate whose elimination led to the largest p-value was selected and eliminated from the model if this p-value was larger than 0.05. This procedure was iterated until it was possible to find a covariate whose elimination produced a p-value larger than 0.05.

This backward elimination procedure led to the selection of 4 covariates: age class, educational level, number of previous holidays in the same area and type of interview.

A null model (obtained by eliminating all the covariates from the model) was also fitted to the data.

In Table 17 it is shown a comparisons between the model containing the selected covariates and the null and complete model.

Table 17: Comparison among models

	Loglikelihood	Parameters	AIC	BIC	Chisq	df	p-value
selected covariates	-3963.797	94	8115.595	8474.403			
Null model (no covariates)	-4077.562	59	8273.124	8498.333	227.529	35	4.482E-30
Complete model (all covariates)	-3936.710	134	8141.419	8652.912	54.176	40	0.067

As it is possible to see, the selected model is significantly better than the null one. Furthermore, considering all the covariates does not lead to a significant improvement (the complete model is not significantly better than the selected one).

Table 18 reports the Wald test statistics and the corresponding p-value obtained by testing the significance of the specific covariate effects on each factor.

The number of previous holidays in the Delta Po area seems to affect the distributions of all factors, apart from factor 1. In particular, tourists that have already spent some holidays in the Delta Po area tends to give lower importance to landscape features in their decision, have an higher attitude to consume local products but at the same time a lower attitude to exploit recreational services related to landscape. Finally, they seem to give higher importance to the “seaside-type vacation”.

As far as educational level is concerned, this covariate has significant effects only on factor 3 and 4: highly educated tourists show higher attitude both to consume local products and to exploit recreational services related to landscape.

With respect to the type of interview, it is possible to note that this covariate significantly affects factor 1, 2, 4 and 5. Namely, tourists interviewed on a beach seem to give higher importance to the “seaside-type vacation” and lower importance to landscape (with respect to both promotional activities and landscape features) in their decisions, and they show a lower attitude to exploit recreational services related to landscape.

Finally, age class seems to be related only to factor 2 and 5: younger tourists are characterized by a lower importance of landscape features in deciding the present holiday destination and a higher importance to the “seaside-type vacation”.

Table 18: Inference on covariate effects on latent factors

	DFactor1		**DFactor2**		**DFactor3**		**DFactor4**		**DFactor 5**	
	Promot. elements		**Landscape elements**		**Local products**		**Recreat. activities**		**Seaside**	
Covariates	**Wald**	**p-value**	**Wald**	**p-value**	**Wald**	**p-value**	**Wald**	**p-value**	**Wald**	**p-value**
Previous holidays	1.997	0.160	6.369	0.012	1.645	0.200	2.832	0.092	4.715	0.030
Educational level	1.214	0.550	2.172	0.340	5.562	0.062	7.682	0.021	1.774	0.410
Type of interview	5.988	0.050	5.332	0.070	1.180	0.550	14.390	0.001	8.995	0.011
Age class	2.621	0.270	14.943	0.001	1.337	0.510	0.967	0.620	5.761	0.056

1.3.3.4 Association among factors

Table 19 summarizes the results obtained with respect to the parameters (and corresponding Wald test statistics) in the model that are related to the associations among factors. As it is possible to see, some of these parameters are not significantly different from zero, thus implying conditional independence among some factors. Note that the sign of the association parameters may take negative values also in presence of a positive association because for some factors (in particular factors 2, 3 and 5) the ordinal category corresponding to the high level is the first one (and not the last one, as for factors 1 and 4).

Table 19: Inference on association between latent factors

DFactors	DFactor1	Wald	p-value	DFactor2	Wald	p-value	DFactor3	Wald	p-value	DFactor4	Wald	p-value
DFactor2	-1.281	6.040	0.014									
DFactor3	0.485	0.472	0.490	0.723	1.411	0.230						
DFactor4	0.829	1.633	0.200	-2.643	5.678	0.017	-0.933	0.551	0.460			
DFactor5	-6.623	7.266	0.007	2.877	2.999	0.083	3.417	8.176	0.004	0.270	0.039	0.840

Significant associations seem to relate factor 1 with factor 2 (high importance of promotional activities seems to be associated with high importance of landscape features), factor 2 with factor 4 (importance of landscape features seems to be positively associated with high attitude to exploit recreational services related to landscape). Finally, factor 5 (importance of "seaside-type vacation") seems to show significant positive associations with all factors, apart from factor 4.

Figure 2 summarizes the structure of the final model showing only significant associations between factors and relations between factors and observed variables.

Figure2: Model structure for tourists (only significant associations between factors)

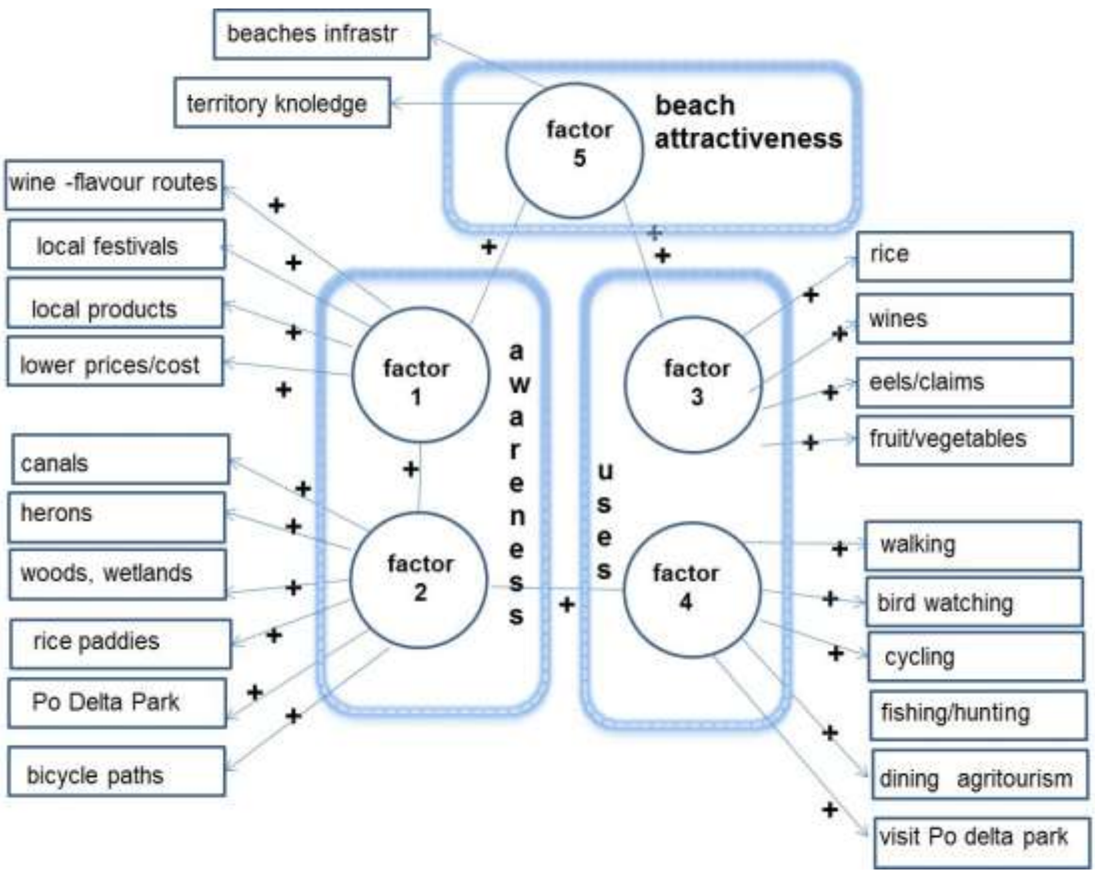
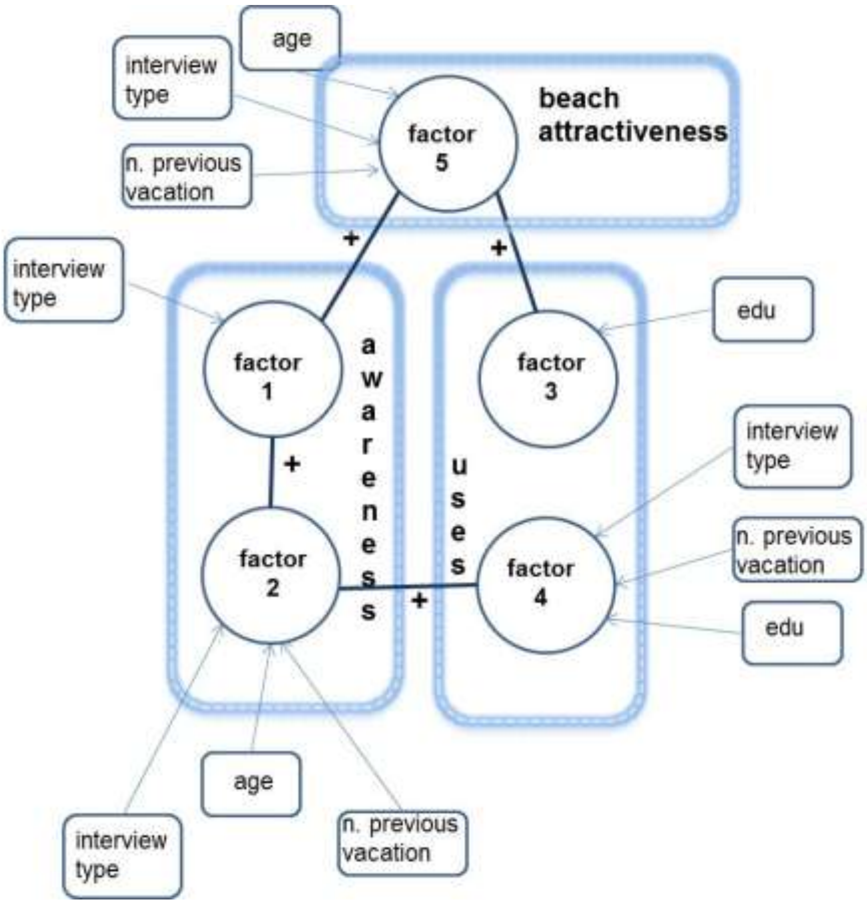


Figure 3 summarizes the final structure of the model for tourists showing significant associations between factors and only significant covariate effects on latent factors.

Figure3: Model structure for tourists (only factors and significant covariates)



1.4 Discussion

The two discrete factor models have been obtained using observed indicators that refer to different aspects of the role attributed to promotional activities related to landscape and landscape features. Nevertheless, the results obtained from the data analyses suggest that their general structures are partly similar.

In particular, both models highlight a significant positive association between factor 1 and factor 2 (awareness of the relevance/importance attributed to promotional activities relate to landscape and awareness of the relevance/importance attributed to landscape features).

Furthermore, both models give some support to the hypothesis that awareness/importance attributed to landscape is positively associated to the attitude to use landscape services: this is confirmed by the significant positive association between factor 2 and factor 4 (awareness of the relevance/importance attributed to landscape features and attitude to exploit recreational services related to landscape). At the same time, however, it is interesting to note that both models are characterized by the absence of a "direct link" between that awareness/importance attributed to landscape and attitude to consume local products (no significant associations found between factor 1 and factor 3 and between factor 2 and factor 3).

The results validate the presence of a significant association between landscape awareness and ecosystem service uses. However the relevance of these results is mitigated by the low dimension of the groups identified. In fact the results show that only 9% of the residents appreciate landscape elements associated to an high use of landscape services (both recreational activities and local product purchases. This percentage increases to 19% considering the tourist model. This opens the question on choosing the best strategy to exploit the agricultural landscape in order to improve local competiveness, which may involve increase the knowledge on positive landscape aspects, acting on landscape management in order to improve further landscape features, valorise local landscape services towards a wider population.

References

Magidson J., Vermunt J. K. (2001) Latent class factor and cluster models, bi-plots, and related graphical displays. Social Methodology 31, 223-264.

Vermunt J. K., Magidson J. (2005) Technical Guide for Latent GOLD 4.0: Basic and Advanced. Statistical Innovations Inc., Belmont, MA.

APPENDIX 1: Questionnaire

Buonasera, parlo con la famiglia del sig./sig.ra **{Cognome}**? Sono un'intervistatrice/tore del Centro Demoscopico Metropolitano della Provincia di Bologna e la sto contattando per conto dell'Università di Bologna. Stiamo svolgendo alcune interviste sul **legame tra paesaggio ed attività economiche nelle aree rurali** e per **ottenere conoscenze sul futuro sociale ed ambientale come conseguenza dei cambiamenti della politica agricola**. Il sondaggio fa parte di un progetto europeo (CLAIM) ed aiuterà a fornire indicazioni alla Commissione Europea nei processi di riforma della Politica Agraria Comune. Posso farle alcune domande? L'intervista durerà pochi minuti *Le ricordo che le informazioni raccolte verranno utilizzate esclusivamente ai fini della ricerca, comunicate e diffuse esclusivamente in forma aggregata, nel rispetto delle norme sulla privacy e sulla tutela delle persone e dei dati personali.* **Lei è maggiorenne e residente all'indirizzo a cui la sto chiamando?**

Se minorenne o non residente all'indirizzo a cui la si sta chiamando l'intervista non può essere svolta.

domanda: **2**
Indicare il genere
[01] Singola - maschio
[02] Singola - femmina

domanda: **2.1**
Le posso chiedere la sua età (in anni compiuti)?

intervistare persone con età compresa tra i 18 anni i 70 anni compiuti.

Classi: 18-34 |35-54| 55-70
[01] Testo - età
[99] Singola - Non risponde

domanda: **2.2**
Codificare l'età appena chiesta secondo le seguenti classi (et=[2.1]).

Se non ha voluto dichiarare i propri anni usare questa domanda: in quale delle seguenti classi d'età la posso inserire?
[1] Singola - 18-34
[2] Singola - 35-54
[3] Singola - 55-70

domanda: **2.5**
Come prima cosa le chiedo di indicarmi 3 elementi del paesaggio che secondo lei caratterizzano la zona in cui vive
[01] Testo Multilinea - specificare (ANDARE A CAPO PER OGNI ELEMENTO INDICATO)
[77] Singola - Non ci sono elementi caratteristici del paesaggio
[88] Singola - Non so
[99] Singola - Non risponde

3.0

Ora le proporrò un elenco di **elementi del paesaggio**; per ciascuno mi dovrà dire **se rappresentano un vantaggio o uno svantaggio** per: **il settore agricolo**, **il sistema turistico/commerciale/alberghiero** o **per chi abita sul territorio**.

3.01

Secondo lei la presenza di **canali e specchi d'acqua** è un vantaggio, uno svantaggio, nessuno dei due, per:

	un vantaggio	uno svantaggio	nessuno dei due	Non so	Non risponde
3.01.1 Il settore agricolo	☐	☐	☐	☐	☐
3.01.2 Il sistema turistico, commerciale e alberghiero	☐	☐	☐	☐	☐
3.01.3 Per chi vi abita	☐	☐	☐	☐	☐

3.02

Secondo lei la presenza di **aironi, altri volatili, animali acquatici** è un vantaggio, uno svantaggio, nessuno dei due, per:

	un vantaggio	uno svantaggio	nessuno dei due	Non so	Non risponde
3.02.1 Il settore agricolo	☐	☐	☐	☐	☐
3.02.2 Il sistema turistico, commerciale e alberghiero	☐	☐	☐	☐	☐
3.02.3 Per chi vi abita	☐	☐	☐	☐	☐

3.03

Secondo lei la presenza di **boschi e piante caratteristiche, siepi, zone umide e altre zone non coltivate** è un vantaggio, uno svantaggio, nessuno dei due, per:

	un vantaggio	uno svantaggio	nessuno dei due	Non so	Non risponde
3.03.1 Il settore agricolo	☐	☐	☐	☐	☐

3.03.2 Il sistema turistico, commerciale e alberghiero	□	□	□	□	□
3.03.3 Per chi vi abita	□	□	□	□	□

3.04

Secondo lei la presenza di **risaie e relativa fauna (anfibi, insetti, etc.)** è un vantaggio, uno svantaggio, nessuno dei due, per:

	un vantaggio	uno svantaggio	nessuno dei due	Non so	Non risponde
3.04.1 Il settore agricolo	□	□	□	□	□
3.04.2 Il sistema turistico, commerciale e alberghiero	□	□	□	□	□
3.04.3 Per chi vi abita	□	□	□	□	□

3.05

Secondo lei le **aree protette del parco del Delta del Po** sono un vantaggio, uno svantaggio, nessuno dei due, per:

	un vantaggio	uno svantaggio	nessuno dei due	Non so	Non risponde
3.05.1 Il settore agricolo	□	□	□	□	□
3.05.2 Il sistema turistico, commerciale e alberghiero	□	□	□	□	□
3.05.3 Per chi vi abita	□	□	□	□	□

3.1
Parliamo adesso delle **attività di valorizzazione e promozione del territorio e dei prodotti locali.** Come nel caso precedente mi dovrebbe dire se ciascuna è **un vantaggio o uno svantaggio** per **i settori produttivi** o **per i cittadini del Comune dove vive.**

3.11
Secondo lei la **rete di piste ciclabili** è un vantaggio, uno svantaggio, nessuno dei due, per:

	un vantaggio	uno svantaggio	nessuno dei due	Non so	Non risponde
3.11.1 Il settore agricolo	☐	☐	☐	☐	☐
3.11.2 Il sistema turistico, commerciale e alberghiero	☐	☐	☐	☐	☐
3.11.3 Per chi vi abita	☐	☐	☐	☐	☐

3.12
Secondo lei la **Strada dei vini e dei sapori** è un vantaggio, uno svantaggio, nessuno dei due, per:

	un vantaggio	uno svantaggio	nessuno dei due	Non so	Non risponde
3.12.1 Il settore agricolo	☐	☐	☐	☐	☐
3.12.2 Il sistema turistico, commerciale e alberghiero	☐	☐	☐	☐	☐
3.12.3 Per chi vi abita	☐	☐	☐	☐	☐

3.13
Secondo lei le **feste e le sagre locali** sono un vantaggio, uno svantaggio, nessuno dei due, per:

	un vantaggio	uno svantaggio	nessuno dei due	Non so	Non risponde
3.13.1 Il settore agricolo	☐	☐	☐	☐	☐
3.13.2 Il sistema turistico, commerciale e alberghiero	☐	☐	☐	☐	☐

3.13.3 Per chi vi abita	☐	☐	☐	☐	☐

3.14
Secondo lei i **disciplinari legati alla produzione tipica (IGP, DOC, DOCG)** sono un vantaggio, uno svantaggio, nessuno dei due, per:

	un vantaggio	uno svantaggio	nessuno dei due	Non so	Non risponde
3.14.1 Il settore agricolo	☐	☐	☐	☐	☐
3.14.2 Il sistema turistico, commerciale e alberghiero	☐	☐	☐	☐	☐
3.14.3 Per chi vi abita	☐	☐	☐	☐	☐

domanda: **4.1.1**
Le chiederò ora la frequenza di acquisto di alcuni prodotti tipici locali.

Lei o la sua famiglia acquista riso tipico della zona (zona dei comuni del Delta del Po)?
[01] Singola - Sempre (ogni volta che fa questo genere di acquisto)
[02] Singola - Spesso (il più delle volte che ne ha necessità, ma non sempre)
[03] Singola - Qualche volta (per particolari occasioni)
[04] Singola - Raramente (se capita)
[05] Singola - Mai
[88] Singola - Non ricorda
[99] Singola - Non risponde

domanda: **4.1.1.1** (SE ACQUISTA RARAMENTE O MAI)
Per quale motivo non acquista riso tipico della zona?
[01] Mono - Non consuma questo prodotto
[02] Multipla - Non sa dove acquistarlo
[03] Multipla - I prodotti locali costano troppo
[04] Multipla - Non ha fiducia nei produttori locali
[05] Multipla - Non ha interesse per le produzioni tipiche o locali
[99] Mono - Non risponde
domanda: **4.1.2**
Lei o la sua famiglia acquista vino tipico della zona (zona dei comuni del Delta del Po)?

[01] Singola - Sempre (ogni volta che fa questo genere di acquisto)
[02] Singola - Spesso (il più delle volte che ne ha necessità, ma non sempre)
[03] Singola - Qualche volta (per particolari occasioni)
[04] Singola - Raramente (se capita)

[05] Singola - Mai
[88] Singola - Non ricorda
[99] Singola - Non risponde

domanda: **4.1.2.1** (SE ACQUISTA RARAMENTE O MAI)
Per quale motivo non acquista vino tipico della zona?
[01] Mono - Non consuma questo prodotto
[02] Multipla - Non sa dove acquistarlo
[03] Multipla - I prodotti locali costano troppo
[04] Multipla - Non ha fiducia nei produttori locali
[05] Multipla - Non ha interesse per le produzioni tipiche o locali
[99] Mono - Non risponde

domanda: **4.1.3**
Lei o la sua famiglia acquista <u>anguille o vongole</u> della zona del Delta del Po?
[01] Singola - Sempre (ogni volta che fa questo genere di acquisto)
[02] Singola - Spesso (il più delle volte che ne ha necessità, ma non sempre)
[03] Singola - Qualche volta (per particolari occasioni)
[04] Singola - Raramente (se capita)
[05] Singola - Mai
[88] Singola - Non ricorda
[99] Singola - Non risponde

domanda: **4.1.3.1** (SE ACQUISTA RARAMENTE O MAI)
Per quale motivo non acquista anguille o vongole tipiche della zona?
[01] Mono - Non consuma questo prodotto
[02] Multipla - Non sa dove acquistarlo
[03] Multipla - I prodotti locali costano troppo
[04] Multipla - Non ha fiducia nei produttori locali
[05] Multipla - Non ha interesse per le produzioni tipiche o locali
[99] Mono - Non risponde

domanda: **4.1.4**
Lei o la sua famiglia, acquista <u>frutta o verdura</u> tipica della zona (zona dei comuni del Delta del Po)?
[01] Singola - Sempre (ogni volta che fa questo genere di acquisto)
[02] Singola - Spesso (il più delle volte che ne ha necessità, ma non sempre)
[03] Singola - Qualche volta (per particolari occasioni)
[04] Singola - Raramente (se capita)
[05] Singola - Mai
[88] Singola - Non ricorda
[99] Singola - Non risponde

domanda: **4.1.4.1** (SE ACQUISTA RARAMENTE O MAI)
Per quale motivo non acquista frutta o verdura tipica della zona?
[01] Mono - Non consuma questo prodotto
[02] Multipla - Non sa dove acquistarlo
[03] Multipla - I prodotti locali costano troppo
[04] Multipla - Non ha fiducia nei produttori locali
[05] Multipla - Non ha interesse per le produzioni tipiche o locali
[99] Mono - Non risponde
domanda: **4.1.5** (SE ACQUISTA SEMPRE, SPESSO O QUALCHE VOLTA)
RIEPILOGO ACQUISTI

Riso: [risposta **4.1.1]**

Vino: [risposta **4.1.2]**

Anguille e/o vongole: [risposta **4.1.3]**

Frutta e/o verdura: [risposta **4.1.4]**

In base a quello che mi ha appena detto, per quali motivi acquista i prodotti agro-alimentari tipici della zona (zona dei comuni del Delta del Po)?

Può darmi fino a 2 risposte.

LE RISPOSTE RUOTANO

[01] Multipla - Costano meno (migliore rapporto qualità/prezzo)
[02] Multipla - Hanno pi sapore (sono buoni)
[03] Multipla - Fiducia nei pro locali
[04] Multipla - Sostegno all'econom locale
[05] Multipla - Consigliato da amici e parenti
[06] Multipla - Favorevole agli acquisti a km 0
[07] Multipla - Per fare regali ad amici/conoscenti
[66] Testo - Altro
[99] Mono - Non risponde

4.3
Nel corso del 2013 ha svolto una delle seguenti attività in una zona rurale del suo comune o dei comuni del Delta?
Tenga conto che parleremo di una frequenza che va da: più volte alla settimana, una o due volte alla settimana, una o due volte al mese, meno di una volta al mese; oppure mai

	Più volte alla settimana	Una o due volte alla settimana	Una o due volte al mese	Meno di una volta al mese	Mai	Non so	Non risponde
4.3.1 una passeggiata	☐	☐	☐	☐	☐	☐	☐
4.3.2 birdwatching (osservazione e studio di uccelli e volatili in ambiente naturale)	☐	☐	☐	☐	☐	☐	☐
4.3.3 un giro in bicicletta	☐	☐	☐	☐	☐	☐	☐
4.3.4 pesca nei canali del Delta o in specchi d'acqua (non in mare) o caccia	☐	☐	☐	☐	☐	☐	☐
4.3.5 consumo di pasti in un agriturismo della zona	☐	☐	☐	☐	☐	☐	☐
4.3.6 entrata ad un Centro visita del parco del Delta del Po	☐	☐	☐	☐	☐	☐	☐

domanda: **4.4**
Dove si trova l'abitazione in cui vive?
[01] Singola - In un centro abitato (nucleo o frazione) del comune

[02] Singola - Vicino a canali o specchi d'acqua
[03] Singola - In una zona agricola (ma non vicina a canali o specchi d'acqua)
[99] Singola - Non risponde

domanda: **4.7**
Lei sa quali servizi fornisce il Consorzio di Bonifica della pianura ferrarese? Può darmi anche più di una risposta. NON LEGGERE LE RISPOSTE
[00] Mono - Non conosce l'esistenza del Consorzio
[01] Multipla - Progettare, eseguire, gestire, mantenere opere di bonifica
[02] Multipla - Partecipare alla formazione dei piani urbanistici
[03] Multipla - Tutela dell'ambiente dall'inquinamento
[04] Multipla - Gestione ed erogazione del patrimonio idrico
[05] Multipla - Tutela delle acque destinate all'irrigazione
[06] Multipla - Raccogliere e far defluire le acque piovane
[66] Testo - Altro, specificare:
[77] Mono - Non sa che servizi offre il Consorzio
[99] Mono - Non risponde

domanda: **4.8** (SE CONOSCE ALMENO UN SERVIZIO)
Quanto è soddisfatto del servizio che riceve dal Consorzio di Bonifica della pianura ferrarese?
[01] Singola - molto soddisfatto
[02] Singola - abbastanza
[03] Singola - poco
[04] Singola - per niente soddisfatto
[88] Singola - non sa
[99] Singola - non risponde

domanda: **5.1**
Siamo alle ultime domande. Le chiederò alcune informazioni a fini statistici.

L'ultimo titolo di studio che ha conseguito?
[01] Singola - Senza titolo o Licenza elementare
[02] Singola - Licenza di scuola media inferiore
[03] Singola - Diploma professionale (2-3 anni)
[04] Singola - Diploma di scuola media superiore (4-5 anni)
[05] Singola - Master o corsi professionali post-diploma
[06] Singola - Laurea o diploma universitario
[07] Singola - Dottorato (PhD) / Master o titoli post-laurea
[99] Singola - Non risponde

domanda: **5.1.1**
DA NON LEGGERE: HA MENO DI 20 ANNI ED E' LAUREATO Scusi, Lei mi ha detto di avere [2.1] anni e di essere laureato: corretto?
[01] Singola - ha più di 19 anni
[02] Singola - non è laureato
[03] Singola - ha meno di 20 anni ed è laureato

domanda: **5.2**
Lei attualmente :
[01] Singola - Occupato
[02] Singola - Lavoratore precario
[03] Singola - Mobilità

[04] Singola - Cassa integrazione
[05] Singola - Disoccupato (ex-occupato)
[06] Singola - In cerca di prima occupazione
[07] Singola - Studente
[08] Singola - Ritirato dal lavoro (pensionato)
[09] Singola - Casalinga
[10] Singola - Altra condizione
[99] Singola - non risponde

domanda: **5.2.0.1**
DA NON LEGGERE: RISULTA CASALINGA ED E' MASCHIO Mi può dire di nuovo la sua condizione professionale?
[01] Singola - non è maschio
[02] Singola - non è casalinga
[03] Singola - è maschio e casalinga

domanda: **5.2.0.2**
DA NON LEGGERE: RISULTA PENSIONATO/A ED HA MENO DI 54 ANNI Scusi, lei mi ha detto di avere meno di 54 anni e di essere [5.2]: corretto?
[01] Singola - ha più di 54 anni
[02] Singola - non è pensionato
[03] Singola - ha meno di 54 anni ed è pensionato

domanda: **5.2.1** (SE E' OCCUPATO)
Ed occupato come:
[01] Singola - Imprenditore
[02] Singola - Artigiano/familiare coadiuvante
[03] Singola - Commerciante, agente commercio, rappresentante, …
[04] Singola - Libero professionista
[05] Singola - Dirigente
[06] Singola - Docente, insegnante scuola superiore
[07] Singola - Insegnante media, elementare, materna
[08] Singola - Quadro, direttivo, tecnico
[09] Singola - Impiegato
[10] Singola - Operaio
[99] Singola - non risponde

domanda: **5.2.2** (SE E' OCCUPATO)
E lavora in uno di questi ambiti: LEGGERE LE RISPOSTE
[01] Singola - coltivazioni agricole; agro-alimentare
[02] Singola - pesca, itticoltura (allevamento pesci)
[03] Singola - turismo (alloggio, ristorazione)
[04] Singola - servizi ambientali (trattamento acqua, gestione rifiuti, …)
[05] Singola - gestione del verde (giardinaggio, vivaistica, …)
[06] Singola - trasporti
[07] Singola - altro ambito
[99] Singola - non risponde

domanda: **5.3**
La sua famiglia di tipo:
[01] Singola - Unipersonale/single

[02] Singola - Coppia senza figli
[03] Singola - Coppia con figli
[04] Singola - Genitore singolo con figli
[05] Singola - Nucleo con altri familiari o parenti conviventi
[06] Singola - Persone conviventi non legate da vincoli affettivi (colleghi, amici, studenti, …)
[99] Singola - non risponde

domanda: **5.4**
Da quanti anni risiede nell'attuale abitazione?
[01] Singola - da sempre (dalla nascita)
[02] Singola - dal 2013 (da quest'anno)
[03] Singola - dal 2012 (dall'anno scorso)
[04] Singola - dal 2011 (da due anni)
[05] Singola - dal 2010 (da tre anni)
[06] Singola - dal 2007-2009 (da 4-5 anni)
[07] Singola - dal 2002 - 2006 (da 6-10 anni)
[08] Singola - dal 1982-2001 (da 11-30 anni)
[09] Singola - dal 1966 - 1981 (da 31 - 46 anni)
[10] Singola - dal 1965 o prima (da più di 47 anni)
[88] Singola - Non ricordo
[99] Singola - Non risponde

domanda: **5.4.1** (SE NON RISIEDE DA SEMPRE NELL'ATTUALE ABITAZIONE)
E dove viveva prima di trasferirsi nell'attuale casa?
[01] Assistita - in un comune della zona del Delta del Po
[02] Singola - in altro comune provincia di Ferrara
[03] Singola - in provincia di Ravenna
[04] Singola - in provincia di Rovigo
[05] Singola - in provincia di Bologna
[06] Assistita - altra provincia emiliano-romagnola
[07] Singola - altra regione del nord d'Italia
[08] Singola - altra regione del centro Italia
[09] Singola - altra regione del sud Italia o isole
[10] Singola - all'estero
[99] Singola - Non risponde

domanda: **5.5**
Infine l'ultima domanda.

Mi potrebbe indicare in quale delle seguenti fasce si colloca il reddito annuo della sua famiglia?
[01] Singola - Meno di 14.000 euro
[02] Singola - 14.001-28.000 euro
[03] Singola - 28.001-42.000 euro
[04] Singola - Oltre 42.000 euro
[88] Singola - Non so
[99] Singola - Non risponde

domanda: **6.0**
L'intervista finita. Grazie per il tempo che ci ha dedicato.

Se vuole può lasciare un commento sulle questioni che abbiamo trattato.
[01] Testo - commento
[02] Singola - nessun commento

APPENDIX 2: Detailed output for resident model with factor distributions

Distribution of factor 1 and conditional distribution of indicators within categories of factor 1

	DFactor1		
	0 (Level1)	**0.5 (Level2)**	**1 (Level3)**
DFactor Level Size	0.685	0.249	0.066
n_van_agr_prom			
0	0.000	0.000	0.203
1	0.000	0.117	0.734
2	0.078	0.763	0.063
3	0.922	0.119	0.000
n_van_tur_prom			
0	0.000	0.000	0.153
1	0.000	0.018	0.751
2	0.010	0.751	0.096
3	0.990	0.231	0.000
n_van_res_prom			
0	0.000	0.000	0.305
1	0.000	0.111	0.655
2	0.078	0.809	0.039
3	0.922	0.079	0.000

Distribution of factor 2 and conditional distribution of indicators within categories of factor 2

	DFactor2		
	0 (Level1)	**0.5 (Level2)**	**1 (Level3)**
DFactor Level Size	0.242	0.539	0.219
n_van_agr_elem			
0	0.026	0.001	0.000
1	0.190	0.021	0.001
2	0.221	0.062	0.005
3	0.338	0.242	0.053
4	0.153	0.277	0.155
5	0.064	0.297	0.422
6	0.009	0.100	0.363
n_van_tur_elem			
0	0.042	0.000	0.000
2	0.178	0.002	0.000
3	0.279	0.019	0.000
4	0.356	0.194	0.012
5	0.139	0.601	0.287
6	0.005	0.185	0.701
n_van_res_elem			
0	0.014	0.000	0.000
1	0.126	0.000	0.000
2	0.315	0.003	0.000
3	0.433	0.076	0.000
4	0.104	0.345	0.010
5	0.008	0.504	0.268
6	0.000	0.072	0.722

Distribution of factor 3 and conditional distribution of indicators within categories of factor 3

	DFactor3	
	0 (Level1)	1 (Level2)
DFactor Level Size	0.809	0.191
rice		
NO	0.274	0.651
YES	0.726	0.349
wine		
NO	0.512	0.832
YES	0.488	0.168
eels/claims		
NO	0.081	0.349
YES	0.919	0.651
Fruits/vegetables		
NO	0.032	0.273
YES	0.968	0.727

Distribution of factor 4 and conditional distribution of indicators within categories of factor 4

	DFactor4		
	0 (Level1)	0.5 (Level2)	1 (Level3)
DFactor Level Size	0.309	0.577	0.115
walkings			
NO	0.009	0.333	0.964
YES	0.991	0.667	0.036
bird watching			
NO	0.761	0.953	0.992
YES	0.239	0.047	0.008
cycling			
NO	0.085	0.275	0.607
YES	0.915	0.725	0.393
Fishing/hunting			
NO	0.794	0.927	0.976
YES	0.206	0.073	0.024
Dining agr			
NO	0.459	0.904	0.991
YES	0.541	0.096	0.010
Visit Po Delta park			
NO	0.765	0.968	0.997
YES	0.235	0.032	0.004

Conditional distributions of the selected covariates within each category of the four factors

		DFactor1			DFactor2			DFactor3		DFactor4		
		Level1	Level2	Level3	Level1	Level2	Level3	Level1	Level2	Level1	Level2	Level3
Age class	18-34 years	0.215	0.240	0.145	0.254	0.212	0.187	0.245	0.099	0.281	0.214	0.059
	35-54 years	0.484	0.398	0.402	0.360	0.483	0.505	0.489	0.325	0.473	0.492	0.244
	54-70 years	0.300	0.362	0.453	0.386	0.305	0.309	0.267	0.576	0.247	0.294	0.697
Labour condition	employed	0.52	0.46	0.29	0.41	0.48	0.59	0.56	0.20	0.72	0.44	0.08
	unemployed	0.11	0.11	0.09	0.16	0.09	0.11	0.13	0.05	0.01	0.16	0.16
	other	0.37	0.43	0.61	0.44	0.42	0.31	0.32	0.75	0.26	0.40	0.76
Family type	Couple w/out children	0.212	0.292	0.347	0.244	0.246	0.224	0.238	0.253	0.178	0.266	0.285
	Couple w/childern	0.602	0.568	0.496	0.596	0.585	0.580	0.655	0.294	0.611	0.613	0.383
	other	0.186	0.141	0.157	0.160	0.169	0.196	0.107	0.454	0.211	0.121	0.333
Years of residence	Up to 5 years	0.078	0.100	0.207	0.112	0.099	0.049	0.070	0.183	0.138	0.078	0.031
	6-10 years	0.113	0.074	0.144	0.071	0.104	0.146	0.084	0.195	0.212	0.060	0.046
	11-30 years	0.529	0.552	0.184	0.429	0.516	0.594	0.557	0.319	0.512	0.529	0.424
	>30 years	0.281	0.275	0.465	0.389	0.281	0.210	0.289	0.303	0.138	0.333	0.500
Income declared	NO	0.394	0.444	0.498	0.528	0.379	0.372	0.384	0.538	0.248	0.445	0.701
	YES	0.606	0.556	0.502	0.472	0.621	0.628	0.616	0.462	0.752	0.555	0.299
Gender	female	0.498	0.500	0.703	0.662	0.490	0.401	0.453	0.764	0.331	0.537	0.874
	male	0.502	0.500	0.297	0.339	0.510	0.599	0.547	0.236	0.669	0.463	0.126
Educational level	low	0.391	0.413	0.547	0.417	0.423	0.356	0.395	0.456	0.329	0.415	0.576
	intermediate	0.507	0.485	0.251	0.531	0.490	0.420	0.496	0.435	0.512	0.498	0.348
	high	0.102	0.102	0.202	0.052	0.087	0.224	0.109	0.109	0.160	0.087	0.077

APPENDIX 3: Detailed output for tourists model with factor distributions

Distribution of factor 1 and conditional distribution of indicators within categories of factor 1

	DFactor1	
	0 (Level1)	1 (Level2)
DFactor Level Size	0.525	0.475
Wine/taste routes		
NO	0.939	0.166
YES	0.061	0.834
Local festivals		
NO	0.818	0.250
YES	0.182	0.750
Typical local products		
NO	0.844	0.127
YES	0.156	0.873
Lower prices/costs		
NO	0.591	0.412
YES	0.409	0.588

Distribution of factor 2 and conditional distribution of indicators within categories of factor 2

	DFactor2	
	0 (Level1)	1 (Level2)
DFactor Level Size	0.641	0.360
canals		
NO	0.340	0.952
YES	0.661	0.048
herons		
NO	0.227	0.929
YES	0.773	0.071
Woods/wetlands		
NO	0.344	0.886
YES	0.656	0.114
Rice paddies		
NO	0.716	0.984
YES	0.284	0.016
Po Delta park		
NO	0.133	0.839
YES	0.867	0.161
Bicycle paths		
NO	0.369	0.841
YES	0.631	0.159

Distribution of factor 3 and conditional distribution of indicators within categories of factor 3

	DFactor3	
	0 (Level1)	**1 (Level2)**
DFactor Level Size	0.646	0.354
rice		
NO	0.527	0.929
YES	0.473	0.071
wine		
NO	0.497	0.817
YES	0.503	0.184
eels/claims		
NO	0.351	0.906
YES	0.649	0.094
Fruits/vegetables		
NO	0.049	0.751
YES	0.951	0.249

Distribution of factor 4 and conditional distribution of indicators within categories of factor 4

	DFactor4	
	0 (Level1)	**1 (Level2)**
DFactor Level Size	0.607	0.393
walkings		
NO	0.246	0.028
YES	0.754	0.972
bird watching		
NO	0.956	0.583
YES	0.044	0.417
cycling		
NO	0.559	0.379
YES	0.441	0.621
Fishing/hunting		
NO	0.932	0.877
YES	0.068	0.123
Dining agr		
NO	0.793	0.448
YES	0.207	0.552
Visit Po Delta park		
NO	0.924	0.277
YES	0.076	0.723

Distribution of factor 4 and conditional distribution of indicators within categories of factor 4

	DFactor5	
	0 (Level1)	**1 (Level2)**
DFactor Level Size	0.708	0.292
Beach infrastructure		
NO	0.074	0.463

YES	0.927	0.537
Territory knoledge		
NO	0.201	0.685
YES	0.800	0.315

Conditional distributions of the selected covariates within each category of the five factors

		DFactor1		DFactor2		DFactor3		DFactor4		DFactor5	
		Level1	**Level2**	**Level1**	**Level2**	**Level1**	**Level2**	**Level1**	**Level2**	**Level1**	**Level2**
Number of previous vacations	**0**	0.266	0.264	0.312	0.181	0.160	0.456	0.200	0.366	0.140	0.568
	1 or more than 1	0.735	0.736	0.688	0.819	0.840	0.544	0.800	0.634	0.860	0.432
Educational level	**low**	0.186	0.208	0.211	0.171	0.169	0.246	0.240	0.129	0.222	0.134
	intermediate	0.537	0.529	0.478	0.631	0.519	0.558	0.565	0.482	0.524	0.554
	high	0.277	0.264	0.311	0.198	0.312	0.196	0.194	0.389	0.254	0.312
Type of interview	**beach**	0.668	0.591	0.548	0.779	0.742	0.428	0.830	0.323	0.792	0.240
	guest house	0.159	0.219	0.233	0.106	0.104	0.340	0.134	0.271	0.084	0.438
	Po Delta park	0.173	0.191	0.219	0.115	0.154	0.232	0.036	0.406	0.124	0.322
Age class	**18-34**	0.168	0.134	0.086	0.269	0.148	0.159	0.184	0.102	0.174	0.099
	35-54	0.568	0.669	0.625	0.600	0.610	0.628	0.606	0.632	0.599	0.658
	55-70	0.264	0.197	0.289	0.131	0.243	0.213	0.210	0.266	0.228	0.243

2 CSA1: Using BBN to evaluate the influence of landscape on the creation of second-order effects: the case of agritourism.

Authors

Rosa Manrique, Davide Viaggi and Meri Raggi

2.1 Abstract

We developed a Bayesian Belief Network (BBN) to model the cascade effect of landscape elements on local economy. The BBN shows the interaction of landscape, service producers and consumers, which most influence the local economy trough the generation of second-order effects. The BBN, basically, represents the correlation and causal relationships among variables. We derived estimates of prior and conditional probabilities (CPT's) from a mix of survey data, regional statistics and expert judgment. Sensitivity analysis identified that the wetlands and seminatural vegetation cover influence the level of attractiveness of the local landscape. Furthermore, such level of attractiveness has an influence on the agritourism density, which are also influenced by the farms density. The model also shows the contribution of agritourism and the food service offered (second-order effect) on the local economy due to residents consumption.

2.2 Introduction

Many research questions emerge regarding the landscape as a driver of competitiveness, and the various mechanisms (antropical and environmental) that can influence the land use for the creation of services from the ecosystem. One of the main problems analyzing the effect of human activities on the Ecosystem Services (ES) supply is the lack of information about the cause-effect relationship between landscape and socio-economic benefits generated from the use of such services.

One of the many mechanisms that influence the land use, is the application of policy measures to support agriculture. It is recognized the profound changes caused by a direct influence of the Common Agriculture Policy (CAP) on the agricultural landscape (Turner, Pearce, & Bateman 1993; Plieninger *et al.* 2012). The application of specific measures with direct effects on landscape attributes (structure and composition) can trigger socio-economic benefits not only for farmers as direct beneficiaries, but also the local community, trough the production of other services different from agriculture, which directly contributes to generate new profits. For example, most cultural services (e.g. landscape aesthetics, recreational opportunities, spiritual fulfillment), which are directly experienced and appreciated by society, often help to improve the public support for protecting the environment that gives such cultural opportunities (e.g. Gobster *et al.* 2007).

However, the mechanisms to incentivize the production of such landscape-related services are not enough studied. This is an important gap in times when the need of increasing production requires a responsible management of the environment and public goods (e.g. Braat and ten Brink 2008). The contribution of the ES generated in the agricultural context to local economy is not well known, nor the trade-offs among them (Power 2010).Thus, the contribution of many public goods such as the beauty of the landscape, biodiversity, the air quality and many others, is not so evident, as well as their weight in the local economy (Dale & Polasky 2007).

There is lack of knowledge on the interrelationships between society and the ecosystem functioning, specially understanding the supply of goods and services by landscape, which determine the value of the landscape benefits and their contribution to local economy. Environmental studies have put attention on the assessment of the landscape functioning through landscape indicators and structure-based metrics, but there is an increase of interest in evaluating the socio-economic benefits, to evidence how the ES flow fulfill the demand of society, which requires the knowledge of the needs and preferences of stakeholders involved (Hein *et al.* 2006).

In this context, a Bayesian belief network (BBN) is able to describe the cascade effect of ES (Haines-Young & Potschin 2009; De Groot *et al.* 2010) due to its ability of representing complex domains in a simple way. BBNs have increased their usage to support landscape and natural resources management (Marcot et al. 2001; McCann, Marcot, and Ellis 2006; Marcot et al. 2006; Newton et al. 2006; Smith et al. 2007; Uusitalo 2007; Haines-Young 2011; McCloskey, Lilieholm, and Cronan 2011; Potschin and Haines-Young 2011; Landuyt et al. 2013), and have been extensively used as a decision support tool. They can help to link different types of knowledge that usually generate separate outputs. Their capacity to deal with data missing, organize current knowledge in causal graphs, generate testable hypothesis and possible scenarios, together with their ability to update knowledge as new data becomes available, are the main advantages of using this method.

In this paper, an example for estimating the likelihood of contribution to local economy of wetlands and seminatural vegetation in the third agrarian region of Ferrara, a 893 Km^2 area located in the eastern plain of the province, is introduced using a BBN. The model is based on evidence on landscape perception and the frequency of meals consumption in agritourism, using data from a survey in the study area carried out within activity c) of the project, regional statistics, and expert judgments obtained during CLAIM stakeholders laboratories (see deliverables 2.6 and 2.7).

2.3 Methodology

2.3.1 Reference framework for public goods and second order effects

The landscape spreads its benefits to society normally outside the market, in the form of particular public goods, some internalizations are possible; for example service suppliers can integrate the value of some public goods in their products and add value to the final product, generally a private good. In theory, the capability of public goods to generate private goods increases the value of the former, and should justify the support of public goods and services, and the improvement of their management. To meet this, the source of ES generation, i.e. the landscape, should be managed in response of needs and demands of society, accounting for both private and public goods. However, as many services provided by the landscape are public goods (Boyd & Banzhaf 2007; de Groot *et al.* 2012) their economic value is underestimated or simply unknown, making difficult to estimate their contribution to the economy and to obtain an optimal service production.

It is documented that local economic benefits arise from activities linked to the environment and natural heritage (Courtney, Hill, & Roberts 2006). In the agricultural context, many socio-economic benefits derive from public goods (Cooper, Hart, & Baldock 2009), not necessarily by direct means but frequently indirect and in some cases by accident (Courtney *et al.* 2013). These benefits include tourism and recreation activities, socio-cultural benefits, market opportunities, and jobs creation opportunities, in particular, by farm diversification activities (OECD 2009). However, it is not so evident how landscape contributes to create such benefits.

The project CLAIM has developed a conceptual framework to better analyze the causal relationships between landscape and ES supply, as well as management and local competitiveness effects (van Zanten *et al.* 2013). This framework evidences three main areas (1, 2 and 3, Figure 1), where different mechanisms can have an influence on the landscape's cascade effect. Firstly, through the landscape management, influencing directly structure, composition and functioning of the landscape, with direct consequences on ES supply. Secondly, through policies that incentivize the demand of services, for instance, rural tourism, recreation, cultural amenities, traditional and quality products, which contribute to adding value to the correlated ES; and thirdly, through payments that support certain ES to generate more economic benefits, and that can influence the ES quality, for example air, water or soil quality.

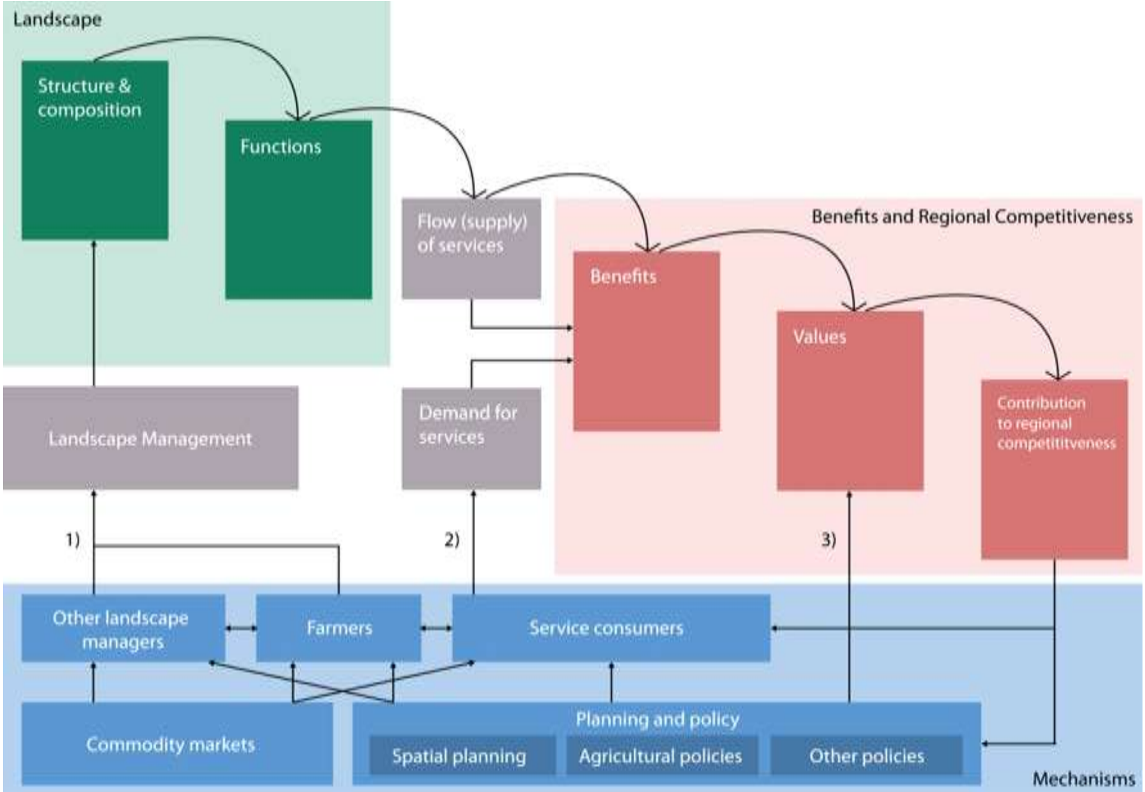


Figure 1. CLAIM framework (van Zanten et al. 2013)

Due to its complexity, we restrict our analysis to a portion of such framework to highlight the socio-economic effects generated from the interaction of service producers and consumers. To do that, we focus on the generation of second-order effects as a result of the use and transformation of public goods. We concentrate on the second and third area of the CLAIM framework, analyzing simultaneously the effects of the ES supply and the demand side.

We claim that ES, that are mainly public goods, contribute to local economy trough the improvement and development of second-order services, which are the result of the conversion of public goods by producers or service suppliers in private and club goods in order to satisfy human needs and to obtain a profit (Manrique *et al.* 2013a; c). The quantity of demanded services by consumers may support the ES supply and improve the local economy through the consumption of services generated from public goods.

2.3.2 The BBN

A Bayesian network defines a factorization of a joint probability distribution over the variables that are represented by the nodes of the network, where the factorization is given by the directed links of the network nodes:

$$P(X_v) = \prod_{v \in V} P(X_v | X_{pa(v)})$$

The resulting network specifies a set of dependence and independence assumptions that will be enforced on the joint probability distribution, which is then specified in terms of a set of conditional probability distributions that are represented as:

$$P(X_v | X_{pa(v)})$$

We developed several causal statements of the type:

$X \rightarrow Y$

where X is a cause of Y, and where Y often takes the role of an observable effect of X, which typically cannot be observed itself. We derived the posterior probability distribution: $P(X|Y = y)$

given the observation Y=y using $P(Y|X)$ specified in the model. Bayes' law provided the rule for such calculations:

$$P(X|Y = y) = P(Y = y|X)P(X)/P(Y = y)$$

Bayes' rule tell us how to obtain the posterior distribution by multiplying the prior distribution $P(Y)$, or our initial belief about Y, by the ratio $P(X|Y)P(X)$, known as the 'normalized likelihood' of Y given X, thus:

$$posterior \propto prior \times likelihood$$

See Kjaerulff & Madsen (2013) for more details.

2.3.3 Study area

The study area is located in the eastern side of the Region Emilia-Romagna, province of Ferrara. It is the third agricultural region of Ferrara, which comprises 9 municipalities: Codigoro, Comacchio, Goro, Lagosanto, Massa Fiscaglia, Mesola, Migliaro and Migliarino. It is a plain area with a minimum elevation of 3m below sea level to a maximum of 8m above sea level. A large part of the territory is within the Po Delta Park, contains some Natura2000 sites and holds 25 km of sandy beaches. Land use has been highly influenced by the intensification of mechanization to improve agricultural production, replacing the typical landscape elements, such as wetlands (Table 1).

Since the reclaimed lands have substituted the humid environments, the predominant landscape is composed by agriculture (74% of the study area) with small areas of wetlands and pine woods patches (15% of the study area), with also large extensions of embankments and water channels (4%). Land reclamation activities have increased agricultural production, and most important, have assured the stability and good hydraulic regime on declivous terrains, controlled the water drainage and maintained a good hydraulic conditions around the territory. Artificial areas (ca. 6%, urban areas, small villages) are characterised by their ancient history and the high presence of historic buildings. Visitors to the study area (mainly Italians) increase considerably during summer, the demand for beaches and the presence of areas of high naturalistic value, and the historical places have promoted an increment of receptive structures.

Table 1 Main land use in the study area (in square kilometres)

Municipality	agricultural area	wetland areas	water areas	forest & seminatural areas	Artificially modelled	Total area
Codigoro	150	4	4	2	10	170
Comacchio	144	105	11	4	20	284
Goro	15	4	3	2	7	31
Lagosanto	31	0	1	0	2	34
Massa Fiscaglia	56	0	0	0	2	58
Mesola	63	0	4	11	6	84
Migliarino	34	1	1	0	3	35
Migliaro	18	0	0	0	1	22
Ostellato	151	4	11	1	7	174
Total (sqkm)	662	118	35	20	58	893

2.3.4 Service supplier

We chose agritourism as service supplier for different reasons. It is well developed in the rural areas of Italy, and it is a combination of natural heritage and local agriculture that joins a tourism experience. It includes providing tourists with opportunities to experience a broad spectrum of local agriculturally-based products and services, and while it reduces the agrifood supply chain stages, is able to be the contact point between the request for quality products (Renting, Marsden, & Banks 2003).

In fact, the use of agritourism has increased in the last years. Data from ISTAT for the period 2002-2011 shows that the agritourism number in Ferrara has been triplicated, following the increase of the agritourism number in Italy (+67%), and hence incrementing the capacity of reception of guest rooms and food service (main services). This follows the trend of continuous growth in the number of farms offering agritourism activities, both in Europe and in North America (ISTAT, 2012; Che, Veeck, and Veeck 2005). This may support the actual possibilities of agritourism to enhance farmers revenue streams, but also means an opportunity to improve landscape and cultural identity (Agri@Tour 2010). In Table 2, we show the agritourism number in the study area.

In the study area, the law that regulates the agritourism activity (R.L. n.34, August 27, 1983; R.L. n. 4, March 31, 2009) has the goal of promoting the development and multifunctionality of farm activities. Activities involve bringing visitors to a working farm. The activities mainly offered are: accommodation; food service (using farm and local production, promoting typical food and using quality products); organization of local products tasting; organization of different recreational activities and/ or itineraries (e.g. cultural, social, educational, sportive, pleasure trips, horse-riding). All of these activities use the cultural and historical values, the quality of local products (e.g. organic farming, their originality (typical products), as well as, the potential activities in the surroundings (e.g. naturalistic tours, go for walking, gastronomical itineraries, bird watching, bike rides, fishing and boat trips) to increase the attractiveness of the area. In other words, they offer landscape-related services.

Furthermore, approximately 80% of the financial support of the axis 3 of the Rural Development Program (RDP 2000-2006) to support farm diversification in the Emilia-Romagna Region, was employed for the creation and support of agritourism. This support of agritourism activities has given a relevant contribute to the farm income (Fanfani & Pieri 2012) and created job opportunities (Isola & Zuppiroli 2010). In the study area, for the 2008 year, only farmers from one municipality have asked for support (i.e. Ostellato).

Table 2 Number of farms and agritourisms (source: ISTAT 2011)

Municipality	Agritourism	Farms
Codigoro	2	327
Comacchio	2	293
Goro	0	24
Lagosanto	0	68
Massa Fiscaglia	0	102
Mesola	3	282
Migliarino	2	92
Migliaro	1	52
Ostellato	2	349
Total	12	1589

2.3.5 Consumer's data

It is widely recognized that the general public has a preference for landscapes associated with traditional and extensive farming activities with natural elements, such as trees, water bodies, and mountains (Arriaza et al. 2004; Howley et al. 2012). It is also known that people valorize specific elements of the landscape in specific areas and time (Boyd 2007). For this reason, we selected the most characteristic landscape elements of the study area, that is, wetlands and seminatural vegetation (138km^2), that have been highly influenced by agriculture intensification, and because we supposed that land transformation may have affected residents.

Since the use of agritourism in Ferrara have increased in the last years (+39% and +45%, Italians and foreigners, respectively, source: ISTAT period 2009-2011), and a preliminary analysis (see previous ad-hoc study) has evidenced a significant correlation between perception and behavior, we got the resident's perception of wetlands and seminatural vegetation (Table 3), and associate them to the frequency of meals consumption in agritourism (Table 4).

Table 3. Perception of residents about wetlands and seminatural vegetation (in percentage)

Municipality	Advantage	Disadvantage	Other
Codigoro	75.56	15.56	8.89
Comacchio	71.43	16.19	12.38
Goro	58.33	25.00	16.67
Lagosanto	73.68	10.53	15.79
Massa Fiscaglia	69.57	17.39	13.04
Mesola	59.38	15.63	25.00
Migliarino	64.71	23.53	11.76
Migliaro	33.33	50.00	16.67
Ostellato	76.92	11.54	11.54
Total	69.47	16.84	13.68

Table 4 Meals consumption by residents in agritoursim (in percentage)

Municipality	Many times	Few times	Never
Codigoro	11.11	64.44	24.44
Comacchio	1.90	52.38	45.71
Goro	8.33	50.00	41.67
Lagosanto	0.00	42.11	57.89
Massa Fiscaglia	0.00	42.11	57.89
Mesola	4.35	34.78	60.87
Migliarino	6.25	56.25	37.50
Migliaro	0.00	58.82	41.18
Ostellato	0.00	83.33	16.67
Total	3.86	55.09	41.05

2.3.6 The structure of the network

In order to understand in which way public goods-type ES are contributing to local economy, we built a direct acyclic graph (DAG) to represent the cascade network that links landscape to local competitiveness (Figure 2). It shows the effect of the perception on a specific landscape element, and the relationship with the service producer, which is able to generate second-order-services due to the interaction of consumer's behaviour and service supply. The second-order-service influence the added value of farms and create job opportunities, improving the local competitiveness.

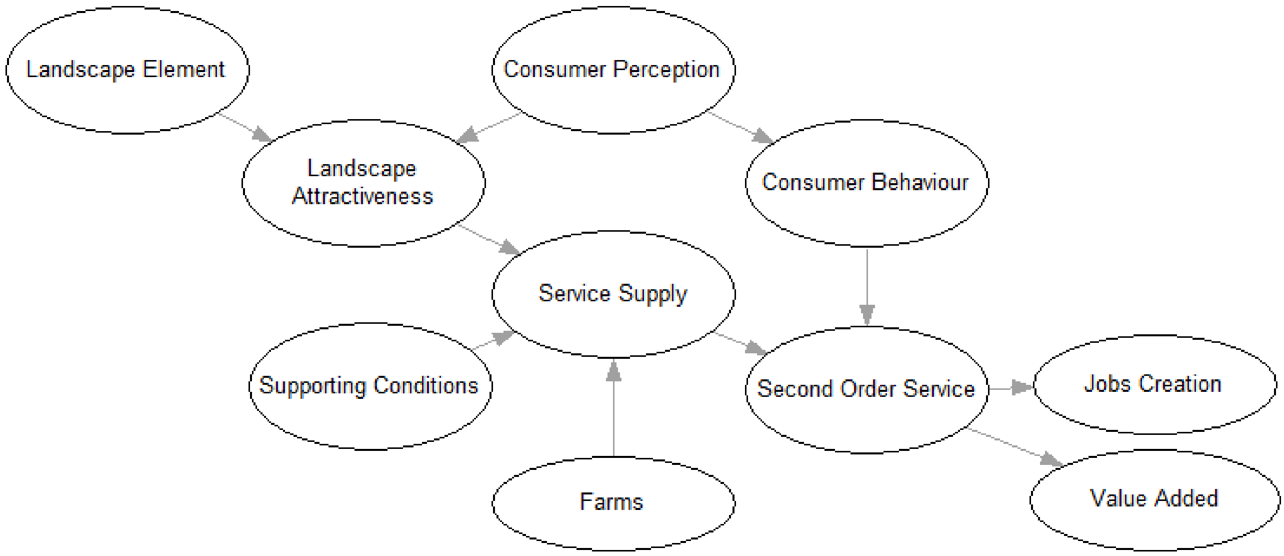


Figure 2. DAG showing the final structure of the network. Variables (nodes) are shown in the circles connected by rows (arcs) representing direct links of the network nodes.

This DAG was built on the following assumptions:

- Public goods are transformed by producers (service suppliers) in a market product to satisfy societal demands, this action means to put into the market a product with added value.
- Consumers use public goods freely, but may receive the added value of the public good transformed in a new service, mainly private.
- Second order effects are the services created from the indirect use of public goods by consumers.

We simplified the structure of the CLAIM framework (Figure 1) to manage the complexity of the system, however, we put a lot of attention in making the network describe adequately the key process we were interested to analyze. We explored different model structures via direct acyclic graphs (DAGs) prior to parameterize the final network (Manrique *et al.* 2013b). DAGs enabled us to rapidly select different approaches to deal with the main problem.

In Table 5 we report the description and data sources of the variables used in the final network.

Table 5 Description of variables and data sources

Variable	Definition	Type	States	Source
Landscape:				
Wetlands cover	Percentage of wetlands, forest and seminatural areas by municipality (landscape element).	Continuous	>20% 10 to 20 <10%	Region Emilia-Romagna (land use map, 2008)
Wetlands Residents Perception	It is a direct indicator of resident's awareness for specific landscape elements.	Discrete	Advantage Disadvantage Other	Survey in the study area (2013)
Landscape Attractiveness	Is the result of peoples' perception and the occurrence of the landscape element. A negative peoples' perception will indicate a low level of attractiveness of the landscape.	Discrete	High Low	No data available
Consumers demand:				
Residents frequency	It provides evidence of the real behavior of consumers, data expresses the percentage of residents visiting an agritourism for meals consumption in a month.	Discrete	Many times Few times Never	Survey in the study area (2013)
Service providers:				
Agritourism/sqkm	It is the actual number of agritourism by square kilometer in each municipality (agritourism density).	Continuous	>0.04 0.01 to 0.04 <0.01	ISTAT 2011
Seats for Eating/sqkm	It expresses the capacity of agritourism (seats for eating) in the food service by square kilometer given the consumers request. We used the number of seats for eating divided by the number of agritourisms in the Ferrara province as a coefficient, then: $seats\ for\ eating = coefficient \times agrito$	Continuous	>0.8 0.4 to 0.8 0 to 0.4 None	No data, data approximation from Ferrara province (Camera di Comercio di Ferrara 2011)
Landscape management:				
Measure311	It gives information about the participation of the study area (at municipality level) to the measure 311 of the RDP	Discrete	Yes No	Region Emilia-Romagna (2008)
Farms/sqkm	It is the number of farms by square kilometer in each municipality. It should contribute to increase the probability to	Continuous	>3	ISTAT 2010

	find an agritourism.		1.5-3 <1.5	
Contribution to local economy:				
Jobs number/sqkm	It is used to express the probability to create jobs due to agritourism activity. Data approximation is obtained from: $Jobs\ created = (seats\ for\ eating \times coef$	Continuous	>0.01 0 to 0.01 None	No data, data approximation from Region Emilia-Romagna (Isola and Zuppiroli 2010)
Value added (Euro/sqkm)	It is used to express the value added to the farm due to the agritourism activity. An approximation was obtained considering the added value of food service and accommodation by worker in Italy: $Value\ added = jobs\ number \times 20.000$	Continuous	>300 0 to 300 None	No data available, data approximation from 'Annuario Statistico Italiano' (2011)

2.3.7 Implementation of the network

Only after having decided the final structure of the network we proceeded to implement the network, which consist in populating the CPTs with conditional probabilities. We put attention in an adequate representation of the states of the variables to ensure the information elicited is represented adequately and the network is sensitive to changes of the parent variables within reasonable ranges. However we preferred to use few states than using too many to avoid large CPTs.

Variables without actual data (i.e. landscape attractiveness, seats for eating, value added and jobs number) were feed using best available expectations (in particular literature review or expert knowledge) making few assumptions about dependencies and independencies and thus postulating fewer hypothetical solutions:

- Landscape attractiveness results from the landscape's element perception by residents. For example, when the perception of the element is low/negative and the presence/cover of that element is high, then the probability of higher attractiveness should be low.
- Seats for eating (number of seats for eating/km^2) is influenced by the presence of agritourism (number of agritourisms/km^2) and the residents' frequency taking meals in agritourism. A higher density of agritourism plus a higher frequency of taking meals should increase the probability of higher density of seats for eating. Otherwise, will decrease this probability.
- Value added and jobs number are positively correlated with the density of seats for eating. Thus, we expect that higher the probability of seats for eating, the higher the probability of increasing the value added and the jobs number.

Data about resident's perception and its relationship with the frequency of eating meals in agritourism (the residents' behaviour) for the study area were obtained from the survey (Table 6). The other parameters that corresponded the network structure (i.e. wetlands cover, measure 311, farms density, agritourism density) (Table 7) were used to learn the CPT's through maximum likelihood estimation using Netica^{TM} software (Norsys Software Corporation). Parameters were estimated using the expectation-maximization (EM) algorithm (Lauritzen 1995). This algorithm calculates the maximum likelihood and the maximum a posterior (MAP). The EM algorithm proceeds by iterating two steps: the expectation step (E-step) and the maximization step (M-step).

The E-step computes the expected data frequencies under an initial assignment of parameters, while the subsequent M-step maximizes the log-likelihood of the parameters under the expected data frequencies. The M-step computes new estimates interpreting the expected data frequencies as actual data frequencies from the database of cases. The two steps are alternated iteratively until a stopping criterion is satisfied, which is until convergence of the log-likelihood function. In other words, convergence is achieved when the difference between the log-likelihood of two consecutive iterations is less than or equal to a log-likelihood threshold (Kjaerulff & Madsen 2013).

Table 6 CPT for the node residents frequency (times of meals consumption in a month) in the study area (sample size = 285 residents)

	Residents frequency (counts of meals consumption)		
Wetlands perception	Many times	Few times	Never
Advantage	6	115	77
Disadvantagee	4	24	20
Other	1	18	20

2.3.8 Model assessment

We analyzed the network to evidence some problematic aspects between relationships (Kjaerulff & Madsen 2013). We focused on sensitivity analysis and error confusion matrix for the network assessment. Sensitivity analysis was done in order to show how much the beliefs of the target node could be influenced by a single finding of other nodes in the network. It is particularly useful for identifying parameters that have a large or small impact on the probability of occurrence of a particular state of the target node, but it also provides information about findings nodes which will provide the most information about the target node (Kjaerulff & Madsen 2013). Thus, it was possible to test our initial assumptions given the evidence. Netica's entropy reduction (i.e. mutual information) was used as the measure of sensitivity.

We tested the network checking if it provided coherent outputs of carefully selected set of inputs (i.e. agritourism density, seats for eating). Case data was used to test the accuracy of the model predictions for agritourism density due to the updating beliefs influenced by the other variables. In the case of number of seats for eating, we used the case expected values to assess the prevision of the network. The number of seats for eating, the number of jobs created and added value were obtained at larger scales (Ferrara province and Region E-R) and scaled down to our study area (Table 7). These data were used to test the prediction of the model.

One of the most used test is a confusion matrix, which compares predicted with actual outcomes. Some standard scoring rules to evaluate the classification include the logarithmic loss, quadratic loss and spherical payoff (Morgan & Henrion 1990). We choose the spherical payoff since it is the most useful index (see Marcot et al. 2006), it varies from 0 to 1, with 1 indicating the best performance.

Table 7 Data variables by municipality (*=data approximation)

Municipality	Wetlands cover (%)	Farms /sqkm	Agritourism /sqkm	Measure 311	Seats for Eating/sqkm (*)	Jobs Number /sqkm (*)	Added Value (Euro/sqkm) (*)
Codigoro	3.53	1.93	0.01	No	0.259	0.009	172.45
Comacchio	38.36	1.03	0.01	No	0.155	0.005	103.20
Goro	18.09	0.76	0.00	No	0.000	0.000	0.00
Lagosanto	0.00	1.98	0.00	No	0.000	0.000	0.00
Massa Fiscaglia	0.00	1.76	0.00	No	0.000	0.000	0.00
Mesola	13.05	3.35	0.04	No	0.782	0.026	521.30
Migliarino	2.82	2.60	0.06	No	1.242	0.041	828.11
Migliaro	0.00	2.31	0.04	No	0.977	0.033	651.48
Ostellato	2.88	2.01	0.01	Yes	0.253	0.008	168.60

2.4 Results

We present here a BBN model as an example of the application of the method for depicting the residents perception of landscape and the influence on the consumption of meals in local agritourisms. The compiled model is shown inFigure 3, each node shows the beliefs as column bars representing the probability or likelihood that a variable is in a certain state (each node in the model and their states were described in Table 5). Note that although landscape attractiveness has been classed as a landscape variable, strictly is an intermediate node formed by the residents perception and the vegetation cover.

The sensitivity analysis of the model is presented in tables Table 8, Table 9, and Table 10, values are ranked according the degree of influence of the variables findings. Agritourism density is the most significant factor causing the largest entropy reduction in the number of seats (10.3%), followed by the residents frequency (5.3%). Added value and jobs creation are highly correlated to seats for eating since both are indicators (symptoms) of the agritourism capacity in food service (Table 8). On the other hand, going up the cascade network, the sensitivity analysis shows that landscape attractiveness is the most significant factor (28.6%) on agritourism density (Table 9)

Landscape attractiveness, in turn, is most influenced by wetlands cover and wetlands perception by residents, which causes an entropy reduction of 14.8% and 9% each (Table 10). The agritourism density is highly correlated to it.

In Table 11 and Table 12 it is shown the error matrix for agritourism density and seats for eating, respectively. The error rate of agritourism density means that in 11% of the cases for which the case file supplied a density of agritourisms value, the network predicted the wrong value, where the prediction was taken as the state with lowest belief. In the case of number of seats for eating, the error rate was low (11%), which means that cases for which the network make a prediction are not so different from the case file provided with the approximation of the actual values (expected values). In the case of value added and jobs number the error rate was zero.

Additionally, we provided some preliminary simulations on two key variables: the changes in belief about residents behavior and financial support through measure 311 (Table 13 and Table 14, respectively). The results show that although the number of seats for eating is highly sensitive to agritourism density, changing the actual evidence on residents frequency taking meals (Residents_freq=Many times) it will likely increase the higher density of seats for eating (+26.1%). Similarly, augmenting the participation to measure 311 for farm activities diversification (Measure311=Yes), it will probably occur an increase of the moderate density of agritourism (+46.8%).

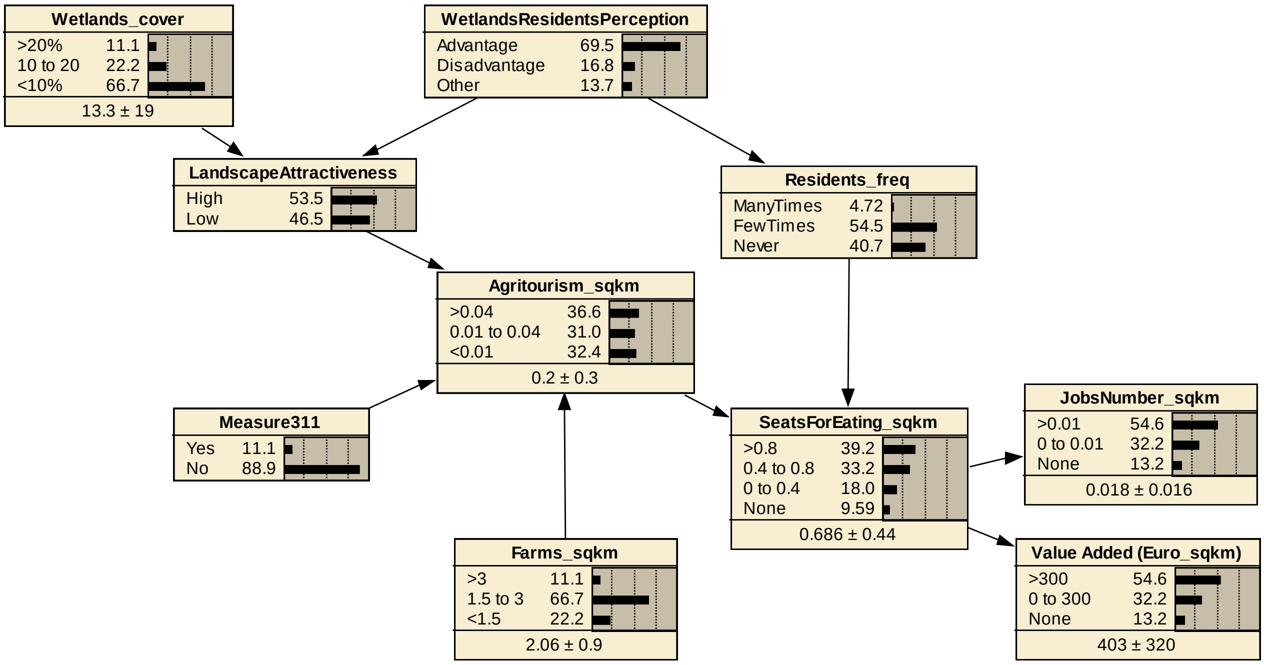


Figure 3 The BBN model of second-order service (seats for eating) in the study area.

Table 8. Sensitivity analysis results ranked in decreasing order of influence on ‘seats for eating’.

Variable (node)	Mutual info/Entropy reduction (%)	
SeatsForEating_sqkm	0.1974	(100)
JobsNumber_sqkm	0.08704	(44.1)
Euro_sqkm	0.08704	(44.1)
Agritourism_sqkm	0.02039	(10.3)
Residents_freq	0.01055	(5.34)
LandscapeAttractiveness	0.0037	(1.87)
Farms_sqkm	0.001523	(0.771)
Wetlands_cover	0.0006854	(0.347)
WetlandsResidentsPercept	0.0005273	(0.267)
Measure311	4.176e-05	(0.0212)

Table 9. Sensitivity analysis for 'agritourism density'.

Variable (node)	Mutual info/Entropy reduction (%)
Agritourism_sqkm	0.08743 (100)
LandscapeAttractiveness	0.025 (28.6)
Farms_sqkm	0.008803 (10.1)
Wetlands_cover	0.004731 (5.41)
SeatsForEating_sqkm	0.004702 (5.38)
ValueAdded	0.003015 (3.45)
JobsNumber_sqkm	0.003015 (3.45)
WetlandsResidentsPercept	0.002941 (3.36)
Measure311	0.001858 (2.12)
Residents_freq	4.103e-05 (0.0469)

Table 10. Sensitivity analysis for 'landscape attractiveness'.

Variable (node)	Mutual info/Entropy reduction (%)
LandscapeAttractiveness	0.99655 (100)
Agritourism_sqkm	0.36033 (36.2)
Wetlands_cover	0.14788 (14.8)
WetlandsResidentsPercept	0.08978 (9.01)
SeatsForEating_sqkm	0.01672 (1.68)
JobsNumber_sqkm	0.01098 (1.1)
Euro_sqkm	0.01098 (1.1)
Residents_freq	0.00118 (0.119)
Farms_sqkm	0.00000 (0)
Measure311	0.00000 (0)

Table 11. Error matrix showing the accuracy for the agritourism density

Actual value	Predicted value		
	>0.04	0.01 to 0.04	<0.01
>0.04	3	-	-
0.01 to 0.04	-	2	1
<0.01	-	-	3

Error rate =11.11%

Spherical payoff = 0.8665

Table 12 Error matrix showing the accuracy of the predicted value for seats for eating.

Actual value	Predicted value			
	>0.8	0.4 to 0.8	0 to 0.4	None
>0.8	2	-	-	-
0.4 to 0.8	1	-	-	-
0 to 0.4	-	-	3	-
None	-	-	-	3

Error rate =11.11%

Spherical payoff = 0.9225

Table 13 Effect of changes in belief of residents behavior (Residents_freq=ManyTimes) on the variables.

Variables and states	Change in belief (variation in %)
Wetlands perception	-
Advantage	51.3 (-18.2)
Disadvantage	34.9 (+18.1)
Other	13.8 (+0.1)
Landscape attractiveness	-
High	45 (-7)
Low	55 (+8.5)
Agritourism	-
>0.04	41.9 (+5.3)
0.01 to 0.04	27.5 (-3.5)
<0.01	30.6 (-1.8)
Seats for eating	-
>0.8	65 (+26.1)
0.4 to 0.8	24.4 (-8.9)
0 to 0.4	7.5 (-10.5)
None	3.06 (-6.53)
Jobs number	-
>0.01	69.1 (+14.5)
0 to 0.10	26.3 (-5.9)
None	4.56 (-8.64)
Added value	-
>300	69.1 (+14.5)
0 to 300	26.3 (-5.9)
None	4.56 (-8.64)

Table 14 Effect on changes in belief for financial support (measure311=yes) for the variables

Variables and states	Change in belief (variation in %)
Agritourism	-
>0.04	11.1 (-25.5)
0.01 to 0.04	77.8 (+46.8)
<0.01	11.1 (-21.3)
Seats for eating	-
>0.8	41.4 (+2.2)
0.4 to 0.8	32.3 (-0.9)
0 to 0.4	17.1 (-0.9)
None	9.19 (-0.4)
Jobs number	-
>0.01	55.7 (+1.1)
0 to 0.10	31.7 (-0.5)
None	12.6 (-0.6)
Added value	-
>300	55.7 (+1.1)
0 to 300	31.7 (-0.5)
None	12.6 (-0.6)

2.5 Discussion

This model shows the causal-effect chain from landscape to the local economy, through the relationship among specific landscape elements (wetlands and seminatural vegetation) to service suppliers (agritourisms) and consumers (residents). It first shows the interaction between landscape elements and consumer perception, generating landscape attractiveness given the presence of elements positively perceived. Then, it shows the probability of service's supplier (agritourism) to develop activities (food service) linked to landscape attractiveness. It also shows the potential contribution of second-order services (seats for eating) to the local economy, through the added value generated by farms due to agritourism activity (food service) and employment opportunity.

A positive perception of the landscape element influenced positively the landscape attractiveness of the study area. Wetlands and seminatural vegetation is considered an advantage among residents (69.5%), although it is poorly represented (less than 10%). This result is relevant when valuing ES. For example it has been found that the interrelationship between human and nature has been uncaptured by most of the conventional valuation methods (see Kumar & Kumar 2007).

Another aspect highlighted in our results, is that public goods and landscape are inputs for the generation of second-order services. This is supported by Boyd (2007) and Boyd & Banzhaf (2007) that claim that end products of nature can be inputs to marketed products. However, if society does not appreciate the present attributes of the landscape, the potential of ES/public goods is neglected. This will probably have immediate effects on producers that will catch the low level of attractiveness from the landscape indicator, affecting the generation of second-order services as a consequence. In our case, the model showed that the second-order service (i.e. seats for eating) is highly sensitive to the interaction of consumers behavior and service producer.

The consumers behavior revealed a low frequency of meals consumption in agritourism (data from the survey), which can be due to different reasons. It has been highlighted, during our stakeholders laboratories (see deliverable 2.7) that residents of our study area are almost indifferent to landscape when referring to going to take meals outside, and that the main agritourism's consumer is mainly urban, while residents who already live in a rural context are not susceptible to that activity because of cultural factors. In other areas, the use of agritourism by residents is, in turn, much higher, contrary to that evidenced in our study area.

The residents behavior about agritourism consumption can be also explained by the recent agricultural history in the study area. The agritourism activity is relatively new, contrary to the more traditional, such as 'trattoria'. The land where agritourism is emerging now are fairly recent due to the historical and depth transformation of the territory (i.e. land reclamation). Thus, the agritourism is considered a new element that it is not part of the cultural identity. Land reclamation has altered the original landscape and force people to adapt to a different situation (Campiani & Garberi 2008).

At present, the agritourism activity should be intended as a complementary activity to the usual farm work (R.L. n. 4, March 31, 2009). Agritourism operators are mainly the farmer supported by the farmer family including all the workers of the farm. Opening an agritourism implies to be prepared in different aspects, and to have some qualifications, which is a requirement to get access to financial support of measure 311. Together with the positive trend of tourist arrivals in the province of Ferrara (+66% of foreigners, +43% Italians, ISTAT 2009-2011), it is expected that the agritourism should help to promote the local competitiveness in the study area.

One way to contribute to local competitiveness is improving job opportunities, as has been shown by Isola and Zuppiroli (2010) in the Region Emilia-Romagna. The job opportunities, in the agritourism, are related to the management and recreational activities. In general, agritourism offers the client landscape-related benefits such as the proximity of specific elements of the landscape (e.g. water bodies, historical and cultural heritage, green areas, sites of naturalistic importance, birds diversity), incorporating to its services other benefits such as the beauty of the place, the silence and relax, and the opportunity to do recreational activities.

Thus, it is likely that the interaction of a high landscape indicator value and high people's preference for the ES will offer a high probability of producing second-order services. Depending on the degree of service supply and demand side, the probability of producing second-order services will be high, moderate or low, and that will be the main indicator of the indirect contribution of public goods and/or ES to local economy.

Stakeholders of our study area are very concerned about the need of job opportunities in the study area, which was highlighted during the local meetings (see deliverables 2.6 and 2.7). There is a primarily vision concerning jobs creation and competitiveness. Stakeholders evidenced the highest value of food supply, it was highlighted that the main role of agriculture and farmers is food production, but also evidenced the need of different activities to support the creation and maintenance of jobs, local investment and the creation of added value. The discussion evidenced the need of linking specific landscape elements that may support economy in different ways: through the service management (e.g. 'consorzio di bonifica' water management) or through public (e.g. Po Delta park, cultural and recreation activities) and private service suppliers (e.g. agritourism).

Nevertheless, from the point of view of the stakeholders, entrepreneurship capacity is needed to maintain landscape. The quality of enterprises is important to create revenues and better landscape management. For example, bigger farms have more capital and are more able to invest, and thus to diversify; while smaller farms, although more original and closer to quality products, need more financial support because low revenues. They stated that one factor that influences the scarce results of entrepreneurship in the study area is the difference between being a farmer and being an entrepreneur. Farmers in the study area have no an entrepreneurial attitude. This is relevant, considering that much of the incentives focused on improving rural economy is based on farms diversification. Some studies have shown that not all the farms/farmers are diversifiers (Valbuena, Verburg, & Bregt 2008).

Additional implications of our results are limited to data variables and the BBN limitations. Indeed, a limitation of our results is that we did not considered the effect of tourists (Italians and foreigners) on meals consumption. This could have been useful to figure out the total contribution of food service to local economy considering the positive trend of agritourism number in the province. In fact, the data used to obtain the approximated values of number of seats for eating, value added of agritourism and jobs number, were taken from statistics that consider the total consumers number, not only residents.

One limitation of the method is time and space-related. The BBN does not allow feedback loops among variables (static), but this weakness can be improve building dynamic systems that change over time, while with appropriate data the model can be spatially explicit. It can be added complexity to the model to explore future scenarios, such as the effect of agriculture on landscape composition, or the effect of new incentives for greening payments and a sustainable agriculture, or to continue supporting agriculture intensification, which can directly influence the remaining cover of natural and seminatural vegetation, and affect the degree of landscape attractiveness. This will depend on the ability of modeling trade-offs, which is difficult to obtain using only BBNs. Different methods are necessary to integrate different modeling techniques including different data sources and expert opinions.

Finally, the main advantage of using the BBN, in this study, was the possibility to explore different scenarios, even with a small sample size and limited data. In our example we saw how the change in belief of resident's behavior can affect the number of seats for eating. Thus, a higher request about a service should improve the service supply. Similarly, an improving participation in the measure 311 for farm diversification should increase the number of agritourisms. This can have some policy implications concerning the ability of farms diversification to contribute to rural economy.

2.6 Conclusions

This study investigated the possibility to represent the effects of ES of public good type on the provision of public goods and socio-economic development through agritourism activity.

The results corroborate the belief that producers of services, which are the convertor of ES into new non-public services, are directly influenced by the ES appreciation by society that values landscape attractiveness. Producers are directly influenced by landscape indicators and potential conditions that support the activity. The probability that will exist convertors for a specific ES will depend on the agents (i.e. producers and consumers) feedback.

The BBN allowed us to quantify these connections and their relationships in a consistent framework and to test the potentiality of this method in this type of exercise. We found that the BBN was helpful in analysing second-order-effects of landscape-related public goods on several grounds. Firstly, the instrument was useful to figure out and synthesise the CLAIM framework. We wanted to articulate, in an efficient way, what we know about the effect of landscape on the regional competitiveness, to understand the effect of using and transforming public goods through farm activities and its effect on landscape, and to recognize the socio-economic consequences in the rural context. We found that BBN help us structure the problem and made it operational even with a small quantity of data. Its ability of combining empirical information with stakeholders information revealed to be an advantage in this case.

Secondly, it helped us to structure the idea that consumers (represented by residents in our case study) may use the public goods not only directly (for free) but possibly will receive it with an added value, trough an intermediate agent (i.e. the agritourism) who offers the society a specific quality of the public good (e.g. the landscape attractiveness) through elements of landscape of high interest (e.g. wetlands) offering landscape-related services (e.g. food service, typical products, recreation activities).

In addition, while the BBN remains flexible to integrate different sources of information, the results and the potential for simulation are not indifferent to the quality of original information. Better and more consistent (scale, scope, time) data sets, would certainly allow a better use of this method, particularly for simulation.

Although some trade-offs between public goods and private services could be explored using the model described here, the incorporation of consumers and producers decision-making process, would require extending the BBN to the factors that most influence them (i.e. supporting conditions, limitations, advantages, socio-cultural factors, etc.). The same largely applies to policy simulation beyond the measure 311 effect. In addition, for both consumers and policy, a more fine-tuned evidence about the relationship between descriptive parameters of context conditions and agent behaviour would be necessary to provide more meaningful simulation results. An alternative might be the usage of agent-based models (ABMs) (Macal & North 2009) or even the combination of BBN and ABMs (e.g. Sun & Müller 2012).

2.7 References

Agri@Tour. (2010) European meeting on agritourism. *European meeting on agritourism* (ed MiPAAF), p. 7. Arezzo (Italy), 12 November.

Boyd, J. & Banzhaf, S. (2007) What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics*, **63**, 616–626.

Braat, L. & ten Brink, P. (2008) *The Cost of Policy Inaction. The Case of Not Meeting the 2010 Biodiversity Target*. Final Report for the European Commission.

Campiani, E. & Garberi, M.L. (2008) Cambiamenti di uso del suolo dal 1853 ad oggi nel territorio della provincia di ferrara. *12 Conferenza Nazionale ASITA, 21-24 October* pp. 601–606. L'Aquila, Italy.

Che, D., Veeck, A. & Veeck, G. (2005) Sustaining production and strengthening the agritourism product: Linkages among Michigan agritourism destinations. *Agriculture and Human Values*, **22**, 225–234.

Cooper, T., Hart, K. & Baldock, D. (2009) *Provision of Public Goods Trough Agriculture in the European Union*. Report prepared for DG Agriculture and Rural Development, Institute for European Environmental Policy. London.

Courtney, P., Mills, J., Gaskell, P. & Chaplin, S. (2013) Investigating the incidental benefits of Environmental Stewardship schemes in England. *Land Use Policy*, **31**, 26–37.

Dale, V.H. & Polasky, S. (2007) Measures of the effects of agricultural practices on ecosystem services. *Ecological Economics*, **64**, 286–296.

Fanfani, R. & Pieri, R. (2012) *Il Sistema Agro-Alimentare dell'Emilia-Romagna, 2011* (eds R Fanfani and R Pieri). Maggioli editore, Repubblica di San Marino.

Gobster, P.H., Nassauer, J.I., Daniel, T.C. & Fry, G. (2007) The shared landscape: what does aesthetics have to do with ecology? *Landscape Ecology*, **22**, 959–972.

De Groot, R.S.S., Alkemade, R., Braat, L., Hein, L. & Willemen, L. (2010) Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecological Complexity*, **7**, 260–272.

De Groot, R., Brander, L., van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., Christie, M., Crossman, N., Ghermandi, A., Hein, L., Hussain, S., Kumar, P., McVittie, A., Portela, R., Rodriguez, L.C., ten Brink, P. & van Beukering, P. (2012) Global estimates of the value of ecosystems and their services in monetary units. *Ecosystem Services*, **1**, 50–61.

Haines-Young, R. (2011) Exploring ecosystem service issues across diverse knowledge domains using Bayesian Belief Networks. *Progress in Physical Geography*, **35**, 681–699.

Haines-Young, R. & Potschin, M. (2009) *Methodologies for Defining and Assessing Ecosystem Services*. UK.

Hein, L., van Koppen, K., de Groot, R.S. & van Ierland, E.C. (2006) Spatial scales, stakeholders and the valuation of ecosystem services. *Ecological Economics*, **57**, 209–228.

Isola, M. & Zuppiroli, A. (2010) *Agriturismo, Scelta Per La Competitività*. Bologna.

Kjaerulff, U.B. & Madsen, A.L. (2013) *Bayesian Networks and Influence Diagrams: a Guide to Construction and Analysis*, Second Edi. Springer, New York.

Kumar, M. & Kumar, P. (2007) Valuation of the ecosystem services: A psycho-cultural perspective. *Ecological Economics*, **64**, 808–819.

Landuyt, D., Broekx, S., D'hondt, R., Engelen, G., Aertsens, J. & Goethals, P.L.M. (2013) A review of Bayesian belief networks in ecosystem service modelling. *Environmental Modelling & Software*, 1–11.

Macal, C.M. & North, M.J. (2009) Agent-based modeling and simulation. *Proceedings of the 2009 Winter Simulation Conference (WSC)* pp. 86–98. IEEE.

Manrique, R., Targetti, S., Galimberti, G., Raggi, M. & Viaggi, D. (2013a) CAP and landscape management in a Ecosystem Service perspective: defining and tracing second order effects. *Second Conference of the Italian Association of Agricultural and Applied Economics* 6-7 June, Parma- Italy.

Manrique, R., Targetti, S., Galimberti, G., Raggi, M. & Viaggi, D. (2013b) Agricultural landscapes and ecosystem service tradeoffs: A preview from an empirical case study in the eastern plain of Ferrara, Italy. *Changing European Landscape. IALE European Congress* Manchester, September 9-12.

Manrique, R., Targetti, S., Viaggi, D., Galimberti, G. & Raggi, M. (2013c) Pac e gestione del paesaggio: quali gli effetti di secondo ordine? *AGRIREGIONIEUROPA*, 1–4.

Marcot, B.G., Holthausen, R.S., Raphael, M.G., Rowland, M.M. & Wisdom, M.J. (2001) Using Bayesian belief networks to evaluate fish and wildlife population viability under land management alternatives from an environmental impact statement. *Forest Ecology and Management*, **153**, 29–42.

Marcot, B.G., Steventon, J.D., Sutherland, G.D. & Mccann, R.K. (2006) Guidelines for developing and updating Bayesian belief networks applied to ecological modeling and conservation. *Can.J. For. Res.*, **36**, 3063–3074.

McCann, R.K., Marcot, B.G. & Ellis, R. (2006) Bayesian belief networks: applications in ecology and natural resource management. *Can.J. For. Res.*, **36**, 3053–3062.

McCloskey, J.T., Lilieholm, R.J. & Cronan, C. (2011) Using Bayesian belief networks to identify potential compatibilities and conflicts between development and landscape conservation. *Landscape and Urban Planning*, **101**, 190–203.

Morgan, M.G. & Henrion, M. (1990) *Uncertainty: a Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis*. Cambridge University Press, New York.

Newton, A.C., Marshall, E., Schreckenberg, K., Golicher, D., Velde, D.W., Edouard, F. & Arancibia, E. (2006) Use of a Bayesian Belief Network to Predict the Impacts of Commercializing Non-timber Forest Products on Livelihoods. *Ecology and Society*, **11**, 24.

OECD. (2009) *The Role of Agriculture and Farm Household Diversification in the Rural Economy: Evidence and Initial Policy Implications*.

Plieninger, T., Schleyer, C., Schaich, H., Ohnesorge, B., Gerdes, H., Hernández-Morcillo, M. & Bieling, C. (2012) Mainstreaming ecosystem services through reformed European agricultural policies. *Conservation Letters*, **5**, 281–288.

Potschin, M.B. & Haines-Young, R.H. (2011) Ecosystem services: Exploring a geographical perspective. *Progress in Physical Geography*, **35**, 575–594.

Power, A.G. (2010) Ecosystem services and agriculture: tradeoffs and synergies. *Philosophical transactions of the royal society B: biological sciences*, **365**, 2959–2971.

Renting, H., Marsden, T. & Banks, J. (2003) Understanding alternative food networks: exploring the role of short food supply chains in rural development. *Environment and Planning*, **35**, 393–411.

Smith, C.S., Howes, A.L., Price, B. & McAlpine, C. a. (2007) Using a Bayesian belief network to predict suitable habitat of an endangered mammal – The Julia Creek dunnart (Sminthopsis douglasi). *Biological Conservation*, **139**, 333–347.

Sun, Z. & Müller, D. (2012) A framework for modeling payments for ecosystem services with agent-based models, Bayesian belief networks and opinion dynamics models. *Environmental Modelling & Software*, 1–14.

Turner, R.K., Pearce, D.W. & Bateman, I. (1993) *Environmental Economics. An Elementary Introduction* (ed F Pellizzari 2003). Il Mulino, Bologna.

Uusitalo, L. (2007) Advantages and challenges of Bayesian networks in environmental modelling. *Ecological Modelling*, **203**, 312–318.

Valbuena, D., Verburg, P.H. & Bregt, A.K. (2008) A method to define a typology for agent-based analysis in regional land-use research. *Agriculture, Ecosystems & Environment*, **128**, 27–36.

Van Zanten, B.T., Verburg, P.H., Espinosa, M., Gomez-y-Paloma, S., Galimberti, G., Kantelhardt, J., Kapfer, M., Lefebvre, M., Manrique, R., Piorr, A., Raggi, M., Schaller, L., Targetti, S., Zasada, I. & Viaggi, D. (2013) European agricultural landscapes, common agricultural policy and ecosystem services: a review. *Agronomy for Sustainable Development*, 1–17.

3 CSA1: An Agent Based Model approach to the CSA 1 Ferrara Lowlands.

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3.1 Introduction

Since landscape has become the object of policy measures, researchers from different disciplines (ecology, architecture, economics, sociology, psychology) have been involved in the assessment and evaluation of preferences and values attached to different landscapes. The available techniques for the assessment and evaluation of landscape services can be categorized as (see also CLAIM D 3.17; Targetti et al 2012): 1) Monetary evaluation (*e.g.* stated and revealed preference evaluation, market-related methods); 2) Non-monetary techniques (*e.g.* public opinion surveys, deliberative approaches, multicriteria techniques); 2) Landscape indicators (*e.g.* landscape metrics, indicators of social attributes); 3) Simulation models (*e.g.* mathematical programming models, biological models, agent based models).

Simulation models are based on assumptions regarding the characteristics of the relevant decision-makers, behaviours, and specific relationships that link actions. These models can be used to simulate the given phenomenon under different conditions with respect to e.g. changes in policy content, market prices, and climate conditions. Despite their wide use, the application of models' results for policy implementation is not straightforward. Transaction costs, information asymmetries and the co-existence of complex ecological and social systems hamper the employment of simulation model results, which are originated by simplified model structures. This is clear for example for the assessment of the potential effects of agricultural policies on the rural landscape and the downstream generation of economic value, given the ecological and social complexity of the object of the policy, and the inherent uncertainty that permeates the agricultural decision-making process. Some of the most ambiguous topics are for example:

- The assessment of the societal willingness to pay for landscape services (*e.g.* biodiversity);
- The identification of the proper policy package that will achieve the expected results (*e.g.* the conservation of biodiversity);
- The effect on the landscape of homogenous and voluntary-based policies that are filtered through an heterogeneous group (mostly farmers) who is characterised by different behaviours, objectives, mechanism of decision-making, institutional arrangements and attitudes towards environmental values (see *e.g.* Valbuena *et al.,* 2008);
- The effect on the landscape structures of the interactions among the relevant decision makers and local stakeholders.

Agent Based Models (ABM) are a class of simulation models that are specifically aimed at reproducing the behaviour of a relatively large number of agents acting in a given setup. ABMs are thus especially designed for the analysis of 1) system properties that emerge from the interactions of agents, 2) feedback systems, 3) the representation of heterogeneous groups, and thus they are a proper tool for the reproduction of a complex system in a controlled and virtual environment (An, 2012; Heckbert et al., 2010; Janssen and Ostrom, 2006b). The significant differences of ABM to other models' approaches (*e.g.* mathematical programming) lie in the possibility to focus on "small" scale effects and the possibility to include interactions elicited by "movement" and interactions of the actors that can go beyond elementary changes of state.

Increasingly, ABM are used to investigate the relationship between the different components of socio-ecological systems, rural economy, land use change and agricultural policies (An, 2012; Filatova et al., 2013). More specifically on agriculture, ABMs have been used to analyse the effect of agricultural policy on structural changes (Balmann, 1997; Berger, 2001; Happe et al., 2011, 2008, 2006), on the landscape structure (Brady et al., 2012) and resilience (Schouten *et al.,* 2013) and its multifunctionality (Berkel and Verburg, 2012). Other applications include the analysis of how agent preferences influence the distribution of landscape elements (Kelley and Evans, 2011), or the effect of network incentives on the environmental conservation (Caillault et al., 2013).

The introduction of feedbacks among agents in an ABM of land use change is a rather complex task and only recently scholars have been trying to include them (Le et al., 2012). Le et al. (2012) provides both a theoretical framework and its application for the introduction of feedback in ABMs. They distinguish between (1) a primary feedback loop: a reaction to the environment as it is; (2) a secondary (higher-order) feedback loop implies a qualitative change in the behaviour of the agents (see also Weisbuch, 2000). In this context, ABM have been used to analyse the co-evolution of policies and pastoralists behaviour (Janssen et al., 2000), a Darwinian selection of land use allocation (Manson, 2006), the role of imitation in land use change (Gotts and Polhill, 2009), effects on wild fauna of farm-biodiversity incentives (Polhill *etal.,* 2012). Interestingly, Weisbuch (2000) and Weisbuch and Boudjena (1999) use a cellular automata to model the spread of the adoption of agri-environmental measures in the EU, where the adoption is based on an imitation process of the neighbours farmers. While the model is theoretical, the author claims the results are comparable with real-world dynamics found for the uptake of environmental measures e.g. in Northern Italy. For these reasons, ABM seem to be a valid tool for an analysis of second order effects as outlined by the CLAIM framework (van Zanten *et al.,* 2013) and the CLAIM Deliverable 3.14 (Schaller et al., 2013).

The objective of the current report is the development of an empirical methodology to analyse by means of an ABM the emergence of second order effects resulting from the interactions among i) agri-environmental policies, ii) farmers and iii) "consumers".

The model is applied to the structure of landscape-related mechanisms emerged by the case study Ferrara Lowland of the CLAIM project. In this context, consumers "attach" value to landscape quality by translating their perception of landscape features in behaviours. The model represents an exercise to create a virtual laboratory that can be used to test in which conditions the conservation and promotion of landscape features (e.g. wetlands, hedges, wild fauna) triggered by agri-environmental policies can become a "self-sustainable" process. Specifically, landscape valorisation can promote complex interactions and raise awareness about the (economic and social) advantages stemming from landscape assets. This can drive landscape managers (e.g. farmers) to choose "landscape-friendly" practices. For instance -in the case study area- the attraction of tourists/consumers from the beach-side to the rural/natural park area is a relevant issue. Agri-environmental measures aimed at landscape valorisation could help the take-off of such a process and raise the awareness of farmers towards the economic opportunities underneath landscape valorisation. While not using real life data, the exercise is focused on developing a numerical application using real life issues of the area in problem structuring, building on area description, stakeholder interactions (LSL meetings) and insights from the application of the other methods in the same case study area.

3.2 Model description and scenario

We model the interactions among agri-environmental policies and 2 heterogeneous groups of agents: farmers and consumers (tourists), and their effects on the landscape and the environmental quality. The structure of the model is organised to allow for a contingent implementation with empirical data and analysis from other activities performed in the CSA (local stakeholders' laboratories, Bayesian belief network, statistical model, Analytic Network Process) and *ad-hoc* survey.

Farmers are modelled as fixed patches of a fictitious landscape, whereas consumers are moving agents. Farmers decide which activity to activate between conventional farming (no policy agreement) and green farming (environmental policy agreement), where the reward from farming is dependent on a fixed patch parameter (that can be interpreted as soil or farm typology), and the reward from green farming depends on the level of the agri-environmental payment. In doing so, they determine the environmental quality of the landscape, which is only dependent on the spatial distribution of the green farms (landscape quality attribute rewards to clustered green farming).

The consumers start from a neutral area (the beach), which is not subject to the farm decision-making and move around the landscape being attracted by the patches whose landscape quality is above an individual-specific threshold (individual perception), and they purchase (individual behaviour) local products, thus positively affecting the gross margins of the farmers. Physical movements of consumers towards the patches simulate the correlation between perception and behaviour of the agents. By doing that we link perception with purchase of local products and not only on-farm selling.

A more precise mathematical description, subdivided in subsequent procedures for any model steps (subscript *t*), follows.

Farmers (subscript *p*) choose between two activities: conventional farming and green farming according to a binary variable $Z_{t,p,i} \in \left[0,1\right]$ with *i= f, e* where *f* is the conventional farming, and *e* is the green farming. The land allocations are mutually excludable:

$$\sum_{i} Z_{t,p,i} \leq 1.$$

In step A, the farmers compute the expected profits from the different activities. The decision is based on some elements that are deterministically known (conventional farming productivity - $Y_{t,p}$, the cost of the policy compliance - *k*[1], the agri-environmental payment - *AEP*), and elements that are uncertain, namely the mean size of the group of consumers that have purchased at *t-1* from either conventional or green farming in the landscape (assuming perfect information of consumers' purchases):

$$E\left(\Pi_{t,p,f}\right) = Y_{t,p} + c \cdot \bar{T}_{t-1,f}$$

$$E\left(\Pi_{t,p,e}\right) = \left(1-k\right) y_{t,p} + AEP + c \cdot \bar{T}_{t-1,e}$$

A) Based on A) farmers select the best activity.

$$E\left(\Pi_{t,p,f}\right) \geq E\left(\Pi_{t,p,e}\right) \Rightarrow Z_{t,p,f} = 1$$

$$E\left(\Pi_{t,p,f}\right) \leq E\left(\Pi_{t,p,e}\right) \Rightarrow Z_{t,p,e} = 1$$

B) For each patch, call *S* the set of the eight surrounding patches. The environmental quality ($Q_{t,p}$) for each patch is determined by whether the given patch selected (from B) the green farming activity and by the sum of the green patch that surround it. Thus, a red patch is allowed to have a positive environmental quality in relation to the surrounding green patches.

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[1] In percentage terms.

$$Q_{t,p} = Z_{p,e} + \sum_{p \in \mathbf{S}} Z_{p,e}$$

$Q_{t,p}$ is then transformed in a probability of attractiveness ($i_{t,p}$) given by $i_{t,p} = Q_{t,p}/10$

C) In the preliminary model, a random number is assigned to each consumer/tourist according to a uniform distribution: $\partial_{t,c} \in [0,1]$. This procedure will be furthere developed by using the results from a statistical model.

D) Consumers move to a random patch whether the patch complies with the following rule: $\partial_{t,c} \leq i_{t,p}$

E) In the procedure, the model computes the number of consumers that are on each patch ($T_{t,p}$) and the mean number of consumers that is on the conventional and on the green patches $\bar{T}_{t,j} = \sum_{p} Z_{p,j} \bar{T}_{t,j} \Big/ \sum_{i} Z_{p,j}$ which is the value that enters in step A).

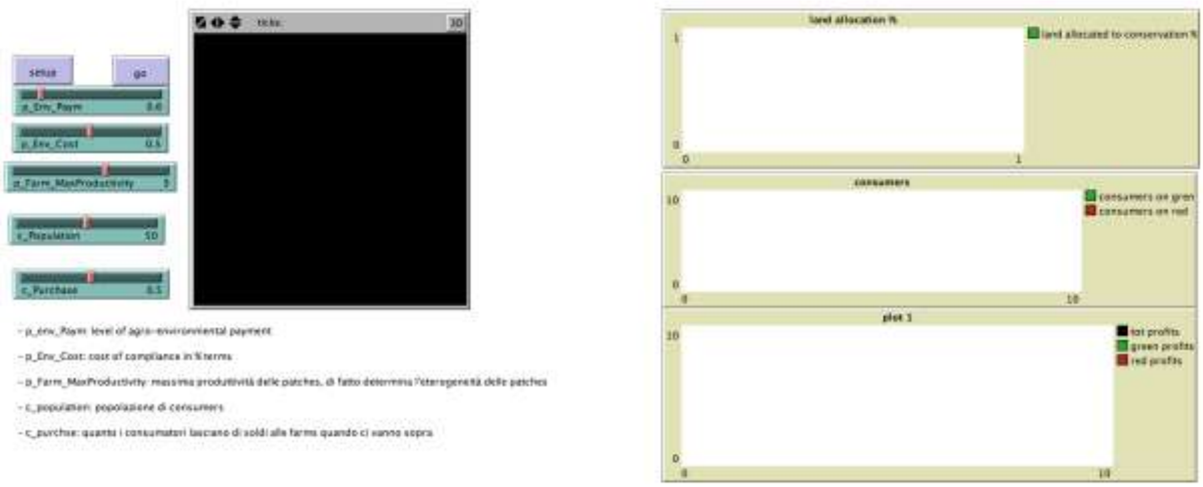
F) Finally, actual profits are computed:

$$\Pi_{t,p,j} = Z_{t,p,e}\left[(1-k)\, y_{t,p} + AEP + c \cdot \bar{T}_{t-1,e}\right] + Z_{t,p,f}\left[Y_{t,p} + c \cdot \bar{T}_{t-1,f}\right]$$

G) The consumers move back to the “beach”

The model is formulated in NetLogo (http://ccl.northwestern.edu/netlogo/). Figure 1 shows the interface.

Figure 1. Model interface in NetLogo



3.3 Preliminary results

Despite the theoretical nature and the simplicity of the model, the potential evolution of the land allocation of the area seems to exhibit some complex behaviour and can highlight some of the elements that characterize the interaction among the relevant components affecting a landscape.

First, the model seems to show the potential emergence of secondary effects originated by the interactions among environmental policies, farmers’ decisions and consumers’ preferences. In the current example, the implementation of policies creates incentives for the environmental protection (figure 2). The higher landscape quality in turn attracts tourism, and eventually creates a landscape that stands alone and provides enough incentives for a partially self-sustained environmental protection. In figure 3, when the policy payment is at the level 10, the full protection of the landscape is reached at t=7, after this point the policy payment might be reduced by up to 50% (payment at level 5) and the full protection endures. This result seems to emerge more likely in case of a medium level average productivity for the conventional farming.

By comparing the evolutions of the land allocation originated by two initial levels of policy payments (Figure 3), a path dependence/ hysteretic process seems to emerge. As we have seen above, starting from a policy payment at level 10, after some time is possible to reduce the agro-environmental payment up to a payment at level 5 while still maintaining the full protection of the landscape. On the other hand, starting from the payment at level 5, the full protection of the area is never reached.

Moreover, simulations performed with different parameter values (not shown here) suggest that the once the full protection is reached, the landscape hardly switch back to conventional agriculture, indicating the potential presence of threshold effects in the evolution.

Finally, free riding issues might easily emerge in the institutional arrangement that is introduced in the models (a voluntary policy payment). In the simulations this is shown by the rapidity of land allocation change from a period to the next one. This behaviour is especially frequent in case the conventional agriculture is widely surrounded by the green agriculture. In these conditions, the conventional agriculture free rides on the green agriculture, hosting the tourism that is actually attracted by the latter. However, since farmers can observe all the consumers, the green agriculture expects a relatively high level of tourism even in case they were conventional, and thus they tend to change the specialization. In the next steps tourism is less attracted by the area, conventional agriculture experiences a loss in comparison to the previous period, and hence in the following it goes back to green agriculture. The frequent changes are due to the specification of the models (the farmers do not have a memory longer than one period, and the land allocation can be chosen at any step) but highlight the potential free riding issue.

Figure 2. Land allocation for different level of payment when interactions and learning are absent.

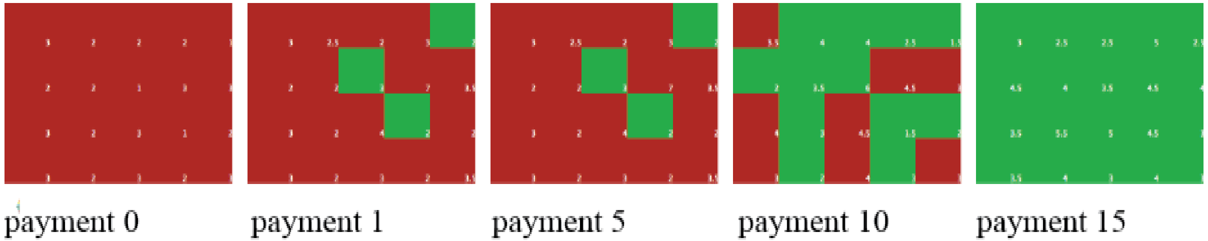
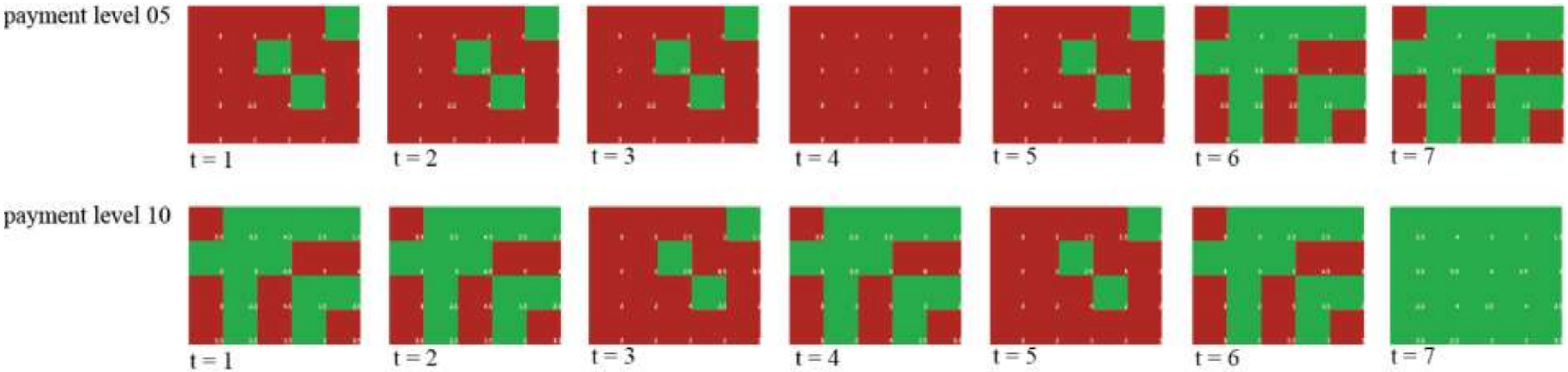


Figure 3. Evolution of the land allocation for two levels of policy payments (p= 5 and p= 10) for a period of 7 steps.



3.4 Discussion

The model represents an initial attempt to analyse the emergence of secondary effects in the rural landscape. The model is tailored to the logic of the real world case study of the Ferrara plain area, and it is fed numerically by artificial data for illustration purposes. Given its nature the results are inconclusive, because they are highly dependent on the relative values of the relevant parameters. Informative results are clearly dependent on the application of the model to a real case study and to the feasibility of collecting empirical data.

However, the exercise to use real life issues of the area in problem structuring already yielded several insights. In fact, the ability to provide a non-trivial schematisation of real life complexity is a clear learning step in model development. Some consideration can be outlined. The possibility to trigger self-sustainable loops at landscape level through second order effects is a new insight in the topic of the public goods issue that was developed in the CLAIM Project. The ABMs seem to be a valid tool able to analyze that process consistently by means of its peculiarities. Specifically:

- The inclusion of landscape effects of agri-environmental measures (even though not georeferenced) and the influence of farmers' neighbours on decisions;
- The possibility to simulate behaviours and perceptions of consumers towards local products and the inclusion of "local" market effects;
- The dynamic interactions of the agents following "loop" rationale (farmers influence landscape -> landscape influences consumers -> consumers influence farmers).

The model can be more precisely specified. The introduction of uncertainty in the model specification can affect the perception of the relevant agents on the profitability of the environmental policy payments, and thus the decisions and the resulting landscape structures. For instance, allowing for imperfect and asymmetric information would add more realistic results. The decision-making process can be modelled within a real-option approach, which would enable the assessment of the time inconsistency of the policy (option value, lock-in effects). Moreover, transaction costs are one of the key features that influence the adoption of policy measures. The introduction of the transaction costs within the model certainly improves the validity of the results. In this direction, an even more sophisticated approach would also be to explore the modelling of a learning process that affects dynamically the level of the transaction costs. Adding realistic features to the model inevitably will add complexity in the calibration and implementation. Therefore, the inclusion of empirical data and procedures should follow an attentive selection of the driving factors in the system. The CLAIM analytical framework will be a valid support in that selection process.

3.5 Conclusions

The model structuring and numerical exercise shows the potential emergence for secondary effects as a result of the interactions between groups of agents and policy measures. The results indicate that in certain conditions policies can create a positive feedback in the landscape, at relatively high levels of payment. This increases the attractiveness of the landscape for consumers, so that the landscape itself becomes a driver of environmental protection by providing incentives for an activity that would not be rewarded otherwise.

However the model should be validated by both a more detailed specification of the decisional behaviour (e.g. a real-option approach that can enable the assessment of potential effects of the time inconsistency of the policy), and by the implementation of empirical data from the case study area.

ABM seem to be a promising tool for the analysis of the effect of agricultural policies on the rural landscape, a tool that can generate useful insight that conventional simulation models can hardly provide. ABM have the ability to represent complex mechanisms, by explicitly including in the model formulation the relevant social interactions, and to apply it to broad context. ABM strengths are also their weaknesses: 1) they needs the specification of social interactions and mechanisms that are not yet fully understood, 2) their results are difficult to validate, given the complexity they take into account.

References

An, L., 2012. Modeling human decisions in coupled human and natural systems: Review of agent-based models. Model. Hum. Decis. 229, 25–36.

Balmann, A., 1997. Farm-based modelling of regional structural change: A cellular automata approach. Eur. Rev. Agric. Econ. 24, 85–108.

Berger, T., 2001. Agent-based spatial models applied to agriculture: a simulation tool for technology diffusion, resource use changes and policy analysis. Agric. Econ. 25, 245–260.

Berger, T., Schreinemachers, P., 2006. Creating Agents and Landscapes for Multiagent Systems from Random Samples. Ecol. Soc. 11.

Berkel, D., Verburg, P., 2012. Combining exploratory scenarios and participatory backcasting: using an agent-based model in participatory policy design for a multi-functional landscape. Landsc. Ecol. 27, 641–658.

Brady, M., Sahrbacher, C., Kellermann, K., Happe, K., 2012. An agent-based approach to modeling impacts of agricultural policy on land use, biodiversity and ecosystem services. Landsc. Ecol. 27, 1363–1381.

Caillault, S., Mialhe, F., Vannier, C., Delmotte, S., Kêdowidé, C., Amblard, F., Etienne, M., Bécu, N., Gautreau, P., Houet, T., 2013. Influence of incentive networks on landscape changes: A simple agent-based simulation approach. Themat. Issue Spat. Agent-Based Models Socio-Ecol. Syst. 45, 64–73.

Filatova, T., Verburg, P.H., Parker, D.C., Stannard, C.A., 2013. Spatial agent-based models for socio-ecological systems: Challenges and prospects. Themat. Issue Spat. Agent-Based Models Socio-Ecol. Syst. 45, 1–7.

Gotts, N.M., Polhill, J.G., 2009. When and how to imitate your neighbours: lessons from and for FEARLUS. J. Artif. Soc. Soc. Simul. 12, 2.

Happe, K., Balmann, A., Kellermann, K., Sahrbacher, C., 2008. Does structure matter? The impact of switching the agricultural policy regime on farm structures. Agent-Based Models Econ. Policy Des. Agent Based Models 67, 431–444.

Happe, K., Hutchings, N.J., Dalgaard, T., Kellerman, K., 2011. Modelling the interactions between regional farming structure, nitrogen losses and environmental regulation. Agric. Syst. 104, 281–291.

Happe, K., Kellermann, K., Balmann, A., 2006. Agent-based analysis of agricultural policies: an illustration of the agricultural policy simulator AgriPoliS, its adaptation and behavior. Ecol. Soc. 11, 49.

Janssen, M.A., Walker, B.H., Langridge, J., Abel, N., 2000. An adaptive agent model for analysing co-evolution of management and policies in a complex rangeland system. Ecol. Model. 131, 249–268.

Kelley, H., Evans, T., 2011. The relative influences of land-owner and landscape heterogeneity in an agent-based model of land-use. Ecol. Econ. 70, 1075–1087.

Le, Q.B., Seidl, R., Scholz, R.W., 2012. Feedback loops and types of adaptation in the modelling of land-use decisions in an agent-based simulation. Environ. Model. Softw. 27–28, 83–96.

Manson, S.M., 2006. Bounded rationality in agent-based models: experiments with evolutionary programs. Int. J. Geogr. Inf. Sci. 20, 991–1012.

Schaller, L., Kapfer, M., Kantelhardt, J., 2013. Landscape as a driver for competitiveness. Deliverable D3.14 of the CLAIM Project. Available at: http://www.claimproject.eu/docup/Deliverable_D3.14_def.pdf.

Valbuena, D., Verburg, P.H., Veldkamp, A., Bregt, A.K., Ligtenberg, A., 2010. Effects of farmers' decisions on the landscape structure of a Dutch rural region: An agent-based approach. Landsc. Urban Plan. 97, 98–110.

Weisbuch, G., 2000. Environment and institutions: a complex dynamical systems approach. Ecol. Econ. 35, 381–391.

Weisbuch, G., Boudjema, G., 1999. Dynamical Aspects in the Adoption of Agri-Environmental Measures. Adv. Complex Syst. 02, 11–36.

4 CSA2: Land-cover based assessment of landscape capacity to provide ecosystem services

As a first attempt to assess the potential supply of landscape services in the CSA Märkische Schweiz, the approach proposed by Burkhard et al. (2009) was implemented. The approach is based on Corine Land Cover classes (EEA, 2007); these are available free of charge and downloadable at the following URL: http://www.eea.europa.eu/data-and-maps/data#c12=corine+land+cover+version+13.

The assessment matrix is based upon different land cover types' capacities to provide individual services and adopt the following scale:

0 = no relevant capacity

1 = low relevant capacity

2 = relevant capacity

3 = medium relevant capacity

4 = high relevant capacity

5 = very high relevant capacity

A number of ecosystem services are considered based on Müller and Burkhard (2007), de Groot (2006), MA (2003) and Costanza et al. (1997). The individual services are grouped in four categories (Burkhard et al., 2009): i) ecological integrity (i.e. supporting services), ii) provisioning services, iii) regulating services, and iv) cultural services. The following tables shows the assessment matrix for each service category considering only the land cover classes observed in the CSA according to CORINE. In the case of the supporting services, 7 services are taken into account for the calculation of the total capacity: abiotic heterogeneity, biodiversity, biotic waterflows, metabolic efficiency, energy capture, reduction of nutrient loss and soil organic matter storage capacity (Table 1). The individual services considered to assess landscape supply capacity of provisioning services are 11 (Table 2): crops, livestock, fodder, capture fisheries, aquaculture, wild foods, timber, wood fuel, energy biomass, biochemicals and medicine, fresh waters. As for regulating services potential provision, this is based upon 9 individual services (Table 3): local climate, global climate, flood protection, ground water recharge, air quality, erosion control, nutrient regulation, water purification, and pollination. In the case of the fourth category, that referring to cultural services, the two following services are considered in the assessment matrix (Table 4): recreation and aesthetic values, and intrinsic value of biodiversity.

CLC CODE	CLC description	SUM EI	Abiotic Heterog.	Biodiv.	Biotic Waterflows	Metabolic efficiency	Energy capture	Reduction of Nutrient Loss	SOM storage capacity
111	Continuous urban fabric	0	0	0	0	0	0	0	0
112	Discontinuous urban fabric	7	1	1	1	1	1	1	1
121	Industrial or commercial units	2	1	1	0	0	0	0	0
124	Airports	7	1	1	1	1	1	2	0
131	Mineral extraction sites	4	2	2	0	0	0	0	0
142	Sport and leisure facilities	16	2	2	2	1	4	3	2
211	Non-irrigated arable land	18	3	2	3	1	4	3	2
231	Pastures	24	2	2	4	5	5	2	4
243	Agriculture & Natural Vegetation	19	3	3	3	2	3	2	3
311	Broad-leaved forest	31	3	4	5	4	5	5	5
312	Coniferous forest	30	3	4	4	4	5	5	5
313	Mixed forest	32	3	5	5	4	5	5	5
321	Natural grasslands	30	3	5	4	4	4	5	5
324	Transitional woodland-shrub	21	3	4	2	3	3	4	2
411	Inland marshes	25	3	2	4	4	4	3	5
512	Water bodies	23	4	4	0	4	4	3	4

Table .1. Matrix for the assessment of supporting services for the land cover type present in the CSA (Burkard et al., 2009)

CLC CODE	CLC description	Sum Prov	Crops	Live-stock	Fodder	Capture Fisheries	Acqua-culture	Wild Foods	Timber	Wood Fuel	Energy Biomass	Biochem. /Medicine	Fresh waters
111	Continuous urban fabric	0	0	0	0	0	0	0	0	0	0	0	0
112	Discontinuous urban fabric	3	1	0	1	0	0	1	0	0	0	0	0
121	Industrial or Commercial units	0	0	0	0	0	0	0	0	0	0	0	0
124	Airports	1	0	0	1	0	0	0	0	0	0	0	0
131	Mineral extraction sites	0	0	0	0	0	0	0	0	0	0	0	0
142	Sport and leisure facilities	0	0	0	0	0	0	0	0	0	0	0	0
211	Non-irrigated arable land	21	5	5	5	0	0	0	0	0	5	1	0
231	Pastures	10	0	5	5	0	0	0	0	0	0	0	0
243	Agriculture & Natural Vegetation.	21	3	3	2	0	0	3	3	3	3	1	0
311	Broad-leaved forest	21	0	0	1	0	0	5	5	5	0	5	0
312	Coniferous forest	21	0	0	1	0	0	5	5	5	0	5	0
313	Mixed forest	21	0	0	1	0	0	5	5	5	0	5	0
321	Natural grasslands	5	0	3	0	0	0	2	0	0	0	0	0
324	Transitional Woodland -shrub	5	0	2	0	0	0	1	0	2	0	0	0
411	Inland marshes	7	0	2	5	0	0	0	0	0	0	0	0
512	Water bodies	12	0	0	0	3	0	4	0	0	0	0	5

Table 2 Matrix for the assessment of provisioning services for the land cover type present in the CSA (Burkard et al., 2009).

CLC CODE	CLC Description	Sum Reg	Local Climate	Global Climate	Flood protect.	GW recharge	Air Quality	Erosion	Nutrient	Water Pur	Pollination
111	Continuous urban fabric	0	0	0	0	0	0	0	0	0	0
112	Discontinuous urban fabric	0	0	0	0	0	0	0	0	0	0
121	Industrial or commercial units	0	0	0	0	0	0	0	0	0	0
124	Airports	0	0	0	0	0	0	0	0	0	0
131	Mineral extraction sites	0	0	0	0	0	0	0	0	0	0
142	Sport and leisure facilities	9	1	1	0	2	1	1	1	1	1
211	Non-irrigated arable land	5	2	1	1	1	0	0	0	0	0
231	Pastures	8	1	1	1	1	0	4	0	0	0
243	Agriculture& Natural Vegetation	13	3	2	1	2	1	3	0	1	0
311	Broad-leaved forest	39	5	4	3	2	5	5	5	5	5
312	Coniferous forest	39	5	4	3	2	5	5	5	5	5
313	Mixed forest	39	5	4	3	2	5	5	5	5	5
321	Natural grasslands	22	2	3	1	1	0	5	5	5	0
324	Transitional woodland-shrub	3	1	0	0	0	0	0	0	0	2
411	Inland marshes	14	2	2	4	2	0	0	4	0	0
512	Water bodies	7	2	1	1	2	0	0	1	0	0

Table.3 Matrix for the assessment of regulating services for the land cover type present in the CSA (Burkard et al., 2009).

CLC CODE	CLC Description	Sum Cul	Recreatation and Aesthetic value	Intrinsic Value of Biodiversity
111	Continuous urban fabric	0	0	0
112	Discontinuous urban fabric	0	0	0
121	Industrial or commercial units	0	0	0
124	Airports	0	0	0
131	Mineral extraction sites	0	0	0
142	Sport and leisure facilities	5	5	0
211	Non-irrigated arable land	1	1	0
231	Pastures	3	3	0
243	Agriculture&Natural Vegetation	5	2	3
311	Broad-leaved forest	10	5	5
312	Coniferous forest	10	5	5
313	Mixed forest	10	5	5
321	Natural grasslands	6	3	3
324	Transitional woodland-shrub	4	2	2
411	Inland marshes	0	0	0
512	Water bodies	9	5	4

Table .4 Matrix for the assessment of cultural services for the land cover type present in the CSA (Burkard et al., 2009).

The Corine Land Cover (EEA 2006, 100 m grid) map for the CSA "Märkische Schweiz" is shown in Fig. 2.1.1; the area share of the individual land use are reported in par. 1.2.2 of this report.

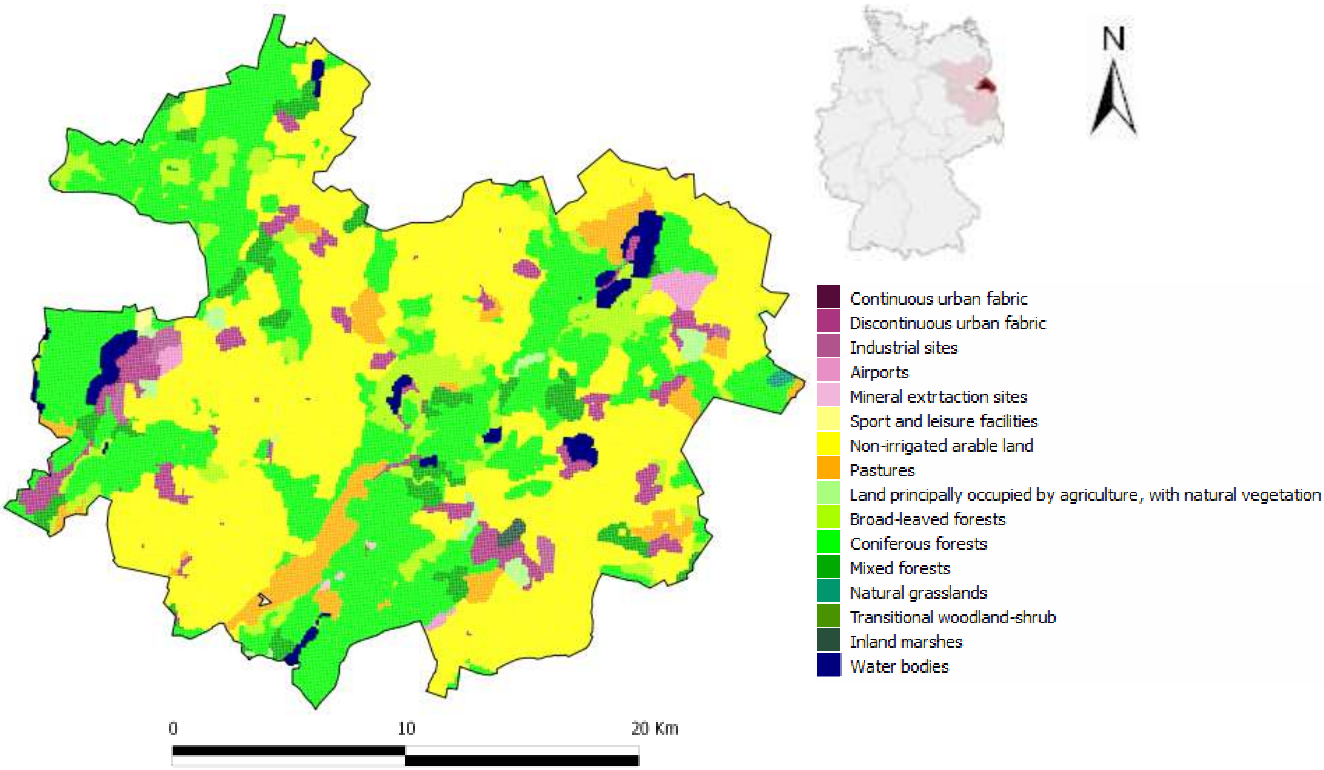


Figure 1. Case study area Märkische Schweiz : Corine land cover map (EEA, 2007).

The following table 5 highlights the rationale behind the assessment matrix of the individual services in each cathegory.

Landscape services	Rationales	Potential Indicators
Supporting		
Abiotic heterogeneity	The provision of suitable habitats for different species, for functional groups of species and for processes is essential for the functioning of ecosystems.	Abiotic habitat components' diversity indices; Heterogeneity indices, e.g. humus contents in the soil; Number/area of habitats
Biodiversity	The presence or absence of selected species, (functional) groups of species, biotic habitat components or species composition	Indicator species representative for a certain phenomenon or sensitive to distinct changes
Biotic water flows	Referring to the water cycling affected by plant processes in the system	Transpiration/total evapotranspiration
Metabolic efficiency	Referring to the amount of energy necessary to maintain a specific biomass, also serving as a stress indicator for the system	Respiration/biomass (metabolic quotient)
Exergy capture	The capability of ecosystems to enhance the input of usable energy. Exergy is derived from thermodynamics and measures the energy fraction that can be transformed into mechanical work. In ecosystems, the captured exergy is used to build up biomass (e.g. by primary production) and structures.	Net primary production; Leaf area index LA
Reduction of nutrient loss	Referring to the irreversible output of elements from the system, the nutrient budget and matter flows.	Leaching of nutrients, e.g. N, P
Storage capacity	Is referring to the nutrient, energy and water budgets of the system and the capacity of the system to store them when available and to release them when needed.	Solved organic matter; N, Corg in the soil; N, C in biomass
Regulating		
Local climate regulation	Changes in land cover can locally affect temperature, wind, radiation and precipitation.	Temperature, albedo, precipitation, wind; Temperature amplitudes; Evapotranspiration
Global climate regulation	Ecosystems play an important role in climate by either sequestering or emitting greenhouse gases.	Source-sink of water vapour, methane, CO_2
Flood protection	Natural elements dampening extreme flood events	Number of floods causing damages
Groundwater recharge	The timing and magnitude of runoff, flooding, and aquifer recharge can be strongly influenced by changes in land cover, including, in particular, alterations that change the water storage potential of the system, such as the conversion of wetlands or the replacement of forests with croplands or croplands with urban areas.	Groundwater recharge rates
Air quality regulation	The capacity of ecosystems to remove toxic and other elements from the atmosphere	Leaf area index; Air quality amplitudes
Erosion regulation	Vegetative cover plays an important role in soil retention and the prevention of landslides.	Loss of soil particles by wind or water; vegetation cover
Nutrient regulation	The capacity of ecosystems to carry out (re)cycling of, e.g. N, P or others.	N, P or other nutrient turnover rates
Water purification	Ecosystems have the capacity to purify water but can also be a source of impurities in fresh water.	Water quality and quantity
Pollination	Ecosystem changes affect the distribution, abundance, and effectiveness of pollinators. Wind and bees are in charge of the reproduction of a lot of culture plants.	Amount of plant products; Distribution of plants; Availability of pollinators
Provisioning		
Crops	Cultivation of edible plants	Plants/ha; kJ/ha
Livestock	Keeping of edible animals	Animals/ha; kJ/ha
Fodder	Cultivation and harvest of animal fodder	Fodder plants/ha; kJ/ha
Capture fisheries	Catch of commercially interesting fish species, which are accessible for fishermen.	Fishes available for catch/ha; kJ/ha
Aquaculture	Animals kept in terrestrial or marine aquaculture	Number of animals/ha; kJ/ha
Wild foods	Harvest of, e.g. berries, mushrooms, wild animal hunting or fishing	Plant biomass/ha; Animals available/ha; kJ/ha
Timber	Presence of trees or plants with potential use for timber	Wood/ha; kJ/ha
Wood fuel	Presence of trees or plants with potential use as fuel.	Wood or plant biomass/ha; kJ/ha
Energy (biomass)	Presence of trees or plants with potential use as energy source.	Wood or plant biomass/ha; kJ/ha
Biochemicals and medicine	Production of biochemicals, medicines	Amount or number of products; kg/ha
Freshwater	Presence of freshwater	Liters or m3/ha
Cultural		
Recreation & aesthetic values	Refers specifically to landscape and visual qualities of the resp. case study area (scenery, scenic beauty). The benefit is the sense of beauty people get from looking at the landscape and related recreational benefits.	Number of visitors or facilities; Questionnaires on personal references
Intrinsic value of biodiversity	The value of nature and species themselves, beyond economic or human benefits.	Number of endangered, protected or rare species or abitats

Table.5. Based on de Groot et al. (2010), Burkhard et al. (2009), Müller and Burkhard (2007) and MA (2003).

The application of the assessment matrix to the CSA is straightforward; the following figures show the results in terms of sums for the four categories of landscape services listed above.

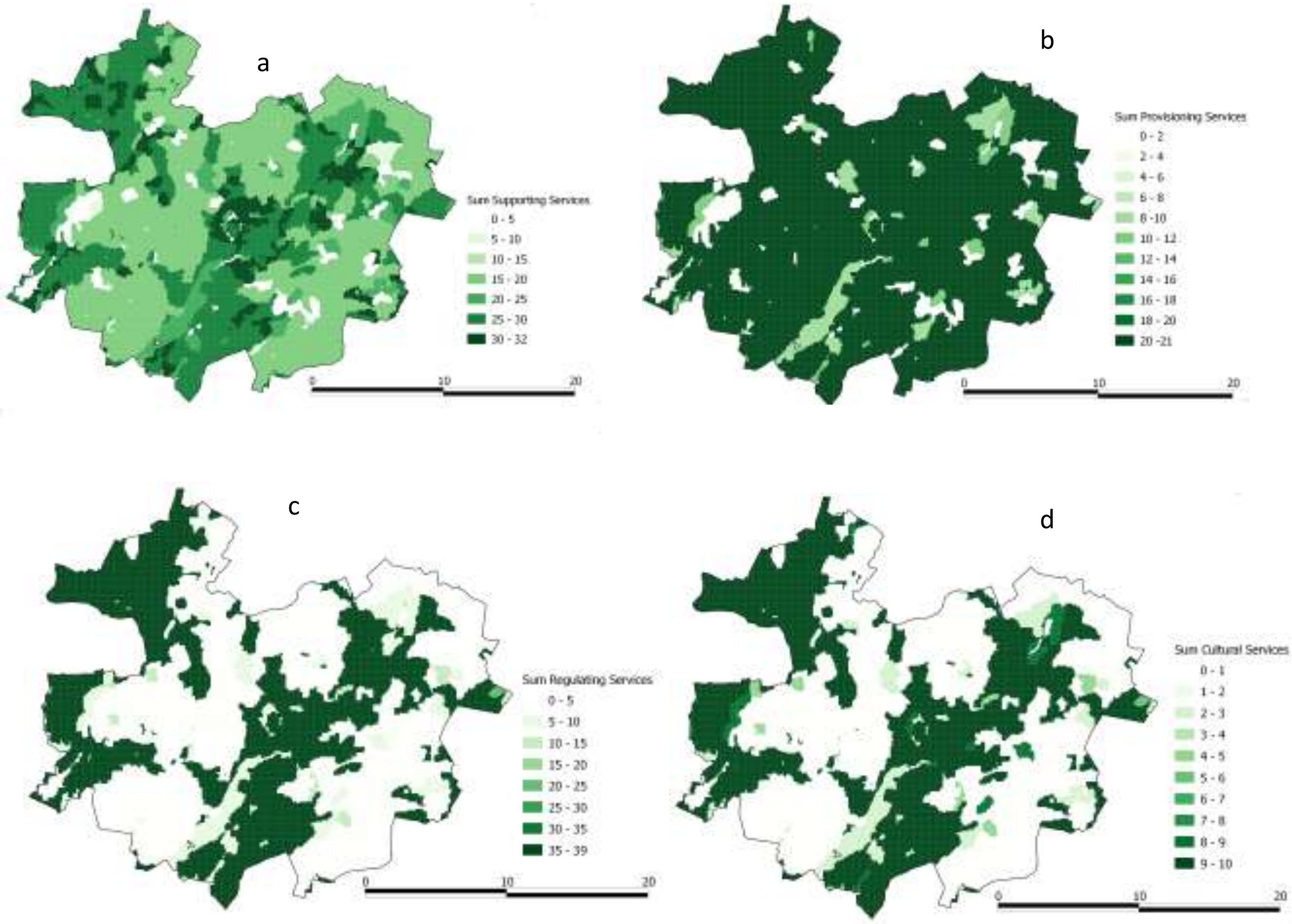


Figure 2 Spatial distribution of aggregated ecosystem services for the following categories: a) supporting services; b) provisioning services; c) regulating services; d) cultural services.

In order to provide a better representation of the actual landscape and land use in CSA the rough spatial resolution of CORINE and its thematic generalization need to be integrated with the available information from different sources. In the case study area these are represented by area, linear and point landscape elements. These elements are present, alone or in combination, in about 20.5% of the CLC cells and need to be accounted for when assessing landscapes' capacity to provide ecosystem services based on land cover. In this study the focus is on provisioning and supporting services.

Linear elements, summing up to about 640 ha, refer to the following biotopes according to the Biotopkartierung Brandenburg (*Landesamt für Umwelt, Gesundheit und Verbraucherschutz*, 2011): i) Water courses (30 typologies), ii) Water bodies (11 typologies), iii) Anthropogenic soil sites with pioneer ruderal vegetation (3 typologies), iv) Marshes and swamps (2 typologies), v) Grass and perennial herbs (19 typologies), vi) Deciduous shrubs, copses, alleys, rows of trees and groups of trees (37 typologies), vii) Marsh and swamp forests(1 typology), viii) Built-up areas, transportation facilities and ix) special areas (9 typologies).

The areal landscape elements, summing up to a total of about 2085 ha (96% of which represented by water bodies of different types), refer to the following typologies: i) Inland dunes, ii) Tree rows, iii) Single trees, iv) Wetlands and marshes, v) Group of trees, vi) Field margins, vii) Rock and stone areas, viii) Hedgerows, ix) Stonewalls, and x) Lakes and ponds. The presence of one or more of these elements within the CLC cells can be accounted for in the implementation of the described assessment approach, allowing for a more detailed and closer to reality evaluation of landscape capacities to provide ecosystem services. Adopting the same assessment matrix, it is possible to define a scale of service provision for each landscape element and calculate a weighted sum for each CLC cell based on the extent of the element, in the case of areal elements, or using a proper weighting factor in the case of linear elements.

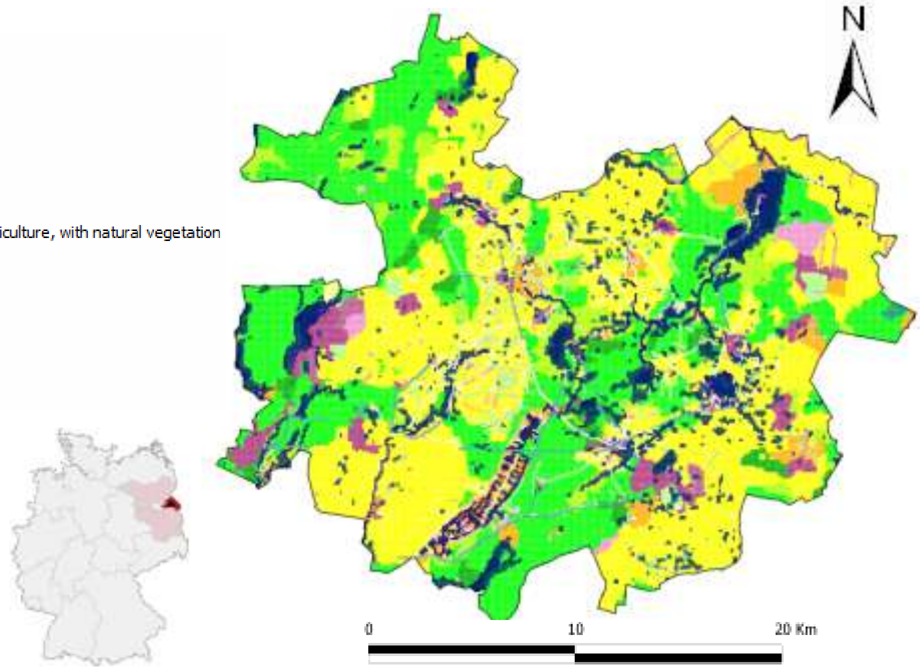


Figure 3 Corine Land Cover (EEA 2007, 100 m grid) and landscape elements in the CSA Märkische Schweiz.

In the case of supporting and provisioning services, the assessment procedure has been applied in two steps, first considering separately linear and areal elements and then by combining the two. As a third step, the differences between the reference CLC assessment and the landscape elements integrated assessment have calculated in terms of aggregated services and for the single underpinning services. The following figures illustrate the different steps of the assessment.

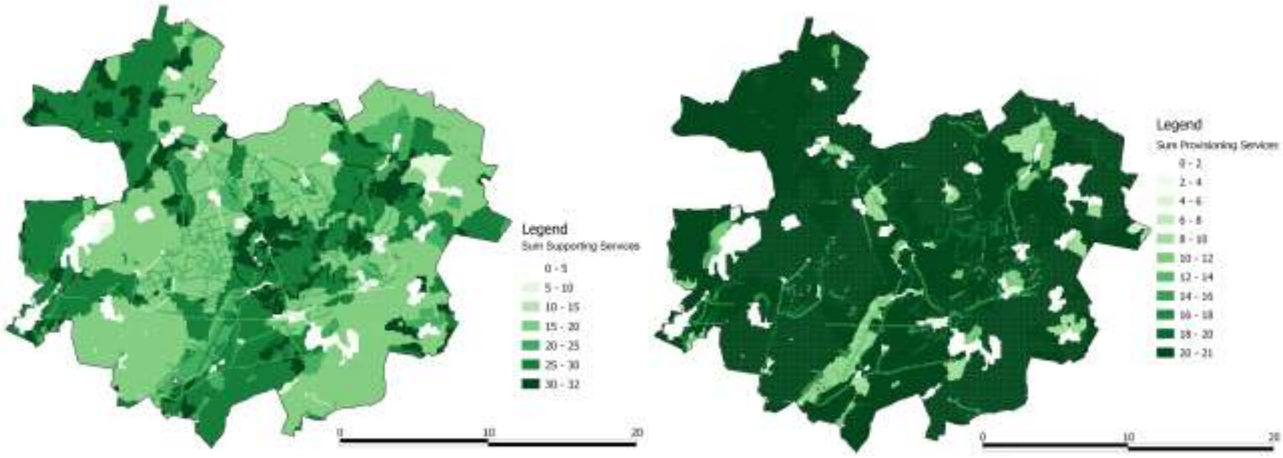


Figure 4 Spatial distribution of aggregated ecosystem services considering landscape linear elements: left) supporting services; right) provisioning services.

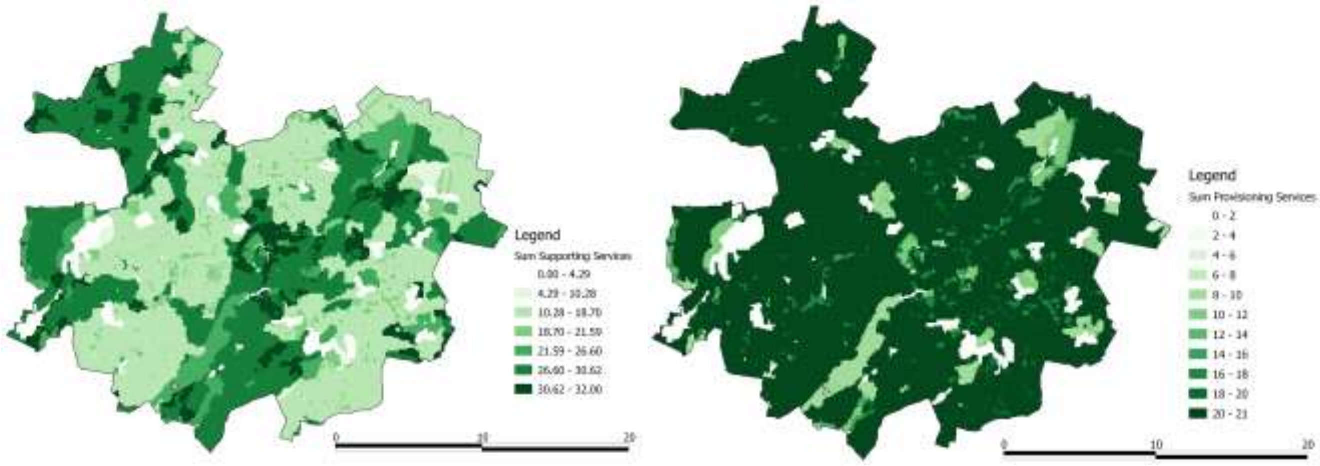


Figure 5 Spatial distribution of aggregated ecosystem services considering landscape areal elements: left) supporting services; right) provisioning services.

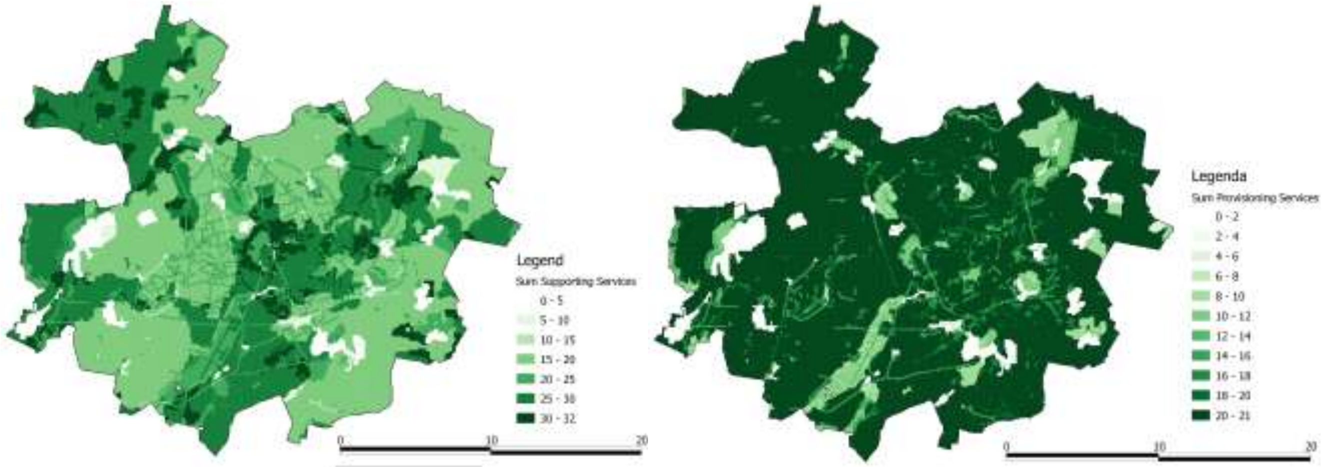


Figure 6 Spatial distribution of aggregated ecosystem services considering landscape linear and areal elements: left) supporting services; right) provisioning services.

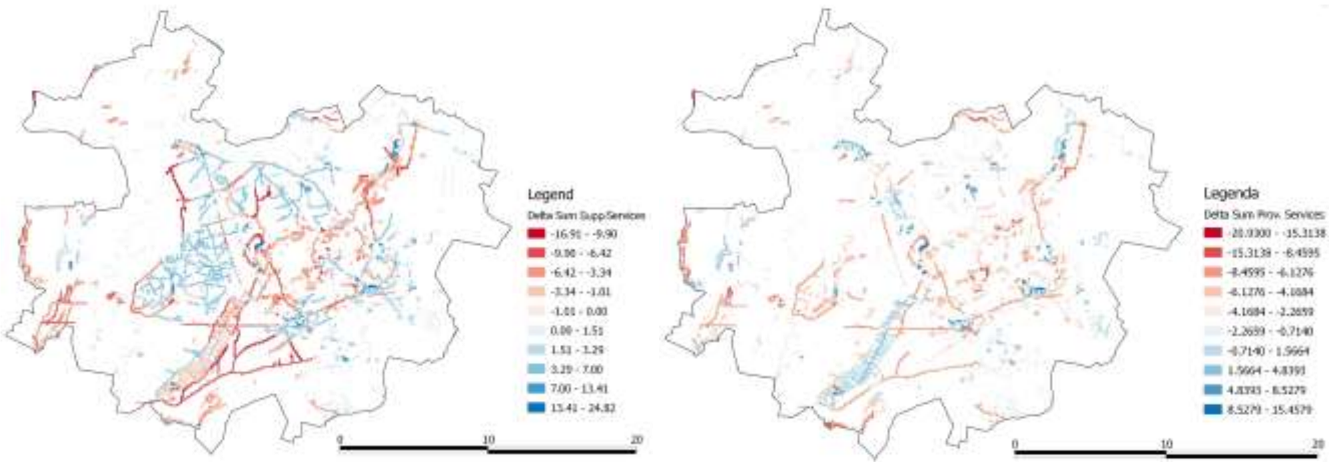


Figure 7 Spatial distribution of the differences between the reference CLC assessment and the landscape elements integrated assessment: left) supporting services; right) provisioning services.

Considering the whole case study area, accounting for landscape elements results in an overall lower capacity to provide both supporting and provisioning services. In the first case the difference in the average sum of scores is not statistically significant (p<0.05), while it is so for the second group of landscape services. In the case of supporting services the lower capacity is mostly due to its reduction in the services provided by forests, with a global average difference equal to -0.7, and to a lower extent to the reduction of services provided by grasslands, with a global average difference equal to -0.5. These reductions in potential service provision are partially counterbalanced by their increase in arable land (+.0.4). In the case of provision services, again, accounting for landscape elements results in an average overall reduction of service supply potential is observed and in this case the difference in the average sum of scores is statistically significant (p<0.05).

Obviously the global increase or decrease will depend upon the variation in the capacity to provide the individual services considered and how this are modified in different land uses due to the presence of specific landscape elements. Furthermore in order to guide and support management decisions, it is more relevant to focus on those locations in the landscape where elements occur and change in services provision are detected. To this aim, the following table shows the relative changes in the scores for the single services and for the total score considering only the locations where landscape elements are present. In the case of supporting services provision, this is generally increased in arable land while the opposite is observed in grasslands (with the exception of abiotic heterogeneity and biodiversity which are both positively affected) and forests (with the exception again of abiotic heterogeneity). The largest increases in single supporting services potential provision from arable land regard metabolic efficiency (+65%), biodiversity (+28%) and SOM storage capacity (+27%). These are counterbalanced by reduced provision services point delivery (Table 8): crop (-29%), livestock (-26%) and fodder (-25%).

Supporting services	Arable	Grassland	Forest
Abiotic Heterogeneity	2%	23%	4%
Biodiversity	28%	29%	-7%
Biotic Waterflows	-1%	-22%	-32%
Metabolic efficiency	65%	-12%	-9%
Energy capture	0%	-11%	-15%
Reduction of Nutrient Loss	8%	18%	-19%
SOM storage capacity	27%	-13%	-17%
Total	11%	-5%	-15%

Table7. Supporting services: relative change in potential service provision considering landscape elements.

Provisioning services	Arable	Grassland	Forest
Crops	-29%	nd	nd
Livestock	-26%	-31%	nd
Fodder	-25%	-29%	-17%
Capture fisheries	nd	nd	nd
Acquaculture	nd	nd	nd
Wild foods	60%	377%	-9%
Timber	18%	607%	-21%
Wood fuel	18%	607%	-21%
Energy biomass	-17%	0%	99%
Biochemicals/Medicine	-11%	607%	-21%
Fresh waters	56%	317%	45%
Total	-17%	8%	-22%

Table 8. Provisioning services: relative change in potential service provision considering landscape elements.

From these results it appears that the integration of landscape elements in the assessment matrix of landscape service provision is a necessary step to get a realistic picture of the case study area as it is characterised by a high degree of heterogeneity within the different land use classes. The use of Corine Land Cover alone would not result into an accurate assessment especially at a local scale, as its coarse resolution would ignore the relevant contribution of the many landscape elements which characterise the CSA in delivering landscape services. Furthermore the assessment is based on qualitative ranking scores which are, at least to some extent, subjective and, even more important, without site specific measurements of specific indicators for each individual service a meaningful quantification is hardy feasible.

References

Burkhard, B., Kroll, F., Müller, F., Windhorst, W., 2009. Landscapes' Capacities to Provide Ecosystem Services - a Concept for Land-Cover Based Assessments. Landscape Online 15, 1-22. DOI:10.3097/LO.200915

Costanza, R., D'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S. , O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., Van Den Belt, M.,1997. The value of the world's ecosystem services and natural capital. Nature, 387, 253–260.

EEA, 2007. CLC 2006 technical guidelines. Technical report No 17/2007. European Environmental Agency, Copenhagen, 70 pp.

de Groot., R.S., Alkemade, R., Braat, L., Hein, L., Willemen, L., 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecological Complexity, 6, 453-462.

Landesamt für Umwelt, Gesundheit und Verbraucherschutz, 2011. Biotopkartierung Brandenburg

MA (Millennium Ecosystem Assessment) 2003. Ecosystems and Human Well-being. Millennium Ecosystem Assessment (MA). Island Press. Washington D C.

Müller, F., Burkhard, B., 2007. An ecosystem based framework to link landscape structures, functions and services. In: Mander, Ü.; Wiggering, H. & K. Helming (eds.): Multifunctional Land Use – Meeting Future Demands for Landscape Goods and Services. Pp. 37-64, Springer. Berlin - Heidelberg - New York MA (2005).

5 CSA2: Mapping landscape services, competition and synergies. A case study using variogram models and geostatistical simulations in a rural landscape in Germany

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Abstract

Methodologies used for identifying, assessing and mapping ecosystem and landscape functions and services are diverse and frequently inconsistent and notwithstanding the examples from available literature, evident methodological gaps are still present. This paper presents a probabilistic approach to mapping and assessment of services provided by landscapes, based on variogram modelling and geostatistical simulations. Of operational value is the fact that within this framework several services can be treated and mapped simultaneously, providing an efficient tool to model the heterogeneity of different landscape components. Using spatial data, complemented with information from governmental databases on management strategies, the methodology has been adopted to characterize and model the spatial heterogeneity of supporting, provisioning and recreational landscape services in the case study area of *Märkische Schweiz* in North-East Germany. The methodology consists of: (i) observations of landscape services at random points within a regular reference grid, (ii) indicator coding and variogram analysis, (iii) kriging of single and multiple indicators via sequential Gaussian simulations, and (iv) probabilistic mapping of landscape services. Results provide new insights about the relevance of spatial abundance of landscape elements or management practices related services for the composition and interrelation of multiple services in a region. Its application can contribute to a more holistic picture of effects of landscape management and thus may support better policy effectiveness. The general applicability of the methodology for joint mapping and hence multiple hot spot analysis of landscape services is discussed.

Keywords: Landscape services; Spatial heterogeneity; Semivariograms; Sequential simulations; Multiple service hotspots

5.1 Introduction

Among the growing stock of research in ecosystem and landscape functions and services (de Groot et al., 2010; TEEB, 2010), their spatial determination is not fully understood and operationalized, still requiring the development of methods and tools to quantify and map different services across the landscape (Anton et al., 2010). Improved ecosystem services (ESS) assessments could be achieved resorting to different methods to aggregate data, indicators, maps and models without losing relevant information (Burkhard et al., 2013). In order to support sustainable land use decision-making the analysis of spatial heterogeneity and patterns of the diverse functions and services across a given landscape should be able to explore and identify interaction effects and potential spatial synergies, i.e. 'multiple win locations' or multifunctional 'hotspots' (Gimona and van der Horst, 2007; Egoh et al., 2008; Wu et al., 2013).

The availability of spatially explicit information on the state and trends of landscape services is crucial to mainstreaming landscape services into policies and decision making (Maes et al., 2012). Also the EU biodiversity Strategy to 2020 has stressed the need to account for ESS through mapping and valuation (European Commission, 2011). Furthermore, spatial considerations are important not only for the estimation and evaluation of ESS but also for their maintenance (Syrbe and Walz, 2012).

There is a growing body of available literature on ESS mapping which highlights a number of different methodological approaches at different spatial and temporal scales (Baral et al., 2013). As effective spatial scales and patterns of landscape services differ, in order to assess the multifunctionality of a given landscape, scale dependency must be taken into account selecting the proper approach depending of the indicators to map (Gulickx et al., 2013). A summary of possible methodologies is given by Maes et al. (2012), while Crossman et al. (2013) have newly integrated the reviews of Martínez-Harms and Balvanera (2012) and Egoh et al. (2012). Depending on the scale of investigation, the data availability, and the type of services investigated, approaches to ecosystem and landscape services mapping can be either based on: i) thematic maps at different resolution, such as land use-land cover maps (Burkhard et al., 2012; Haines-Young et al., 2012; Koschke et al., 2012), or landscape-landform types maps (Hermann et al., 2014); ii) primary data statistics (FAO, 2013); iii) bio-physically based model outputs (Bryan and Crossman, 2013); iv) value transfer methodologies (Costanza et al., 1997; Troy and Wilson, 2006; Bateman, 2009), v) biological data, ecosystem structure or habitat data (Lavorel et al., 2011; Brown et al., 2013); vi) dynamic process-based ecosystem models (Kareiva et al., 2011; Bagstad et al., 2013). Some of these methodologies are more suitable for large scale studies, where services are directly related to land use, and are typically qualitative, while other, such as those based upon modelling outputs, can have application from the plot to the landscape scale. Yet, the application of spatially explicit methods that incorporate the locations of supply and demand of ESS represents a key challenge for research, and there is the necessity to develop and test different approaches to quantify and (jointly) map different services across the landscape, highlighting "hotspots" with synergies and conflicts.

To this aim we implemented a flexible and generally applicable probabilistic approach to assess and map different services across the landscape of the case study area *Märkische Schweiz* in North-East Germany. Within this framework, highly adaptable and consistent, landscape elements and services are considered as the realization of a stochastic process called random function (Chilès and Delfiner, 1999). Their spatial properties can be described and modelled using second order statistics, such as the variogram which describes the spatial relationships between data and models the spatial heterogeneity of the different landscape components. The use of variograms and other geostatistical tools to model and map environmental variables is not new in environmetrics (Jensen et al., 2006) and landscape ecology (Rossi et al., 1992; Maisel and Turner, 1998), and an applications to linear landscape elements mapping at small scale has been recently provided by van der Zanden et al. (2013). Nevertheless their potential in ESS and landscape services provision assessment has not yet been fully tested and assessed. Therefore the main objective of this work is to analyse and model the spatial heterogeneity and patterns of the diverse functions and services across the given landscape and to explore and identify in probabilistic terms services hotspots and ranges.

5.2 Material and Methods

5.2.1 2.1 Study area

The case study area (576.4 km²) is located in the Federal State of Brandenburg, County of Märkisch Oderland (Fig. 1a), extending from the Eastern fringe of Berlin towards the Odra valley at the German-Polish border. It encompasses ten municipalities including Strausberg (population ca. 26,000) and Müncheberg (population ca. 7,000). The area is located in the humid continental climate zone, characterised by severe winter and warm summers The average annual temperature is 8.8°C, with -1.2°C in January and 18°C in July; the average precipitation does not exceed 500 to 560 mm/year (27 mm in February to 70 mm in July) (MLUR 2000). The landscape morphology was shaped by cyclic glacial advances of terrestrial Scandinavian ice sheets as well as by peri-glacial geomorphologic processes, resulting in heterogeneous natural conditions (geomorphology, pedology and topography) with elevation ranges between 5.8 m and 144 m a.m.s.l., different soil types and fertility (BfN, 2012; Scholz, 1962, MLUR, 2000). Therefore the area has been subdivided into six major sub-landscapes (Meynen and Schmithüsen, 1962; Fig. 1b): Glacial valleys: 1) *Rotes Luch* (45.0 km², 7.8%) and 2) *Buckow Valley* (92.0 km², 15.6%); Ground- and end-moraines plateaus: 3) *Lebus Plateau* (88.1 km², 15.3%), 4) *Barnim Plateau* (206.6 km², 37.8%) and 5) *Oberbarnim* (88.0 km², 15.3%); Slope sides; (6) *River Oder Valley* (45.0 km², 7.8%). The soil typologies are quite heterogeneous across the sub-landscapes, and are all characterised by a general low fertility. This is assessed based on the German Soil Evaluation System (Fig.1.c) as being between 30 and 60 for arable land and between 30 and 50 for grassland in a scale from 0 to 100 (MLUR, 2000). Due to differences in natural conditions also land use varies between the sub-landscapes. Whereas forest areas (39.9% of total area) occupy most of the plateau and moraines areas (49%), agricultural land (45.8% of the total area) is dominant in the ground and loamy terminal moraines where they represent nearly 73% of the area (EEA, 2007, Fig. 1a). Nearly all the area (94%) is under Less-favoured area schemes (LFA, Council Regulation (EC) No 1698/2005). NATURA 2000 (Directive 92/43/EEC) and Flora-Fauna-Habitat (Directive 92/43/EEC) areas cover 31% and 9% respectively of agricultural land. In the study area about 43% of the territory (245 km²) is under a form of nature protection and management. The major protection area is the *Naturpark Märkische Schweiz* (205 km^2), encompassing bird protection areas (179.7 km², Directive 2009/147/EC); NATURA 2000 areas (92.2 km²) and areas designated to accordingly to regional nature protection (13.3 km²) represent 38 and 5.5% respectively of the areas under protection.

Describing the relationship between landscape management, landscape structure and composition as well as the landscape functions, it is necessary to make a clear distinction between the mainly forested areas under nature conservation measures as core area of the *Naturpark* and the adjacent peripheral agricultural areas surrounding it. Whereas in the core area mainly policies are in place dealing with nature protection or forest restructuring, the agriculture area is much more subject to policies aiming at landscape management of a narrow sense, such as extensive management, and maintenance of typical landscape elements as tree lines, hedge rows, field margins, and small ponds. However, it is necessary to keep a holistic picture of the area, as the historically developed land use and land management practices have shaped not only the *Naturpark* and its agrarian surroundings. The appearance of the entire area as half-open countryside with numerous natural amenities contributing to the regions high potential as cultural landscape with habitats for biodiversity, with recreation and water resource provision functions as well as location for food and fibre production has been a result of land use and management.

5.2.2 Landscape structures and services

Different data sources have been used to identify and select the landscape elements and their related services in the study area. A list of landscape services, along with their category (De Groot et al., 2006), the landscape indicator used for the assessment and the data sources is given in Tab. 1. The services objects of this study were selected after interviews with local stakeholders and are assessed with reference to the agricultural areas within the landscape. These services include: habitat for species (HAB), agricultural production (PRO), water supply (WAS) and water regulation (WAR), visual appreciation (VIS), recreation and cultural heritage (CUL), and recreation for cyclists (CYC). The proxies adopted to infer the potential services supply are described in the following paragraphs.

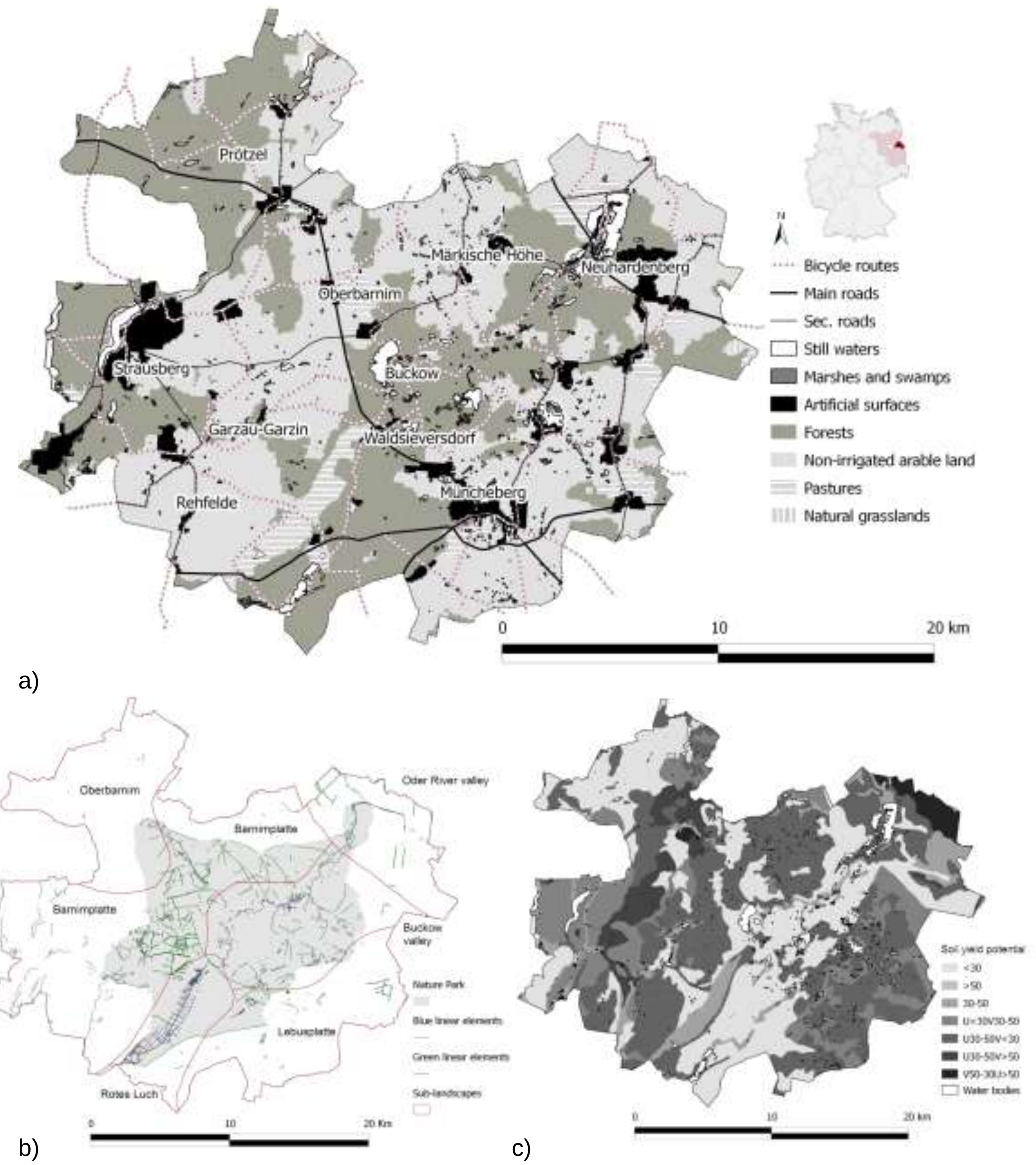

Fig. 1 Case study area Märkische Schweiz. a) Major land use classes, municipalities and infrastructures.; b) Six sub-landscapes, protected areas (Natur Park Märkische Schweiz) and green and blue linear elements in the landscape; c) Soil potential classes according to the German Soil Evaluation System (U: predominant; V: common).

Table 1. Landscape elements, spatial characteristics and data sources used to identify the landscape services addressed in this paper.

Landscape elements / Spatial characteristics	Landscape service	Categories of services	Data source
Soil type Yield potential	Crop production	Provision	Bundesanstalt für Geowissenschaften und Rohstoffe: Bodenübersichtskarte 1:200.000 (BÜK 200)
Land use	Crop production	Provision Supporting	Corine Land Cover 2006, European Environment Agency
Field size Area designation	Habitat for species	Supporting	Digitales Feldblockkataster (DFBK) des Landes Brandenburg 2012
Primary, 2ary and 3ary roads, tracks, footways and cycle ways Cultural heritage City/Village Tourism facilities Recreational areas	Recreation and mental and physical health Tourism Aesthetic appreciation and inspiration for culture, art and design Spiritual experience and sense of place	Cultural	Fahrradkarte Berlin - Märkische Schweiz 2010 1:75 000, mr-kartographie - Ingenieurbüro und Verlag Topographische Freizeitkarte Märkische Schweiz. Wandern, Radfahren 1:25 000, Landesvermessung und Geobasisinformation Brandenburg
Group of trees and single trees hedgerows, tree lines, alleys	Habitat for species Aesthetic appreciation and inspiration for culture, art and design	Supporting Provision Regulation Cultural	Biotopkartierung Brandenburg – Liste der Biotoptypen mit Angaben zum gesetzlichen Schutz (§32 BbgNatSchuG), zur Gefährdung und zur Regenerierbarkeit 2011
Wetlands, Marshes and ponds, Streams, small rivers, ditches	Water storage and supply Water regulation Habitat for species Recreation and mental and physical health Aesthetic appreciation	Supporting Provision Regulation Cultural	Biotopkartierung Brandenburg – Liste der Biotoptypen mit Angaben zum gesetzlichen Schutz (§32 BbgNatSchuG), zur Gefährdung und zur Regenerierbarkeit 2011

5.2.2.1 Habitat for species

The share of areas under protection schemes in the agricultural fields and grasslands has been used as proxy of habitat provision. As threshold for the service provision, a share ≥30% for any given field was adopted. The total shares of areas under NATURA 2000 are about 28% and 63% for agricultural fields and grasslands respectively, and rise up to 82% in the case of permanent crops (Digitale Feldblöcke des Landes Brandenburg, 2012). Entirely or partially overlapping with those are the area under other designation schemes, as the FFH designated areas (ca. 5% of agricultural fields and 51% of grasslands) or those under the §32 of the Brandenburg Nature Protection Act (ca. 0.5% of agricultural fields and 13% of grasslands).

5.2.2.2 Crop production

The yield potential for field crops in the area ranges from very low to medium (Fig.1c). Accordingly to the German Soil Evaluation System, seven classes of yield potential are found in the area (*Reichsbodenschätzung*, MLUR 2000): the classes <30 (two classes), representing ca. 46% of the area, are under forestry, while the classes >50 (three classes) occupy only about 7% of the area and are those with the most productive agricultural soils. The areas with the intermediate classes with a score between 30 and 50 (two classes, ca. 47% of the area) are under cultivation. Typical crops include winter rye (*Secale cereale*), winter rape (*Brassica napus*), silage mais (*Zea mays*) and winter wheat (*Triticum aestivum*). As spatially explicit data on crop productions in the study area are not available, yield potential was used as an indicator for this provisional service, adopting a threshold for service provision corresponding to the lower intermediate class with a predominant score between 30 and 50.

5.2.2.3 Water supply and regulation

Water bodies (20.2 km^2) and wetland areas (ca. 1.0 km^2) contribute to fresh water supply and are of great importance as they are a typical feature of the peri-glacial landscape. With an average density of 1.6 km^{-2}, the majority of water bodies in agricultural fields (74.5%) are glacially created kettle holes, i.e. lentic shallow water bodies of with an area <1ha (mean 0.31 ha, *N* = 474; total area 146 ha), which collect water from internal or closed catchments in young moraine landscapes (Kalettka and Durat, 2006). Although protected by federal law, intense land use results in pollution, structural changes, drainage and obliterations. Voluntary water protection measures (Federal state scheme) are implemented in about 30% of the agricultural fields (40% of agricultural area). The length of channels, ditches and water streams (61% natural; 39% modified by human intervention) is 219.9 km, with an average density of 382 $m*km^{-2}$. These contribute to surface water regulation and groundwater control, providing habitat for species and offering cultural services.

5.2.2.4 Visual appreciation

Green linear elements, such as tree rows, tree alleys and hedgerows with an total length of 268 km and an average density of 1017 m km^{-2} are another relevant key feature of the agrarian landscape of the *Märkische Schweiz*. Alleys and tree rows represent the dominant element type with a share of nearly 50% of the total length, followed by hedgerows and windbreaks representing 39% of the total length. Other types, like woodlots and fruit trees account for the residual share of 11.5%. The presence of these elements results in a half-open agricultural landscape of high aesthetic value, which is highly appreciated by tourists and valued as integral part of the regional identity by residents. Nevertheless scale enlargement and increasing land use intensity are currently affecting the spatial structure and composition of the rural landscapes, as being often associated with the risk of removal of landscape elements following the changes in field plot sizes (Stoate et al., 2009).

5.2.2.5 Recreation and cultural heritage

The area is well known for offering visitors and residents several opportunities for recreation, reflection and artistic inspiration. Cultural heritage sites, water areas, small beaches, forest paths, field margins provide landscape opportunities for a number of activities which make the area potentially very attractive. Using the information from tourist maps, a georeferred dataset with 207 entries has been built and used for further analysis. Following the categories defined in the Millennium Ecosystem Assessment (MA, 2005), 50% of the sites can be referred to cultural, intellectual and spiritual inspiration, 22% to recreation and mental and physical health, and 28% to tourism.

5.2.2.6 Recreation for cyclists

The *Märkische Schweiz* is a popular destination for cyclists due to its scenic diversity and the rolling hills topography which differentiate it from most of the biking destinations in the region. We used a popular bicycle route map to identify recreation for cyclists. The local network encompasses a total of 334.4 km of bicycle routes, amongst which Euroroute R1, most of them designed to touch point of interests and landscape amenities.

5.2.3 Characterization of spatial pattern of landscape structures and services

In order to characterize the heterogeneity and spatial patterns of the diverse landscape elements and related services, a non-parametric probabilistic approach has been adopted (Journel, 1983). Within this framework the information about the provision of a given landscape service at any given position u_α = (x_α, y_α) within the landscape can take the form of an indicator $i(u_\alpha)$ of presence/absence of the service at that point or within a buffer around it:

$$i(u_\alpha) = \begin{cases} 1 & \text{if the landscape service is provided} \\ 0 & \text{otherwise} \end{cases} \qquad (1)$$

The area was divided into grid cells of 1 km^2 within which two random points were drowned, representing the sites at which the selected landscape elements and services were assessed. This stratified random sampling design led to a total of 1,344 points, with an average sampling density equal to 2.3 km^{-2}. At each point, buffers of different size, ranging from 125 to 500 m, were applied to assess the presence or absence of specific landscape features. The buffer size depends upon the spatial extent of the service and on the kind of data require for its assessment: i) one-to-one relation to land cover or to soil type; ii) single data source (e.g., single landscape element); iii) multiple data sources (e.g., share of area under protection schemes at field scale). For each of the selected services an indicator dataset was then created and experimental semivariograms were used to characterise its spatial pattern. The indicator variogram is computed as the half of the expected squared increment of the values between locations u_α and $u_{\alpha+h}$:

$$\hat{\gamma}_I(h) = \frac{1}{2n} \sum_{\alpha=1}^{N(h)} \left[i(u_\alpha) - i(u_\alpha + h) \right]^2 \qquad (2)$$

where $N(h)$ is the number of pairs within a given spatial distance (and direction) known as lag h. The spatial increment, i.e. the term in square brackets, is non-zero only if at two locations a distance h away the status of the service supply considered is different. In this way it is possible to model the transition between the occurrence and the absence of any given services in the landscape. In the presence of spatial clusters of provision of a service the variogram value is expected to increase with the lag h and reaches a plateau, the sill, at a given distance, called range, corresponding to the average size of these clusters. Data separated by a distance larger than the range are uncorrelated. If the sill is not reached within a given distance, which is generally taken as half of the maximum extent of the area (Chilés and Delfiner, 1999), the observed spatial variability is not completely encompassed at the scale of investigation. Generally, variograms exhibit nested structures, i.e. they are the result of a number of superimposing structures with different ranges. Another important aspect is the behaviour of the variogram near the origin which typically shows a more or less marked discontinuity. This discontinuity, called nugget effect, is due either to uncorrelated spatial noise or to spatial structures not detected at the scale of investigation. The experimental variogram provides only an empirical description of the spatial distribution of a given landscape structure or element. A model fitted to the experimental values, i.e. a valid mathematical function, is then necessary to provide a parametric description of the spatial heterogeneity components. The possible functions are defined as authorized models (Wackernagel, 2003), and to account for multiple scales in data variability linear combination of these models can be used, resulting in extended or nested model semivariogram model. A nested variogram model is the weighted sum of n elementary models and is suitable to describe specific sets of spatial structures, over imposed in the same area and each related to a different spatial scale. A nested variogram model can be expressed as follows:

$$\gamma(h) = \sigma^2 \sum_{n=1}^{n=i} f_n g_n(r_n, h) \qquad (3)$$

where n is the number of elementary variogram models $g_n(r_n,h)$. As such it is appropriate to describe the two components of spatial heterogeneity in any given landscape: i) the overall degree of landscape heterogeneity as expressed by a given landscape element is given by the total sill σ^2, and ii) the spatial structure of any given element is characterised by parameters of the model, i.e. its ranges r_n and fractions of the total variance f_n related to each range. This last component can be summarised in a single parameter, the mean length scale D_n (Garrigues et al., 2006), i.e. the weighted average of the different range parameters, where the weights are provided by the n fractions of total variance of each structure. For a linear combination of spherical variogram models D_n can be calculated as (Lantuéjoul, 2002):

$$D_n = \left(\sum_{n=1}^{n} \frac{c_n}{\sigma^2} \cdot \frac{\pi r_n^2}{5} \right)^{0.5} \qquad (4)$$

where n is the number of elementary models, c_n and r_n their sill and range components and σ^2 the total sill. The amplitude of this parameter is related to the mean extent and to the connectivity of the landscape element considered, and can be used to assess if the size of the area under investigation is suitable to describe the spatial structure of the element using variograms.

5.2.4 Mapping single and joint probability of landscape service potential supply

Based on the variogram models, the probability of service provision has been mapped via conditional sequential indicator simulations; a detailed introduction on the SIS method can be found in Goovaerts (1997) and has been widely applied to address many environmental issues. The estimate conditional probability p_k* of occurrence of a given service supply is calculated at the nodes of a regular grid u_0 as the linear combination of the neighbouring data u_α:

$$p_k^*(u_0) = \sum_{\alpha=1}^{n} \lambda_\alpha(u_0) \cdot i(u_\alpha) \qquad (5)$$

where the weights λ_α are computed solving the ordinary kriging system. Differently from kriging based estimators, the simulation approach takes into account not only the spatial variation of observed data at sampled locations but also the variation in estimations at unsampled locations. In doing so simulations honour the data and the variogram model and allow for a correct portray of spatial variability and for a more realistic depiction of short range heterogeneity. The search radii for simulation were set as half the maximum range of the variogram models, and the number of data to use within the search radii ranged from 4 to 16. For each landscape service, 1,000 realizations have been generated at the node of a 100 m square grid for a total of 57,657 simulated values for each realization. In post-processing the simulation outcomes, the E-type estimator (Deutsch and Journel, 1998) was calculated at each simulation node, i.e. the expectation p_E* of the cumulative conditional distribution function F (ccdf) which represents the mean probability of service provision within a buffer around a given grid node given n conditional observations:

$$p_E^*(u_0) = \int_{-\infty}^{+\infty} p \, dF(u_0; p | (n)) \qquad (6)$$

Assuming they are independent, the joint probability of occurrence of any couple of services LS_1 and LS_2 at any given position u_o can be calculated as:

$$p_E^* \, LS_1 \, LS_2 \, (u_0) = p_E^* \, LS_1 \, (u_0) \cdot p_E^* \, LS_2 \, (u_0) \qquad (7)$$

where $p_E^* \, LS_1 \, (u_0)$ and $p_E^* \, LS_1 \, (u_0)$ are the local conditional expectations of the distribution functions for the two services at the same location. Joint probability values can be then used to assess the presence of hot or cold spots of service supply in the study area. All the geostatistical analyses presented in this paper were carried out with the software Wingslib 1.3.1 (Statios, 2000), which works in conjunction with the GSLIB90 executables (Deutsch and Journel, 1998). All GIS operations and mapping were performed using QGIS v1.8.0. (QGIS Development Team, 2012).

5.3 Results

5.3.1 Spatial structure of landscape services

Different buffer sizes around the sampling points were tested, ranging from 125 to 500 m, with increasing steps equal to 125 m. For all the considered landscape elements, with the exception of those related to recreation and cultural heritage (CUL), a buffer size of 250 m around sampling points was selected. With greater buffers spatial resolution decreases, while smaller buffers do not intercept enough elements to catch and model their spatial structure and hence are associated with a lack of detected variability. In the case of recreation and cultural heritage, the buffer around sampling points was set equal to 375 m. In the case of habitat (HAB) and production services (PRO), values were taken at the points, as the available information in these two cases is referred to polygonal objects, i.e. field plots and soil units respectively. Table 2 summarizes the potential services supply at the 1,344 sampling points expressed in terms of probability of occurrence and its standard deviations. Fig. 2 show the location of the sampling points and the indicator coding for each service.

Table 2. Potential services supply within buffer centred around 1,344 sampling points: mean probabilities of occurrence, standard deviations

Landscape service	*Buffer size(m)*	*Intercepted elements*	*Probability of occurrence*	*Standard deviation*
Recreation and cultural heritage (CUL)	*375*	*130*	*0.097*	*0.296*
Recreation for cyclists (CYC)	*250*	*287*	*0.214*	*0.410*
Habitat for species (HAB)	*at point*	*285*	*0.212*	*0.409*
Agricultural production (PRO)	*at point*	*711*	*0.533*	*0.499*
Visual appreciation (VIS)	*250*	*290*	*0.216*	*0.412*
Water Regulation (WAR)	*250*	*201*	*0.150*	*0.357*
Water Supply (WAS)	*250*	*440*	*0.327*	*0.469*

The experimental indicator semivariograms were calculated assuming a lag, i.e. an incremental step over the distance, equal to 400 m. The maximum distance was set to 12,000 m, i.e. about half the maximum width of the area. The experimental variograms and the models fitted to them are shown in Fig. 3. Nested spherical models with a nugget component provided the best fit to the experimental variograms which are all characterised by discontinuity at the origin, linear behaviour with change of slope and convergence to a sill. The parameters of the models fitted to the experimental semivariograms are shown in Tab. 3. In all cases a nugget and two components well described the experimental data, only in the case of the green linear element (VIS) a third component were added. The quote of unresolved variability ranges from 4 to 20% of the total sill, with the minimum observed for water supply (WAS) and the maximum for habitat provision (HAB). All the services are characterised by at least two superimposed scales of spatial variation: the smaller one ranges from 836 (CYC) to 2,200 m (PRO) and accounts for a share of spatially structured variation ranging from 36% (HAB) to 71% (WAS); the greater one ranges from 1,671 m (CYC) to 6,900 m (PRO) and accounts for a share of spatially structured variability ranging from 24% (WAR) to 44% (HAB). A third component over a range of 12,000 m accounts for 14% of the spatially structured variability observed for the visual appreciation of green linear elements.

The structural information of the variogram models for the individual landscape services provided by the fractions of the total variance and their ranges summarised in a single parameter D_n, are illustrated in (Fig. 4). Cultural services (D_n = 1,096 m) and services for cyclists (D_n = 936 m) exhibit low connectivity across the landscape, being localised in a few small localised clusters and in a number of isolated points. Highest connectivity is observed for landscape elements related to aesthetic appreciation (D_n = 3,864 m); well-connected are also crop production (D_n = 3,434 m) and habitat provision services (D_n = 3,104 m). The highest heterogeneity characterize water supply (total sill = 0.22), followed by services for cyclists (total sill = 0.17) and habitat provision services (total sill = 0.16).

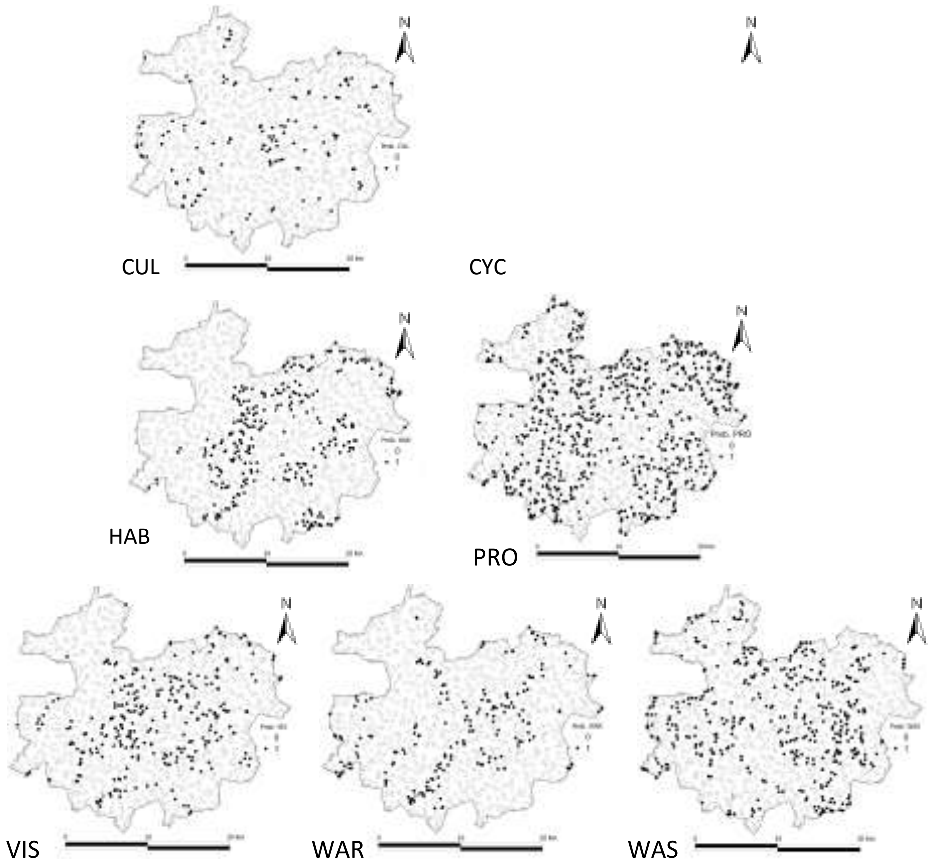

Fig. 2. Distribution of sampling points in the case study area for the selected landscape services. Black dots indicate sampling points where a given service is observed. CUL: recreation and cultural heritage; CYC: recreation for cyclists; HAB: habitat for species; PRO: agricultural production; VIS: visual appreciation; WAR: water regulation; WAS: water supply.

Table 3. Variogram model parameters for the selected landscape services. Dn: mean length scale (m).

	CUL	*CYC*	*HAB*	*PRO*	*VIS*	*WAR*	*WAS*
Nugget	0.010	0.013	0.033	0.020	0.027	0.011	0.012
(std.)	12.0%	8.0%	20.0%	15.3%	16.0%	9.0%	4.0%
Sill 1	0.050	0.098	0.060	0.065	0.076	0.084	0.153
(std.)	57.0%	59.0%	36.0%	49.7%	45.0%	67.0%	71.0%
Sill 2	0.027	0.058	0.074	0.045	0.042	0.030	0.051
(std.)	31.0%	35.0%	44.0%	34.4%	25.0%	24.0%	26.0%
Sill 3					0.02		
(std.)					14.0%		
Range 1 (m)	943	836	1,700	2,200	1,100	1,500	1,056
Range 2 (m)	2,130	1,671	5,700	6,900	3,500	3,500	4,422
Range 3 (m)					12,000		
Total sill	0.085	0.170	0.167	0.130	0.170	0.126	0.216
Obs. Var	0.087	0.166	0.167	0.131	0.170	0.126	0.215
Dc,m	1,096.4	934.4	3,104.0	3,434.1	3,864.4	1,672.0	1,921.4

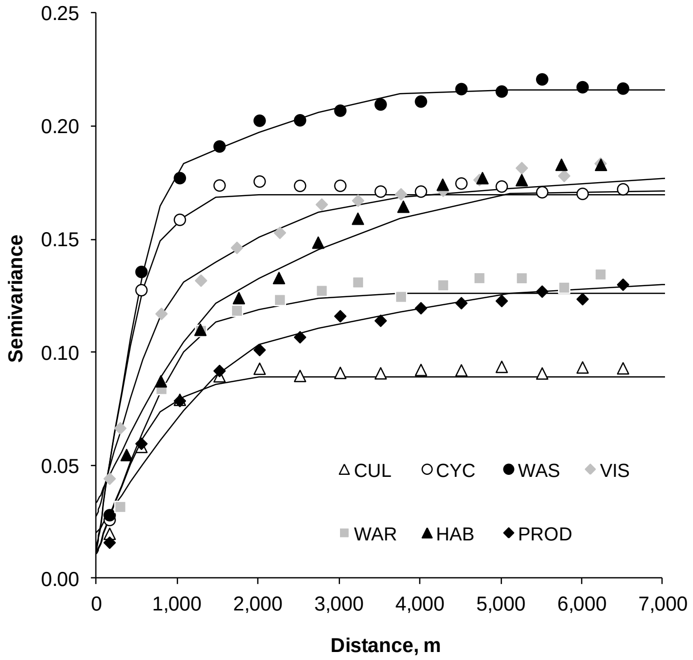

Fig. 3. Experimental indicator semivariograms for the occurrence of the selected landscape services. CUL: recreation and cultural heritage; CYC: recreation for cyclists; HAB: habitat for species; PRO: agricultural production; VIS: visual appreciation; WAR: water regulation; WAS: water supply.

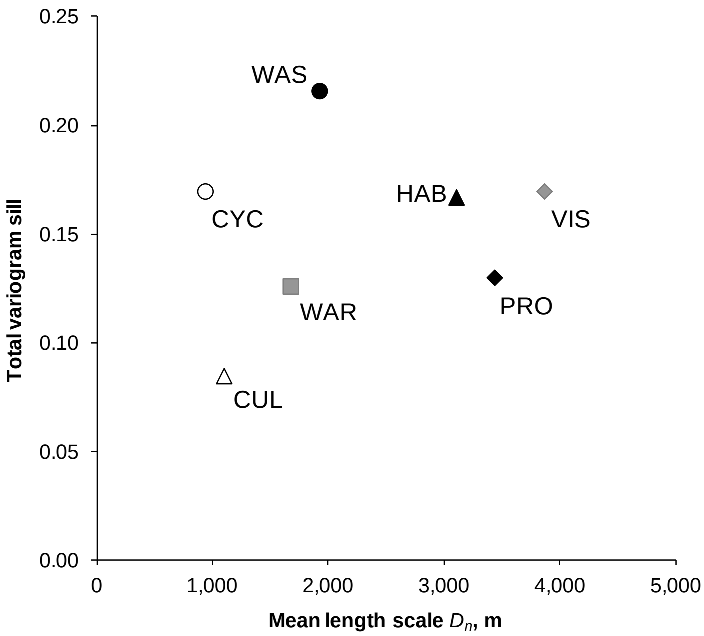

Fig. 4. Landscape services spatial variability: variogram sill versus mean length scale for the seven services under study. CUL: recreation and cultural heritage; CYC: recreation for cyclists; HAB: habitat for species; PRO: agricultural production; VIS: visual appreciation; WAR: water regulation; WAS: water supply.

5.3.2 Mapping single and joint probabilities of landscape service supply

Using the variogram models, the probability of occurrence of the selected landscape services have been mapped over a regular 100 x 100 m grid via sequential simulation with ordinary kriging. The spatial distributions of mean simulated probabilities are shown in Fig. 5, while Tab. 4 summarizes the descriptive statistics for the probability of occurrence of the selected landscape services for the whole case study area and reports the Pearson’s *r* among the target services. The maps of the E-type estimates depicted in Fig. 5 clearly reveal distinctly different spatial patterns of the seven landscape services.

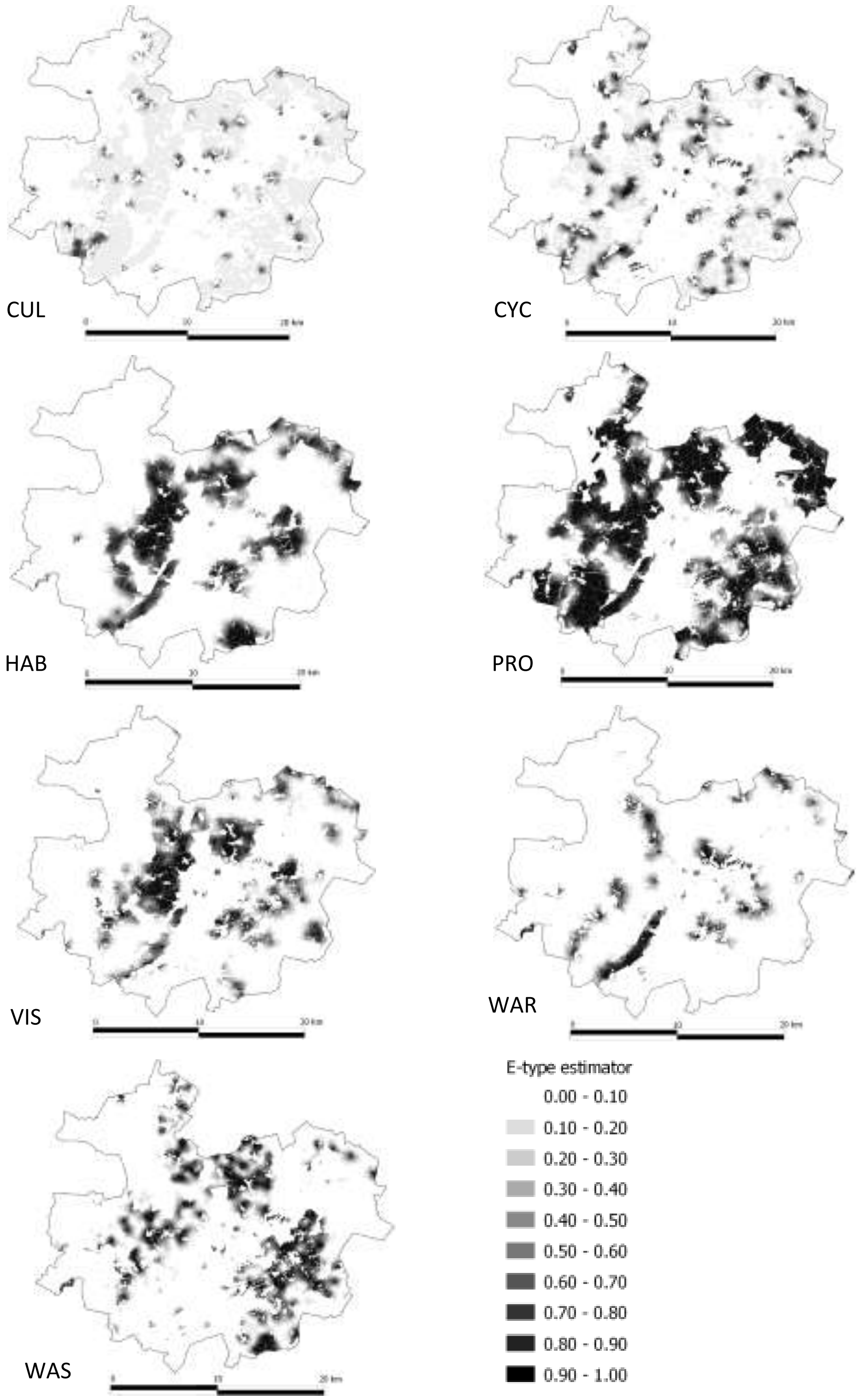

Fig. 5. Landscape services probability maps: E-type estimates (N=1,000). CUL: recreation and cultural heritage; CYC: recreation for cyclists; HAB: habitat for species; PRO: agricultural production; VIS: visual appreciation; WAR: water regulation; WAS: water supply.

Cultural and recreational services (CUL) occur typically in localised clusters scattered in the whole area, while services for cyclists (CYC) exhibit a higher number of more continuous areas of service supply. This feature is similarly observed also for water regulation services (WAR) but rather concentrated in five distinct large clusters, the largest of which in the south-west of the area corresponding to the glacial valley of the *Rotes Luch*. Habitat provision services (HAB) are mainly clustered around the core of the case study area represented by the *Naturpark*, but spots of high service supply occur also in the north-eastern and south-eastern edges. Areas with high visual appreciation (VIS) are similarly clustered around the central protected area but the clusters on the eastern part of the area are smaller and less contiguous. Provision concentration of water supply services (WAS) are found mainly in the south-east and north-west, while the opposite is observed for crop provision services (PRO) which, although rather ubiquitous, are significantly clustered in the north-eastern and in the south-western parts of the area. The highest probability is that referring to crop provision services (mean 0.74), as most of the agricultural fields occur in high yield potential areas. With the exception of habitat for species (mean 0.36) and water regulation (mean 0.32) all the selected services show mean probability <0.30. Most of the simulated E-type distributions are strongly asymmetric and positively skewed, with values >1 observed for CUL (skewness 2.72), CYC (skewness 1.20) and WAR (skewness 1.85). The maps of the potential supply of these three services are indeed characterized by well-defined local clusters of high values.

The differences in the spatial distribution of the potential supply of the single services can eventually be summarised and visualised for each of the six sub-landscapes, highlighting the differences in allocations of the selected services as depending upon landscape structure and composition. The spider graphs in Fig. 6 depict the trade-offs between the selected landscape services: three out of six sub-landscapes (*Lebus Plateau* and *Oberbarnim*, and the *River Oder Valley*) are strongly oriented towards the provision of one single service, i.e. crop provision (PRO), while in the other three landscapes a joint supply of diversified services is observed.

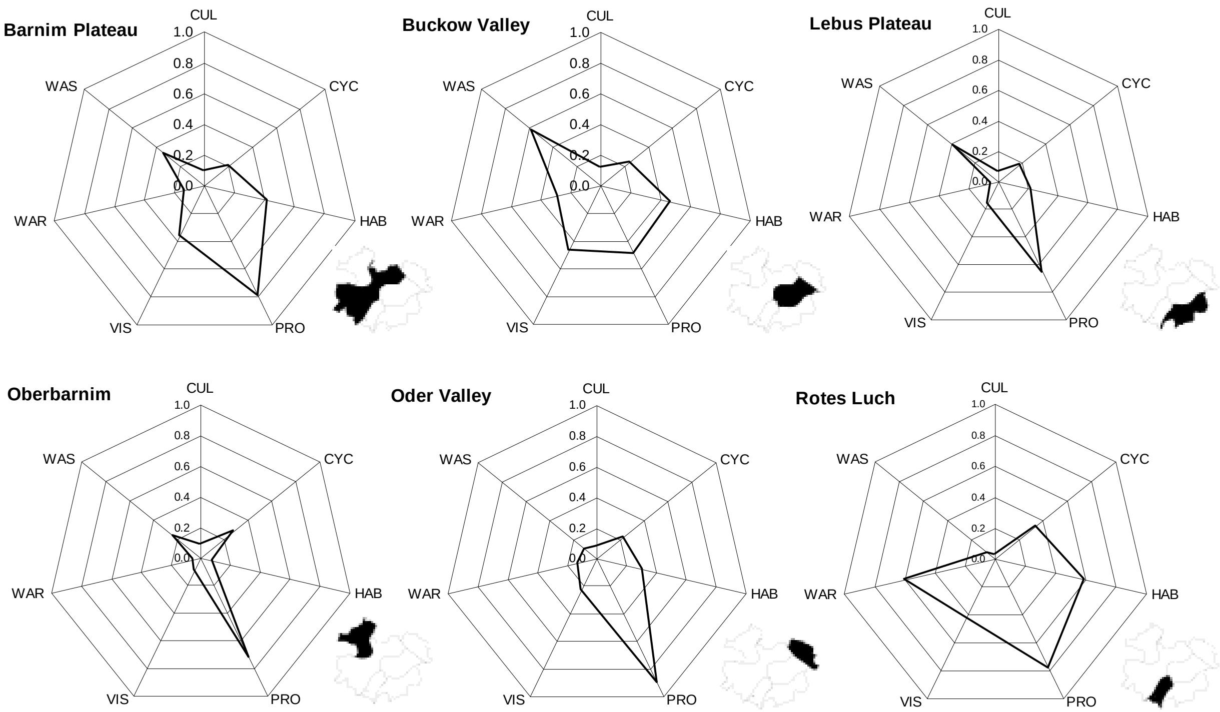

Fig. 6. Trade-offs between the seven landscape services in the six sub-landscapes of the study area. CUL: recreation and cultural heritage; CYC: recreation for cyclists; HAB: habitat for species; PRO: agricultural production; VIS: visual appreciation; WAR: water regulation; WAS: water supply.

In the sub-landscape of the *Barnim Plateau*, PRO is still the dominant service, nevertheless relevant potential supply of both VIS HAB and WAS services are observed. In the case of the glacial valley of Rotes Luch, HAB and WAR supplies are nearly as relevant as PRO, while in the case of the other glacial valley, i.e. the *Buckow Valley*, the supply of WAS is more relevant of PRO, followed by a substantially equivalent provision of VIS and HAB services.

Table 4. Descriptive statistics and Pearson's r for the probability of occurrence of the selected landscape services for the whole case study area under agricultural land uses. The values can range between 0 (no service provision) and 1 (full service provision).

	CUL	CYC	HAB	PRO	VIS	WAR	WAS
No.	26,390	26,390	26,390	26,390	26,390	26,390	26,390
Mean	0.085	0.219	0.355	0.738	0.299	0.151	0.320
SD	0.157	0.253	0.350	0.267	0.321	0.258	0.324
Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Median	0.020	0.103	0.250	0.838	0.158	0.018	0.175
Max	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Correlations							
CUL	1						
CYC	0.219*	1					
HAB	-0.153*	-0.015	1				
PROD	-0.034*	0.027*	0.177*	1			
VIS	0.084*	0.157*	0.537*	0.089*	1		
WAR	0.076*	0.149*	0.253*	-0.011	0.351*	1	
WAS	0.128*	0.016	0.187*	-0.031*	0.159*	0.086*	1

* significant at *p* <0.01.

Table 4 shows the correlation among any couple of services. VIS and HAB exhibit the highest significant (*p*< 0.01) positive correlation (*r* = 0.54), followed by those between VIS and WAR (*r* = 0.35), HAB and WAR (*r* = 0.25) and CUL and CYC (*r* = 0.22). Negative significant correlations are observed between CUL and HAB (*r* = -0.15), CUL and PRO (*r* = -0.03) and PRO and WAS (*r* = -0.03). In these cases, services supply changes in opposite direction. However, these are general trends and local clusters of high occurrence of both services, leading to synergies or conflicts, cannot be excluded based on these results. The existence of different bundles of services with synergies and conflicts is then clearly suggested by the sign and the strength of the correlation, but their joint supply can be better elucidated only mapping the joint probability of occurrence of different pair of services. The descriptive statistics of the global joint probability of occurrence of any given couple of landscape services, calculated after Eq. (7) are shown in Tab. 5.

Table 5. Mean joint probability values and standard deviations (in brackets) for the occurrence of pairs of selected landscape services for the whole case study area under agricultural land uses. (N = 26,390*)*

Landscapes services	*CUL*	*CYC*	*HAB*	*PROD*	*VIS*	*WAR*	*WAS*
CUL	-						
CYC	0.027 (0.079)	-					
HAB	0.022 (0.063)	0.076 (0.149)	-				
PROD	0.061 (0.122)	0.164 (0.209)	0.279 (0.310)	-			
VIS	0.030 (0.084)	0.078 (0.155)	0.166	0.228	-		
WAR	0.016 (0.059)	0.043 (0.115)	0.076 (0.166)	0.111 (0.207)	0.112 (0.187)	-	
WAS	0.034 (0.091)	0.071 (0.140)	0.076 (0.166)	0.233 (0.266)	0.112 (0.187)	0.055 (0.142)	-

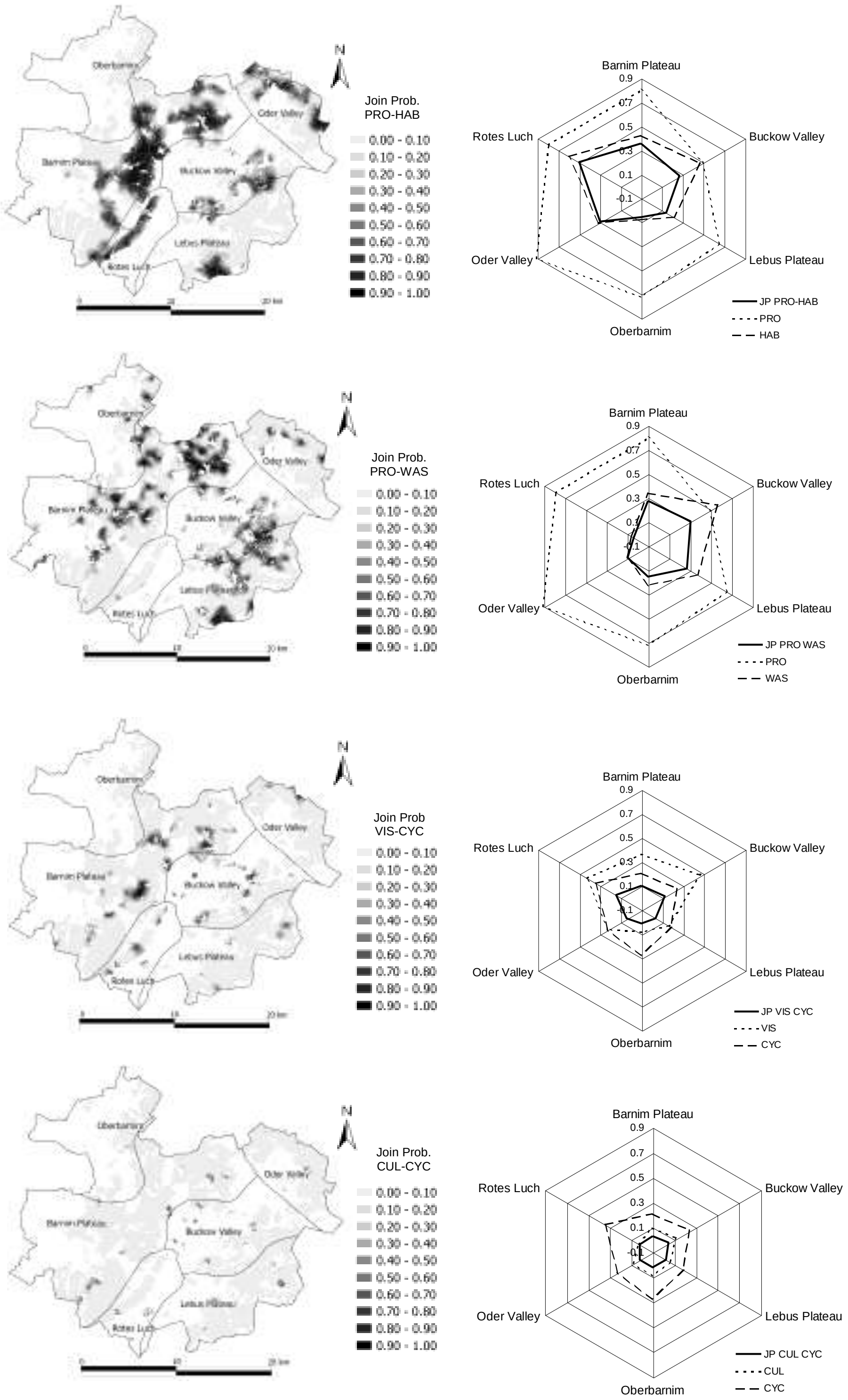

Fig. 7. Joint probability maps for selected pairs of landscape services and mean values of single and join probabilities for any given pair at sub-landscape level. CUL: recreation and cultural heritage; CYC: recreation for cyclists; HAB: habitat for species; PRO: agricultural production; VIS: visual appreciation; WAS: water supply

The highest mean join probability is that observed for the joint supply of PRO and HAB services (0.28), followed by those for PRO and WAS (0.23) and PRO and VIS (0.22). These findings highlight the occurrence of hotspots of service provision with possible conflicts between the on-going intensification of agricultural management, often associated to field enlargement and to the removal of landscape elements, and the maintenance of landscape features such as tree elements or kettle holes, which underpin the delivery of service others than food provision. Mean global join probabilities >0.1 are observed for the following pairs of landscape services: HAB-VIS (0.17), PRO-CYC (0.16), PRO-WAR (0.11), VIS-WAR (0.11) and VIS-WAS (0.11).

These global figures refer to the whole study area, whereas for management and planning purposes it is more relevant to identify the local differences in joint services provision, which can be made visually explicit in join probability maps. Exemplarily the joint probability for four couples of selected services along with their average in the six sub-landscape of the area is illustrated Fig. 7. The maps show clearly the extent and the degree of the spatial co-occurrence for specific couples of services, i.e. hotspots of service supply as resulting from the interplays between the specific pairs of indicators. The joint supply of provision and habitat services (Fig. 7a) is particularly relevant in the *Rotes Luch*, the main grassland production area where >90% of the fields are under protection schemes, and in the more productive landscapes of the *Barnim Plateau* and of the *River Oder Valley*. The presence of hotspots of PRO and WAS services (Fig. 7b) is above average in the *Buckow Valley* and in the *Lebus* and *Barnim Plateaux*. In first case it is the high occurrence of WAS to underpin the high joint supply of services, notwithstanding a probability for PRO supply (0.49) well below the global mean (0.74); in other sub-landscapes it is the co-occurrence of high single probabilities for each services to return a higher probability of spatially associated services. The joint probability of CYC and other services, such as VIS (Fig. 7c) or CUL (Fig. 7b) reveals that attractiveness of the sub-landscapes in terms of leisure cycling activities is affected by the co-occurrence of visual amenities or other opportunities for recreation. A mismatch in the provision of the CYC and VIS services is observed in the sub-landscapes of *Oberbarnim* and *Barnim Plateau* whereas a good provision synergy is observed in the *Buckow Valley*. In all other sub-landscapes the observed join probabilities are below the global average.

5.4 Discussion

In this paper we explore the potential of geostatistical techniques in mapping the occurrence of multiple landscape services adopting a probabilistic approach to landscape service assessment. The selected indicators of landscape services are site-specific referring to points or buffer around points, randomly allocated in the landscape within a regular reference grid. The proposed methodological framework characterises the spatial patterns of landscape services potential supply using variogram models. These allow for a robust and synthetic description of the heterogeneity and connectivity of a number of landscape services. The variogram models are input into sequential geostatistical simulations which in turn provide a probabilistic description of landscape services occurrence over a given area. Although not differentiating among its sources, the approach allows for an explicit assessment of uncertainty associated to the estimates of landscape services: this is currently a limitation of many studies on landscape or ecosystem services which causes major concerns (Johnson et al. 2012; Hou et al. 2013). The results displayed as probability maps for each service or as joint probability of any desired number of services are easily readable and comparable. Geostatistical simulations can be viewed as the spatial counterpart of Monte Carlo simulation; as such a significant number of simulations are required for stable results and to reproduce the statistical features of the sampled population, i.e. its histogram and its semivariogram. In doing so, simulations provide also a tool to assess and map the uncertainty about the simulated values. Setting of different probability thresholds supports identification of hotspots of multiple service supply. For example setting a probability threshold of service occurrence > 0.50, 9% of the area under agricultural land uses provides no landscape services, 30% delivers one service while 27% and 19% supply two and three services respectively. The shares of agricultural area with a potentially supply of four and five services jointly are equal to 10 and 4 % respectively, while only 0.4% of the area has a potential to deliver 6 joint landscape services. Furthermore the probabilistic framework does not require any further standardization of results as all the services are assessed in terms of probability of occurrence, i.e. ranging from 0 to 1, which are in turn based on meeting the criteria defined for the indicators of their potential supply. Therefore the joint probability calculation represents a straightforward tool to provide a valuable integration to approaches based on proportional overlap (Wu et al., 2013), weighting scheme (Gimona and van der Horst, 2007), or relative capacity (Baral et al., 2012).

A relevant aspect of the proposed methodology is the choice of the optimal buffer size around sampling points, which requires careful consideration of both case-specific objectives and the nature of spatial characteristics of the elements observed. Although it was not the specific focus of this work, we tested four different buffer sizes, ranging from 125 to 500 m, in order to assess their effect on the spatial structure as described by the experimental semivariograms. In general increasing the size of the buffer would result in a spatial structure which is more continuous over the two (or three) superimposed scales of variations. With increasing buffer size it is possible to obtain a more precise quantification of the actual spatial scale of the process, but this is counterbalanced by a smoothing effect over shorter distances where variograms suggest a higher degree of spatial continuity which is actually not observed in reality. The actual degree of spatial correlation at short distances is indeed better described by the smaller buffers considered, while large scale correlation are similarly detected and reproduced at any buffer size. With smaller buffer, the probability associated to the random points is lower than the observed due to lack of intercepted elements within the buffer which in turn results in a general underestimation. The opposite is observed for larger buffers, where more elements are intercepted resulting in a general overestimation, i.e. high probability of landscape services where actually they do not occur. The "optimal" buffer size requires balancing of these two contrasting effects.

5.5 Conclusion

In this study the spatial structures of seven landscape services in a multifunctional agricultural landscape in North-East Germany are modelled and mapped resorting to a probabilistic approach using geostatistical simulations. The proposed methodology is of general applicability and can be implemented wherever basic georeferenced information on landscape elements is available. At the landscape level, variogram analysis allows the characterization and the synthesis of the spatial heterogeneity and of the spatial ranges of landscape elements and related services. This approach highlights and explicitly quantifies the differences in the spatial structure of the selected services. The choice of the optimal buffer size for service sampling and variogram calculation is not straightforward and depends mainly on the objective pursued and on the nature of the elements observed. The decrease of spatial resolution (i.e. increase in buffer size) nevertheless is not associated to a loss of spatial variability and data regularization seems to affect only short range variability. Probability maps provide a straightforward visualization tool to explore the impact of one or more continuous or ordered categorical covariates on the likelihood of single or joint landscape services potential supply and the assessment of service richness can be made at different aggregation levels in order to support different stakeholder in planning and decision making.

Acknowledgments

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References

Anton, C., Young, J., Harrison, P., Musche, M., Bela, G., Feld, C.K., Harrington, R., Haslett, J.R., Pataki, G., Rounsevell, M.D.A., Skourtos, M., Sousa, J.P., Sykes, M.T., Tinch, R., Vandewalle, M., Watt, A., Settele, J., 2010. Research needs for incorporating the ecosystem service approach into EU biodiversity conservation policy. Bio. Conserv. 19 (10), 2979-2994.

Bagstad, K.J., Semmens, D.J., Waage, S., Winthrop, R., 2013. A comparative assessment of decision support tools for ecosystem services quantification and valuation. Ecosyst. Serv. 5, 27-39.

Baral, H., Keenan, R.J., Fox, J.C., Stork, N.E., Kasel, S., 2013. Spatial assessment of ecosystem goods and services in complex production landscapes: A case study from south-eastern Australia. Ecol. Complexity 13, 35-45.

Bateman, I.J., 2009. Bringing the real world into economic analyses of land use value: incorporating spatial complexity. Land Use Policy 26, 30-42.

Burkhard, B., Crossman, N., Nedkov, S., Petz, K., Alkemade, R., 2013. Mapping and modelling ecosystem services for science, policy and practice. Ecosyst. Serv. 4, 1-3.

Burkhard, B., Kroll, F., Nedkov, S., Müller, F., 2012. Mapping ecosystem service supply, demand and budgets. Ecol. Indic. 21, 17-29.

Brown, K.A., Johnson, S.E., Parks, K.E., Holmes, S.M., Ivoandry, T., Abram, N.K., Delmore, K.E., Ludovic, R., Andriamaharoa, H.E., Wyman, T.M., Wright, P.C., 2013. Use of provisioning ecosystem services drives loss of functional traits across land use intensification gradients in tropical forests in Madagascar. Bio. Conserv. 161, 118-127.

Bryan, B.A., Crossman, N.D., 2013. Impact of multiple interacting financial incentives on land use change and the supply of ecosystem services. Ecosyst. Serv. 4, 60-72.

Chilès, J.-P., Delfiner, P., 1999. Geostatistics: modelling spatial uncertainty. Wiley, New York.

Costanza, R., D'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., Van Den Belt, M., 1997. The value of the world's ecosystem services and natural capital. Nature 387, 253–260.

Crossman, N.D., Burkhard, B., Nedkov, S., Willemen, L., Petz, K., Palopmo, I., Drakou, E.G., Martín-Lopez, McPhearson, T., Boyanova, K, Alkemade, R., Egoh, B., Dunmabr, M.b., Maes, J., 2013. A blueprint for mapping and modelling ecosystem services. Ecosyst. Serv. 4, 4-14.

de Groot, R.S., Alkemade, R., Braat, L., Hein, L., Willemen, L., 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecol. Complexity 7 (3), 260-272.

Deutsch, C.V., Journel, A.G., 1998. GSLIB, Geostatistical Software Library and User's Guide, 2nd Ed. Oxford University press, New York.

Egoh, B., Drakou, E.G., Dunbar, M.B., Maes, J., Willemen, L., 2012. Indicators for mapping ecosystem services: a review. Report EUR 25456 EN. Publications Office of the European Union, Luxembourg.

Egoh, B., Reyers, B., Rouget, M., Richardson, D.M., Le Maitre, D.C., van Jaarsveld, A.S., 2008. Mapping ecosystem services for planning and management. Agric. Ecosyst. Environ. 127 135–140.

European Commission, 2011. Our life insurance, our natural capital: an EU biodiversity strategy to 2020. Publications Office of the European Union, Luxembourg.

FAO, Food and Agriculture Organization of the United Nations, 2013. FAOSTAT (pilot version) http://faostat3.fao.org/faostat-gateway/go/to/home/E.

Garrigues, S., Allard, D., Baret, F., Weiss, M., 2006. Quantifying spatial heterogeneity at the landscape scale using variogram models. Remote sensing of Environment 103, 81-96.

Gimona, A., van der Horst, D., 2007. Mapping hotspots of multiple landscape functions: a case study on farmland afforestation in Scotland. Landscape Ecol. 22, 1255-1264.

Goovaerts, P., 1997. Geostatistics for Natural Resources Evaluation. Oxford University Press, New York.

Gulickx M.M.C., Verburg P.H., Stoorvogel J.J., Kok K., Veldkamp A., 2013. Mapping landscape services: A case study in a multifunctional rural landscape in The Netherlands. Ecol. Indic. 24, 273-283

Haines-Young, R., Potschin, M., Kienast, F., 2012. Indicators of ecosystem service potential: mapping marginal changes and trade-offs at European scales Ecol. Indic. 21 39-53.

Hermann, A., Knutter, M., Hainz-Renetzeder, C., Konkoly-Gyuró, E, Tirászi, A., Brandenburg, C., Allex, B., Ziener, K., Wrbka, T. 2014. Assessment framework for landscape services in European cultural landscapes: An Austrian Hungarian case study. Ecol. Indic. 37A, 229-240.

Hou, Y., Burkhard, B., Müller, F., 2013. Uncertainties in landscape analysis and ecosystem service assessment. J. Environ. Manage. 127, Supplement, 2013, S117-S131.

Jensen, O.P., Christman, M.C., Miller, T.J., 2006. Landscape-based geostatistics a case study of the distribution of blue crab in Chesapeake Bay. Environmetrics, 17, 605-621

Johnson, K.A., Polasky, S., Nelson, E., Pennington, D., 2012. Uncertainty in ecosystem services valuation and implications for assessing land use tradeoffs: An agricultural case study in the Minnesota River Basin. Ecol. Econ. 79, 71-79.

Journel, A.G., 1983 Non parametric estimation of spatial distributions. Math. Geol. 15, 445 - 468.

Kalettka, T., Rudat, C., 2006. Hydrogeomorphic types of glacially created kettle hoels in NE Germany. Limnologica 36, 54-64

Kareiva, P., Tallis, H., Ricketts, T.H., Daily, G.C., Polasky, S., 2011. Natural Capital. Theory and Practice of Mapping Ecosystem Services. Oxford University Press. Oxford.

Kliskey, A.D., 2000. Recreation terrain suitability mapping: a spatially explicit methodology for determining recreation potential for resource use assessment. Landscape Urban Plan. 52, 33-43.

Koschke, L., Fürst, C., Frank, S., Makeschin, F., 2012. A multi-criteria approach for an integrated land-cover-based assessment of ecosystem services. Ecol. Indic., 21, 54-66.

Lantuéjoul, C., 2002. Geostatistical simulation: models and algorithms. Springer, Berlin.

Lavorel, S., Grigulis, K., Lamarque, P., Colace, M., Garden, D., Girel, J., Pellet, G., Douzet, R., 2011. Using plant functional traits to understand the landscape distribution of multiple ecosystem services. J. Ecol. 99, 135–147.

MA, 2005. Millenium Ecosystem Assessment. Ecosystems and Human Well-Being: biodiversity Synthesis. Island Press, Washington DC.

Maes, J., Egoh, B., Willemen, L., Liquete, C., Vihervaara, P., Schägner, J.P., Grizzetti, B., Drakou, E.G., La Notte, A., Zulian, G., Bouraoui, F., Peracchini, M.L., Braat, L., Bidoglio, G., 2012. Mapping ecosystem services for policy support and decision making in the European Union. Ecosyst. Serv. 1, 31-39.

Maisel, J.E., Turner, M.G., 1998. Scale detection in real and artificial landscape using semivariance analyses. Landscape Ecol. 13, 347-362.

Martínez-Harms, M.J., Balvanera, P., 2012. Methods for mapping ecosystem service supply: a review. International Journal of Biodiversity Science, Ecosyst. Serv. Manage. 8, 17-25.

Meynen, E., Schmithüsen, J., 1962. Handbuch der naturräumlichen Gliederung Deutschlands, 9 Lieferung, Bundesanstalt für Landeskunde.

MLUR, 2000. Bodenbewertung für Planungs- und Zulassungsverfahren im Land Brandenburg – Abschlußbericht zum Forschungsprojekt im Auftrag des Ministeriums für Landwirtschaft, Umweltschutz und Raumordnung des Landes Brandenburg.

QGIS Development Team, 2012. QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org.

Rossi, R.E., Mulla, D.J., Journel, A.G., Franz, E.H., 1992. Geostatistical tools for modelling and interpreting ecological spatial dependence. Ecol. Monogr. 62 (2), 277-314.

Statios, 2000. WinGslib version 1.3. Statios Software and Services, San Francisco.

Syrbe, R.U., Walz, U., 2012. Spatial indicators for the assessment of ecosystem services: Providing, benefiting and connecting areas and landscape metrics. Ecol. Indic. 21, 80-88.

TEEB, 2010. The Economics of Ecosystems and Biodiversity. Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB.

Troy, A., Wilson, M.A., 2006. Mapping ecosystem services: practical challenges and opportunities in linking GIS and value transfer. Ecol. Econ. 60, 435-449.

Van der Zanden, E., Verburg, P.H., Mücher, C.A., 2013. Modelling the spatial distribution of linear landscape elements in Europe. Ecol. Ind. 27, 125-136.

Wackernagel, H., 2003. Multivariate geostatistics: An introduction with applications. Springer, Berlin.

Wu, J., Feng, Z., Gao, Y., Peng, J., 2013. Hotspot and relationship identification in multiple landscape services: A case study on an area with intensive human activities, Ecol. Indic. 29, 529-537.

6 CSA 2: Assessing the effect of scale enlargement on the provision of landscape services in a rural landscape in Germany

(draft paper to be submitted to Ecosystem Services)

Abstract

Scale enlargement and intensification of agricultural management often results in a marked and irreversible alteration the spatial structure and composition of the rural landscapes due to the removal of landscape elements. This paper presents a methodology to model and to analyse the effect of landscape elements removal on the land system architecture in the Märkische Schweiz, central eastern Brandenburg, a cultural landscape characterised by it small-scale and semi-open landscape structure.

To assess potential changes in landscape characters and services, we simulate the increasing removal of landscape elements such as single trees, tree groups and lines, hedgerows, alleys and windbreaks following field enlargements and intensification of agricultural management. The methodology is based upon a probabilistic approach to landscape services spatial modelling and assessment making use of geostatistical simulations. It allows the quantification of spatial heterogeneity and modelling of changes in the whole landscape architecture associated with the different rates of landscape elements removal. In setting different scenarios, plots of increasing size are merged and associated elements removed. Effects of these elements removal on landscape structure are assessed via observations of landscape elements at random points within a regular reference grid, followed by indicator coding, variogram analysis and kriging of single indicators via sequential simulations. The effects of elements removal on the provision of landscape services are assessed for habitat provision for a threatened bird species, the red-backed shrike *Lanius collurio*.

The operational relevance of this method is related to its use for benchmarking maximum extent of endowment with different landscape elements. As it is flexible and generally applicable, it can support mapping and complement participatory expert or stakeholder assessment based approaches and decision making.

Keywords: Landscape structure; Field enlargement; Semivariograms; Sequential simulations; Habitat services

6.1 Introduction

Scale enlargement and intensification of agricultural management is an issue of growing concern in post-Soviet Eurasia (Visser and Spoor, 2011) and also in Eastern Germany, where land market dynamics resulted in an increase of land prices by 132% between 2006 and 2013, while it was only 19% in Western Germany. This generated high pressure and competition for local cooperatives and individual farmers to leave their fields to larger companies. These changes are currently affecting the spatial structure and composition of the rural landscapes being often associated with the risk of removal of landscape elements following the changes in field sizes (Stoate et al., 2001, 2009).

There is a large amount of literature addressing the effects of intensification of agricultural systems on terrestrial and aquatic ecosystems, and general trends and possible scenarios have been clearly assessed and analysed at European level (Temme and Verburg, 2011; Verburg et al., 2008). Nevertheless at local scale it is pivotal importance to assess to which extent these actual and potential changes in landscape structure affect the potential supply of landscape services given a set of specific driver in order to guide expert or stakeholder assessment based approaches and decision making.

The actual agricultural landscape of north-east Germany is the result of long lasting anthropogenic activities over more than 300 years. After the implementation of the three-field system between the 8th and the 13th century, agriculture and forestry in Central Europe lay in a state of substantial stagnation until the 17th

century when the Holy Roman Empire's agricultural structures were abolished. Substantial changes in land ownership and landscape structure were first induced by Frederick William, Elector of Brandenburg (1640-1688), later by his great-grandson Frederick II of Prussia (1712-1786), and continued trough the 19th century. This phase marks the beginning of the formation of the specific cultural landscape of Eastern Germany as we know it today: canals construction and a massive drainage program allowed land reclamation and large field units were established often delimitated by linear elements and bordered by productive forests; by 1848 the cultivated land area increased by 71% (Büsch and Erich, 1992) and production raised by 40% (Fehrenbach, 1986). The land east of the Elbe River was characterised by estates larger than those in the rest of northern Germany and the rural landscape differed sharply from the landscape of small peasant farmers west of the Elbe and in Southern Germany east of the Elbe (Rugg, 1988). These estates were commonly held by absentee owners (*Junkers*), and in 1939 their average size was 288 ha with fields much larger than those wests of the Elbe River (Vogeler, 1996). The events of World War II and then the land reform under the Soviet occupation at first and then under the GDR rule led to a never-ending chain of expropriation and changes of ownership, with an overall collectivisation of agriculture characterised by a marked increase of acreage per management unit which had another dramatic impact on landscape structures and elements. This resulted in a "*remodeling and removal of the East German agricultural landscapes to a previously unknown extent. In particular, in the traditionally intensively used, and therefore already structurally poorer, farming areas countless corridor or landscape elements of great ecological and aesthetic value of the area disappeared*" (Philip, 1997). As a result fences, hedges, and even drainage ditches were mostly eliminated, with a decrease in hedgerows density by almost a fifth (Vogeler, 1996). With the German Reunification, agriculture underwent a comprehensive technical modernization and at the same time was to some extent transformed into more extensive management systems due to reprivatization of estates. Nevertheless in most cases the sizes and shapes of cultivated areas from the GDR times persisted after reprivatization. Large areas of the landscape were put under some form of protection (national parks, biosphere reservations, nature park, landscape protection areas), and rivers, streams and marshlands were gradually brought back to their natural state. In the same time, the transfer of state-owned agricultural enterprises of the former GDR to a number of trusts and bodies responsible for setting the rules to privatization resulted in a number of conflicts between (former) farmers and new forms of ownerships. This process of reprivatization is still ongoing today, and in Eastern Germany land market dynamics resulted in an increase of land prices by 112% between 2007 and 2011, while it was only 24% in Western Germany with a fraction of 1.1 to 1.4% of UUA sold per year in the East against 0.4% in the West (Tietz et al. 2013). In 2011 there were still 300,000 hectares of former state-owned land under lease, i.e. about 5.4% of the total UAA of former DGR available for sale, and non-agricultural and supra-regional investors are known to have purchased many farms, often far apart from each other (Tietz et al. 2013). As a consequence, farming activities are often being carried out by non-local personnel with large-scale machinery and across several locations. The resulting scale enlargement and intensification of agricultural practices strongly influence landscape structures and elements and the delivery of related services, with notably crucial effects on biodiversity and habitat for species (Brown et al., 2013; la Féon et al. 2010; Uematsu et al., 2010 Donal et al. 2006). Among the landscape elements of great ecological and aesthetic value, the different trees typologies which still characterise the rural landscape of Eastern Germany have been profoundly affected by historical events which challenged their role as landscape service supply hotspots in the agricultural landscape, as fields' enlargement is often if not always, coupled with the removal of these elements.

This paper presents a methodology to model and to analyse the effect of tree elements removal on the land system architecture in the "Märkische Schweiz", central eastern Brandenburg (North-East Germany), with a cultural landscape characterised by a small-scale and semi-open landscape structure. To this aim we used a spatially explicit and generally applicable probabilistic approach to assess and map landscape elements and related services, assuming a stepwise removal following gradual field enlargement. Landscape elements and services are considered as the realization of a stochastic process called random function (Chilés and Delfiner, 1999), and within this probabilistic framework their spatial properties con be described and modelled using second order statistics, such as the variogram. At each removal step we then describe the spatial relationships between data and model the spatial heterogeneity of the remaining landscape elements. Goal of this work is to analyse and model the changes in the spatial architecture of the landscape as resulting from increasing removal of tree elements following field enlargement and to assess how these changes in turn affect the supply of habitat services across the landscape.

6.2 Material and Methods

6.2.1 Study area

The case study area (576.4 km²) is located in Brandenburg (North-east Germany), County of Märkisch Oderland, extending from the eastern fringe of Berlin towards the Oder valley at the German-Polish border, and encompass ten municipalities (Fig. 1),. The climate is humid continental, with an average annual temperature of 8.8°C (-1.2°C in January and 18°C in July) and an average precipitation not exceeding 500-560 mm/year (27 mm in February to 70 mm in July; MLUR 2000). The geomorphology is the result of cyclic glacial advances of terrestrial Scandinavian ice sheets and of peri-glacial geomorphologic processes, and the elevation ranges between 5.8 m and 144 m a.m.s.l. The area has been subdivided into six major sub-landscapes (Fig.1; Meynen and Schmithüsen, 1962): Glacial valleys: 1) Rotes Luch (45.0 km², 7.8%) and 2) Buckow Valley (92.0 km², 15.6%); Ground- and end-moraines plateaus: 3) Lebus Plateau (88.1 km², 15.3%), 4) Barnim Plateau (206.6 km², 37.8%) and 5) Oberbarnim (88.0 km², 15.3%); Slope sides; (6) River Oder Valley (45.0 km², 7.8%). Forests occupy 39.9% of the total area, agricultural land represents 45.8% of the total area (of which 8.8 % is represented by grasslands), artificial surfaces cover 6.5%, and water bodies 2%. In the study area about 43% of the territory (245 km²) is under a form of nature protection and management; the major protection area is the *Naturpark Märkische Schweiz* (205 km^2), which is the core of the study area (Fig.1).

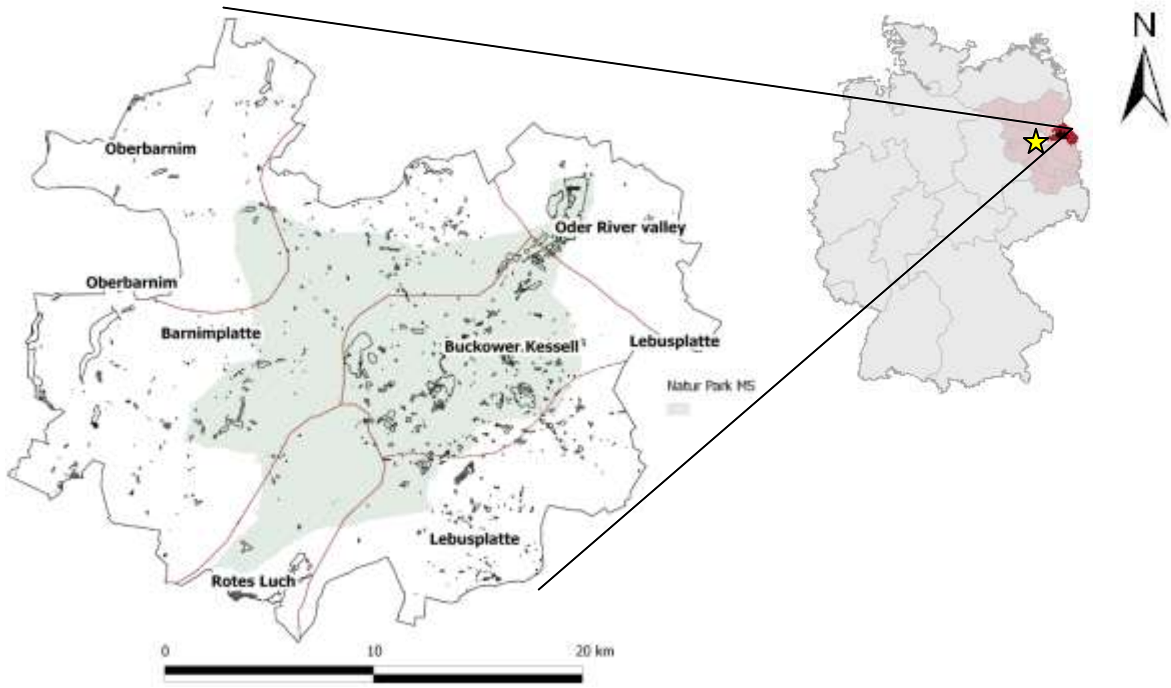


Figure 1. CSA area Märkische Schweiz:sub-landscapes and natur park.

The historically developed land use and land management practices have shaped not only the *Naturpark* and its agrarian surroundings but the whole area. This appear as an half-open countryside characterised by many natural amenities conferring the region a high potential as cultural landscape with habitats for biodiversity, with recreation and water resource provision functions as well as location for food and fibre production. Nevertheless the area has to face various conflicting services in the landscape, mostly due to intensification of farming practices and field enlargements, with consequent removal of landscape elements and reduction of habitats for biodiversity.

Field size ranges between 0.01 and 353 ha (Tab. 1), the average field size is about 22 ha (N=1,202), but 50% of the fields is slightly above 5 ha; the standard deviation is larger than the mean, as distribution is strongly positively skewed (skewness 13.76). Mean field sizes inside (18.0 ha) and outside (24.5 ha) the Naturpark are significantly different ($p < 0.05$). Although existing, data on field ownership and on actual farm size are not available due to privacy issues.

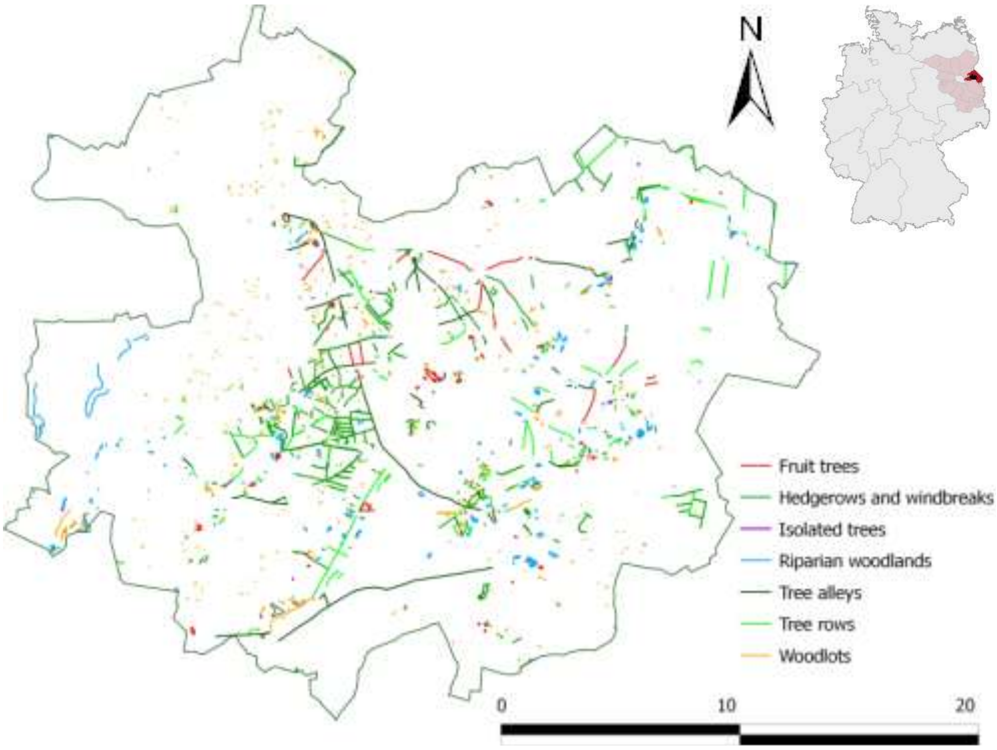


Figure 2. CSA area Märkische Schweiz: typology and occurrence of tree elements in landscape.

Table 1. Field size statistics for the whole area and for the sub-areas inside and outside the Naturpark

	Mean	*N*	Sum	Dev. Std.	Err. Std.	Min.	Perc. 10	Perc. 25	Median	Perc. 75	Perc. 90	Max.
Outside Naturpark	24.50	722	17,687.8	41.96	1.56	0.01	0.65	1.59	5.44	28.97	78.86	353.0
Inside Naturpark	18.04	480	8,660.3	34.10	1.56	0.11	0.56	1.39	4.69	18.81	53.29	290.2
Whole area	21.92	1202	26,348.2	39.12	1.13	0.01	0.59	1.51	5.14	24.03	64.80	353.0

6.2.2 Tree elements in the agricultural landscape

The official database of biotopes of Brandenburg (*Biotopkartierung Brandenburg – Liste der Biotoptypen mit Angaben zum gesetzlichen Schutz* (§32 BbgNatSchuG), *zur Gefährdung und zur Regenerierbarkeit*, 2011) and the Brandenburg digital cadastres (*Digitales Feldblockkataster* (DFBK) *des Landes Brandenburg*, 2012) provided the basic information about the current status of fields sizes and tree elements in the agricultural land in the case study area. In the data bases seven major tree typologies are identified and mapped (Figure 1): fruit trees, hedgerows, isolated trees/tree groups, riparian woodlands, tree rows, tree alleys and woodlots. Figure 3 portraits examples the different typologies, while the number of elements for each typology and their shares are reported in Tab. 2; areas were computed assuming a 5 m buffer around linear elements.

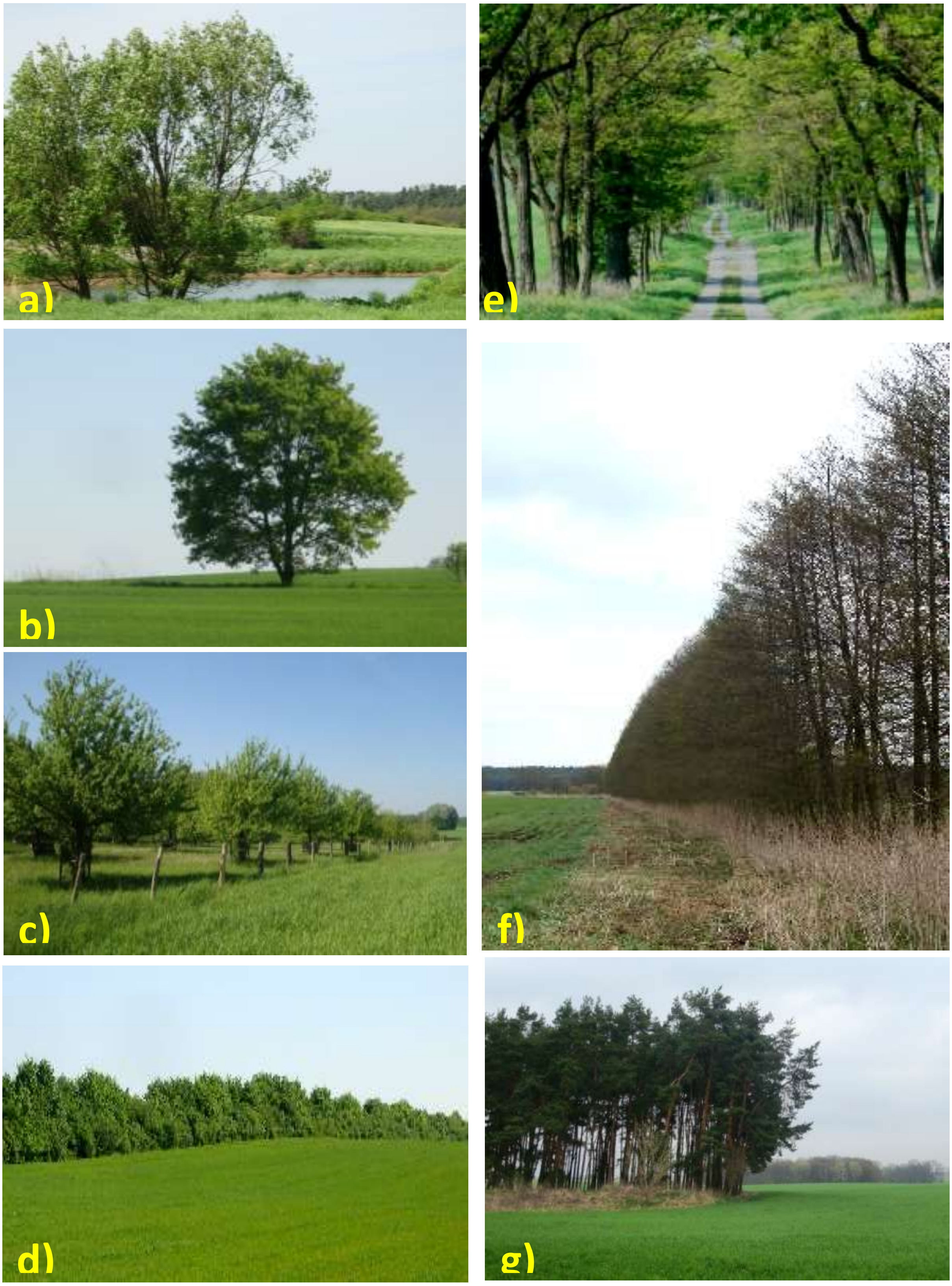


Figure 3. Different tree elements typologies in the CSA: a)riparian woodlands; b) isolated tree; c)fruit trees; d)hedgerow; e)tree alley; f) tree row; g) woodlot (Photo: F. Ungaro).

Table 2. Number of elements for each the typology and their shares in the CSA.

Typology	**Num elements**	**Share elements**	**Length m**	**Share length**	**m km^{-2}**	**Area ha**	**Share area**	**m^2 km^{-2}**
Fruit trees	99	5.5%	41,756	8.3%	140.9	41.8	6.9%	1,410.6
Hedgerows	430	24.0%	136,248	27.1%	459.8	178.9	29.6%	6,036.3
Isolated trees/Tree groups	59	3.3%	4,351	0.9%	14.7	3.5	0.6%	118.0
Riparian woodlands	251	14.0%	86,785	17.2%	292.9	86.2	14.3%	2,908.3
Tree alleys	92	5.1%	66,065	13.1%	222.9	66.7	11.1%	2,250.5
Tree rows	260	14.5%	72,698	14.4%	245.3	87.8	14.6%	2,964.1
Woodlots	604	33.6%	95,725	19.0%	323.0	138.6	23.0%	4,676.0
Total	1,795		503,628			645.3		20,364

Each typology underpins specific functions and provides a number of landscape services at different spatial scales and in different domains, i.e. ecological, economic and social (Plieniger, 2011); a summary of the main services provided is reported in Table 3.

Table 3. Examples of services provided by tree typologies in agricultural landscapes

	Provisioning services		**Regulating services**				**Supporting services**		**Cultural services**	
	Food	Raw Materials	Air quality	C storage	Erosion prevention	Water quality	Genetic diversity	Habitats for species	Scenic values	Regional identity
Fruit trees	X	X	X	X			X	X	X	X
Hedgerows		X	X	X	X			X	X	X
Isolated trees/Tree groups		X	X	X				X	X	
Riparian woodlands		X		X		X		X		
Tree alleys		X	X	X				X	X	
Tree rows		X	X	X	X			X	X	
Woodlots		X	X	X	X			X	X	

6.2.3 Simulating tree elements removal: methodology and scenarios settings

To assess potential changes in landscape characters and services, we simulate the increasing removal of landscape elements such as single trees, tree groups and lines, hedgerows, alleys and windbreaks following field enlargements. In doing so we made the following assumptions: i) non all tree elements are considered to be removable, but only those within or bordering agricultural fields, while all the tree elements along primary, secondary, and tertiary roads, and those within urban and periurban areas are assumed to be not removable (Figure 4); ii) tree removal occur stepwise and is simulated assuming that smaller fields are merged to larger fields and that the tree elements within or bordering them are eliminated; iii) fields are classified into ten size classes (Figure 5) and at each step 50% of the elements within a given field size class are randomly selected and removed until all removable elements within all classes are removed (Table 4). The share of removed elements at each step is not equal but constantly decreasing as it is related to the number of field plots within every size class. Total length is reduced by nearly 75% (from 504 to 125 km), and, considering all tree elements (i.e. removable and not removable), the average density drops from 1912 to 476 m km^{-2}.

Table 4. Field size classes and tree removal steps.

Field size class	Removal Steps	Num. of deleted elements	Num. of retained elements	Share of del. elements	Cum. share of del.	Length tot. km	Length del. km	Density* m/km^2
All	Step 0	0	1795	0	0	504	0	1436
<10 ha	Step 1	225	1570	13	12.5	458	45	1264
<10 ha	Step 2	225	1345	12.5	25.1	393	110	1016
10-20 ha	Step 3	92	1253	5.1	30.2	374	129	944
10-20 ha	Step 4	87	1166	4.8	35	354	150	866
20-40 ha	Step 5	82	1084	4.6	39.6	337	166	804
20-40 ha	Step 6	83	1001	4.6	44.2	306	197	687
40-60 ha	Step 7	58	943	3.2	47.5	287	217	612
40-60 ha	Step 8	56	887	3.1	50.6	261	242	515
60-80 ha	Step 9	57	830	3.2	53.8	251	252	479
60-80 ha	Step 10	53	777	3	56.7	225	278	378
80-100 ha	Step 11	43	734	2.4	59.1	217	286	348
80-100 ha	Step 12	47	687	2.6	61.7	200	303	283
100-150 ha	Step 13	42	645	2.3	64.1	188	315	238
100-150 ha	Step 14	43	602	2.4	66.5	160	343	134
150-200 ha	Step 15	25	577	1.4	67.9	157	346	121
150-200 ha	Step 16	25	552	1.4	69.2	150	353	94
200-250 ha	Step 17	33	519	1.8	71.1	143	360	68
200-250 ha	Step 18	31	488	1.7	72.8	133	370	29
> 250 ha	Step 19	23	465	1.3	74.1	130	374	16
> 250ha	Step 20	21	444	1.2	75.3	125	378	0

*only of removable elements

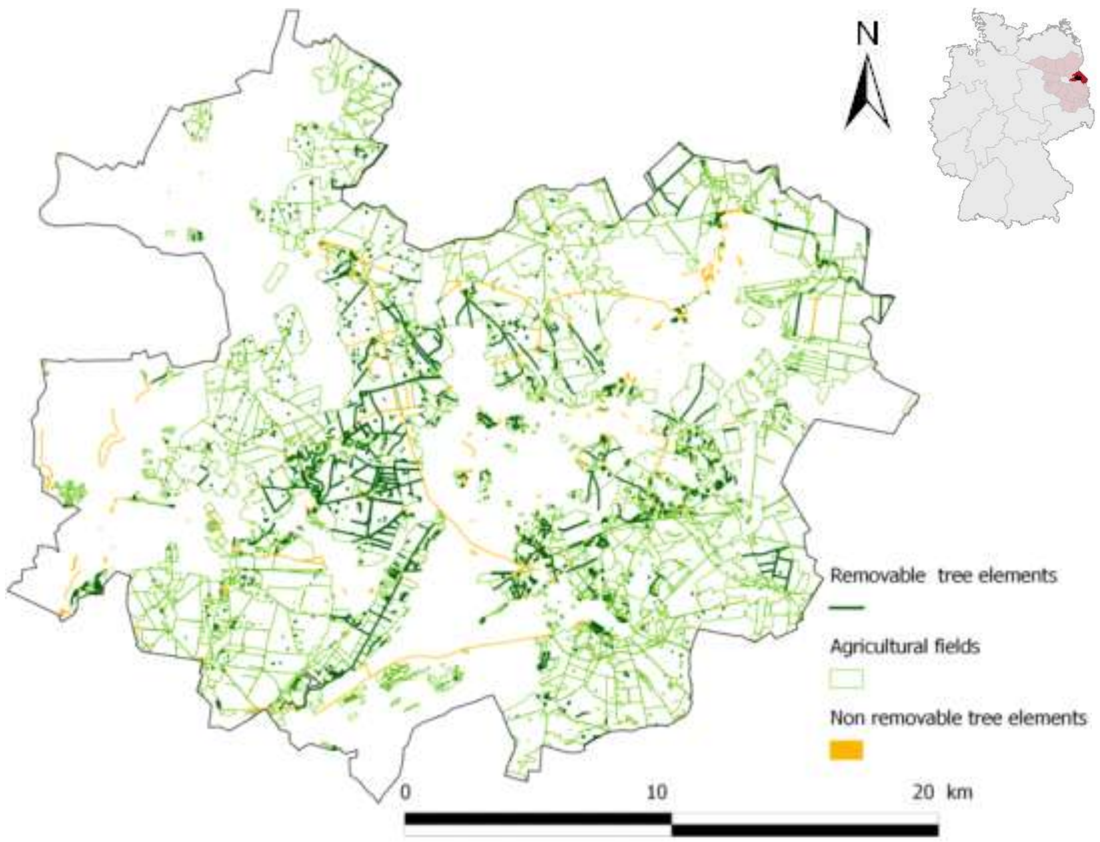


Figure 4. Removable and not removable tree elements in the agricultural landscape.

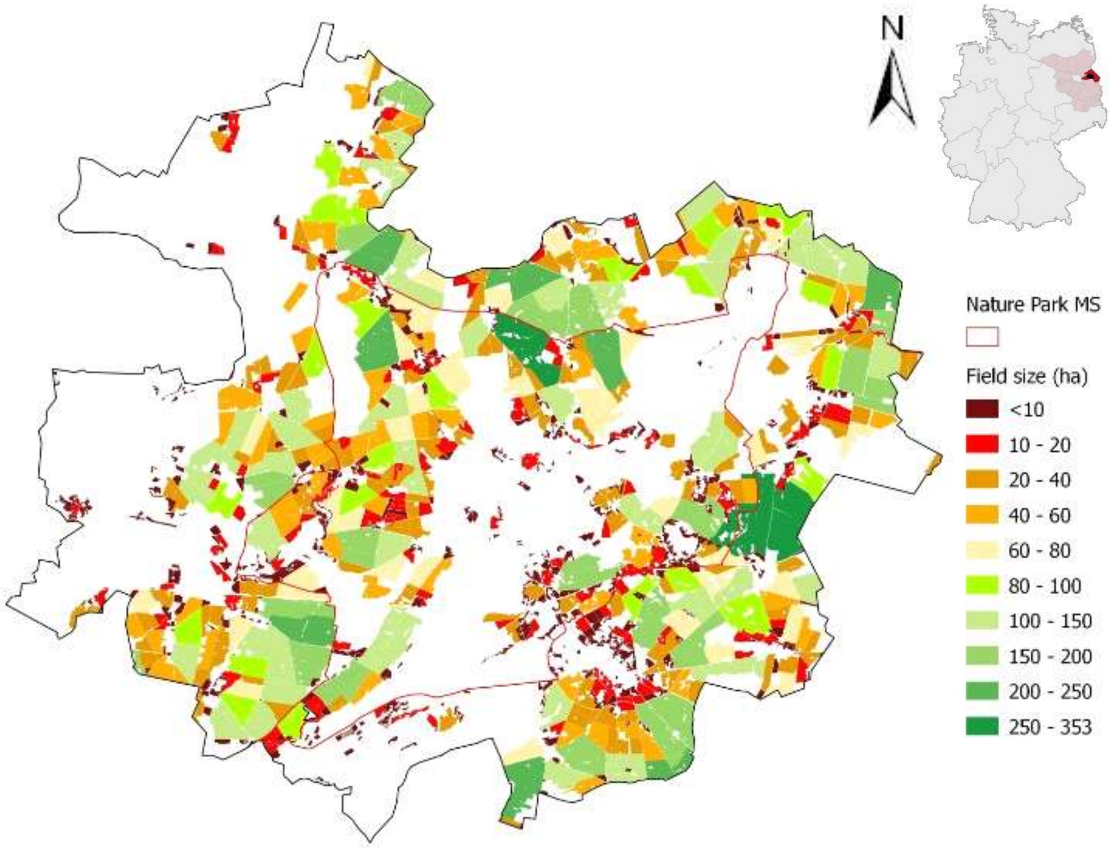


Figure 5. Field size classes in the CSA.

In order to explore the effect of tree removal on landscape services, the case of the habitat provision for one bird species, namely the red-backed shrike (*Lanius collurio*), was investigated assessing the changes in tree density at six steps (namely at step. 0, 3, 7, 11, 16, and 20), assuming an optimal element density of 40 m ha^{-1} (Pfister and Naef-Daenzer, 1987). The red-backed shrike, listed in the European bird conservation guideline, has high conservation priority in Germany, and is of particular regional importance (Hoffman and Greef, 2003; Latus et al., 2004).

6.2.4 Characterization of spatial pattern of landscape elements and services

The effects of tree elements removal on landscape structure are assessed at each step via observations of landscape elements at random points within a regular reference grid, followed by indicator coding, variogram analysis and kriging of single indicators via sequential indicator simulations (Journel, 1983). The approach allows the quantification of spatial heterogeneity and modelling of changes in the whole landscape architecture associated with the different rates of landscape elements removal.

Within this framework the information about the presence/absence of a given tree element at any given position $u_\alpha = (x_\alpha, y_\alpha)$ within the landscape can take the form of an indicator $i(u_\alpha)$ of presence/absence of the element at that point or within a buffer around it:

$$i(u_\alpha) = \begin{cases} 1 & \text{if the landscape element is present} \\ 0 & \text{otherwise} \end{cases} \qquad (1)$$

The area was then dived into square cells of 1 km^2 and in each cell two random points were randomly drowned. This stratified random sampling design led to a total of 1,344 points, with an average sampling density equal to 2.3 km^{-2}. At each point, buffers of 250 m were drawn in order to assess the presence/absence of tree elements at step 0 and at each following removal step; In the case of habitat provision for the red-backed shrike (*Lanius collurio*), the average density within the 250 m buffer was calculated and coded 1, 0 depending on the observed density, i.e. 1≥40 m ha^{-1}, 0 otherwise.

At each step an indicator data set was then created and experimental semivariograms were be used to characterise the spatial pattern of these indicator data. The indicator variogram is computed as the half of the expected squared increment of the values between locations u_α and $u_{\alpha+h}$:

$$\hat{\gamma}(h) = \frac{1}{2n} \sum_{\alpha=1}^{N(h)} [i(u_\alpha) - i(u_\alpha + h)]^2 \qquad (2)$$

where $N(h)$ is the number of pairs within a given spatial distance (and direction) known as lag h. The spatial increment, i.e. the term in square brackets, is non zero only if at two locations a distance h away the status of the element considered is different. In this way it is possible to model the transition between the occurrence and the absence of any given element in the landscape. In the presence of spatial clusters of tree elements, the variogram value is expected to increase with the lag h and reaches a plateau, the sill, at a given distance, called range, corresponding to the average size of these clusters. Data separated by a distance larger than the range are uncorrelated. If the sill is not reached within a given distance, which is generally taken as half of the maximum extent of the area (Chilés and Delfiner, 1999), the observed spatial variability is not completely encompassed at the scale of investigation. Generally variograms exhibit nested structures, i.e. they are the result of a number of superimposing structures with different ranges. Another important aspect is the behaviour of the variogram near the origin which typically shows a more or less marked discontinuity. This discontinuity, called nugget effect, is due either to uncorrelated spatial noise or to spatial structures not detected at the scale of investigation. The experimental variogram provide only an empirical description of the spatial distribution of a given landscape structure or element; a model fitted to the experimental values, i.e. a valid mathematical function, is then necessary to provide a parametric description of the spatial heterogeneity components. The possible functions are defined as authorized models (Wackernagel, 2003), and to account for multiple scales in data variability, linear combination of these models can be used, resulting in extended or nested model semivariogram model called linear model of regionalization (Wackernagel, 2003). This nested variogram model is the weighted sum of n elementary models and is suitable to describe specific sets of spatial structures, over imposed in the same area and each related to a different spatial scale. A nested variogram model can be expressed as follows:

$$\gamma(h) = \sigma^2 \sum_{n=1}^{n=i} f_n g_n(r_n, h) \qquad (3)$$

where n is the number of elementary variogram models $g_n(r_n,h)$. As such it is appropriate to describe the two components of spatial heterogeneity in any given landscape: i) the overall degree of landscape heterogeneity as expressed by a given landscape element is given by the total sill σ^2, and ii) the spatial structure of any given element is characterised by parameters of the model, i.e. its ranges r_n and fractions of the total variance f_n related to each range. This last component can be summarised in a single parameter, the mean length scale D_n (Garrigues et al., 2008; Garrigues et al., 2006), i.e. the weighted average of the different range parameters, where the weights are provided by the n fractions of total variance of each structure. For a linear combination of spherical variogram models D_n can be calculated as (Lantuéjoul, 2002):

$$D_n = \left(\sum_{n=1}^{n} \frac{c_n}{\sigma^2} \cdot \frac{\pi r_n^2}{5} \right)^{0.5} \qquad (4)$$

where n is the number of elementary models, c_n and r_n their sill and range components and σ^2 the total sill. The amplitude of this parameter is related to the mean extent and to the connectivity of the landscape element considered, and can be used to assess if the size of the area under investigation is suitable to describe the spatial structure of the element using variograms.

6.2.5 Mapping the probability of occurrence of tree element in the landscape

Based on the variogram models, the probability of elements' occurrence and service provision has been mapped via conditional sequential indicator simulations; a detailed introduction on the SIS method can be found in Goovaerts (1997) and has been widely applied to address many environmental issues. The estimate conditional probability p_k* of occurrence of a given service supply is calculated at the nodes of a regular grid u_0 as the linear combination of the neighbouring data u_α:

$$p_k^*(u_0) = \sum_{\alpha=1}^{n} \lambda_\alpha(u_0) \cdot i(u_\alpha) \tag{5}$$

where the weights λ_α are computed solving the well known kriging system. Differently from kriging based estimators, the simulation approach takes into account not only the spatial variation of observed data at sampled locations but also the variation in estimations at unsampled locations. In doing so simulations honour the data and the variogram model and allow for a correct portray of spatial variability and for a more realistic depiction of short range heterogeneity. The search radii for simulation were set as half the maximum range of the variogram models, and the number of data to use within the search radii ranged form a minimum of 4 to a maximum of 16. For each landscape service, 1,000 realizations have been generated at the node of a 100 m square grid for a total of 57,657 simulated values for each realization. In post processing the simulation outcomes, the E-type estimator (Deutsch and Journel, 1998) was calculated at each simulation node, i.e. the expectation p_E* of the cumulative conditional distribution function *F* (ccdf) which represents the mean probability of service provision within a buffer around a given grid node given *n* conditional observations:

$$p_E^*(u_0) = \int_{-\infty}^{+\infty} p \, dF(u_0; p \,|\, n)) \tag{6}$$

All the geostatistical analyses presented in this paper were carried out with the geostatistical software Wingslib 1.3.1 (Statios, 2000), which works in conjunction with the GSLIB90 executables (Deutsch and Journel, 1998). All GIS operations and mapping were performed using QGIS v1.8.0. (QGIS Development Team, 2012).

6.3 Results

6.3.1 3.Spatial structure of landscape elements and services

Table 5 and 6 summarizes, respectively for the tree elements and for the target species habitat service provision, the observed probability of occurrence and its standard deviations at the 1,344 sampling points.

Table 5.

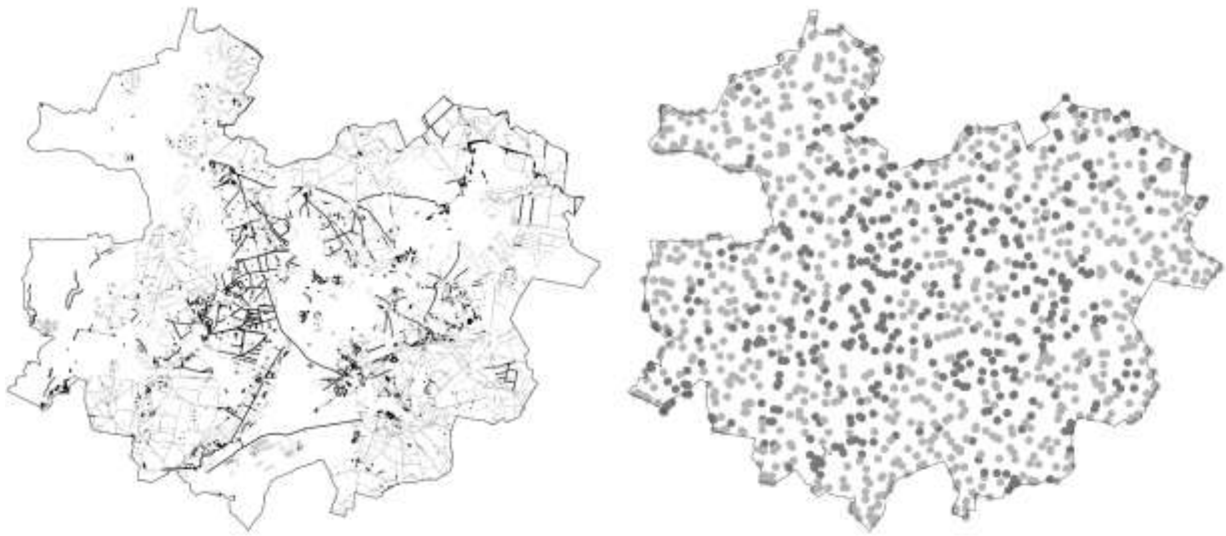
Removal step	Intercepted tree elements	Mean (N = 1,344)	Dev.Std.
Step 0	451	0.336	0.472
Step 1	427	0.318	0.466
Step 2	406	0.302	0.459
Step 3	393	0.292	0.455
Step 4	378	0.281	0.450
Step 5	359	0.267	0.443
Step 6	341	0.254	0.435
Step 7	332	0.247	0.431
Step 8	317	0.236	0.425
Step 9	309	0.230	0.421
Step 10	302	0.225	0.418
Step 11	299	0.222	0.416
Step 12	285	0.212	0.409
Step 13	277	0.206	0.405
Step 14	259	0.193	0.395
Step 15	253	0.188	0.391
Step 16	246	0.183	0.387
Step 17	237	0.176	0.381
Step 18	226	0.168	0.374
Step 19	223	0.166	0.372
Step 20	217	0.161	0.368

Table 6.

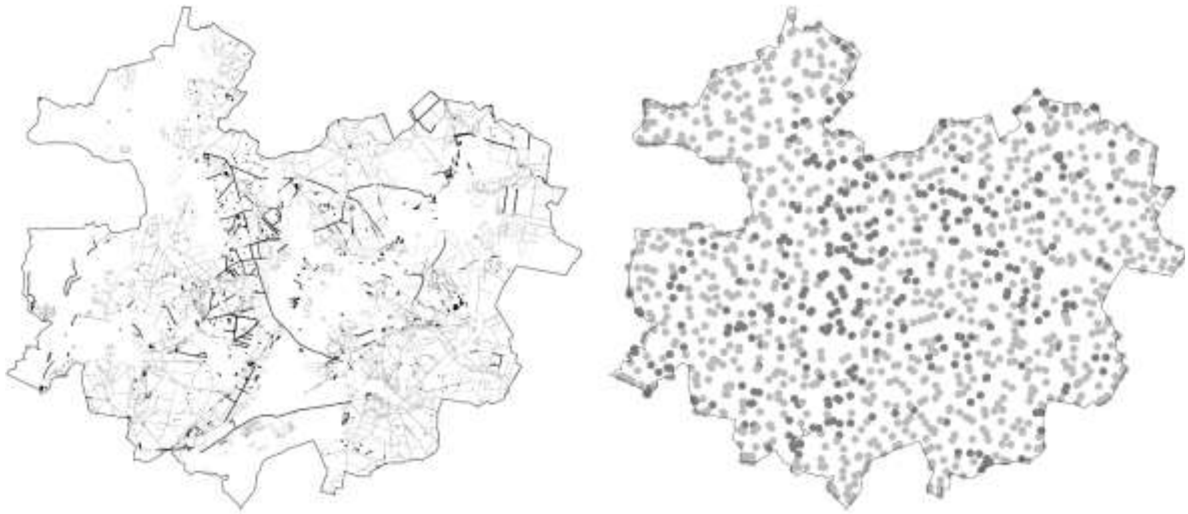
Removal step	Num. oss with density ≥40 m ha^{-1}	Mean (N = 1,344)	Dev.Std.
Step 0	96	0.071	0.258
Step 3	63	0.047	0.211
Step 7	38	0.028	0.166
Step 11	24	0.018	0.132
Step 16	16	0.012	0.108
Step 20	11	0.008	0.090

As an example, Figures 6a and 6b show the occurrence of tree elements in the landscape at step 0 and at the removal steps 3, 7, 11, 16 and 20 along with the sampling points where those elements are intercepted.

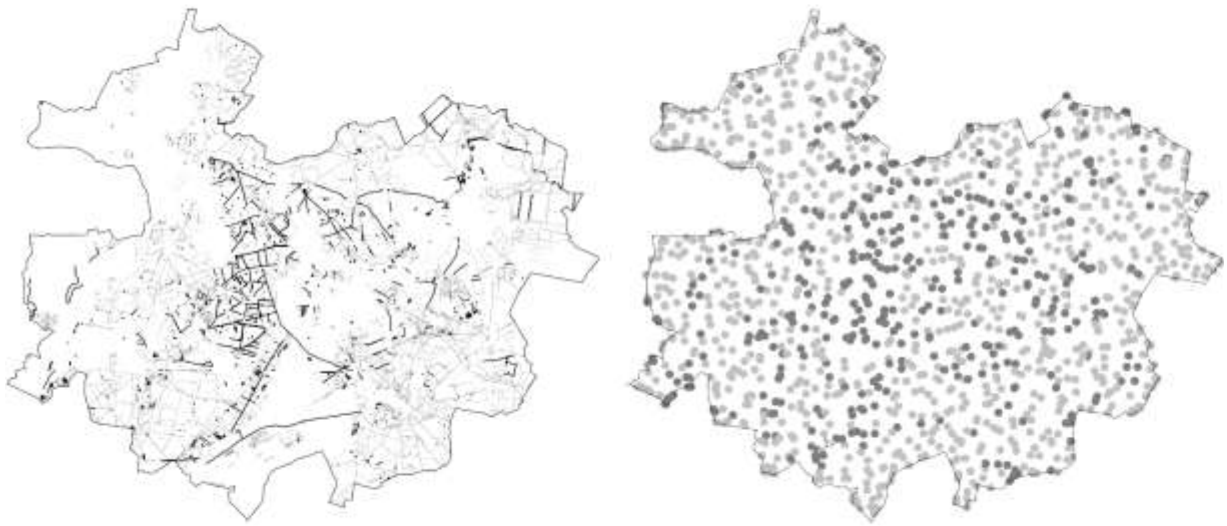
The experimental indicator semivariograms were calculated assuming a lag, i.e. an incremental step over the distance, equal to 400 m; the maximum distance was set to 12,000 m, i.e. about half the maximum width of the area. The experimental variograms and the models fitted to them are shown in Fig. 7 for a number of selected steps. Nested spherical models with a nugget component provided the best fit to the experimental variograms which are all characterised by discontinuity at the origin, linear behaviour with change of slope and convergence to a sill. The parameters of the models fitted to the experimental semivariograms are shown in table 7 and 8. In all cases a nugget and two components well described the experimental data.



Step 0



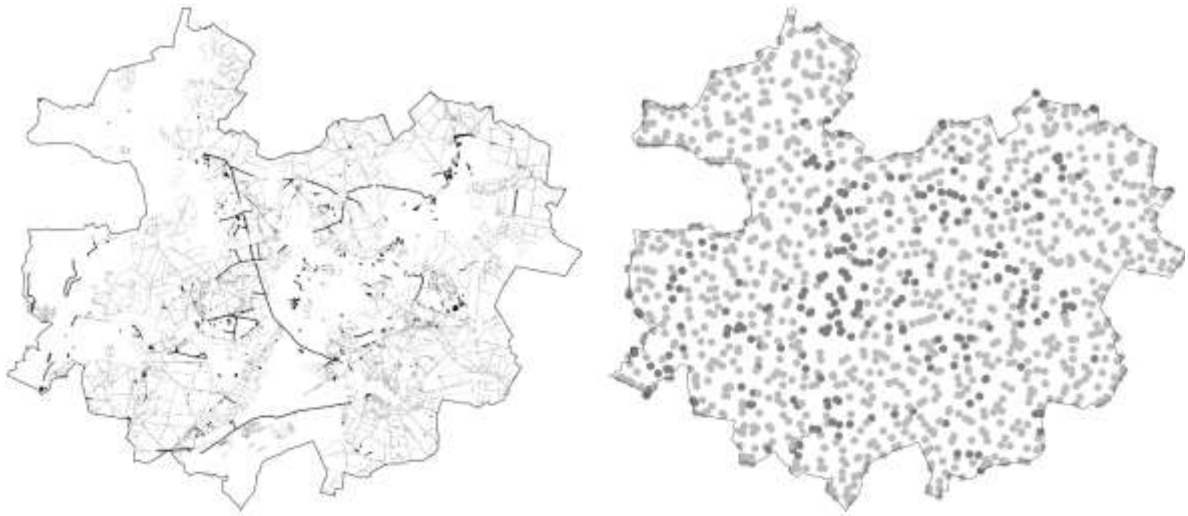
Step 3



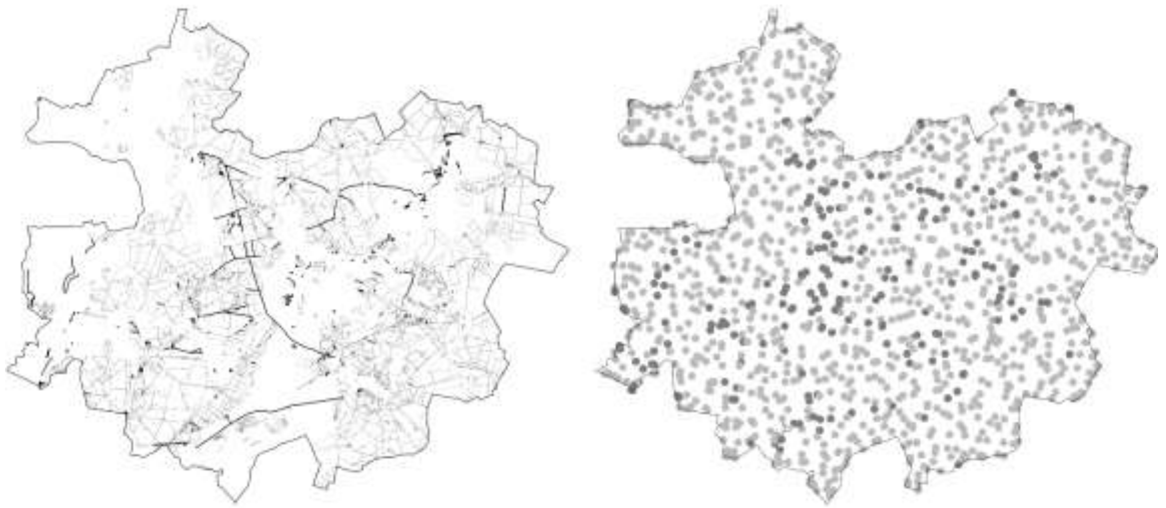
Step 7

Figure 6a. Occurrence of tree elements in the landscape (left) and intercept elements (right, dark dots) at step 0, 3 and 7.

Step 11



Step 16



Step 20

Figure 6b. Occurrence of tree elements in the landscape (left) and intercept elements (right, dark dots) at step 11, 16 and 20.

Table 7. Variogram model parameters for the occurrence of tree elements in the landscape. Dc: mean length scale (m)

	Step 0	Step 3	Step 7	Step 11	Step 16	Step 20
Nugget	0.0330	0.0550	0.0400	0.0370	0.0250	0.0200
(standardised)	14.8%	26.6%	21.3%	21.0%	15.6%	13.8%
Sill 1	0.1370	0.1000	0.0900	0.072	0.075	0.0690
(standardised)	61.4%	48.3%	47.9%	40.9%	46.9%	47.6%
Sill 2	0.0530	0.0520	0.0580	0.0670	0.060	0.0560
(standardised)	23.8%	25.1%	30.9%	38.1%	37.5%	38.6%
Range 1 (m)	1400	1200	900	700	900	600
Range 2 (m)	5000	4500	3700	3750	3900	4000
Total Sill	0.2230	0.2070	0.1880	0.1760	0.1600	0.1450
Obs variance	0.2231	0.2071	0.1861	0.1731	0.1496	0.1355
Dc, m	2119	1906	1702	1868	1955	1998

Table 8 Variogram model parameters for Lanuis collurius habitat provision service in the landscape. Dc: mean length scale (m)

	Step 0	Step 3	Step 7	Step 11	Step 16	Step 20
Nugget	0.008	0.006	0.005	0.006	0.002	0.001
(standardised)	11.0%	12.8%	17.4%	32.4%	16.7%	12.5%
Sill 1	0.04	0.025	0.014	0.006	0.0065	0.005
(standardised)	54.8%	53.2%	48.6%	32.4%	54.2%	62.5%
Sill 2	0.025	0.016	0.010	0.0065	0.0035	0.002
(standardised)	34.2%	34.0%	34.0%	35.1%	29.2%	25.0%
Range 1 (m)	1500	1000	1000	900	800	600
Range 2 (m)	6000	5000	3700	3000	4000	6000
	0.073	0.047	0.029	0.019	0.012	0.008
Total Sill	0.066	0.045	0.027	0.018	0.012	0.008
Obs variance	2919	2384	1798	1467	1775	2408
Dc, m	0.008	0.006	0.005	0.006	0.002	0.001

In the case of the tree elements, the quote of unresolved variability ranges from to 28% of the total sill, with the minimum observed at step 19 and the maximum at step 4. At all removal steps the spatial structures of tree elements are characterised by two superimposed scales of spatial variation: the smaller one ranges from 600 (step 20) to 1400 m (step 0) and accounts for a share of spatially structured variation ranging from 41 (step 10) to 61% (step 0); the greater one ranges from 3500 (step 8) to 5000 m (steps 0-2) and accounts for a share of spatially structured variability ranging from 21 (step 2) to 40% (step 17). The relevance of the two superimposed spatial structures reflect the composition of the tree elements in the landscape at each steps, as the relative incidence of long range linear structures (alleys, hedgerows, tree lines) and short range point structures (isolated trees/groups of trees, woodlots, riparian woodland) is affected by their random stepwise removal while the incidence of the specific composition of the non-removable tree elements, characterised by a dominance of linear elements, becomes gradually more relevant.

The variogram models for the indicator of optimal habitat density for the red-backed shrike, exhibit an increase in spatially uncorrelated variance from step 0 (11% of total sill) to step 11 (32% of total sill), followed by a decrease in the last two steps; this was also observed for the occurrence of tree elements, but in that case the decrease starts already at step 6. The contribution of the first structured component of spatial variability follows the same pattern in both cases, with constantly decreasing values with minimum at step 11, followed by a relative increase until step 20. The corresponding ranges follow an identical pattern, with constantly decreasing values from step 0 to step 20. Different is the pattern observed for the long range spatially structured component: in the case of the presence of tree elements, the relative incidence of this component increase almost constantly from step 0 to step 20, and the corresponding ranges decrease from step 0 to step 9 and then increase slightly but almost constantly until step 20. As for the optimal habitat density, the opposite is observed: the relative incidence of the long range component is nearly constant between step 0 and 11, and then drops by 10% at step 20. The corresponding ranges, nevertheless, exhibit a similar patter to that observed for the occurrence of tree elements, with a minimum at step 11 and maxima at steps 0 and 20.

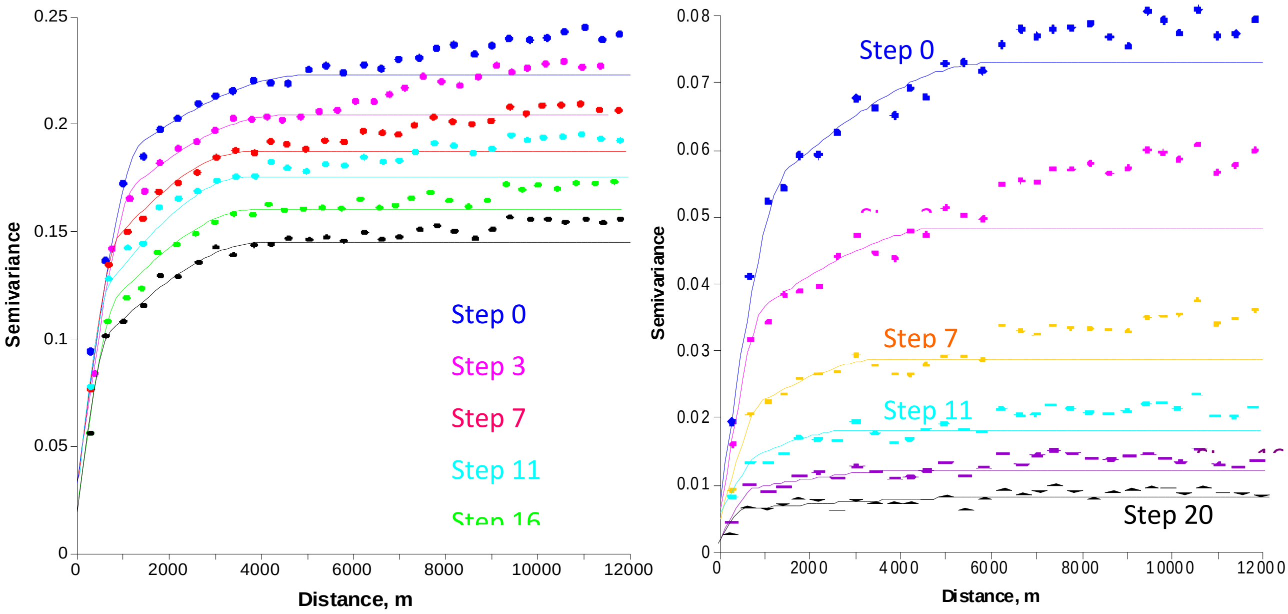


Figure 7. Experimental variograms (dot) and fitted model (continuous lines) for the occurrence of tree elements (left) and optimal habitat density for rad-backed shrike.

The structural information of the variogram models provided by the fractions of the total variance and their ranges can be summarised in a single parameter D_n, i.e. the integral range, and a plot of the total variances vs. the integral ranges of all the services provide an efficient visualization of the spatial heterogeneity and of the degree of spatial connectivity of the different elements in the landscape at each removal step (Fig. 8). The plot then depicts the change in landscape architecture and its rate following tree removal. The occurrence of tree elements in the landscape at the different steps, is characterised by a constant decrease of spatial heterogeneity, i.e. the resulting landscape is more homogeneous as a consequence of elements' removal. As expected, the degree of connectivity of the tree elements decrease constantly between step 0 and step 7, but from step 8 on it increase again regularly until step 20. The clear point of inversion at step 7 marks then the increasing dominance of the infrastructural elements which are not removed over those which are considered removable, whose influence on the resulting spatial structure, and in the whole landscape architecture, is fading step by step until only the "infrastructural green" elements are left (road network, urban and peri-urban areas). This would also suggest that in correspondence of the inversion point, the agricultural landscape reaches the limits of its resilience in term of functions and services associated to the removed elements (see table 3). In the case of the optimal density for habitat provision for the selected target species, the overall pattern is similar, i.e. we observe a constant reduction of the overall variability, coupled first with a reduction of the spatial connectivity, and then with an increase, but in this case the latter take place at step 11. Furthermore the relative reduction of the mean length scale at the tipping point, i.e. when non removable elements start to became dominant, is equal to 50% of that at step 0, corresponding to 75% relative reduction in spatial variability, while in the case of the occurrence of tree elements, the same figure was equal to 20% of the initial value, corresponding to 21% relative reduction in spatial variability. These figures would then suggest a faster rate of change in the indicator of optimal elements density with respect to the simple elements occurrence indicator.

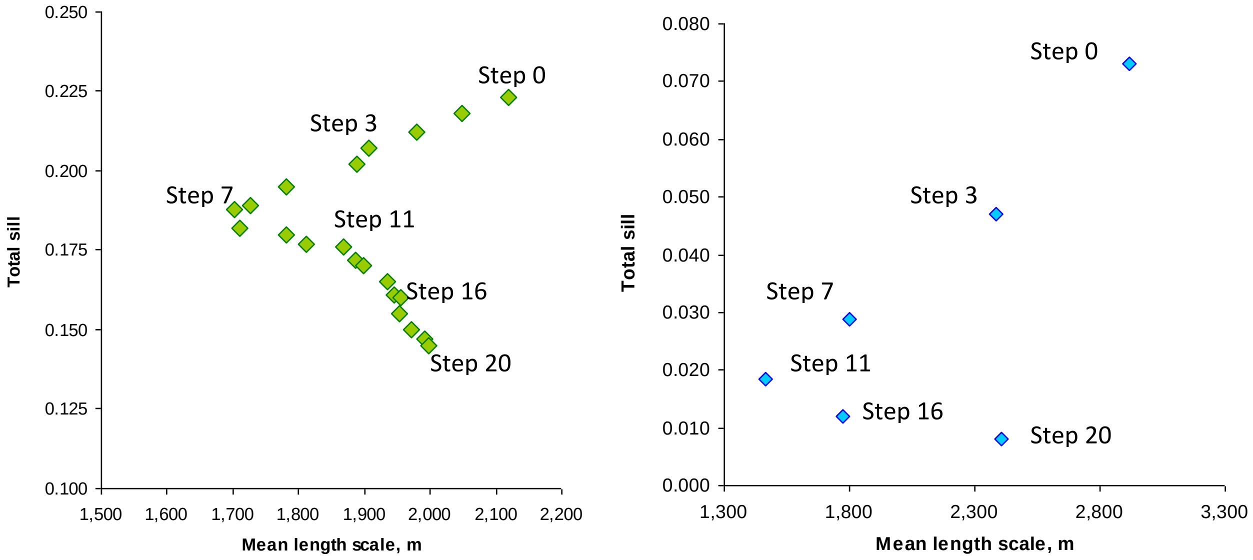


Figure 8. Landscape services spatial variability: variogram sill versus mean length scale at the different removal steps.

6.3.2 Mapping single and joint probabilities of landscape service supply

Using the variogram models for each removal step, the probability of occurrence of the tree elements in the landscape and of the associated habit provision service have been mapped over a regular 100 x 100 m grid via sequential simulation with ordinary kriging.

Table 9. Descriptive statistics and Pearson's correlation coefficients

	Tree elements probability						Optimal habitat probability					
	step 0	step 3	step 7	step 11	step 16	step 20	step 0	step 3	step 7	step 11	step 16	step 20
Num	26390	26390	26390	26390	26390	26390	26390	26390	26390	26390	26390	26390
Mean	0.437	0.387	0.330	0.286	0.224	0.183	0.106	0.080	0.045	0.023	0.014	0.007
Dev.Std.	0.34	0.31	0.30	0.28	0.28	0.25	0.22	0.19	0.13	0.08	0.07	0.04
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Perc. 10th	0.02	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Perc. 25th	0.11	0.10	0.06	0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Median	0.41	0.33	0.24	0.18	0.08	0.06	0.0048	0.0033	0.0018	0.0012	0.0007	0.0004
Perc. 75th	0.74	0.65	0.56	0.48	0.36	0.27	0.07	0.02	0.01	0.01	0.00	0.00
Perc. 90th	0.93	0.85	0.80	0.74	0.71	0.60	0.44	0.32	0.12	0.04	0.01	0.01
Max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Skewness	0.22	0.41	0.68	0.90	1.27	1.56	2.37	2.84	3.90	5.82	7.65	11.35
Kurtosis	-1.37	-1.15	-0.80	-0.36	0.40	1.43	4.80	7.41	15.94	40.67	69.73	167.27
Correlations												
Tree el. step 0	1											
Tree el. step 3	0.93	1										
Tree el. step 7	0.84	0.91	1									
Tree el. step 11	0.77	0.84	0.92	1								
Tree el. step 16	0.68	0.73	0.80	0.87	1							
Tree el. step 20	0.65	0.69	0.75	0.81	0.91	1						
Opt. hab. step 0	0.49	0.50	0.49	0.48	0.50	0.55	1					
Opt. hab. step 3	0.43	0.47	0.47	0.44	0.45	0.49	0.9	1				
Opt. hab. step 7	0.33	0.36	0.40	0.33	0.30	0.30	0.66	0.75	1			
Opt. hab. step 11	0.30	0.33	0.36	0.40	0.38	0.33	0.53	0.59	0.75	1		
Opt. hab. step 16	0.24	0.27	0.30	0.35	0.39	0.31	0.40	0.43	0.53	0.82	1	
Opt. hab. step 20	0.20	0.22	0.25	0.27	0.31	0.32	0.29	0.3	0.34	0.50	0.67	1

Table 9 summarizes the descriptive statistics for the whole case study area and reports the Pearson's *r* among elements and target services at each step; the table refer to agricultural land uses only as defined and mapped at a 1:10,000 scale accordingly to the Digitale Feldblöcke des Landes Brandenburg (2012). The average probability of occurrence of tree element in agricultural fields is equal to 43.7% at step 0, with a corresponding average probility of optimal habitat provision of 10.6%; the final figures at step 20 are equal to 18.3 and 0.7%, respectively. Figure 9 illustrates the functional relationship between the two indicators at the considered six removal steps; it can be described with a power law with exponent equal to 3.09 and a constant term equal to 1.36 (R^2 = 0.99). With the removal of the elements, the resulting distributions are progressively more positively skewed and leptokurtic. All the correlations in Table 9 are significant at p<0.01, but the strength of the correlation between the probability of elements' occurrence and that of optimal elements' density decrease from 0.49 at step 0 to 0.32 at step 20.

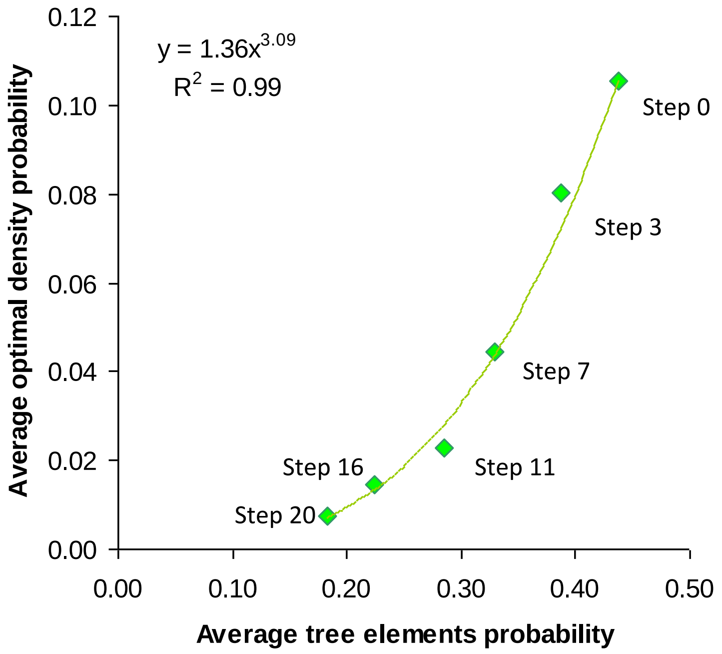
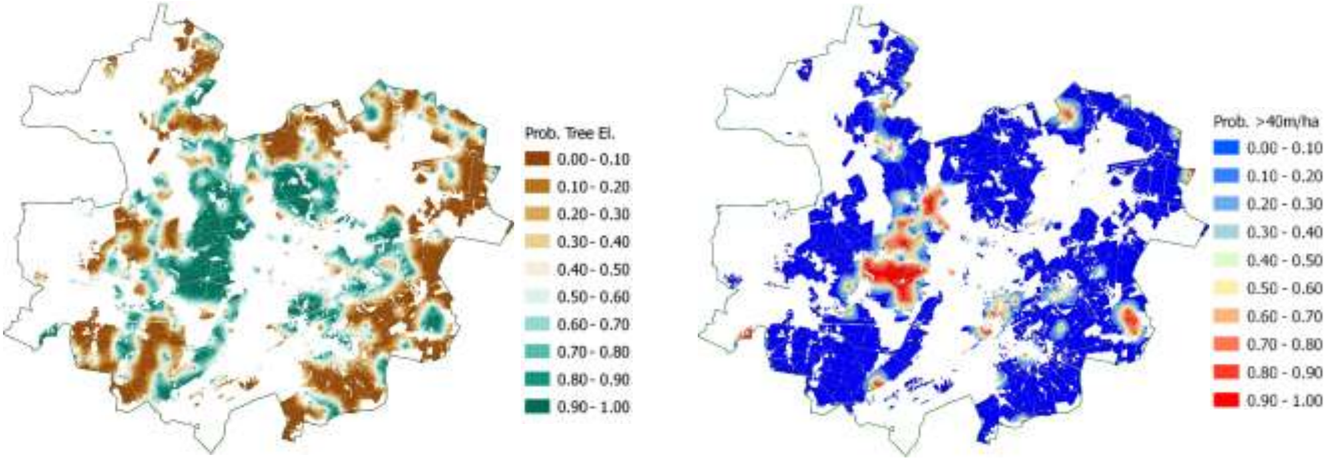
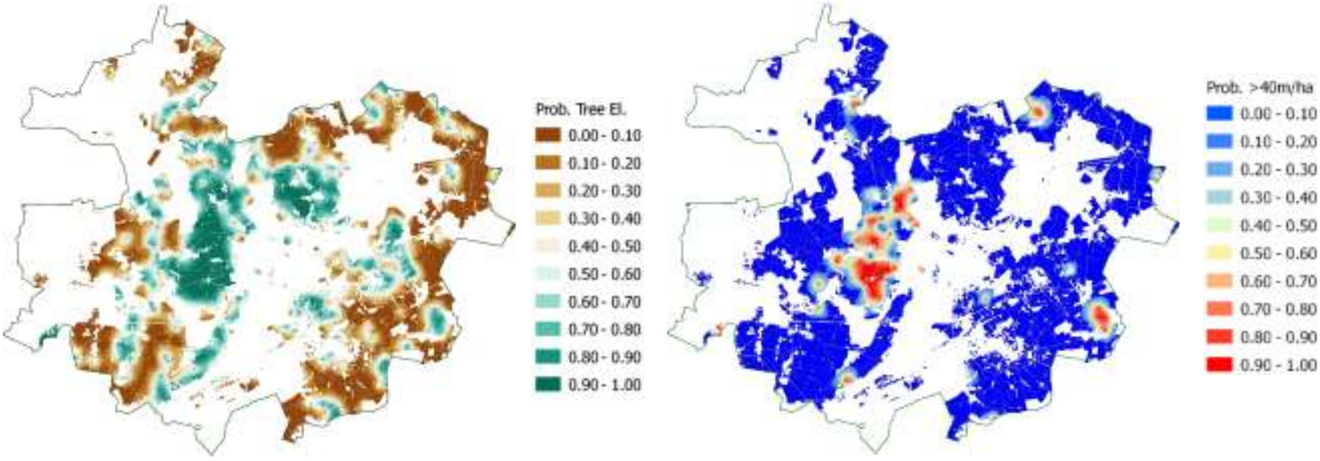


Figure 9. Average probability of tree elements' occurrence vs. average optimal habitat density for the red-backed shrike (Lanius collurio) at six removal steps.

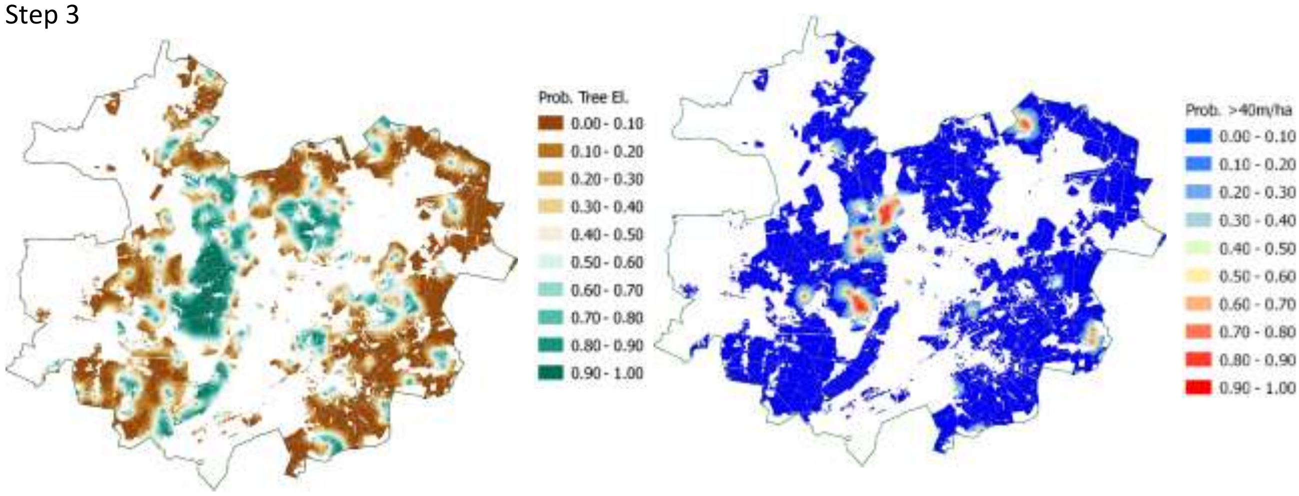
The spatial distribution of mean simulated probabilities at selected steps is shown in Figures 10a and 10b for the occurrence of tree elements and for the optimal habitat density. The maps of the E-type estimates show clearly how the spatial patterns of the two indicators are affected by the stepwise removal of elements. At step 0, areas with high probability of occurrence of tree elements are mainly clustered continuously around the core of the case study area represented by the nature park, but spots of high elements' occurrence are observed also in the north east and in the south-east corners of the area, but these clusters are smaller and less contiguous. In terms of habitat provision, at step 0 three relevant clusters are observed in the central-west part of the area and only isolated smaller hot spots are observed in the north- and in the south-east parts of the area.



Step 0

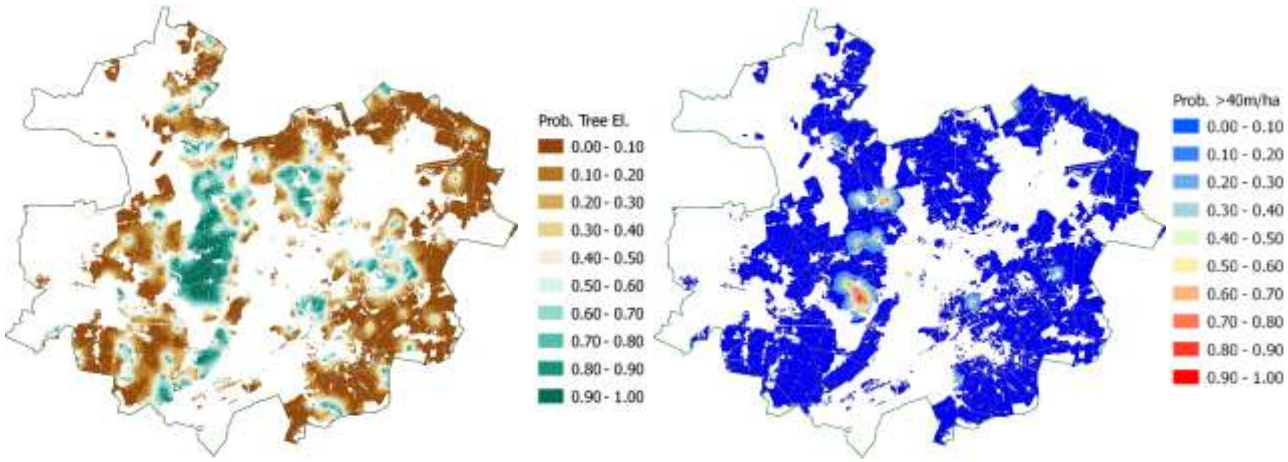


Step 3

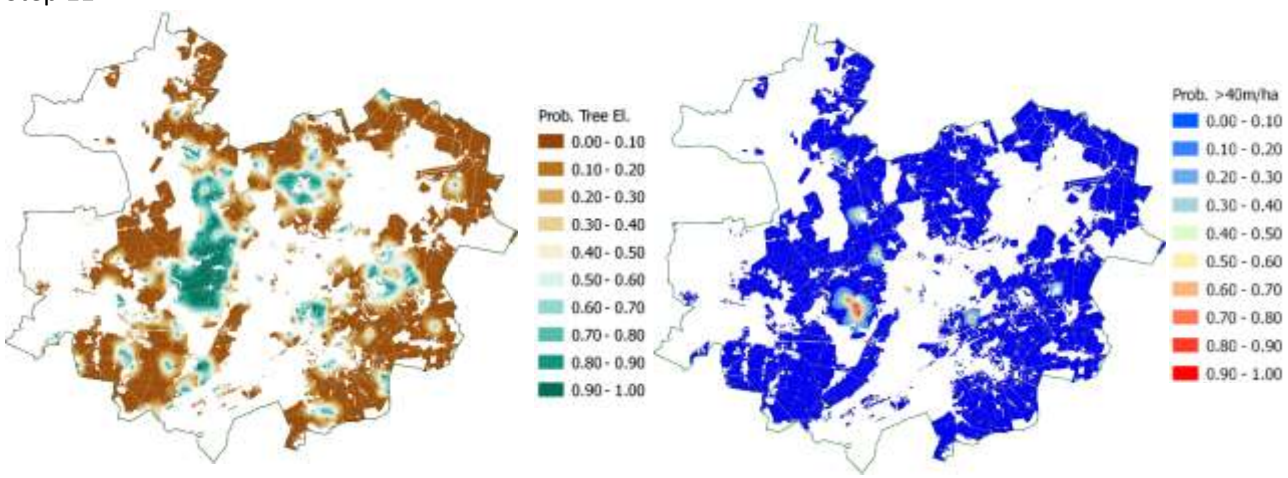


Step 7

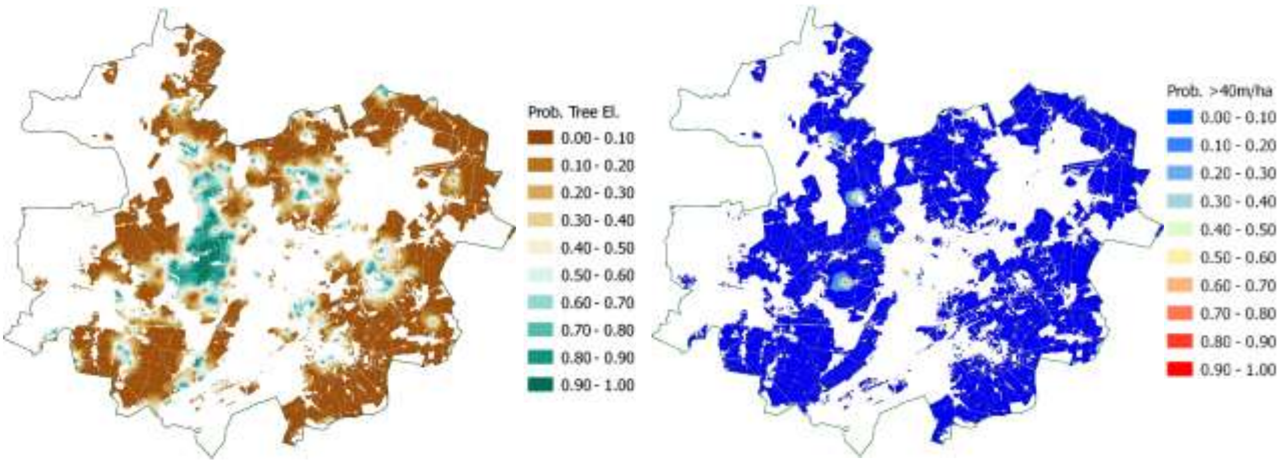
Figure 10a. Landscape services probability maps at different step of elements removal: E-type estimates (N = 1,000); left: average probability of occurrence of tree elements; right: average probability of occurrence of optimal habitat density for the red-backed shrike (Lanius collurio).



Step 11



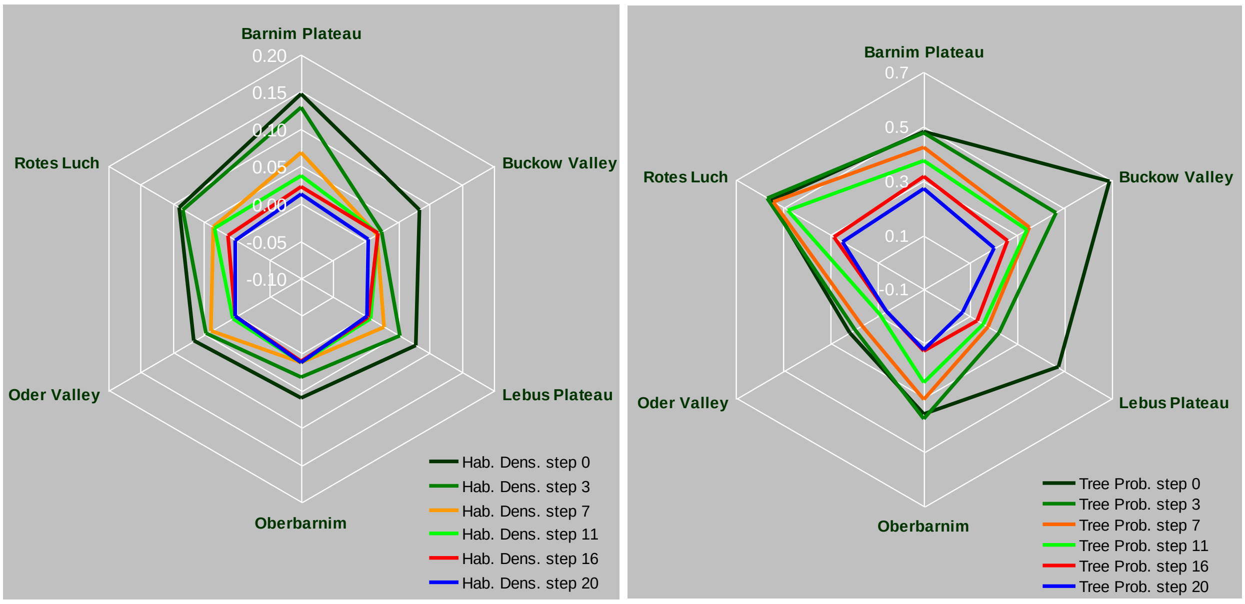
Step 16



Step 20

Figure 10b. Landscape services probability maps at different step of elements removal: E-type estimates (N = 1,000); left: average probability of occurrence of tree elements; right: average probability of occurrence of optimal habitat density for the red-backed shrike (Lanius collurio).

The differences in the spatial distribution of the landscape elements and associated habitat provision service can eventually be summarised and visualised at each step and for each of the six sub-landscapes encompassing the study area, highlighting the differences in allocations of the selected service indicators as depending upon landscape structure and composition. Based on the data shown in Table 10, the spiderweb graphs in Fig. 11 depict well the differences in provisioning the target service (Fig. 11a) as related to elements occurrence in the six sub-landscapes (Fig 11b).



a) *b)*

Figure 11. Habitat provision service and elements' occurrence in the six sub-landscapes at different removal steps.

Table 10. Mean probabilities of optimal habitat density and of tree elements' occurrence in the six sub-landscapes of the study area.

Optimal habitat density	N	Step 0 Mean	Step 3 Mean	Step 7 Mean	Step 11 Mean	Step 16 Mean	Step 20 Medie
Barnim Plateau	11276	0.147	0.128	0.068	0.037	0.023	0.013
Buckow Valley	3204	0.083	0.023	0.019	0.019	0.018	0.004
Lebus Plateau	5134	0.078	0.052	0.029	0.007	0.004	0.001
Oberbarnim	2203	0.060	0.033	0.012	0.012	0.011	0.011
Oder Valley	3206	0.067	0.046	0.039	0.006	0.001	0.001
Rotes Luch	1367	0.089	0.083	0.035	0.034	0.013	0.001
All groups	26390	0.106	0.080	0.045	0.023	0.014	0.007

Tree elements' occurrence	N	Step 0 Medie	Step 3 Medie	Step 7 Medie	Step 11 Medie	Step 16 Medie	Step 20 Medie
Barnim Plateau	11276	0.508	0.476	0.421	0.372	0.316	0.271
Buckow Valley	3204	0.582	0.462	0.350	0.336	0.258	0.199
Lebus Plateau	5134	0.267	0.220	0.174	0.155	0.126	0.063
Oberbarnim	2203	0.396	0.378	0.306	0.246	0.129	0.124
Oder Valley	3206	0.272	0.196	0.164	0.088	0.063	0.060
Rotes Luch	1367	0.612	0.565	0.540	0.476	0.279	0.244
All groups	26390	0.437	0.387	0.330	0.286	0.224	0.183

It is relevant to note that at sub-landscapes level, the high probability of occurrence of tree element is not always coupled with a high probability of habitat provision. At step zero, simulations results return significant (p<0.01) higher mean probabilities of elements' occurrence in Rotes Luch (0.61) and in the Buckow Valley (0.58), which together represent a central continuous area with a NE-SW orientation;

significantly lower mean probabilities (<0.3) are observed in the eastern sub-landscapes of the Oder Valley (NE) and Lebus Plateau (SE), while intermediate values characterise the two western sub-units, i.e the Barnim Plateau (0.51) and the Oberbarnim (0.40). In terms of probability of optimal density for habitat provision at step 0, only one sub-landscape, i.e. the Barnim Plateau, has a mean value (0.15) which is above the global average (0.11) and significantly different from all the other landscape untis. The lowest probability of habitat service provision for the target species is expected in the Oberbarnim, whose mean probability (0.05) is significantly different from those of all the other sub-landscapes (p<0.01) with the exception of that of the Oder Valley (0.07). Intermediate mean probability values between 0.089 and 0.078 characterise the other three sub-landscapes which do not differ significantly from each-other. In the case of the Lebus Plateau then a low probability of tree elements occurrence (0.27) is nevertheless associated to nearly average probability of habitat service provision. The rate of habitat provision decrease with the removal of tree elements differs in the different sub-landscapes. This is due not only to the above described differences in initial conditions, but also to differences in the local distributions of field size classes. These are indeed not evenly distributed in the sub-landscape units, as for example the Buckow Valley and the Rotes Luch are characterised by a relevant share of fields in the small size classes, while the opposite is observed in the Lebus Plateau, and Oder Valley, where large cultivation units dominate the agrarian landscape.

This results in functional relationships between the two indicators which are, for some units, significantly different form the one presented in Fig. 9; again the landscape-based relationships can be described resorting to a power laws (Fig. 12).

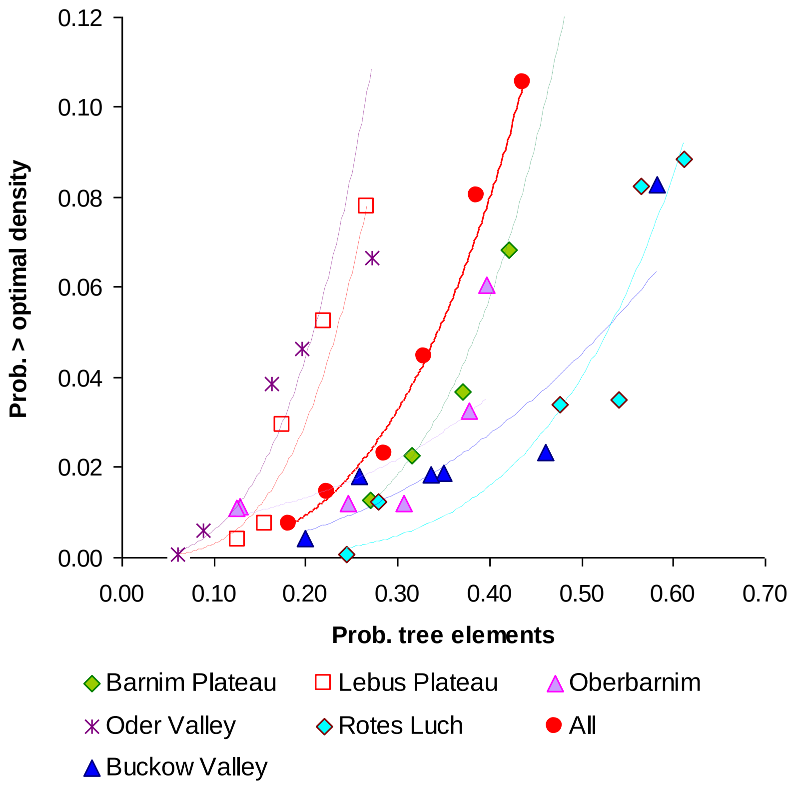


Figure 12. Average probability of tree elements' occurrence vs. average optimal habitat density for the red-backed shrike (Lanius collurio) at six removal steps in the six sub-landscape units.

At stage 20, when about 75% of the total tree elements have been removed, leaving only "infrastructural" elements, the mean probability of element occurrence dropped by nearly 26%, and the mean probabilities of occurrence are above the global average (0.18) in three landscape units, namely the Barnim Plateau (0.27), Rotes Luch (0.24) and Buckow Valley (0.20). Nevertheless, only in Barnim Plateau (0.013) and in the Oberbarnim (0.011) the mean optimal density for habit service provision are above the global average (0.007).

6.4 Discussion

Knowledge about the spatial distribution of tree elements in the agricultural landscape is essential to assess the role played by landscape structure on the delivery of landscape services (van der Zanten et al., 2013) and to highlight the possible changes of so called 'tree outside forests' (FAO, 2000) due to to agricultural management changes (e.g. intensification, abandonment). In this paper we further explore the potential of geostatistical techniques in mapping the occurrence of arboreal landscape elements adopting a probabilistic approach to describe fine-scale spatial dynamics to assess landscape services under field enlargement and agricultural intensification scenarios. In doing so some of the drawbacks often observed in ecosystem service mapping (Maes et al, 2012), are explicitly accounted for, i.e. possibility to be applied to historical land cover and to projected hypothetical changes, the production of refined maps and tabular outputs (Haines-Young et al, 2012).

The scenarios' settings assume a gradual removal of landscape elements within or bordering agricultural fields, from smaller to larger fields. A methodological limitation is due to the fact that, being spatially explicit information related to farms allocation and properties not available, the merging of smaller field into larger units cannot be simulated in a topologically explicit way. For this reason we did not simulated a factual merging of agricultural fields but only the possible removal of specific landscape elements associated to each field, following a randomised stepwise approach base upon field size classes.

In order to assess the effect of tree elements removal on ecosystem services provision, we selected a specific habitat service for a target bird species, the red-backed shrike (Lanuis collurio), based on an optimal element density of 40 m ha-1. Not all the tree elements in the landscape were considered as removable, as those along the road network and in urban and peri-urban areas, accounting for ca. 25% of the total, were not removed. The assessment of landscape elements at each removal step is site-specific, as referred to 250 m buffer around points, randomly allocated in the landscape within a 1 km regular reference grid. The proposed methodological framework aims to i) characterise the spatial patterns of landscape elements and their services potential supply using variogram models, ii) to produce probability maps of landscape elements and services' occurrence and iii) post processing of simulation results in term of establishing functional relationship between landscape elements and related services for the whole area and for landscape sub-units. Experimental variography and modelling allow for a synthetic and robust description of the heterogeneity and connectivity of both landscape elements and services. Furthermore, at each removal step, variogram models' parameters can be used for scenario's analysis in order to assess and display the rate of changes in spatial pattern as landscape elements are increasingly removed. At each removal step, the overall spatial structure of the resulting landscape are analysed and modelled in terms of its elements' heterogeneity and connectivity. The observed response in terms of both landscape elements and services show a first decrease of both connectivity and heterogeneity till a threshold value which marks an inversion with increasing values of connectivity associated to decreasing heterogeneity. The turning point corresponds to a landscape architecture and functions which became increasingly dominated by the non removable tree elements associated with non agricultural land uses. As these elements are mainly linear, well connected and on average significantly ($p<0.01$) longer (500 m) than the removable ones (326 m), their increasing relative contribution to the overall landscape architecture is associated to a increasingly higher mean length values Dc (1998 m at step 20) although the homogeneity of the landscape increases by a further 19% beyond the turning point. It is reasonable to infer that such structural changes are associated with functional ecosystem changes and with services supply and that they indicate the resilience of the system in terms of it functions. This is confirmed by the analysis of the selected habitat service associated to tree elements in the agricultural landscape. In this case a similar trend was observed but the decrease of service supply potential proceeds to a faster rate. This is expected as this indicator is based on tree density per unit area and not solely on the occurrence of tree element within a given buffer around sampling points, and the turning point can be used for benchmarking the maximum extent of endowment for the specific service associated to the occurrence of tree elements in the agricultural fields.

The variogram models are then input into sequential geostatistical simulations which in turn provide a probabilistic and dynamic description of landscape elements and services occurrence over a given area at a given step. The results, displayed as probability maps for element occurrence and service supply at each removal step, allow for further analysis in terms of functional relationship between landscape elements occurrence and service supply, This can be described at global level, i.e. for the whole case study area, or at different sub-levels of interest, e.g., for mechanisms' knowledge elucidation or for local governance and policy implementation. In the case study area, given the current landscape architecture and spatial characteristics of landscape elements, it has been observed that the rate of habitat provision decrease with the removal of tree elements differs in the landscape sub-units as a response to specific local settings in term of spatial variability and element connectivity.

6.5 Conclusions

This study presents a data-based, spatially explicit, fine-scale methodology to assess the effect of removal of specific landscape elements within the framework of a 'what if' scenario setting which could support decision makers in the process of policy development and implementation at local and regional scale. Although the scenarios' settings project observed spatial dynamics to a rather extreme extent, i.e. the removal on nearly 75% of tree elements and a reduction of their density by nearly one fourth, there are useful to assess and quantify landscape responses to management options at a scale which is often ignored when modelling coarser land-cover class changes at regional or global scale. Via variogram analysis, it is possible to characterize and synthesize the spatial heterogeneity of landscape elements and related services at local scale, but depending on georeffered data availability and scale of investigation the approach presented in this study can be tailored to tackle regional or global scales. Our findings highlight the potential changes in landscape architecture following field enlargement and tree elements removal and present a quantitative assessment of the decrease in habitat service supply for a target bird species of local and regional relevance. Furthermore they offer the possibility to identify structural and functional resilience thresholds for the management of multifunctional agricultural landscapes with potential for decision support in steering (policy, planning) landscape services.

Acknowledgments

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References

Brown, K.A., Johnson, S.E., Parks, K.E., Holmes, S.M., Ivoandry, T., Abram, N.K., Delmore, K.E., Reza Ludovic, Andriamaharoa, H. E., Wyman, T.M., Wright, P.C., 2013. Use of provisioning ecosystem services drives loss of functional traits across land use intensification gradients in tropical forests in Madagascar. Biological Conservation, 161, 118-127

Büsch, O., Erich, K. 1992. *Handbuch der preussischen Geschichte*. de Gruyter, Berlin, pp. 501

Chilès, J.-P., Delfiner, P., 1999. Geostatistics: modelling spatial uncertainty. New York, Wiley Inter-Science, 695 pp.

Deutsch, C.V., Journel, A.G., 1998. GSLIB, Geostatistical Software Library and User's Guide, 2nd Ed. Oxford University press, New York. 369 pp.

Donald, P.F., Sanderson, F.J., Burfield, I.J., van Bommel, F.P.J., 2006. Further evidence of continent-wide impacts of agricultural intensification on European farmland birds, 1990-2000. Agriculture, Ecosystem and Environment, 116, 189-196.

FAO, 2000. Global forest resources assessment 2000 – main report. FAO Forestry Paper 140, Rome: UN Food and Agricultural Organisation.

Fehrenbach, E., 1986. *Von Ancien Régime zur Wiener Kongress*, Oldenburg Grundriss der Geschichte 7, pp. 109

Garrigues, S, Allard, D., Baret, F.., 2008. Modeling temporal changes in surface spatial heterogeneity over an agricultural site. Remote sensing of Environment, 112, 588-602.

Garrigues, S., Allard, D., Baret, F., Weiss, M., 2006. Quantifying spatial heterogeneity at the landscape scale using variogram models. Remote sensing of Environment, 103, 81-96.

Goovaerts, P., 1997. Geostatistics for Natural Resources Evaluation. Oxford University Press, New York.

Haines-Young, R., Potschin, M., Kienast, F., 2012. Indicators of ecosystem service potential: mapping marginal changes and trade-offs at European scales Ecol Ind 21 39-53.

Hoffman, J., Greef, J.M., 2003. Mosaic indicators. Theoretical approach for the development of indicators for species diversity in agricultural landscapes. Agriculture, Ecosystems and Environment, 98, 387-394.

Journel, A.G., 1983 Non parametric estimation of spatial distributions. Mathematical Geology, 15, 445 - 468.

La Féon, V., Schermann-Leginnet, A., Delettre, Y., Aviron, S., Blleter, R., Butger, R., Hendrickx, F., Burel, F., 2010.Intensification of agriculture, landscape composition and wild bee communities: a large scale study in four European countries. Agriculture, Ecosystem and Environment, 137, 143-150.

Lantuéjoul, C., 2002. Geostatistical simulation: models and algorithms. Springer Verlag, Berlin, 256 pp.

Latus, C., Schultz, A., Kujawa, K., 2004. Occurrence of the red-backed shrike (Lanius collurio) depends on natural factors and mode of land use in the Quillow catchment, Germany. Biological Letters, 41 (2), 87-93.

Maes J., Egoh B., Willemen L., Liquete C., Vihervaara P., Schägner J.P., Grizzetti B., Drakou E.G., La Notte A., Zulian G., Bouraoui F., Peracchini M.L., Braat L., Bidoglio G., 2012. Mapping ecosystem services for policy support and decision making in the European Union. Ecosystem Services 1, 31-39.

Meynen, E., Schmithüsen, J., 1962. Handbuch der naturräumlichen Gliederung Deutschlands, 9 Lieferung, Bundesanstalt für Landeskunde.

MLUR 2000: Bodenbewertung für Planungs- und Zulassungsverfahren im Land Brandenburg – Abschlußbericht zum Forschungsprojekt im Auftrag des Ministeriums für Landwirtschaft, Umweltschutz und Raumordnung des Landes Brandenburg (unveröffentlicht).

Philipp, H.-J., 1997. Brandenburger Landbewohner und Agrarlandschaftsausschnitte. Ergebnisse einer explorativen Studie zur Gemarkungskenntnis, nutzung und bewertung. Müncheberg 1997 (ZALF – Berichte Nr. 30).

Pfister, H.P., Naef-Daenzer, B., 1987. Der Neuntöter und andere Heckenbrüter in der modernen Kulturlandschaft. Beihefte Veröff. Naturschutz Landschaftspflege Bad.-Württ. 48, 47-157.

Plieninger, T., 2012. Monitoring the directions and rates of change in trees outside forests through multitemporal analysis of map sequences. Applied Geography, 32, 566-576.

Plieniger, T., 2011. Capitalizing on the carbon sequestration potential of agroforesty in Germany's agricultural landscapes: realigning the climate change mitigation and landscape conservation agendas. Landscape Research 36, 4, 435-454.

QGIS Development Team, 2012. QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org

Rugg, D.S., 1985. Eastern Europe. Longmann, New York.

Statios, 2000. WinGslib version 1.3. Statios Software and Services, San Francisco, CA.

Stoate, C., Boatman, N.D., Borralho, R.J., Carvalho, C.R., Snoo, G.R., Eden, P., 2001. Ecological impacts of arable intensification in Europe., Journal of Environmental Management, 63, 337-365.

Stoate, C., Báldi, A., Beja, P., Boatman, N.D., Herzon, I., van Doorn, A., de Snoo, G.R., Rakosy, L., Ramwell, C., 2009 Ecological impacts of early 21st century agricultural change in Europe – A review . Journal of Environmental Management, 91(1), 22-46.

Temme, A.J.A.M., Verburg, P.H., 2011. Mapping and modelling of chamges in agriculturaò intensity in Europe. Agriculture, Ecosystem and Environment, 140, 46-56.

Tietz, A., Forstner, B., Weingarten, P., 2013. Non-agricultual and supra-regional investors on the German agricultural land market: an empirical analysis of their significance and impacts. German Journal of agriculture Economics, 62,2, 86-98.

Uematsu, Y., Koga, T., Mitsuhashi, H,m Ushimaru, A., 2010. Abandonment and intensified land use of agricultural land decrease habitats of rare herbs in semi-natural grasslands. Agriculture, Ecosystem and Environment, 135, 304-309.

van der Zanten, E.H., Verburg, P.H., Mücher, C.A., 2013. Modelling the spatial distribution of linear landscape elements in Europe. Ecological Indicators, 27, 125-136.

Verburg, P., Eickhout, B., Meijl van, H., 2008. A multi-scale, multi-model approach for analyzing the future dynamics of European land use. The Annals of Regional Science 42, 57–77.

Visser, O., Spoor, M., 2011. Land grabbing in post-Soviet Eurasia: the world's largest agricultural land reserves at stake. The Journal of Peasant Studies, 38(2), 299-323.

Vogeler, I., 1996. State hegemony in transforming the rural landscape of Eastern Germany: 1945-1994. Annals of the Association of American Geographers, 86, 3, 432-458.

Wackernagel, H., 2003. Multivariate geostatistics: An introduction with applications. Springer Verlag, Berlin, 387 pp.

7 CSA 2: Assessing Cultural Ecosystem Services: A visual choice experiment on agricultural landscape preferences from a user perspective in the case study Märkische Schweiz, Germany

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Keywords: Cultural Ecosystem Services, Visual quality, Stated Preference, Choice-Based Conjoint-Analysis, Discrete Choice Modelling, Landscape planning, Spatial analysis

Abstract

The provision of natural amenities and the aesthetic quality of agricultural landscapes represent an important territorial asset for rural tourism and quality of the living environment. As the visual value of a given landscape depends on individual preferences for its components and composition, targeted and cost-effective investments in their conservation and management is required. We conducted a stated preference survey in the case study region "Märkische Schweiz" (ca. 580 km^2), 30 km east of the city of Berlin aiming at identifying variances in landscape preferences of local residents and visitors from Berlin (N=200).

Therefore photorealistic landscape visualisations of four different landscape attributes have been applied, including green point (e.g. trees) and linear elements (e.g. hedges), crop diversity as a function of field size and the presence of grazing livestock. Attributes are differentiated into three levels (low, medium, high) or two levels (present, not present), respectively. A multinomial-logit model (MNL) was chosen to estimate the preferences for landscape attributes and a random parameter (mixed)-logit model (RPL) to allow for individual specific values and the socio-economic influence.

Results of the analysis revealed significant differences in preferences for various landscape attributes, with a highest general preference for a high level of point elements. We also found preferences to be dependent on individual's socio-cultural background, e.g. level of education, gender or attitude and value setting. The spatial distributions of cumulative preference values were mapped on a regular 100 x 100 m grid, showing hot and cold spots of aesthetic quality. The results can help to improve the efficiency of the policy delivery and to identify priority areas for the local landscape management from an aesthetic value perspective.

The full paper will be completed by March 2014.

8 CSA 3: The role of stakeholder networks in landscape valorization: results of a Social Network Analysis

L. Schaller, V. Ehmeier, J.Kantelhardt

8.1 Introduction

In recent years, importance is increasingly attached to the question, how agricultural landscape and the valorisation of landscape services contribute to the development and competitiveness of rural regions. It is assumed that the valorisation of landscape services results in socio-economic benefits like the enhancement of the stability and growth of the local population, the generation of jobs, the creation of added value, or the increase of local investments. Such benefits potentially influence and enhance regional competitiveness (e.g. VAN ZANTEN *et al.* 2013; COOPER *et al.* 2009; COURTNEY *et al.* 2006; VAN DER MEULEN *et al.* 2011; COURTNEY *et al*. 2013; DISSART&VOLLET, 2011). However, the causal relationships between the valorisation of landscape services and the resulting socio-economic benefits are complex and up to now not comprehensively understood (Dissart&Vollet, 2011).

The results of the 1st stakeholder laboratory indicate that functioning networks of regional actors are of utter importance for successful landscape valorisation. Also literature reveals that the successful involvement of stakeholders is a major factor for an effective management of complex social processes (BEIERLE, 2000; BRYSON ET AL., 1990; BRYSON, 2004; BEIERLE&CAYFORD, 2002, NUTT, 2002; STAVE, 2002). In regional economies social networks are of particular importance as they can improve competitiveness by influencing cost effects due to the bundling of activities and by increasing innovation potentials (BACHINGER *et al.*, 2011).

Against this background our study applies a Social Network Analysis (BORGATTI *et al.* 2002) which targets at identifying the network of actors having a stake in local landscape management and landscape valorisation. To locate strategical gaps in the network and to detect potential starting points for the improvement and bundling of landscape valorisation strategies, the study particularly takes into account the different strategies of landscape valorisation which are pursued by the single actors within the network.

The SNA method has been applied to describe and analyse social networks in various research fields. Normally, the method is used to analyse stakeholder networks. PRELL et al. (2008) for example uses SNA to identify the stakeholder network of social learning projects in district national parks. Recently, SNA is often used in analysing stakeholder networks in the context of natural resource management and governance (e.g. BODIN AND CRONA, 2009; BODIN *et al*., 2006; DE NOOY, 2013). In particular as regards natural resource management, the importance of communication and network structures is highlighted by NEWMAN AND DALE (2005), BODIN *et al*. (2006) or CHANG *et al.* (2012).

For regional research however – despite being suitable – the method is still rarely used. KOCH (2010) analyses a regional stakeholder network in the context of a biosphere reserve. HÜBNER (2013) for example uses SNA for investigating a stakeholder network in the context of landscape management of different peatland sites in Germany. In the context of landscape valorisation however, SNA has, to our knowledge, not been applied before.

The study takes place in the Austrian study region “Mittleres Ennstal”, which represents a typical remote mountain area, characterized by rather low-intensive dairy farming in a classical and richly structured mountainous landscape.

8.2 Social Network Analysis

In general, Social Network Analysis measures the relationships between actors and groups of actors. At this, it distinguishes between ego and complete networks. ‘Complete networks’ focus on all actors and all ties between these actors. ‘Ego networks’, in contrast, are aimed to analyse only the relations of one central actor (ego) (e.g. personal/friendship networks). In SNA, actors are also called ‘nodes’ or ‘vertices’, while the connecting relationships are called ‘links’ or ‘ties’. Pairs of actors and the ties between them represent ‘dyads’. Within a ‘directed’ network, it can be distinguished between ‘tie sender’ and ‘tie receiver’. Dyads are 'reciprocal' if both actors within the dyad confirm the tie between them (both actors send out ties to the other actor within the dyad), elsewise the dyad is called 'asymmetric' (WASSERMAN AND FAUST, 2009).

Network data can be evaluated either weighted or binary. At this, binary evaluation reflects the quantity of a relation while weighted evaluation reflects the quality of a relation (JANSEN, 2006). SNA connects absolute attributes with relational attributes and therefore enables the description of internal group structures (JANSEN, 2006, S.51).

Network measures are calculated based on graph theory. The core aspect of this method is to calculate a valued graph G(v) which considers nodes (N), links/ties (L) and values (V) of a group:

$$G(N, L, V) = G(v)$$

where $N = \{n1, n2, \dots, ng\}$ $L = \{l1, l2, \dots, lL\}$ $V = \{v1, v2, \dots, vL\}$.

2.1 Actor-level based parameters

To identify the relevant stakeholders of landscape management and landscape valorisation, the first level of the analysis targets at the level of actors. On this level all respondents are fully addressed in the sense of information control and potential communication activity.

On actors' level we focus on the basic SNA measure of "*degree centrality*". With degree centrality, the immediate contacts an actor has to other actors in the network, is measured. In "*directed*" networks degree centrality is distinguished into *indegree* and *outdegree centrality*. At this, *indegree* counts received (incoming) ties, while *outdegree* counts sent (outgoing) ties (BORGATTI *et al.*, 2013, p.178).

In line with PRELL, (2011, p.100), indegree and outdegree is calculated as follows:

Indegree: $C_1(i) = \sum_{j=1}^{n} xji \qquad i \neq j$

$x_{ji} = value\ of\ the\ tie\ from\ actor\ j\ to\ actor\ i\ (value\ being\ either\ 0\ or\ 1)$

$n = total\ number\ of\ nodes\ in\ the\ network$

Outdegree: $C_0(i) = \sum_{j=1}^{n} xij \qquad i \neq j$

$x_{ij} = value\ of\ the\ tie\ from\ actor\ i\ to\ actor\ j\ (value\ being\ either\ 0\ or\ 1)$

$n = total\ number\ of\ nodes\ in\ the\ network$

Degree centrality assesses the involvement of an actor in the network. High scores of degree centrality refer to actors who represent "channels" of information (PRELL, 2011, S.97). Such actors access and spread information faster than others (PRELL, 2011, p.97).

As second value on actor-level, we calculate "*betweenness centrality*". Betweenness centrality computes a score for individual actors, considering other actors' ties. The measure includes the placement of an actor within the network. Betweenness centrality is sophistically calculated using binary data (BORGATTI *et al.*, 2013, p.179).

$$C_B(k) = \sum \delta_{ikj} / \delta_{ij} \qquad i \neq j \neq k$$

$\delta_{ikj} = the\ number\ of\ geodesics\ linking\ actors\ i\ and\ j\ that\ pass\ trough\ node\ k$

$\delta_{ij} = the\ number\ of\ geodesics\ linking\ actors\ i\ and\ j$

Betweenness centrality describes the actors' potential to control information (Jansen, 2006, S.137). High values of betweenness centrality indicate that an actor is often placed on the shortest path between two unconnected actors (PRELL, 2011,p.104; HENNIG, 2012,p.126). Actors with high betweenness centrality have more control considering the information flow; consequently such actors can spread but also distort or withhold information easily (JANSEN, 2006, p.137). Furthermore, actors with high betweenness centrality potentially reduce the buffering capacity of the network in case of losing those actors. Thus, in the case of fragmentation, the network can experience a reduction of confidence and confidence building (Borgatti, 2003).

2.2 Network-level based parameters

Parameters chosen to describe the network-level are '*density*' and '*dyad-based reciprocity*'. Using unvalued data, results of the calculation of 'density' and '*dyad-based reciprocity'* show scores between 0 and 1; here, scores approaching 1 indicate very dense and reciprocal networks.

As regards the '*density'* of relations, this parameter is calculated by the proportion of possible ties to realised counted ties (JANSEN, 2006, S.110f.; WASSERMAN AND FAUST, 2009).

$$Density = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N} x_{ij}}{N(N-1)} \qquad i \neq j$$

Basically, high density of a social network is assumed to foster mutual confidence and group identity (JAMES, 1990 cited in BODIN *et al*., 2006). On the other hand, in very dense networks the heterogeneity of the actors involved can decrease: in general, the heterogeneity of actors within a network is decisive for broad and multifaceted knowledge base - which has positive effects on the capacity for innovation (FOLKE et al., 2005). In very dense networks however, homogeneity of experience and attributes can be promoted. In such situations the capacity for economic, political or cultural innovation can be considerably reduced (NEWMAN and DALE, 2005; GRABHER, 1993).

As regards '*dyad-based reciprocity*', this parameter addresses the problem that in communication networks it is necessary to be suspicious of the social desirability bias (Borgatti et al., 2013, p.176) Since, for example, the actors' network in our study is based on a small (geographical) region, actors may declare connections because of the perception that they 'should' know or have contact with other actors in the network. An actor's capability of self-reflection becomes obvious by the reciprocity of ties. Considering the topic on network level, therefore "*dyad-based reciprocity*" of ties is calculated.

Dyad-reciprocity is defined by relation between the amount of reciprocal dyads and the amount of all dyads (JANSEN, 2006, p.111; WASSERMAN AND FAUST, 2009).

$$dyad - based\ reciprocity = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N}(x_{ij} + x_{ji})}{\left(\frac{[N(N-1)]}{2}\right)}$$

$$f\ddot{u}r\ i \neq j, i < j\ und\ (x_{ij} + x_{ji}) = 1, if\ both\ values\ are\ 1, otherwise\ 0$$

Additionally to density and dyad-based reciprocity, on network-level '*average degree'* and '*average distance'* are calculated. '*Average degree'* represents the average number of ties of each node. '*Average distance'* focuses on the average distance between two nodes, considering the length of the shortest path (BORGATTI *et al*., 2002). At this, a path is a 'walk' which can only be passed once by each actor and each relation (HANNEMAN AND RIDDLE, 2005).

2.3 Sub-network-level based parameters

One aim of this study is the analysis of landscape valorisation strategies and the connection of actors pursuing such strategies in the network. Therefore, during the survey, data on strategies of landscape valorisation pursued by the different actors is gathered. These strategies are used as 'blocking' attributes in order to describe strategical "sub-networks", which are subject to a separate analysis.

As regards 'blocking' of actors, literature describes different methods: Firstly, in "a posteriori block models", blocking takes place according to the structure of the network (e.g. similar positions of actors) (SCHMIDT AND AUFENVENNE, 2013). Secondly, in "a priori block models", blocking is based on pre-set attributes (SCHMIDT AND AUFENVENNE, 2013). An example for an "a priori block model" is KOCH's (2010) study analysing a regional actors' network by using the "sphere of activity" and the "regional or trans-regional connectivity of actors" as blocking variables (KOCH, 2010).

Similar to KOCH's (2010) approach, our study applies an "a priori block model". As blocking attributes the "strategies" of landscape valorisation are used. In doing so, e.g. all actors pursuing the strategy "tourism" are put into the sub-network "tourism", while all other actors are put together in the group of "others". Due to blocking, the connectivity of single sub-networks can be analysed.

Additionally, the standard deviation within the blocks is calculated; this measure in particular serves as validity check for the blocking (HANNEMAN AND RIDDLE, 2005). In general, high densities within groups and low densities between groups are a significant sign for a clustered social structure (HANNEMAN AND RIDDLE, 2005).

8.3 Conduction of the study

The social network analysis in this study is based on an extensive survey which aims at considering the whole "landscape valorisation" network in the study region. The relevant actors within the network are identified by combining the realistic and the reputational approach of boundary specification (LAUMANN, 1989): In a first step – based on expert knowledge from the previously held LSL workshop – 5 key-stakeholders are identified, who in turn list all relevant local actors impacting on the valorisation of the local agricultural landscape. In the end, a network of 34 institutions, which represent local agriculture, tourism, local administration, local economy, nature conservation and rural development, is identified.

Following the research approach of HÜBNER (2013) and BENTA (2005), network data is collected using a standardized questionnaire. In particular, three relations are assessed (cf. chapter 0, Annex II):

- *Acquaintance:* This relation describes if an actor is acquainted with other actors. (Yes or no)
- *Communication:* This relation describes if actors are communicating and assesses how intensive the communication is. Here, valued data is collected using a fixed scale reaching from intensity (1) *"occasional contact"*, to intensity (2) "*frequent contact*", to intensity (3) "*intensive contact*"
- *Conformity on strategies of landscape valorisation*: Again using a fixed scale, this relation describes if the strategies pursued have a conformity value of (1) opposite, (2) rather opposite, (3) neutral, (4) rather common or (5) common.

Furthermore, in the questionnaire the institutions' strategies of landscape valorisation are assessed and evaluated by the respondents as regards their contribution to regional competitiveness.

The questionnaire is sent to single representatives of the identified 34 institutions. The representatives are asked to answer the questions considering the collective communication habits of their institution. In the case of institutions represented by more than one actor, or in the case that different institutions represent one unity (e.g. tourism), the single actors questionnaires are clustered. Finally, the complete network consists of 22 institutions. SNA parameters for institutions, where grouping takes place, are calculated by using the average value of all answers.

Due to the character of data collection, which enables the assessment of information on the direction of the communication, the intensity of the communication and the conformity of strategies, the data gathered is valued and directed. To simplify the interpretation, unvalued data is used for calculations, whereas valued data is used for visualisation. Data analysis is done by using the software VISONE (BRANDES AND WAGNER, 2004) and UCINET (BORGATTI, EVERETT AND FREEMAN, 2002 , p.14). VISONE specialises on graph visualisation, while UCINET focuses on matrices and various network analysis parameters (BORGATTI *et al.*, 2002; BAUR, 2008,p.14).

Visualisation of the networks is based on centrality layouts. Within a centrality layout the number of open ties is kept low and link crossing is optimised (Baur, 2008, p.104). Due to this layout-algorithm, actors with similar ties are grouped together (HÜBNER 2013, p.176f).

In the analysis, two network models are investigated. The first model (1) considers all existing contact ties within the network, without making differences as regards intensity of contact. The second model (2) is deviated by using only ties with high intensity scores ("*frequent contact*" and "*intensive contact*"). Social network parameters are calculated on actors level, on network-level for the complete network, and for blocked sub-networks.

8.4 Results

8.4.1 Results Network level

The basic network in model 1 consists of 351 ties including all of the 22rd institutions. The network in model 2 includes 142 ties within the same amount of actors. The number of "possible ties" in model 2 is consequently equal to model 1 (see table1).

Table 1: Key figures on overall network level

Parameters	**Model 1**	**Model 2**
possible ties	461	461
existing ties	351	142
density	0,761	0,308
dyad-based reciprocity	0,712	0,327
average degree	15,95	6,455
average distance	1,240	1,839
average tie value considering contact intensity	1,533	Not analysed
average tie value considering conformity of strategy	3,809	Not analysed

The basic network in model 1 shows a density of 0.761 which is twice as much compared to the density of model 2. Additionally, in model 2 the average degree decreases, whereby the average distance increases compared to the network in model 1. The dyad-based reciprocity of network model 1 is 0,7122; this means that 28.8% of adjacent dyads are not reciprocal.

In figure 2 the basic network on actors level is visualised. Tie width illustrates contact intensities whereas tie colour indicates conformity of strategies.

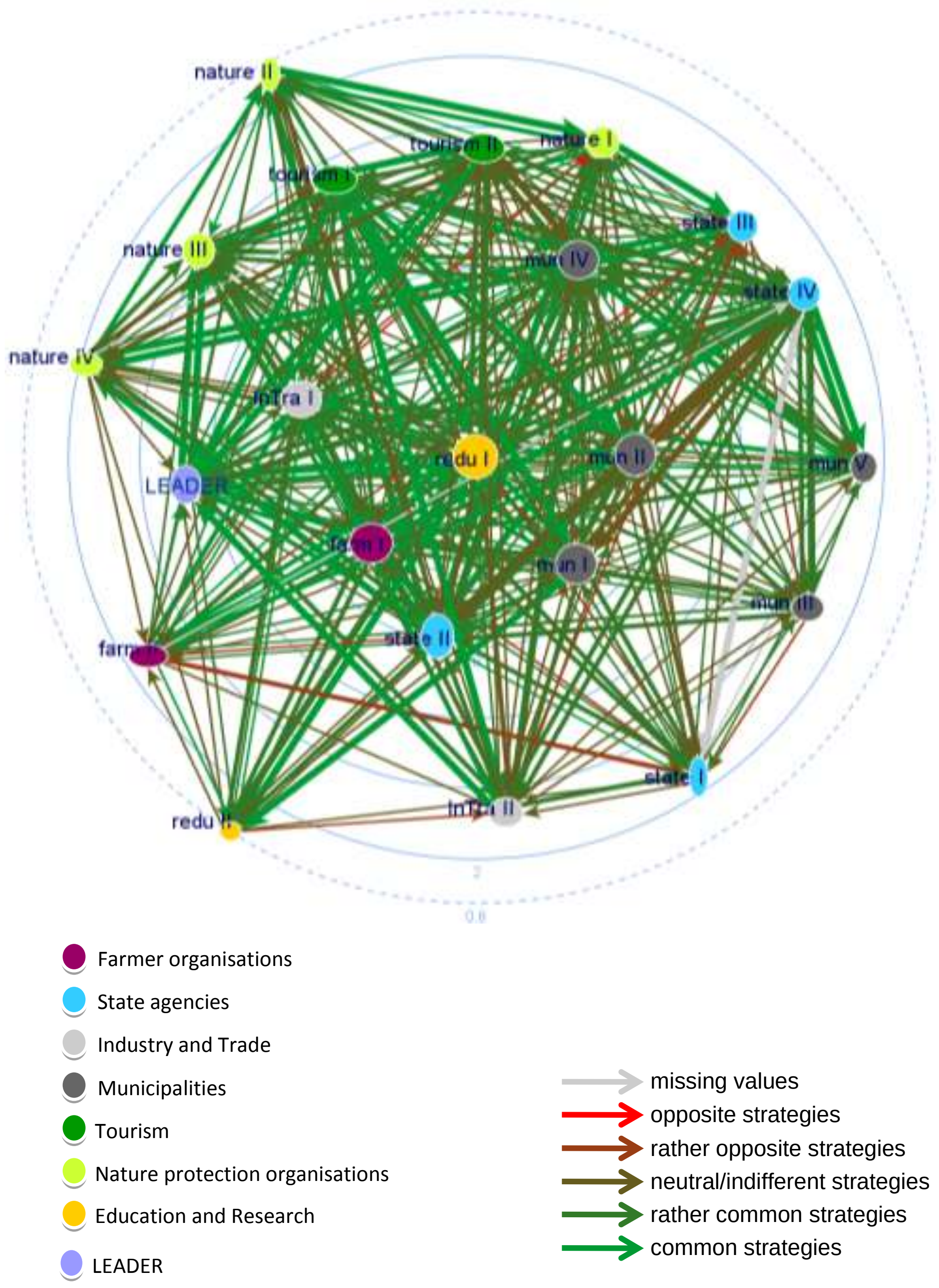


Figure 1: Visualisation of the basic network

Most contacts in the basic network are rather occasional, therefore the average tie weight, describing the average intensity of the contact, is only 1,533. Looking at the conformity of strategies, the average tie value is with 3,809 considerably high; only one tie in the network indicates an opposite strategy combined with occasional contact intensity.

The layout of the graph is based on betweenness centrality, thus node expanses show the characteristics of the scores. Node width is based on outdegree and node height on indegree. Consequently, a balanced number of indegree and outdegree shows a round node. Bigger nodes (higher values) are located more central. For example the actor redu I (=research and education) has the highest betweenness centrality of 13.32 and an equal in- and outdegree of 21. This actor is in contact with every other actor in the network and all of its ties are reciprocal. In contrast Redu II has the lowest scores in all categories and is located in the periphery (cf. Annex Table - A 1and Table - A 2).

8.4.2 Results Sub-Network level

On sub-network level, nine categories of landscape valorisation strategies are differentiated (see table 2).

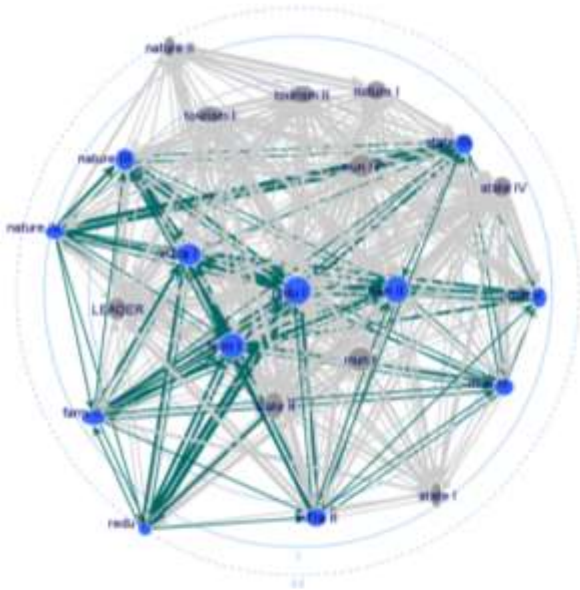
Table 2: Strategies of landscape valorisation

Strategies pursued		Contribution to competitiveness		Frequency of strategies (n)
		Average	Standard deviation	
S1	regional planning	3	0	2
S2	education strategies	4,13	0,835	8
S3	infrastructure	4,67	0,577	3
S4	nature, landscape and environment	4,14	0,9	7
S5	regional products	4	1,578	9
S6	tourism	4,5	0,674	12
S7	support of local businesses	4	1,414	4
S8	agricultural production	4,04	1,01	12
S9	maintenance of cultural heritage	4,5	0,707	2
S10	vertical integration	5	0	1

As regards the contribution of the strategies to regional competitiveness, ‘regional planning’ reached the lowest score on average; its standard deviation (SD) is 0. In contrast, the strategy of ‘marketing strategies of regional products’ has the highest SD of 1,578, the assessed values vary between low and very high. The ‘tourism’ strategy scores at 4.5 and has a low standard deviation. According to three stakeholders pursuing ‘support of local business companies’ (S7) has “high” impact on competitiveness; However one actor estimates the impact of (S7) on regional competitiveness to be rather low.

As regards frequency of strategies, ‘tourism’ (S6) and ‘agricultural production’ (S8) are the most frequently pursued strategies, followed by ‘marketing strategies of regional products’ (S5) and ‘education strategies’ (S2). The categories ‘regional planning’ (S1), ‘infrastructure’ (S3), ‘maintenance of cultural heritage’ (S9) and ‘vertical integration’ (S10) are the least pursued strategies of landscape valorisation. Seven institutions see their strategy in the protection of nature, landscape and environment (S4).

Having a deeper look at the most frequently pursued strategies, three municipalities, two nature protection organisations and the local chambers of economy pursue the strategy ‘agricultural production’ as well as ‘tourism’. However, institutions representing tourism never pursue the strategy ‘agriculture’, while farmer organisations never pursue the strategy “tourism” for landscape valorisation. The local LEADER group focuses only on ‘tourism’ and ‘regional products’. Visualised below (see figure 2) are the sub-networks for the most frequent strategies ‘agriculture’, ‘tourism’ and ‘marketing strategies of regional products’.

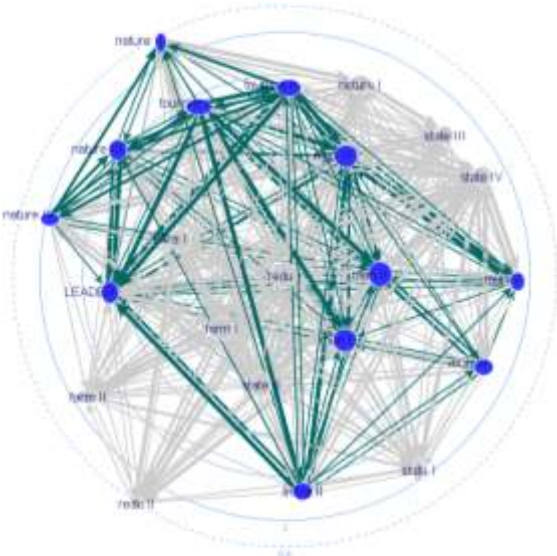


Agricultural Production

density by groups	Model 1	Model 2
in-group others	0.778	0.400
others x agricultural prod. *	0.725	0.317
in-group agricultural prod.	0.720	0.265
agricultural prod. x others**	0.825	0.275

average tie strength of existing ties	Model 1	Model 2
in-group others	1.771	2.500
‘others’ x ‘agricultural prod.’	1.632	2.447
in-group ‘agricultural prod.’	1.432	2.171
‘agricultural prod.’ x ‘others‘	1.374	2.121

*proportion of outgoing ties of group others
**proportion of outgoing ties of group agricultural production

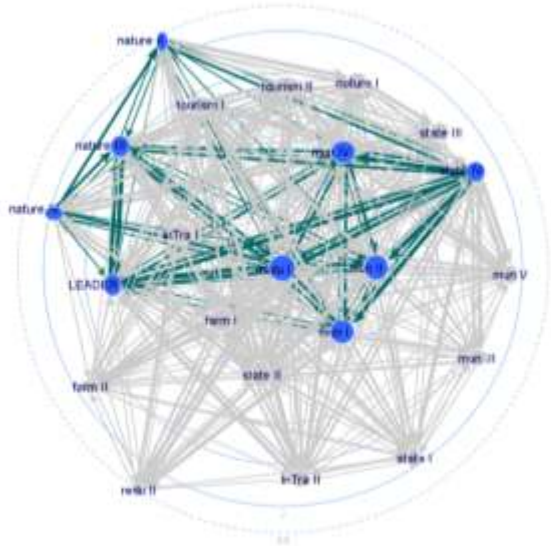


Tourism

density by groups	Model 1	Model 2
in-group ‘others‘	0.733	0.367
‘others’ x ‘tourism’ *	0.758	0.267
in-group ‘tourism’	0.735	0.273
‘tourism’ x ‘others’ **	0.808	0.342

average tie strength of existing ties	Model 1	Model 2
in-group ‘others’	1.667	2.333
‘others’ x ‘tourism’	1.450	2.281
in-group ‘tourism’	1.526	2.416
‘tourism’ x ‘others’	1.526	2.244

*proportion of outgoing ties of group others
**proportion of outgoing ties of group tourism



Regional products

density by groups	Model 1	Model 2
in-group ‘others‘	0.705	0.205
‘others’ x ‘regional products’*	0.812	0.325
in-group ‘regional products’	0.847	0.417
‘regional products’ x ‘others’ **	0.714	0.359

average tie strength of existing ties	Model 1	Model 2
in-group ‘others’	1.355	2.219
‘others’ x ‘regional products’	1.569	2.421
in-group ‘regional products’	1.623	2.266
‘regional products’ x ‘others’	1.659	2.333

*proportion of outgoing ties of group others
**proportion of outgoing ties of group regional products

Figure 2: sub-networks of the most frequent strategies of landscape valorisation

Also in the visualisation of the sub-networks, tie width within the sub-network represents contact intensity. The turquoise highlighted ties visualise the contacts of actors within the sub-networks ('in-group'). Grey ties visualise the contacts of the rest of actors within the network ('others'), pursuing other strategies than the sub-network. Node colour defines the sub-populations. Blue nodes pursue the respective strategy, whereas grey nodes do not. Again, node height and width are based on indegree and outdegree. Node expanse and network layout are based on betweenness centrality.

All blocking models of network model 1 show relatively high density scores within the groups as well as between the groups. However, it also becomes obvious, that the density of the sub-networks of 'agricultural production' and 'tourism' is considerably lower, than the sub-network of actors focussing on the strategy of 'regional products'.

On closer consideration, it furthermore becomes obvious, that the sub-networks 'agricultural production' and 'tourism' show higher outdegree densities than densities within the sub-network itself. The contact to the overall network for these lower-density sub-networks is consequently comparable high. For the sub-network 'regional products' the situation is contrary: Here the density within the network is considerably higher, than the density of all relations of this sub-network to the overall network.

Considering contact intensity, the average tie strengths both within the sub-networks and as regards the sub-networks relations to the overall network, are casual to frequent. Based on the results of model 1, the highest average tie strength exists within the sub-network of 'regional' products. In contrast, the lowest average tie strength can be observed for all institutions in the network that pursue strategies other than 'regional products'. The lowest average tie strength is reached within the comparatively loose sub-network 'agricultural production'. Compared to model 1, results of model 2 show lower densities. Due to the deviation criterion higher average tie strengths with the tendency to frequent contact appear.

8.5 Discussion and Conclusion

The "landscape valorisation network" analysed in this study includes representative institutions from agriculture, higher administration (federal state level), trade and industry, tourism, nature protection, research and education as well as local administration (municipality level). At this, the network appears to cover all relevant actors of the rural society (Bodin and Crona, 2009).

The connections between the different agents in the basic network of model 1 are rather dense. This high connectivity of actors can be seen as a huge potential for fostering common strategies on the one hand. On the other hand, the extremely dense network can also hinder innovation and development due to personal constraints of pushing through new strategies or due to the fact that in dense networks often a reduction of the overall knowledge base takes place (Newman and Dale, 2005; Grabher, 1993). In the 2nd LSL, stakeholders validated the strength of connection between the different actors in the study region. They also agreed that the density of the network actually can be seen not only as a regional strength but also as a problem.

The analysis of the overall network further shows that in particular 1 actor, representing research and education, reaches high betweenness and degree centrality and consequently is placed in a very central position in the network. This actor's potential to spread and control information and communication is very high.

However, what becomes also obvious is, that the communication frequency in the overall network ranges only between 'occasional and frequent'. Insofar the negative effect of the dense networks mentioned above could be reduced due to the overall low communication intensity.

As regards the actor's capability of self-perception the results of the calculation of '*dyad-based reciprocity*' indicate, that the single actors within the study region have a very clear assessment of their communication to other actors within the network. More than 70% of the dyads in the overall network are reciprocal.

Comparing model 1 with model 2, in which only high intensity communication is considered, density and also dyad-based reciprocity significantly decreases.

The results of the SNA show, that the agents/institutions in the study region pursue in parts common, in parts overlapping and in parts different strategies of landscape valorisation. The most important strategies of landscape valorisation and fostering regional competitiveness in the network are 1) agricultural production 2) tourism and 3) the marketing of regional products. However, here the analysis gives hint at important interruptions in potential valorisation chains:

The strategy "Agricultural production" is supported by institutions from agriculture, industry and trade, research and education, nature protection, as well as local and federal administration. However, it becomes clear that institutions representing tourism, which actually are main beneficiaries of the agricultural landscape in the study region, are not taking part in the strategical network of "agricultural production"

In contrast, the strategy "Tourism" is supported by institutions from tourism, industry and trade, nature protection, as well as local and federal administration. Here agriculture, as the main supplier of the cultural services in the agricultural landscape is not included into the strategical network of "tourism"

As regards "Regional products", this strategy is supported by institutions from industry and trade, nature protection, as well as local and in parts federal administration. However, again agriculture, as the main supplier of the raw products to be valorised via "regionality", as well as tourism, as one of the main potential distributer and beneficiary of the marketing of regional products, are not included into the strategical network of "tourism")

Overall, the results of the SNA indicate that within dense "landscape valorisation networks" common strategies can be developed and fostered. The results however show, that for successful and efficient landscape valorisation leading to positive socio-economic effects, it is particularly necessary to close potential value chains and foster straight implementation of commonly developed strategies.

References

BACHINGER, M.; PECHLANER, H.; WIDUCKEL, W. (2011): Regionen und Netzwerke: Kooperationsmodelle Zur Branchenübergreifenden Kompetenzentwicklung. Westdeutscher Verlag GmbH.

BAUR, M. (2008): visone–Software for the Analysis and Visualization of Social Networks. Universität Karlsruhe. urn: nbn: de: swb 90-108975.

BEIERLE, T. (2000): The Quality of Stakeholder-Based Decisions, RiskAnal., 22, 739–749, 2002.

BEIERLE, T.C. UND J. CAYFORD (2002): Democracy in practice: Public participation in environmental decisions. Resources for the Future, Washington, DC.

BRYSON, J. M. (2004): What To Do When Stakeholders Matter: A Guide to Stakeholder Identification and Analysis Techniques. In Public Management Review 6: 21 - 53.

BRYSON, J., BROMILEY, P. UND Y. S. JUNG (1990): 'Influences on the Context and Process on Project Planning Success.' Journal of Planning Education and Research 9(3) 183-185.

BODIN, Ö.; CRONA, B. I. (2009): The role of social networks in natural resource governance: What relational patterns make a difference? Global Environmental Change 19: 366-374.

BODIN, Ö.; CRONA, B.; ERNSTSON, H. (2006): Social Networks in Natural Resource Management: What Is There to Learn from a Structural Perspective? Ecology and Society 11.

BORGATTI, S. P. (2003): The key player problem. In Dynamic Social Networks. Modelling and Analysis. National Academies Press: 241-252.

BORGATTI, S. P.; EVERETT, M. G.; FREEMAN, L. C. (2002): Ucinet for Windows: Software for social network analysis.

BORGATTI, S. P.; EVERETT, M.; JOHNSON, J. C. (2013): Analyzing social networks. London: SAGE.

BRANDES, U.; WAGNER DOROTHEA (2004): Netzwerkvisualisierung. Konstanz: Bibliothek der Universität Konstanz.

BRYSON, J. M. (2004): What To Do When Stakeholders Matter: A Guide to Stakeholder Identification and Analysis Techniques. In Public Management Review 6: 21 - 53.

CHANG, C.-Y. et al. (2012): Network analysis as a method for understanding the dynamics of natural resource management in rural communities. Society & Natural Resources 25: 203-208.

Cooper, T., Hart, K., Baldock, D. (2009): Provision of Public Goods through Agriculture in the European Union. Report Prepared for DG Agriculture and Rural Development, Contract No 30-CE-0233091/00-28, Institute for European Environmental Policy: London.

Courtney, P., Hill, G., Roberts, D., (2006): The role of natural heritage in rural development: an analysis of economic linkages in Scotland. Journal of Rural Studies, 22, 469-484.

Courtney, P., Mills, J., Gaskell, P., Chaplin, S., (2013): Investigating the incidental benefits of Environmental Stewardship schemes in England. Land Use Policy, 31, 26-37.

DE NOOY, W. (2013): Communication in Natural Resource Management: Agreement between and Disagreement within Stakeholder Groups. Ecology & Society 18.

Dissart, J.C., Vollet, D., (2011). Landscapes and territory-specific economic bases. Land Use policy, 28, 563-573.

FOLKE, C., HAHN, T., OLSSON, P., NORBERG, J. (2005): Adaptive governance of social-ecological systems. Annu. Rev. Environ. Resour. 30: 441-473.

GRABHER, G. (1993): Wachstums-Koalitionen und Verhinderungs-Allianzen : Entwicklungsimpulse und -blockierungen durch regionale Netzwerke. Stuttgart : Steiner.

HANNEMAN, R. A.; RIDDLE, M. (2005): Introduction to social network methods. Riverside, CA: University of California, Riverside (published in digital form at http://faculty.ucr.edu/~hanneman/).

HENNIG, M. (2012): Studying Social Networks : A Guide to Empirical Research: A Guide to Empirical Research. Frankfurt: Campus Verlag.

JAMES, C. (1990): Foundations of social theory. Cambridge, MA: Belknap.

JANSEN, D. (2006): Einführung in die Netzwerkanalyse: Grundlagen, Methoden, Forschungsbeispiele. VS Verlag für Sozialw.

JANSSEN, M. A. et al. (2006): Toward a Network Perspective of the Study of Resilience in Social-Ecological Systems. Ecology and Society 11.

KOCH, M. (2010): Eine quantitative regionale Netzwerkanalyse am Beispiel des geplanten Biosphärenparks Lungau. Angewandte Geoinformatik 2010.

NEWMAN, L.; DALE, A. (2005): Network structure, diversity, and proactive resilience building: a response to Tompkins and Adger. Ecology and Society 10: r2.

NUTT, P. (2002): Why decisions fail: Avoiding the Blunders and Traps That Lead to Debacles. San Francisco: Berrett-Koehler Publishers Inc.

PRELL, C. (2011): Social Network Analysis: History, Theory and Methodology. SAGE Publications.

SCHMIDT, J.-B.; AUFENVENNE, P. (2013): Soziale Netzwerkanalyse für HumangeographInnen. Einführung in UCINET und NetDraw in fünf Schritten. Potsdam: Universitätsverlag Potsdam.

STAVE, K.A. (2002): Using system dynamics to improve public participation in environmental decisions ,System Dynamics Review Vol. 18, No. 2, (Summer 2002): 139–167

VAN DER MEULEN, V., VERSPECHT, A., VERMEIRE, B., VAN HUYLENBROEK, G., GELLYNCK, X. (2011): The use of economic valuation to create public support for green infrastructure investments in urban areas. Landscape and Urban Planning, 103, 198-206.

VAN ZANTEN B.T., VERBURG P.H., ESPINOSA M., GOMEZ-Y-PALOMA S., GALIMBERTI G., KANTELHARDT J., KAPFER M., LEFEBVRE M., MANRIQUE R., PIORR A., RAGGI M., SCHALLER L., TARGETTI S., ZASADA I., VIAGGI D. (2013): European agricultural landscapes, common agricultural policy and ecosystem services: a review. Agronomy for Sustainable development, On-line, DOI 10.1007/s13593-013-0183-4

WASSERMAN, S.; FAUST, K. (2009): Social network analysis methods and applications. 19. print., Cambridge [u.a.]: Cambridge Univ. Press.

ANNEX I:-Results

Table - A 1: Single Actors outdegree, Indegree and betweenness centrality

1. Actors	2. Outdegree	3. Indegree	4. Betweenness
5. redu I	6. 21	7. 21	8. 13.32
9. farm I	10. 20	11. 19	12. 9.56
13. mun I	14. 19	15. 19	16. 9.26
17. mun II	18. 19	19. 20	20. 8.94
21. InTra I	22. 19	23. 17	24. 8.22
25. state II	26. 15	27. 21	28. 8.20
29. mun IV	30. 19	31. 18	32. 7.09
33. LEADER	34. 14	35. 18	36. 5.24
37. tourism II	38. 20	39. 14	40. 4.60
41. tourism I	42. 21	43. 13	44. 4.56
45. nature I	46. 16	47. 15	48. 3.76
49. nature III	50. 15	51. 17	52. 3.66
53. state III	54. 14	55. 15	56. 3.45
57. InTra II	58. 16	59. 14	60. 3.28
61. mun III	62. 15	63. 13	64. 3.19
65. state IV	66. 15	67. 16	68. 3.10
69. farm II	70. 18	71. 11	72. 2.63
73. mun V	74. 12	75. 15	76. 2.55
77. state I	78. 9	79. 19	80. 2.40
81. nature IV	82. 15	83. 11	84. 2.17
85. nature II	86. 9	87. 16	88. 1.07
89. redu II	90. 10	91. 9	92. 0.76

Table - A 2**: Reciprocity of ties on actors' level**

Actors	Symmetric	Non-Symmetric	Sym/Out	Sym/In
state I	0,474	0,526	1,000	0,474
state II	0,714	0,286	1,000	0,714
farm I	0,857	0,143	0,900	0,947
nature I	0,722	0,278	0,813	0,867
mun I	0,900	0,100	0,947	0,947
mun II	0,857	0,143	0,947	0,900
mun III	0,750	0,250	0,800	0,923
mun IV	0,850	0,150	0,895	0,944
mun V	0,688	0,313	0,917	0,733
state III	0,611	0,389	0,786	0,733
InTra I	0,714	0,286	0,789	0,882
LEADER	0,778	0,222	1,000	0,778
redu I	1,000	0,000	1,000	1,000
nature II	0,471	0,529	0,889	0,500
nature III	0,778	0,222	0,933	0,824
nature IV	0,625	0,375	0,667	0,909
redu II	0,583	0,417	0,700	0,778
state IV	0,722	0,278	0,867	0,813
farm II	0,526	0,474	0,556	0,909
tourism I	0,619	0,381	0,619	1,000
tourism II	0,700	0,300	0,700	1,000
InTra II	0,579	0,421	0,688	0,786

BORGATTI et al. (2002):

Symmetric: The total number of reciprocated ties involving ego divided by the number of ties to and from ego.

Non-symmetric: One minus the symmetric score.

Sym/Out: gives proportion of ego's outgoing ties that are reciprocated

Sym/In: gives proportion of ego's incoming ties that are reciprocated

ANNEX II: Questionnaire

Umfrage und Netzwerkanalyse

Fragenmodul 1: Kontaktdaten

	Fragen	Antworten
(1.1)	Welche Organisation/Institution vertreten Sie? (siehe Liste S.4 - 5)	
(1.2)	Wie heißen Sie?	
(1.3)	Wie sind Sie zu erreichen (Telefonnummer, E-Mail Adresse)?	
(1.4)	Welche Funktion haben Sie innerhalb der Organisation (Geschäftsführer, Mitarbeiter, Mitglied des Vorstandes etc.)?	

Fragenmodul 2: Allgemeine Daten über Ihrer Institution/Organisation

	Fragen	Antworten
(2.1)	In welchem Jahr wurde Ihre Organisation/ Ihre Institution gegründet?	
(2.2)	Wie viele Mitglieder hat Ihre Organisation/ Institution (z.B.: ca. 10 Aktive & ca. 50 Interessierte)?	
(2.3)	Welcher Art ist Ihre Institution/ Organisation? (z.B. Interessensvertretung, Forschungseinrichtung, Privatperson, Verwaltung, Einzelhandelsbetrieb, Gewerbe, Handwerk, Industrie etc.)	

Fragenmodul 3: Ziele und Maßnahmen

Die Agrarlandschaft kann durch unterschiedliche Strategien in Wert gesetzt werden (z.B. Intensivierung der landwirtschaftlichen Produktion, durch Förderung des Tourismus, Erhöhung der Vermarktung regionaler Produkte, Ansiedelung von Unternehmen etc.). Diese Inwertsetzung kann einen Beitrag zur regionalen Entwicklung und der Wettbewerbsfähigkeit in der Untersuchungsregion leisten.

(3.1) Welche Strategien, die Agrarlandschaft in Wert zu setzen, verfolgt Ihre Institution/Organisation?

(3.2) Bitte treffen Sie eine Einschätzung, wie stark Ihre Strategien zur Wettbewerbsfähigkeit der Region beitragen

Strategie	Sehr gering 1	2	3	4	Sehr stark 5
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

Fragenmodul 4: Netzwerkdaten: Bitte beantworten Sie die folgenden Fragen.

Falls Sie den Akteur kennen, beantworten Sie die folgenden Fragen:

(4.1) Kennen Sie die folgenden Akteure?			**(4.2)** Beurteilen Sie die allgemeine **Intensität des Kontaktes** Ihrer Institution/Organisation mit dem genannten Akteur. (eine Antwortmöglichkeit)				**(4.3)** Inwieweit verfolgen ihre Institution/Organisation und der genannte Akteur hinsichtlich der **Inwertsetzung der Agrarlandschaft die gleichen Strategien**? (Inwieweit ziehen Ihre Institution/Organisation und der genannte Akteur hinsichtlich dieser Inwertsetzung „am gleichen Strang"?).(eine Antwortmöglichkeit)				
Akteur	JA	NEIN	keinen Kontakt	gelegentlicher Kontakt	häufiger Kontakt	intensiver Kontakt	gegensätzliche Strategien	eher gegensätzliche Strategien	neutrale/ indifferente Strategien	eher gemeinsame Strategien	gemeinsame Strategien
Abteilung Bau- und Raumordnung des Landes Steiermark	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Abteilung Anlagentechnik und Baukultur, Land Steiermark	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Amtssachverständigendienst für Naturschutz des Landes Steiermark	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Baubezirksleitung Liezen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bezirksbauernkammer Liezen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Berg- und Naturwacht Liezen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bezirkshauptmannschaft Liezen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

			Falls Sie den Akteur kennen, beantworten Sie die folgenden Fragen:								
(4.1) Kennen Sie die folgenden Akteure?			**(4.2)** Beurteilen Sie die allgemeine **Intensität des Kontaktes** Ihrer Institution/Organisation mit dem genannten Akteur. (eine Antwortmöglichkeit)				**(4.3)** Inwieweit verfolgen ihre Institution/Organisation und der genannte Akteur hinsichtlich der **Inwertsetzung der Agrarlandschaft die gleichen Strategien**? (Inwieweit ziehen Ihre Institution/Organisation und der genannte Akteur hinsichtlich dieser Inwertsetzung „am gleichen Strang“?).(eine Antwortmöglichkeit)				
Akteur	JA	NEIN	keinen Kontakt	gelegentlicher Kontakt	häufiger Kontakt	intensiver Kontakt	gegensätzliche Strategien	eher gegensätzliche Strategien	neutrale/ indifferente Strategien	eher gemeinsame Strategien	gemeinsame Strategien
Bezirksjäger Liezen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bürgermeisteramt Aigen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bürgermeisteramt Bad Aussee	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bürgermeisteramt Donnersbach	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bürgermeisteramt Irdning	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bürgermeisteramt Oppenberg	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bürgermeisteramt Pürgg-Trautenfells	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bürgermeisteramt Stainach	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Gebietsbetreuung der Europaschutzgebiete	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Landgenossenschaft Ennstal	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Leader Bergregion Ennstal	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
LFZ Raumberg Gumpenstein	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Nationalpark Gesäuse	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Naturpark Sölktäler	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Naturschutzbund Ennstal-Ausseerland	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Österreichische AG f.Grünlandwirtschaft und Futterbau	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Regionalmanagement Liezen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Stadtmarketing Liezen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Falls Sie den Akteur kennen, beantworten Sie die folgenden Fragen:

(4.1) Kennen Sie die folgenden Akteure?			**(4.2)** Beurteilen Sie die allgemeine **Intensität des Kontaktes** Ihrer Institution/Organisation mit dem genannten Akteur. (eine Antwortmöglichkeit)				**(4.3)** Inwieweit verfolgen ihre Institution/Organisation und der genannte Akteur hinsichtlich der **Inwertsetzung der Agrarlandschaft die gleichen Strategien**? (Inwieweit ziehen Ihre Institution/Organisation und der genannte Akteur hinsichtlich dieser Inwertsetzung „am gleichen Strang“?).(eine Antwortmöglichkeit)				
Akteur	JA	NEIN	keinen Kontakt	gelegentlicher Kontakt	häufiger Kontakt	intensiver Kontakt	gegensätzliche Strategien	eher gegensätzliche Strategien	neutrale/ indifferente Strategien	eher gemeinsame Strategien	gemeinsame Strategien
Steirischer Bauernbund	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tourismusverband Aigen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tourismusverband Oppenberg	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tourismusverband Pürgg-Trautenfells	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tourismusverband Stainach	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tourismusverbund Schladming Dachstein	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Verein Schloss Trautenfels	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wildbach- und Lawinenverbauung Liezen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wirtschaftskammer Steiermark	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9 CSA3: Measuring the influence of landscape on the competitiveness of rural areas – an Austrian case study on municipality level

A. Reindl, L. Schaller, M. Kapfer, J. Kantelhardt

9.1 Introduction

The question, how to measure 'regional competitiveness' is subject to a rather long-standing, yet still ongoing discussion – both on scientific and political level (KRUGMANN, 1990; PORTER, 1992; KRUGMANN, 1994; EUROPEAN COMMISSION, 1999a, 1999b, 2009 and 2010; PORTER & KETALS, 2003; THOMSON & WARD, 2005). There is broad consensus that the crux of measuring 'regional competitiveness' lies in the sound definition of the term itself and in finding indicators which are fully suitable and – moreover – available on regional level, to conduct a reliable and comprehensive assessment. Literature reveals that a strictly economic definition of competitiveness has clear shortages as economic factors alone can't represent all assets characterizing a region (KRUGMANN, 1990; PORTER, 1992; KRUGMANN, 1994; EUROPEAN COMMISSION, 1999a, 1999b, and 2009; PORTER & KETALS, 2003; THOMSON & WARD, 2005). For a deeper insight and a comprehensive assessment of regional competitiveness, it becomes clear that social and sustainability factors must also be taken into account (KRUGMANN, 1990; PORTER, 1992; KRUGMANN, 1994; EUROPEAN COMMISSION, 1999a, 1999b, and 2009; PORTER & KETALS, 2003; THOMSON & WARD, 2005). Many of the approaches of measuring competitiveness, aim at considering and implementing this understanding (SCHWAB AND PORTER, 2007; DIJKSTRA et al., 2011; STATISTICS AUSTRIA, 2006).

In recent literature, increasingly the question is raised how and to which extent also 'landscape' can represent a factor of territorial development and regional 'competitiveness' (VAN ZANTEN et al., 2013; FIELDSEND, 2011; ENRD, 2010; COOPER et al., 2009). In particular the concept is discussed that landscapes hold the potential to provide private as well as public good-type (ecosystem) services which represent a resource not only for local inhabitants but also for different sectors of the rural economy, such as agriculture, forestry, tourism or the trade and services sector (VAN ZANTEN et al., 2013; FIELDSEND, 2011, TEEB, 2010; DE GROOT et al., 2010, HAINES-YOUNG & POTSCHIN, 2010; ENRD, 2010; COOPER et al., 2009). However, the cause-effect chains between the supply of goods from landscapes and the development and competitiveness of rural regions still remain mostly unclear. In particular this is due to the fact that the socioeconomic effects and benefits resulting from the use landscape services often are multi-staged and multi-faceted and therefore difficult to assess. On the one hand, the use of private and public good-type services from agricultural landscapes can create "direct" and "linear" socioeconomic benefits, e.g. from the production and marketing of agricultural goods or from the direct use of recreation possibilities by both local population or tourists. Here, at least as regards the benefits of the direct use of private good-type services, the assessment of the monetary impact on the development and competitiveness of a region appears comparatively easy. In contrast, already the assessment of economic benefits from the direct use of public good–type services is often complicated due to the mostly missing market price for such services (RUDD, 2009; SCHAEFFER, 2008; DIAZ-BALTEIRO & ROMERO, 2008). Moreover, the use of services provided by a landscape can also create "indirect" and "non-linear" socioeconomic benefits (COOPER et al., 2009, FIELDSEND, 2011, ENRD, 2010): For example, the use of the beauty of a landscape in combination with the agricultural products supplied in a landscape can enable new marketing concepts of regional speciality products (COOPER et al., 2009). Just the same, the landscapes' function of moderating extreme events, or again even the beauty of a landscape, can lead to the establishment of businesses in a special area. BALDERJAHN & SCHNURRENBERGER (1999) showed in a qualitative survey with top managers, that attractiveness of landscape does have an influence on the choice of locating a company. Such economic activities in turn can create, influence and alter other economic activities, for example by developing the regional income side due to creating jobs for the local population or by developing the supplier side due to enhanced demand. Here, one can speak of "multiplier effects", whereas "multiplication" can go through various stages before it dies out (Domanski & Gwosdz, 2010).

Against these backgrounds, our paper aims at answering two main questions. First, we want to test if Data Envelopment Analysis (DEA) is a suitable method to measure the competitiveness of rural regions in terms of "efficiency" on a municipal level. Here, the major challenge lies in defining suitable and data-based LAU2 competitiveness factors and related indicators, allowing for measuring regional competitiveness both in its economic and social sense. As human capital is a crucial factor for economic growth in a modern knowledge-based society (HUOVARI et al. 2001, 4) in our paper we put the focus of competitiveness on the outcome of the population living in a region. Second, the paper targets to assess the influence of landscape on the competiveness of a region. Here we comparatively apply correlation analysis, OLS multiple regression as well as Tobit regression to selected, both landscape and non-landscape related factors, of which we assume to have an impact on competitiveness. Again, the major challenge is to find appropriate and data based impact-factors and related indicators available on LAU2 level.

To answer our research questions, our paper has been developed as follows. The next section is devoted to the literature on regional competitiveness and the indicators of measuring competitiveness on a regional level. In the third section, a short, general description of the methods applied is given. The forth section presents our study region and specifies our model assumptions as well as the indicators selected. In the fifth section we show our results in terms of competiveness on municipality level and in terms of the impact of landscape and non-landscape related factors on competitiveness. Finally, in the sixth chapter we discuss our results and point out major conclusions to be drawn out of our study.

9.2 Measuring Competiveness of Rural Municipalities

In general, "competitiveness" can be defined as the ability "to withstand market competition" (EU, 1999b). On micro-economic level, e.g. for firms or companies, "competitiveness" as a measure of economic viability is broadly accepted. Here, "competitiveness is the ability to produce the right goods and services of the right quality, at the right price, at the right time" in a competitive market, while "meeting customers' needs more efficiently and more effectively than other firms do" (THOMSON & WARD, 2005). Moreover, micro-economically, competitiveness is the sustainable ability of a company or a sector, to gain or save profit-making market shares (MARTIN 1991, 1456), or, very straight forward, the capacity of a company or sector to compete, grow and be profitable (MARTIN et al., 2006).

However, in a territorial context, that is, for nations or regions, the reasonableness of measuring competitiveness is intensively discussed (e.g. PORTER, 1992, KRUGMANN, 1994A, B; KRUGMANN 1996; EUROPEAN COMISSION, 1999a): KRUGMANN (1996) points out that applying the concept of competitiveness on regions or nations implies an intern competition between them. Nations or regions, failing to achieve the productivity of competing nations or regions, will face the same kind of crisis as a company that cannot match the productivity of its rivals. However, such a comparison is problematic, since goals and circumstances of nations, regions and companies differ significantly and, furthermore, a nation or region that does "not compete" will still not cease to exist and go out of business – like a non-competitive company (KRUGMANN, 1996; KRUGMANN 1994a, THOMSON & WARD, 2005). Nevertheless, to measure competitiveness of nations or regions still appears useful, as quantitative and comparable assessment could help to identify regional weaknesses and uncover factors mainly driving these weaknesses. This can, assumedly, support regions in the catching up process (EUROPEAN COMMISSION, 2010).

Until now, various definitions of competitiveness have been formulated in order to more comprehensively describe the "competitive" potential of nations or regions: On macro-economic, national level, one of the most important definitions for sure is given by the World Economic Forum in line with the development of the *Global Competitiveness Index* (GCI): Here, competitiveness is defined as the "set of institutions, policies, and factors determining the level of productivity of a country" (SCHWAB & PORTER, 2007; OECD, 2013, 4). On regional level, e.g. the EU's *Sixth Periodic Report on the Regions* defines competitiveness as "the ability […] to generate, while being exposed to international competition, relatively high levels of income and employment (EUROPEAN COMMISSION, 1999a). Another approach, introducing the term "territorial competitiveness" (EU, 1999b), goes beyond this still rather "productivity-driven" definition and describes an area's competitiveness by the ability "to face up to market competition whilst at the same time ensuring environmental, social and cultural sustainability, based on the dual approach of networking and inter-territorial relationships" (EU, 1999b). Also more recent definitions go beyond the sole productivity meaning of competitiveness by including social and sustainability aspects: Here the focus is set on the link between regional competitiveness and regional prosperity while competitiveness is characterised by the ability of a locality or a region to generate high and rising incomes, enhancing the overall standards of living and improving the livelihoods of the people living there (BRISTOW, 2005, HUGGINS, 2003, MEYER-STAMER, 2008, EUROPEAN COMMISSION, 2009).

A practical problem of measuring 'regional' or even 'local' competitiveness is the establishment of appropriate indicators. On national level a range of widely accepted indicator systems and competiveness indices exists, such as the IMD's World Competitiveness Yearbook (IMD, 2000), the World Economic Forum's Global Competitiveness Index (SCHWAB & PORTER, 2007), the OECD's New Economy Report (OECD, 2001) or the European Competitiveness Index (HUGGINS & DAVIES, 2006). However, national indices cannot be easily transferred to a regional scale, since information is often unavailable or meaningless on regional level (HUOVARI et al., 2001). MARTIN (2004) describes two approaches to assess competitiveness on regional level. The first approach explores the influence of particular single drivers on competitiveness, such as demographical development [Florida, 2000], business environment and innovative milieu [RITSILÄ, 1999], governance and institutional capacity [Moers, 2002] or industrial structure [EUROPEAN COMMISSION, 1999A; EUROPEAN COMMISSION, 2001] (MARTIN 2004). The second approach analyses competitiveness as a cumulative outcome of factors (MARTIN, 2004). Prominent examples for this approach are the UK's regional and local competitiveness index [HUGGINS & DAY, 2006; HUGGINS & THOMPSON, 2010]; the European Commission's reports on economic, social and territorial cohesion (EUROPEAN COMMISSION, 2002 – 2013), or the recently developed European, regional-based competitiveness index (RCI) on NUTS 2 level (DIJKSTRA et al., 2011). Here, the different approaches use a variety of different factors and indicators to describe and measure competitiveness on a rather small scale. Depending on the approach, strictly "economic" factors like GDP, income levels and labour productivity, "efficiency factors" like labour market efficiency, education and training or market size, "innovation" factors like, innovation, business sophistication or technological readiness, or other "basic" factors like infrastructure, investments, institutions or also health or quality of life are considered and combined. However, it becomes obvious that many of these "regional" indicators are still not necessarily suitable for measuring regional competitiveness – at least not for all regional "basic-conditions" and also not necessarily on really small-scale levels such as municipalities. For example, many of the regional competitiveness factors in use focus on urban and not on rural areas. For instance, to describe the factor "Innovation" DIJKSTRA et al., (2011) uses the number of patents as indicator. Yet, the number of patents will be of minor importance in rural areas as larger companies or research centres are mainly located in urban areas. Also, the availability of data on LAU2 might not be given for all factors. For instance data on GDP per Head or Household is often only available on LAU2 level. Consequently, to measure the competiveness of rural areas on municipality level specific competitiveness factors and related indicators are required.

One set of factors particularly suitable for our study, which takes place in Austria is suggested by STATISTICS AUSTRIA (2006). It considers the factor groups (1) *Demography – migration* (population change, net migration, natural population change) (2) *Economy – human capital - infrastructure* (forms of employment, importance of different sectors, importance of public sector, capacity of collective tourist accommodation, occupancy of collective tourist accommodation, weight of manufacturing, weight of tertiary sector, relative changes of unemployment, human capital, potentially available resources, relative changes of employment), (3) *Accessibility to services – infrastructure* (availability of roads/rails, supply with schools, and proximity to primary schools and (4) *social well-being* (relative wealth of the population, poverty, quality of life).Actually, the set aims to measure rural development, however the suggested indicators are also appropriate for measuring competitiveness of rural areas in Austria. However, also with regard to this approachit is to note that not all indicators are available on municipality level.

9.3 Methods

9.3.1 Data Envelopment Analysis

To analyse the competitiveness of rural municipalities, we conduct a Data Envelopment analysis (DEA). Based on the work of FARRELL (1957), CHARNES, COOPER and RHODES (1978) introduced the method in its present form. Since then, researchers from many different fields used the DEA as an excellent and easy way for modelling operational processes for performance evaluation (COOPER et al. 2011, 2). In the context of comparative competitiveness assessment, e.g. HUGGINS AND DAVIES (2006) use DEA while calculating the European competitiveness index (ECI). However, their assessment is carried out on NUTS1 level (HUGGINS AND DAVIES, 2006). On municipality level, an example of using DEA for measuring the performance of municipalities can be seen in WORTHINGTON and DONNERLY (2000).

Data Envelopment Analysis is a non-parametric and deterministic method for measuring efficiency of Decision Making Units (DMUs). DEA compares production processes out of a sample of DMUs, without priori assumptions of the functional form. The production performance is rated by calculating the output-to-input ratio of the respective production processes; the less input is required for producing a given output or the more output is produced with a given input, the higher is the efficiency score. By using the DEA approach, it is possible to consider multiple inputs and outputs which can have different measuring units. Consequently, even factors which cannot (or only at great expense) be expressed in monetary units can be included in the assessment. This technique thus allows the integration of multiple economic, environmental and social aspects.

The technical efficiency score is derived within DEA by benchmarking the output-to-input ratio of each municipality against the output-to-input ratio of those municipalities with the best performance (COOPER ET AL., 2006). Thus, DEA compares single DMUs not to the average of the sample, but to the best performing DMUs. The technical efficiency of each DMU is measured with a linear programming model which is solved as follows for an output-oriented model:

$$\max \quad \omega_0 = \sum_{j=1}^{s} \mu_{o,j} * j_{o,j}$$

$$\text{s.t.} \qquad \sum_{i=1}^{r} v_{o,i} * x_{o,i} = 1$$

$$\sum_{j=1}^{s} \mu_{o,j} * y_{k,j} \leq \sum_{j=1}^{s} v_{o,j} * x_{k,j} \, \forall k = 1, \dots, n$$

$$\mu_{o,j} \geq 0 \quad \forall j = 1, \dots, s$$

$$v_{o,j} \geq 0 \quad \forall j = 1, \dots, r,$$

where m indicates the number of inputs, s the number of outputs, n the number of DMUs, v the weight of inputs, µ the weight of outputs, x the input vector and y the output vector.

In our case we set up three different model regions, which will be explained in Chapter 3.2. and apply a single-input, multiple-output DEA for each of these three model regions. The model is output orientated and we assume constant returns to scale. Our model is applied on municipality level, consequently we treat municipalities as DMUs. The data is pre-processed with Microsoft Excel® and Microsoft Access® and the measurement is done with RStudio®, which contains the package "Benchmarking" to perform efficiency analysis. Moreover, our study follows a spatial approach. Therefore the results are combined with a spatial analysis with ArcMap 10.1 from Esri®.

9.3.2 Second Stage Regression

DEA efficiency scores might be influenced by contextual factors, which cannot be managed by the DMUs, but have to be accepted by the DMU as a given external factor (in literature these factors are also often called environmental factors). To test the potential influence of such external factors, we apply a two-stage DEA. This means that we utilise our DEA efficiency scores (derived at the first stage of the analysis) as dependent variable and regress it on the contextual variables. In literature there are numerous studies applying second stage DEAs on municipal level, such as BALAGUER-COLLet al. (2007), ALFONSO and FERNANDES (2006), DE BORGER et al. (1994) and KRIESE (2008).

In our study we conduct two forms of second stage analysis, which we apply on all of the three model regions: in form of a correlation analysis and in form of a multiple linear regression model. The multiple linear regression is calculated with an ordinary least squares model. Furthermore, since DEA efficiency scores are restricted to a range between 0 and 1, we conduct a Tobit-regression applying the Tobit function of the R-package AER. In order to deal with heteroscedasticity, we logarithmise our contextual variables with exception of the indicator “openness of landscape” (cf. chapter 9.4.2.)

9.4 Model Regions and Model Specification

9.4.1 Definition of Model regions

Our study focusses on the competitiveness of rural areas. Rural areas are defined on basis of European Commission and OECD typologies of territorial units (Statistics Austria, 2014; OECD, 2010; European Commission, 2012; European Commission, 2013b and European Commission, 2013c). The study takes place on municipality level (LAU 2). We set up three different model regions, which are all located in Austria and differ with regard to specific selection criteria. Furthermore, we have a specific look at the results of 4 selected mountain municipalities located in Styria: in this municipalities we established further qualitative analysis, which allows us to triangulate DEA results with qualitative results in order to get deeper insights into the relation between landscape and competitiveness in mountainous municipalities.

Model region 1 consists of all 1988 Austrian “rural” municipalities. The classification of municipalities is based on the classification system of Statistics Austria, which follows the Eurostat/European Commission and OECD typologies of territorial units (Statistics Austria, 2014, s.p.; OECD 2010, s.p.; European Commission 2012, s.p.; European Commission 2013a, s.p. and European Commission 2013b, s.p.). In general, the classification suggests three types of territorial units, namely thinly-populated areas (rural areas), intermediate populated areas (towns, suburbs) and densely populated areas (cities, urban areas, urban centres). The basic idea for considering only rural municipalities into our analysis is to harmonize our DMU sample: DEA requires the assumption of homogeneity of the units under assessment (Dyson et al., 2001, 247). Since the characters, aims and goals of urban and rural areas differ significantly, it is not reasonable to also include urban municipalities in our sample.

Model region 2 consists of 710 rural and mountainous municipalities. We establishe this model regions, since landscapes are particularly in mountainous regions of major importance. Municipalities are classified as “mountainous”, when agriculturally used mountain pastures exists. The classification is done on basis of INVEKOS data.

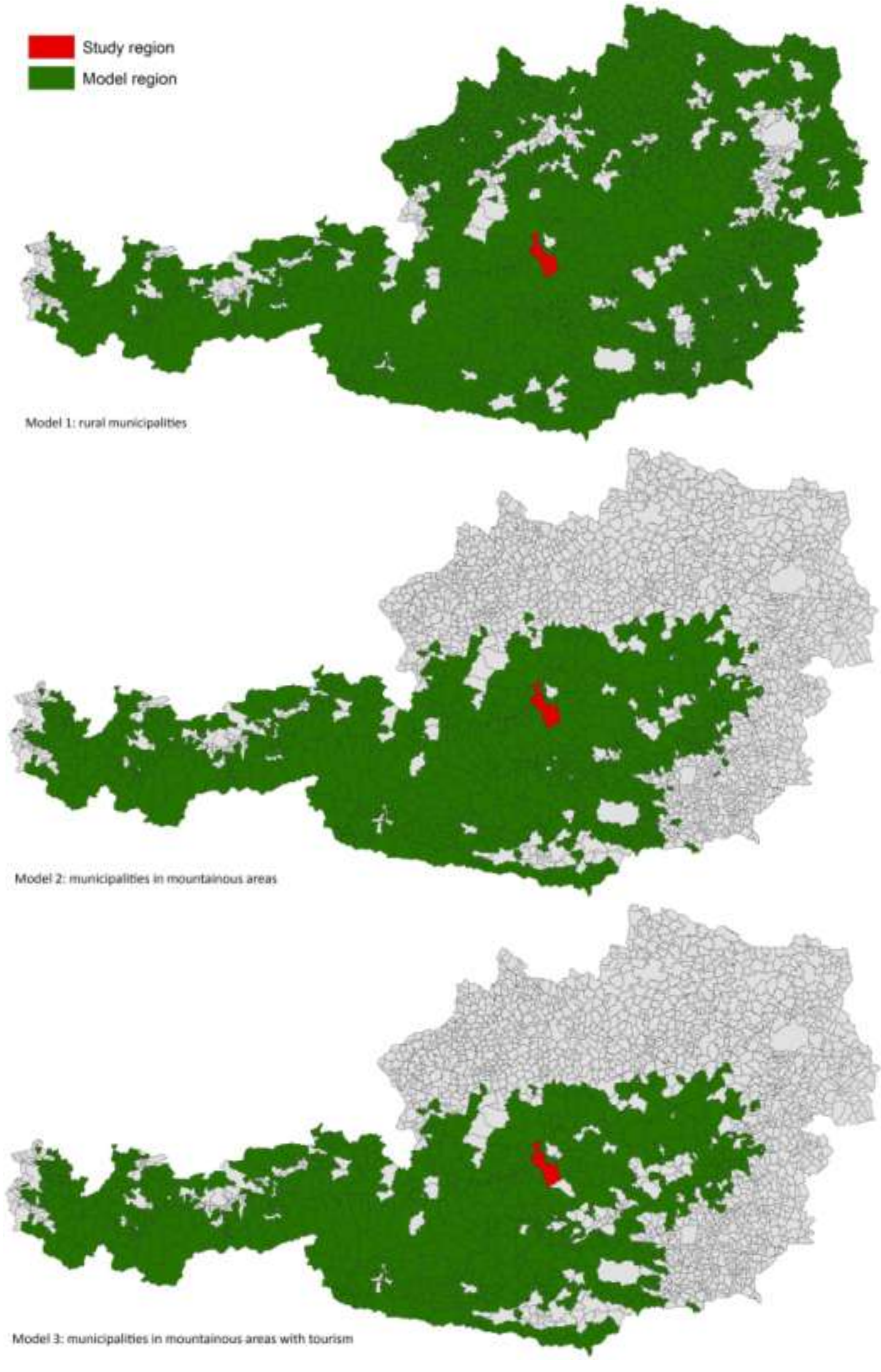
Model region 3 comprises 649 mountainous, rural municipalities with tourism. As indicator for tourism we use overnight stays, which must show a positive number. Tourism is considered as a key factor to set a link between rural competitiveness and landscape.

Four case study municipalities are of specific interest in our analysis, namely “Aigen im Ennstal”, “Oppenberg”, “Pürgg-Trautenfels” and “Stainach”. All are located in the region “Mittleres Ennstal” in the northern Austrian Alps in the district of “Liezen” in the federal state of Styria. Thee region represents a typical mountain area covering a main and two side valleys, including an urban centre and a couple of small villages. The landscape is characterised by sheer rock walls and block heaps as well as of gentle mountainous formations and the plains of the valley. The whole scenery of the valley is strongly influenced by the mountains framing the valley. The valley itself is characterized by the river Enns and a multitude of landscape elements. The higher regions are characterized by an “own” alpine scenery that consists of alpine meadows, pastures and forests.

As regards agricultural land management the case study municipalities are characterised by rather small, traditional, family farms specialised on dairy or mixed farming. Agricultural land use first and foremost takes place as small structured grassland. Only in the river-valley, UAA to some extent is used as arable land nearly exclusively for forage production. Grassland to a high percentage is managed with comparatively low intensity in form of alpine meadows and pastures and other extensive grassland.

As regards competitiveness, the case study municipalities fall behind other regions in Austria and also behind the country’s average. The income level in the district is by 9% lower than the Styrian average and by 11% lower than the national average. However, the unemployment quote is lower than the average of both Styria and Austria. The average tax revenue per inhabitant in three of the Municipalities among the lowest of the district “Liezen”, only in the municipality including the urban centre tax revenue is comparatively high (RLP, 2011). At the moment, the municipalities of the study region are faced by a constant and severe emigration especially of young and educated people (WIRTSCHAFTSKAMMER STEIERMARK 2013).

Figure 1 presents the municipalities of our model regions 1, 2 and 3 (green colour) as well as the 4 case study municipalities (red colour).



9.4.2 Definition of DEA Input and Output Factors

Our DEA model is a single-input, multiple-output model. In general, when choosing our input and output factors we aimed at responding to the appraisal that competitiveness should be addressed not only in the economic sense but also by considering social and sustainability components. However, taking into account existing indicator systems assessing regional competitiveness (see chapter 9.2), it became clear that most of the suggested "productivity" and "economic" indicators, measuring GDP, GVA, wage levels, etc., and of the "social" and "sustainability" indicators measuring the wellbeing of the local population, to the quality of life, the development of human capital, or the sustainable use of resources, etc. are either not suitable for describing rural areas or not available on municipal level in Austria. Therefore, we chose the best factors available while not losing our target to cover competitiveness in as many dimensions as possible. Finally, the basic idea of our model is that "population", living in a specific community, is the main "input" for economic and social outcome. The respective outcome is defined by four output factors: "Education level", "Economic performance", "Employment rate" and "Population development". The DEA is identically applied in all three study regions. The data for all input and output factors is taken from Statcube, a statistical data basis compiled by Statistics Austria. The chosen input and output factors are presented in Table 1.

Table 1: Variables; adjusted DEA model

Input	Outputs
Population	Education level
	Economic performance
	Employment rate
	Population development

Input factor "Population"

Population is the sole input factor of our model. It represents all inhabitants living in the respective municipalities in the year 2010. In order to be counted as an inhabitant the inhabitant has to have his principal residence in the respective municipality.

Output factor "Education level"

The first output factor is the "education level". As Romer (1986) shows, education of the local population is a key factor for the competitiveness of a region. In our analysis the indicator has to be aggregated into a single value. For this reason we weight the different education forms and multiply it with the number of inhabitants with the same level of education. Table A - 1 in the appendix gives an overview on the different education levels and the respective factors. Furthermore it provides brief information of the respective school types.

Output factor "Economic performance"

"Economic performance" is the second output factor of our DEA model. As indicator for economic performance we use municipal tax. It has to be paid by every employer (with the exception of for institutions caring for elderly people, youth, families, handicapped people, ill people, blind people and health); the rate tax is 3 % of the overall gross income of all employees in the company. Consequently, the revenue for the municipality generated by this tax indicates the economic activity in the municipality. It is to note, that we originally preferred to use the regional gross domestic product (GDP), but this data is not available on LAU 2 level.

Output factor "Employment situation"

The third output factor is the "Employment rate". The availability of skilled workers is an essential part for economic growth and innovation in a region. There is also a social component when looking at employment as a factor for competitiveness. Work is an essential part of human`s life and the basic source of prosperity.

There are numerous studies that focus on the link between happiness and employment (see e.g. LANE (1991), WILSON (1996) and WARR (1999)). The employment rate is measured by the number of working places in the municipality in the year 2010.

Output factor "Population development"

The fourth output factor is "Population development". In literature this factor is used to express the economic attractiveness of municipalities. For instance, WALTERT and SCHLÄPFER (2010) measure the attractiveness of residential areas via migration rates, which is directly linked to population development. Population development is calculated by with the following formula:

$$P_{\Delta t} = (B_{\Delta t} + D_{\Delta t}) + (I_{\Delta t} - E_{\Delta t}),$$

where P stands for Population development, B for Births, D for Deaths, I for Immigration, E for Emigration and Δt for the respective period of time. The population development of a period is influenced by natural growth (B+D) and the mechanical growth (I-E), which is mostly driven by social factors. For our analysis in particular the second part of the formula is important, since it indicates the migration rate. In our study the migration rate is calculated as follows:

$$M_{\Delta t} = (Z_{\Delta t} - W_{\Delta t}) + (V_{\Delta t} - W_{\Delta t}),$$

where M stands for the migration rate, Z for the immigrants from foreign countries, W for emigrants into foreign countries, V for immigrants from other municipalities, W for emigrants to other municipalities and Δt again for the respective period of time.

The implementation of the migration rate into DEA requires a transformation, since resulting values might be even negative and DEA allows only for positive values. For this reason the population development is calculated as the difference of population from 2002 to 2010 including natural growth. We measure the correlation between the migration rate and the population development to see if there are changes in the results when using population development instead of migration rate. The result is a correlation coefficient of 0.99. So this replacement does not highly influence the results. We transform these values for population development with multiplicative inversed scaled values. It means that the values were transformed into positive values to be able to use in DEA. For an in-depth description of this transformation confer to FRANZEL (2013, 13).

Table 2 gives a summarising overview on the statistical characteristics of our DEA input and output factors. The information in the table is sub-grouped with regard to our model regions.

Table 2: Statistical characteristics of DEA input and output variables

		Population persons	Education level factor	Economic performance €	Population development persons	Employment situation persons
Model 1	Minimum	61	57	1	4	60
	Maximum	11341	14318	438000000	7041	11981
	Mean	1732	2066	492932	516	1760
	Median	1410	1651	137497	324	1428
	SD	1306	1634	9825031	602	1362
Model 2	Minimum	61	57	1	10	64
	Maximum	10385	13445	3035923	5638	10060
	Mean	1673	2006	295448	535	1687
	Median	1312	1545	150748	315	1319
	SD	1344	1726	399821	657	1389
Model 3	Minimum	61	57	979	10	64
	Maximum	10385	13445	3035923	5638	10823
	Mean	1725	2055	313992	550	1742
	Median	1351	1579	165847	327	1355
	SD	1352	1708	410837	640	1419

9.4.3 Second-Stage Regression

Our second-stage analysis aims to analyse, which factors are driving regional competiveness. For this purpose we have chosen a set of contextual factors, which can be subdivided into two groups: landscape-related factors shall help to determine the influence of landscape on regionals competitiveness, non-landscape-related factors aim to analyse the influence of geographical and economic aspects. Similar to the DEA factors, we also have to emphasise with regard to the second-stage contextual variables, that data availability was a main criteria for selecting variables.

Openness of landscape (OL)

Particularly in mountainous areas open, non-forested land is perceived as attractive. The results of survey of local residents and tourists conducted within the KuLaWi project (a project which focussed on the future of cultural land and land use in the alpine land of Tyrol and South Tyrol) show that the preservation of the traditional cultural land is considered as one of the most important outputs of agriculture (SCHERMANN et al., 2011, 96f). As indicator for the openness of landscape we use the proportion of non-forestry area to total area (including forest area and non-forest area). Land use is calculated on basis of CORINE (UMWELTBUNDESAMT, 2001, s.p.). Forest land includes (1) deciduous forests, (2) conifers forests and (3) mixed forests. Non-forest land includes (1) non-irrigated arable land, (2) vineyards, (3) grassland and pastures, (4) complex landscape area, (5) land for agricultural use with significant level of natural land included, (6) natural grassland, (7) heathen and moorland, (8) land with bush vegetation, (9) barren ground with vegetation, (10) barren ground without vegetation, (11) glaciers, (12) swampland and (13) peat land.

Degree of mountainous of the landscape (ML)

The degree of mountainous the landscape is expressed as the altitude difference between the highest and the lowest agricultural field of the municipality. The factor indicates the slope and the alpine level of the municipality. The data is taken from the INVEKOS data set from 2009.

Characteristic landscape (CL)

SCHERMANN et al. (2011, s.p.) show that complex and diverse structures of landscape are highly attractive for tourists and consequently determining the attractiveness of landscapes. In order to measure this characteristic and attractiveness of landscapes, we choose characteristic types of land use out of the CORINE land cover (UMWELTBUNDESAMT, 2001) and aggregate them to one value. The following types of land use are considered: (1) complex landscape area, (2) land for agricultural use with significant level of natural land included natural grassland, (4) heathen and moorland, (5) land with bush vegetation, (6) swampland, (7) peat land and (8) barren ground with vegetation.

Mountain Pastures (MP)

Also mountain pastures are considered as determining the attractiveness of landscapes. For instance, it is very common to use pictures of mountain pastures in tourism-related advertising campaigns. Mountain pastures are areas for recreation and hiking, which are considered as highly attractive landscape areas (KIRCHENGAST, 2006, 140). Based on INVEKOS data we measure the extent of mountain pastures square meters.

Tourism (T)

As a first non-landscape-related factor we choose tourism. As indicator for this factor we use the number of overnight stays in 2010, which is a common indicator for tourism intensity. The data is provided by Statistics Austria. The relation between tourism and landscape is explored in numerous studies (e.g. KNUDSEN et al., 2008). HOFBAUER (1992, 16) considers landscape as the main pillar for Austrian tourism. A survey from PRUCKNER (1993) underlines this importance of landscape for Austrian tourism: 84% of foreign tourists consider cultivated landscapes as important for the choice of their holiday destinations. Our data set is provided by Statistics Austria.

Distance to the next urban area (ND)

The second non-landscape-related factor is the distance to the next urban area. This factor is chosen in order to analyse, if the adjacency to urban areas influences the competitiveness of rural municipalities. The basic concept lying behind this hypothesis is the central place theory established by CHRISTALLER (1933). In order to calculate the distance of rural municipalities to the next urban area, we classify all municipalities with regard to rurality: based on Statistic Austria we consider all type 3 municipalities (thinly-populated) as rural municipalities and type 1 (intermediate populated) and type 2 municipalities (densely populated) as urban municipalities. In the next step we identify for all municipalities the central point. Finally the distance from each central point of a rural municipality to the nearest urban central point is calculated with the ArcGis® “neardist” function.

Value of land (VL)

A final (non-landscape-related) factor is the value of land. As indicator for this factor we use the municipal land tax revenues in 2010. This tax is raised for construction land and for agricultural land. The basic rate is determined by the Austrian government, but municipalities are allowed to raise it individually within a predefined frame. Land tax revenues indicate the economic attractiveness of municipalities. Consequently land tax revenues should be clearly correlated to our DEA results, which express the competitiveness of the respective municipalities. Consequently, we apply for this variable solely a correlation analysis, but do not include it into the multiple linear regression model.

Table 3 gives a summarising overview on the statistical characteristics of our contextual factors. The information in the table is sub-grouped with regard to our three spatial models.

Table 3 Statistical characteristics of our contextual factors

		OL %	ML m²	CL m²	MP m²	T overnig ht stays	ND m	VL €
Model 1	Minimum	0.002	3.0	0.0	2.9	0.0	883.3	923.0
	Maximum	1	2098	5642	23130	2180000	50900	1389000
	Mean	0.54	486	273	1212	45560	12270	11680
	Median	0.56	273	68.28	646.80	3452	10390	80320
	SD	0.35	460	524.87	1689.92	145706	8013	118471
Model 2	Minimum	0.002	9	0	2.86	0	883	3794
	Maximum	1.00	2098	2088	23130	2180000	50900	980200
	Mean	0.30	985.8	297	1212	105900	14600	130100
	Median	0.22	987	219.30	646.80	23040	12290	82350
	SD	0.25	390	298.32	1689.92	224197	9512	139362
Model 3	Minimum	0.001	15	0	2.86	66	883	3794
	Maximum	0.96	2098	2088	23130	2180000	50900	980200
	Mean	0.30	1018	308.90	1304	115900	15030	137500
	Median	0.24	1017	239.30	734.30	28710	13060	89170
	SD	0.25	379	301.60	1737.22	232035	9585	142915

9.5 Results

The results are divided in two main parts, where the first one includes the results of the DEA analysis for competitiveness of the municipalities and the second includes the regression analysis on the DEA results to explain the DEA results.

9.5.1 DEA results

The results of the efficiency calculations are presented in table 4. The efficiency scores range from 0.7 to 1 indicating a generally high efficiency level. The lowest value is observed in model region 1, whereas the lowest efficiencies are higher in model region 2 and 3 (being identical in both models). This result indicates that the municipalities in model 2 and 3 are more homogenous. The average efficiency scores are also higher in the models 2 and 3.

Looking at the distribution of the efficient municipalities it is to note that the number of DMUs building the efficiency frontier is low in all three model regions. In model region 1, seven out of 1988 (0.4 %) are efficient, while 59 (3.5%) municipalities are located in the last three deciles. The majority of the municipalities is located in the fourth decile. In model 2 eleven out of 710 municipalities are efficient (1.6 %), which is a slightly higher percentage than in model 1. With 13.66% there are also more highly efficient observations in the last 3 deciles in model 2. Model 3 shows similar results to model 2. Eleven municipalities out of 649 (1.7 %) have an efficiency score of 1 and 13.6% are in the last 3 deciles.

Table 4: Summary of DEA results

	Model region 1		Model region 2		Model region 3	
Number and share of DMUs						
	obs.	share	obs.	share	obs.	share
Total DMUs	1988	100.0	710	100.0	649	100.0
Efficient DMUs	7	0.4	11	1.6	11	1.7
Distribution of efficiency scores (number of municipalities)						
No of decile	obs.	share	obs.	share	obs.	share
1st	17	0.9	5	0.7	4	0.6
2nd	137	6.9	24	3.4	21	3.2
3rd	425	21.4	84	11.8	74	11.4
4th	585	29.4	131	18.5	114	17.6
5th	438	22.0	142	20.0	133	20.5
6th	227	11.4	138	19.4	132	20.3
7th	90	4.5	89	12.5	83	12.8
8th	39	2.0	48	6.8	44	6.8
9th	17	0.9	24	3.4	19	2.9
10th	6	0.3	14	2.0	14	2.2
Statistical parameters of efficiency score distribution						
Minimal efficiency	0.70		0.76		0.76	
Mean efficiency	0.82		0.88		0.88	
Standard deviation	0.04		0.05		0.05	
Kurtosis	1.33		0.07		0.15	
Skewness	0.82		0.45		0.46	

In Figure 2 the efficiency scores of the 3 model regions are geographically displayed. The map displaying model region 1 shows that municipalities with high efficiency scores are particularly located to densely populated areas (indicated green in the map). Such agglomerations of highly efficient municipalities can be especially found in the areas around the cities of Vienna, Graz, Klagenfurt and Linz. Also municipalities located in the valley of Inn near Innsbruck show a better performance with regard to competitiveness. Municipalities located in the alpine areas show in general lower efficiency scores. There are only a few exceptions, such as *Sölden* (efficiency score: 0.923), *Tweng* (0.892) and *Lech* (0.923), which are mostly of high touristic importance.

With regard to the results of model region 2, it is to note that agglomerations of highly efficient municipalities are particularly observed along the *Inn valley* close to *Innsbruck*. Low efficient municipalities are agglomerated in the south of Tyrol, in Eastern Tyrol, as well as in region of *Liezen*, in-between the *Mur valley* and the *Enns valley* (not considering the municipalities located directly in these main valleys). Finally it is to annotate that model 3 results are very similar to model 2 results.

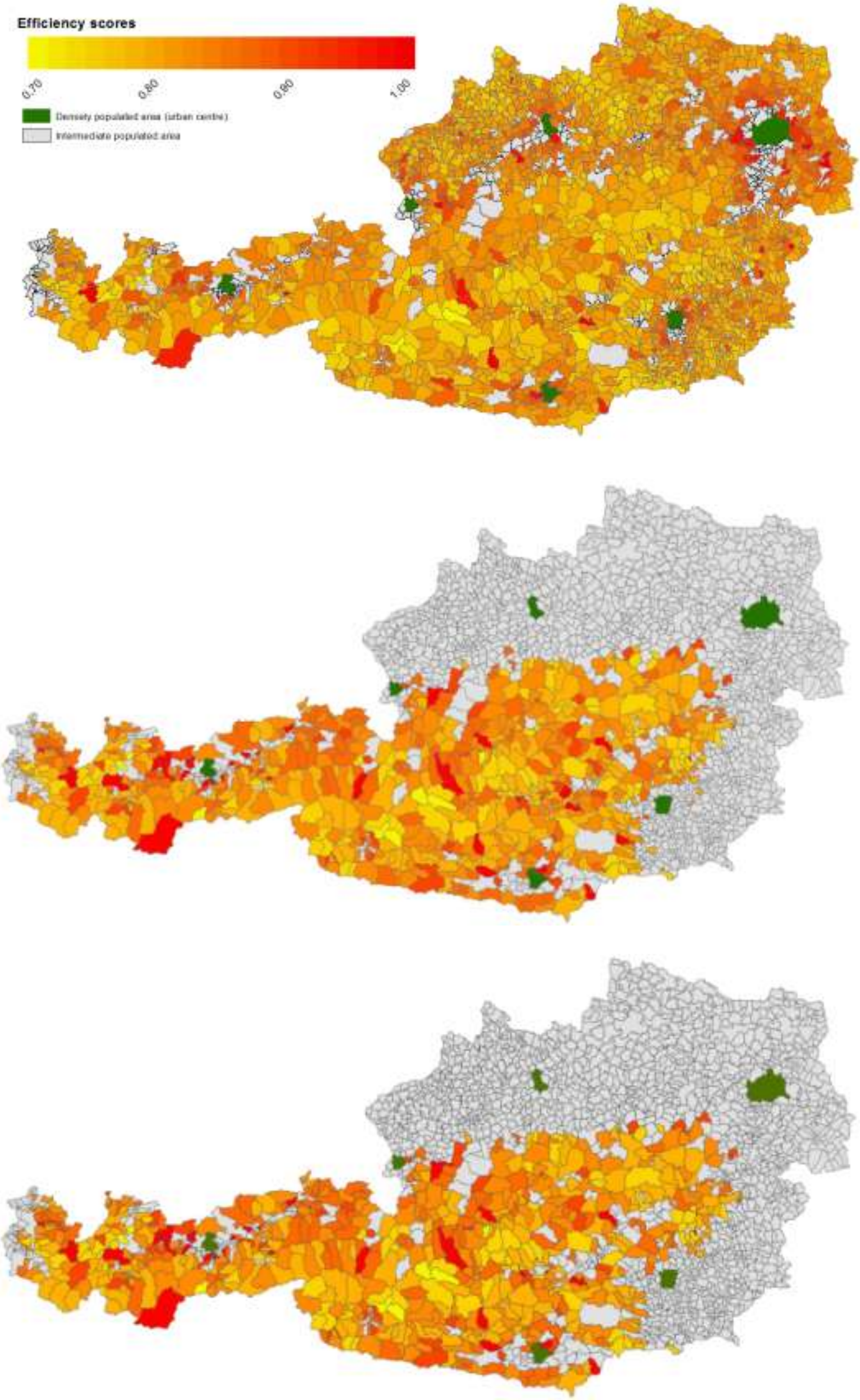


Figure 2: Spatial distribution of efficiency scores; model region 1, 2 and 3

Looking at our case study municipalities, *Stainach* is the highest ranked case study municipality; this applies with regard to all three geographical models (Table 20). *Stainach* futhermore it is the only case study municipality with an efficiency score in the first quantile. The efficiencies of the remaining case study municipalities *Aigen im Ennstal*, *Pürgg-Trautenfels* and *Oppenberg* are by far lower than in *Stainach*. The rank order of case study municipalities is identical in all three models: the two municipalities located in the main valley show higher efficiency scores than the two municipalities located in side valleys.

Table 20: Summary results, study region

		Model region 1		Model region 2		Model region 3	
		Efficiency		Efficiency		Efficiency	
Municipality	**Type of valley**	score	Rank	Score	Rank	Score	Rank
Stainach	Main valley	0,8584	369	0,9279	95	0,9278	86
Aigen im Ennstal	Main valley	0,8111	1108	0,8745	340	0,8745	317
Pürgg-Trautenfels	Side valley	0,8046	1237	0,8652	400	0,8652	373
Oppenberg	Side valley	0,7750	1728	0,8377	562	0,8377	521

9.5.2 Results of the second stage analysis

In the following chapter we present the results of the second stage analysis. Firstly we implement a correlation analysis, which is subdivided into non-landscape- and landscape-related factors (Table 5). The most important non-landscape-related factor is the "Value of land"; the correlation is in all three models clearly positive and highly significant. Also with regard to "Tourism" there is in two models a significant correlation, the "Distance to the next urban area" is only in model 1 significant and the negative correlation is quite small.

Correlations of landscape-related factors to DEA scores are in general lower. However, the indicator "Mountainous of landscape" show significant correlations in all three models and is therefore the most important factor of this group. In contrast to this, the correlation between DEA scores and "Openness of landscape" is only in model 1 significant, and even there the correlation is with 0.17 rather small. With regard to the mountainous municipalities (model 2 and model 3) no significant correlations can be observed. With regard to the remaining two indicators, "Characteristic landscape" and "Mountain pastures", we do not observe any significant correlation.

Table 5 Results of correlation analysis

	Model region 1		Model region 2		Model region 3	
Non-landscape-related factors	r		r		r	
Tourism	0.14	***	-		0.24	***
Dist. next urban area	- 0.34	***	- 0.17		-0.20	
Value of land	0.42	***	0.46	***	0.48	***
Landscape-related factors	r		r		r	
Openness of landscape	0.17	***	-0.04		-0,05	
Mountainous landscape	0.24	***	0.10	**	0.14	***
Characteristic landscape	<0.01		-0.02		-0.04	
Mountain pastures	-		0.01		-0.01	

t-test, significance levels: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Not surprisingly, the OLS multiple regression results are very similar to the results of the correlation analysis (Table 6). R^2 is the highest in model 1 (0.1898) followed by model 3 (0.1592) and model 2 (0.09814). The p-value indicates a high significance of all three models. In model 1 four indicators have a significant influence on DEA efficiency scores, namely tourism, distance to the next urban area, openness of landscape and mountainous landscape. In model 2 three indicators are significant (tourism, stance to the next urban area, mountainous landscape) and in model 3 again four indicators show a significant influence (tourism, distance to the next urban area, openness of landscape and mountainous landscape).

Table 6: Results multiple regression, OLS model

	Model region 1		Model region 2		Model region 3	
R^2	0.1898		0.0981		0.1592	
Adj. R^2	0.1878		0.0905		0.1513	
p-value	<2e-16		1.076e-13		6.371e-08	
T	0.0015	<2e-16***	0.0025	<2.0e-16***	0.0094	<2e-16***
ND	-0.0215	<2e-16***	-0.0131	9.74e-09***	-0.0121	<2e-16***
OL	0.0083	0.0099**	-0.0133	0.061.	-0.0211	0.0049**
ML	-0.0098	<2e-16***	-0.0159	1.57e-05***	-0.0168	3.44e-05***
CL	0.0002	0.6360	-0.0003	0.713	-0.0009	0.211
MP	-	-	0.0021	0.130	-0.0006	0.688

significance levels: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

With regard to our second regression model, the Tobit regression, it is to annotate, that the results are very similar to the OLS regression results; all in all no substantial differences exists and our OLS results are confirmed (Table 7).

Table 7: Results multiple regression, Tobit model

	Model region 1		Model region 2		Model region 3	
p-value	<2e-16***		<2e-16***		<2e-16***	
T	0.0015	<2e-16***	0.0025	<2e-16***	0.0095	<2e-16***
ND	-0.0215	<2e-16***	-0.0132	<2e-16***	-0.0122	6.5e-07***
OL	0.0083	0.0096**	-0.0135	0.0606.	-0.0212	0.0049**
ML	-0.0098	<2e-16***	-0.0159	<2e-16***	-0.0168	3.5e-05***
CL	0.0002	0.513	-0.0002	0.7349	-0.0008	0.2274
MP	-	-	0.0021	0.1353	-0.0006	0.6786

significance levels: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

9.6 Discussion

In this paper, we test if the competitiveness of rural regions can comprehensively be measured on municipal level by applying a single-input, multiple-output DEA model. As input-factor, our model considers "population", as output-factors "demographical chance", "educational attainment", "municipal tax" and "number of jobs". Basically, the selection of input and output factors followed two main criteria, namely 'relevance' and 'data-availability'. At this point it has to be noted, that first we tried to establish an ideal model of measuring competitiveness, considering social and economic factors orientated at existing indices for measuring regional competitiveness. However, it became obvious, that the main problem for using this "ideal" model was data availability. So, for example, data on average income per head or household, regional GDPs or data on the characteristics or even number of companies is not available on LAU2 level. An "ideal" DEA model of measuring regional competitiveness would also consider the approach of dynamic benchmarking, to analyse the performance of the municipalities over a period of time. Again, only few periodically recorded data is available on municipal level so also this idea had to be discarded due to data-shortages. Consequently, it is clear that the input and output-factors finally considered in our model, and also the static approach, are most likely not the be-all and end-all of measuring competitiveness on municipal level; in contrast, our model is rather strongly driven by "data-availability".

However, when looking at our DEA results, we observe that they are consistent to a high degree, despite of the limitations mentioned above. This becomes clear particularly when putting the results into a spatial contextThe municipalities for which our DEA model depicts the highest efficiencies, turn out to be located either in close proximity to cities (e.g. around Vienna, Graz, Linz or Innsbruck) or along major infra-structural routes, such as the important west-east connection between Salzburg and Vienna, or along the northwest – south connection throughout the Alps. In contrast, the municipalities with the lowest efficiencies are located in very remote areas, such as the high Alps. The model also depicts single municipalities within very remote areas, which show exceptional high efficiencies. Also here, the consistency of our model is proven. These outstanding municipalities surrounded by low efficient, remote municipalities represent touristic strongholds, such as e.g. “Sölden”, “Lech” or “Untertauern”, characterised by high-level skiing tourism.

Even when looking at the efficiencies of our case study municipalities, the consistency of our results is confirmed. Here, it becomes obvious, that those two municipalities located in the main valley show a higher efficiency than the ones located in the more remote side valleys. The highest efficiencies we detect for the main-valley municipality “Stainach”. Referring to our up-stream qualitative research results, this is not surprising. In “Stainach”, on the one hand the urban centre is located, and on the other hand a major local food industry company is offering broad employment possibilities. Also as regards agriculture, in the main valley production conditions are significantly better than in the side valleys, where agricultural production is shaped by low-intensive grassland use. The least efficient municipality within our case study area is “Oppenberg”. Also this result is confirming our expectations: Oppenberg is the highest located of the 4 surveyed municipalities and characterized only by agricultural activities. At the moment the municipality is faced with severe migration. The low technical efficiency of this municipality is therefore clearly reliable.

Another demonstration that our model is reliable is given by the correlation analysis: Here, we found the highest correlation between the technical efficiency of a municipality and the value of land. In other words our model indicates that the higher the efficiency of a municipality, the higher is the monetary value of land. This correlation is rather convincing as it can be regarded as undisputed, that the value of land, representing on the one hand the quality of agricultural area and on the other hand the real-estate and building values, to a high extent mirrors the competitiveness of a region.

As regards the assessment of the influence of landscape on the competiveness of a region, again it has to be noted that the selection of indicators was mainly driven by availability of data on LAU2 level. However, also these results are consistent with our expectations. To better assess the potential influence of landscape on regional competitiveness, we look at both landscape-related and landscape-unrelated factors. It becomes rather clear, that first and foremost the “non-landscape” factors, namely “closeness to semi-urban and urban regions”, “tourism” and “property tax” show significant influence on the efficiency of rural regions – whereas it has to be noted that the overall correlations are low. However, the most decisive “non-landscape” factor turns out to be the closeness to semi-urban and urban regions.

As regards “landscape” related factors our results reveal that their influence on regional competitiveness is far lower than the influence of non-landscape related factors. Here both correlations and also significance clearly decrease. The influence of the landscape factor “openness of landscape” varies throughout our three model regions as regards algebraic sign. While in Model region 1 the influence of openness of landscape is positive, in the “mountainous” model regions 2 and 3, the influence is negative. This result is not surprising, as model 1 includes high percentages of productive, flat and open landscapes with good agricultural pre-conditions. Also most Austrian cities and infrastructural strongly developed regions are located rather in non-mountainous, open area. In contrast, in the mountainous regions the percentage of open land is significantly lower, while open land is to a high share of bad quality and managed with low intensity.

Our analysis also shows that the more “mountainous” a municipality is located, the less efficient it is. It is to note that the correlation describing this impact is low, however it is significant. In general, the factor “mountainous landscape” can be taken as a structural parameter, as the more a region is located in the mountains, the more remote it is as regards access to infrastructure, education and labour markets.

The last result of our analysis to be discussed is the influence of the factors “characteristic landscape” and “mountain pastures”, which both considers very specific landscape elements within the Austrian mountainous landscape and , consequently, match very clearly the aesthetic and intrinsic value of landscapes. Our results reveal that such factors have no significant influence on competitiveness – if any non-significant correlation can be detected, the influence appears to be rather negative. Especially when referring to our up-stream research, this result is sobering enough, as exactly such factors, being crucial for the “beauty” of alpine rural landscapes and the related cultural services provided in a landscape, are to a high degree appreciated and valued by the local society while up to now this valorisation is obviously not reflected in terms of competitiveness.

In a final statement it is to say that our study results reveal that the more remote an area, the less competitive it is, even if the landscape is beautiful and rich of potential landscape services – except if landscape is completely valorised by intensive tourism – on cost of cultural identity and authenticity.

References

BRISTOW, G. (2005). Everyone’s a ‘winner’: problematising the discourse of regional competitiveness. Journal of Economic Geography, 5: 285-304.

CHRISTALLER, W. (1933). Die zentralen Orte in Süddeutschland : eine ökonomisch-geographische Untersuchung über die Gesetzmäßigkeit der Verbreitung und Entwicklung der Siedlungen mit städtischen Funktionen. Darmstadt : Wiss. Buchges.

COOPER, T., HART, K., BALDOCK, D. (2009). Provision of Public Goods through Agriculture in the European Union. Report Prepared for DG Agriculture and Rural Development, Contract No 30-CE-0233091/00-28, Institute for European Environmental Policy: London.

DE BORGER, B.;KERSTENS K., W.;MOESEN, W. and J. VANNESTE (1994). Explaining differences inproductive efficiency: An application to Belgian municipalities, Public Choice 80, 339-358.

DE GROOT, R., ALKEMADE, R., BRAAT, L., HEIN, L. AND L. WILLEMEN. (2010). Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making, Ecological Complexity 6, 453-462.

DEPARTMENT OF TRADE AND INDUSTRY (2002). Productivity and Competitiveness Indicators. DTI, 2002.

ENRD (2010). Thematic Working Group 3: Public Goods And Public Intervention: Final Report. European Network for Rural Development. Brussels

EUROPEAN COMMISSION (2009). European Competitiveness Report 2008, Communication from the Commission COM(2008) 774 final. European Commission, Luxembourg, 2009

EUROPEAN COMMISSION (1999a). Sixth Periodic Report on the Social and Economic Situation of Regions in the EU, 1999.

EUROPEAN COMMISSION (1999b). Territorial competitiveness - Creating a territorial development strategy in light of the LEADER experience, “Rural Innovation” Dossier n° 6 - LEADER European Observatory

European Commission (2002 – 2013). Periodic reports on economic, social and territorial cohesion. Report from the commission. In: http://ec.europa.eu/regional_policy/information/reports/index_en.cfm

EUROPEAN COMMISSION (2010). EU Regional competitiveness Index 2010. Publications Office of the European Union, Luxembourg, 2010

EUROPEAN COMMISSION (2012). Degree of urbanisation (DEGURBA) – Local Administrative Units. In: http://ec.europa.eu/eurostat/ramon/miscellaneous/index.cfm?TargetUrl=DSP_DEGURBA (12.02.2014).

EUROPEAN COMMISSION (2013a). Regional Typologies Overview. In: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Regional_typologies_overview (12.02.2014).

EUROPEAN COMMISSION (2013b). Urban-rural typology – update.In: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Urban-rural_typology_update. (12.02.2014).

EUROPEAN COMMISSION (2001). Second Report on Economic and Social Cohesion (2001)

FIELDSEND, A. (2011). Determining the Socio-economic Value of Agricultural Landscapes Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Horticulture, Vol 68, No 1 (2011)

FLORIDA, R., (2000). The Economic Geography of Talent. SWIC Working Papers, September. 2000.

FRANZEL, M. (2013). Nicht-parametrische Effizienzmessung landwirtschaftlicher Betriebe unter Berücksichtigung von Umweltaspekten auf Grundlage von Buchführungsdaten. Universität für Bodenkultur Wien. Diplomarbeit. Wien.

GUJARATI, D. N. (2003). Basic Econometrics. 4th Edition.International Edition. McGraw-Hill/Irwin: New York.

HAINES-YOUNG, R. AND M. POTSCHIN (2010). The links between biodiversity, ecosystem services and human well-being. In: RAFFAELLI, D.G. and FRID, C.L.J., eds., Ecosystem ecology: a new synthesis Cambridge University Press. 110-139

HOFBAUER, N. (1990). Kooperation tut Not!. Agrarische Rundschau. Heft 1.

Huggins, R. (2003). Creating a UK Competitiveness Index: regional and local benchmarking. Regional Studies 37(1), pp. 89-96.

HUGGINS, R. AND W. DAVIES (2006). European Competitiveness Index 2006-07. Robert Huggins Associates Ltd. 2006

HUGGINS, R. AND J. DAY (2006). UK Competitiveness Index, 2006: University of Wales Institute, Cardiff – UWIC: Robert Huggins Associates Ltd.

Huggins, R and P. Thompson (2010).. UK Competitiveness Index, 2010. Centre for International Competitiveness, University of Wales Institute, Cardiff, 2010

IMD (2000).The World Competitiveness Yearbook, Lausanne, 2000.

KIRCHENGAST, C. (2006). Über Almen - sozial- und kulturanthropologische Betrachtungen zur Almwirtschaft in Österreich. Project„ALP Austria“.Vienna: Lebensministerium.

KNUDSEN, C.; METRO-ROLAND, M. M.; SOPER, A. K. and GREER, E. (2008). Landscape, Tourism and Meaning. Hampshire: Ashgate Publishing Limited.

KRIESE, M. (2008): Effizienz der sächsischen Gemeinden. Ifo Dresden berichtet.3-13.

KRUGMAN, P. (1990). The Age of Diminished Expectations. Cambridge MA, MIT Press, p.9.

KRUGMAN, P. (1994a). Competitiveness: A Dangerous Obsession’, Foreign Affairs, Vol. 73(2), pp. 28-44.

KRUGMAN, P. (1994b). The myth of competitiveness, Foreign Affairs.

LANE, R. (1991). The Market Experience. Cambridge: Cambridge University Press.

MARTIN, L.; WESTGREN, R. and VAN DUREN, E. (1991). Agribusiness Competitiveness across National Boundaries. American Journal of Agricultural Economics 73, 1456–1464.

Martin, R. (2004). A Study on the Factors of Regional Competitiveness - A draft final report for The European Commission Directorate-General Regional Policy In: http://ec.europa.eu/regional_policy/sources/docgener/studies/study_de.htm

Martin, R., Kitson, M. and P.Tyler (2006). Regional Competitiveness. London: Routledge.

Meyer-Stamer, J. (2008). “Systematic Competitiveness and Local Economic Development.” In Shamin Bodhanya (ed.) Large Scale Systemic Change: Theories, Modelling and Practices. http://www.meyer-stamer.de/2008/Systemic+LED_SouthAfrica.pdf

Organisation for Economic Cooperation and Development (OECD). The New Economy: Beyond the Hype, 2001.

OECD (2010). OECD Regional Typology. Directorate for Public Governance and Terretorial Development. In: http://www.oecd.org/gov/regional-policy/42392595.pdf(12.02.2014).

PORTER, M. (1992). COMPETITIVE ADVANTAGE: CREATING AND SUSTAINING SUPERIOR PERFORMANCE. LONDON: PA CONSULTING GROUP, P. 40.

PORTER, M AND C.KETALS (2003). UK COMPETITIVENESS: MOVING TO THE NEXT STAGE, DTI ECONOMICS PAPER NO. 3, ECONOMIC AND SOCIAL RESEARCH COUNCIL AND DEPARTMENT OF TRADE AND INDUSTRY, P.11.

PRUCKNER, G. (1993). Ökonomische Quantifizierung natürlicher Ressourcen. Eine Bewertung überbetrieblicher Leistungen der Land- und Forstwirtschaft. Dissertation. Universität Linz.

RITSILÄ, J. J. (1999). Regional Differences in Environments for Enterprises, Entrepreneurship & Regional Development, 1999, Vol. 11, pp. 187-202.

ROMER, P. M. (1986. Increasing Returns and Long Run Growth. Journal ofPolitical Economy, 94, 1002–37.

SCHERMANN, M.; BACHER, M. and U.TAPPEINER (2011). Wer will welche Landschaft? – Zur Konzeption von Kulturlandschaft in Nord- und Südtirol. SÜDTIOL: VBA. 85-110.

STATISTICS AUSTRIA (2014). Zuordnung Grad der Urbanisierung zu Gemeinden. In: http://www.stat.at/web_de/klassifikationen/regionale_gliederungen/stadt_land/index.html. (12.02.2014).

STEEL, R.G.D, and J.H.TORRIE (1969). Principles and Procedures of Statistics with Special Reference to the Biological Sciences., McGraw Hill, 1960, pp. 187, 287.

Schwab, K. and M. Porter (2007). The Global Competitiveness Report 2007-2008. World Economic Forum. Geneva, Switzerland.

TEEB (2010a). The economics of ecosystems and biodiversity: mainstreaming the economics of nature: a synthesis of the approach, conclusions and recommendations of TEEB

Thomson, N. & N. Ward (2005). Rural Areas and Regional Competitiveness, Centre for Rural Economy Research Report, Report to Local Government Rural Network ISBN 1 903964 23 7

UMWELTBUNDESAMT (2001). CORINE Land Cover. In: http://www.umweltbundesamt.at/umweltsituation/umweltinfo/opendata/oed_landbedeckung/?cgiproxy_url=http%3A%2F%2Fhttpapp5.umweltbundesamt.at%2Fdata%2Fdataset.jsf%3Bjsessionid%3D3588B90213085F7B4763982921929863%3Fid%3D6. (15.02.2014).

VAN ZANTEN B.T., VERBURG P.H., ESPINOSA M., GOMEZ-Y-PALOMA S., GALIMBERTI G., KANTELHARDT J., KAPFER M., LEFEBVRE M., MANRIQUE R., PIORR A., RAGGI M., SCHALLER L., TARGETTI S., ZASADA I. AND D. VIAGGI (2013) European agricultural landscapes, common agricultural policy and ecosystem services: a review. Agronomy for Sustainable development, On-line, DOI 10.1007/s13593-013-0183-4

WARR, P. (1999). Well-being and the Workplace. In: Kahneman D., Diener E. and Schwarz N. (eds.): Well-being: The foundations of Hedonic Psychology. New York: Russel Sage Foundation, 392-412.

WILSON, W. J. (1996). When Work Disappears. New York: Knopf.

WORTHINGTON, A. C. and B.E.DOLLERY (2000). An empirical survey of frontier efficiency measurement techniques in local government. Local Government Studies 26, 23–52.

Appendix

Table A-1: Different education levels and the respective factors

Type of education	Factor	Additional information
Compulsary School Compulsory Schools (Pflichtschule)	1	- Compulsory School, - -Elementary School (4y) +Secondary School (5y) - 9 years - Usual age:6-15
Apprenticeships (Lehre)	1	- Practical education - Working based learning with additional school - 4 years - Usual age: 15-18
Intermediate Technical and Vocational Schools(BMS)	2	- Practically job related based learning - No permission for universities (Matura) - 3 years - Usual age:15-17
Academic Secondary Schools (AHS)	2	- General education - No specific job-related education - 8 years - Usual age: 10-18 - Permission for university (Matura)
Higher Technical and Vocation Schools (BHS)	2	- Specific job related education - Specialization mostly in technical or economic education - 9 years - Usual age: 10-19 - Permission for university (Matura)
Post-Secondary Courses (College)	2	- Specific job related education - Specialization mostly in technical or economic - Additional education for graduates from Grammar School to get a job related education similar to Higher Vocation Schools - 2 years - Matura needed
Post-Secondary Colleges	3	- Institutions similar to univerity - Most common example is Nursing School - Mostly 3 years
University/Universities of Applied Sciences (Universitaet/ Fachhochschule)	3	- Matura required - Bachelor’s studies, 3 years - Master’s studies, 2 years - Diploma studies, 4 years

10 CSA 3: The impact of agricultural landscapes on rural development and regional competitiveness – Results of a short expert evaluation

L. Schaller, V. Ehmeier, M.Kapfer, J.Kantelhardt

10.1 Introduction

Agricultural landscapes provide private as well as public-good type services that can represent a resource not only for local inhabitants but also for different sectors of the rural economy, such as agriculture, forestry, tourism or the trade and services sector. Landscape services consumed are mainly "*Provisioning Services"* (e.g. food, timber, raw materials), "*Regulating services"* (e.g. climate regulation, moderation of extreme events, erosion prevention, water purification, etc) and "*Cultural services"* (e.g. aesthetic values, recreation, sense of place). "Supporting services" (habitats for species, genetic diversity) can mainly be seen as the natural basis upon which "consumable" services depend (MÜLLER ET AL., 2010, TEEB, 2010). Depending on the valorisation of the services provided, agricultural landscapes can support the rural economy and the quality of life in rural areas and can become a factor of territorial development and regional "competitiveness" (COOPER ET AL., 2009, FIELDSEND, 2011, ENRD, 2010).

However, the cause-effect chains between the supply of services from agricultural landscapes and the development and competitiveness of rural regions still remain mostly unclear; in particular this is due to the fact that the socioeconomic effects and benefits resulting from the use of services provided by agricultural landscapes often are multi-staged and multi-faceted and therefore difficult to assess:

On the one hand, the use of private and public good-type services from agricultural landscapes can create "direct" and "linear" socioeconomic benefits, e.g. from the production and marketing of agricultural goods or from the direct use of recreation possibilities by both local population or tourists. Here, at least as regards the benefits of the direct use of private good-type services, the assessment of the monetary impact on the development and competitiveness of a region appears comparatively easy. In contrast, already the assessment of economic benefits from the direct use of public good–type services is often complicated due to the mostly missing market price for such services (RUDD, 2009; SCHAEFFER, 2008; DIAZ-BALTEIRO & ROMERO, 2008). On the other hand, the use of services provided by a landscape can also create "indirect" and "non-linear" socioeconomic benefits (COOPER ET AL., 2009, FIELDSEND, 2011, ENRD, 2010): The use of both private and public good-type services from landscape can foster existing or create new economic activities. For example, the use of cultural services in combination with provisioning services can enable new marketing concepts of regional speciality products (COOPER ET AL., 2009). Just the same, the landscapes' function of moderating extreme events, or even the beauty of a landscape, can lead to the establishment of businesses in a special area. Such economic activities in turn can influence and alter other existing economic activities or even lead again to the creation of other new economic activities, for example by developing the regional income side due to creating jobs for the local population or by developing the supplier side due to enhanced demand. Here, one can speak of "multiplier effects", whereas the "multiplication" can go through various stages before it dies out (DOMANSKI & GWOSDZ, 2010).

Against this background, in our study we aims at estimating, how much agricultural landscape is perceived to impact on different factors of competitiveness and which actors within a rural society mainly benefit from landscape-valorisation. Furthermore, being assumed to have the strongest influence on agricultural landscape management and consequently on the landscape services provided, the study targets to assess the impact of different agro-environmental measures on regional competitiveness. Finally, the study addresses the question, if the actual development of the agricultural landscape management in the study region corresponds to a management which would be fostering regional development and competitiveness.

To answer our research questions, our study is carried out in form of a short expert survey which takes place in a rural, high-alpine region in the Northern Austrian.

10.2 Study region

The study region "Mittleres Ennstal" is located in the northern Austrian Alps in the district of "Liezen" in the federal state of Styria. The region represents a typical mountain area covering a main and two side valleys, including an urban centre and a couple of small villages. With 252 km² in sum, the study region covers four municipalities. The landscape is characterised by sheer rock walls and block heaps as well as of gentle mountainous formations and the plains of the valley. The whole scenery of the valley is strongly influenced by the mountains framing the valley. The valley itself is characterized by the river Enns and a multitude of landscape elements. The higher regions are characterized by an "own" alpine scenery that consists of alpine meadows, pastures and forests.

As regards agricultural land management the region is characterised by rather small, traditional, family farms specialised on dairy or mixed farming. Agricultural land use first and foremost takes place as small structured grassland. Only in the river-valley, UAA to some extent is used as arable land nearly exclusively for forage production. Grassland to a high percentage is managed with comparatively low intensity in form of alpine meadows and pastures and other extensive grassland.

As regards competitiveness, the region falls behind other regions in Austria and also behind the country's average. The income level in the district is by 9% lower than the Styrian average and by 11% lower than the national average. However, the unemployment quote is lower than the average of both Styria and Austria. The average tax revenue per inhabitant in three of the Municipalities among the lowest of the district "Liezen", only in the municipality including the urban centre tax revenue is comparatively high (RLP, 2011). At the moment, the municipalities of the study region are faced by a constant and severe migration especially of young and educated people (WIRTSCHAFTSKAMMER STEIERMARK 2013).

10.3 Database and Method

To answer our study's research questions, a short expert survey is conducted. The survey takes into account a network of local institutions, all dealing with the question of landscape valorisation. The identification of the institutions is supported by 5 key stakeholders, who have been identified in line with an upstream local stakeholder laboratory. Finally, 22 institutions representing agriculture, tourism, local administration, local economy, nature conservation and rural development take part in the survey (see Figure 1).

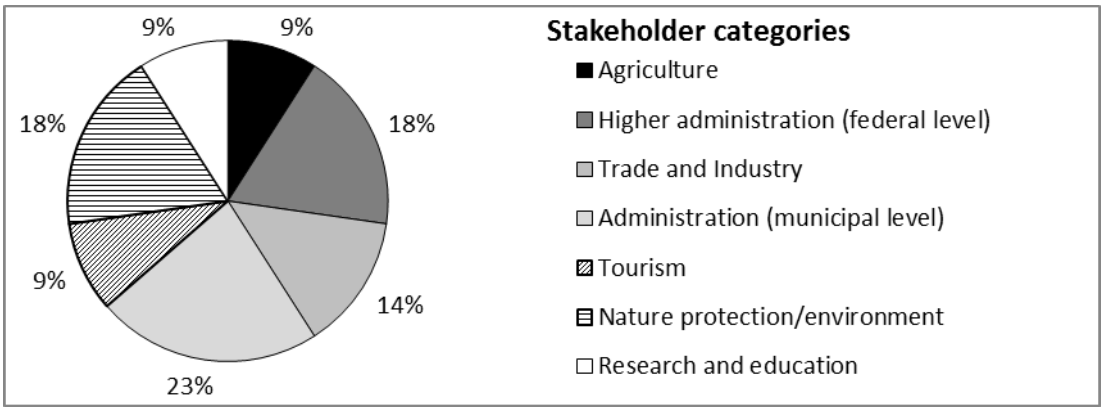


Figure 1: Share of stakeholder groups taking part in the survey

The survey itself is carried out using a structured questionnaire sent out to all institutions. The questionnaire contains four questions:

1. Please evaluate, how much agricultural landscape impacts on factors of competitiveness?
2. Please evaluate, which beneficiaries profit from landscape valorisation?
3. Please evaluate, how much impact different agro-environmental measures have on the competitiveness of the study region?
4. Please evaluate, how the agricultural management in the study region develops at the moment?

5. Please evaluate – against the background of fostering regional competitiveness – how agricultural management in the study region should develop?

All questions are accompanied by a list of fixed indicators and factors to be directly addressed (see chapter 10.4). As the study mainly targets at estimations on characteristics of the parameter in question, for answering, fixed evaluation scales are provided.

10.4 Results

10.4.1 The impact of landscape on different factors of competitiveness

For the assessment of how much the agricultural landscape in the study region impacts on different factors of local competitiveness, the study follows the overall approach of the CLAIM project by addressing "local competitiveness" as a combination of economic and social factors. As regards "economic factors" the indicators '*local labour market', 'local investments', the 'marketing of regional products'* and the '*development of infrastructure'* are considered. Social components taken into account are the '*wellbeing of the local population'*, the '*maintenance of the cultural heritage'* or the *'demographical development'* in the region.

Figure 2 shows the strength of the impact of agricultural landscape on the above listed competitiveness indicators.

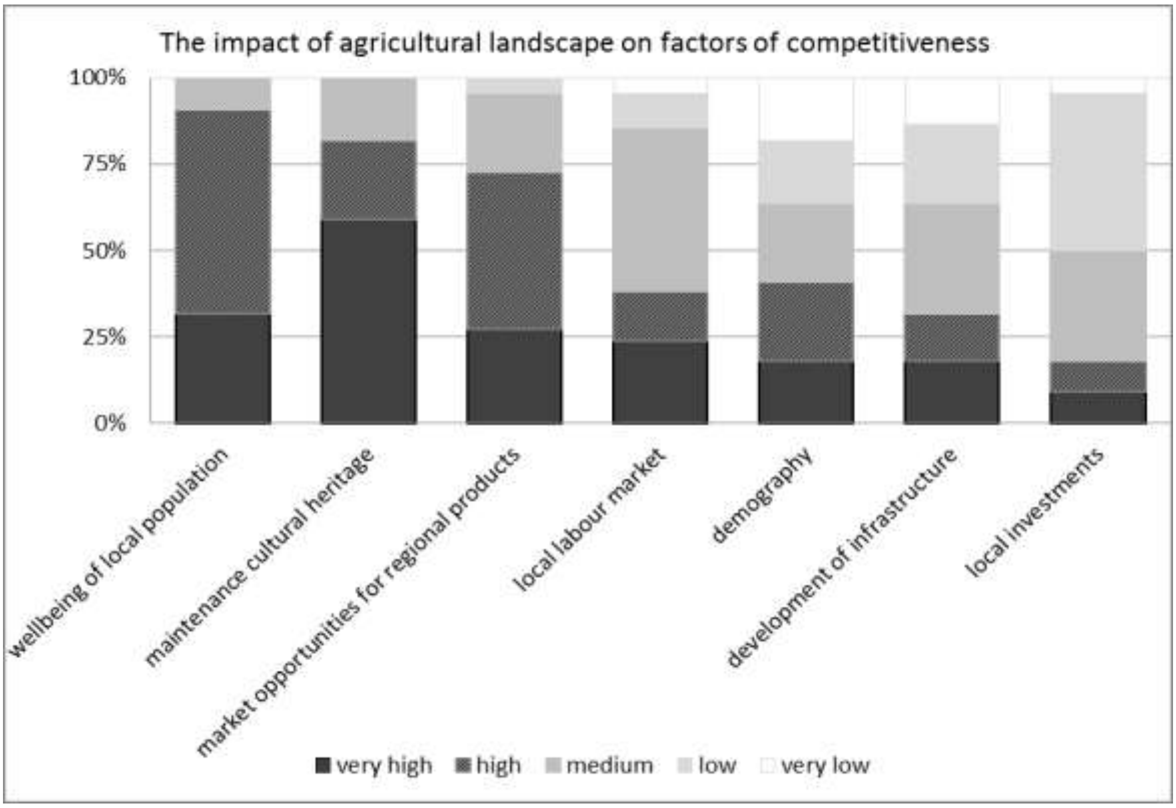


Figure 2: The impact of agricultural landscapes on indicators of competitiveness

The results show that, in the view of the experts, agricultural landscape has very high impacts first and foremost on rather "soft" factors of competitiveness: Especially the impact of agricultural landscape on the wellbeing of the local population is estimated to be high and very high – by nealy all experts. Also the contribution of the agricultural landscape to the maintainance of the cultural heritage is estimated to be high and very high by more than 80% of the experts.

The only "economic" factor, on which agricultural landscape is estimated to have a high impact, are market opportunities for regional products. As regards all other "economic" indicators, the influence of agricultural landscape is evaluated to be considerably lower.

10.4.2 The beneficiaries of landscape valorisation

The second question to be answered in line with this survey is, who mainly benefits from the valorisation of the local agricultural landscape and at which level benefits are felt. Focussing on a rural context, potential beneficiaries of the agricultural landscape can be both consumers and producers of landscape services within the rural community. Consequently, included into the survey are the beneficiary groups of '*local agriculture and forestry'* (farmers, forestry managers, land owners, etc.), the group of *'local population'* (inhabitants of the municipalities), the group of '*local tourism'* (hotels, restaurants, tourist operators, travel agencies, etc.), as well as the groups of '*local trade and commerce'* and '*local service companies'*. Taking into account the processing sector for the two main private good-type services within the region, namely supply of food and timber, furthermore the two groups '*local food industry'* and '*local wood-processing industry'* are included.

To answer the question, if the use of services from agricultural landscapes is creating local benefits or if landscape services provided in one region have also effects that go beyond "localism", the '*study region'* itself, as well as '*other regions'* are listed as "beneficiaries".

Figure 3 shows the results of the experts' estimation on who of the potential beneficiaries profits most of the valorisation of agricultural landscapes.

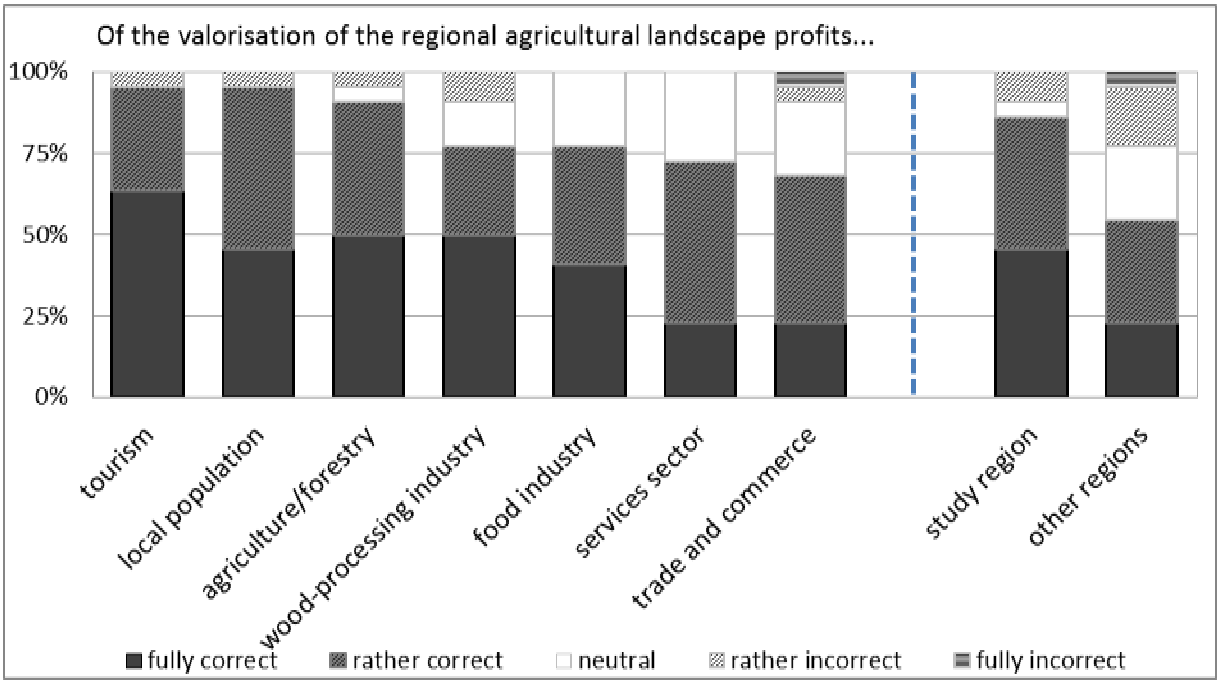


Figure 3: Beneficiaries of landscape valorisation

In general, the results reveal that the valorisation of the local agricultural landscape creates benefits for all of the beneficiary groups.

Perceived to be benefitting the most is the group of '*tourism'*. Here, it becomes clear that in particular the use and valorisation of cultural landscape services is creating benefits. Also *local population* is evaluated to rather strongly benefit from landscape valorisation. However, here the results of the first question of the survey (see **Errore. L'origine riferimento non è stata trovata.**) lead to the assumption, that benefits from landscape valorisation for the '*local population'* are mainly "soft benefits" resulting again from the use of cultural services, such as landscape aesthetics, sense of place, local identity and recreation possibilities. As producers and therefore beneficiaries of the private-good type services 'food' and 'timber', also 'a*griculture and forestry'* are perceived to be rather strong beneficiaries of the valorisation of the local landscape.

Already as regards the '*wood-processing industry'* and the *'food industry'* however, the influence of landscape valorisation on potential benefits is perceived to become lower. The lowest impact of landscape valorisation however is attributed to the beneficiary groups of '*trade and commerce'* and the '*local service companies'*.

In sum, the answers quite clearly show that landscape is still perceived to be valorised mainly by making use of cultural services as well as making use of private-good type, “marketable” services.

As regards the question, where benefits of the valorisation of landscape are felt, the evaluation of the experts clearly emphasise the local level.

10.4.3 The influence of agro-environmental measures on the competitiveness of the region

The third target of the survey is to assess, if and how much agro-environmental measures are capable to impact on the competitiveness of a region.

In general, the main policy instrument influencing the agricultural landscape in the study region is the Common Agricultural Policy (CAP). Amongst the – as regards amount of funding – most important CAP measures in the study region are Pillar I *direct payments*, Pillar II, Axis 1, *modernisation of farms* (M121), Pillar II, Axis 2, *less favoured area* (M211) and Pillar II, Axis 2 *agro-environmental measures* (M214) (IACS, 2009-2012). As regards Pillar II, Axis 3 and 4, these measures make up only a very small fraction of overall funding (1-2% of Pillar II payments each). The focus of funding on *direct payments*, *less favoured area payment* and *agro-environmental measures* payments indicates that the maintenance of the small structured landscape, managed with rather low intensity by the traditional family farms, is mainly a result of the CAP funding.

The results of the survey show, that experts in general perceive those CAP measures accompanied by high funding amounts, as the ones contributing the most to the competitiveness of the region (see Figure 4).

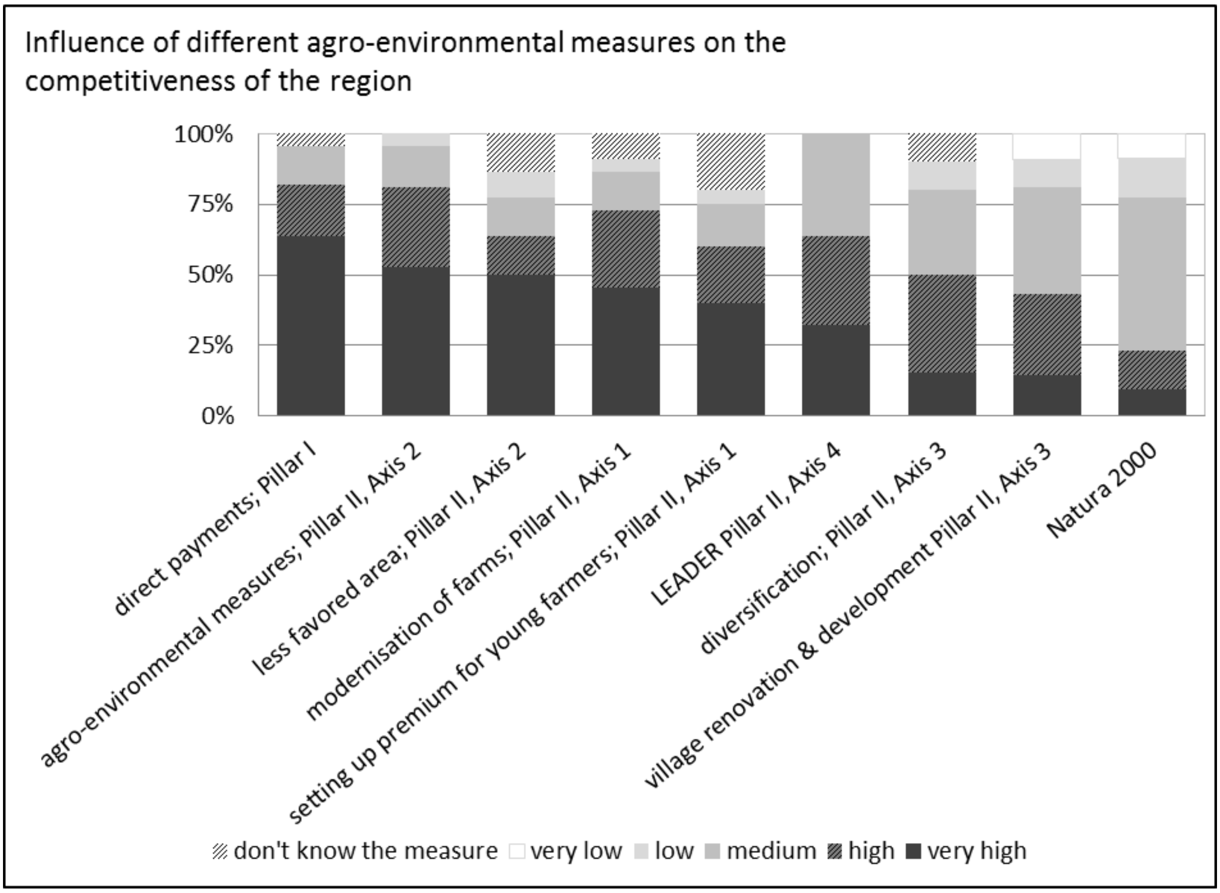


Figure 4: Influence of different agro-environmental measures on the competitiveness of the region

Consequently, focussing on the question of “very high influence”, the strongest contribution to regional competitiveness is estimated to come from *direct payments* (Pillar I), from *agro-environmental measures* (Pillar II) and *less favoured area* (Pillar II) payments. Also rated of rather high importance is the rural development program *modernisation of farms*. The influence of the bottom-up approach of “*Leader*” is also estimated to have in sum a medium to very high contribution to the regional competitiveness; even if this evaluation is not reflected in high payments.

Against the background of landscape valorisation, the rather low influence experts attribute to the CAP measure "*diversification*" is noticeable: The support of the EU for agro-tourism, gastronomy, improvements in value chains, marketing of regional products, consulting, as well as the support of social and communal services, renewable energy etc. in principle target at possibilities to better valorise agricultural landscape management via higher level socio-economic effects.

The measure contributing the least to regional competitiveness is estimated to be measure Natura 2000.

10.4.4 The influence of agro-environmental measures on the competitiveness of the region

The last question of the survey assesses the question, if the actual development of the agricultural landscape management corresponds to a management, which is estimated to foster regional development and competitiveness.

Taking into account the actual landscape management and farm organisations in the study region, the question is focused on the development of the intensity of the agricultural management, the development of the number of farms and the development of the size of the agricultural fields (see Figure 5.)

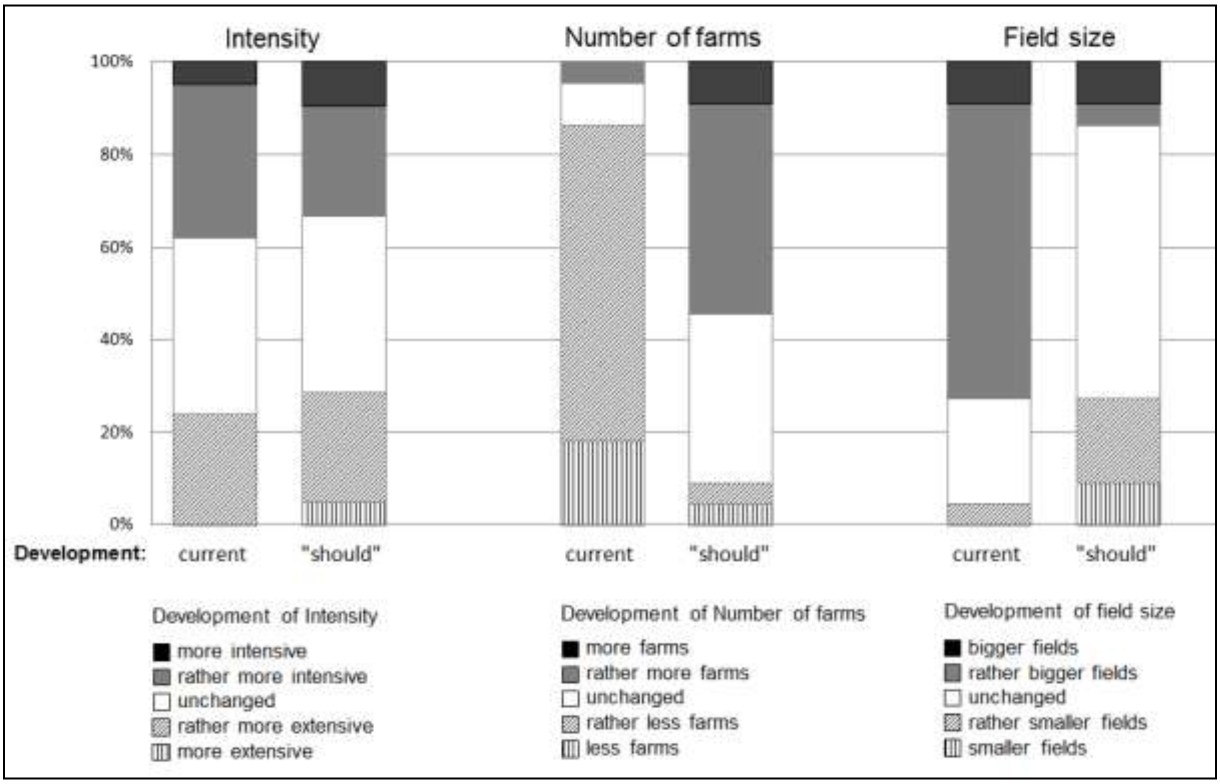


Figure 5: Actual/target comparison of the development of agriculture against the topic of regional competitiveness

As regards the intensity of the agricultural management, the results show that the actual development and the – against the objective of regional competitiveness – demanded development mostly correspond in the eyes of the experts: nearly 40% of the experts observe and also demand no clear changes in the intensity levels. Other 30-40 % of the experts in contrast observe and also demand an intensification of the agricultural management. Again contrastingly, between 20 and 30% of the experts observe and also demand an extensification of agricultural land management. The splitting up into both intensification and extensification perceptions has been explained in line with the downstream 2nd stakeholder laboratory: Here, the difference of the landscape structure is held responsible for the opposite directions of answers: In the flat river valley locations, where grassland management is fully mechanised, intensification tendencies are felt. From a production point of view, this intensification contributes to the competitiveness of the agricultural sector. In contrast, particularly in the high alpine locations, the management can only in parts be mechanised and involves a significant amount of manual work. It represents a big workload for the farmers while not being profitable. Here, agricultural management in parts is abandoned or maintained at minimal costs.

As regards the perceptions towards the development of the number of farms and the size of agricultural fields, the experts' estimations reveal clear discrepancies between the actual and the target development. Nearly all experts observe a decrease of the numbers of farms in combination with an increase of field sizes. To foster competitiveness in the study region yet, experts' clearly express, that the decrease of numbers of farms should at least be stopped, if not even be made undone. The same accounts for the increase of field sizes. The experts take the actual small-structured landscape for a competitiveness factor, which should be maintained as it is.

10.5 Discussion and conclusion

The results of the expert survey indicate that landscape in the study region is perceived to have first and foremost an influence on "soft" competitiveness factors, such as the wellbeing of inhabitants and the maintenance of the cultural heritage. The main beneficiaries of landscape are consequently perceived to be local inhabitants and tourism, both benefitting from "soft factors" within the field of cultural services. The only strategy besides tourism, which is awarded to some potential of landscape valorisation occurs to be the marketing of regional products.

The influence of landscape on higher-level socio-economic factors driving regional competitiveness, such as "job-creation" "demography", "infrastructural development" or "investments" is perceived to be considerably lower. Hand in hand with this evaluation goes the perception, that landscape has only a important influence on such sectors of the local economy, which are directly connected to the landscape: the agricultural and forestry sector for example is perceived to strongly benefit from landscape as the direct producer of marketable goods. On economic sectors which are not directly connected to landscape – like the trade&commerce or the services sector- the influence of landscape appears to be low.

As regards the influence of policies, the results of the study show that the CAP measures implemented so far have had a strong "maintaining" character, which means that CAP payments are essential maintain agricultural management in the region. In this sense, CAP measures so far clearly contribute to the competitiveness of agriculture in the region, which would have no chance in the competition with agricultural production in areas less unfavourable. The results of the survey shows, that this influence of the CAP is highly appreciated and estimated to also have impacts on the competitiveness of the region.

However, the results also reveal, that the agricultural management in the region changes. First and foremost a decrease of the numbers of farms, and an increase of field (and most probably also) farm sizes is observed. In the eyes of the experts, this development against the background of regional competitiveness is unfavourable. The regional landscape is perceived as an important asset, which should, in the eyes of the experts, not be basically changed. Nevertheless, at the moment strategies to completely yield the landscapes potential to foster the development and competitiveness of a region, are not fully established. The results of a data envelopment analysis in the region, targeting similar questions show, that at the moment regional competitiveness is rather influenced by non-landscape factors such as the closeness to urban centres or semi-urban areas. Actually, it turns out that the more remote an area, the less competitive it is, even if the landscape is beautiful and rich of potential landscape services – except if landscape is completely valorised by intensive tourism – on cost of cultural identity and authenticity.

References

COOPER, T., HART, K. & BALDOCK, D. (2009). Provision of Public Goods through Agriculture in the European Union. Report Prepared for DG Agriculture and Rural Development, Contract No 30-CE-0233091/00-28, Institute for European Environmental Policy: London. Available at: http://wdl.wzw.tum.de/fileadmin/user_upload/Bilder/Aktuelles/IEEP.report_en.pdf

DIAZ-BALTEIRO, L. & C. ROMERO (2008): Valuation of environmental goods: A shadow value perspective, Ecological Economics, Volume 64, Issue 3, Pages 517–520

DG AGRI INTERNAL PAPER (2011). Landscape and rural areas: towards an economic valuation of socio-economic impacts, European Comission Directorate General for Agriculture and Rural Development

DOMANSKI, B. & K. GWOSDZ (2010), Multiplier effects in local and regional development, Uaestiones Geographicae 29(2)

ENRD (2010). Thematic Working Group 3: Public Goods And Public Intervention: Final Report. Brussel: European Network for Rural Development, Available at http://enrd.ec.europa.eu/app_templates/filedownload.cfm?id=260BDAAE-0BDA-C671-41E7-31CED794278A

FIELDSEND, A. (2011). Determining the Socio-economic Value of Agricultural Landscapes Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Horticulture, Vol 68, No 1 (2011), Available at: http://journals.usamvcluj.ro/index.php/horticulture/issue/view/179

MÜLLER, F., DE GROOT, R. & WILLEMEN L. (2010). ECOSYSTEM SERVICES AT THE LANDSCAPE SCALE: THE NEED FOR INTEGRATIVE APPROACHES, LANDSCAPE ONLINE 23, 1-11. DOI:10.3097/LO.201023

RLP (Raumplanung Steiermark) (2011):. Regionsprofil Liezen. Amt der Steiermärkischen Landesregierung Abteilung 16 – Landes- und Gemeindeentwicklung, Graz. In. http://www.raumplanung.steiermark.at/cms/dokumente/11142226_28444368/ce87522b/Liezen_2011.pdf. (25.01.2014)

RUDD, M.A. (2009): Nonmarket Economic Valuation and "The Economist's Fallacy". Journal of MultiDisciplinary Evaluation, Vol.6(11), p.112

SCHAEFFER, P. (2008): Thoughts concerning the economic valuation of landscapes. Journal of environmental management. v. 89, issue 3 p. 146-154

TEEB (2010). THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY: MAINSTREAMING THE ECONOMICS OF NATURE: A SYNTHESIS OF THE APPROACH, CONCLUSIONS AND RECOMMENDATIONS OF TEEB, ISBN 978-3-9813410-3-4

WIRTSCHAFTSKAMMER STEIERMARK (2013): Standortstudie Liezen 2013+ - Handlungsfelder für die Regionalpolitik. Steirische Regionalpolitische Studien Nr. 06/2013. Institut für Wirtschafts- und Standortentwicklung der Wirtschaftskammer Steiermark, Graz, 2013. In: https://www.wko.at/Content.Node/Interessenvertretung/Standort-und-Innovation/stmk/Standortstudie_Liezen_2013.pdf (25.01.2014)

11 CSA 4: Visitors' landscape preference for a set of specific landscape attributes using visualized choice experiments

11.1 Introduction

Agricultural landscapes provide multiple ecosystem services beside the production of food, feed and fibers (van Zanten et al., 2014). Amongst the most common services are recreational and tourism values as well as cultural heritage and aesthetic functions, often summarized as cultural services (Chan et al., 2012; Daniel et al., 2012). In Winterswijk national landscape, a well-developed rural tourism sector ensures that second order effects related to cultural services are increasingly important for regional competitiveness. However, it remains largely unknown how cultural services relate to the structure and composition of the agricultural landscape. We address this knowledge gap by assessing stated preferences of visitors for a set of general agricultural landscape attributes that describe the landscape structure and composition.

Landscape preferences have been addressed by numerous empirical studies that applied different methodologies originating from different disciplines, among others environmental psychology, landscape ecology, environmental economics and geography. Despite addressing a similar problem, methodological heterogeneity constrains the comparison of landscape preferences across empirical studies and, therefore, inhibits the advancement of cross-case evidence. An important conceptual distinction between empirical preference studies arises from differences between expert-based and stakeholder-based assessments of landscape quality. The former type of studies regard landscape quality to be an intrinsic attribute of the landscape, whereas the latter type regards landscape quality as subjective value derived through the eyes of the beholder (Lothian, 1999).

In stakeholder-based landscape assessments, researchers have applied both cognitive (e.g. Sevenant & Antrop 2009) and physical landscape attribute approaches (e.g. Arnberger & Eder 2011; Dachary-Bernard & Rambonilaza 2012) to measure visual preferences for landscapes. Cognitive attributes, such as landscape coherence, disturbance, and naturalness often measure how landscape preferences can be related to evolutionary theories that emerged from environmental psychology (Appleton, 1975; Kaplan & Kaplan, 1989). This category of attributes does not address preferences for a specific physical component of a landscape, but provides a holistic assessment of landscape character (Tveit, Ode, & Fry, 2006). Physical attributes address preferences for tangible and quantifiable landscape components, such as the presence of hedges or a land cover type. Studies that address physical attributes, often estimate a change in preferences as a result of (potential) landscape change. Hunziker et al., (1999) for instance, examined stakeholder preferences for different stages of afforestation in Switzerland. Campbell (2007) estimated the economic value of attributes, such as hedgerows and stone walls in Ireland, using stated preferences.

This study aims to assess which physical landscape attributes are most important for the visual quality cultural service delivery of the agrarian landscape as perceived by visitors in Winterswijk national landscape. In addition, we aim to estimate a willingness to pay of visitors for different landscape alternatives. We address these aims by applying monetary and a non-monetary visual choice experiment. A stronger knowledge base on relations between landscape structure and composition and cultural services in Winterswijk could assist the prioritization and spatial targeting of agri-environmental measures and improve the contribution of landscapes to the regional competitiveness of the case study area.

In addition to the relevance of this study in the case study context, we aim to test and develop new methodologies that enable upscaling of landscape preferences and comparison of landscape preferences for general set of landscape attributes (e.g. hedges, crops, or presence of livestock) across different case study areas in European agrarian landscapes. Until now, results of empirical studies that address preferences for particular landscape attributes tend to be very context specific and, therefore, lack external validity (Bateman, Day, Georgiou, & Lake, 2006). Local case studies are valuable to gain understanding on local causal mechanisms (i.e. how does one's occupation as a farmer affect one's landscape preferences?), but the strength and magnitude of causal effects could differ from place to place (Gerring, 2007; Rudel, 2008). We address this issue by applying a choice experiment with a set of general landscape attributes, derived from a meta-analysis of landscape preference studies in agrarian landscapes (van Zanten, Verburg, Koetse, & van Beukering, subm) that can be compared across landscape contexts.

This report is structured as follows: in section 2) we present the methodological steps that were taken in both experiments; section 3) presents the results, including the results of the non-monetary choice experiment, the monetary experiment and a comparison to a non-monetary experiment in the German case study in the CLAIM project (the Märkische Schweiz); section 4) presents a discussion of the results.

11.2 Methods

11.2.1 Choice experiments to study landscape preferences

Choice experiments are increasingly applied to value different policy alternatives with regard to rural landscape management and planning (Campbell, 2007; Dachary-Bernard & Rambonilaza, 2012; Liekens et al., 2013). Some of these studies elicited visual preferences for different landscape scenarios under different policy regimes (Arnberger & Eder, 2011; Rambonilaza & Dachary-Bernard, 2007; Vecchiato & Tempesta, 2013), whereas other studies also included non-visual attributes such as pest control, regional products and accessibility (Moran, McVittie, Allcroft, & Elston, 2007; Westerberg, Lifran, & Olsen, 2010). In stated choice experiments, a landscape alternative (or scenario) is defined by the levels of the selected attributes. Individuals evaluate multiple landscape alternatives as a whole by trading-off the attributes (Louviere, 2000). According to random utility theory, the choice of a landscape alternative by an individual implies that the selected alternative has a higher utility than the other landscape alternatives. In the context of landscape preferences research, choice experiments are a powerful tool to depict which (combinations of) landscape attributes are important for the perceived value or quality of landscapes. In addition, eliciting preferences for different landscape alternatives predict how the value of landscapes will change as result of landscape different landscape policies and management.

11.2.2 Attribute selection

This study addresses relative preferences for four types of attributes of landscape management in Winterswijk national landscape. The attributes that are included in our analysis aim to describe the general variations in the land cover structure and composition that determine the visual quality of agricultural landscapes. The selected attributes were derived from a typology of European agrarian landscape attributes (van Zanten et al., subm), which distinguishes between four main types of landscape attributes in landscape preference studies: agricultural management practices, land cover composition, landscape elements and non-agricultural biophysical features (e.g. presence of water, elevation/mountains). As attributes, we included therefore (i) the presence of livestock as the most important attribute in the category of agricultural management practices (van Zanten et. al, subm); (ii) diversity of agricultural land use to describe the land cover composition of arable land and pastures; (iii) extent of green linear elements, such as hedgerows and treelines and (iv) the extent of point elements in the landscape, such as groups of trees and small forest patches in agricultural plots. The selected attributes were validated and discussed extensively in a workshop with local stakeholders involved in landscape management (see Annex 5). The attributes and their levels in the choice experiment were adapted to their occurrence in the local landscape context.

- **Presence of livestock**. This visual landscape attribute has two levels: presence of livestock and no presence of livestock. In both areas, the dominant livestock type in the agricultural landscape is cattle. Therefore, this attribute was visualized in both cases as the presence of cattle in the visual landscape.
- **Diversity of agricultural land use**. This visual landscape attribute has three levels: low diversity, medium diversity and high diversity. As the Märkische Schweiz is dominated by arable land use, this attribute is defined as the variety of different agricultural crops in the visual landscape. In Winterswijk, pastures are the dominant agricultural land use, but there is a relatively small (10-

15%, **ref)** share of land used to grow maize. Therefore, diversity of agricultural land use is defined as the grasslands/maize ratio in the visual landscape.

- **Extent of green linear elements**. This visual landscape attribute has three levels: low extent, medium extent and high extent of linear elements. In both areas, this attribute is visualized as the length of hedgerows or tree lines in the visual landscape.
- **Extent of point elements**. This visual landscape attribute has three levels: low extent, medium extent and high extent of point elements. In the Märkische Schweiz, this attribute is defined as the amount of ponds with riparian vegetation and the amount of single trees or groups of trees in agricultural plots. In Winterswijk, this attribute is defined as the number of groups of trees or small patches of forest in agricultural plots.
- **Extra costs per overnight stay**. This cost attribute was only included in the monetary experiment. In the questionnaire, this attribute was explained as the extra overnight cost for the accommodation (e.g. tent, hotel room or bungalow) respondents would be willing to pay. This attribute has four levels: 1 euro, 2.50 euro, 5 euro and 10 euro. A large price range was chosen because large variation exists in the overnight costs of accommodations.

11.2.3 Spatial analysis

To examine the spatial extent and variation of the landscape attributes within the case study areas, a spatial analysis was conducted. The maps that are shown in Figure 5 indicate the spatial distribution of the three of the four attributes in a visual landscape in both case study areas. The presence of livestock is not mapped, because no spatial data is available in the Winterswijk case.

In the Winterswijk area, the spatial analysis was conducted by using a moving-window analysis for a 1.5 km2 area around each 25*25 meter grid cell. The 1.5 km2 area is assumed to be the visual landscape an indvidual perceives at any point in the case study area. This assumption is based on the visible landscape area in the base picture that was used for the visualization of the landscape altenatives displayed in Figure 6.

With respect to the agricultural land use diversity maps, Figure 1 indicates the grassland-maize ratio. A low diversity level in the map points at a visual landscape dominated by grasslands, whereas high diversity indicates a higher share of maize in relation to grasslands. The green linear elements map (hedgerows and tree lines) depicts the accumulated length of linear elements in the visual landscape of 1.5 km2. In Winterswijk, the point elements map shows the amount of small forest patches and tree groups in the visual landscape around each grid cell.

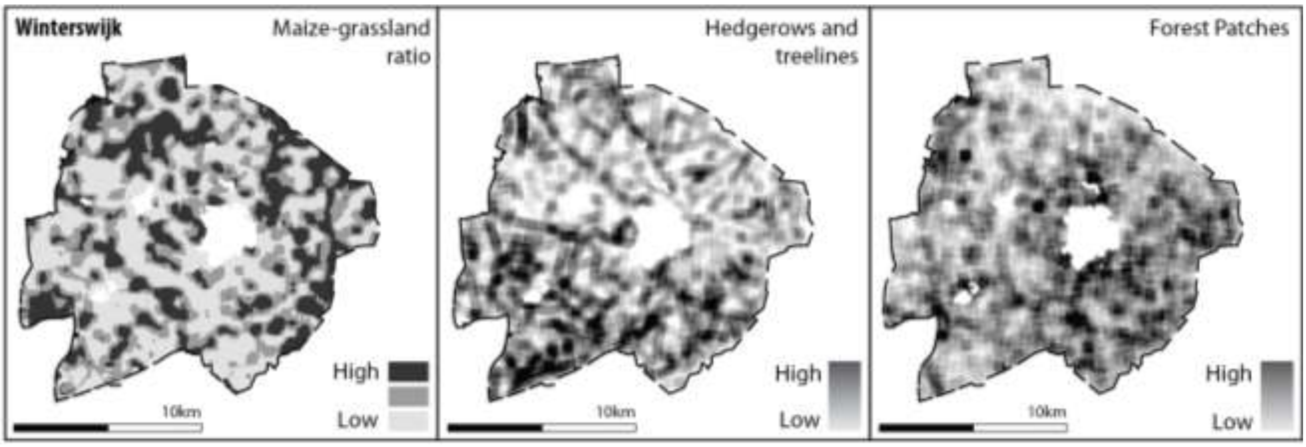


Figure 1: variation of the landscape attributes in the case study area

11.2.4 Landscape visualizations

In order to develop landscape alternatives that are representative for the case study area, results of the spatial analysis presented in Figure 1, were used to develop photorealistic landscape representations for the choice experiment survey (Figure 3). For Winterswijk national landscape, a representative landscape view was selected as base picture for visualization of the different landscape alternatives (Lovett et al., 2010). The picture was taken from a slightly elevated perspective to enable the visualization of all the attributes. The area that that is visible on the base picture is visible in Figure 2. Everything is kept constant in the pictures except for the different landscape attribute levels.

Based on this base picture, landscape alternatives were created by varying the levels of the different attributes in the base picture using Adobe Photoshop software package. The three attribute levels of agricultural land use diversity, linear elements and point elements were visualized as follows: (i) a minimum level (low) without the visual representation of the attribute; (ii) an intermediate level indicating the (approximate) mean level of the attribute in the case study area derived from the spatial analysis; (iii) a high level indicating the (approximate) mean plus two standard deviations level of the attribute in the CSA derived from the spatial analysis. The visualized landscape alternatives were pre-tested (n=10) in a choice experiment setting to test the quality of the visualizations.

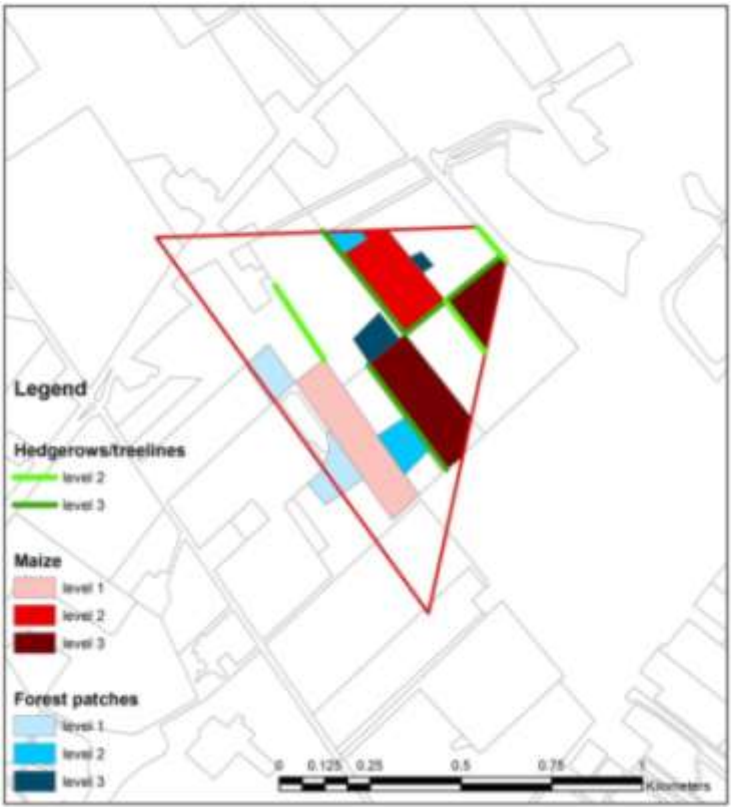


Figure 2: a map of the visualized landscape area in the choice experiment with the attribute levels.

Figure 1 shows how the landscape attribute levels were translated to the map and Figure 2 shows the visualization of the landscape attributes for the choice experiment. A similar visualization approach was applied as was conducted by Arnberger et al., (2011). For a choice experiment, it is required that all attributes can vary independently. No combinations of attributes were excluded, so in the there are 54 (3*3*3*2) possible landscape alternatives in the choice experiment.

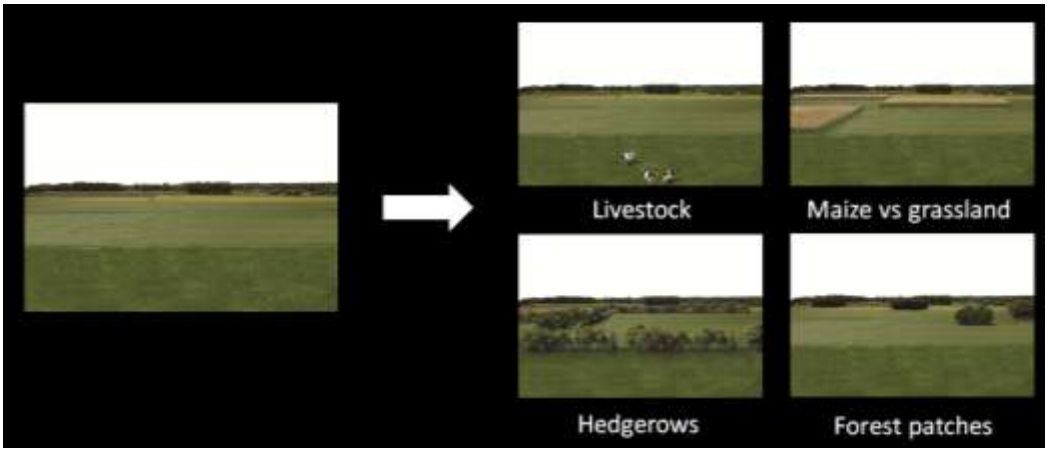


Figure 3: the base picture used for the visualizations and the visualization of the individual landscape attributes.

11.2.5 Data collection

An orthogonal choice experiment design was generated using Sawtooth software package (for an example of a choice card, see Annex 2). This orthogonal design was developed for an on-site pre-test for both the monetary and the non-monetary desing (n=50 for both). The attribute parameters from multinomial logit models, estimated based on the pre-test data, were applied as priors to generate statistically efficient designs using NGene software. In the efficient design, created for both the monetary and the non-monetary experiment, there are eight choice situations per respondents and six different survey versions. An efficient design aims at the maximization of the information collected per choice situation, by removing choice situations that are 'easy to predict'.

In Winterswijk national landscape, the pre-tests were conducted in June and July 2013. The final survey was conducted in July 2013. 191 visitors were interviewed for the non-monetary experiment and 235 visitors were interviewed for the monetary experiment. The survey was conducted by an experienced group of interviewers that all hold an MSc degree. To obtain a representative sample of visitors, respondents were interviewed at different locations. In Winterswijk most visitors stay overnight and, thus, respondents were approached at touristic accommodations – such as campsites, hotels and bed & breakfasts – in morning and evening hours. About 35 touristic accommodations were approached in advance to request persmission for interviews. At the accommodations, respondents were interviewed in a systematic way to avoid a selection bias of respondents by the interviewers.

11.2.6 Data analysis

The collected was analysed using the Nlogit software package. We estimated multinomial logit models for the monetary and non-monetary choice experiment. The dependent variable in these logistic regression models represents the choice of a preferred landscape alternative out of three landscape alternatives by a respondent. The attribute levels are dummy-coded for all landscape alternatives in the choice experiment design. Each individual was requested to respond to eight choice situations. The adjusted R^2 values are 0.23 for the monetary experiment and 0.28 for the non-monetary respectively.

The relative magnitude of the attribute parameters – the relative preferences for the attributes – was estimated by analysing the ranking of the parameters and the normalized relative preferences. This approach also enables the comparison of the relative magnitude across different model outputs (Carlsson et al., 2007). Mean willingness to pay levels for the attributes were estimated by calculating the marginal rate of substitution for an attribute and the cost attribute.

11.3 Results

11.3.1 Description of the sample

This section provided an overview of the total sample of the monetary and non-monetary surveys combined (n=426) with respect to the background characteristics of the respondents. In this report, we describe the sample based on the differences between the different types of accommodation where the respondents were interviewed.

Figure 4 shows the distribution of different types of accommodations where the interviews took place. Over 40% of the interviews were conducted at either a large campsite or a small campsite a farm. The additional 12% took place at a bed & breakfast or hotel. There are no official figures that can confirm if this is a representative sample, but it was validated by the local stakeholder laboratory as a 'quite representative' sample. They mentioned that, depending on the season, there might be an over-representation of respondents from small farm campsites.

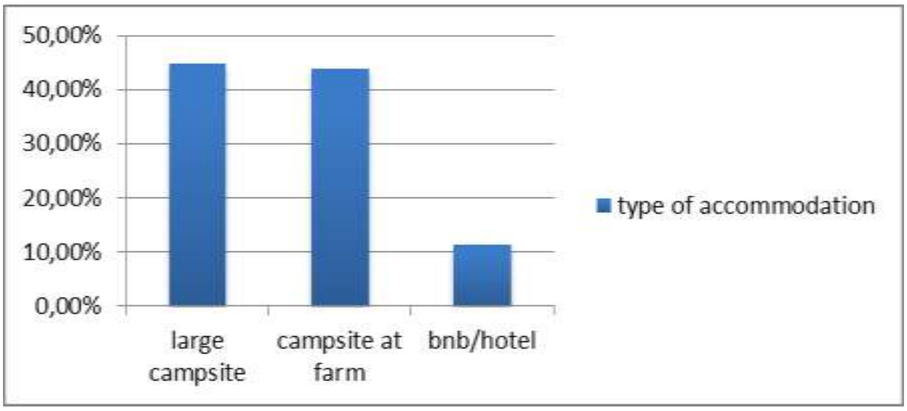


Figure 4: the type of accommodation where respondents were interviewed

Figure 5 shows age distribution of respondents at both large campsites and small farm campsites. The graphs display a running average of year of birth. At both type of accommodations, the majority of the people that were interviewed was born in the 1940s and 1950s. However, at large campsites the age distribution is skewed to the left, indicating that there is also a relatively large share of respondents that were born in the 1960s and 1970s. With respect to these figures, the LSL judged the age distribution representative.

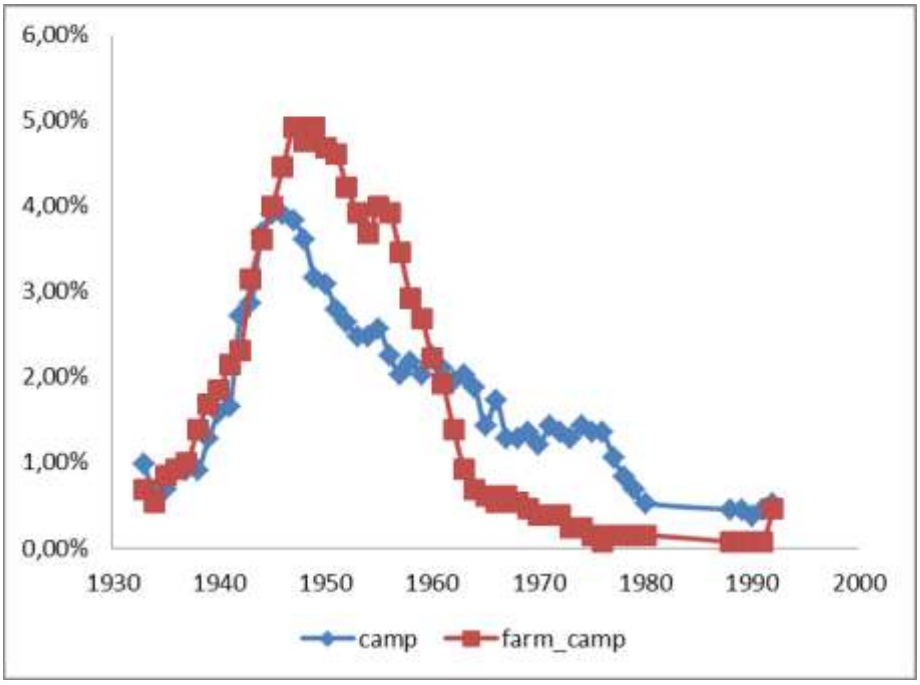


Figure 5: running average of year of birth of respondents interviewed at large campsites and farm campsites.

The number of days that respondents in our sample stay in Winterswijk national landscape (so not at that accommodation per se) varies significantly between the different types of accommodations (Figure 6). Most bed & breakfast guests stay 2,3 or 4 days, whereas at large campsites tourists often stay two or three weeks.

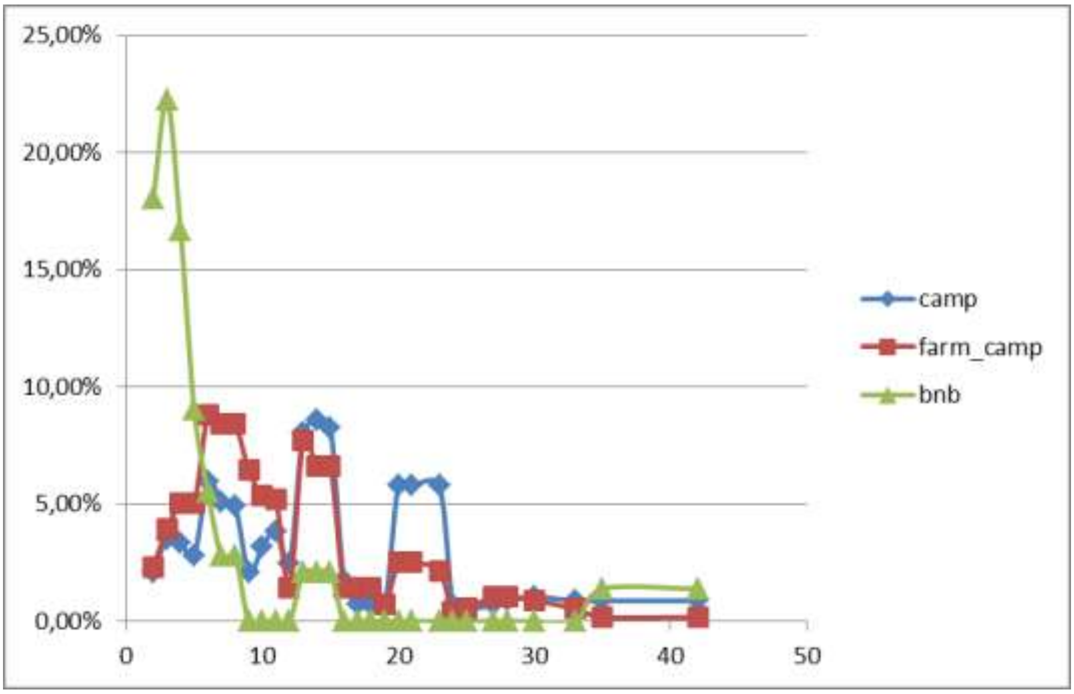


Figure 6: running average of days that respondents stay at the accommodation where they were interviewed

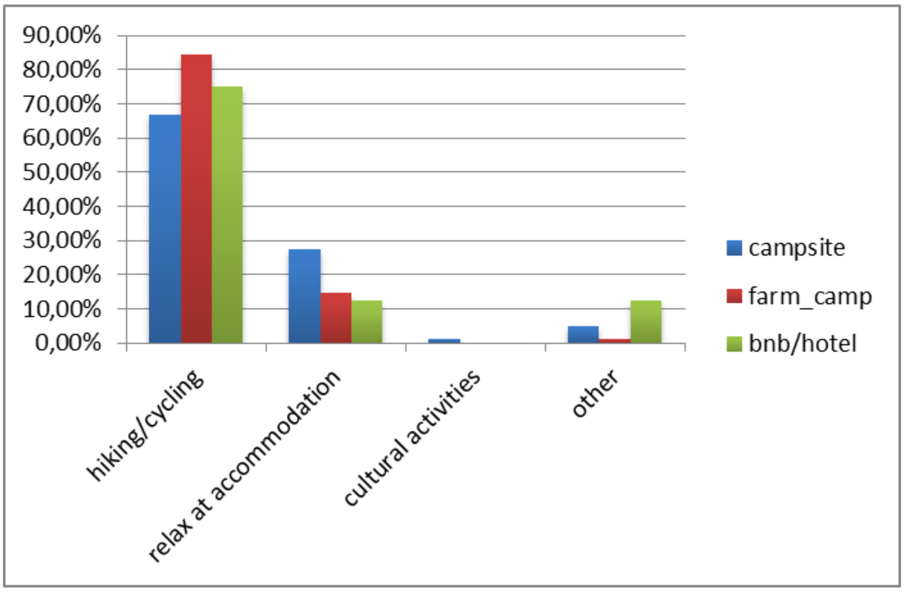


Figure 7: main type of activities of respondents

Figure 7 shows the main activities of the respondents in our sample. On all accommodations the largest share of respondents, on average 75%, stated that cycling or hiking was their main activity during their holiday in Winterswijk. As was expected by the LSL, the share of hikers and cyclists is higher on farm campsites than on large campsites, where a larger share of people stated that their main activity is 'relax at the accommodation'.

11.3.2 Non-monetary choice experiment

Table 1 shows the output of the multinomial logit model of the non-monetary experiment. The dependent variable in these logistic regression models represents the choice of a preferred landscape alternative out of three landscape alternatives by a respondent. The attribute levels are dummy-coded for all landscape alternatives in the choice experiment design. Each individual was requested to respond to eight choice situations. The adjusted R2 value is 0.28 respectively. The number of observations equals the number of individuals times eight because each individual questionnaire included eight choice situations.

In this model, all coefficients suggest a positive relation between the medium and high levels of the attributes in the landscape and the probability of choice. Hence, the presence of all landscape attributes in this choice experiment is evaluated positively. Moreover, all effects are statistically significant at 1%. The ranks of the coefficients indicate the relative preferences for each attribute level (Table 1). In Winterswijk a high level of linear elements is highest ranked, whereas the second ranked attribute is a medium level of linear elements and the presence of livestock is ranked third.

Table 1: multinomial logit model output of the non-monetary choice experiment

	Winterswijk	
Attribute	Coefficient	Coefficient Rank
Presence of livestock	1.245***	3
Med agri LU diversity	.300***	6
High agri LU diversity	.612***	5
Med linear elements	1.595***	2
High linear elements	2.063***	1
Med point elements	.215***	7
High point elements	.713***	4
Log-likelihood	-1199	
Adjusted-R^2	0.28	
Number of observations	1528	
Number of individuals	191	

Figure 8 shows the normalized relative magnitude of the coefficients providing more detail about the differences in relative preferences for the attributes and their levels in the case study area. It becomes clear that linear elements in the landscape – indicating the presence of hedges and tree lines – are by far the most preferred landscape elements. For visitors in Winterswijk, the utility derived from a high level of linear elements is almost twice as high as the third ranked attribute; the presence of livestock.

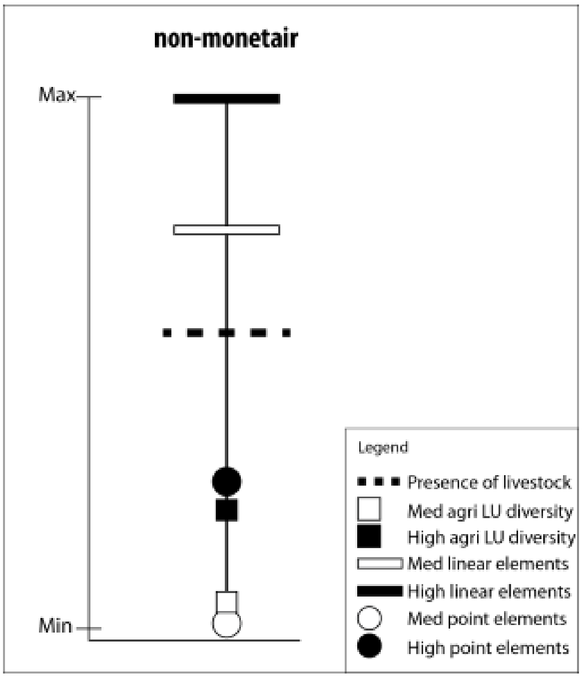


Figure 8: relative preferences for the landscape attributes

The utility derived from the presence of forest patches and the diversity of agricultural land use are the lowest attributes in this non-monetary choice experiment.

Translating the multinomial logit output, presented in Table 1, into a market simulation approach enables the calculation of market shares of for different landscape scenarios. Figure 9 shows the market share distribution for three potential landscape scenarios. The market shares (percentages) indicate the relative amount of visitors that would prefer the particular landscape scenario over the other landscape scenarios. The results of the simulation show that scenario 2 has a larger market share than scenario 3. This indicates that the marginal utility that visitors attribute to the presence of livestock is slightly higher than the marginal utility of high levels of linear and point elements compared to a medium level of linear and point elements.

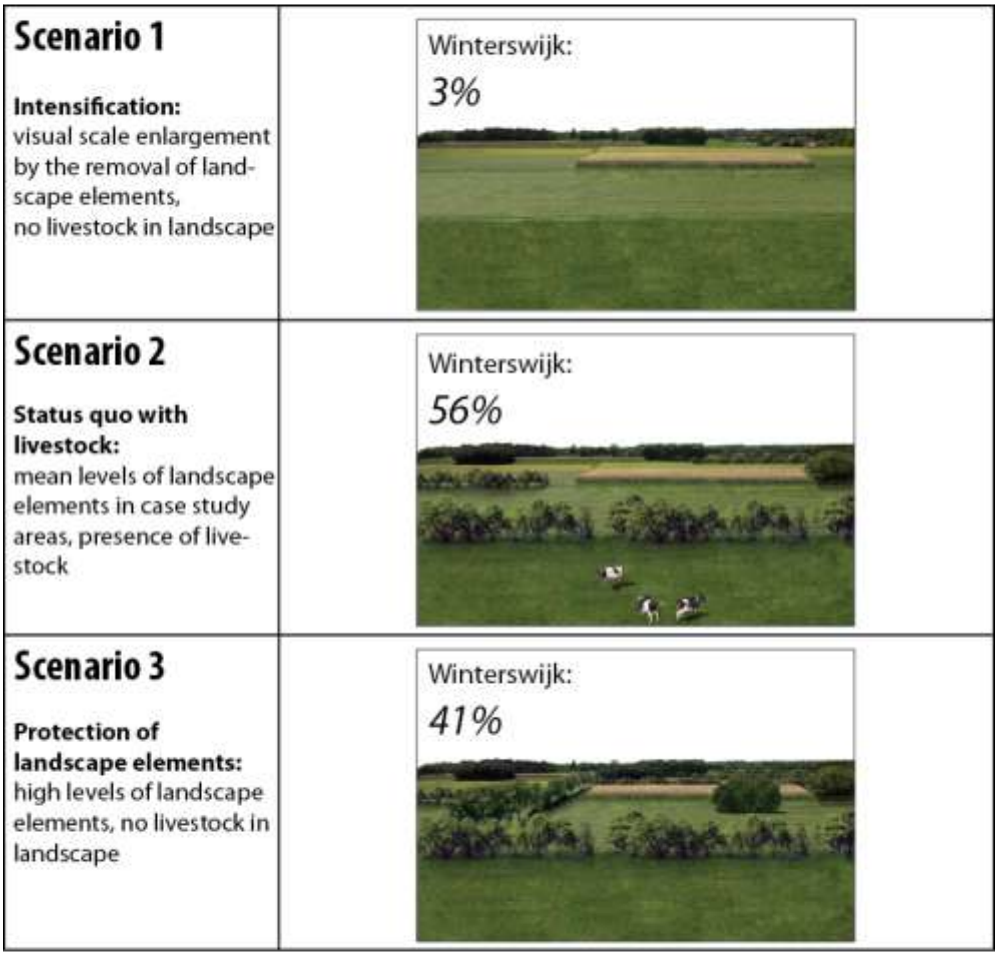


Figure 9: market shares of different landscape scenarios

11.3.3 Comparison to results from the Märkische Schweiz

A similar non-monetary choice experiment was conducted in the Markische Schweiz case study area, using a parallel research design and focusing on preferences for the same type of landscape attributes. Figure 10 shows the normalized relative magnitude of the coefficients to describe relative preferences for the attributes and their levels in the German and the Dutch case study area. When we compare the results, we find that visitors in the Markische Schweiz expressed strong preferences for a high level of point elements – by far the most preferred attribute – whereas in Winterswijk this attribute was one of the less preferred attributes in the landscape and ranked fourth. Visitors in NLW expressed strongest preferences for a high and medium level of linear elements in the agricultural landscape, whereas a medium level of linear elements is one of the least preferred attributes in NMS. In addition, there is a notable difference in the relative preferences for the presence of livestock, which is more preferred in the Dutch case study area. Also, there is a considerable difference between the relative preferences for a high level of agricultural land use diversity, which yields higher relative preference scores in the Märkische Schweiz than in Winterswijk.

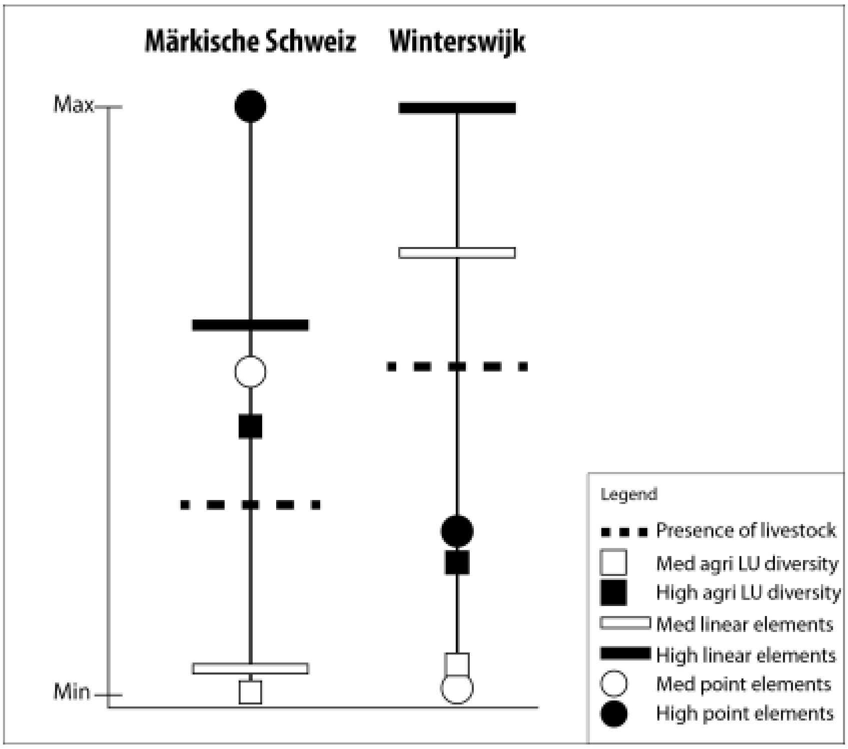


Figure 10: comparison of relative preferences for landscape attributes between the Winterswijk case study area and the Markische Schweiz

11.3.4 Monetary choice experiment

Table 2 shows the output of the multinomial logit model of the monetary choice experiment. The dependent variable in this logistic regression model represents the choice of a preferred landscape alternative out of three landscape alternatives by a respondent. The attribute levels are dummy-coded for all landscape alternatives in the choice experiment design. Each individual was requested to respond to eight choice situations. The adjusted R2 value is 0.23 respectively. The number of observations equals the number of individuals times eight because each individual questionnaire included eight choice situations.

Table 2: multinomial logit model output of the monetary choice experiment

	Winterswijk	
Attribute	Coefficient	Coefficient Rank
Presence of livestock	.712***	3
Med agri LU diversity	.171***	6
High agri LU diversity	.172**	5
Med linear elements	1.472***	2
High linear elements	1.721***	1
Med point elements	-.020	7
High point elements	.405***	4
Cost attribute	-.139***	
Log-likelihood	-1571	
Adjusted-R^2	0.23	
Number of observations	1872	
Number of individuals	234	

In this model, most coefficients suggest a positive relation between the medium and high levels of the attributes in the landscape and the probability of choice, but as was expected the cost attribute yields a negative coefficient. In addition, a medium level of forest patches in the landscape has a negative, statistically insignificant, coefficient. Hence, the presence of all landscape attributes, except for a medium level of forest patches, in this choice experiment is evaluated positively. Except for medium forest patches, all effects are statistically significant at least 5%. The ranks of the coefficients indicate the relative preferences for each attribute level (Table x). Similarly to the results of the non-monetary attribute, a high level of linear elements is highest ranked, whereas the second ranked attribute is a medium level of linear elements and the presence of livestock is ranked third.

We compare the relative preferences for the landscape attributes between the non-monetary and the monetary choice experiments in Figure 11. The left-side bar shows the results of the monetary experiment and the right-side bar shows the non-monetary results. The numbers indicate the mean willingness to pay levels for each landscape attribute, that were obtained by calculating the marginal rates of substitution for the individual landscape attributes and the cost attribute. The willingness to pay level indicates the mean amount in euros that visitors are willing to pay extra per night in their accommodation for that specific landscape attribute.

In addition, Figure 11 shows the differences in relative preferences for the landscape attributes in the monetary and non-monetary experiment. In the monetary experiment, the difference between a high level of linear elements and a medium level of linear elements is smaller than in the non-monetary experiment. This points out that, when the experiment includes financial tradeoffs, the marginal preferences for a high level of linear elements decrease. The same effect is observed for the presence of livestock. Furthermore, in the monetary experiment respondents are indifferent towards medium or high levels of agricultural land use diversity. Relative preferences for the high and medium levels of forest patches in the landscape are similar in the monetary and non-monetary experiment.

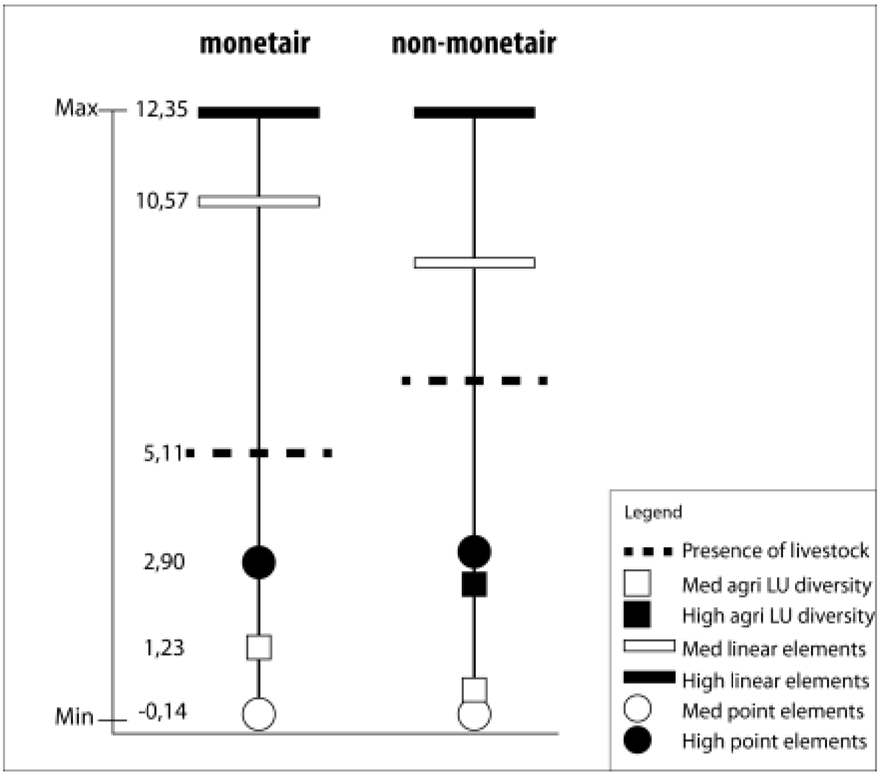


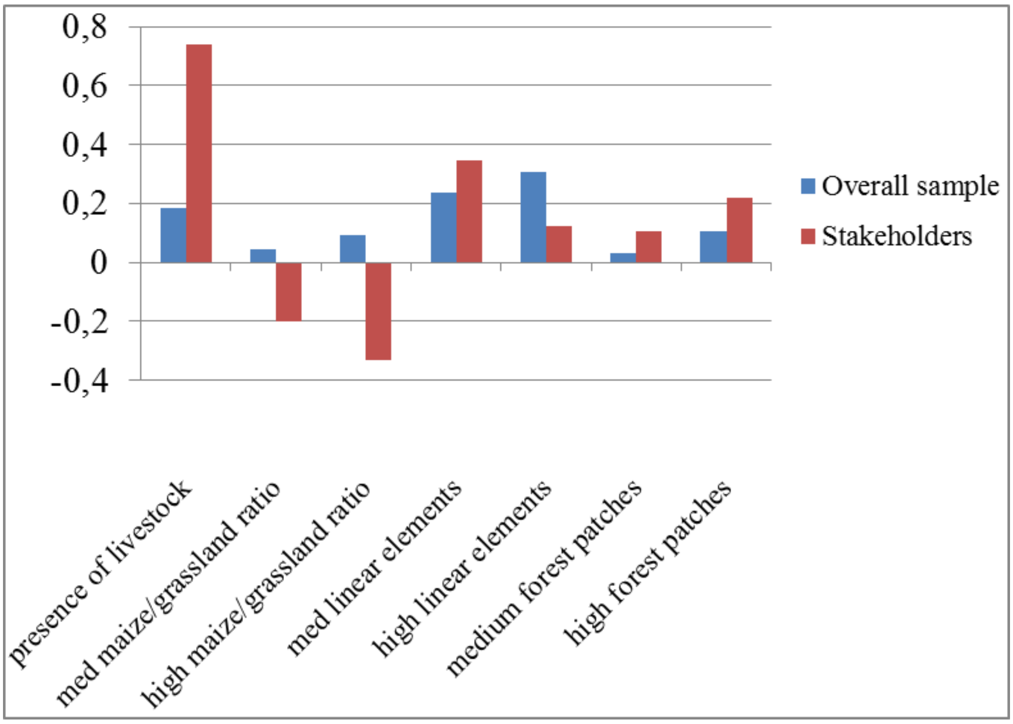
Figure 11: comparison of relative preferences for landscape attributes in the monetary and non-monmetary choice experiment

11.4 Discussion

This study aimed to assess which physical landscape attributes are most important for the visual quality cultural service delivery of the agrarian landscape as perceived by visitors in Winterswijk national landscape. In addition, we aimed to estimate a willingness to pay of visitors for different landscape alternatives. We have addressed these aims by applying monetary and a non-monetary visual choice experiment in Winterswijk national landscape.

In Winterswijk, linear landscape elements, such as hedgerows and tree lines are perceived as most valuable attributes of the agricultural landscape. In both the monetary and the non-monetary choice experiment, a high and medium level of linear elements received the highest relative preferences (Figure 15). The third ranked landscape attribute was in both experiments the presence of livestock in the landscape. Surprisingly, the presence of forest patches in the landscape was perceived as less important, as well as the diversity of agricultural land uses (maize-grassland diversity).

The results of the present empirical study in WInterswijk were validated and discussed by the local stakeholder panel. Figure 12 shows the relative preferences of the overall sample (the non-monetary experiment) to the preferences of the local stakeholder laboratory. There are significant differences between these two groups. Compared to the overall sample, the local stakeholders have much stronger preferences for the presence of livestock. Furthermore, where the overall sample of visitors has weak positive preferences for maize in the landscape, the stakeholders expressed strong negative preferences for maize.



The methodology that was applied in this study contributes to the literature of cultural ecosystem services and landscape preference research. As the methodology elicits preferences for a general set of landscape attributes, relative preferences for specific characteristics of agricultural landscapes (for instance the abundance of green linear landscape elements) can be compared across cases. Moreover, visualizing these attributes in the local landscape setting enables respondents to state preferences for that particular landscape context. This is important because the perception of landscape attributes differs from place to place.

The main purpose of the present methodology is to assist landscape management and policy-making prioritizing in the protection of agricultural landscape attributes across multiple decision-making scales. From local landscape farmer-collectives, such as the WInterswijk case study area, to European Union level decision-making. As agricultural landscape policies are increasingly developed at European level, it is important to understand the value of agricultural landscapes with respect to cultural ecosystem services and how these landscapes, through cultural services, contribute to the competitiveness of regions.

References

Arnberger, A., & Eder, R. (2011). Exploring the Heterogeneity of Rural Landscape Preferences: An Image-Based Latent Class Approach. *Landscape Research*, *36*(1), 19–40. doi:10.1080/01426397.2010.536204

Brander, L. M., Florax, R. J. G. M., & Vermaat, J. E. (2006). The Empirics of Wetland Valuation: A Comprehensive Summary and a Meta-Analysis of the Literature. *Environmental & Resource Economics*, *33*(2), 223–250. doi:10.1007/s10640-005-3104-4

Campbell, D. (2007). Willingness to Pay for Rural Landscape Improvements: Combining Mixed Logit and Random-Effects Models. *Journal of Agricultural Economics*, *58*(3), 467–483. doi:10.1111/j.1477-9552.2007.00117.x

Carlsson, F., Frykblom, P., & Lagerkvist, C. J. (2007). Preferences with and without prices - does the price attribute affect behavior in stated preference surveys? *Environmental and Resource Economics*, *38*(2), 155–164. doi:10.1007/s10640-006-9068-1

Dachary-Bernard, J., & Rambonilaza, T. (2012). Choice experiment, multiple programmes contingent valuation and landscape preferences: How can we support the land use decision making process? *Land Use Policy*, *29*(4), 846–854. doi:10.1016/j.landusepol.2012.01.002

De Haas, W., Kranendonk, R., & Pleijte, M. (1999). Valuable man-made landscapes (VMLs) in the Netherlands: a policy evaluation. *Landscape and Urban Planning*, *46*(1-3), 133–141. doi:10.1016/S0169-2046(99)00037-7

Dienst Landelijk Gebied. (2005). *Uitwerkingsplan Winterswijk Oost* (p. 45).

EAA (European Environment Agency). (2012). CORINE Land Cover 2006 raster data – 100 m, version 16. Retrieved October 10, 2013, from http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2006-raster-2#tab-metadata

Geist, H. J., & Lambin, E. F. (2002). Proximate Causes and Underlying Driving Forces of Tropical Deforestation. *BioScience*, *52*(2), 143–150.

Hynes, S., & Campbell, D. (2011). Estimating the welfare impacts of agricultural landscape change in Ireland: a choice experiment approach. *Journal of Environmental Planning and Management*, *54*(8), 1019–1039. doi:10.1080/09640568.2010.547691

Hynes, S., Campbell, D., & Howley, P. (2011). A Holistic vs. an Attribute-based Approach to Agri-Environmental Policy Valuation: Do Welfare Estimates Differ? *Journal of Agricultural Economics*, *62*(2), 305–329. doi:10.1111/j.1477-9552.2010.00287.x

Jongeneel, R. a., Polman, N. B. P., & Slangen, L. H. G. (2008). Why are Dutch farmers going multifunctional? *Land Use Policy*, *25*(1), 81–94. doi:10.1016/j.landusepol.2007.03.001

Korevaar, H. (2011). *Tussentijdse evaluatie GLB pilot Winterswijk* (p. 46). Wagen. Retrieved from http://edepot.wur.nl/199694

Korevaar, H., Meulenkamp, W. J. H., Agricola, H. J., Geerts, R. H. E. M., & Schaap, B. F. (2008). *Kwaliteit van het landelijk gebied in drie Nationale Landschappen.* (p. 92). Wageningen.

Liekens, I., Schaafsma, M., De Nocker, L., Broekx, S., Staes, J., Aertsens, J., & Brouwer, R. (2013). Developing a value function for nature development and land use policy in Flanders, Belgium. *Land Use Policy*, *30*(1), 549–559. doi:10.1016/j.landusepol.2012.04.008

Lovett, A., Dockerty, T., Suennenberg, G., & Appleton, K. (2010). *The use of landscape visualisations in the RUFUS case studies* (p. 61). Norwich.

Moran, D., McVittie, A., Allcroft, D. J., & Elston, D. a. (2007). Quantifying public preferences for agri-environmental policy in Scotland: A comparison of methods. *Ecological Economics*, *63*(1), 42–53. doi:10.1016/j.ecolecon.2006.09.018

Mücher, C. a., Klijn, J. a., Wascher, D. M., & Schaminée, J. H. J. (2010). A new European Landscape Classification (LANMAP): A transparent, flexible and user-oriented methodology to distinguish landscapes. *Ecological Indicators*, *10*(1), 87–103. doi:10.1016/j.ecolind.2009.03.018

Provincie Gelderland. (2007). *Nationaal Landschap Winterswijk; Integraal Uitvoeringsprogramma*.

Rambonilaza, M., & Dachary-Bernard, J. (2007). Land-use planning and public preferences: What can we learn from choice experiment method? *Landscape and Urban Planning*, *83*(4), 318–326. doi:10.1016/j.landurbplan.2007.05.013

Rudel, T. K. (2008). Meta-analyses of case studies: A method for studying regional and global environmental change. *Global Environmental Change*, *18*(1), 18–25. doi:10.1016/j.gloenvcha.2007.06.001

Schouten, M., Opdam, P., Polman, N., & Westerhof, E. (2013). Resilience-based governance in rural landscapes: Experiments with agri-environment schemes using a spatially explicit agent-based model. *Land Use Policy*, *30*(1), 934–943. doi:10.1016/j.landusepol.2012.06.008

Valbuena, D., Verburg, P. H., & Bregt, A. K. (2008). A method to define a typology for agent-based analysis in regional land-use research. *Agriculture, Ecosystems & Environment*, *128*(1-2), 27–36. doi:10.1016/j.agee.2008.04.015

Valbuena, D., Verburg, P. H., Bregt, A. K., & Ligtenberg, A. (2009). An agent-based approach to model land-use change at a regional scale. *Landscape Ecology*, *25*(2), 185–199. doi:10.1007/s10980-009-9380-6

Van Berkel, D. B., & Verburg, P. H. (2012a). Combining exploratory scenarios and participatory backcasting: using an agent-based model in participatory policy design for a multi-functional landscape. *Landscape Ecology*, *27*(5), 641–658. doi:10.1007/s10980-012-9730-7

Van Berkel, D. B., & Verburg, P. H. (2012b). Spatial quantification and valuation of cultural ecosystem services in an agricultural landscape. *Ecological Indicators*. doi:10.1016/j.ecolind.2012.06.025

Van Berkel, D. B., & Verburg, P. H. (2014). Spatial quantification and valuation of cultural ecosystem services in an agricultural landscape. *Ecological Indicators*, *37*, 163–174. doi:10.1016/j.ecolind.2012.06.025

Van Berkel, D., & Verburg, P. H. (2010). *Deliverable D 5.3: single case study report Winterswijk* (p. 42). Amsterdam.

Van der Kolk, J. W. H., Korevaar, H., Meulenkamp, W. J. H., Boekhoff, M., van der Maas, A. A., Olde Loohuis, R. J., & Rijk, P. J. (2007). *Verkenning duurzame landbouw; doorwerking van wereldbeelden in vier Nederlandse regio's*. *Hydrobiologische Vereniging* (Vol. 6, p. 104). Wageningen. doi:10.1007/BF02334722

Van Zanten, B. T., Verburg, P. H., Espinosa, M., Gomez-y-Paloma, S., Galimberti, G., Kantelhardt, J., … Viaggi, D. (2014). European agricultural landscapes, common agricultural policy and ecosystem services: a review. *Agronomy for Sustainable Development*. doi:10.1007/s13593-013-0183-4

Van Zanten, B. T., Verburg, P. H., Koetse, M. J., & van Beukering, P. J. H. (n.d.). Landscape preferences in European agrarian landscapes: a meta analysis of case studies. *Landscape and Urban Planning*.

Vecchiato, D., & Tempesta, T. (2013). Valuing the benefits of an afforestation project in a peri-urban area with choice experiments. *Forest Policy and Economics*, *26*, 111–120. doi:10.1016/j.forpol.2012.10.001

Wascher, D. M., & Pérez-soba, M. (2004). *Learning from Transfrontier Landscapes - Project in Support of the European Landscape Convention* (p. 58).

Wildenbeest, G. (1989). Recent Farmers' protests in a Dutch Municipality: the Legacy of the past. In J. Boisserain & J. Verrips (Eds.), *Dutch dilemmas: Anthropologist look at the Netherlands*. Assen: van Gorcum.

Appendix 1: Questionnaire

The questionnaire below was used for the monetary choice experiment. Exept for the monetary attribute in the choice experiment, the questionnaire for the non-monetary experiment is identical.

Voorkeuren voor landschapskenmerken in agrarische landschappen in Nationaal Landschap Winterswijk

[INTERVIEWER: STEL VAST DAT DE RESPONDENT EEN RECREANT/TOERIST IS VOOR AANVANG VAN DE ENQUETE EN DAT HIJ/ZIJ AL MINIMAAL EEN DAG IN DE OMGEVING VAN WINTERSWIJK HEEFT DOORGEBRACHT]

I [IN TE VULLEN DOOR INTERVIEWER]

a. Naam interviewer	….	
b. Datum en tijd	….	
c. Locatie	….	
d. Interview nummer	….	

II Inleidende tekst

Agrarische landschappen zijn voortdurend aan veranderingen onderhevig. Door veranderingen in de agrarische sector, maar ook door landschapsbeleid. Landschapsbeleid is erop gericht de culturele en ecologische waarde van het landschap te beschermen door agrariers te stimuleren bepaalde landschapselementen te onderhouden. Zo ontvangen veel agrarische ondernemers in dit gebied subsidie voor onderhoud van heggen en bomenrijen. Dit onderzoek richt zich op de voorkeuren van toeristen en recreanten voor verschillende kenmerken van het agrarische landschap in het nationaal landschap winterswijk.

Dit is een anonieme vragenlijst en de uitkomsten zullen gebruikt worden om de landschapsvoorkeuren van toeristen en recreanten voor agrarische landschappen te onderzoeken.

III Landschapsbeleving

1. In wat voor mate is de aantrekkelijkheid van het agrarische landschap in de omgeving van Winterswijk reden voor uw bezoek aan deze regio?

In zeer geringe mate		←→		In zeer sterke mate
1] ☐	2] ☐	3] ☐	4] ☐	5] ☐

2. Wat is de belangrijkste categorie activiteiten waarvoor u specifiek naar Winterswijk en omgeving bent gekomen?

1] Fietsen en/of wandelen in de omgeving	☐
2] Uitrusten en ontspannen, met name op de camping/accomodatie	☐
3] Winkelen, horeca en musea, met name in de bebouwde omgeving	☐
4) overige: specificeer……………………	☐

3. Hoeveel uur besteedt u gemiddeld per dag dat u hier bent aan de volgende activiteiten?

1] Fietsen	.................uur
2] Wandelen	.................uur
3] Uitrusten en ontspannen	.................uur
4] Winkelen, horeca en musea	.................uur
5] Andere activiteiten namelijk.......	.................uur

4. Hoeveel dagen verblijft u (of bent u ongeveer van plan te verblijven) in de omgeving van Winterswijk tijdens dit bezoek?

...... dagen

IV Keuze-experiment

(INTERVIEWER: VUL VERSIENUMMER IN ___)

Herinner de respondent dat het een anonieme vragenlijst betreft.

Laat voorbeeldkaart zien >>

In het volgende onderdeel wordt u gevraagd een keuze te maken tussen drie verschillende landschappen die het resultaat zijn van verschillende manieren van landschapsbeheer door boeren. De landschappen verschillen op de volgende kenmerken:

1) De aanwezigheid van vee in de weide
2) De verhouding tussen weilanden en akkerland met maisteelt
3) De hoeveelheid heggen en bomenrijen in het landschap
4) De hoeveelheid bomengroepen en percelen met bos in het landschap
5) De extra overnachtingskosten per kamer/kampeerplek per nacht

U wordt gevraagd om tien maal een keuze te maken. Bij elke vraag zullen de opties verschillend zijn. Probeer u voor te stellen welke situatie uw voorkeur geniet, waarbij u rekening houdt met alle eerder genoemde landschapskenmerken. Op basis hiervan maakt u uw keuze. Houdt er rekening mee dat er geen 'beste keuze' is, maar dat wij benieuwd zijn naar de afwegingen die u maakt wanneer u moet kiezen tussen verschillende landschapskenmerken. Wij zijn geinteresseerd in uw mening; er zijn geen foute antwoorden.

Hieronder is een voorbeeld te zien van een keuzekaart met drie landschapsopties. Om een keuze te maken uit deze opties, dient u alle kenmerken waarop de landschappen verschillen.

Beschrijf voorbeeldkaart [1]:

Optie A (1111): op deze landschapsfoto is er geen vee aanwezig in de weide, het overgrote deel grasland en weinig akkerland, geen heggen en bomenrijen en een minimaal aantal bosjes en percelen met bos

Optie B 2213: op deze landschapsfoto is er vee aanwezig in de weide, is er relatief veel akkerland met mais ten opzichte van grasland, zijn er geen heggen of bomenrijen en is er een hoog aantal bosjes en percelen met bos.

Optie C 2333 op deze landschapsfoto is er vee aanwezig in de weide, is er is er relatief veel akkerland met mais ten opzichte van grasland, zijn er veel heggen of bomenrijen en is er een hoog aantal bosjes en percelen met bos.

Opties A, B en C verschillen per kaart. Waarschijnlijk zullen de meeste opties niet aan uw ideaalbeeld voldoen en zullen keuzes soms moeilijk zijn. Elke kaart geeft een nieuwe keuze weer heeft en niets te maken met eerdere gemaakte keuzes.

[**Probeer de respondent minder te helpen bij de eerste keuzekaart in het experiment, tenzij hij/zij het echt niet begrijpt. Geef kort de verschillen tussen de verschillende opties aan als het echt nodig is. Voorkom ten alle tijden de respondent te sturen**]

5. [Start het keuze-experiment]

Keuze / Landschap	1	2	3	4	5	6	7	8
A								
B								
C								

6. Hoe heeft u over het algemeen uw keuzes gemaakt?

1] eerste indruk	☐	3] Door voornamelijk op 1 kenmerk van het landschap te letten	☐
2] willekeurig	☐	4] Door een afweging te maken op basis van het hele landschap	☐

7. Welke van de vier kenmerken van het landschap heeft u meegenomen in uw keuzes (meerdere antwoorden mogelijk)? **[INTERVIEWER: NIET OPLEZEN, MEERDERE ANTWOORDEN MOGELIJK]**

1] Vee in de weide	☐	3] de hoeveelheid heggen en bomenrijen	☐
2] verhouding grasland versus akkerland met maisteelt	☐	4] de hoeveelheid bomengroepen en percelen met bos in het landschap	☐

8. Bent u agrarier of heeft u banden met agrariers (meerdere antwoorden mogelijk)?

[INTERVIEWER: LEES OPTIES VOOR]

1] Ik ben agrarier	☐	3] Ik heb directe familie (ouders, broers/zussen, ooms/tantes, grootouders, neven/nichten) met een agrarisch bedrijf	☐
2] Ik ben opgegroeid op een agrarisch bedrijf	☐	4] Ik heb goede vriend(en) met een agrarisch bedrijf	☐

9. Hoe vaak heeft u reeds een bezoek gebracht aan Winterswijk en omgeving voor dagrecreatie of toerisme?

[INTERVIEWER: LEES OPTIES VOOR WANNEER NODIG]

1] Eerste keer	☐	3] 5-10 keer	☐
2] 2-5 keer	☐	4] > 10 keer	☐

10. Hier volgen enkele stellingen over uw verbondenheid met het landschap in Winterswijk en omgeving.

[INTERVIEWER: LEES STELLINGEN VOOR]

	Mee oneens	←→			Mee eens
1] Ik vind dit het mooiste landschap van Nederland	1] ☐	2] ☐	3] ☐	4] ☐	5] ☐
2] Ik ben opgegroeid in dit landschap	Onjuist ☐		Juist ☐		
3] Mijn familie is afkomstig uit deze omgeving	Onjuist ☐		Juist ☐		

11. Aan welke van de volgende plaatsen in de omgeving van Winterswijk heeft u tijdens deze of eerdere vakanties wel eens een bezoek gebracht? **[INTERVIEWER: LAAT KAART ZIEN (BIJLAGE) EN VUL DE LOKATIE VAN DE ACCOMMODATIE WAAR HET INTERVIEW PLAATS VINDT IN]**

1] de omgeving van buurtschap Kotten	☐	6] de omgeving van buurtschap Henxel	☐
2] de omgeving van buurtschap Meddo	☐	7] de omgeving van buurtschap Huppel	☐
3] de omgeving van buurtschap Ratum	☐	8] de omgeving van buurtschap Brinkheurne	☐
4] de omgeving van buurtschap Woold	☐	9] het Korenburgerveen	☐
5] de omgeving van buurtschap Corle		10] de omgeving van de steengroeve	

V Algemene kenmerken

12. [**IN TE VULLEN DOOR INTERVIEWER**]

Geslacht:

1] Man	☐	2] Vrouw	☐

13. Wat is uw geboortejaar: ....

14. Wat is uw hoogst voltooide opleiding?

1] Basisonderwijs	☐	5] hoger algemeen en voorbereidend wetenschappelijk onderwijs	☐
2] middelbaar voortgezet onderwijs	☐	6] hoger beroepsonderwijs	☐
3] lager beroepsonderwijs	☐	7] wetenschappelijk onderwijs	☐
4] middelbaar beroepsonderwijs	☐	8] Anders, namelijk....	☐

15. Wat zijn de 4 cijfers van uw postcode? ….

16. In welke categorie valt het maandelijks netto inkomen van uw gehele huishouden?

1] minder dan 1000 euro	☐
2] 1000-1500 euro	☐
3] 1500-2000 euro	☐
4] 2000-2500 euro	☐
5] 2500-3000 euro	☐
6] 3000-3500 euro	☐
7] meer dan 3500 euro	☐

Namens het Instituut voor Milieuvraagstukken en de Vrije Universiteit wil ik u hartelijk bedanken voor uw medewerking. Zou u in de toekomst nog een keer mee willen werken aan een dergelijk onderzoek?

1] Ja	☐	2] Nee	☐

Naam:

E-mail adres:

Appendix 2: Examples of choice cards

Non-Monetary Experiment

Alternative A

Alternative B

Alternative C

Monetary experiment

Alternative A

2.50 Euro extra per night

Alternative B

1 Euro extra per night

Alternative C

5 Euro extra per night

12 CSA 5: Is landscape attractiveness a driver of rural economy? The case of a pathway restoration in olive groves

Rodríguez-Entrena, M., Colombo, S., Arriaza, M.

12.1 Introduction

The agricultural landscape is a non-traded good that is set by the farmers' decision making regarding the production of traditional marketable commodities. Thus, the farmers' decisions on the farming management, crops selection and farming practices provide to society landscapes which affect human well-being and identity (Kapland and Kaplan, 1989; Council of Europe, 2000). As landscape holds in the most cases the characteristics of "public good" (non-excludable and non-rival in its consumption) the challenge for policy makers is to determine the appropriate provision of landscapes which maximize social welfare, avoiding the market failure that usually appears in agricultural productions (OECD, 2001). The Common Agricultural Policy (CAP) has to some extent addressed this issue through different instruments aimed at protecting (e.g. Natura 2000) and provisioning (e.g. cross-compliance and agri-environmental schemes) agricultural public goods[2], as farmers have to be encouraged to pursue certain farming practices (Rodríguez-Entrena and Arriaza, 2013) to maintain landscape features, restore specific habitats or to manage natural resources such as water and soils, for example. In this process, it is important to recognize the role of landscape diversity and aesthetic for the tourism industry and for the general well-being of European population. This has to be done by considering the joint provision of environmental goods and services (ancillary benefits) by agriculture (Glenk y Colombo, 2011; Rodríguez-Entrena et al., 2013), given the close inter-linkages between landscape and other environmental externalities such as biodiversity preservation, soil erosion, cultural values etc. Thus, the policy making process must be reviewed and adjusted on a regular basis to achieve the desirable level of landscape provision. To do so, policy actions require information about the social demands towards landscape aesthetic and the possible land use changes which are able to provide the demanded landscapes features.

The economic valuation of the agricultural landscape has been deeply investigated using stated preferences methods (Drake, 1992; Garrod and Willis, 1995; Campbell, 2007; Hanley et al., 2007; Johns et al., 2008; Hanley et al., 2009; Hasund et al., 2011). This methodology has mainly been applied to the economic evaluation of the aesthetic value of the agricultural landscape, being recent studies the one of Campbell et al. (2007), Hanley et al. (2007), Borresch et al. (2009), Hasund et al. (2011), Burgess et al. (2012) and Grammatikopoulo et al. (2012). Results derived from these studies show that, in general, landscape elements as stonewalls, farm buildings, covers crops, wooded pastures and mountain land impact positively on utility of the individuals. However, in most of this studies the landscape changes presented to the citizens are computer assisted designs (Campbell et al., 2007; Burgess et al., 2012), where different pictograms are used to describe the intensity of each attribute levels (Hanley et al., 2007), and auxiliary pictures are used only for illustrating the attributes not for the choices (Gramatikopoulo, 2012). Moreover, landscape is usually broken down into different components and no views or scenes of landscapes are shown as a whole but are shown of each attributes separately (Campbell et al., 2007; Hanley, 2007; Gramatikopoulo, 2012). Finally, the spatial configuration of landscape features used to show the landscape changes has also been omitted, when it may have an impact on landscape preferences and therefore potentially on

[2] We acknowledge that CAP is not a landscape policy. Nonetheless, CAP provides incentives to modify land use and farming practices, which in turn havs the potential to foster the delivery of landscape public goods.

economic values (Burguess et al.; 2012). As a result, these approaches may subtract realism to the choice experiment task, especially when target is the estimation of the aesthetic value of agricultural landscapes. Indeed, the more the digital framework differs from the real landscape features, the more likely is that the hypothetical preferences differ from the real ones.

In addition, most studies on the economic valuation of the agricultural landscape focus on first order effects (FOEs), consisting on the assessment of willingness to pay for landscape changes. In this sense, Cooper et al. (2009) points out that the FOEs are a measure of the inherent value of the landscape as a public good. This approach is much closer to the concept of direct socio-economic benefits (DSEBs) used by the DG Agri (2010). However, there are also second order effects (SOEs) from the management of agricultural landscapes in terms of economic activities (e.g. rural tourism) and employment in rural areas. These effects are of particular importance because link the landscape management to the territorial and rural development of rural areas. According to Cooper et al. (2009), overall, landscape is likely to be the most important public good contributing to the provision of such second order effects, although evidences of quantified economic impacts are still lacking. The ENRD (2010) links the SOEs with the concept of indirect socio-economic benefits (ISEBs) of public goods depicting a nine items list of social and economic benefits that occur depending, partly or totally, on the existence of the public goods from agriculture. Likewise, the DG Agri (2010) connects the SOEs with the ISEBs for the agricultural sector (e.g. direct selling of farm products, stimulation of the general demand for local products, etc.) and the whole regional economy (development of tourist industry, niche-market opportunities for local products, employment creation and maintenance, income effects on the wider rural economy, etc.).

As such the landscape is not only an essential element to be preserved per se to maximize its aesthetic appreciation, but also an economic asset which can offer significant opportunities for the economic and rural development of rural areas. Even assuming the difficulty in some case to isolate both effects independently, it is clear for policy analysis the relevance of the assessment of such SOEs in order to evaluate land use alternatives.

In this study, we estimated the economic value of landscape attractiveness of olive orchards due to changes in the management of olive groves (i.e. presence of green cover, stonewalls and woodland islets) by means of the Choice Experiment (CE) method. To overcome some of the shortcomings previously described, we employ in the CE real pictures of the current landscape and real pictures of the hypothetical changes used to improve the landscape attractiveness. So, the existing approaches to assess visual quality of landscape (Briggs and France, 1980) are combined: the direct one which considers the whole scene (Arthur et al., 1977; Pérez, 2002) and the indirect approach which evaluates its components and aggregates them. Furthermore, we analyze the increase in the recreational demand which arises from the improved landscape attractiveness by gathering information about the probability of visiting the agricultural landscapes as a function of the visual elements investigated. This allow us to estimate the economic impact that the recreation demand associated to landscape attractiveness has on local economy and rural development (SOEs) to provide evidences between the linkage of landscape features, local development and social welfare.

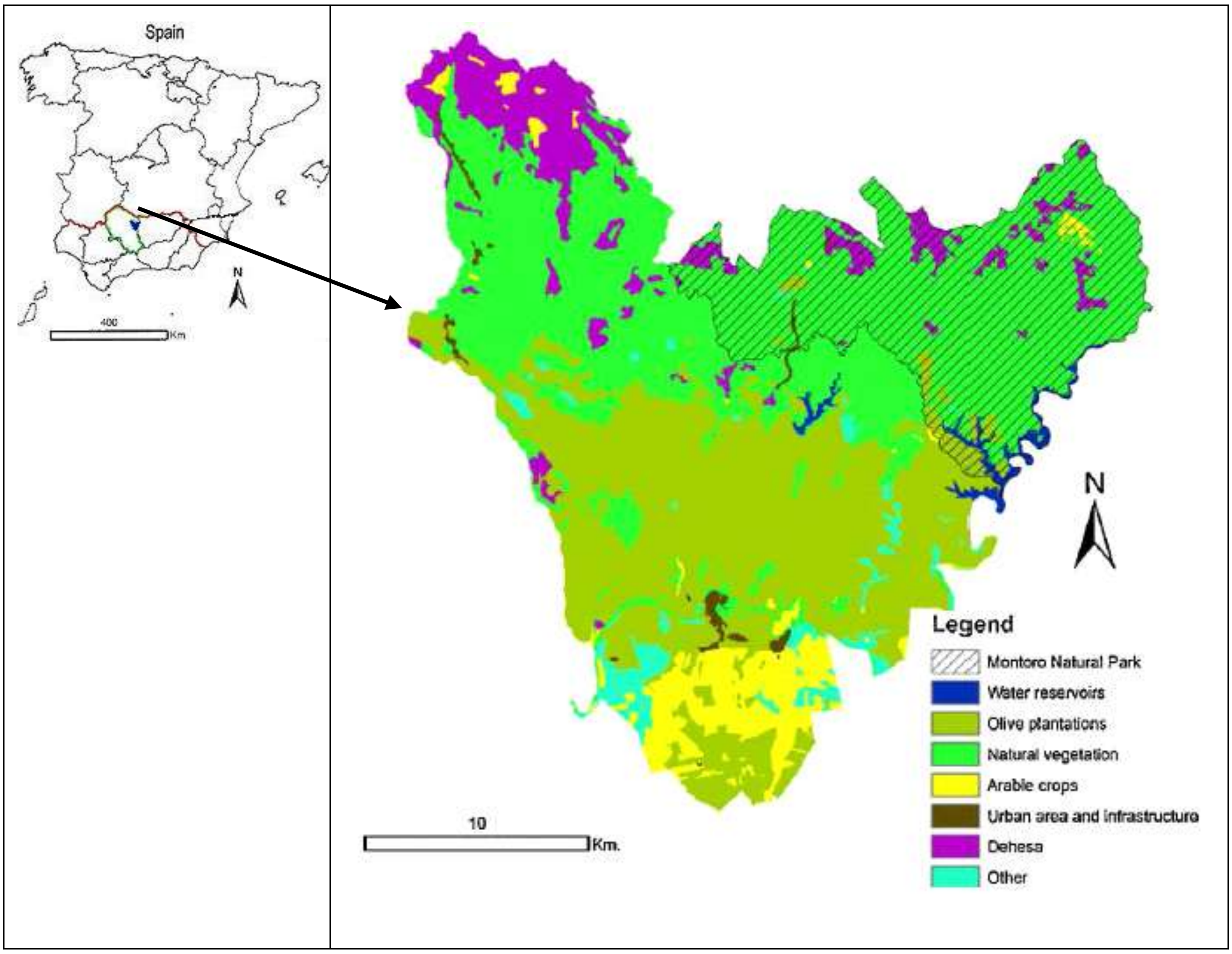
The remainder of the paper is structured as follows. The next section presents the survey design and methodological approach used to assess the economic value of the agricultural landscape improvements. The results are depicted in section three and the papers ends with a discussion that highlights the policy implications to promote the landscape as the cornerstone of the rural development.

12.2 Research design

12.2.1 Case study

The present study is one out of nine case studies of the CLAIM European Project (www.claimproject.eu). The case study is located in the municipality of Montoro in the Province of Cordoba, southern Spain. The landscape is characterized by a variety of agricultural ecosystems (pasture, olive groves and annual crops) and forest/shrub natural vegetation near the agricultural areas. Elevations range from 140 m to 790 m a.s.l. Land use includes the Natural Park of Cardeña-Montoro (27,272 ha), olive groves (20,009 ha), dehesa[3] and other pastures (4,855 ha) and arable crops (3,645 ha). The central and northern parts of Montoro are mostly highlands with steep slopes that make agriculture difficult and expensive. For this reason, most agricultural production in this region is based on traditional olive groves and pasture. The following map shows its location and land use.

Map 1. Land use map of Montoro



[3] Dehesa is grassland with scattered trees and a well-developed herbaceous formations (Spanish Society for Pasture Research). These agrosilvopastoral systems are characterized by a savanna-like physiognomy (Martín and Fernández, 2006).

Taking into account the importance of the olive oil production in the municipality a focus group composed by local stakeholders suggested that the diversification of the olive groves landscape could have a regional impact in the rural economy through the increase of rural tourism[4]. Within this goal, they analyzed which landscape elements could be changed in the olive groves to increase the provision of public goods (cultural services, soil erosion prevention and preservation of biodiversity) and, at the same time, contribute to the rural economy by attracting new visitors. Three landscape elements were mentioned: use of stonewalls, presence of woodland islets in the olive groves and the use of green cover between olive trees.

Amongst various projects of landscape restoration, the focus group suggested the conditioning of two pathways (7 and 3 km in length), within the olive groves and other Mediterranean vegetation, to be considered as recreational space for visitors. Also, they emphasized the need to provide some basic infrastructures such as informational signs and rest area. As such, the improvement of landscape attractiveness by means of adding stonewalls, woodland islets and green cover along these pathways was chosen as study case.

12.2.2 Choice experiment administration and experimental design

The target population was the potential visitors from the nearest city (Cordoba, some 320,000 inhabitants, 47 km away). A quota sampling procedure by age and gender was followed to obtain a sample of 331 individuals. For the CE exercise, we selected the three landscape elements suggested by the focus group, namely use of stonewalls, presence of woodland islets in the olive groves and the use of green cover between olive trees. These elements represented the CE attributes and were allowed to take two values to represent either the presence or the absence of each attribute in the scene, giving a total of 8 possible landscape combinations. For each landscape combination four pictures were taken to reduce the scene bias. The pictures were taken from real landscapes existing in the neighborhoods of the two pathways. The payment vehicle was determined by consulting a discussion group of 10 citizens which suggested a parking fee as the most suitable and credible instrument. The levels were chosen by revealing the participants’ maximum willingness to pay for a day parking; then the maximum and minimum values were eliminated and a consensus was reached about the levels of €1.5, 3, 4.5 and 6.

The choice experiments (CE) were implemented by facing respondents with a sequence of choice tasks comprising three options of olive grove landscapes. One represented the status quo with no additional payment (no parking fee); the two others combined the proposed landscape features with the parking fee. The usual reminders concerning budgetary constraints and availability of substitutes were applied. Furthermore, the surveyors were informed on the amount of hectares which were included in the restoration project. Previous literature, as Tveit et al. (2006) and Gobster et al. (2007), pointed out the viewing distance has an effect on the visual quality of the scene. Most studies consider 1 km as the high visibility area (Scarfo et al., 2013; Sevenant and Antrop, 2007). However, in this study, due to the orography of the olive groves, the visibility area is limited along the pathways. As such, a buffer area of 300 m was chosen at each side of the paths. As a result, 600 hectares of olive orchards were considered as the restoration project area. The final part of the questionnaire included sociodemographic characteristics, about the respondents’ recreation activities and attitudes and beliefs on possible ways of carrying out the aesthetic improvements of the landscape.

[4] They emphasized the olive grove landscape is degraded displaying a poor aesthetic value.

The full factorial design corresponding to the CE attributes levels led to 32 potential landscapes (3^2x4) that were halved using an orthogonal optimal in the difference fractional factorial design, following the methodological approach of Street and Burgess (2007). The resulting 16 choice sets were split into 2 blocks to face each respondent with 8 choice cards. Finally, the experimental design was repeated four times to represent the four versions of the landscape scenes. The use of four different versions of the same landscape picture was explicitly used to better portray the existing landscape aesthetic heterogeneity of the considered landscape features. However, at the same time, it may have included an additional source of unobserved heterogeneity relative to exogenous factors which may impact respondents' choices, such as picture framing, luminosity, contrasts etc. To take this into account, we included in the model specification a set of dummy variables which consider the four set of pictures.

Each block was randomly assigned to respondents who were asked to choose the most preferred landscape picture and to declare the associated probability of visiting the place in an interval scale from 0 to 10. Thus, changes in probability of visit would measure differences in the recreational demand of the pathways according to the landscape features shown in the choice cards.

2.4. Modelling framework

In this study we focused on the estimation of direct and indirect use values relative to agricultural landscape[5]. For this purpose, the theoretical basis of the stated preference approach is supported on creating a hypothetical market situation where the individuals are asked to disclose their willingness to pay (WTP) for agricultural landscape changes. Concretely, the CE approach has a theoretical grounding in Lancaster's model of consumer choice (Lancaster, 1966) combined with the "random utility theory" (McFadden, 1974). Earlier applications of the approach were modelled assuming homogeneous preferences across the sample. Recognition of respondent heterogeneity preferences in economic analysis is relevant for estimating unbiased models and enhancing the accuracy and reliability when demand, marginal welfare or total welfare are estimated (Colombo et. al. 2009; Rodríguez-Entrena et al., 2014).

Among the different options available to incorporate preference heterogeneity into choice modelling we opted for the Latent Class Model (LCM) due to its potential advantages to recognize the preferences heterogeneity and revealing the causes of such heterogeneity (Shen, 2009; Hess et al., 2011). Indeed, the LCM reveals a considerable richness in the structure of preferences, supporting the hypothesis that there are latent classes, which would otherwise be unobservable with other approaches (Scarpa et al., 2005). Hynes et al. (2008) reinforce that the LCM approach may offer an in-depth understanding of preference heterogeneity supplying a great range of potentially useful information for policymakers.

The latent class model approach assumes that individual choice behavior depends on observable attributes and on latent heterogeneity that varies with factors which are unobserved by the analyst (Greene and Hensher, 2003). Latent heterogeneity is analyzed through a model of discrete parameter variation, where it is assumed that individuals are implicitly sorted into a set of C classes. However, the specific class of each individual is unknown to the analyst. Therefore, the LCM approach is based on a class membership probability equation associated to the classical conditional logit formula for homogeneous preferences. The situation can be viewed as one in which preference heterogeneity is captured by simultaneously assigning individuals to behavioral groups or latent classes while estimating a choice model (Glenk and Colombo, 2011). The sequence of choices ($y_1, y_2, \ldots y_T$), made by a randomly chosen individual *n* is given by:

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[5] According to the Secretariat of the Convention on Biological Diversity the total economic value of agricultural landscape can consist of use value (direct, indirect and option value) and non-use value (SCBD, 2007).

$$P_n([y_1, y_2, ...y_T]) = \sum_{s=1}^{S} \left[\frac{\exp(\alpha_s Z_n)}{\sum_{s=1}^{S} \exp(\alpha_s Z_n)} \right] \left[\prod_{t}^{T} \frac{\exp(\beta_s X_{nit})}{\sum_{j=1}^{J} \exp(\beta_s X_{njt})} \right] \qquad s = 1, ..., S \qquad [1]$$

where the first expression in brackets is the probability of observing the individual in class *s* according a set of individual-specific characteristics (the Z_n variables), and the second term is the probability of the sequence of choice ($y_1, y_2, \dots y_T$), conditional on belonging to class *s*. Here, β_s is the parameter vector of class *s* associated with a vector of explanatory choice attributes X_{nit}. Equation (1) encapsulates the LC approach to choice modeling. An overview of the specification of the LCM can be found in Greene and Hensher (2003).

In LC modelling the number of latent segment must by imposed exogenously by the analyst. To date, there is no verified theory to ensure the optimal number of classes that define the underlying structure of preferences. Several ways have been proposed in the literature, such as the minimum Akaike Information Criterion (AIC), and the minimum Bayesian Information Criterion (BIC). The number of classes that minimize each of the measures suggests the preferred model. Nonetheless, several studies demonstrate that statistical criteria do not ensure an optimal number of segments (Andrews and Currim, 2003; Nylund et al., 2007). Hence, applied researchers have since used a combination of criteria to guide the final decision, where both analyst judgment and model parsimony play a key role (Scarpa and Thiene, 2005). In this study, the AIC was slightly lower in the three classes model than in the two classes. However, the three classes model showed some inconsistencies in the parameters estimates of the third class, to which was also assigned a low probability. Considering the significance of parameter estimates and the class probabilities, we opted for the two classes model in this study.

From the model coefficients the estimation of the marginal WTP for a discrete change in an attribute level provides insights into the relative importance that respondents give to the attributes. In this application, the WTP aggregated over respondents is a measures of the first order effects (FOEs) resulting from improving landscape attractiveness and can be used by policy makers to assign more resources in favor of the landscape changes which have associated higher WTP values. The WTP for the presence of landscape element *A is* estimated by dividing the coefficient of the landscape element by the coefficient of the cost attribute:

$$WTP_A = -\left[\beta_A / \beta_{COST} \right] \qquad [2]$$

Given the payment vehicle employed was a parking fee, the resulting WTP is a measure of the value associated by the direct use of the landscape by potential visitors[6] that it can be interpreted in terms of first order effects (FOEs). These individuals would also generate a set of socio-economics benefits to the rural area which fall under the definition of second order effects (SOEs). These effects originate from the increase of the economic activity in the area due to the demand for goods and services by visitors, and can be divided into; i) second order effects directly associated to visitors' expenditure (SOEsV); and ii) second order effects associated to the multiplier effects in the regional economics (SOEsM).

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[6] We recognize that there may a set of indirect use values and non-use values which have not been considered in the estimation of WTP. However, given the specific and limited scale of the landscape intervention, we expect that these values are low in comparison to the use ones.

The SOEsV were estimated by means of a benefit transfer exercises where we employed a literature review of similar infrastructures to size the visitor potential expenditure. Thus, Luque-Valle (2011) made a study about green pathways in Andalusia where an average expenditure per visitor of €5 was found. Other studies carried out in the “Sierra Norte de Sevilla” green pathway (Andalusia), Girona’s green way network (Catalonia) and the Tajuña green way (Madrid) depicted €9, 3.9 and 8 respectively as average expenditure (MERCODES, 2008). The average of these figures was chosen as the potential visitor expenditure (6.5€).

The SOEsM were estimated considering the multiplier effects of the economy which are conceptualized as an increase (or decrease) in income or employment in a local or regional economy triggered by the emergence of a new economic activity. Thus, the multiplier is an attempt to quantify the power of this new economic activity (Domanski and Gwosdz, 2010). Amongst the theoretical approaches existing in the literature, input-output models have been employed to show the linkages between different types of economic activities and to analyse the impact of changes in one sector of the economy (tourism in our case) on other sectors (agriculture, agro-food industries, handicraft) in a given region. In our case, the aggregated impact in the regional economy and the multipliers effects by economic sector in terms of rent triggered by the new tourism demand were estimated by using the regional Social Account Matrix (SAM) for Cordoba. This Matrix is the representation of Cordoba linkages between its economy structural features and the distribution of households’ incomes and expenditures. It was estimated from Mary et al. (2013) where multiplier effects are identified for urban and rural areas inside the studied province.[7]

12.3 Results

Table 1 summaries the respondents’ socio-demographic features and their opinion on possible ways to implement the policy measures related to the provision of agricultural landscape. The chi-square tests for equality of distributions do not reject the null hypothesis of equality between sample and population proportions, supporting the representativeness of the sample for both, gender and sex (X^2=0.12, p=0.001; X^2=3.97 p=0.001, respectively). Concerning the respondents’ attitudes towards the landscape use for recreation, 30% of the interviewed did not go to the countryside in the last year, whereas 23% are frequent users. Most respondents are aware of the existence of the natural park where the proposed recreational pathways are located. In the survey, we also inquired about the possibility of coercing farmers to improve the landscape attractiveness and about the share of the rural development budget to be spent in activities not related to agriculture. Respondents are generally against compelling farmers to carry out the landscape program and also to devote a large part of the rural development budget to activities not related to agriculture. This suggests a social legitimacy towards the current rural development program in the region.

[7] To estimate the aggregated impact in the Montoro’s local economy and the multipliers effects by economic sector in terms of rent we would need a Social Account Matrix (SAM) for the municipality which not exists. However, the SAM of Córdoba for the rural areas was designed to represent the input-outputs effects for rural municipalities inside this province and can be considered a close representation of the Montoro municipality.

Table 1. Definition of the variables representing individual characteristics included in the analysis

Variable	Description	Mean	s.d.
PROPERTY_RIGHTS	Farmers should compulsorily adopt the olive orchard landscape programme (1 if yes)	0.32	0.46
RURAL_BUDGET	Earmark the 50% of an hypothetical rural development budget to activities not related to agriculture (1 if yes)	0.22	0.41
VISIT_FRECUENCY	Frequency of recreation activities in the countryside undertaken by the individual in the last year (0=0; 1=1 or 2; 2=3 to 5; 3= 6 to 10; 4=more than 10)	1.81	1.51
YOUNG	Respondent has an age between 18 and 34 years old (1 if yes)	0.33	0.47
MIDDLE	Respondent has an age between 35 and 55 years old (1 if yes)	0.47	0.49
MATURE	Respondent has an age between 56 and 85 years old (1 if yes)	0.20	0.39
PARK_AWARENESS	Respondent's awareness about the Cardeña and Montoro regional natural park (1 if yes)	0.63	0.48

Source: Own elaboration

Of the 331 respondents who faced the CE, 23 stated a protest response, by choosing always the status quo option without trading off the attributes shown in the choice cards[8]. These respondents were omitted from the analysis. The results of the LC model are shown in Table 2, where we also portray the coefficients of a conditional logit model that assumes preference homogeneity. The LC model is highly significant and allocates 68% of respondents to class one and 32% to class two. Compared with the conditional logit model the LC model shows a significant improvement in fitting and in the log-likelihood function at convergence (LR=776, $p<0.000$), revealing that the incorporation of heterogeneity contributes to a better understanding of respondents' choices. Regarding class membership, it is important to bear in mind that the model estimates the effect of variables on membership probability relative to the second segment, for which all parameters are normalized to zero to allow estimation. In class one, all parameters except the park awareness are statistically significant. In comparison with class two, membership to class one is associated with a stronger belief that farmers should be compelled to improve the landscape aesthetic and that part of the rural development budget can be used for this purpose. Respondents who belong to this class are younger and go to the countryside for recreation activities more often. Turning to the utility function parameters of this class, the green cover and the stonewalls coefficients are highly significant with the expected sign. Individuals of class one prefer a landscape program which incorporate green cover and stonewalls to the olive orchards. The presence of woodland islets seemed not to be important according to the respondents' preferences. A possible reason is the weak visibility of these islets inside the wooded orchards, as the vegetation islet does not stand out over the olive trees and, in general, weak chromatic differences appear in the pictures. As it may be expected, the coefficient of the parking fee is negative and highly significant revealing that the respondents' probability of visiting decreases with higher fees. The high significance and the negative sign of the constant show that there are other reasons associated to the aesthetic

[8] In every stated preference survey, a certain number of respondents choose the status quo option because they object to the manner in which they are being asked to pay ('the payment vehicle'), or they do not find the scenario credible enough, rather than because they have no value for the good itself or can't afford to contribute more.

improvement of the landscape, not described by the attributes used in this study, which provide utility to individuals (Boyd and Krupnick, 2009). Finally, the significance of the coefficient of the landscape scenes belonging to set B reveals that there is a framing effect[9]. In particular, respondents are more likely to choose a landscape scene that is portrayed in this set. A possible reason could be that in general this set of pictures are slightly brighter which convey a greener aspect of the vegetation cover, which is the most valued landscape element[10]. People who belong to class two only experience an increase of utility from the green cover element of the landscape. They are neutral to the presence of either stonewalls or woodland islets. The coefficient of the parking fee is significantly smaller compared to that of class one, indicating that respondents of this class have a larger disutility from higher parking fees. Likewise, respondents of this class showed a higher probability of selecting B scenes.

Table 2. Latent class estimates

Utility function	***Conditional logit***	***Latent class 1***	***Latent class 2***
ASC_{SQ}	-0.198**	-1.118***	-0.359
GREEN-COVER	1.065***	1.082***	1.098***
STONEWALLS	0.486***	0.546***	0.246
GREEN ISLET	0.043	0.060	0.067
PAYMENT	-0.267***	-0.182***	-0.919***
SET A	-0.051	-0.097	0.060
SET B	0.249**	0.385**	0.785***
SET C	-0.171	-0.287	0.267
Class membership function			
Intercept		-1.265***	--
PROPERTY_ RIGHTS		1.717***	--
VISIT_FRECUENCY		0.219**	--
YOUNG		0.889*	--
MIDDLE		0.945**	--
RURAL_BUDGET		0.898**	
PARK_AWARENESS		0.453	
Latent class probability		0.68	0.32
LL	-2378.22	-1990.95	
ρ^2	0.12	0.265	
Number of choices	2464	2464	

Note: *,**,*** asterisks denote statistical significance at 10%, 5% and 1% respectively.

The marginal WTP for the presence or absence of landscape elements can be estimated from the model coefficients. This is particularly useful for policy analysis since it allows for assessment of welfare gains from landscape changes. Table 3 shows the implicit prices for the attributes and the two classes, along with the 95% confidence intervals estimated using the Delta method. Respondents of class one are, on average, willing to pay a daily parking fee of about €6 for visiting the paths when the olive orchards are covered with a green cover and €3 for the presence of stonewalls in the orchard boundaries. There is not WTP for the presence of woodland islets. Those belonging to class

[9] We estimated other models by changing the reference set (D in Table 2) and always found the same result.

[10] We must admit that additional sources of unobserved heterogeneity might be related to the higher preference by the B set. Nonetheless, this issue is beyond the scope of this paper.

two are willing to pay only for the green cover element of the landscape, although the lower marginal utility of income reduces the WTP by a factor of five. Overall, considering the class probability, green cover is the most valued landscape element (€4.41 per household) and the presence of stonewalls is the second (€2.11 per household). The existence of woodland islets by itself has not a social value. Moreover, individuals have a WTP for a combination of the three landscape elements. As shown in the third column of Table 4, landscapes with either two or three elements were preferred by individuals. In particular, the most valued landscape was the one with green cover and stonewalls. In the same table, it is possible also to see that the least preferred landscape is the one with only woodland islets. Assuming independence between the WTP for the individual landscape elements, WTP for various combinations of landscape features can be obtained by adding the WTP values for the individual elements. Thus, the WTP for a landscape with the most valued elements (green cover and stonewalls) is about €6.52[11].

Table 3. Marginal willingness to pay (WTP) estimates for each attribute across classes

	WTP [a] **Latent class 1**	**Latent class 2**	**Overall weighted WTP [b]**
GREEN COVER	5.95*** (4.32 – 7.57)	1.19*** (0.76 – 1.62)	4.41** (3.29 – 5.52)
STONE_WALLS	3.00*** (1.95 – 4.05)	0.27ns (-0.12 – 0.66)	2.11*** (1.40 – 2.83)
WOODLAND_ISLET	0.38ns (-0.36 – 1.01)	0.09ns (-0.29 – 0.44)	0.22ns (-0.23 – 0.72)

[a] 95% confidence intervals were calculated using the Delta method.

[b] Assuming the protest answers (7%) exhibit the same WTP of the sample.

Having analyzed the landscape preferences, the inclusion of the question concerning the probability of visiting allowed us to estimate the potential demand of the projected pathways with and without changes on the landscape. To do that we estimated the potential demand for the current situation and the increase of this demand due to the presence of the landscape elements which are supposed to improve the landscape attractiveness. The potential demand for the status quo situation was estimated by considering the share of the individuals in the sample who declared to prefer the status quo situation and associated a probability of visiting of at least 8 point over a scale of 10. This cutoff value was chosen according to a wide literature review on stated intentions and real behavior and after discussion with the local stakeholders in a second focus-group[12]. In particular, Sun and Morwitz (2010) found that individual exaggerate the stated intentions to buy compared to the real purchase in hypothetical exercises and warned that ignoring the discrepancies

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[11] It is well known in the stated preference literature that the value of a good can differ from the sum of the values of its attributes, a phenomenon called part whole bias (Bateman et al 1997). Just for comparison, in analysis not shown here we estimated a model in which we allowed for all the attribute interactions. From the estimated coefficients we calculated the implicit prices for a landscape that contained the three elements investigated. We found that the WTP from this landscape (€8.6 with 95% confidence interval 6.0 – 11.3) did not differ statistically at 95% level from the ones estimated by summing the parts. We did not employ the model with all the interaction in the paper because the experimental design used (main effects) did not allow for the independent estimation of the interaction effects from the main effects.

[12] The first focus group determined the landscape elements to be analyzed and payment vehicle. The second focus group, made up of the same local stakeholders, validated the survey results and discussed the potential demand of the restored pathways.

between intentions and purchasing can produced biased forecast of future demand. Furthermore, as pointed out by Morwitz et al. (2007), these discrepancies are smaller for existing and durable goods than for new and non-durable ones; for short than for long time horizons; when purchase intentions are collected in a comparative mode than when they are collected monadically. Finally, Hsiao et al. (2002) find out the respondents exaggerate their future demand for socially desirable goods. Three experts on Montoro tourism sector[13] in the local stakeholder focus group also considered adequate this cutoffs point. According to the respondents' preferences and the cutoff point above indicated, 2.7% of the potential population would visit the path in the next year without any landscape intervention, leading to a potential demand for the SQ of 5,766 individuals from the city of Cordoba (see Table 4)[14].

The marginal demand resulting from improving the landscape attractiveness relative to the SQ situation was estimated in two steps. First, we calculated the marginal probability of visit for all the landscape scenarios relative to the status quo. This was accomplished by subtracting the respondents' stated probability of visit without any change (the probability of visiting the SQ) from the stated probability of visit when some landscape element was included. If the presence of the landscape elements increases the landscape attractiveness, we would expect a positive value in the marginal probabilities of visit. Indeed, this is what it happened as can be seen in the fourth column of Table 4 where all landscape combinations have associated positive averaged marginal values of visit over the SQ, being the landscape with the three elements the one which increases the most the probability of visit.

In the second step we used this marginal probability to estimate the potential demand that it may generate. Thus, we weighed the marginal probability of visiting each landscape compared to the status quo by the choice frequency of each landscape over the SQ choice frequency.

$$MD_i = \left[\frac{(PV_i - PV_{SQ})}{PV_{SQ}} * \frac{CF_i}{CF_{SQ}} \right] \qquad [3]$$

Where MD_i is the marginal demand expected to be generated by landscape *i,* PV_i is the average probability of visit landscape *i,* PV_{SQ} is the average probability of visit the SQ, CF_i is the choice frequency of landscape *i* and CF_{SQ} is the choice frequency of the SQ. The marginal demand generated by landscape *i* represents the percentage increase in the number of visitors to the pathways over the status quo situation. As Equation 3 shows, the marginal demand encapsulates both the increase in the probability of visiting and the choice frequency of any landscape. Thus, as can be seen in the fifth column of Table 4, Landscape 2 generates the largest impact on demand regardless there are landscape combinations with higher probability of visit (Landscape 3, 4 and 6). These, however, have associated lower choice frequencies. In the last column appears the number of additional visits compared with the status quo: the landscape with green cover and stonewalls presents the largest increase in the demand of visiting. In addition, it highlights the lowest marginal demand of the woodland islets when the green cover and stonewalls are not present in the landscape. Finally, the green cover is a key driver of the olive grove landscape public preferences since it is present in the three landscapes with the highest shares of marginal demand. Overall, Landscape 2 and Landscape 3

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[13] Namely, the Head of the Natural Park "Sierra de Cardeña y Montoro", the Head of the Cordoba Chamber of Commerce and a rural tourism consultant.

[14] We acknowledge that the selected threshold is somewhat arbitrary although conservative and may not accurately forecast the future demand. Because of that, in analysis not shown in this paper, we carried out a sensitivity analysis of the cutoff point. Here we selected the 70% and 90% of probability of visit in addition of the 80% described in the paper. Results showed that the potential demand ranged from 1,929 (0.91%) to 12,805 (6.04%) potential visitors.

have the highest potential to increase the demand for the Montoro pathways and to trigger a set of second order and multiplier effects as described hereafter.

Table 4. Number of visitors for each landscape change

	Description	Choice frecuen-cy (CF)	Averaged marginal probability of visiting (PV_i)	Marginal impact on Demand (MD_i) (%)	Marginal number of visitors over status quo (5,766 visitors) [b]
1	Woodland islets	77	2.26	11.75	**678** (226-1,505[c])
2	Green cover + Stonewalls	378	2.89	73.83	**4,256** (1,424-9,454)
3	Green cover + Stonewalls + Woodland islets	280	3.34	63.12	**3,640** (1,218-8,083)
4	Stonewalls + Woodland islets	191	3.08	39.77	**2,293** (767-5,093)
5	Green cover	230	2.36	36.72	**2,118** (708-4,703)
6	Stonewalls	145	2.97	29.06	**1,675** (560-3,721)
7	Green cover + Woodland islets	327	1.81	40.09	**2,312** (773-5,133)
	Status quo (bare soil, none stonewalls and none woodland islets)	703	2.10[a] (AP_{sq})		

[a] AP_{sq}- Averaged visit probability of the SQ landscape
[b] Marginal demand and potential demand of visitors according to the landscape combination
[c] In parenthesis we indicated the confidence intervals considering the cut-off points 70% and 90% respectively.

To illustrate the overall economic impact on the rural economy which may result from improving the landscape attractiveness of the olive groves surrounding the Montoros' pathways, the following four scenarios have been considered (see Table 5):

- Scenario 1: this scenario represents the current situation, where the landscape is characterized by the absence of green cover, stonewalls and woodland islets.
- Scenario 2: this scenario is characterized by the presence of green cover and stonewalls in the olive orchards. We called this scenario "optimal in terms of potential demand" given that it corresponds to the most demanded landscape by potential visitors of the pathways. Besides, the green cover provides positive effects on reducing soil erosion and on increasing carbon stocking into soil.
- Scenario 3: the stonewalls of scenario 2 are replaced by the woodland islets, despite the low value assigned by respondents to this landscape feature. Nonetheless, the woodland islets are considered paramount for biodiversity purposes hosting a variety of arthropods useful as food for insectivorous birds, amphibians and also which provide ecosystem services as pollination and biological control of pest. We defined this scenario as "optimal in terms of agricultural multifunctionality".
- Scenario 4: in this scenario green cover are the only elements added to the current landscape. We called it "optimal in terms of implementation simplicity" given that there are already agri-environmental measures which may be used to sow green cover in olive orchards.

In Table 5 we show the FOEs and SOEsV for the four scenarios, assuming for the SOEsV an average expenditure of €6.5 for each respondent. The FOEs can be associated to the revenues obtained by the parking fees, whilst the SOEsV to the visitors' expenditures during their trip. The main result is that there are important gains in both FOEs and SOEsV when the landscape attractiveness is improved. For example, comparing the status quo scenario (Scenario 1) with the second scenario, we observe an increase in the FOEs and SOEsV of €29,118 and €27,670 respectively. The overall benefit of Scenario 2 with respect to the status quo is calculated as the sum of the FOEs and the marginal SOEsV, this is, €56,788.

Table 5. Valuation scenarios of the olives groves landscape options

Escenario	FOEs[a]	SOEsV	Marginal SOEsV ($SOEsV_{scenario\ i}$ – $SOEsV_{scenario\ sq}$)	Overall marginal impact
SC1: Status quo (absence of green cover, stonewalls and woodland islets)	0 visitors €0	5,766 visitors €37,479 (€12,539€ – €83,233)	€0	€0
SC2: Green cover + Stonewalls Optimal in terms of potential demand	4,257 visitors €29,118 (€9,741-€64,664)	10,023 visitors €65,149 (€21,796-€144,682)	€27,670 (€9,257-€61,450)	€56,788 (€18,998-€126,114)
SC3: Green cover+W. islets Optimal in terms of agricultural multifunctionality	3,640 visitors €24,895 (€8,329-€55,287)	9,406 visitors €61.137 (€20,453-€135,771)	€23,658 (€7,915-€52,539)	€48,553 (€16,243-€107,826)
SC4: Green cover Optimal in terms of implementation simplicity	2,117 visitors €14,483 (€4,845-€32,164)	7,883 visitors €51.242 (€17,143-€113,798)	€13,763 (€4,605-€30,566)	€28,247 (€9,450-€62,730)

[a] In parenthesis we indicated the confidence intervals considering the cut-off points 7 and 9 respectively for estimating the potential demand for the status quo.

The expected impact of the marginal demands on the local economy is estimated using the SAM of the province of Cordoba for rural municipalities (Espinosa et al., 2013), to which Montoro belongs to. Table 6 presents the regional impact considering two extreme scenarios, status quo versus green cover and stonewalls. According to Table 5, the marginal demand from restoring the path and with no landscape changes introduces via tourism €37.479 (SOEsV of status quo) which in turn produce a global impact of €103,645 in the economy of the province. This impact is mainly directed to the tourism sector followed by the agro-food industry. Improving the visual elements of the landscape by means of the use of green cover and stonewall increases by a factor of 2.5 the global impact on the economy, being likewise the tourism the most benefitted sector. The expected total impact on economy is 263,534 €.

Table 6. Income multiplier effects of landscape change

Landscape	Local income (€)	Total impact on the economy of the province (€)	Impact by sector (€)
Status quo	37,479 from tourism (SOEsV)	103,645	Tourism = 41,148 Agro-Food Industry = 21,231 Trade = 13,181 Public Services = 7,525 Permanent crops = 2,576 Other sectors = 17,984
Green cover and stonewalls	29,118 from public services (FOEs) 65,149 from tourism (SOEsV)	263,534	Tourism = 75,203 Public services = 51,590 Agro-Food Industry = 43,945 Trade = 31,070 Permanent crops = 5,581 Other sectors = 56,145

Source: Own elaboration from the Social Account Matrix of Córdoba.

12.4 Discussions and conclusions

In this study we investigated the economic value associated to the improvement of agricultural landscape aesthetic in olive orchards. Three landscape elements have been considered, namely green cover, stonewalls and woodland islets. We found that the presence of these landscape features originates a set of benefits to the rural areas where they are located. First, they generate revenues related to the use of the landscape. Second, they contribute to the conservation of the environment by reducing the soil erosion, preserving the biodiversity and reducing the agriculture contribution to climatic change. Finally, they produce an improvement in the rural economies by triggering a set of second order effects which are related to the visitors' expenditure and to the economic activities which originates to satisfy the visitor demand.

Despite all these benefits, farmers are not incentivized to produce these landscape features given that markets do not pay them for the supply of these public goods or services. Solving this market failure requires determining the amount of payment that can be given to farmers. In this context, in the economic evaluation of the landscape, it is important to identify who are the beneficiaries of the visual landscape improvements, to be able to determine who should bear with the costs of the measures necessary to compensate farmers for the public goods and services supplied. For instance, users should compensate farmers for the increase in the landscape aesthetic they experience in their visit whilst no users should do it for the general services provided by the landscape elements to the public well-being. Finally, local dwellers should also contribute for the benefits generated in their rural areas which are "external" to the landscape effects.

The information generated in this study can be helpful to disentangle these values from the general economic value of landscape aesthetic to tailor the instruments employed to incentivize farmers for the supply of public goods and services. In this study we measure the use value associated to the improvement of landscape aesthetic which represents a "proxy" of the economic value of landscape aesthetic awarded by users. According to the results, amongst the landscape feature investigated, green cover was the most evaluated element, followed by stonewalls. The presence of vegetation islets was not deemed important. The improvement of the visual quality of the Montoro's paths, considering for instance the "simplest" implementation scenario (green cover in the olive orchards), originates 14,483 euros a year in term of parking fees. This value represents the amount of money users of landscape would be willing to pay to farmers as a compensation for the increase in the landscape visual quality. Dividing it by the area affected by the landscape changes it is possible to obtain an approximate value of the per hectare payment that users would be willing to pay to farmers. Considering a visibility area of 600 ha, a hypothetical bonus payment of 24 €/ha could be granted to farmers. The payment could be administered by the local authority that would be also the responsible of managing the parking which grants the access to the paths and of the system to perform the payment.

Landscape aesthetic is also positively correlated to the provision of public goods and services, as outlined by previous studies (Lefebvre et al., 2013; Villanueva et al., 2014) which are not directly related to the use of the landscape. In the specific case of this study, the landscape elements which increase the visual quality also improve the environmental conditions of the area by reducing soil erosion, preserving biodiversity and increasing the carbon content of the soils. These ancillary benefits affect the general population and as such this is the "entity" which should bear with the cost of the measures needed for the provision of these benefits. Two studies have been published in the literature to evaluate the economic value of these externalities in olive orchards in Andalusia. It is important to say that both studies did not consider the landscape aesthetic; however, they focused the attention on the externalities resulting from sowing a grass cover in olive orchards and as such the landscape aesthetic change is similar to the one proposed in this study. Colombo et al. (2005) estimated the willingness to pay for the reduction of the soil erosion effects and estimated a value between 130–150 euro/ha[15]. Rodríguez-Entrena et al. (2014) determined a set compensatory payment for farmers undertaking different management options aimed at providing public goods (carbon sequestration, erosion reduction and biodiversity improvement), quantifying the payment at 121 €/ha for a management option involving green cover.

The increases of the visitor demand and in the economic activities necessary to satisfy this demand create benefits to the local dwellers economy. The improvement of landscape visual quality by means of green cover and stonewalls in the olive orchards introduces 26,760 € in the local economy in terms of visitor expenditure which trigger a set of effects that have the potential of increasing by a factor of 2.5 the local economy relative to the situation when no landscape changes are considered. In this process the tourism sector would be the most benefitted. In the case of Montoro, the PDO olive oil and honey would benefit from this valorization of the landscape, as other studies have demonstrated (Volleta et al., 2008; Tempesta et al., 2010). This indicates that the tourism sector should be the most interested in compensating farmers for the provision of the landscape elements valued by users and society.

Results of this study underline that the landscape aesthetic in olive orchards is an economic asset which can contribute to the economic and territorial development of rural areas. The improvement of landscape attractiveness would provide benefits to society, landscape users and local dwellers. However, currently there are not any policies in the studied region aiming at improving the visual quality of olive groves landscape. This is particularly remarkable considering that olive groves are the iconic crop of Andalusia occupying more than 30% of agricultural lands and 17% of the total area of the region (over 1.45 million ha).

The result of the absence of a specific landscape policy is that the existing landscape in olive groves is the un-intended by-product of agricultural production, although recent changes in the common agricultural policy (CAP) have contributed (somewhat unintentionally or indirectly) to the

[15] The interval is due to different methodologies (contingent valuation and choice experiment) employed in the study

improvement of the visual quality of olive orchards[16]. The positive correlation between the agri-environmental measures and landscape attractiveness in providing benefits point out that there are synergies that could be exploited in the future design of landscape policies. Relative to the current policies which are designed to foster the provision of some positive externality, landscape base policies should be based in promoting the visual quality of landscape by incentivizing landscape elements which in turn are able to create other positive externalities. For instance, green cover and stonewalls can be used to increase the landscape aesthetic, to reduce soil erosion and to preserve biodiversity.

These landscape policies provide extra benefits to users and to local dwellers who should contribute more to the cost of the policy implementation. Therefore, a combination of market (parking fees and financial aid by producer associations) and policy instruments (agri-environmental measures) should take place to increase the provision of public goods from the European agriculture, especially in the case of landscape (Ferraria and Rambonilazab, 2008). This approach could be used to set compensatory payments for farmers from a demand point of view in contrast to the current context of compensatory payments based on additional costs or forgone revenues.

Results of this study are associated to a set of assumptions which need to be taken into account before accepting and extrapolating them to other areas. First we estimated the potential demand of landscape users associated to three landscape elements. Of course, there may be other elements which impact the demand that have not been considered. We also assumed that the users' demand is related to the landscape aesthetic, while it may also have other components close to the no-use or existence value; although the exercise was designed to reduce as much as possible these components, we do not know the exact extent of their effect. The potential demand of visitor for the current landscape has been calculated assuming a (conservative) cutoff of 8 in a 10 point likert scale. This cutoff point may not reflect the true potential demand and may provide a bias estimate of it. However, despite the cutoffs point employed, it is clear that there is a positive contribution of the landscape aesthetic to the rural economies and general well-being. The second order effects were estimated using secondary data. Future research may tune up this value by carrying out direct surveys to visitor to the Montoros' natural park. Finally, in the quantification of the welfare effects we assumed that the same landscape change can be applied to all the visual area affected by the restoration project. In practice it is more likely that a mixture of the landscapes with the elements investigated would be implemented, probably according to the landscape policy offered to farmers. As such, the value of the local impact of landscape aesthetic in the rural economy would be the weighted sum of the different landscape values for their respective representation in the studied area.

[16] We refer to the introduction of the Good Agricultural and Environmental Condition (GAEC) and agri-environment schemes. In the case of olive groves in sloping lands GAEC compels farmers in keeping the soil protected using different materials (inert or vegetal) whilst agri-environmental measures under axe 2 incentivize farmers in sowing green covers between the olive trees.

References

Andrews, R. L., and I. S. Currim. 2003. “A comparison of segment retention criteria for finite mixture logit models.” *Journal of Marketing Research* 40(2): 235-243. DOI: 10.1509/jmkr.40.2.235.19225.

Arthur, L. M., T. C. Daniel, and R. S. Boster. 1977. “Scenic assessment: an overview.” *Landscape Planning* 4: 109-129. DOI: 10.1016/0304-3924(77)90014-4.

Bateman, I., A. Munro, B. Rhodes, C. Starmer, and R. Sugden. 1997. "Does part–whole bias exist? An experimental investigation." *The Economic Journal* 107(441): 322-332. DOI: 10.1111/j.0013-0133.1997.160.x.

Briggs, D. J., and J. France. 1980. “Landscape Evaluation: A comparative study.” *Journal of Environmental Management* 10: 263-275.

Borresch, R., S. Maas, K. Schmitz, and P. M. Schmitz. 2009. “Modelling the value of a multifunctional landscape -A discrete choice experiment-” Paper presented at the International Association of Agricultural Economists Conference, Beijing, August 16-22.

Burgess, D., G. Finney, D. Matthews, and M. Patton. 2012. “Landscape Valuation: Choice Experiments or Contingent Valuation?” Paper presented at the 86th Annual Conference of the Agricultural Economics Society, Warwick, April 16-18.

Campbell, D. 2007. "Willingness to Pay for Rural Landscape Improvements: Combining Mixed Logit and Random-Effects Models." *Journal of agricultural economics* 58(3): 467-483. DOI: 10.1111/j.1477-9552.2007.00117.x.

Colombo, S., N. Hanley, and J. Louviere. 2009. "Modeling preference heterogeneity in stated choice data: an analysis for public goods generated by agriculture." *Agricultural economics* 40(3): 307-322. DOI: 10.1111/j.1574-0862.2009.00377.x.

Cooper, T., K. Hart, and D. Baldock. 2009. *The provision of public goods through agriculture in the European Union*, London: Institute for European Environmental Policy.

Council of Europe 2000. *The European Landscape Convention*. Firenze (ETS No. 176). http://conventions.coe.int/Treaty/en/Treaties/Html/176.htm.

DG Agri 2010. *Landscape and rural areas: towards an economic valuation of socio-economic impacts*, Brussels: European Comission Directorate General for Agriculture and Rural Development.

Domański, B. and K. Gwosdz. 2010. "Multiplier effects in local and regional development." *Quaestiones Geographicae* 29(2): 27-37. DOI: 10.2478/v10117-010-0012-7.

Drake, L. 1992. "The non-market value of the Swedish agricultural landscape." *European review of agricultural economics* 19(3): 351-364. DOI: 10.1093/erae/19.3.351.

ENRD (European Network for Rural Development) 2010*. Thematic Working Group 3: Public Goods And Public Intervention: Final Report,* Brussel: European Network for Rural Development. http://enrd.ec.europa.eu/app_templates/filedownload.cfm?id=260BDAAE-0BDA-C671-41E7-31CED794278A.

Espinosa, M., D. Psaltopoulos, F. Santini, E. Phimister, D. Roberts, S. Mary, T. Ratinger, D. Skuras, E. Balamou, M. A. Cardenete, and S. Gomez y Paloma. 2013. "Ex-Ante Analysis of the Regional Impacts of the Common Agricultural Policy: A Rural–Urban Recursive Dynamic CGE Model Approach." *European Planning Studies*: 1-26. DOI: 10.1080/09654313.2013.786683.

Ferraria, S., and M. Rambonilazab. 2008. “Agricultural multifunctionality promoting policies and the safeguarding of rural landscapes: How to evaluate the link?” *Landscape Research* 33(3): 297-309. DOI: 10.1080/01426390802045947.

Garrod, G. D., and K. G. Willis. 1995. "Valuing the benefits of the South Downs environmentally sensitive area." *Journal of agricultural economics* 46(2): 160-173. DOI: 10.1111/j.1477-9552.1995.tb00763.x.

Glenk, K., and S. Colombo (2011). "Designing policies to mitigate the agricultural contribution to climate change: an assessment of soil based carbon sequestration and its ancillary effects." *Climatic change* 105(1-2): 43-66.

Gobster, P., J. Nassauer, T. Daniels, and G. Fry. 2007. “The shared landscape: What does aesthetics have to do with ecology?” *Landscape Ecology* 22, 959-972. DOI: 10.1007/s10980-007-9110-x.

Grammatikopoulou, I., E. Pouta, M. Salmiovirta, and K. Soini. 2012. "Heterogeneous preferences for agricultural landscape improvements in southern Finland." *Landscape and Urban Planning* 107(2): 181-191. DOI: 10.1016/j.landurbplan.2012.06.001.

Greene, W. H. and D. A. Hensher. 2003. "A latent class model for discrete choice analysis: contrasts with mixed logit." *Transportation Research Part B: Methodological* 37(8): 681-698. DOI: 10.1016/S0191-2615(02)00046-2.

Hanley, N., S. Colombo, P. Mason, and H. Johns. 2007. "The reform of support mechanisms for upland farming: paying for public goods in the severely disadvantaged areas of England." *Journal of agricultural economics* 58(3): 433-453. DOI: 10.1111/j.1477-9552.2007.00114.x.

Hanley, N., R. Ready, S. Colombo, F. Watson, E. A. Bergmann. 2009. "The impacts of knowledge of the past on preferences for future landscape change." *Journal of environmental management* 90(3): 1404-1412. DOI: 10.1016/j.jenvman.2008.08.008.

Hasund, K. P., M. Kataria, and C. J. Lagerkvist. 2011. "Valuing public goods of the agricultural landscape: a choice experiment using reference points to capture observable heterogeneity." *Journal of Environmental Planning and Management* 54(1): 31-53. DOI: 10.1080/09640568.2010.502753.

Hess, S., M. Ben-Akiva, D. Gopinath, and J. Walker. 2011. "Advantages of latent class over continuous mixture of logit models." Accessed March 10. http://www. stephanehess. me. uk/papers/Hess_Ben-Akiva_Gopinath_Walker_May_2011. pdf.

Hsiao, C., B. Sun, and V. G. Morwitz. 2002. "The role of stated intentions in new product purchase forecasting." *Advances in Econometrics* 16: 11-28. DOI: 10.1016/S0731-9053(02)16002-6.

Hynes, S., N. Hanley, and R. Scarpa. 2008. "Effects on welfare measures of alternative means of accounting for preference heterogeneity in recreational demand models." *American journal of agricultural economics* 90(4): 1011-1027. DOI: 1011-1027. 10.1111/j.1467-8276.2008.01148.x.

Johns, H., N. Hanley, S. Colombo, and E. Ozdemiroglu. 2008. "Economic valuation of environmental impacts in the severely disadvantaged areas in England." In *Choice Experiments Informing Environmental Policy: A European Perspective*, edited by Ekin Birol and Phoebe Koundouri, 82-105. Cheltenham: Edward Elgar. DOI: 10.4337/9781848441255.00011.

Kaplan, R., and S. Kaplan. 1989. *The experience of nature: A psychological perspective.* Cambridge: Cambridge University Press.

Lancaster, K. J. (1966). "A new approach to consumer theory." *Journal of political economy* 74: 132-157. https://www.iei.liu.se/nek/730g83/artiklar/1.328858/Lancaster2.pdf.

Lefebvre, M., M. Espinosa, S. Gomez y Paloma, A. Piorr, and I. Zasada. 2013. “Agricultural landscapes as multi-scale public good and the role of the Common Agricultural Policy. II” Paper presented at the AIEAA Conference, Between Crisis and Development: which Role for the Bio-Economy, Parma, June 6-7.

Luque-Valle, Pablo. 2011. “Análisis del modelo de uso-visita de los deportitas-turistas de las vías vedes andaluzas”. PhD diss., Universidad de Granada. ISBN: 978-84-694-9405-9.

Martín, A., and R. Fernández. 2006. Long term persistence of dehesas. Evidences from history. *Agroforestry Systems* 67(1): 19-28. DOI: 10.1007/s10457-005-1110-8.

Mary, S., F. Santini, M. Espinosa, M. A. Cardenete, and S. Gomez y Paloma. 2013. *The rural-urban spillovers of EU structural policies in Cordoba, Spain*, Seville: Institute for Prospective and Technological Studies, Joint Research Centre. DOI: 10.2791/33016.

McFadden, D. 1974. "The measurement of urban travel demand." *Journal of Public Economics* 3(4): 303-328. http://elsa.berkeley.edu/reprints/mcfadden/measurement.pdf.

MERCODES (Mercado, Comunicación y Desarrollo S.L.) 2008. *Consultoría y asistencia para la creación del producto cicloturismo. Vías Verdes*, Madrid: Ministerio de Industria, Turismo y Comercio. http://www.viasverdes.com/prensa/documentos/interes/Estudio_Ciclotur.pdf.

Moran, D., A. McVittie, D. J. Allcroft, and D. A. Elston. 2007. “Quantifying Public preferences for agri-environmental policy in Scotland: A comparison of methods.” *Ecological Economics* 63: 42-53. DOI: 10.1016/j.ecolecon.2006.09.018.

Morwitz, V. G., J. H. Steckel, and A. Gupta. 2007. "When do purchase intentions predict sales?" *International Journal of Forecasting* 23(3): 347-364. DOI: 10.1016/j.ijforecast.2007.05.015.

Nylund, K. L., T. Asparouhov, and B. O. Muthén. 2007. "Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study." *Structural Equation Modeling* 14(4): 535-569. DOI: 10.1080/10705510701575396.

OCDE (Organisation for Economic Co-operation and Development) 2001. *Multifunctionality - towards an analyticalframework,* Paris: OECD. http://www.oecd.org/tad/agricultural-policies/40782727.pdf.

Pérez, J. G. 2002. “Ascertaining landscape perceptions and preferences with pair-wise photographs: planning rural tourism in Extremadura, Spain.” *Landscape Research* 27(3): 297-308. DOI: 10.1080/01426390220149539.

Rodríguez-Entrena, M., and M. Arriaza. 2013. "Adoption of conservation agriculture in olive groves: Evidences from southern Spain." *Land Use Policy* 34: 294-300. DOI: 10.1016/j.landusepol.2013.04.002.

Rodríguez-Entrena, M., M. Arriaza, and J. A. Gómez-Limón, J.A. 2014. “Determining economic and social factors in the adoption of cover crops under mower control in olive groves.” *Agroecology and Sustainable Food Systems*. 38(1): 69-91, DOI: 10.1080/21683565.2013.819478.

Rodríguez-Entrena, M., J. Barreiro-Hurlé, J. A. Gómez-Limón, M. Espinosa-Goded, and J. Castro-Rodríguez. 2012. "Evaluating the demand for carbon sequestration in olive grove soils as a strategy toward mitigating climate change." *Journal of environmental management* 112: 368-376. DOI: 10.1016/j.jenvman.2012.08.004.

Scarfo, F., R. Mercurio, and C. del Peso. 2013. “Assessing visual impacts of forest operations on a landscape in the Serre Regional Park of southern Italy.” *Landscape and Ecological Engineering* 9(1): 1-10. DOI: 10.1007/s11355-011-0168-x.

Scarpa, R., and M. Thiene. 2005. "Destination choice models for rock climbing in the Northeastern Alps: a latent-class approach based on intensity of preferences." *Land economics* 81(3): 426-444. DOI: 10.3368/le.81.3.426.

SCBD (Secretariat of the Convention on Biological Diversity) 2007. *An Exploration of Tools and Methodologies for Valuation of Biodiversity and Biodiversity Resources and Functions*, CBD

Technical Series No.28. Montreal: Secretariat of the Convention on Biological Diversity.

Sevenant, M. and M. Antrop. 2007. “Settlement models, land use and visibility in rural landscapes: Two case studies in Greece.” *Landscape and Urban Planning* 80(4): 362-374. DOI: 10.1016/j.landurbplan.2006.09.004.

Shen, J. 2009. "Latent class model or mixed logit model? A comparison by transport mode choice data." *Applied Economics* 41(22): 2915-2924. DOI: 10.1080/00036840801964633.

Street, D. J., and L. Burgess. 2007. *The construction of optimal stated choice experiments: theory and methods*, New Jersey: John Wiley & Sons.

Sun, B., and V. G. Morwitz. 2010. "Stated intentions and purchase behavior: A unified model." *International Journal of Research in Marketing* 27(4): 356-366. DOI: 10.1016/j.ijresmar.2010.06.001

Tempesta, T., R. A. Giancristofaro, L. Corain, L. Salmaso, D. Tomasi, and V. Boatto. 2010. “The importance of landscape in wine quality perception: An integrated approach using choice-based conjoint analysis and combination-based permutation tests.” *Food Quality and Preference* 21: 827–836. DOI: 10.1016/j.foodqual.2010.04.007.

Tveit, M., A. Ode, and G. Fry. 2006. “Key Concepts in a framework for analyzing visual landscape character.” *Landscape Research* 313: 229-255. DOI: 10.1080/01426390600783269.

Villanueva, A. J., J. A. Gómez-Limón, M. Arriaza, and O. Nekhay. 2014. “Analysing the provision of agricultural public goods: The case of irrigated olive groves in Southern Spain.” *Land Use Policy* 38(1), 300-313. DOI: 10.1016/j.landusepol.2013.11.018.

Volleta, D., J. Candau, L. Ginelli, Y. Michelin, L. Ménadier, H. Rapey, and L. Dobremez. 2008. “Landscape elements: Can they help in selling ‘Protected Designation of Origin’ products?” *Landscape Research* 33(3): 365-385. DOI: 10.1080/01426390802046077.

13 Preferences, awareness and expectations towards agricultural landscape: the example of Chlapowski Landscape Park in Polan and the Impact of Landscape composition and structure on regional competitiveness

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13.1 Introduction

The main objective of the study performed in the Polish case study region (CSA) in Chlapowski Lanscape Park was to contribute to a development of knowledge base on the relations between landscape structure and composition, functions and benefits, and the contribution to the regional competitiveness and creation of socio economic effects of typical agricultural landscape. The focus of the CSA 6 is presented on the figure 1. The main knowledge gaps observed in the CSA were expressed by the research questions addressed in the study, and are as follows:

1. What is the character of two different landscapes (components, structure) in the Park and outside in the adjacent region?
2. What are the preferences of stakeholders towards landscape components?
3. How good is awareness of landscape services among different groups of stakeholders
4. Are mechanisms and governance compatible with expectations of stakeholders towards landscape?
5. What might be the potential impact of Landscape composition and structure on regional competitiveness?

Answers to these questions were partly presented in the first part of the final report. The more detailed elaboration can be found in this report.

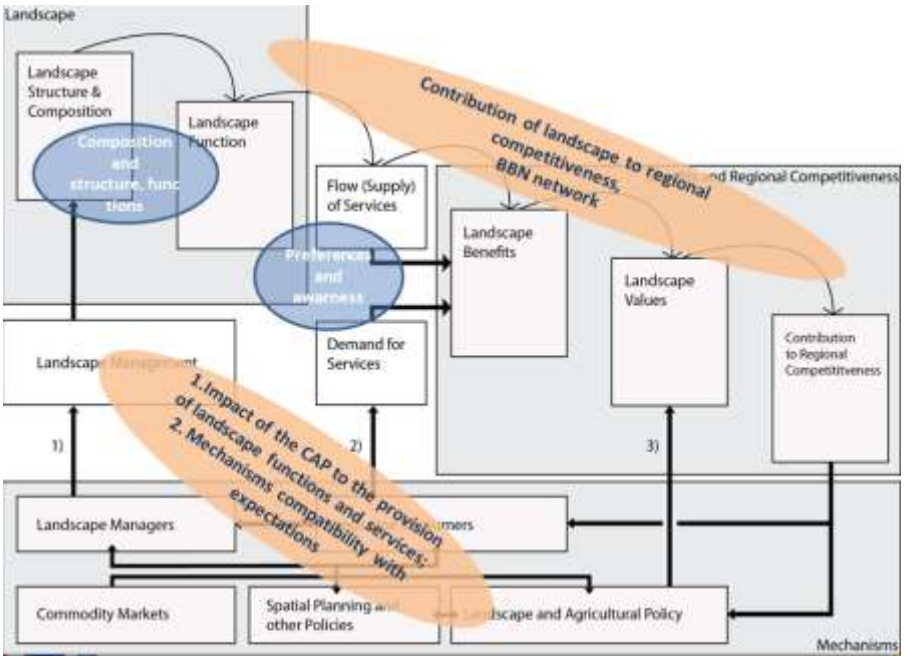


Figure 1. Contribution of the CSA 6 - Chlapowski Landscape Park to the CLAIM scheme of relations.

The case study region in Poland - landscape and main functions

The Polish case study region “Chłapowski Landscape Park” is located in the voivodship “Wielkopolska” (NUTS2) in the Central-Western part of Poland. The study region covers 172,2 km² and consists of the four communities: Kościan, Czempin, Krzywin and Śrem. The region is characterized by typical agricultural lowland landscape, rich in small-structured landscape elements like field ponds, water catchments and shelterbelts. Agriculture in the region is semi-intensive, characterised by coexistence of large scale commercial farms (up to 2500 ha) and medium size family farms (20-30 ha) with crops, milk and pigs production. The structure of agricultural land is dominated by crops (65,5%) – mainly grains. The average farm size is 19 ha and is larger by 32% then the province average. Chlapowski Park has also good natural conditions for animal production. There are 3317 farms in the region (NUTS 4), from which about 71% have animals, mainly dairy cattle and pigs. The flat and lowland area with sandy soils is strongly threatened by the wind and water erosion. To mitigate this risk the windbreaks – rows of trees, were introduced. This green linear structure shapes and diversifies monotonous landscape of the region. Therefore the main landscape services in the CSA are *food provisioning* and *regulating* (mainly wind-erosion). *Provisioning* is the main output of agriculture (food provision), and depends largely on regulating services provided by shelterbelts. Provision of wood is less important in this region and can be attributed to shelterbelts (4% of area of the park) and forests (11%). Regarding *regulating* services, shelterbelts have a very important regulation function in this region, protecting the fields against wind and water erosion, and regulating the water and nutrient cycle. They additionally support development of biodiversity in the region (habitat for different animals and birds). Existence of this landscape element allows to increase yields of agricultural production and to produce crops which would not grow in these conditions, if there was no protection against wind , e.g. highly profitable sugar beets and oilseed rape.



Results

The main knowledge gaps observed in the CSA were expressed by the research questions addressed in the study and explained in the introduction to this report. Below the methods as well as results of the research are presented regarding the Chlapowski Lanscape Park CSA.

13.2 Research questions

13.2.1 Research question 1. What is the characteristics of two different landscapes (components, structure) in the Park and outside in the adjacent region?

13.2.1.1 Method

Research was conducted in two agricultural areas of distinctly different landscape features, but located in the neighbourhood, adjacent to each other:

a) in selected area of *Koscianski Plains*, within the boarder of the Chlapowski Landscape Park, that have the highest share of: woodlots (shelterbelts), field-forest boundaries and roadside plantings. It was assumed that the landscape surrounding Turew, the central village of the Park, is the most typical agricultural landscape for this region;

b) in selected two areas of *Łowicko – Błonska Palains*, with a small share of shelterbelts, the boundaries of agro-forestry and roadside plantings, and where the landscape has low natural and cultural values. The Łowicko-Błonska Plain is similar to Koscianski Plains in terms of a high share of agricultural land (over 80%). However this is the area of much smaller share of forests and hedgerows. It was assumed that the landscape surrounding Czempin, and Kobylniki are the most typical agricultural landscapes for this region.

In the extracted three areas: *Turew* - in the Park, and two adjacent areas - *Czempin* and *Kobylniki* the detailed analysis of the structure of the landscape was made. Landscape structure of the sites has been compared. The fundamental analysis was made on the area divided into 1 km ^{2} (100 hectares) fields in each defined region. Analysis of the landscape structure was performed with the use of topographic maps at the scale of 1:25 000, aerial photographs and on the basis of field research.

The structure of the landscape was distinguished according to four thematic layers, containing the following information (GIS):

Layer 1: kilometre grid ; hydrographic network , the network of roads, settlement units;

Layer 2: shelterbelts, (including windbreaks and other woodlots in the vicinity of fields and internal roads that are not classified in any of the categories of public roads);

Layer 3: field-forest borders;

Layer 4: roadside plantings (tree-rows).

With use of GIS, soil maps and other material we prepared detailed maps of the selected three regions On the basis of prepared maps, the composition and structure of the landscape has been calculated. The complexity of landscape is expressed by two indicators - Shannon Index (H) and Herfindahl–Hirschman Index (HHI).

The Shannon diversity index (H) has the following formula:

$H = -\sum_{i=1}^{n}(p_i \times \ln p_i)$ (Shannon, 1948)

pi – share of the element in the landscape structure

A greater H value implies greater landscape diversity.

The second indicator which we used was the Herfindahl–Hirschman Index (HHI), which in economics is a measure of industry concentration and an indicator of the strength of competition among them. We adjusted the index for measuring complexity of the landscape, by replacing the shares in the market by the share of each landscape element in the landscape structure. The general formula for HHI is:

$$\text{HHI} = \sum_{i=1}^{n} s_i^{\ 2}$$

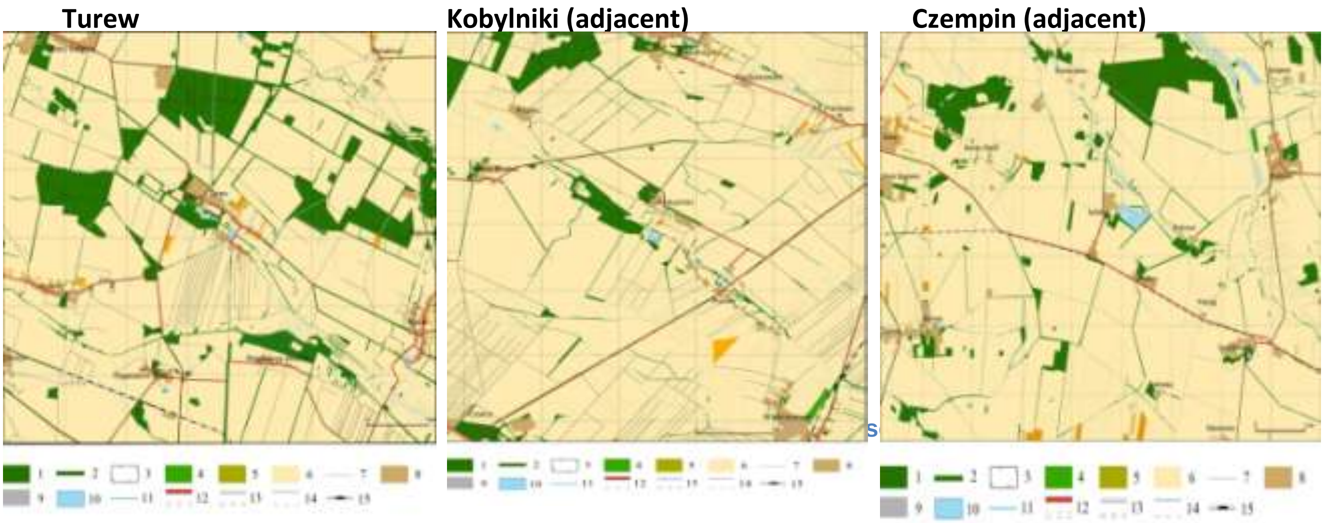
S – share of the element in the landscape structure, i - number of elements

The Herfindahl Index (*H*) ranges from 1/*N* to one, where *N* is the number of elements in the structure of landscape.

Prepared maps and regional characteristics contributed to the general description of the landscape in the CSA and created a background for the Ad-hoc study 1 (for research questions 2,3 and 4).

13.2.1.2 Results - Landscape structure and elements

The following pictures (Figure 3) present the structure of landscape typical for the Chlapowski Landscape Park (Turew) and for two communities adjacent to the Park – Kobylniki and Czempin.



In some more details the characteristics of landscapes in the Chlapowski Park and two adjacent areas selected for comparisons is presented in table 1. The agricultural landscape in the park is mainly shaped by the shelterbelts in-between the fields and rows of trees (linear elements) along the roads. Concentration of this element in the case study region is almost two times greater than in the neighbouring regions (53 meters/ha vs. 27 and 39 m/ha). The landscape composition is more diversified in the Park than in the two other studied regions. It can be expressed by a higher Shannon index and lower Herfindhal Hirshman concentration index. The selected regions have a similar built-up area (about 2.6-2.8%), but differ in terms of the share of agricultural land, green-linear elements, forests and water reservoirs. The share of manor parks is also double in case of the Chlapowski park, comparing to neighbouring regions.

Table 1. Structure of landscape elements in the case study region - Chlapowski Landscape Park and adjacent regions.

Community (NUTS5)	**TUREW** (within the park)	**KOBYLNIKI** (outside the park)	**CZEMPIN** (outside the park)
Field-tree/forest borders (km)	225 km (53m/ha)	131 (39m/ha)	140 (27m/ha)
Shannon index *H*:	0,70	0,56	0,46
Landscape concentration Index (Herfindhal-Hirschman Index)	0,68	0,81	0,79
	Share of specific landscape elements in the total area of the selected region [%]		
Agricultural land	81.35	86.84	90.08
Forests and woodlands	10.88	7.26	3.58
Linear elements - trees	3.72	1.93	2.85
Lakes and ponds	0.14	0.33	0.01
Manor parks	0.91	0.37	0.53
Built-up areas	2.64	2.61	2.85
Other (orchards etc.)	0.35	0.65	0.33

Source: own calculations. HH index – the sum of the squares of the shares of distinguished elements in the landscape structure: the lowest index the greater diversification of landscape elements. Shannon index - a greater H value implies greater landscape diversity

13.2.2 Research questions 2 & 3. What are the preferences of stakeholders towards landscape components and how good is awareness of landscape services among different groups of stakeholders?

Awareness of the landscape determines the attitude towards the landscape and is the basis for the assessment of its value. The higher the degree of awareness of the landscape the more complete understanding of its meaning and perception of its value. Because of this relationship, individual and social consciousness of the landscape, and its intentional reference, are crucial for the management of the landscape. This aspect devotes a lot of attention in the documents relating to the implementation of the European Landscape Convention, in which we can read: "Type of relationship that develops between society and the natural environment is a major factor in forming our landscapes, both as a result of changes occurred during the use of natural resources and thought the attempt to create new landscapes" (Europan Council 2011).

In the case of the landscapes in rural areas the human factor plays a particularly important role, because the area covered by the management belongs almost entirely to the farmers. The question arises to what extent the state of the countryside landscape depends on the awareness among farmers and local inhabitants? Therefore it is important to obtain the knowledge about the landscape consciousness among farmers, their preferences towards the landscape elements and their criterions of the landscape valorisation. The main purpose of the study was to determine the relationship between: natural and cultural features of the agricultural landscape and landscape awareness among the farmers and their preferences towards different landscape elements.

13.2.2.1 Method

For measuring the stakeholders preferences towards landscape components we used pair-wise ranking approach - Thurstone's model of statistical judgment (Thurstone, 1927). We conducted the survey with 198 respondents divided into four groups of stakeholders: farmers living in the Chlapowski Park; other (then farmers) inhabitants of the Park, habitants outside the Park (in adjacent area), tourists visiting the park.

We asked the respondents to rank in pairs different landscape components: forest, fields, meadows and pastures, roadside plantings (tree-lines along the roads); windbreaks (shelterbelts) along the fields, water reservoirs and field ponds and local architecture. To assess the intensity of preferences for individual elements of the landscape we used the Thurstone's model (Case V). The approach allows to obtain the assessment of individual preferences in the interval scale. This determined not only the importance of the different elements of the landscape but also the strength of the preference. Even in the case of two populations averaged giving the same rank it was possible to identify in which population the element is "priced" higher.

For collecting data about the stakeholders awareness of landscape functions we asked the respondents to evaluate in the Likert scale an importance of economic and environmental functions and benefits of shelterbelts. The following economic functions of shelterbelts were evaluated: habitat for beneficial insects and nectar plants, source of raw materials, prevention against wind erosion, water storage, attraction for tourists. Moreover the following environmental functions were taken into consideration: habitat for species, habitat for nectar plants, protection against wind, shelter from the sun, water treatment and sequestration, climate and air quality regulation.

Additionally, due to the great importance of farmers in shaping the rural landscape, 30 in-depth interviews were conducted with this particular group of stakeholders.

All results were then analysed with the use of statistical methods.

13.2.2.2 Results - landscape preferences and awareness

Preferences of stakeholders towards different landscape elements are presented on the figure 4 (according to respondent group) and figure 5 (according to valuated element). It can be observed that preferences of farmers noticeably differ (p=0,0001), comparing to other groups of respondents. Farmers evaluate their preferences more according to an economic utility of the landscape elements, whereas other groups of respondents take into account more aesthetic appreciation. Thus the most important and preferred landscape elements for farmers are fields and pastures, conducive to agricultural production. They do not perceive the shelterbelts as most preferred element of the landscape in this evaluation, despite they appreciate its regulating role in agricultural production.

Habitants outside and inhabitants of the Park do not differ significantly in their preferences (p=0,19). The most preferred element of the landscape for these groups are cultural sites - local architecture, however forests are also evaluated at the high rank. What is interesting to observe that the valorisation of shelterbelts in case of habitants and visitors is higher than in case of farmers, which might be attributed to its aesthetic rather than regulating (utilitarian) function.

Visitor's preferences are different than in both habitants groups, but less significantly (p>0,03). They evaluate the landscape elements according to aesthetic appreciation. On the first place in the ranking they prefer architectural sights, then forests and surprisingly, shelterbelts. The last could seem to be a strange observation, since an agricultural landscape usually is less attractive for sightseeing and recreation use. However Chlapowski Lanscape Park is famous for its specific landscape, shaped by agriculture and characteristic shelterbelts creating green-paths along the roads and fields. This was confirmed by the results of questionnaire in which we asked tourists for their reasons of visits. The area of the Park is also rich in historic buildings like manor houses in Racot, Kopaszewo, and churches. The pathways created by windbreaks and local architecture encourage tourists to come for short term visits for biking or walking, therefore appreciation of these landscape elements could be understandable.

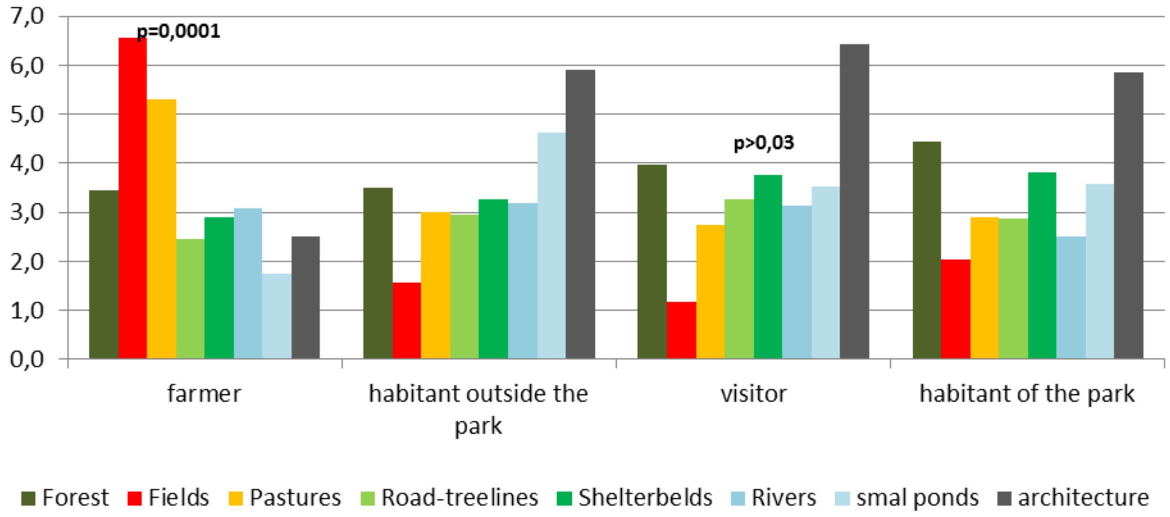


Figure 4: Stakeholders preferences towards various landscape elements by group of stakeholders

(n=198; 48 farmers; 47 habitants outside the Park; 59 visitors; 44 habitants of the Park)

Regarding differentiation of the preferences towards the various landscape elements it can be observed (Figure 5), that the most significantly different preferences are observed in case of fields and pastures, as well as local architecture and field ponds (p<0,0001). As it was already mentioned before, the variation of valuations is mainly contributed to different approach of farmers towards landscape (utilitarian), then the altitude of other groups of respondents (aesthetic).

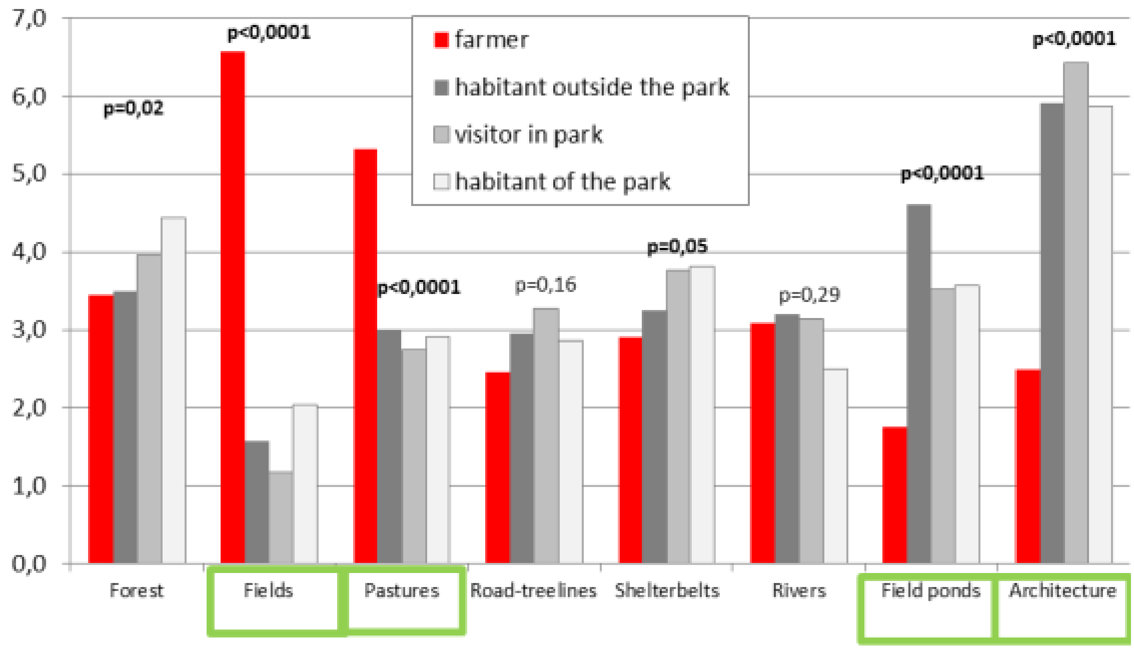


Figure 5: Stakeholders preferences towards various landscape elements in the Chlapowski Landscape

Another important aspect of the analysis was *awareness* of the landscape functions and services among the stakeholders. We tested it on the example of shelterbelts (windbreaks), the characteristic element of the landscape in the case study region. On the figure 6 we presented the valuation results of the different environmental and economic functions of shelterbelts by different groups of respondents. The following economic functions of shelterbelts were evaluated: habitat for beneficial insects and nectar plants, source of raw materials, prevention against wind erosion, water storage, attraction for tourists. Moreover the following environmental functions were taken into consideration: habitat for species, habitat for nectar plants, protection against wind, shelter from the sun, water treatment and sequestration, climate and air quality regulation.

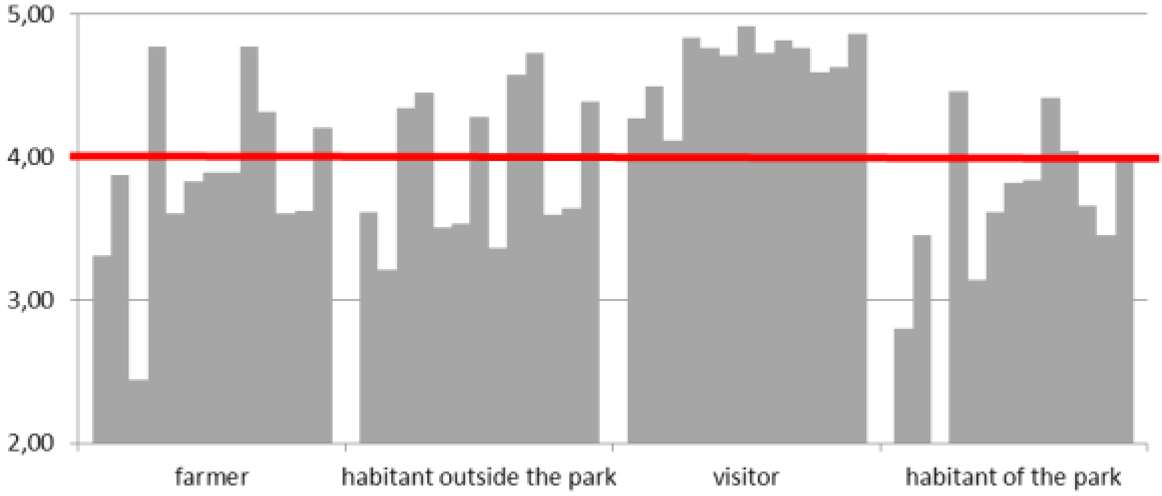


Figure 6. Evaluation of importance of different shelterbelts functions by groups of respondents (1-not important; 5-very important)

It can be stated, that the farmers the most properly evaluated the economic and environmental functions of the shelterbelts. The highest importance they attributed to regulating function of this element (protection from wind and sun, air quality regulation). They also estimated the average growth of yields for about 3,7% due to the regulating function of windbreaks, however responses differed significantly from -50% to +50% (standard deviation = 24), which may indicate that farmers are not sure about the real impact of the shelterbelts on the yields level. Habitants of the Park were also convinced about importance of the regulating function of shelterbelts, however they valuated this importance lower than farmers.

The lowest awareness of the landscape functions were observed in case of visitors. They perceived almost all functions of shelterbelts as important or very important in the region.

Due to the great importance of agriculture and farmers in shaping the rural landscape, it was decided to investigate more thoroughly this group of respondents in terms of landscape awareness. Thus, the additional in-depth interviews were conducted. Farmers were asked a series of questions related to the management of the land by them as well as awareness of their potential influence on the landscape.

The results of this study indicate that 79% of farmers are convinced that they have an influence on the landscape and 58% of them feels obligations relating to its protection. Almost all respondents agree that the shelterbelts have a positive impact on agriculture and landscape, however it is interesting that 95% of them would not allocate their own land for its establishing. This result may arise from the fact that although the farmers are aware of the beneficial effects of shelterbelts on agricultural activity and productivity of land, they are not able to estimate correctly magnitude of this impact (measurable benefits). Therefore, they are not willing to compromise on revenue (added value) generated by agricultural production in favor of uncertain (unrated) benefits from protecting the fields by shelterbelts. They also believe that this type of plantings should be placed in the common (state, government owned) land, and not on their own fields. They are also reluctant to pay for the maintenance of the woodlots.

13.2.2.3 Conclusions

The results of this study indicate that the farmers are convinced about their influence on the landscape and most of them declare to feel obligations relating to landscape protection. The most important and preferred landscape elements for farmers are fields and pastures, conducive to agricultural production. Thus it could be concluded that they formulate their preferences more according to an economic utility of the landscape elements, than aesthetic appreciation. Farmers generally agree that the shelterbelts have a positive impact on agriculture and landscape, however they are not able to estimate correctly the magnitude of this impact (measurable benefits). Therefore, they are not willing to compromise on revenue generated by agricultural production in favor of uncertain (unrated) benefits from protecting the fields by shelterbelts. They are reluctant to pay for the maintenance of the woodlots and designate their own land for new establishments.

Habitants of adjacent regions, inhabitants of the Park and visitors take a different, more aesthetic angle in evaluating the landscape elements. The most preferred element of the landscape for these groups are local architecture and forests, however there are significant differences in the level of evaluation. Is interesting to observe that the valorisation of shelterbelts in case of habitants and visitors is higher than in case of farmers, which might be attributed to its aesthetic, rather than regulating (utilitarian) function. The green pathways created by windbreaks and local architecture enriching this monotonous agricultural landscape, therefore appreciation of these landscape elements can be understandable.

13.2.3 Research question 4. Are mechanisms and governance compatible with expectations of stakeholders towards landscape?

13.2.3.1 Method

For analyzing the mechanisms and governance influencing the provision of socio-economic benefits by the landscape we used interview method and analysis of available documentation. We collected 30 personal interviews with the farmers living in the Chlapowski Lanscape Park and conducted 6 interviews with the representatives of the local government (two in the County Koscian (NUTS 4) - and four in the communities (NUTS 5) Koscian, Czempin, Srem and Krzywin). We asked farmers if they have a knowledge about some activities of local government concerning landscape and about their expectations towards local government in this matter. Interviews in the local governments were focused on actions and regular activities, which facilitate the impact of the local policy on the landscape and also on evaluation of the interest of local inhabitants about the landscape connected issues.

A separate study concerned local documentation. We studied the measures applied and functions attributed to landscape in official regional documents in 8 communities, (NUTS 5) located in 2 counties – 4 communities within Chlapowski Park boundaries and 4 outside the Park. The following documents were analysed: Communal Study of Spatial Preconditions and Directions for Development; (Spatial Policy of Community), Environment Protection Programme (Environmental Policy of Community), Strategy of Community Development or Local Development Programme (Socio-economic Policy).

13.2.3.2 Results - Mechanisms vs. expectations

In the Chlapowski Landscape Park management of the agricultural landscape and creation of socioeconomic effects from landscape are influenced mainly by *policy driven mechanisms*. However *actor-driven mechanisms* are also present in the region.

Policy mechanisms are connected with two areas – impact of *the Common Agricultural Policy* measures (described in the following section and Ad-hoc study 2) and *regional landscape policy*, including spatial planning, strategies of local development and environment protection programs.

<u>Policy-driven mechanisms</u>

The CAP measures and their potential influence on landscape and creation of socioeconomic effects are described in the section 1.5 of the first part of the report. Here we focus on the role of mechanisms of the regional landscape policy.

In the ad-hoc study 1 we studied the measures applied and functions attributed to landscape in official regional documents in 8 communities, (NUTS 5) located in 2 counties – 4 communities within Chlapowski Park boundaries and 4 adjacent to the Park. The following documents were analysed: Communal Study of Spatial Preconditions and Directions for Development; (Spatial Policy of Community), Environment Protection Programme (Environmental Policy of Community), Strategy of Community Development or Local Development Programme (Socio-economic Policy). The most important function attributed to shelterbelts in studied documents is regulating function. The role in reduction of wind erosion, shelter from wind and sun, prevention against formation of snowdrifts or sand drifts, are the most often mentioned regulating effects of shelterbelts. It was observed that the attribution of certain ecological, cultural and economic functions to shelterbelts is present in almost all documents of Spatial Planning Policy and Environment Protection Program, in all studied communities, including those adjacent to the park. In the Socio-economic Policy programs (e.g. Regional Development Strategy) of communities “outside the park” there is much less emphasis on functions of shelterbelts than in communities within the Chlapowski Park borders.

There are various actions and measures applied to landscape maintenance in the studied documents. The most often mentioned are preservation and maintenance of existing shelterbelts and development of new windbreaks. It is interesting that also in communities outside the park, where the shelterbelts have a much lower share in the landscape, there are measures and actions focusing on its implementation and preservation. The most common actions mentioned in documents of environment policy or spatial planning are: “strengthening the environment through shelterbelts development on the soils of the lowest productivity”, “shaping ecological corridors”, ”development of shelterbelts - lines of trees along rivers and local roads”, “inhibition of soil degradation processes through development system of shelterbelts in the territory”, “fields of the size less than 0,5 ha should be developed as shrubs and trees habitats”.

From the interviews with local government representatives it appears, that there are also other actions undertaken by local institutions in order to built the awareness of local society about the landscape and to promote protection of the environment. For example educational programs (offered mainly in schools), building the education paths and biking roads with interesting information on the boards, continuous dialogue with local inhabitants about the environment protection, promoting agro-environmental programs.

From the interviews with local inhabitants it was observed that they have rather moderate interest in landscape protection and small knowledge about actions undertaken by the local governments in this matter. Only about 42% of respondents have a knowledge about some activities of local government concerning environment and landscape; 22% knows that there were some consultations or meetings concerning environmental issues. This might be because of a low awareness of landscape services or just low interest in governmental actions in general. About 25% declared that they receive some information about the environment and landscape from the local government. However, it is interesting that about 90% of respondents would like to receive more information on landscape management (brochures/meetings) from the local institutions.

Actor-driven mechanisms

Regarding *actor-driven mechanisms* contributing to landscape valorization and the creation of socioeconomic effects from the regional landscape the role of local large farm businesses that invested in agricultural production in the region should be emphasized. These important regional players influence the shape of the agricultural landscape, benefit from its provisioning and regulating functions and as the second-order effect, contribute to employment in rural areas. There is also a feedback influence visible on the landscape structure and components. These companies care and protect the existing shelterbelts and also built the new establishments. One of the respondents from LSL said that this behaviour is often “copied” by the local small-holders, who observe practices of this large scale agricultural companies and try to follow them on their farms.

The other important actor in the Chlapowski Lanscape Park is the Research Station of the Polish Academy of Science in Turew. Its role in landscape valorisation, shaping and protection, as well as building the awareness within the local society, cannot be underestimated.

13.2.3.3 Conclusions

There are various actions and measures applied to landscape maintenance in the studied documents (Spatial policy, Environmental policy and Socio-economic policy). The most often mentioned are preservation and maintenance of existing shelterbelts and development of new windbreaks. It is interesting that also in communities outside the park, where the shelterbelts are less present in the landscape, there are measures and actions focusing on its implementation and preservation.

From the interviews with local government representatives it appears, that there are also other (then official documents) actions undertaken by local institutions in order to built the awareness of local society about the landscape and to promote protection of the environment.

Interviews with local inhabitants indicate that they have rather moderate interest in landscape protection and small knowledge about actions undertaken by the local governments in this matter. However it is interesting, that respondents would like to receive more information on landscape management from the local institutions. It might be concluded that there is a visible gap in the information flow between the local government and farmers and other inhabitants of the case study region. This gap might be decreased by wider and also better targeted information actions and consultations with the local society.

13.2.4 Research question 5. What might be a potential impact of Landscape composition and structure on regional competitiveness?

There are many different definitions of the term “competitiveness” or “regional competitiveness”, as well as different competitiveness indicators use in various studies and papers. The most popular were collected and presented in the deliverable D3.14 of the CLAIM project "Landscape as a driver of competitiveness". It became clear, that the idea of productivity and employment is a key, common link between all concepts of competitiveness, most of all in connection with the living standard of the regional population. The European Union’s Sixth Periodic Report on the Regions (EU, 1999) specifies “Regional Competitiveness” as “‘the ability of a region to generate, while being exposed to external competition, relatively high income and employment levels’..." (EU 1999, Claim 2012 D3.14). Therefore in the presented study we understand the regional competitiveness as the ability to generate income, with at the same time, assured employment and wellbeing of the society. The source of competitiveness is the potential of the land, the intellectual resources of its inhabitants and the level of social organization. Kot (2013) among the factors affecting the level of competitiveness in the region mentioned geo-topographical factors, namely the quality of the natural environment, beneficial localisation, natural resources, involving the possibilities of carrying out the activity.

Competitiveness of the region (Koscian NUTS 4) can be estimated as medium. The structure of regional economics and activities is dominated by agriculture-forestry (31% of working population) and processing and manufacturing (25%). The agricultural production, due to medium quality soils, good climate and larger farms results in a good competitive position of the region in relation to other agricultural regions in Poland. Also well-preserved natural environment and rich cultural sites create an opportunity for the development of tourism and related sectors such as trade and services. The degree of economic activity of population in the Koscian region is lower than the voivodeship (GVA = 83% of Wielkopolskie) and country level (GVA = 82% of Poland). The wage level equals 78,8% of country level. This characteristics can be affected by location of the region (outside of the large cities) and by agricultural character of employment, which usually generates lower incomes than the other sectors. The demographic conditions of the region are about the national average. The population density and structure according the age is almost the same as the national average. The migrations are slightly negative but the birth index is positive.

Benefits from landscape for the regional competitiveness in the Chlapowski Landscape Park are clearly connected with agriculture supported by shelterbelts and their regulating (protection) function. This characteristic landscape element allows to increase yields of agricultural production and to produce crops which would not be grown on relatively light soils, if there was no protection against wind erosion (like sugar beets or oil-rape). Therefore increase of the regional competitiveness is mainly attributed to income from agricultural production and safeguarding employment in rural areas (in agricultural production and to a lesser extent, employment in recreation).

13.2.4.1 Method

Assessing influence of landscape on region competiveness is complicated due to complexity of the issue and dependence of competiveness also on other factors like: location, human capital and local investments, governance etc., which hide possible relation of landscape elements to regional competiveness. It is rather a process of many intermediate factors. What is more there is no exact information about variables dependency, even for those intermediate factors. Usually the only available information are opinions of experts about positive or negative correlation between variables. The lack of experimental data practically prevents from the use of classical statistical methods. Therefore we decided to use Bayesian Belief Network (BBN) for determining influence of landscape elements on regional competiveness.

To assess the relation between landscape elements, functions/services, benefits and competitiveness as presented on the CLAIM chart (Figure 1), the Belief Network Approach (BBN) was used. The BBN is a directed acyclic graph (DAG) with a set of conditionals probabilities. The graph consist of nodes and arcs, where nodes represent variables and arcs depict direct (the lack of direct relation) causal relation between variables and the lack of an arc between two nodes does not mean that variables represented by those nodes are independent in the probabilistic sense. One of the most useful features of BBN is propagation, it allows updating all probabilities after setting some variables to observed values. This property can also be used to predict how values of selected variables influence probabilities of the variable of interest. There is a number of programs allowing development of BBN. For this analysis we used the Norsys Software Corp. program Netica.

The relationship between landscape element and regional competiveness is rather complex and difficult for direct assessment. Therefore we followed general framework of the project and divided all variables into 4 layers, with elements of each layer affecting directly only elements of the next one, Figure 7.

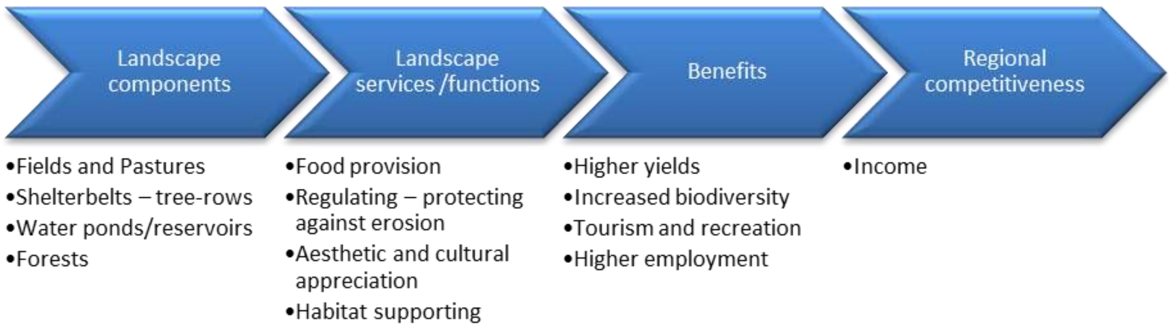


Figure7. Division of variables into layers

The main landscape services in the CSA are food provisioning, regulating (mainly wind-erosion), aesthetic-cultural and habitat supporting (Figure 2 and 3). Provisioning and regulating services are directly linked to agricultural activities. *Provisioning* is the main output of agriculture - fields and pastures, and depends largely on regulating services provided by shelterbelts. Provision of wood is less important in this region and can be attributed to shelterbelts (4% of area of the park) and forests (11% share).

Regarding *regulating* services, shelterbelts have a very important regulation function in this region, protecting the fields against wind and water erosion, and regulating the water and nutrient cycle. Existence of this landscape element allows to increase yields of agricultural production and to produce crops which otherwise could not be grown if there was no protection against wind (e.g. sugar beets and oilseed rape).

Agricultural landscape usually is less attractive to *cultural* and *recreation* use. However Chlapowski Landscape Park is famous for its specific landscape, shaped by agriculture and characteristic shelterbelts creating green-paths along the roads and fields. This was confirmed by the ad-hoc study questionnaire in which we asked tourists for their reasons of visits. Area of the Park is also rich in historic buildings like manor houses in Racot, Kopaszewo, and churches. The pathways created by windbreaks and local architecture encourage tourists to come for short term visits for biking or walking.

Forestry management and wind-breaks maintenance is influencing *habitat and supporting services*. It contributes to the existence of rare species (fauna and flora) living and breeding in the trees, and thus it contributes to rich biodiversity of the region.

The following direct and second order (socio-economic) effects of the use of landscape services were analyzed in the BBN of the case study region: *Increase of productivity* (higher yields and larger variety of crops); *Maintenance and creation employment (*strong agricultural sector provides employment for local inhabitants; inflow of visitors provide possibility of development of the local tourist base); *Tourism and recreation (*specific landscape and cultural heritage attracts tourists); *Increased biodiversity* (diversified landscape trough its habitat supporting function contributes to rich biodiversity).

In general those abovementioned functions and services provided by landscape elements and benefits deriving from its usage, contribute to higher competitiveness of the region, measured by *Income effects.*

The general model of connections between the variables is presented in figure 8 and 9.

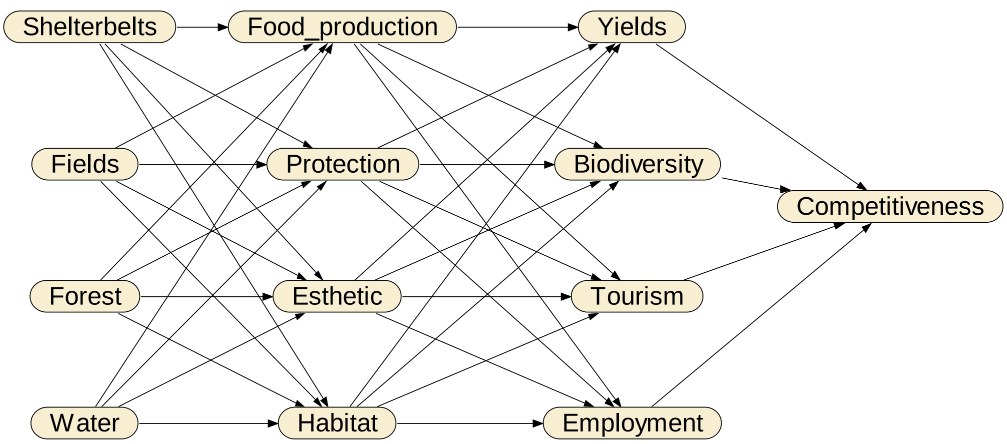


Figure 8. First approximation of the BBN describing influence of the landscape on regional competiveness.

However, as presented on the figure 7, the number of arcs between nodes caused relatively large probability tables with over 300 values which needed to be estimated by experts. In order to reduce that number the pilot survey was carried out. The initial survey showed that many depicted in figure 7 carry relatively small weight. In table 2. strength of relation between landscape elements and landscape functions are presented.

Table 2. Importance of each element for carrying out landscape functions

	Shelterbelts	Fields&Pastures	Forest	Water
Food_production	0.95	**8.1**	0.7	0.25
Protection	**5**	0.8	**3**	1.2
Esthethic	**2.6**	1.4	**4.4**	**1.6**
Habitat	**2.6**	0.8	**5.35**	**1.25**

Scale: 0 – 10

Source: initial survey

On the basis of this initial analysis, but with excluding the relation with a weak dependence, second approximation of structure and questions for conditional probabilities was developed (figure 9). The two states for each variable from second and third layer were: “Low” and “High”, while for landscape elements it answer to question whether the element is important part of landscape or not: “No”, “Yes”. The estimation of probability tables was conducted on the basis of 27 surveys sent to experts.

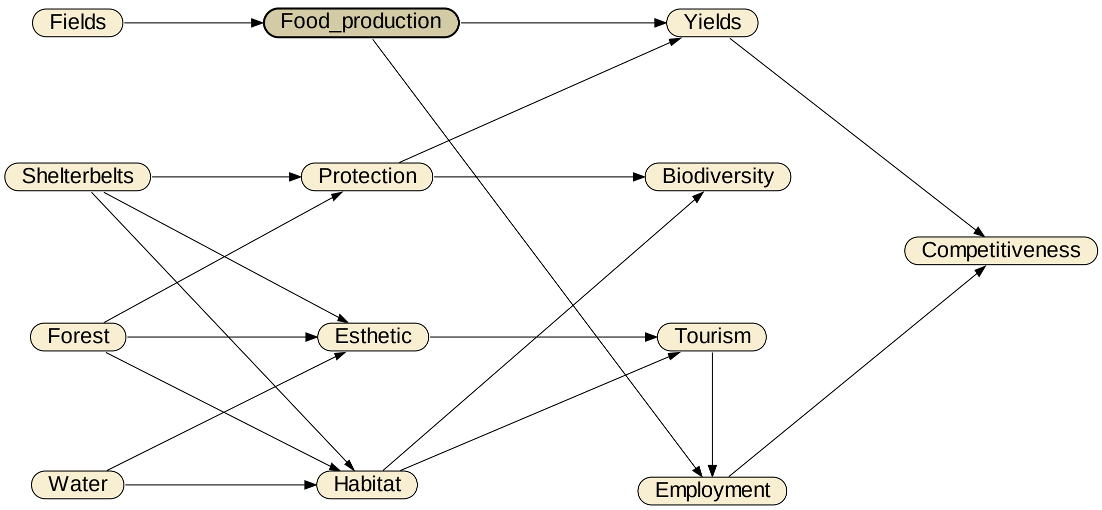


Figure 9. Second approximation of the BBN describing influence of the landscape on regional competiveness

13.2.4.2 Results

On the figure 10 we presented the calibrated BBN model in case of 50% chance of all elements of landscape being important. As the shelterbelts are landmark of analysed region the next two figures 11 and 12 show how probabilities for each variable change between 2 states of shelterbelts.

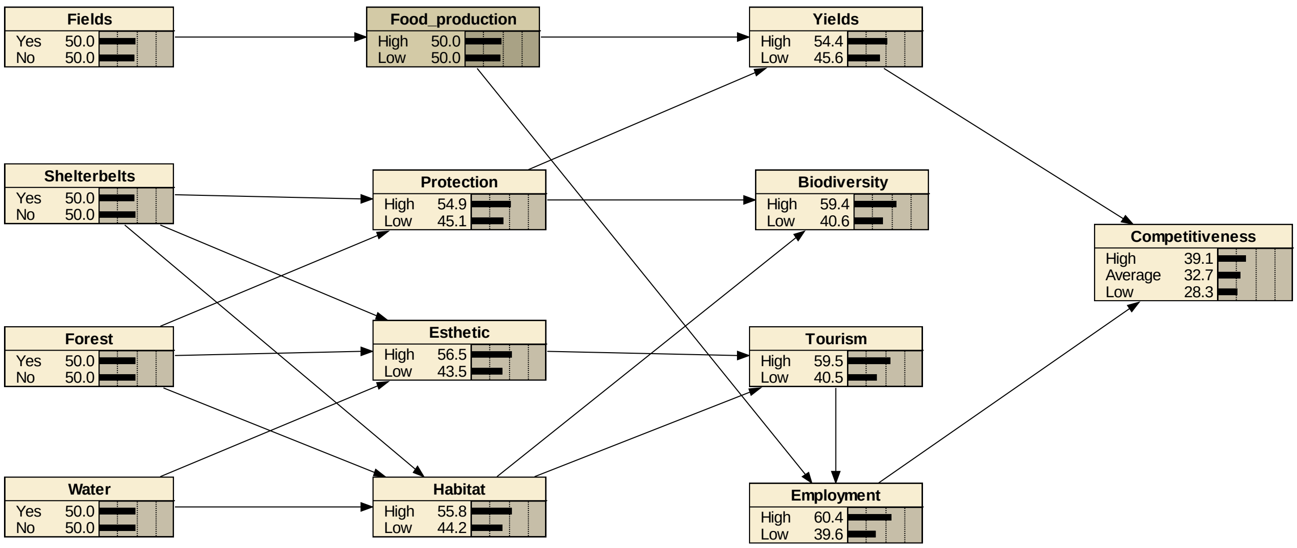


Figure 10. The calibrated BBN belief network.

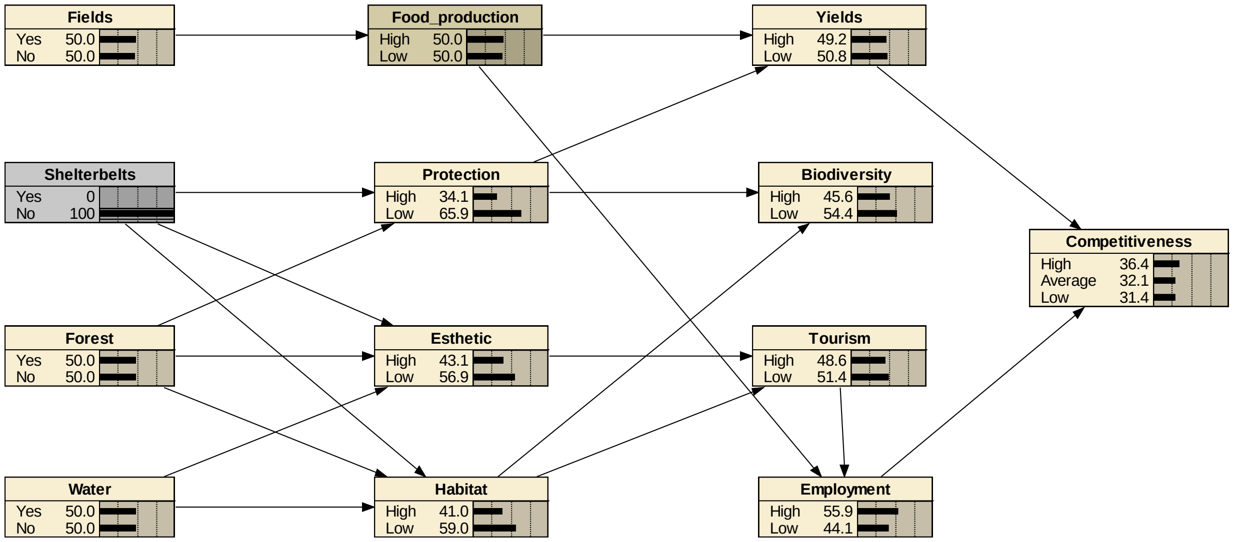


Figure 11. The BBN belief bars in case of 0% chance of shelterbelts being important part of landscape

The changes in probabilities between Figure 11 and 12 can be attributed to existence of *shelterbelts*. It is visible that shelterbelts have a strongly positive impact on the realisation of the protection (regulating) function by increasing by 41,6% (percent points) its probability to be at high level. As it was supposed, these green pathways have a strong positive impact also on the aesthetic appreciation of the landscape, by increasing its valorisation as high as by 26,7%. Existence of windbreaks create as well a good conditions for habitat for species. The probability of realisation of this function rise by almost 30% together with implementing the shelterbelts into the landscape. Realisation of abovementioned services by shelterbelts contributes to generation of certain socio-economic benefits. An increase of the chance for high yields is estimated by the BBN model for 10%, probability of high biodiversity rise by 27,6% and higher tourist movement by 21%. This in turn has an impact on increase of the local employment by 8.9%. In case of regional competiveness there is 5% increase of a chance of achieving high level of competitiveness and 6% decrease of low level chance due to implementation of the shelterbelts.

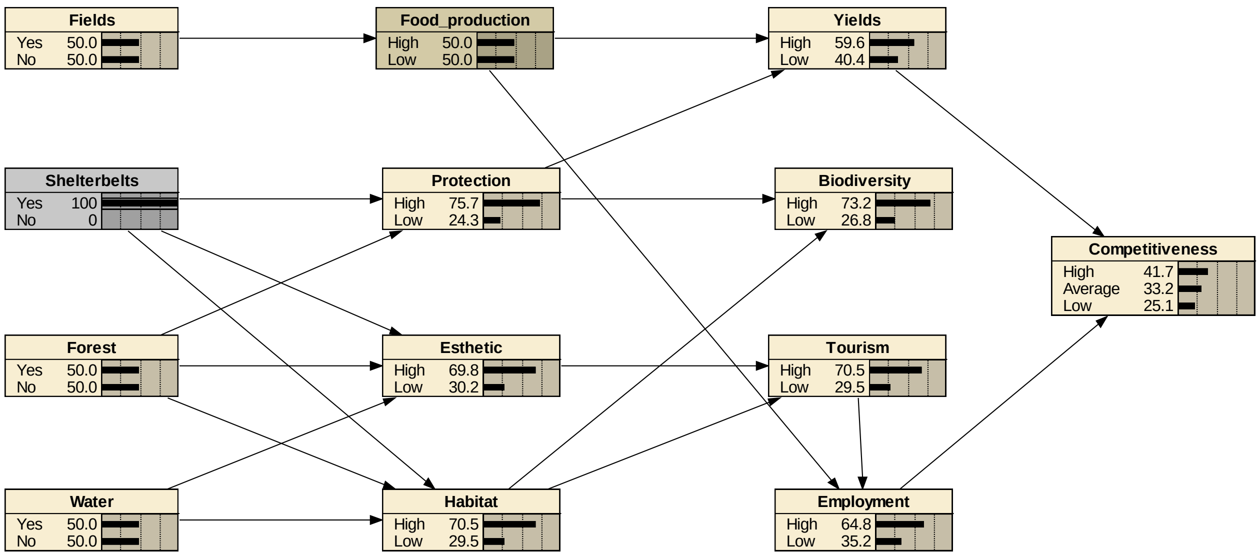


Figure 12. The BBN belief bars in case of 100% chance of shelterbelts being important part of landscape

Similar calculation was carried out for all landscape elements but only result for competiveness are presented in table 3. While all landscape elements display positive influence on regional competiveness, the agricultural land shows the strongest impact by increasing chance of high competiveness by about 20%. Shelterbelts and forest have very similar effects with increase about 5% and water gives almost negligible change of 1.5%.

Table 3. The probabilities for level of regional competiveness for landscape elements

Landscape element	No			Yes		
	Competitiveness High	Competitiveness Medium	Competitiveness Low	Competitiveness High	Competitiveness Medium	Competitiveness Low
Fields	0.294	0.314	0.392	0.487	0.340	0.173
Shelterbelts	0.364	0.321	0.314	0.417	0.332	0.251
Forest	0.358	0.320	0.322	0.423	0.333	0.243
Water	0.384	0.325	0.291	0.398	0.329	0.274

It was also interesting to observe a reverse causality of the BBN model. On the figure 13. we checked what happens when we assume the high level of competitiveness at 100% probability. We compared the results with figure 10 - the calibrated BBN model. It can be observed that 100% chance of high level competitiveness (increase from 39,1% high to 100%) is assured by an increase of importance of fields and pastures in the landscape from 50 to 62%. The other landscape elements were far less significant. It is also worth mentioning that productivity increase (higher yields) has strongest effect on the competitiveness than the employment (creation of jobs). High competitiveness (100% chance) was obtained through increase of probability of high yields by 28% whereas higher employment by 16,7%.

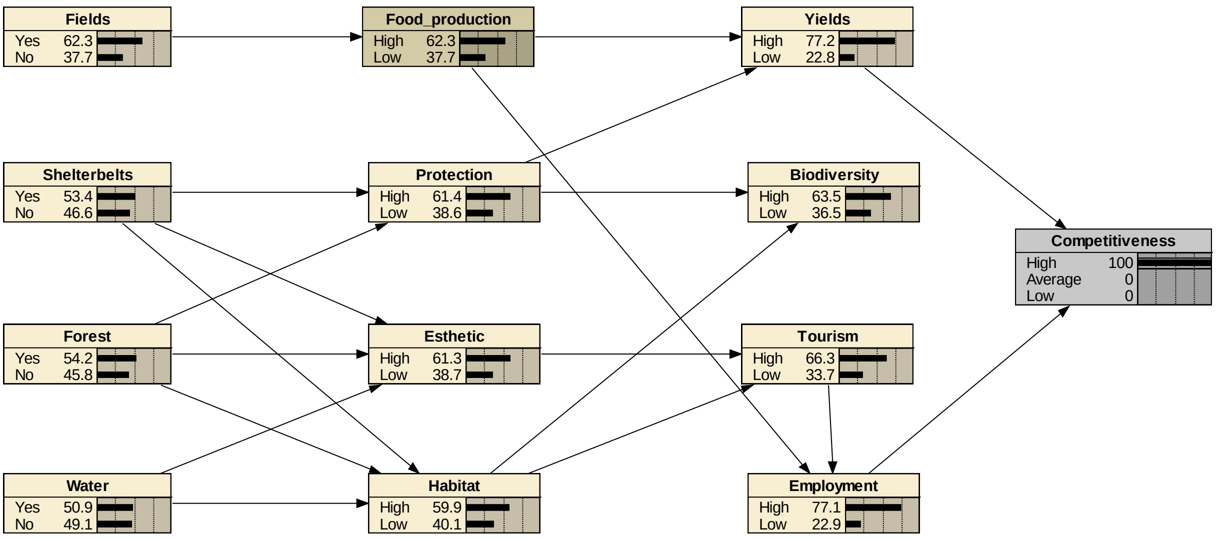


Figure 13. The BBN belief bars in case of 100% chance of high competitiveness.

13.2.4.3 Conclusions

The main conclusion of the study was that all considered landscape elements (fields, forests, shelterbelts, and water reservoirs) have a positive influence on regional competiveness and the potential of agricultural land (through its provisioning function, thus employment and economic effects).

The agricultural fields and pastures have the strongest, positive impact on the competitiveness of the region showing the potential to increase the chance of high competiveness by about 20%. Shelterbelts and forests have very similar effects with increase about 5%. Water gives almost negligible change of 1.5%.

13.3 Summary and conclusions

The main objective of the study performed in the Polish case study region (CSA) in Chlapowski Lanscape Park was to contribute to a development of knowledge base on the relations between landscape structure and composition, functions and benefits, and the contribution to the regional competitiveness and creation of socio-economic effects of typical agricultural landscape.

The Polish case study region "Chłapowski Landscape Park" is located in the Central-Western part of Poland and covers 172,2 km². The region is characterized by typical agricultural lowland landscape, rich in small-structured landscape elements like field ponds, water catchments and shelterbelts. The main landscape services in the case study area (CSA) are *food provisioning* and *regulating* (mainly wind-erosion). *Provisioning* is the main output of agriculture (food provision), and depends largely on *regulating* services provided by shelterbelts. The agricultural landscape in the park is mainly shaped by the shelterbelts in-between the fields and rows of trees (linear elements) along the roads. Concentration of this element in the case study region is almost two times greater than in the neighbouring regions. The landscape composition is also more diversified in the Park than in adjacent regions.

Awareness and preferences of the landscape determines the attitude towards the landscape and are the basis for the assessment of its value. The results of this study indicate that the farmers are convinced about their influence on the landscape. The most important and preferred landscape elements for them are fields and pastures, conducive to agricultural production. Thus it could be concluded that farmers formulate their preferences more according to an economic utility of the landscape elements, than aesthetic appreciation. Farmers generally agree that the shelterbelts have a positive impact on agriculture and landscape, however they are not able to estimate correctly the magnitude of this impact (measurable benefits). Therefore, they are not willing to compromise on revenue generated by agricultural production in favor of uncertain (unrated) benefits from protecting the fields by shelterbelts. They are reluctant to pay for the maintenance of the woodlots and designate their own land for new establishments. Habitants of adjacent regions, inhabitants of the Park and visitors take a different, more aesthetic angle in evaluating the landscape elements. The most preferred element of the landscape for these groups are local architecture and forests. It is interesting to observe that the valorisation of shelterbelts in case of habitants and visitors is higher than in case of farmers, which might be attributed to its aesthetic, rather than regulating (utilitarian) function.

Regarding policy and mechanisms, which have an impact on the landscape, it was observed that there are various actions and measures applied to landscape maintenance at the local government level. The most often mentioned are preservation and maintenance of existing shelterbelts and development of new ones. There are also other activities provided as information actions and consultations. Interviews with local inhabitants indicate that they have rather moderate interest in landscape protection and small knowledge about actions undertaken by the local governments in this matter. However it is interesting, that respondents would like to receive more information on landscape management from the local institutions. It might be concluded that there is a visible gap in the information flow between the local government and farmers and other inhabitants of the case study region. This gap might be decreased by wider and also better targeted information actions for the local society.

Benefits from landscape for the regional competitiveness in the Chlapowski Landscape Park are clearly connected with agriculture supported by shelterbelts and their regulating (protection) function. This characteristic landscape element allows to increase yields of agricultural production and to produce crops which would not be grown on relatively light soils, if there was no protection against wind erosion. Therefore increase of the regional competitiveness is mainly attributed to income from agricultural production and safeguarding employment in rural areas (in agricultural production and to a lesser extent, employment in recreation). The agricultural fields and pastures have the strongest, positive impact on the competitiveness of the region showing the potential to increase the chance of high competiveness by about 20%. Shelterbelts and forests have very similar effects with an increase about 5%.

References:

Claim (2012); Deliverable D3.14 - *Landscape as a driver of competitiveness* - *www.claimproject.eu*

European Commission (1999), 'Sixth Periodic Report on the Social and Economic Situation of Regions in the EU'.

Europan Council (2011) „Zarządzanie obszarem: Gospodarowanie krajobrazem jako proces" CEP – CDPATEP (2011) 13E. Strasburg 2011. *www.gdos.gov.pl/files/OP/management-of-the-territory_PL.pdf*

Kot J. (2013) Przegląd podstawowych pojęć w zakresie innowacji i konkurencyjności regionalnej. Project realised within the activity 2.6 "Regionalne strategie Innowacyjne i transfer wiedzy " *(access 2013)*. www.ujk.edu.pl/iekon/zporr/raport/Kot.doc

Thurstone, L.L. (1927). A law of comparative judgement. Psychological Review, 34, 273-286.

14 CSA6: The impact of shelterbelts and CAP's greening measures on landscape composition and farm performance in the Chlapowski landscape park

Edward Majewski, Adam Wąs, Stefania Czekaj (WAU)

14.1 Introduction

The main objective of the study performed in the CSA 6 in Chlapowski Lanscape Park was to contribute to a development of knowledge base on the relations between landscape structure and composition, functions and benefits, and the contribution to the regional competitiveness and creation of socio economic effects of typical agricultural landscape in the CSA region.

The main objective of this report from Ad-hoc Study 2 is to answer the question, what might be the potential impact of CAP instruments on landscape, its management, and performance of farms located in the Chlapowski Landscape Park.

For over twenty years the CAP has been subject to successive reforms, aimed at increasing market orientation of the EU agriculture, but also providing income support for farmers, increasing requirements of environmental protection and taking action to accelerate the development of rural areas across the EU. One of the most important changes in the CAP organization, which was introduced in earlier reforms, was a transition from product support to producer support with an assignment of existing direct payments to the agricultural area.

The current reform of the Common Agricultural Policy started in 2010 with a public debate, followed by the publication of the Commission's Communication (EC, 2010) which presented a vision of the EU agriculture and the challenges and priorities for the future CAP in the new budgetary period. In June 2013 a political agreement on the reform of the CAP has been reached and finally in December 2013 the Council of EU Agriculture Ministers formally adopted the regulations for the reformed CAP.

Basic objectives of the CAP, presented in those documents are formulated as follows: viable food production, sustainable management of natural resources and climate action balanced territorial development. In order to achieve these long-term objectives of the CAP, the existing policy instruments have to be adjusted. Therefore, the reform of the CAP focuses mainly on operational objectives by providing effective policy measures designed to improve the competitiveness of the agricultural sector and its sustainability in the long term. Giving a high priority to environmental objectives of the reform introduced the various instruments, aiming to provide environmental benefits – this part of the reform is called "greening" of the CAP.

The main aim of this study is to determine the impact of finally adopted CAP reforms on the performance of farms located in the Chlapowski Landscape Park. The focus of the study is on shelterbelts, which are the most distinctive element of the landscape in the study area. The shelterbelts have been established by General Dezydery Chlapowski (1788 - 1879) who, after agricultural training in England and Scotland in the years 1818 - 1819, used the knowledge gained there in his Turew mansion, the center of today's Landscape Park. (Böhm, Zechariah 2000, p. 27). Chlapowski presented his idea in the work entitled "About agriculture" in which he wrote: "I do not know the country other than ours, in which an English approach towards agriculture would be more applicable. (…) On flat areas protections for completely open fields should be created; ... having very large fields there is no need to regret, that their sizes would be slightly reduced." [Chlapowski 1843, p. 124].

The benefits of shelter to the farm have long been recognized and include protection of crops, livestock, and the home, reduction of soil erosion, salinity control and biodiversity improvements (Johnson, Brandle 2003). With some design considerations, shelterbelts can provide significant habitat for wildlife species. They can act as wildlife corridors and provide pest control benefits. Bates (1911) appears to have been the first to make a comprehensive investigation of the effects of shelterbelts on crop plants. Some examples of early reports of shelter on pasture are given by Caborn (1957), who cites papers by Nageli (1941 and 1942) where shelter in Jutland has increased the yield of 'grass' (34%), 'grass and clover' (24%) and 'lucerne' (27%). In America they became common in the 1930s in order to prevent wind erosion on farmlands. The Food Security Act of 1985 approved shelterbelts as a cover type for areas not being farmed. Rackham (1977), discussing hedgerow trees in Britain, which were valued for shade and shelter, noted that during the period 1550 to 1759 they were a major source of timber for house- and ship-building and, where pollarded, for firewood. Income from these trees, in the past, was substantial. Some land-owners there are convinced that tree planting, maintenance and harvesting are essential elements in estate management (Hayes et ed., 1978) and see no incompatibility with planting for both shelter and timber production. Comparing cereal crops with forage crops, Kort (1988) states that 'winter wheat, barley, rye, millet, alfalfa and hay (mixed grasses and legumes) appear to be highly responsive to protection, while spring wheat, oats and corn respond to a lesser degree'.

The concept of shelterbelts is highly compatible with the newest developments in reforming the Common Agricultural Policy. That is why adaptations to the requirements of the "greening" of the CAP have been also considered in the study.

"Greening" of the CAP

Idea of "greening" the CAP has arisen numerous controversies, mostly due to ambiguously defined objectives which effects were difficult to estimate. Introduction of "greening" may affect the size and structure of crop production, and thus may cause changes in the level of farm income, but also an impact on landscape features can be foreseen. This is due to the following basic requirements of the "greening":

- **CROP DIVERSIFICATION**, which sets up minimum number and share of crops in arable land area at the farm. On farms with more than 30 hectares of arable land at least three different crops shall be grown - the main crop should not exceed 75 % of arable land and two main crops together must not exceed 95 % arable land. On farms covering between 10 and 30 hectares of arable land there shall be at least two different crops grown and the main crop shall not exceed 75 % share in the arable land area. Farms below 10 ha of arable land are excluded from obligation of crop diversification.
- **MAINTAINING THE EXISTING AREAS OF PERMANENT GRASSLAND**, with the right to reduce the area by not more than 5% compared to the base year;
- **MAINTAINING ECOLOGICAL FOCUS AREA (EFA),** which includes ecological land such as land left fallow, terraces, landscape features, buffer strips and afforested areas. The minimum area is set as 5% of arable land but starting from 2018 may be increased to 7%. The regulation provides also a "greening equivalency" system to acknowledge certain farming practices beneficial for the environment and the climate which can be considered equivalent to the EFA. Farm's below 15 ha are excluded from this requirement.

In order to avoid penalizing those farmers that already farm in an environmentally-friendly manner there is a number of farms excluded from fulfilment of the "greening" requirements: organic holdings, farms with significant areas of permanent grasslands or other herbaceous forage and fallow land, and finally farms laying north of the 62nd parallel.

Impacts of the CAP post 2013 reform

There are some studies which analyse the potential impacts of the CAP post 2013 reform on various environmental and economic aspects of agriculture. Since the final shape of the reform has been announced very recently, the results of available studies refer to the original EC proposal of October 2011 (EC, 2011a).

Studies by Helming and Terluin (2011) and Van Zeijts et al. (2011) show that the reform will largely improve agricultural incomes in the new Member States, while in the EU15 they will remain almost unchanged. The combination of direct payments and environmental requirements will improve incomes in regions dominated by extensive agricultural production, for example with permanent pasture systems, and will worsen results in regions dominated by intensive agricultural production.

Matthews (2011) concluded, based on the analysis by Directory General Agriculture and Rural Development (EC 2011b), that the implementation of “greening” will cause an increase of production costs in the EU in the long run and a reduction in agricultural incomes in the short run. The cost of “greening” could reach 33 € per ha in 2020 as EFA will displace arable land, reduce agricultural supply, and trigger price increases for agricultural products. Matthews predicted significant price increases for wheat and sugar beet (3%), barley (12%) and live cattle. It is estimated, however, that the increase in prices and the expected increase in yields does not fully compensate for higher production costs, resulting with a decline in agricultural income by 2% on average (Matthews 2011).

The potential impact of a greener CAP on developing countries has been the subject of Nicola Cantore (2013) studies. She points out that in the short term, the “greening” of the CAP will reduce production in the European Union, which may lead to increase in prices of agricultural products. This will stimulate exports from developing countries (up to 3% regarding some countries and commodities), but at the same time hurts countries importing food. In the medium and long term emission of CO_2 will be reduced as well as climate change damage in developing countries.

Other authors focus only on one of the “greening” components, which is maintaining the EFA considered as having the greatest potential to solve environmental problems. For instance study by Westhoek et al. (2011) focuses on the impact of the “greening” of the CAP on the environment alone. The authors conclude that the introduction of the obligation to diversify cropping patterns would not have a significant impact on improving the quality of the natural environment due to the fact that, according to the estimates, the need to comply with this requirement applies only to 2% of the arable area in the EU. According to these authors, only the introduction of EFA as a kind of compulsory setting-aside can help to increase biodiversity and reduce greenhouse gas emissions in the EU, while increasing emissions outside the EU.

The effects of the CAP reform were also analyzed for Poland by the SGGW team members who participate in the CLAIM project (Czekaj S. et al 2011). The results show that “greening” of the CAP based on the original EC proposal (EC 2011a) leads to changes in the cropping structure especially in monoculture and duo-culture farms. The required diversification of the cropping structure and obligatory withdrawal of 7% of arable land to establish ecological focus area (EFA) results in a decline of farm incomes by 3.8% on average. Much greater losses of income are in monoculture farms with high quality soils compared to a baseline scenario which assumes the continuation of the current CAP (Was A et. al 2012).

The recently adopted regulation mitigates requirements imposed on farmers and reduces negative impact of the reform on production and farm incomes (Was et.al 2013).

Importance of the landscape goes, however, beyond purely economic and environmental functions. High quality landscape promotes the development of culture, creates social bonds, protects against eradication, leads to economic benefits and strengthens the political position of the country (Wolski 2011, p.15). Thus, according to Jerzy Wilkin: "The farmer is not only a manufacturer of products (...) Through the relationship with the land, the environment, the surrounding countryside, architecture, traditions, etc., is also hosting a very important part of the natural and cultural resources of the country" [17].

14.2 Methodology

The key objective of the study is to assess impacts of natural landscape elements (shelterbelts) in the case study area on performance of farms in terms of cropping structure, volume of production and farm incomes. An additional objective is to examine potential impacts of the recent reform of the CAP on both, the landscape and agricultural production.

Farm optimization model was used as a tool for the analysis. The model was run for 22 farms of different size and production orientation that are located in the case study area.

There were 6 scenarios considered for modelling:

A: Base Scenario [Base_2013] constructed only for calibration of the model based on data acquired from farms.

B: Baseline_2020 scenario [Baseline 2020]

This scenario assumes continuation of the current CAP without any change to the existing mechanisms of the CAP. Baseline scenario will provide a benchmark for other scenarios of the reformed CAP.

C: Baseline_2020 NO TREES scenario [Baseline NT 2020]

Scenario assuming continuation of the current CAP and removal of shelterbelts. In this scenario the area of shelterbelts will be added to the area of arable land. It is anticipated that due to changes in natural conditions (no protection against winds) some of the crops like sugar beets, rapeseed and spring wheat would provide lower yields and its cultivation becomes more risky. It was assumed that expected yields of sugar beets, rapeseed and potatoes will be respectively 50%, 30% and 20% lower than in case of cultivation with shelterbelts.

D: GREEN_2020 scenario [Green 2020]

In this scenario the area of shelterbelts is maintained and "greening" requirements (diversification, EFA, permanent grassland) are imposed on the model. Meeting the requirements is a condition for receiving the full rate of direct payments (estimated for Poland at 219,05 euro/ha), in which 30% of "green payments" is included. It is also assumed that existing agri-environmental payments per average farm, which will be the subject of modelling, will be reduced by 50% due to the inclusion of “greening” component and the likely reduction in financing for environmental measures of the second pillar.

E: GREEN_2020 NO EQUIVALENTS scenario [Green NE 2020]

Scenario assuming preservation all shelterbelts within The Park and maintaining all CAP reform requirements except Ecological Focus Area equivalent features and practices. In this scenario maintaining shelterbelts will not be recognised as a practice substituting establishment of EFA.

F: GREEN_2020 NO TREES scenario [Green NT 2020]

[17] Interview with Jerzy Wilkin by Hanna Tobolska for "The Wall Street Journal Poland" [in:] Dziennik, 20.06.2007, p.8.

Scenario assuming maintaining all CAP reform requirement but removing shelterbelts with all consequences described in scenario Baseline_2020 NO TREES

Regarding policy measures that may influence landscape structure in the case study area, the following instruments have been taken into account in the scenarios:
a. basic greening requirements as proposed in the final EC proposal;
b. replacing EFA by equivalents, which may bring the same or a higher level of benefits for the environment and climate change. According to the draft regulation18 of the European Commission each Member State will draw up a list of activities, which will be considered to be equivalent to practices related to "greening"19. To convert individual equivalent practices to the EFA area appropriate weighting coefficients will be used taking account of the importance of certain categories of land for the environment. The final values of the coefficients for the various elements of the landscape should be determined by the Member States until 1rst of August 2014. Equivalent practices considered in the farm model will be shelterbelts, nitrogen binding crops (legumes), catch crops and fallow land.

Farm optimization model

To determine the potential effects of CAP changes, the Farm – Opty optimization model expanded with non-linear cost function from the method of Positive Mathematical Programming (Howitt, 1995) was used.

The main assumption on which the model is based, is rational, from an economic point of view, behavior of farmers, who want to maximize their profits. The objective function assumes maximization of the farm income. General form of the objective function is shown in the following equation:

$$\underset{x_i \geq 0}{DR} = \mathbf{p}^T(\mathbf{x} \bullet \mathbf{y}) + \mathbf{s}^T\mathbf{x} + fs - fc - \mathbf{d}^\mathbf{T}\mathbf{x} - \mathbf{x}^\mathbf{T}\mathbf{Q}\mathbf{x}$$

Provided that Ax ≤ B,
where:
DR - agricultural income (numerical value of objective function); p - vector of prices (n x 1); y - vector of yields and productivity (nx1); x - non-negative vector of optimum levels of production (n x 1); x•y – Hanamard product; s - vector of payments for production activities (n x 1), c - vector of input prices (z x 1); T-matrix for consumption expenditure for individual activities (z x n); fc- value or fixed costs; fs- value operational subsidies relatively independent of the level of production; A - resource utilization coefficient matrix (m x n); B - vector of available resources (m x 1), d'x-x'Qx – nonlinear element of the objective function determined during model calibration.

To capture appropriate market effects, which are exogenous factors in farm model the CAPRI model (Britz and Witzke 2012) was used, to calculate for the purpose of this study changes of prices and yields under scenarios considered. CAPRI is a partial equilibrium (PE) model for the agricultural

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[18] Working document of the EU Council 10991/13 "Proposal for a Regulation of the European Parliament and of the Council establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy (CAP Reform)" dated 14.07.2013.

[19] Equivalent practices include such as the use of nitrogen binding crops (legumes), assuming they are grown without the use of mineral fertilizers and pesticides, catch crops, fallow land, terraces, landscape protection elements, buffer zones, agro-forestry systems, green cover, short-rotation areas, for which we do not apply mineral fertilizers and/or pesticides or plot areas adjacent to the edge of the forest. Equivalent practices may also include elements of agri-environmental-climatic programme or national or regional environmental certification systems.

sector. Differently than in other PE models CAPRI estimates supply in a way similar to farm models, however at a higher level of aggregation (NUTS 2). Observed supply responses are confronted with forecasted demand in market module, which includes market support measures like tariffs, tariffs, quotas ect. Import and export streams are estimated in CAPRI using Armington approach.

To maintain specific characteristics of model farms the relative change of yields and prices at analysed scenarios in comparison to base year has been calculated in CAPRI at the country level. Then it was extrapolated to model parameters of each optimized farm.

Data source

The main source of data for modelling was the survey conducted with 22 farmers from the Chlapowski Landscape Park area. Data were collected in the autumn 2013. Majority (21) of farms were randomly selected in the park area. The biggest farm was intentionally selected as an example of commercial, intensive agricultural activity performed on the area of high natural value. Basic characteristic of the sample is presented in the table 1.

Table 1. Basic characteristics of farms selected in the area of Chlapowski Landscape Park for modelling

Farm No.	Arable land [ha]		Permanent grass [ha]		Other land [ha]	Livestock		Employment [AWU*]
	Own	Leased	Own	Leased		Cattle [LU]	Pigs [LU]	
1	10,7	7,86	1,52	-	0,18	24	23	2,2
2	42,19	0,37	-	-	-	40	-	3,2
3	17,2	-	-	-	0,43	-	13	1,2
4	22,33	13,29	7,41	-	0,45	48	103	4,0
5	15,05	5,6	1,25	-	0,07	8	13	2,0
6	18,53	-	-	-	0,05	-	62	0,5
7	42	-	1,5	-	-	-	-	0,8
8	11,33	-	2,9	-	0,1	12	15	1,2
9	8,85	1,5	1	-	0,22	12	8	2,2
10	6,5	3	2,5	2,2	-	27	-	2,2
11	25,34	9,22	6,92	1	0,5	20	-	3,0
12	18,07	-	3,11	-	0,1	9	5	3,0
13	7,72	-	0,42	-	-	6	19	1,4
14	7,47	-	2,13	-	0,2	-	6	0,7
15	9,87	-	1	-	0,04	10	15	2,0
16	25	6,5	4,3	6,7	-	50	10	3,0
17	19,8	-	-	3,05	1,74	26	15	3,3
18	22,5	5	5	1,5	0,89	48	8	3,0
19	35,71	-	3,24	-	2,6	29	15	2,1
20	37,27	-	3,95	-	0,57	16	-	3,1
21	745,63	523,93	140	94,48	21,77	427	-	75,0
22	-	2281,53	-	140,8	73,35	1150	-	77,0

*Annual Work Unit – corresponds to the work performed by one person who is occupied on an agricultural holding on a full-time basis

Source: Own calculations based on the survey.

14.3 Results

Results of all tested scenarios show the importance of shelterbelts and likely reaction of surveyed farmers to the changes in agricultural policy. Impact of the shelterbelts on a cropping structure has been presented as a relative change of share of the cereals and share of the high profit cash crops (HPCC) in the cropping structure. The high profit cash crops consist of winter wheat, corn, sugar beets and rapeseed.

Additionally, the scenarios testing introduction of the "greening" of the new CAP two other indices has been used:

- Shannon index [Shannon 1948], to measure impact on biodiversity;

- and minimal share of the Ecological Focus Area [EFA] as required in the new CAP regulations.

Changes in economic performance of surveyed farms in the scenarios considered have been measured with the farm income and dependence on the EU payments.

Results show that in the policy scenarios that assume removing shelterbelts the share of the most profitable cash crops (HPCC) decreases by 4 percentage points [Figure 1]. This is a consequence of reduced yields of sugar beets, rapeseed and winter wheat due to a lack of wind protection. To some extent these crops are replaced by less vulnerable to wind erosion spring cereals.

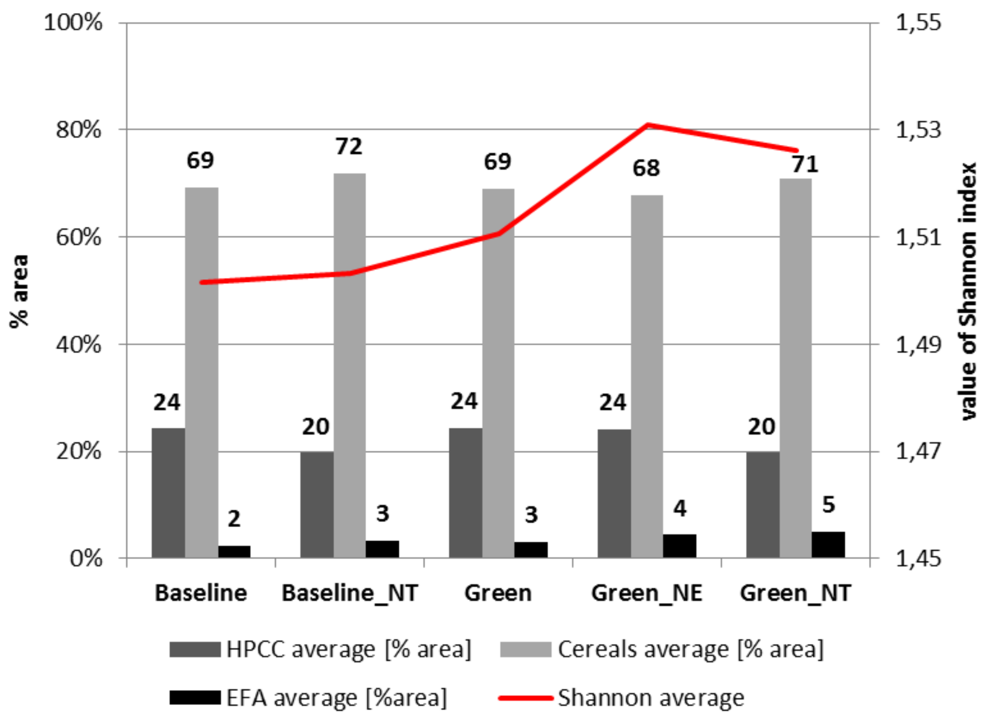

Figure 1 Changes of cropping structure under considered scenarios

Source: Own calculations.

It should be pointed out that, although all farms at the initial state fulfilled crop diversity criteria, introduction of all requirements of CAP greening (Green scenarios) resulted in an increase of crop diversity measured by the Shannon index. Main reason for that is assigning of some of the arable land to areas recognized as EFA (fallow land, protein crops, green cover, herbaceous forage crops. This increase is slightly lower in GREEN NT scenario then in Green NE scenario, due to the reduction in number of HPCC grown, It should be also noticed that, recognizing landscape elements (like eg. shelterbelts or single trees, ponds and forests edges) as the equivalents of EFA in Green scenario, allows for fulfilling the CAP requirements, by assigning only 3% of agricultural land to EFA. In the Green NE scenario the required minimum of EFA share is on the level of 4,4% on average in the sample of farms. This is below the 5% threshold for EFAs share in arable land. This is because farms below 15 ha (six in the sample of 22) are excluded from this requirement [Annex, Table 1].

Conditions of policy scenarios considered influence strongly economic performance of farms [Figure 2].

Farm incomes in both Green scenarios that maintain shelterbelts (Green, Green NE) are the highest in all groups of farms of different size.

The decrease of farm income due to removal of shelterbelts is correlated with the share of HPCC in arable land [Annex, Table 1]. Even if the cropping area is increased by the area released due to removal of shelterbelts, it does not compensate losses in the revenues caused by the assumed decrease of yields of HPCCs, due to lack of protection against winds.

Removing shelterbelts has the most noticeable impact on farm incomes in the largest holdings (over 100 ha). Without shelterbelts the average net farm income decreases by over 40% in this group of farms. This explains why in the interviews small farmers (usually having less HPCC) were not keen to establish new shelterbelts on their land, even with the public support, whilst farmers from the largest farms invested their own resources to extend the system of shelterbelts on their agricultural land.

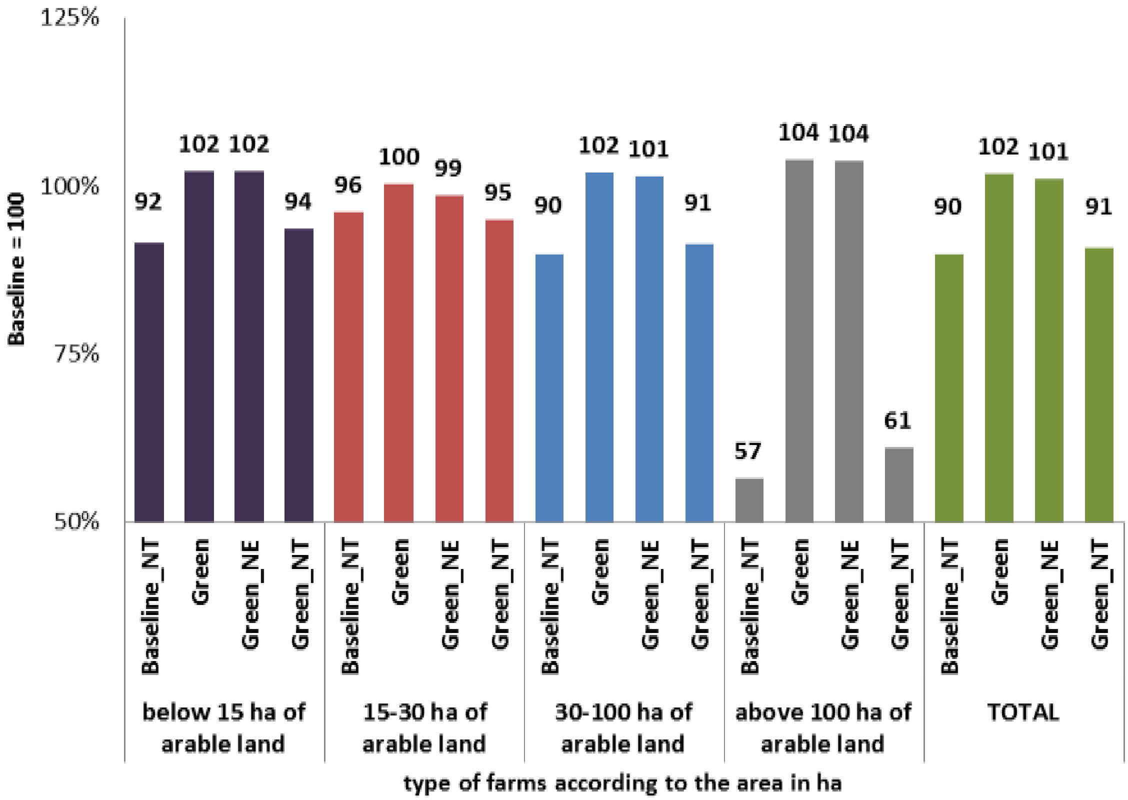

Figure 2: Changes in Net Farm Income per hectare (Baseline = 100 %)

Source: Own calculations.

Differences in the level of farm incomes between considered scenarios correspond with the level of the public support leading higher dependency of farm incomes on the EU payments [Figure 3].

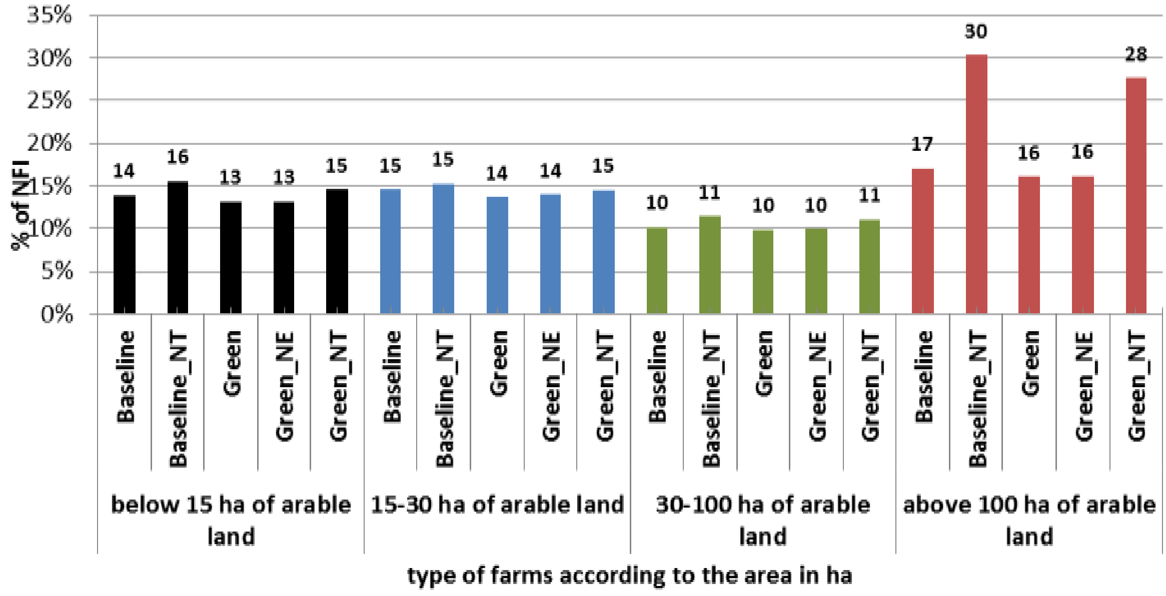

Figure 3: Share of Area Payments in Net Farm Income

Source: Own calculations.

The share of direct payments in the Net Farm Income is slightly depending on the area of arable land on the farm. However, the highest dependency on the public support could be noticed in a group of farms over 100 hectares of arable land.

The share of direct payments in an agricultural income is becoming the most important in scenarios that assume removal of shelterbelts. Arable land unprotected against unfavourable climatic conditions eg. wind erosion, is less suitable for growing the most profitable crops. This leads to the loss in the crop revenues, which consequently increases direct payments importance as a support of the farm income.

Slight decrease of the direct payments rates considered in all green scenarios [Annex, table 2], in connection with the higher revenues due to an increase of prices, is resulting in lower dependence of farms on the public support.

14.4 Conclusions

Main conclusions from the study may be formulated as follows:

1. Shelterbelts, which are a unique and distinctive element of the landscape in the Chlapowski Landscape Park play an essential role in shaping natural conditions for farming in the Park area. Providing protection against wind erosion they allow to grow more profitable crops like sugar beets, oil-seed rape, corn, winter wheat. Without shelterbelts cropping structure in the case study area would be different, with domination of oats, rye, triticale with addition of potatoes and grassland. Thus, it can be stated, that maintaining shelterbelts creates specific landscape features and increases competitiveness of the region, having an impact on productivity and profitability of agricultural sector.

2. Introduction of greening has a low impact on both, farm incomes and production in the Park area, assuming preservation of shelterbelts. It should be noticed that recognition of landscape elements as an EFA equivalent leads to an increase of the net farm income. Thus it could be stated that importance of shelterbelts would be greater, if they were treated as an equivalent of the EFA.

3. CAP scenarios that assume removal of the shelterbelts show the strong negative influence on the level of Net Farm Incomes. Even relatively small decrease of the share of high profit cash crops in the cropping structure (due to reduction of wind-protection) could, have a strong negative influence on the economic performance of farms in the case study area.

Literature

- Bates CG (1911) Windbreaks: their influence and value. US Dept of Agric, Forest Services Bulletin 86 (Washington: Govt Printing Office).
- Böhm A., Zachariasz A. (2000) Architektura krajobrazu i sztuka ogrodowa- Landscape architecture and art of gardening, t. e-j, Ośrodek Ochrony Zabytkowego Krajobrazu, Warsaw.
- Britz, W. & Witzke, P. (2012) CAPRI model documentation 2012. Internet resource, available at: http://www.capri-model.org/docs/capri_documentation.pdf
- Cantore N. (2013) The potential impact of a greener CAP on developing countries. Overseas Deveopment Institute, London.
- Caborn JM (1957) Shelterbelts and microclimate. Forestry Commission Bull No. 29, Edinburgh, UK.
- Chłapowski D. (1843) „O rolnictwie" przez Dezydera Chłapowskiego, Druk Walentego Stefańskiego, Poznan.
- Czekaj, S., Majewski, E. & Wąs, A. (2011) Koncepcja oszacowania skutków reform Wspólnej Polityki Rolnej Unii Europejskiej (WPR) w perspektywie budżetowej 2014-2020. In: Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych, IERiGŻ-PIB, Warsaw.
- EC 2010. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future. Brussels.
- EC 2011a. Legal proposals for the CAP after 2013 – Agriculture and rural development. European Commission Proposal of 12 October 2011, Brussels.
- EC 2011b. Common Agricultural Policy towards 2020 Impact Assessment, Annex 3: Direct payments. Commission Staff Working Paper SEC (2011) 1153 final/2, DG Agriculture and Rural Development, Brussels.
- EC 2013. REGULATION (EU) No 1307/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 december 2013 establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/2009, Official Journal of the European Union, December 2013, Brussels.
- Gadacz (2009) Historia filozofii XX wieku. Nurty. Neokantyzm, filozofia egzystencji, filozofia dialogu t.2, Wydawnictwo Znak, Cracow, p. 110.
- Hayes, T.; Davies, R.; Barker, A. (authors); and Chamberlain, D. (Ed.), (1978) A guide to the profitable uses of trees on the farm. Farmers Weekly Supplement, Dec. 22: ll,'13, 17.
- Helming, J.F.M. & Terluin, I.J. (2011) Scenarios for a CAP beyond 2013. Implications for EU27 agriculture and the cap budget. Werkdocument 267, LEI Wageningen.
- Helming J., Terluin I. & Janssen, S. (2011) Greening the Common Agricultural Policy: impacts on farmland biodiversity on an EU scale. PBL Netherlands Environmental Assessment Agency, The Hague.

- Howitt R.E. (1995) Positive Mathematical Programming. American Journal of Agricultural Economics, 77(2), s. 329-342.
- Johnson Hayley, Brandle James (2003) Shelterbelt design, Landcare Notes, State of Victoria, Department of Sustainability and Environment.
- Kamiński Z.J. (2008) Współczesne planowanie wsi w Polsce. Zagadnienia ruralisty, Wydawnictwo Politechniki Śląskiej, Gliwice.
- Kort J. (1988) Benefits of windbreaks to field and forage crops. Agriculture, Ecosystems and Environment 22–23: 165–190.
- Lewicka M. (2012) Psychologia miejsca. Wydawnictwo Naukowe „Scholar", Warsaw.
- Matthews A. (2011) Post-2013 EU Common Agricultural Policy, Trade and Development. A Review of Legislative Proposals. International Centre for Programme on Agricultural Trade and Sustainable Development (ICTSD), Issue Paper 39:17.
- Matthews A. (2012) Environmental Public Goods in the New CAP: Impact of Greening Proposals and Possible Alternatives. European Parliament, Brussels.
- Matthews A. (2013) Greening CAP Payments. A Missed Opportunity? The Institute of International and European Affairs, Ireland.
- Nageli W. (1941) Ueber dieBedeuting von Windschutzstreifen zum Schutze landwirtschaftlicher Kulturen. Schweiz Z Forstw 11: 223–276.
- Nageli W. (1942) Importance des rideaux-abris contre le vent pour la protection des culturesagricoles. L Forsuisse 93: 1–20.
- Rackham, O. (1977) Hedgerow trees: their history, conservation and renewal. Arboricultural J., 3(3): 169-77.
- Shannon, C. E. (1948) A mathematical theory of communication. The Bell System Technical Journal, 27, s.379–423 i s.623–656.
- Van Zeijts, H., Overmars, K., Van der Bilt, W., Schulp, N., Notenboom, J., Westhoek, H., Helming J., Terluin I. & Janssen, S. (2011) Greening the Common Agricultural Policy: impacts on farmland biodiversity on an EU scale. PBL Netherlands Environmental Assessment Agency, The Hague.
- Wąs, A. (ed.) (2012) Impact of "Greening" of Common Agricultural Policy on Polish Farms. IERiGZ, Warsaw.
- Wąs, A. (ed.) (2013) Impact of the reformed direct payments on the Polish Farms; nr 82.1; IERiGŻ-PIB, Warsaw.
- Westhoek, H., Van Zeijts, H., Witmer, M., Van den Berg, M., Overmars, K., Van der Esch, S. & Van der Bilt, W. (2012) Greening the CAP. An analysis of the effects of the European Commission's proposals for the Common Agricultural Policy 2014-2020. PBL Netherlands Environmental Assessment Agency.
- Wolski P. (2011) Szkic do polityki kształtowania krajobrazu [w:] Ochrona krajobrazu przyrodniczego i kulturowego a rozwój cywilizacyjny. Twórczość, dziedzictwo kulturowe i przyrodnicze bogactwem Polski. Biuletyn Forum Debaty Publicznej, nr 3, kwiecień 2011. Kancelaria Prezydenta Rzeczpospolitej Polskiej, Warsaw, p.15-22 i 57-58.
- Wolski P., Kopczyński K. (2012) Human condition and landscape condition – contribution to landscape management policy [In:] Dymitryszyn I., M. Kaczyńska M., Maksymiuk G.(ed.) Peer Reviewed Proceedings of ECLAS 2012 Conference The Power of Landscape at Warsaw University of Life Sciences – SGGW, Warsaw, p.414.

Annex, Table 1 Changes of cropping structure in selected scenarios with regards of farm area

Scenarios	Total area	Cows	Cattle LU	Pig LU	Total LU	Shannon Index	HPCC	Cereals [% arable land]	EFA
Farms below 15 ha of arable land (6 farms)									
Baseline	11,5	11,8	6,9	12,4	18,8	-1,37	17,1	81,7	0,5
Baseline_NT	11,6	11,8	6,9	12,4	18,8	-1,36	13,9	84,4	0,7
Green	11,5	11,8	6,9	12,4	18,8	-1,37	17,4	81,9	0,5
Green_NE	11,5	11,8	6,9	12,4	18,8	-1,37	17,4	81,9	0,5
Green_NT	11,6	11,8	6,9	12,4	18,8	-1,36	14,2	84,7	0,7
Farms between 15 and 30 ha of arable land (6 farms)									
Baseline	20,7	8,1	12,4	22,0	32,9	-1,38	6,4	84,3	0,5
Baseline_NT	21,0	8,1	12,2	22,1	32,9	-1,38	4,6	84,2	0,8
Green	20,7	8,0	9,8	22,1	32,9	-1,41	6,3	83,3	2,0
Green_NE	20,7	8,0	9,8	22,1	32,9	-1,47	6,2	80,5	5,0
Green_NT	21,0	8,0	9,6	22,2	32,9	-1,45	4,4	80,9	5,0
Farms between 30 and 100 ha of arable land (8 farms)									
Baseline	41,5	27,9	12,2	33,8	48,5	-1,64	31,0	52,9	5,1
Baseline_NT	42,7	26,7	11,8	36,0	48,3	-1,65	25,3	56,0	6,6
Green	41,5	27,9	12,2	33,8	48,5	-1,64	31,2	53,0	5,4
Green_NE	41,5	27,9	12,2	33,8	48,5	-1,66	30,8	51,9	6,7
Green_NT	42,7	26,6	11,9	35,8	48,3	-1,66	25,0	55,6	7,7
Farms above 100 ha of arable land (2 farms)									
Baseline	1969,4	647,7	141,2	-	788,9	-1,71	72,4	52,6	3,0
Baseline_NT	2004,3	647,7	141,2	-	788,9	-1,71	60,3	60,5	5,0
Green	1969,4	647,7	141,2	-	788,9	-1,71	72,2	52,1	4,7
Green_NE	1969,4	647,7	141,2	-	788,9	-1,71	72,1	52,0	5,0
Green_NT	2004,3	647,7	141,2	-	788,9	-1,71	61,1	61,6	6,1

Source: Own calculation.

Annex, Table 2 Changes of economic performance in selected scenarios with regards of farm area [Baseline = 100]

Scenarios	Total area	Net Farm Income	Crop production revenues PLN/ha	Total revenues per hectare	Payments per hectare	Net Farm Income per hectare
Farms below 15 ha of arable land (6 farms)						
Baseline_NT	101,3	91,2	95,5	97,6	100,5	91,6
Green	100	102,2	103,5	101,2	97,6	102,2
Green_NE	100	102,2	103,5	101,2	97,6	102,2
Green_NT	101,3	93,3	99,1	98,8	97,6	93,6
Farms between 15 and 30 ha of arable land (6 farms)						
Baseline_NT	101,6	97,2	94,9	97,4	100,2	96,2
Green	100	100,4	101,4	100,1	97,2	100,4
Green_NE	100	98,6	98,8	99,0	97,2	98,5
Green_NT	101,6	96,1	94,3	96,6	97,2	95,0
Farms between 30 and 100 ha of arable land (8 farms)						
Baseline_NT	102,9	92,2	86,1	91,5	100,7	89,9
Green	100	102,0	103,0	101,3	99,2	102,0
Green_NE	100	101,5	101,9	100,8	99,2	101,5
Green_NT	102,9	93,6	88,3	92,3	99,2	91,3
Farms above 100 ha of arable land (2 farms)						
Baseline_NT	101,8	57,4	72,8	81,7	100,5	56,6
Green	100,0	104,0	102,6	101,6	98,2	103,9
Green_NE	100,0	103,8	102,5	101,5	98,2	103,7
Green_NT	101,8	61,7	76,0	83,6	98,2	61,1
TOTAL (22 farms)						
Baseline_NT	101,8	63,4	88,8	93,8	100,5	89,7
Green	100,0	103,6	102,7	101,0	98,1	101,8
Green_NE	100,0	103,4	101,6	100,5	98,1	101,1
Green_NT	101,8	67,2	90,8	94,4	98,1	90,9

Source: Own calculation.

15 CSA7: Results of a survey of rose producers in Güneykent/Isparta

F. Handan GIRAY, Tufan BAL, M. Cagla ORMECI KART

15.1 Introduction

Rose oil (Rosa damascena mill.) which is known as Pink rose oil, Rose oil or Damascus rose beside the “Isparta rose” is one of the important agricultural products for Isparta. The Isparta rose is cultivated to obtain rose oil, which is the main raw material of perfume industry. The most important world rose oil producers are Bulgaria and Turkey. Rose oil is produced in Isparta in Turkey and Kazanlak region in Bulgaria. Both “Turkish Oil rose” and “Bulgarian Oil rose” are distilled from fresh rose oil flowers (Giray and Ormeci Kart, 2012).

Rose oil cultivation leads to an important commercial dynamism by covering all the agricultural activities such as the planting the gardens, harvesting and processes done for oil extraction, as well as it has a historical and cultural significance (Timur, A. N., 2011). 80 per cent of Turkey’s rose oil is produced in Isparta and the rest comes from the neighbourhood (Afyon, Denizli and Burdur provinces). Roughly 10 000 families deal with rose oil production and 8 700 families out of 10 000 live in Isparta (Anonymous, 2012).

Beside its direct effects on the socio-economic of its producers, rose oil farming has secondary effects on the region's economy, particularly in rural areas. First effect is on the rose oil processing industry which has been important traditionally and developed mostly as a primary sector for exporting row materials. Recently, economic activities associated with the rose oil production have developed in Isparta, as well, products ranged from cosmetics/perfumery to medical/aromatic and food. Second “secondary” effect of the rose oil farming is on rural tourism which relatively newer and less developed. Landscape in the rose oil production areas, especially during the harvesting session from mid-May to August attract people to visit rural areas and it effects the other sectors in public and private sectors.

15.2 Material and Method

This study has been carried out with 79 rose producers in Güneykent town in Isparta where typically represents views of rose producers in Turkey in 2013. Güneykent has 14.29 per cent of rose oil gardens and produces 24.16 per cent of total rose oil production of Isparta (Bilgin and Taskin, 2012).

15.3 Findings and Discussion

According to the results of the analysis of data collected through face to face surveys, 77 per cent of producers are male and average age is 56.4. Average education level was found very low 7 years which higher than the country average education level in rural areas.

51.3 per cent of cultivated area in 2013 allocated for rose production As rose farming is perennial activity, these rates should not expected to change from a year to another. Average size of farms was calculated 0.56 hectares (Table 1), which is relatively higher compare to several studies in the region. (İkiz, 2011; Giray and Ormeci Kart, 2012).

Table 1. Land use in the research area

Crop groups	Hectare
Rose	0.56
Fruits	0.12
Vegetables	0.00
Field crops	0.40
Total	1.09

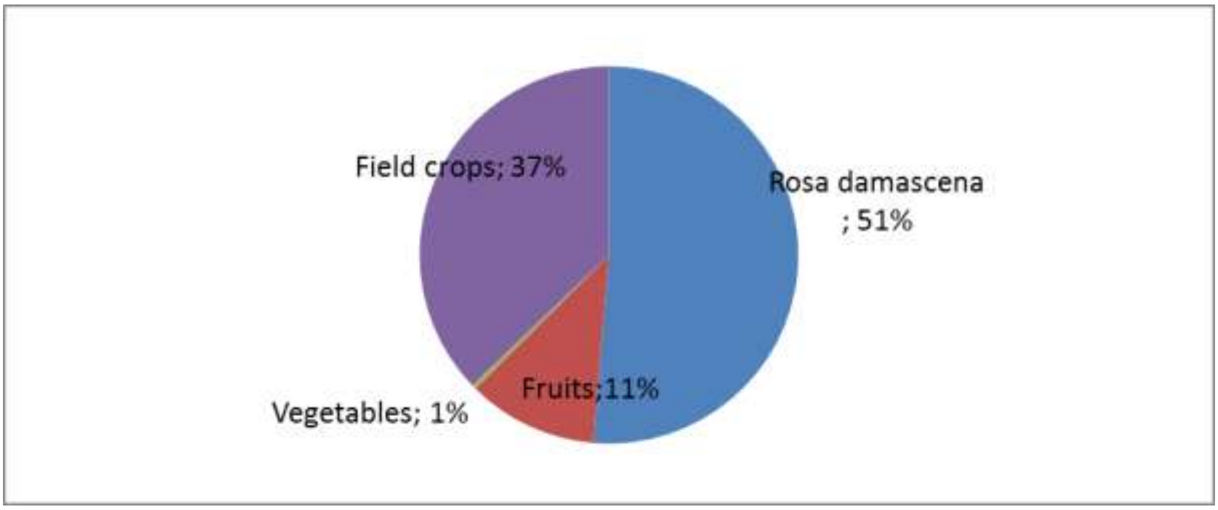

Figure 1. Crop Pattern in Guneykent

Almost half of the producers make their living only from rose production while 37.4 per cent of them have income also from non-agricultural activities and 13.4 per cent of them from other agricultural activities.

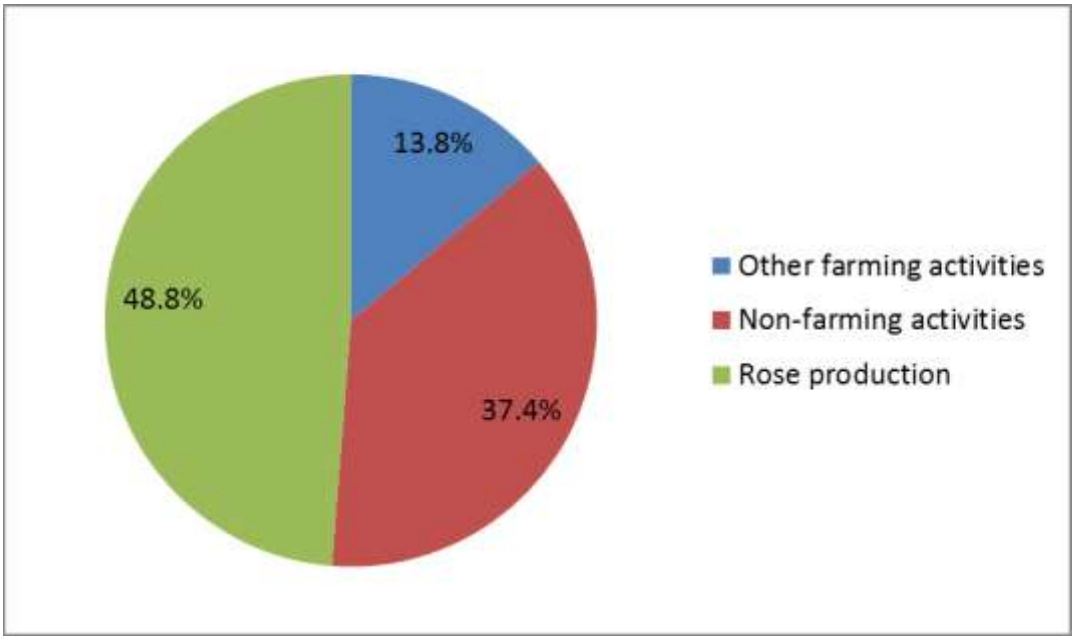

Figure 2. Income sources of the producers

Güneykent town has an important tourism potential due to its landscape attributes comes from rose gardens. However, as the other services for tourism has not been improved properly yet, it develops very slowly. 22.8 per cent of producers interviewed have planned to make an investment about rose tourism in the region. Types of investments plans of the producers were classified in three groups. i)establishment of a hotel, souvenir shop and other tourism services; ii) increase own rose production/ increase rose production area iii) build a rose oil processing plant. Whether they plan to invest or not, all producers and stakeholders think that rose tourism is promising for the future. According to 72 per cent of producers' opinions rose tourism contributes to the region. 36.1 per cent of rose producers have been stated that the most important activities for achieving these contributions are advertising and promotion. 21.3 per cent of rose producers expressed that new hotels, restaurants and cafes should be established in the region for increasing this contribution. 14.8 per cent of the rose producers who thinks the contribution of rose tourism to the region is important expressed that public supports are needed in this regard (Figure 3).

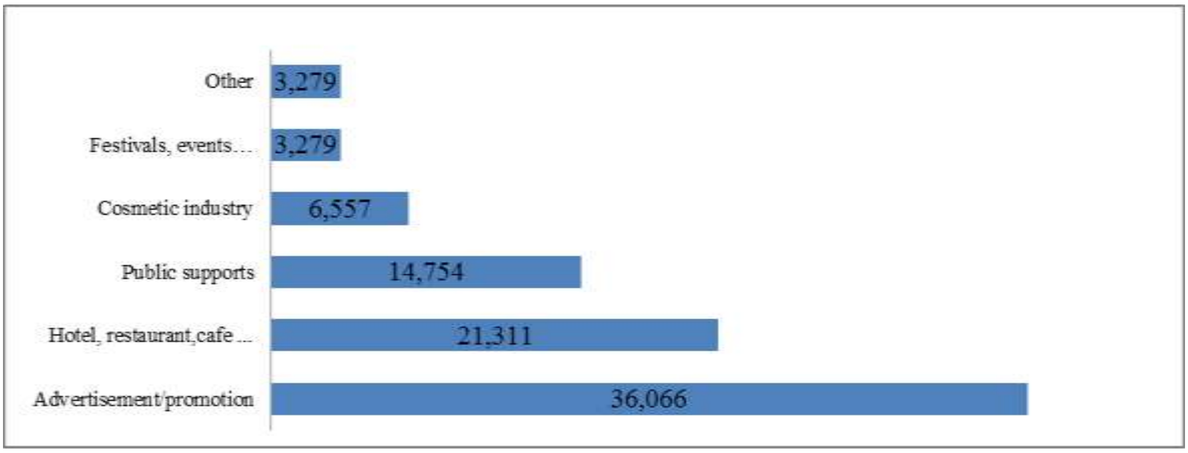

Figure 3. How can be activated rose tourism in Guneykent?

Results show that producers complained that *Rosa damascena* is considered in the groups of ornamental plants and they could not get receive any specific government support. Besides *Rosa damascene* should be considered in industrial crops or specific support, otherwise more than half of the producers think to quit rose production and this will cause loss of landscape attributes in the region (Figure 4).

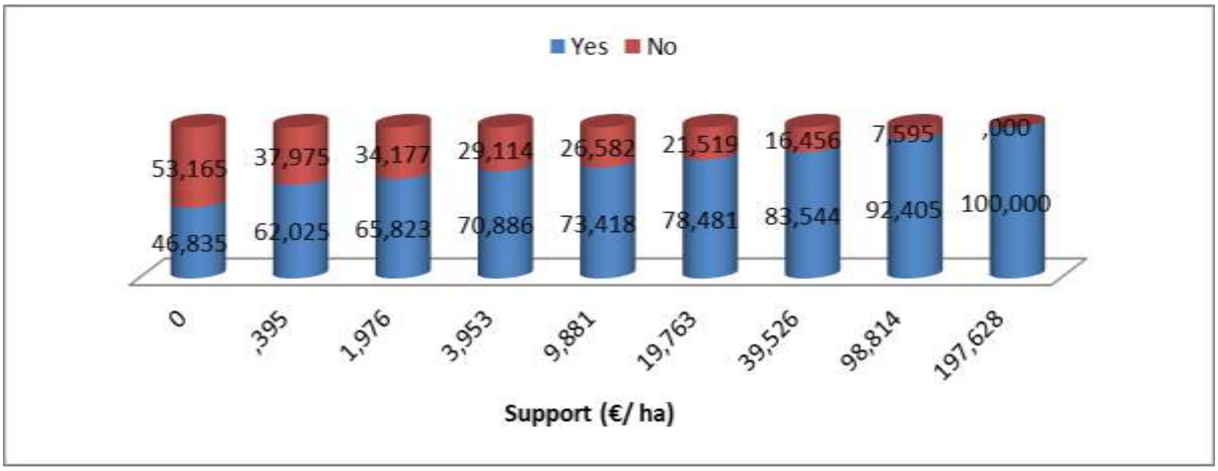

Figure 4. How much should be the support for rose farming?

72.2 per cent of the producers think that rose farming has positive effects on landscape due to increasing tourism activities (24.6%); creating employment and income source (75.4%); Obtaining exchange contribution (7.1%); utilize rain fed fields (7.1%).

Almost all producers stated that rose farming has no negative effect on landscape value. Those who states that rose farming has a negative effect on landscape (6.3%) think that rose farming decrease in diversity of landscape attributes comparing past because as it relatively easier than other agricultural activities and promising for new incomes through tourism and industry, other farming activities such as cattle breeding and F&V production reduce their importance in the region.

Although most of the producers think that rose tourism makes contribution to the region is important, apparently farmers' awareness of landscape value and its contribution to the region is not high as there is no any further intention and/or action more than continuing traditionally by farmers. Related activities at municipal level in last year help to attract people to join rose tours and visit Guneykent.

According to surveys from processing companies, some findings can be summarized as follow;

- Half of rose companies has technology transfer and growing potential.
- There is no cooperation on innovation activities.
- Since share of local sales of rose oil is very low, companies are focus on export.
- Level of advisory services was found very low.
- Communication frequency with local producers were found very high.
- ¾ of companies needs financial supports from bank or development agencies.
- Half of companies has positive approaches to landscape management and rural tourism in the region.
- All of companies agree that rose farming has high contribution to region in terms of employment and income.
- Needs of human resources and knowledge transfer from university is obvious.
- Only half of company managers think that rose tourism would contribute to region
    - For YES, rose museum and spa hotels
    - For NO, rose tourism has limited potential for region
- New investments plans were found very low.

15.4 Conclusion

In order to prevent the leaving of rose farming of the producers *Rosa damascene* should be considered in industrial crops or receive state support. This will encourage the producers not only to stay in rose farming but also invest in rose garden and associated activities; these will help to keep of landscape attributes in the region.

The concept of landscape is not so clear in the minds of rose producers. Increases in the level of the income and awareness of the rose producers will create a positive effect on rose tourism practices in the region.

As a local product and a part of cultural heritage Isparta rose has already known. However, diversification of its products and using area is not known enough. Its contribution to local economy should be increased through keeping value added in Isparta. This needs to create industry (e.g. cosmetics, aromatherapy) which demand rose oil and the other rose products and export more processed products than raw material and increase the share of first producers from the created value added.

References

Bilginturan, S., Taskin, H., 2012. "Oil Rose Farming in Guneykent 2001–2011", Her Yonuyle Gul Sempozyumu, 7-9 June 2012, Isparta.

Giray, F. H. , Ormeci Kart, M. C., 2012. Economics of Rosa damascena in Isparta, Turkey. Bulg. J. Agric. Sci., 18: 658-667.

İkiz, M., 2011. Comparative Economic Analysis of Organic and Conventional Oil Rose (Rosa Damascena) Production in the Lakes Region, M.Sc. Thesis, Suleyman Demirel University Graduate School of Natural and Applied Sciences Department of Agricultural Economics.

Temurçin, K. 2004. Isparta İli Ekonomik Coğrafyası. Ankara Üniversitesi Sosyal Bilimler Enstitüsü, Coğrafya

Tüyer, S., Delikanlı, M., Karagönen, İ. 2012. ISPARTA ÇEVRE DURUM RAPORU 2011

Timor, A.N., 2011. World Production Oil Rose and Rose Oil, e-Journal of New World Sciences Academy, 6 (2):93-110.

http://www.ispartalilardernegi.org/?pnum=35&pt=G%C3%96NEN

16 CSA8: Results of a survey of vine growing holdings in the Pazardjik district

16.1 Farm structure and diversification

- *Farm type*

The contribution of vine growing holdings to the landscape composition is estimated by own conducted survey of 48 entities in Pazardjik district. Major share ¾ of surveyed holdings is sole traders, which are small sized family farms. Another part is cooperatives and corporate entities – ¼, they have large size of production and can benefit by economy of scale. The structure of holdings represented by their legal status is adequate to the structure of whole branch. In such way, the survey can pretend that it has a representative character.

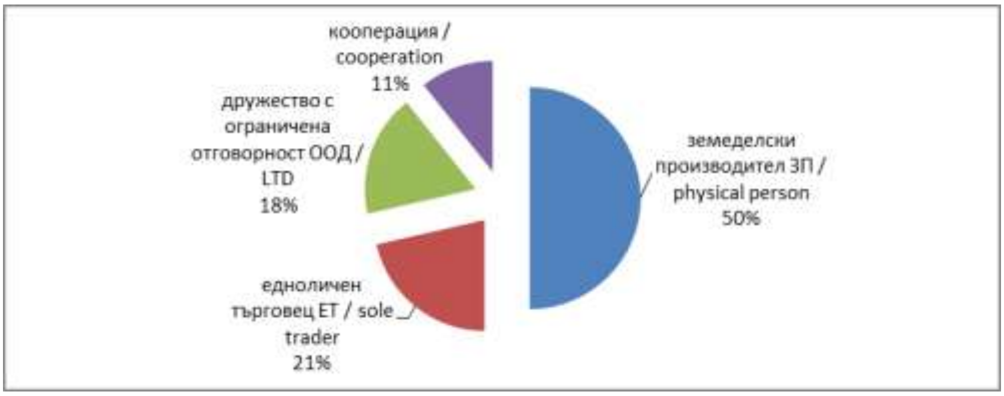

Figure 1: Structure of vine growing holdings according to their legal status

The size of vineyards has significant variation into vine growing holdings. The small sized family holdings managed vineyards, which cover approximately 2 ha. Cooperatives and corporate entities, which have ability to invest much more in production than family holdings, managed 200 ha vineyards.

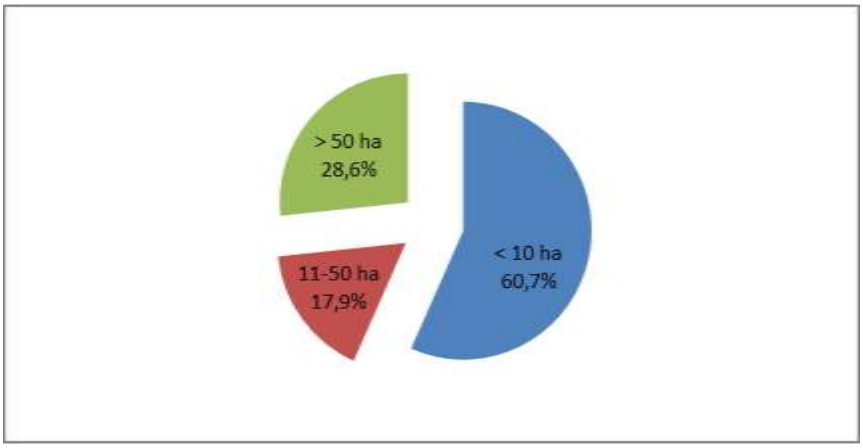

Figure 2: Structure of the vine growing holdings according to the size of managed vineyards

The family holdings have more diversified production than others do. Almost half of them prioritize grape production and their crop rotation consists only of two different crops. Often family holdings diversified their agricultural production by using crop rotation of cereals, table grape and fruits. The choice of crops is based on soil and climate condition of region where the holding is located and the requirements of local market.

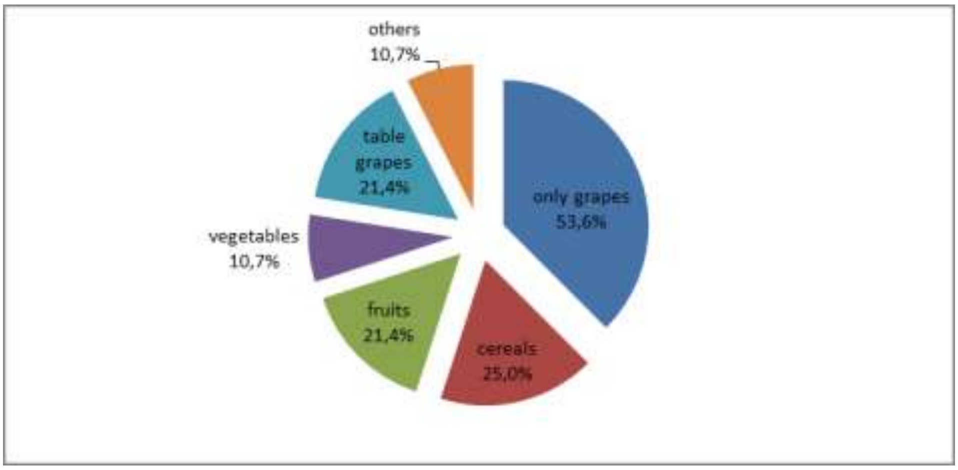

Figure 3: Diversification of production across vine growing holdings

- *Farm activities*

The income of vine growing holdings is formed mainly by agriculture activity. Only 22% of holdings have formed income by non-agriculture activities. Main non-agriculture activities of vine growing holdings are services, trading and wine producing. Wine making is common non-agricultural activity of cooperatives and corporate entities. The holders of family farms prefer non-agricultural activities like trading and services. Main branch of family holdings are agriculture, which form the largest share of income during the year.

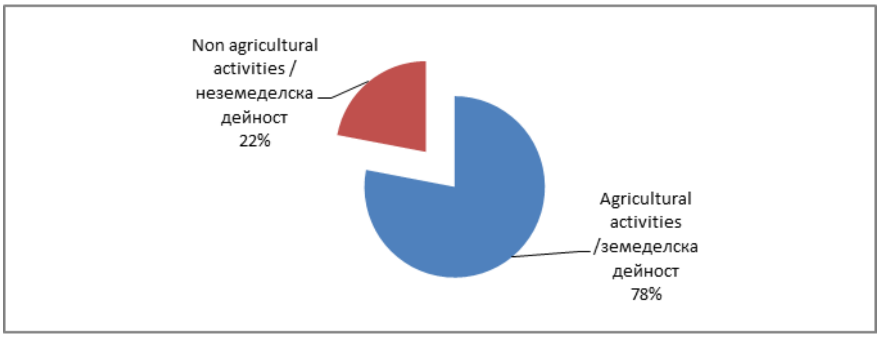

Figure 4: Source of income of the vine growing holdings

The age structure of the vineyards, which are located in surveyed region, is balanced. With biggest share (46%) are vineyards under age of 5 to 10 years, followed by vineyards under age of 11 to 20 years (35%). There is a weak investment activity in creation of new vineyards, only 3% of area under vines is under 4 years.

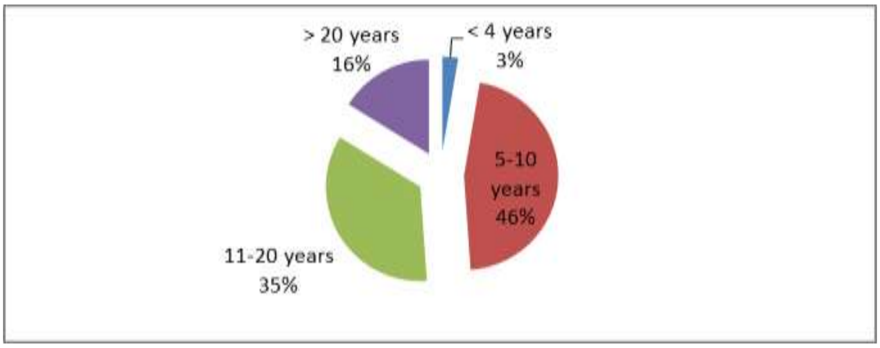

Figure 5: Age structure of vineyards

The sort mixture of vineyards consists of three sorts of vines. There is preference of red grape varieties, the most common are Merlot, Cabernet Sauvignon & Merlot, Pamid. From white varieties the largest areas are occupied by Muscat. The density of planting is 3000-3300 vines per hectare for new farms are typical and intensive plantations with about 5,000 vines per hectare. Yields varied greatly depending on the age of the vineyard, but also on the purpose of the production. Young vines intended for the production of quality wines have an average yield of 5 t/ha, which is artificially limited, the remaining vineyards achieve yield 8-9 t/ha .

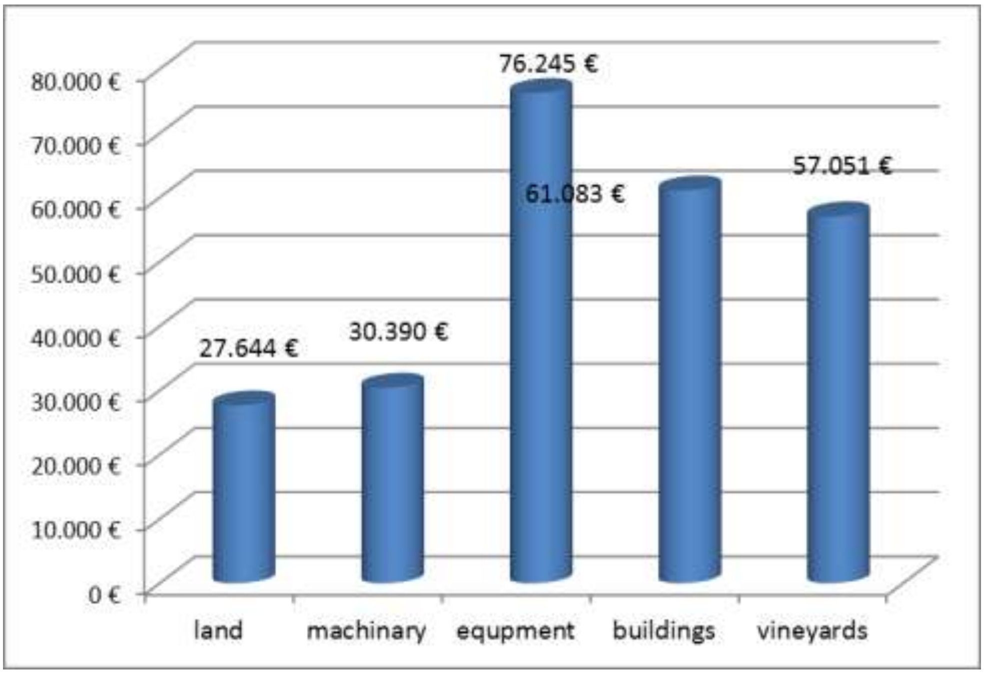

Figure 6: Assets of the vine growing holdings

- *Marketing*

The vine growing holdings make direct sales of grape but in condition of low market price they prefer to processing the grape into wine. Mainly the produced wine is consumed in holding and minor quantities are for direct sales. The vine growing holdings which integrates grape growing with wine making ensure their manufacturing capacity with own grape and rarely buy additional quantities grapes on local market. Major part of vine growing holdings applies traditional techniques in wine making only a few are interested in certification of wine. The vine growing is capital resource branch, which determine higher risk in process of taking investment decision than other branches of agriculture. It can be expected that vine-growing holdings are highly active in using consulting services. The survey shows that these entities do not prefer consulting very often. Only 22% of holdings claim that they use consulting very often and they rely on them. The profile of these entities is – family small sized holdings with high rate of diversification in agricultural activities which managed 2 ha of vineyards under age of 10 years.

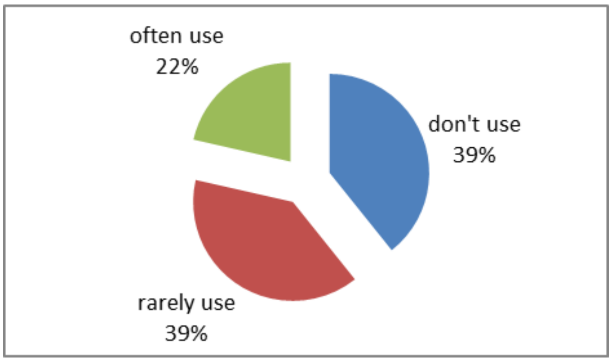

Figure 7: Preferences to the consulting services across different vine growing holdings

Business activities like technical and technological ensuring of production and marketing are difficult task of small sized family farms. Although the fact more of them do not prefer to cooperate and to be part of larger structure such as cooperatives for marketing and technology support – 86% of holders said no to the cooperation in branch. They prefer to take the whole risk in operation of their holdings motivated by freedom of taking managing decisions.

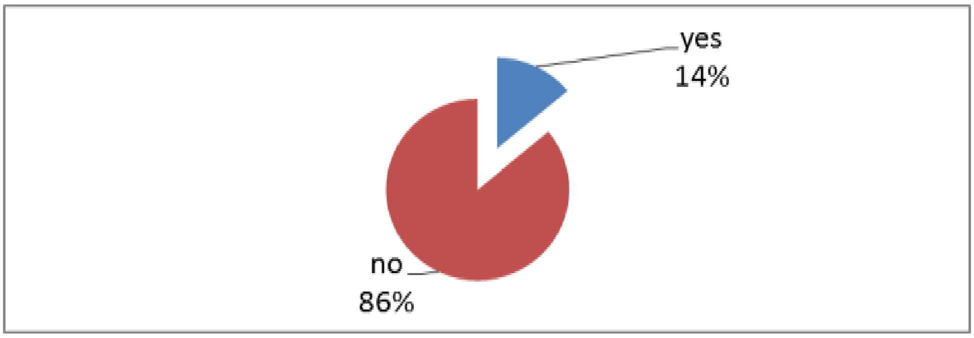

Figure 8: Preferences for cooperation between vine growing holdings

16.2 Landscape and CAP

- *CAP*

All surveyed entities claim that their activities are been financed by pillar 2 of CAP. Some of them are financed by more than one measure. With high interest is measure 121, which covers investments in technical equipment. Other popular measure is 311 and 123. Mainly we can state that measures in axis 1 are more preferred than measures in pillar 2 across vine growing holdings. Cooperatives and corporate entities have higher investment activity than family farms and they use as financial source mainly measures in axis 1. These entities have two and more project financed by different measures.

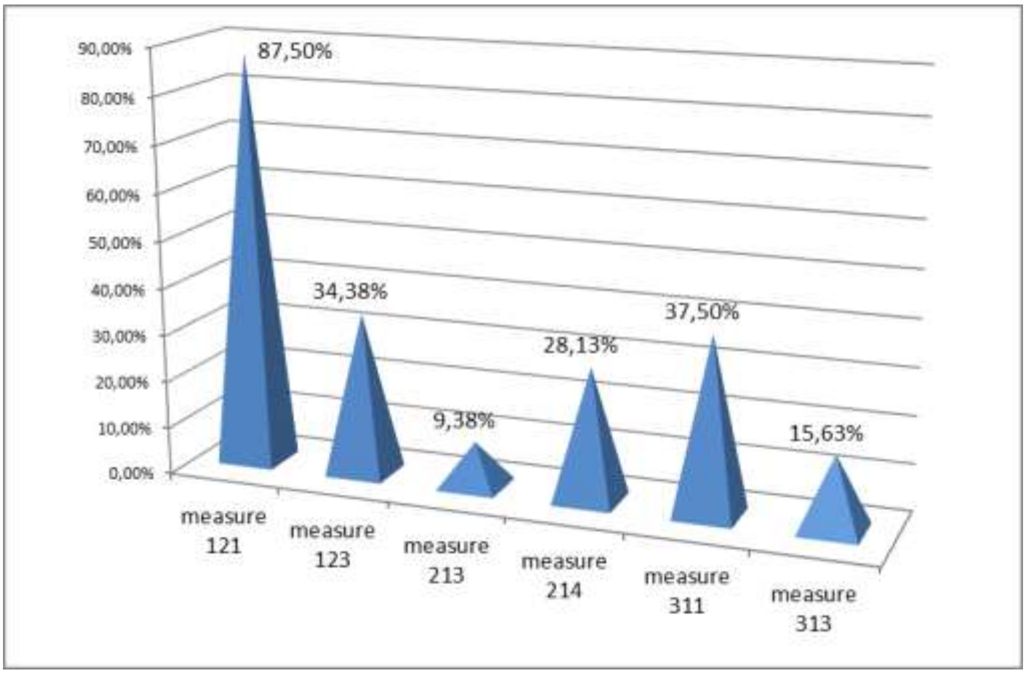

Figure 9: Share of farmers funded by each measure

The emerge of second order effects is measured in applying of all three axis of the second pillar of CAP. There is a big contribution of measures of axis 3, which is emerged as diversification of activities and conservation of local traditions and customs. Second order effects are emerged by applying measures under axis 1, which improve competitive ability of holdings in sector. All vine growers have opinion that CAP has positive influence on their activity. In spite of that, a small group of them claims that attractiveness of business is higher for their successors under CAP influence. All measures under axis 2 forms a weak second order effects only in spatial areas of region. Such effects are emerged in management of low productivity land, preservation of biodiversity and recreation of degraded land. It is necessary to explain that the type of holding plays major role in contribution of second order effects.

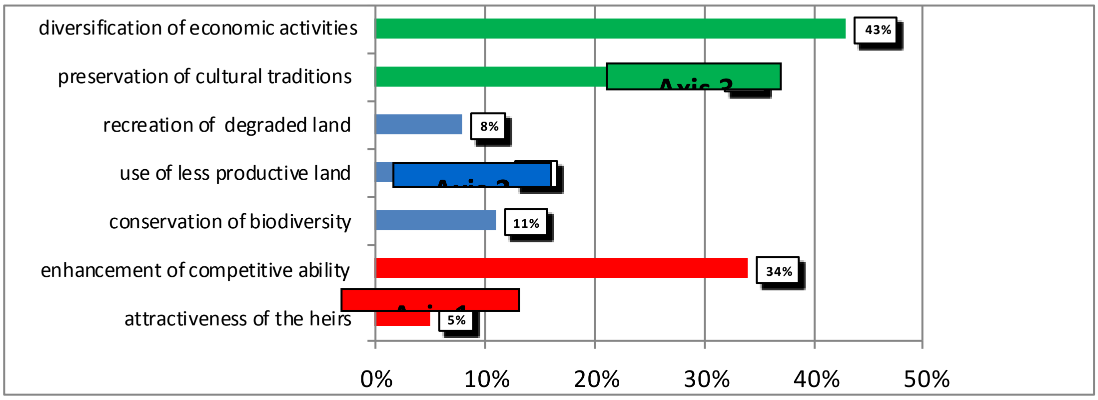

Figure 10: Second order effects of each Axis of CAP

The holding's activity on CAP measures depends on the constraints under which they are facing in application and implementation of projects. Fig. 11 shows that five of the seven restrictions occur everywhere and they are assessed as very strong. It is noteworthy that the problem with the market experiencing almost all vine growers, no differences in terms of their profile. Others, severely impact are difficult to project management, institutional constraints, bureaucracy obstacles and difficulties in securing co-financing of the projects. The remaining two constraints - lack of experience and access to credit also exhibit a high degree and may determine that hinder vine growers. Only entities with a closed cycle of production said that they did not experience difficulties or they are acceptable levels of market access to loans and financing as well as project management.

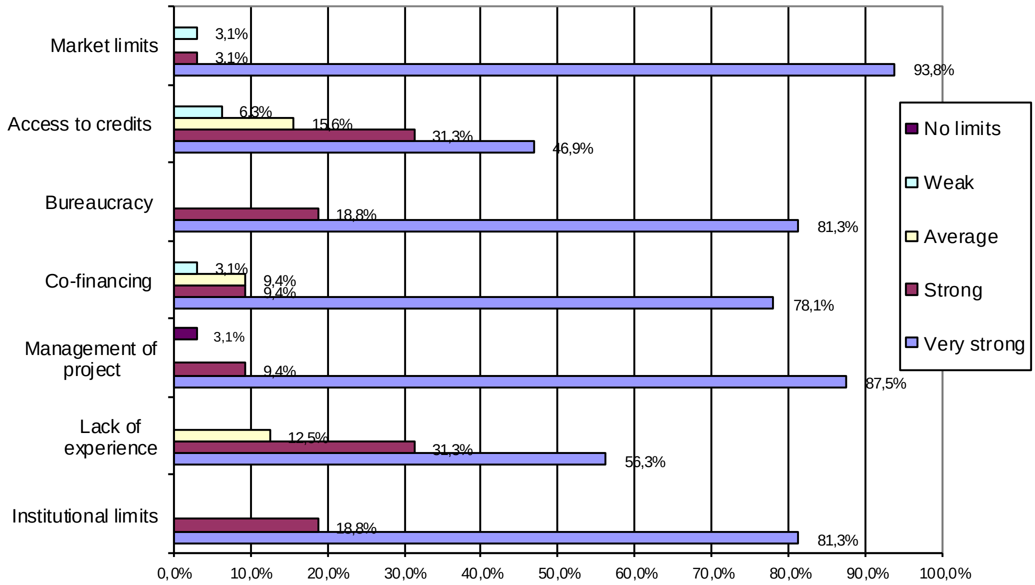

Figure 11: Constraints in development and implementation of projects funded by pillar 2

- *Second order effect*

Contribution of the vine-growing holding to the creation of final product (wine tourism) is evaluated mainly in three aspects - diversification of the landscape, closeness to the market and supply of raw materials for wine making.

Vine growing holdings create an attractive landscape that adds value to final product. Pazardzhik is among the areas in Bulgaria that have high potential for development of tourism. The presence of a thriving viticulture in this region can stimulate tourism. In the region already, operate three entities, which offer tourist product focusing on viticulture and wine. Recently two new ones have been established. The sustainable development of these entities is ensured by presence of vineyards in landscape composition.

Closeness to the market is another important feature of the vine growing holdings in the region. The most of them claim that they have difficulties with the sales of grape. The presence of several renowned wineries gives them an opportunity to increase sales. Vine growing holdings are main suppliers of grape to local wineries. This defines them as a major contributor in producing of wines with designation of origin. Local vine growers combine the appropriate soil and climate conditions of the region with production conditions in their holdings and produce grape with high quality. The area is particularly suited to red varieties such as the contribution of the winegrowers of reputation and preference of the red wines of the region is undeniable.

Although viticulture in the region is widespread and well developed, only a small group of vine growing holdings process grape into wine. The main reasons are institutional constraints and difficulties in financing such projects. They are crucial to small-sized vine growing holdings.

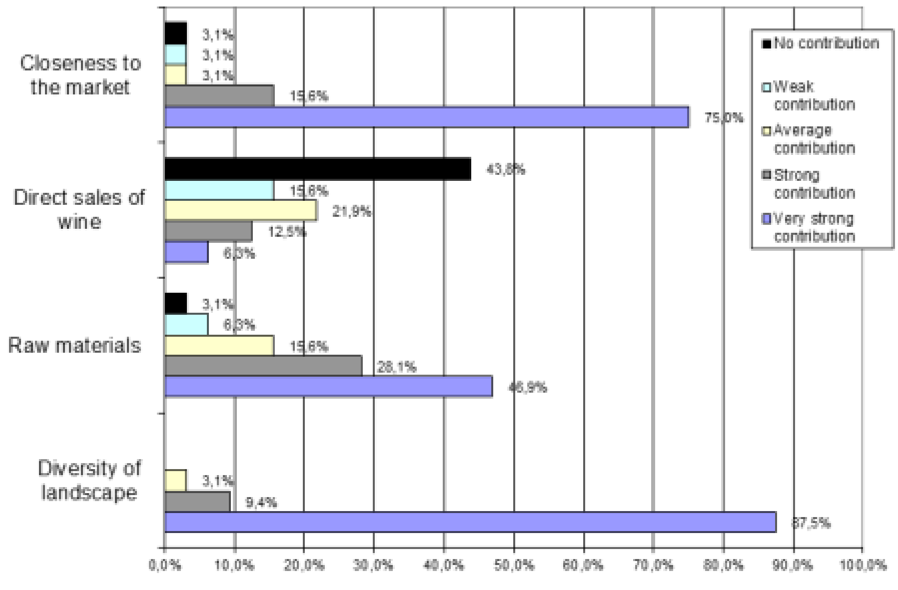

Figure 12: How do you evaluate your contribution to the creation of the final product (wine tourism)

In Table 1 are shown the results of the audit of statistical hypotheses of relationship between the main characteristics of the holding and indicators for their business - financing under Pillar 2 of the CAP, implementation of secondary effects, restrictions apply under pillar 2 of the CAP and contribution to the creation of the final product (wine tourism).

The analysis found a correlation between the size of the vineyards, the use of consultants and the size of the assets of the economy and finances their holdings of Pillar 2 of the CAP. Large-sized vine growing holdings rely on consulting services and having more assets than small-sized farms successfully apply and implement projects under Pillar 2 of the CAP.

The secondary effects are determined by four factors - legal status of entity, diversification of production, the size of the vineyards and assets. Family holdings form effects on axis 2 and 3. The corporate and cooperative entities prefer axis 1. Farms with a higher degree of diversification are key contributors to the effects of Axis 2, farms with large-sized vineyards produce effects on axis 1. The size of their assets and holdings form different secondary effects, such as a larger amount of assets effects are axes 1 and 3. Farms with smaller sized assets create effects on axis 2.

The legal status of entity and size of managed assets define restrictions on the application and implementation of projects financed by Pillar 2. Holdings, which are corporate entities, and these holdings that manage large assets have relatively less restrictions on the application and implementation of projects financed by Pillar 2.

The holding's contribution to the creation of the final product is determined by three factors – diversification of activity, size of the vineyards and size of managed assets. Holdings with a higher degree of diversification are key contributors to diversify of the landscape. Holdings with lower degree of diversification contribute to supply of raw materials and their contribution to the image of local products is clearly identified. There is correlation between managed assets of the holdings and the following two factors - closeness to the market and direct sales of wine. Holdings with more assets are located in convenient place for the consumers and they have shortened the marketing chain. Also holdings which managed small-sized assets is a key contributor in the provision of raw materials for the wine sector.

Table 1. Results of statistical hypothesis testing for correlation

	Funding on pillar 2	Second order effects	Constraints in development and implementation of projects funded by pillar 2	Contribution to the creation of the final product (wine tourism)
legal Status	no correlation	**correlation**	**correlation**	no correlation
diversification	no correlation	**correlation**	no correlation	**correlation**
Size of the vineyards	**correlation**	**correlation**	no correlation	**correlation**
Age of the vineyards	no correlation	no correlation	no correlation	no correlation
Use of consulting services	**correlation**	no correlation	no correlation	no correlation
Assets of the farm	**correlation**	**correlation**	**correlation**	**correlation**

16.3 Conclusions

Based on the study we drawn the following conclusions on the contribution of vine growing holdings in the creation of landscape composition:

- Holdings have the potential to create the landscape - the most part of them are specialized in the production of grapes and managed vineyards with balanced age and varietal structure;
- Axis 3 of the CAP has the strongest impact in creating secondary effects;
- The potential of Axis 2 of the CAP underutilized currently a producer for creating secondary effects;
- Managed assets are key drivers for the creation and utilization of landscape compositions.

APPENDIX

QUESTINARIES' FORMS

PROCESSORS

SDÜ ZiraatFakültesiTarımEkonomisiBölümü

GülİşleyenTesislerAnketi

GENEL BİLGİLER

Anket No:________ Anketör _______ Tarih__________

İşletmecininYaşı____________ Cinsiyeti: Erkek_____ Kadın_____

Kuruluşyılı:____________________ EğitimDurumu:__________

Yürütülendiğerfaaliyetler[20] (2012)

Tanımı	Toplam gelir içindeki payı %_______---
Gül çiçeği işleme faaliyetleri (gülyağı, gülsuyu...)	
Kiralama	
Turizm	
Ticaret	
Diğer	

İşletmeninbüyüklüğü

Göstergeler	Miktar	Değer
Varlıklar		000 TL
Gelirler		000 TL
Tam zamanlı çalışanlar	Kişi	
Kısmı zamanlı çalışanlar	Kişi	
İşlenen gül çiçeği	Ton	000 TL

Masraflar

Çeşit	Değer (000 TL)
Materyal	
Su	
Kimyasal madde (hegzan...)	
Gül çiçeği	
Ambalaj (kutu, şişe.....)	
Dış hizmetler	
Tanıtım	

[20] Örnekler: İşletmede işlem, turizm, elsanatları, arazi iyileştirmesi, toptan / Perakende, sözleşmeli hizmetler, diğer hizmetler, diğerleri; tarım dışından sağlananlar.

Taşıma	
İhracat	
Personel giderleri	
Daimi personel	
Geçici personel	
Amortisman	
Faiz oranları	
Yatırımlar	

Varlıklar

Varlıklar	Değer, TL	Son 3 yıldayapılanyatırımlarTL
Arazi		
Makine		
Araçgereç		
Binalar		
İnşaatlar		
Bağlıklar		

Yenilikler?

Çeşit		Evet	Hayır
Organizasyon	Yatayentegrasyon		
	Dikeyentegrasyon		
Pazarlama	Ürün		
	Dağıtım		
	Marka		
	Fiyat		
Teknoloji	Makinevearaç-gereç		
	Teknolojibilgisi		

Üretimvedağıtım

Dağıtımkanalları	Çeşit	Evet	Hayır
Direksatışlar	Turistler		
	Yereltüketiciler		
Ticaretegidensatışlar	Yerelhotellerverestoranlar		
	Perakendeciler		
	İlgilisanayiler		

Danışmahizmetlerininkullanımı

Danışmanlıkhizmetleri	Asla	Bazen	Sıklıkla	Çoğunlukla	Tamamengüvenmek
Pazarlama					
Yatırımlar					
Yasal					
Muhasabe					
İnsanKaynaklarıYönetimi					
Üretim					

Ağkurma

İşbirliğialanı	Asla	Bazen	Sıklıkla	Tamamengüvenmek
Yerelgıdalarveiçecekler				
Gülturizmigirişimleri				
Diğerleri				

İşlemeninyasalstatüsü

Yasalstatüler	Evet
Gerçekşahıs	
Bağımsıztüccar	
Sınırlıticarişirket	
Anonimşirket	
Kooperatif	
Diğer	

Yardımalıyormusunuz?Evet_____ Hayır_____

Son ürünlerinoluşturulmasınakatkınızınasıldeğerlendirirsiniz?(gülturizmi)

Öneriler	*Çokgüçlü*	*Güçlü*	*Ortalama*	*Zayıf*	*Sınırlarıyok*
Peyzajınçeşitlendirilmesi					
Ham maddeler					
Direksatışlar					
Pazarayakınlık					

Sizcegülüretimininsağladığıolumluveyaolumsuzekonomiketkilernelerdir?

(üretimmaliyetindeartış, doğrudanpazarlamayaolanaksağlaması, tarımdışıişlereeskiyegöredahakolayerişim, çevrekirliliği, turizminartmasıgibi....)

……

……

……

……

Gelecektegülturizmineaityapmayıdüşündüğünüz, planladığınızyeniliklervar mı? Varsaneler?
………

……
……
……

VISITORS/TOURISTS

SDÜ ZiraatFakültesiTarımEkonomisiBölümü

TuristAnketi

GENEL BİLGİLER

Anket No:________ Anketör _______ Tarih__________

İşletmecininYaşı____________ Cinsiyeti: Erkek_____ Kadın_____

EğitimDurumu:__________

Meslek:

Gülturizmiiçinkaçkeregeldi?

İlk defahangiyılgeldi?

Tekrargelmeyidüşünürmüsünüz?

Gülturizminineredenkimdenduydunuz?

Gülturizmiiçingeldiğinizde ne kadarparaharcadınız? (gülveürünlerineyönelik, hediyelikeşyaiçinkonaklama, yeme-içme dahil)...

Gül bahçeleriniziyaretekonaklamayaptınız mı evetiseneredekaldınız?

Çeşit	Evet
Otel	
Aile oteli	
Misafirhane	
Kulübe	
Pansiyon	
Villa	

Ne çeşitturistikaktivitelerilgilendiniz?:

Tür	Evet
Restoranlar	
Gurme	
Kaplıca	
Avcılık	
Balık tutma	
Diğer	

Sizcegülüretimininsağladığıolumluveyaolumsuzekonomiketkilernelerdir?

(üretimmaliyetindeartış, doğrudanpazarlamayaolanaksağlaması, tarımdışıişlereeskiyegöredahakolayerişim, çevrekirliliği, turizminartmasıgibi....)

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....

Sizcegülturizmingeliştirilmesiyaygınlaştırılmasıiçinneleryapılmalıdır?

....
....
....

PRODUCERS

SDÜ ZiraatFakültesiTarımEkonomisiBölümü

GülÜreticileriAnketi

GENEL BİLGİLER

Anket No:________ Anketör _______ Tarih__________

İşletmecininYaşı____________ Cinsiyeti: Erkek_____ Kadın_____

EğitimDurumu:__________

Meslek:

GÜL ÜRETİMİ İLE İLGİLİ SORULAR

1.İşletmenin diğerfaaliyetleri[21] (2012)

	Toplam gelirde % payı
Tarımsal Faaliyetler	
Tarım Dışı Faaliyetler	

2.İşletmenin üretimyapısı

Üretimİşlemleri	İşletmedeÜretilenBitkiselÜrünler	Alan, da	ÜretimMiktarı (kg)
1	Gülçiçeği		
2			
3			
4			
5			
	İşletmedeYetiştirilenHayvansalÜrünler	Adet	
1			
2			
3			
4			

3.Masraflar

Üretimİşlemleri	İşgücü		ÇekiGücü	
	Saat	Tutar	Saat	Tutar
I.TOPRAK HAZIRLIĞI + BAKIM				
a.Derinsürüm				
b.Çapalama				
c.Karıkaçma				
d.Dikim				
e.Cansuyu				

[21]Examples are: on-farm processing, tourism, craft work, property development, wholesaling / retailing, contracting services, other services, others; including those provided out of the farm.

f.Gübreleme		
g.İlaçlama		
II.HASAT-HARMAN		
a.Hasat		
b.Taşıma		

4.İşgücü

İşgücü		
	İşgücüsayısı	Kişibaşınaortalamayıllıkişgünü
Tam süreli		
Kısmi		

5.Varlıklar

Varlıklar	Değer (Bin TL)	Son 3 yıldayapılanyatırımlar
Arazi		
Makine		
Araç-Gereç		
Binalar		
İnşaat		

6.Üretim vedağıtım

GülÇiçeği	GülÇiçeğiSatışlar		GülYağı		
	Miktar (kg)	Gelirler (TL	Miktar	Gelirler	Öztüketim
2012					

7.Kaliteyönetimi

Üzümüretimteknolojisi		İşletmesertifikasyonu		Şarabınsertifikasyonu	
Biyolojiküretim	Gelenekselüretim	ISO	HACCP	Menşeadıolankalite şaraplar	Orijinalisimhakkıgarantiedilmişkalitelişarap

8.Danışmanlıkhizmetininkullanımı

Danışmanlıkhizmetleri	Asla	Bazen	Sıklıkla	Çoğunlukla	Completely rely on

9.İşbirliği veağkurma

İşbirliğialanı	Asla	Bazen	Sıklıkla	Completely rely on
Mekanizasyon				
Üretim				
Satışlar				

10.Devletyardımıalıyormusunuz? Evet_____ Hayır_____

11. Gülüretiminedevametmekiçin en az .... TL yardımalmalıyım (TEK seçenek mi E/H mı?)

	Evet	Hayır
5		
10		
25		
50		
100		
250		

11.Gelişmedekisorunlarvekısıtlar

	Çokgüçlü	Güçlü	Ortalama	Zayıf	Sınıryok
Kurumsalsorunlar					
Deneyimeksikliği					
Yardımcıfinansman					
Bürokrasi					
Krediyeulaşım					
Pazarsınırları					
Diğer					

18. Sizcegülüretimininsağladığıolumluveyaolumsuzekonomiketkilernelerdir?

(üretimmaliyetindeartış, doğrudanpazarlamayaolanaksağlaması, tarımdışıişlereeskiyegöredahakolayerişim, çevrekirliliği, turizminartmasıgibi....)

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....
....--------------------------

19.Sizcegülturizmingeliştirilmesiyaygınlaştırılmasıiçinneleryapılmalıdır?

....

....
....
....

20. Gelecektegülturizmineaityapmayıdüşündüğünüz, planladığınızyeniliklervar mı? Varsaneler?

....

………
………
…………………………………………………………………………………………

17 CSA8: Comparative analysis of wineries in the Pazardjik district

17.1 Case studies

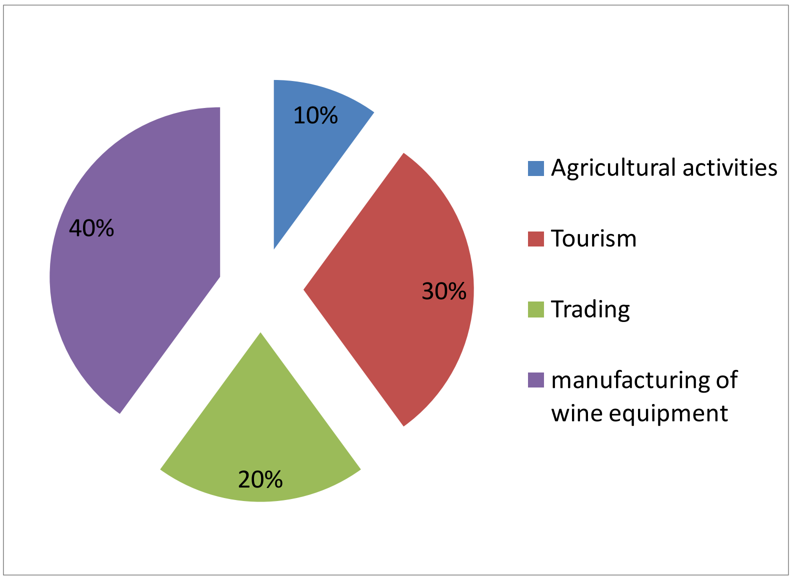
17.1.1 Case study 1: winery “Villa Ustina” LTD

Start of business 2008

Activities carried out on enterprise

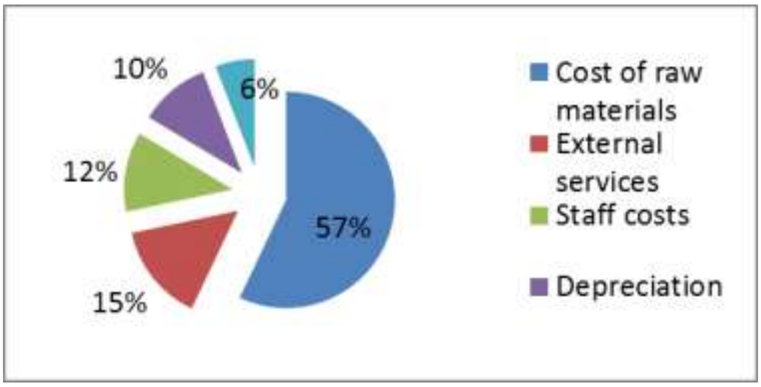
The main activities of the enterprise are manufacturing of wine equipment and wine tourism.

Figure 1: Activities structure



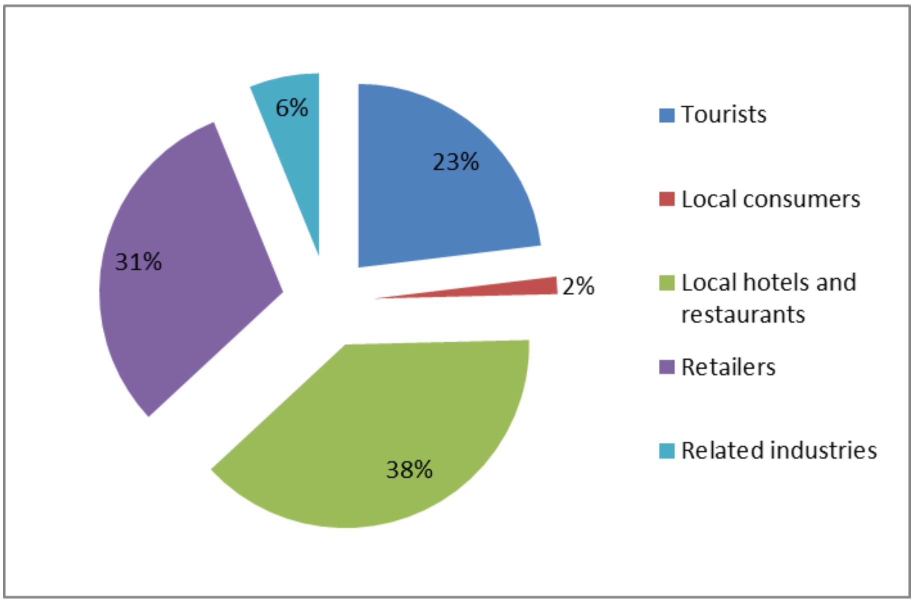
The winery is medium sized. It is assets are more than 5 000 000 euro. Average annual revenues are 650 000 euro. The number of full time employees is 10. There are also 10 part time employees, which are engaged during the harvesting period. The winery cultivate 50 ha vineyards under age of 10 years. The varieties are Merlo (30 ha) and Cabernet sauvignon (20 ha). The winery also buys additional quantities of grapes of native varieties Mavrud and Rubin.

Figure 2: Structure of expenditures



The winery applies organizational innovation such as horizontal and vertical integration. They also apply technological innovations such as new equipment and machinery.

Figure 3: Share of distribution chains



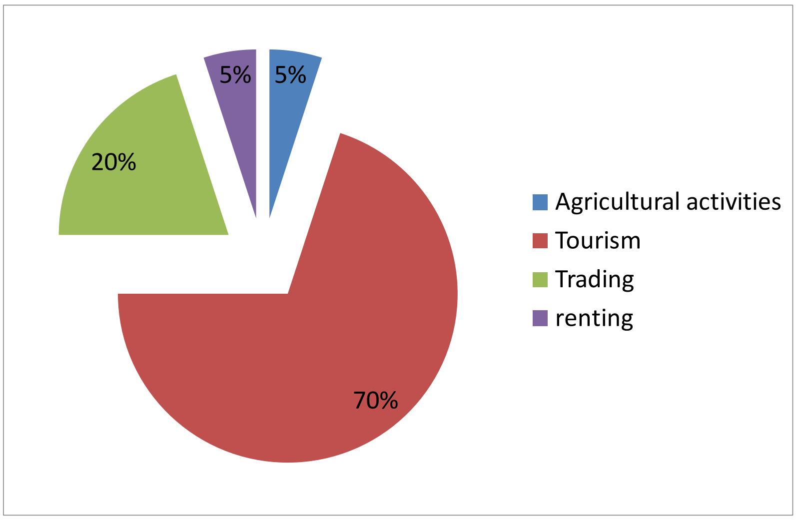
17.1.2 Case study 2: wine hotel “Domaine Peshtera ” LTD

Start of business 2009

Activities carried out on enterprise

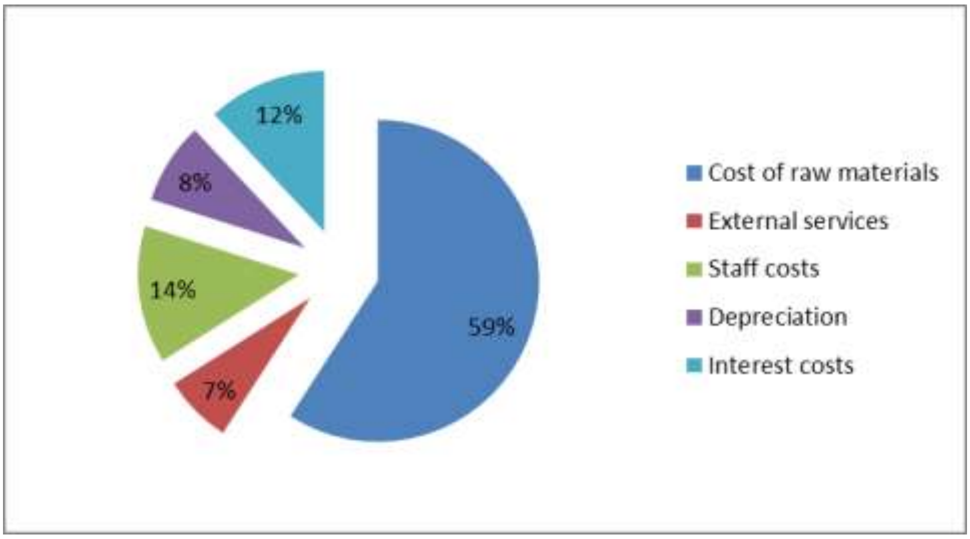
The main activity of the enterprise is wine tourism.

Figure 4: Activities structure



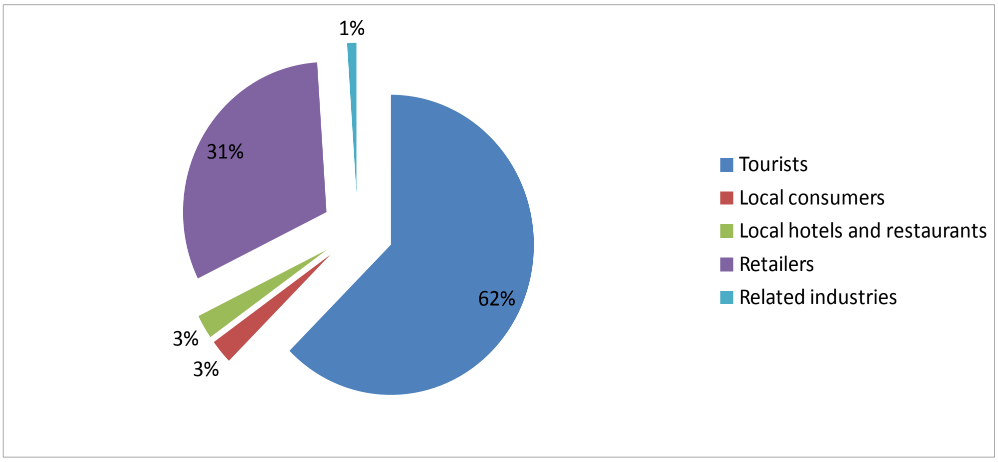
The enterprise is large sized. It is assets are more than 9 000 000 euro. Average annual revenues are 1 920 000 euro. The number of full time employees is 25. The enterprise does not possess own vineyards. The wine hotel is a part of “Vinprom Peshtera” stock company that is the main producer of wine and brandy in Bulgaria.

Figure5: Structure of expenditures



The winery applies organizational, marketing and technological innovations. This result derives from the stock company which has access to know-how and financial funds.

Figure 6: Share of distribution chains



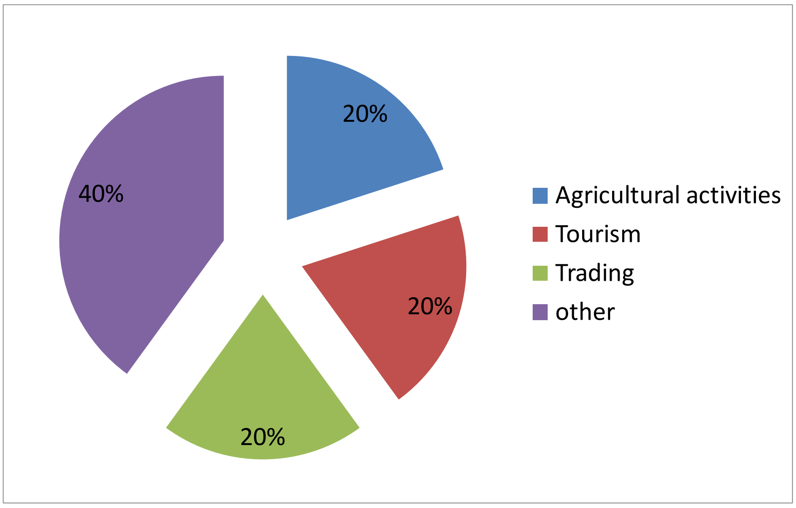
17.1.3 Case study 3: winery "Vinogradetz" LTD

Start of business 1996

Activities carried out on enterprise

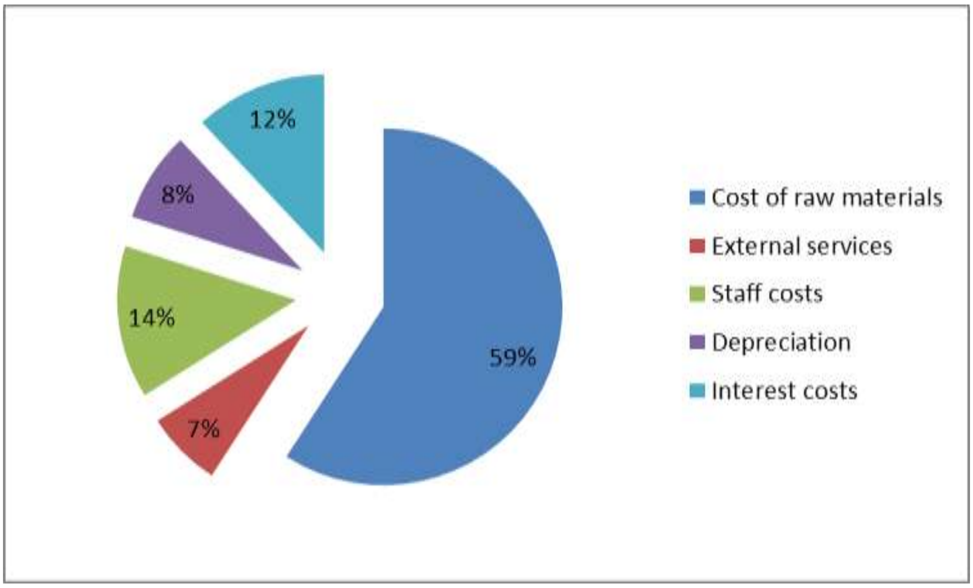
The main activity of the enterprise is not specified. The share of wine tourism is 20%.

Figure 7: Activities structure



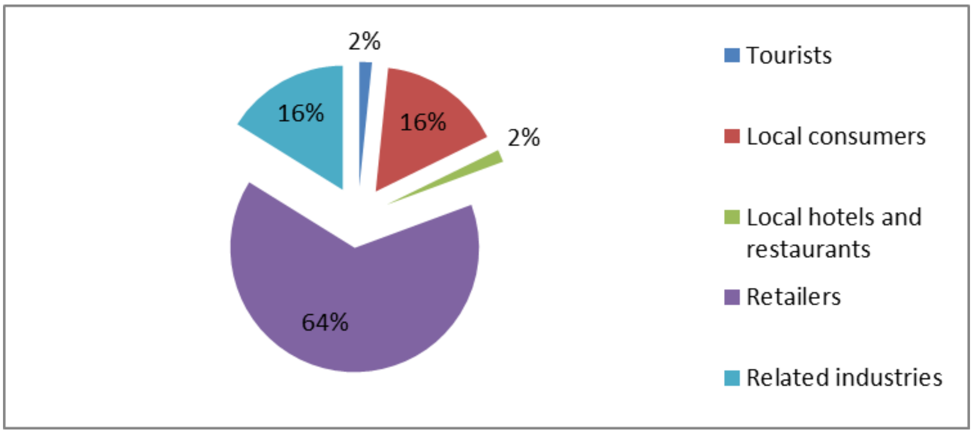
The winery is large sized. It is assets are more than 7 000 000 euro. Average annual revenues are 600 000 euro. The number of full time employees is 7. There are also 22 part time employees, which are engaged during the harvesting period. The winery cultivate 50 ha vineyards under age of 10 years. The varieties are Merlo (10 ha), Cabernet sauvignon (20 ha) and Pamid (20 ha).

Figure 8: Structure of expenditures



The winery applies innovations such as horizontal integration and product innovation.

Figure 9: Share of distribution chains



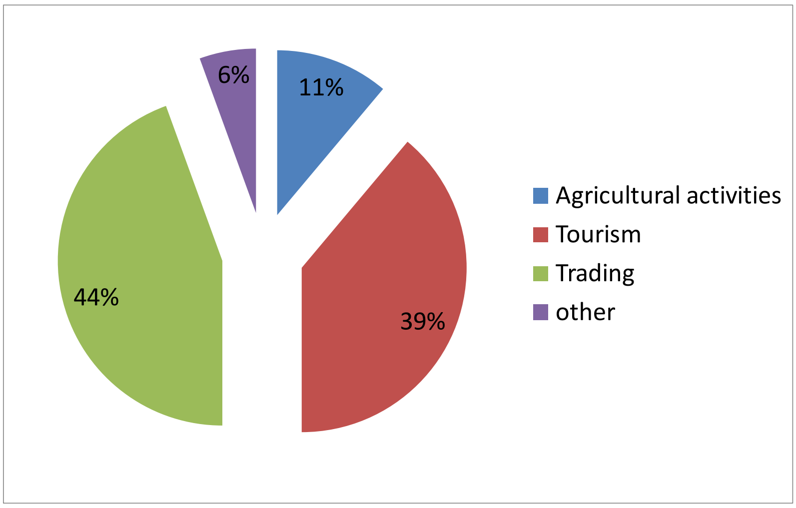
17.1.4 Case study 4: winery "Bessay Valley" LTD

Start of business 2001

Activities carried out on enterprise

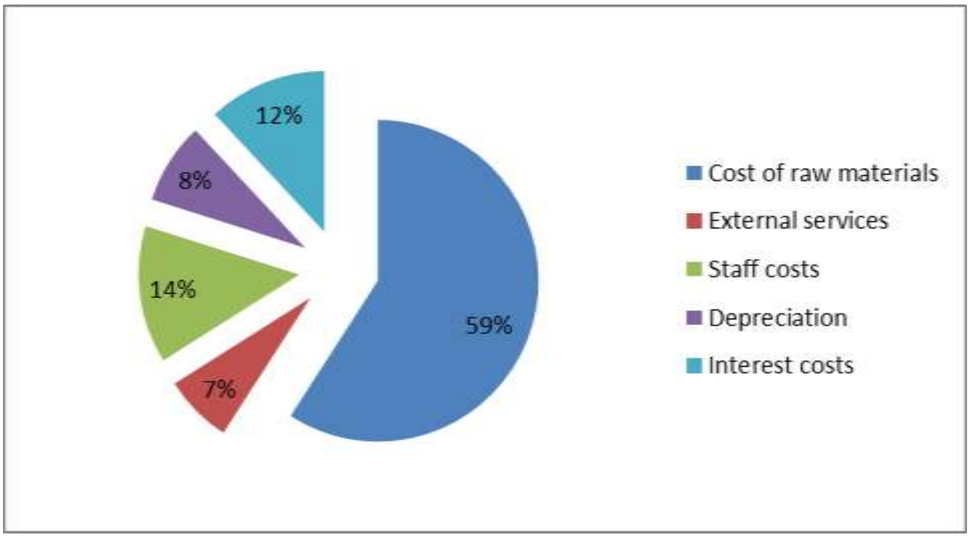
The main activities of the enterprise are manufacturing of wine equipment and wine tourism.

Figure 10: Activities structure



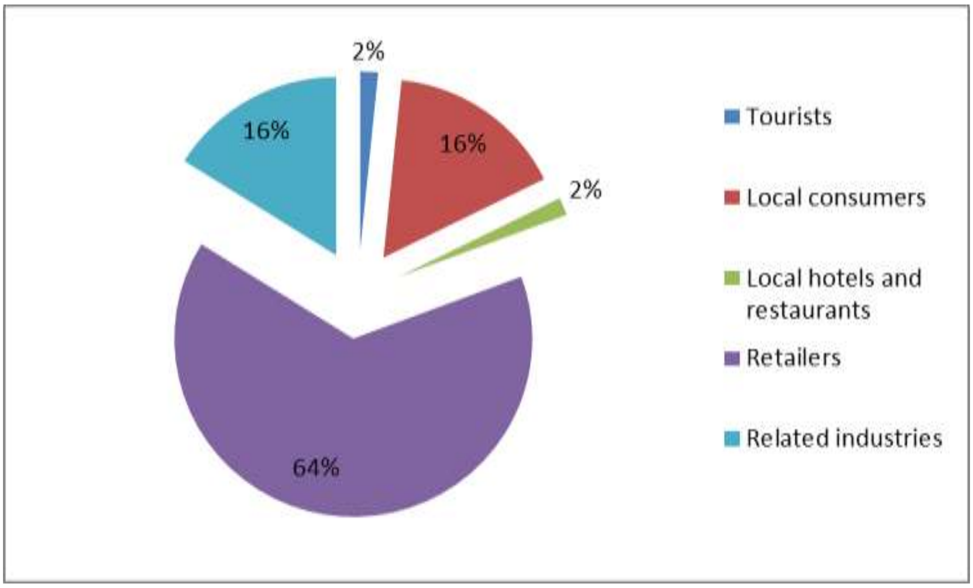
The winery is medium sized. It is assets are more than 6 000 000 euro. Average annual revenues are 820 000 euro. The number of full time employees is 11. There are also 60 part time employees, which are engaged during the harvesting period. The winery cultivate 130 ha vineyards under age of 10 years. The varieties are Merlo (60 ha), Cabernet sauvignon (30 ha), Petit Verdo (20 ha) and Shiraz (20 ha). The winery is specialized in production of high quality red wines.

Figure 11: Structure of expenditures



The winery applies organizational innovation such as horizontal and vertical integration. They also apply technological innovations such as new machinery and equipment.

Figure 12: Share of distribution chains



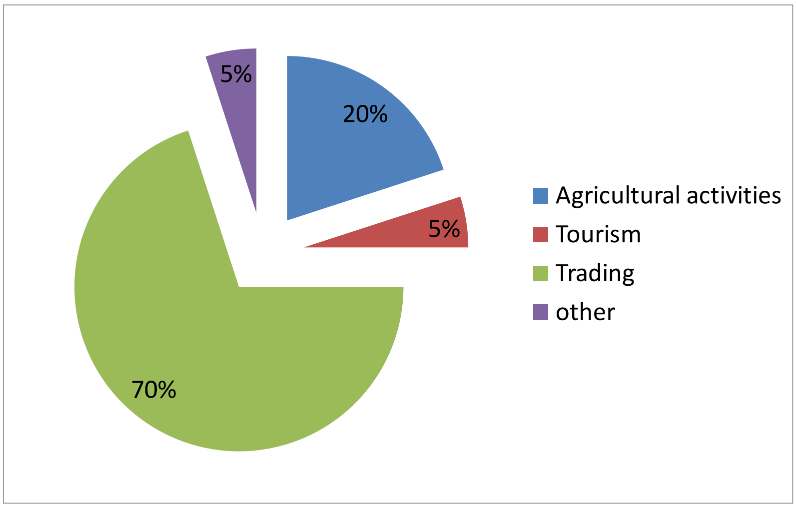
17.1.5 Case study 5: winery "Karabunar" LTD

Start of business 2008

Activities carried out on enterprise

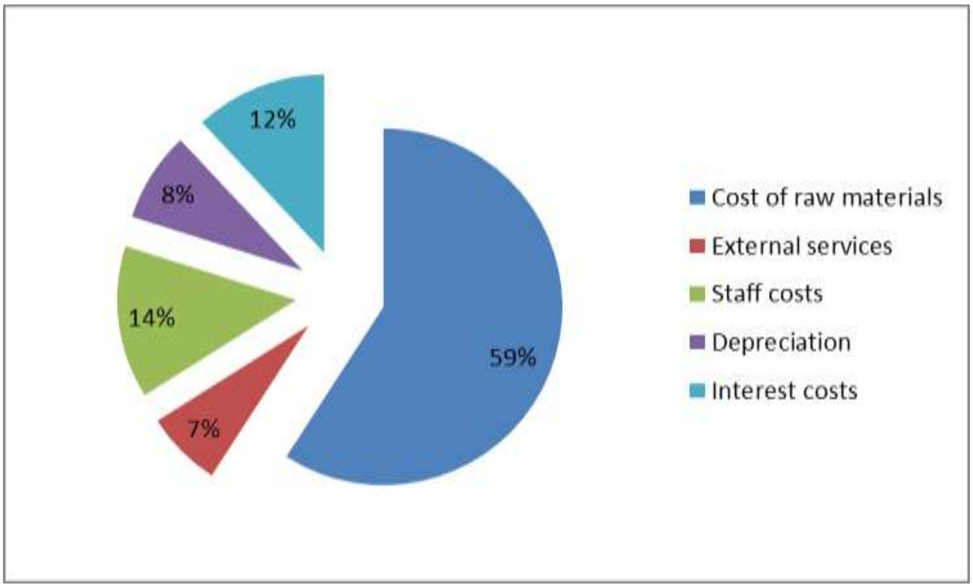
The main activities of the enterprise are trading with wine and alcohol beverages.

Figure 13: Activities structure



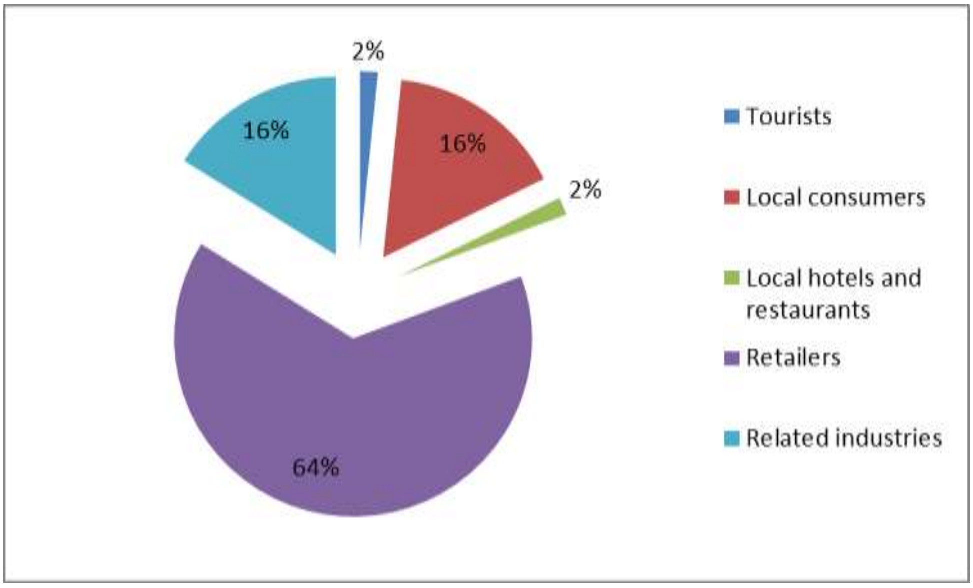
The winery is small sized. It is assets are under 1 000 000 euro. Average annual revenues are 250 000 euro. The number of full time employees is 7. There are also 10 part time employees, which are engaged during the harvesting period. The winery cultivate 20 ha vineyards under age of 10 years. The varieties are native – Dimyat and Red Misket. The winery also buys additional quantities of grapes of variety Cabernet sauvignon.

Figure 14: Structure of expenditures



The winery applies only horizontal integration.

Figure 15: Share of distribution chains



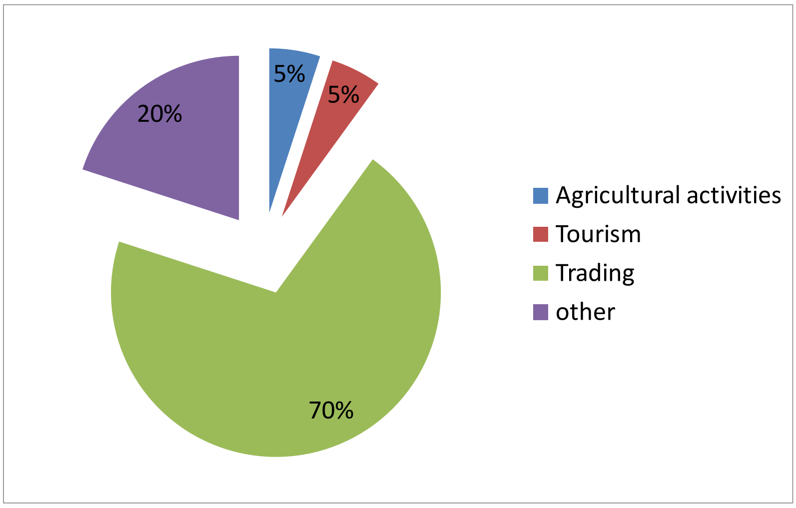
17.1.6 Case study 6: winery "Hebros" LTD

Start of business 2000

Activities carried out on enterprise

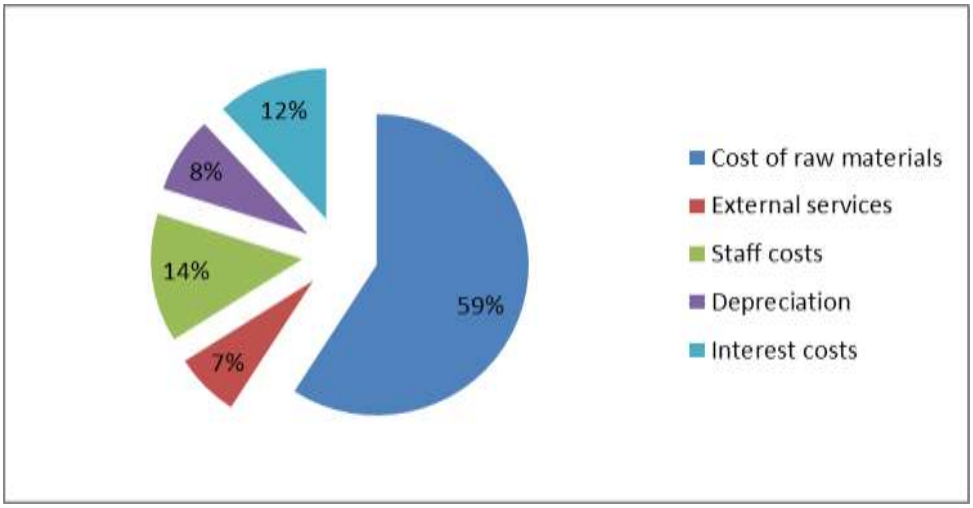
The main activities of the enterprise are trading.

Figure 16: Activities structure



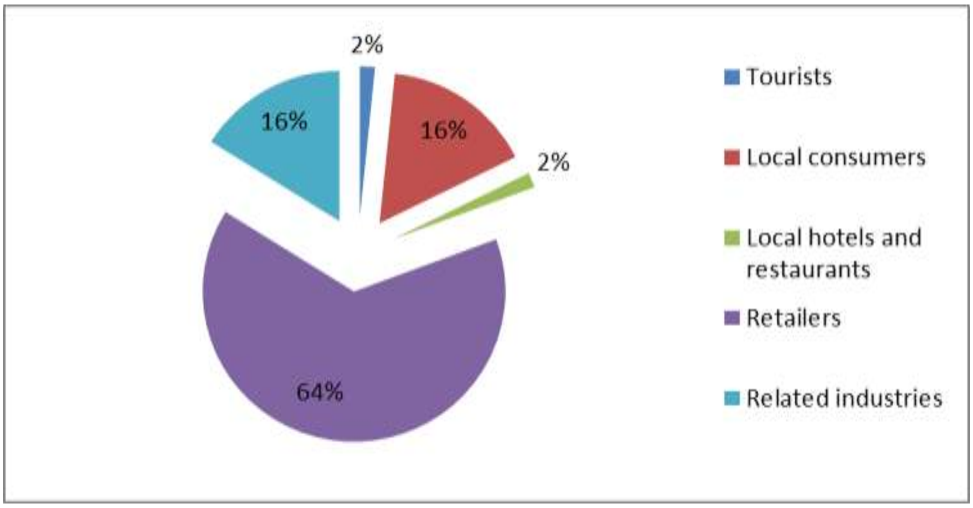
The winery is medium sized. It is assets are more than 5 000 000 euro. Average annual revenues are 250 000 euro. The number of full time employees is 10. There are also 10 part time employees, which are engaged during the harvesting period. The winery cultivate 15 ha vineyards under age of 20 years. The varieties are Merlo (8 ha), Cabernet sauvignon (4 ha) and Pamid (3 ha). The winery also buys additional quantities of grapes.

Figure 17: Structure of expenditures



The winery applies organizational innovation such as horizontal integration.

Figure 18: Share of distribution chains



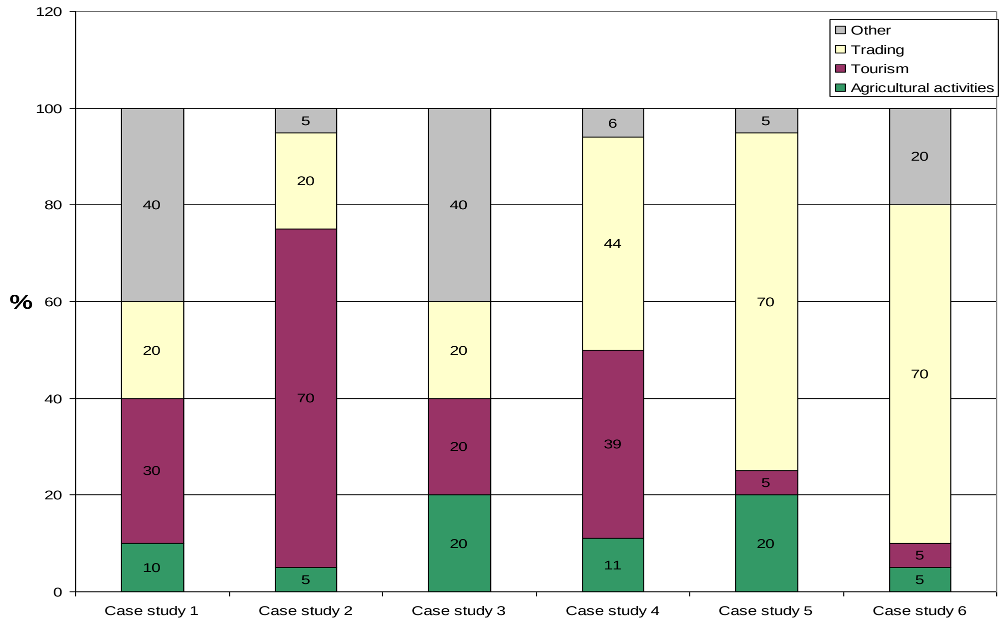
17.2 Comparative economic analysis

Each winery has an average of 8.3 million euro assets and 3.2 million euro basic production funds. Joint stock companies (JSC) run much better resources. In this group of wine enterprises reported the highest return on resources. They have a clear separation of ownership and its management, which indicates that this organizational form is most appropriate for resource management in the industry.

Investment activity of wine enterprises is weak in terms of the financial crisis. Average investment in a winery is 364.9 thousand euro. The majority of the surveyed wineries formed and accumulated operating losses. This determines their inability to cover the investments made at this stage. The rate of return on investment in almost every one entity of the surveyed enterprises was negative. Only one stock company realized return on investment, but it is insignificant. In general it can be concluded that the return on investment at this stage is very low, which determines the low attractiveness of the sector for potential investors. Most of the wine enterprises indicated that the main reason for the accumulated losses is their inability to collect its receivables from customers and suppliers. This determines their inability to be settled with commercial banks accumulated debt in use of investment loans granted by them. Wineries managed to generate revenues that nearly cover operating expenses. Average operating income was 3085.2 thousand euro. Accordingly, the realization of these revenues, the studied wineries make expenditures of 3098.8 thousand euro. As a result, they forming an average loss of activity in the sector amounted to 13.6 thousand euro. Never the less there is optimistic view for development of the market. This can be proved with start of business of a few new wineries in the region, which are still under construction.

According to the structure of the revenues received in the surveyed wineries found that the predominant activities are trade in wine and tourism. Trading sector takes 40% and tourism 28% of the revenues. It can be concluded that these are the main activities of local wineries. Agricultural activities form only 12% of the revenues received during the year. This is explained by lower sales of agricultural products, the most common case is grapes, which is the raw material for the wine making and for this reason the industry does not generate cash revenue.

Figure 19: Activities structure in all case studies

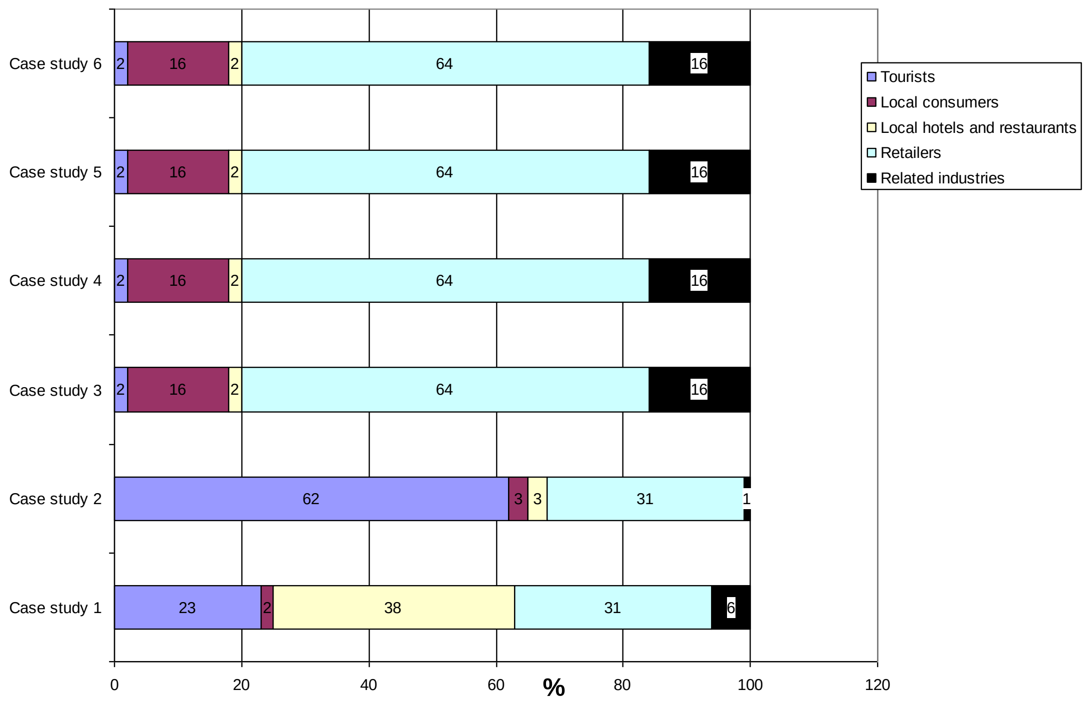


Costs of materials take the major share of total expenditures – 59%. Other important component of cost structure is staff costs – 14%. Interest costs also have performance in total expenditures with 12%. The structure of the expenditures shows that external services are not very popular among wineries, they spend only 7% of total expenditures for such activities.

- **Distribution**

The distribution mix of wineries is predominated by retailers. Wineries do not prefer to sell directly to the tourists or local hotels and restaurants. Retailers form approximately 53% of wineries sells. This means that they have important contribution to the value of chain of the wine tourism. Direct sales to the tourist, which visit directly the winery have insignificant share of product distribution – 15% of total sells. Local consumers also related industries forms only 11% to 12% of total sells.

Figure 20: Distributions channels



- **Using of consulting services**

Using consulting services is not popular among wineries in the region. Most of them states that they never rely on consulting. The wineries prefer to recruit professionals in a filed of marketing, investments, production and human resource management in order to be more sustainable on change of business conditions. The results show that business network is flat and management in purpose to control the quality of product does almost every activity by own (inner) resources.

Table 1: Distributions of consulting services

Consulting services	never	Sometimes	Often	More often	Completely rely on
Marketing	6				
Investments	5	1			
Legal	4	1		1	
Accountancy	5				1
Human Resource Management	5	1			
Production	4	2			

- **Networking**

Networking is also another important issue of creation of competitive value chain. Half of the studied wineries claim that they make participation in wine tourism initiatives. There is no initiative from them in field of creation or advertising of local foods and drinks.

Table 2: Cooperation fields

Field of cooperation	Never	Sometimes	Often	Completely rely on
Local foods and drinks	6			
Wine tourism initiatives	3	1	2	
Others	6			

- **Landscape contribution to the creation of the final product (wine tourism)**

The management of the wineries claims that there is no or weak contribution on diversity of landscape by the activities which they carry out in a context of creation of wine tourism. They prefer not to create landscape. They use landscape composition as natural resource given as a unique feature in value chain of wine tourism. In addition, there is not contribution in creation of raw materials in value chain. In a field of direct sales wineries have strong contribution. According to them (50% of surveyed entities), prefer to make direct sales. There is average or weak contribution in a field of closeness to the market.

Figure 21: Landscape contribution to the wine tourism

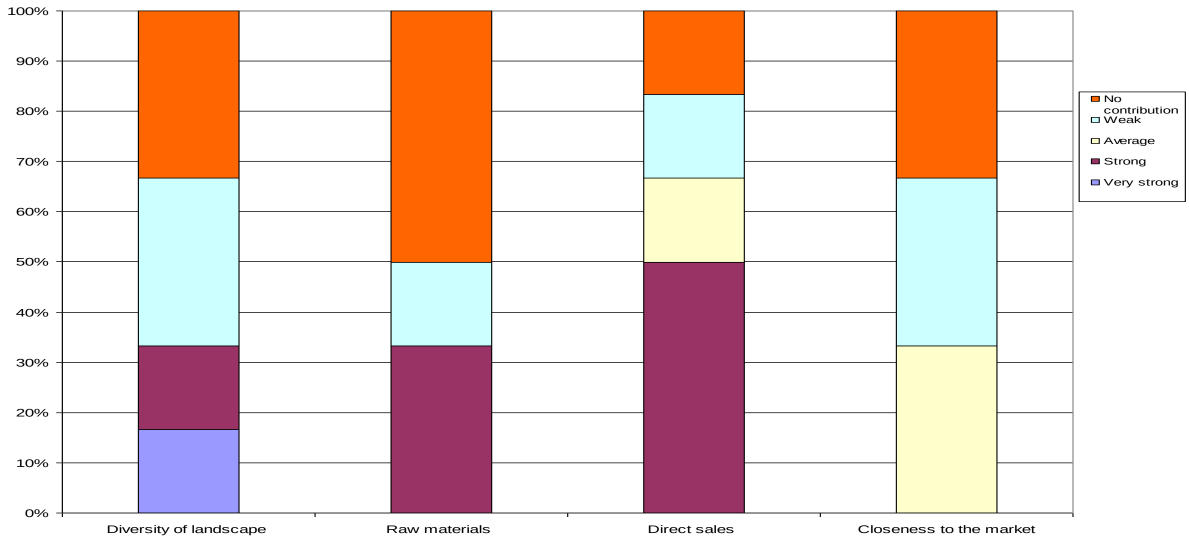


Table 3: Estimation of landscape features

Features:	*Very strong*	*Strong*	*Average*	*Weak*	*No limits*
Diversity of landscape	1	1		2	2
Raw materials		2		1	3
Direct sales		3	1	1	1
Closeness to the market			2	2	2

- **Features of the landscape which add value to the product**

Landscape composition in the region provides functions, which add value to the value chain of wine tourism. 50% of wineries states that there is no contribution of landscape composition to the creation of local brands of food and good image the rest 50% claim that there is strong and very strong dependence on landscape. Local factors, which can add value to the product, are local varieties of grape, which provides local unique wine. Tourists prefer to consume local wines with combination of local foods. Another landscape function, which could add value in chain value of wine tourism, is health and wellbeing. Only two wineries state that landscape provide such a function in region of which they are located. Fifty percent of wineries use landscape composition to add value in their product relying on appropriate conditions for recreation of their costumers. Elements of landscape that are important for recreation are pictures landscape, diversity of landscape, quit place which gives sense of tranquility and relaxation of visitors of winery. Another important element of landscape composition in context of wine tourism is well preserved natural environment. According to 65% of studied wineries, this landscape function has weak or moderate contribution on the value of their product.

One of the most important landscape features which can add value to the product is presence of historical remains, monuments that preserve local traditions and habits. These factors make winery more attractive for local or foreign tourists. 50% or wineries claim that rich heritage of the region of their location has contribution to the value of the product. Another important issue in wine tourism is to offer attractive tourist's services. Landscape can play major role in the process of creation of quality product. Landscape function can give for free attractive services to tourists and in such way it can add significant value to the product. 50% of studied wineries claim that local landscape has not contribution in offering of attractive services for tourists. Another half of studied wineries state there is strong and very strong contribution of landscape composition. Here we have to say that exploitation of some components of landscape has physical and administrative limits. Building a wine cellar and wine tourist complex is a choice defined by location, appropriate climatic and soil conditions, and of course appropriate route infrastructure. Some of studied wineries, which are close to the road infrastructure, loose competitive ability in poor view of pictures landscape and poor condition of well relaxation of tourists. Almost 85% of wineries state that preserving traditions in vine growing and wine production is key factor to attract more tourists.

Figure 22: Landscape and wine tourism product

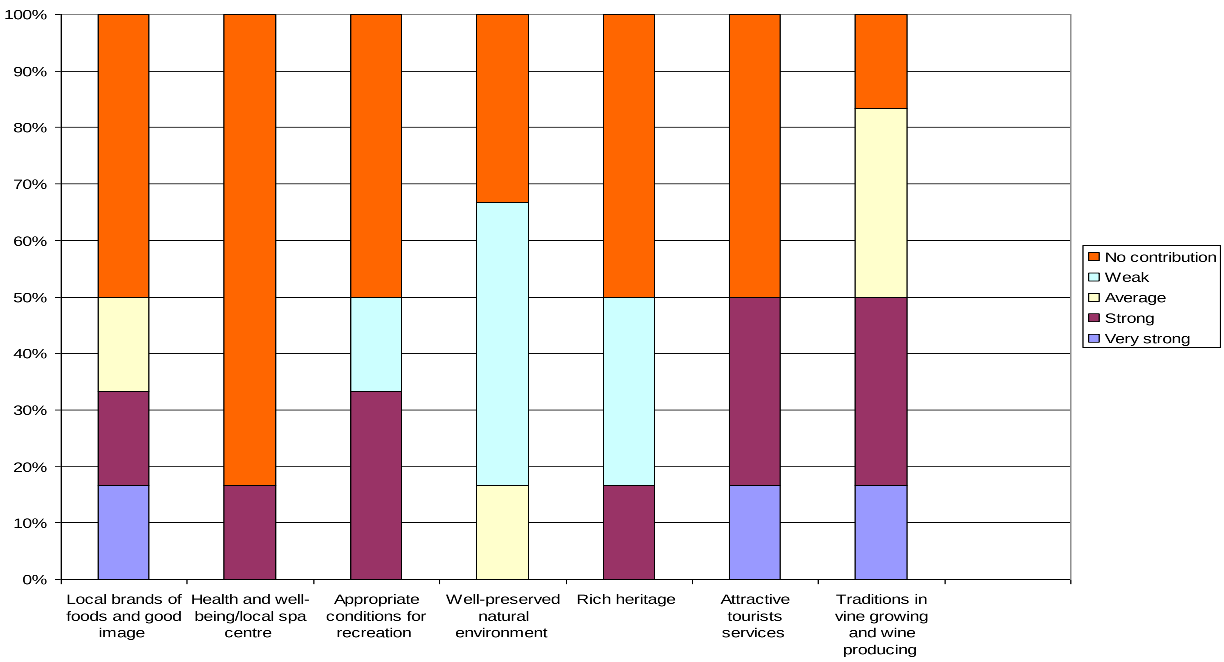


Table 4 Estimation of landscape features on wine tourism

Features:	*Very strong*	*Strong*	*Average*	*Weak*	*No limits*
Local brands of foods and good image	1	1	1		3
Health and well-being/local spa centre		1			5
Appropriate conditions for recreation		2		1	3
Well-preserved natural environment			1	3	2
Rich heritage		1		2	3
Attractive tourists services	1	2			3
Traditions in vine growing and wine producing	1	2	2		1

17.3 Conclusions

There is optimistic view for development of the market. New wineries are emerged to provide more products that are appropriate for local and foreign tourists. New entities rely on strategy to offer unique local brands of wine and foods. These elements of landscape are prerogative for them. According to the some of managers of local wineries competition is good because it will reflex in diversification of product which will increase visitors in region.

The business model in wine tourism rely on own entrepreneurship and poor networking. These factors define value chain as a short with small number of participants. Advantages in this business model can be found in better operation control because almost every activities of entity is run with own resources and independence of implementation of own organizational strategy. Disadvantages are high level of risk because wineries are not interested to share it with other players in value chain and they make huge amount of investments to follow own organizational strategy of business.

Wineries are not interest to create and diversify landscape in area of their localization. This finding is supported by the fact that agricultural activities have no importance in operation of winery and also there are insignificant investments in sector.

Key factors for assembling attractive product are short destination to the winery, open view to the diversity landscape from winery perspective and offering local wines and foods. Visitors can be more attracted by their involvement in local traditions and visiting local historical remains.

18 CSA8: Consumers preferences to the landscape composition in wine tourism – Results of a choice experiment:

18.1 INTRODUCTION

Landscape structure and composition determine the landscape functions and, consequently, the potential supply of landscape services which can add value to the wine tourism. The aim of this research is to be defined the consumer preferences to the landscape composition in wine tourism product in order to give guidelines for improving the competitive ability of wineries and to enhance the quality of product. As a basic method we use choice experiment. Survey is conducted in Pazardjik district in Bulgaria in 2013.

The results of conducted experiment show that the elements of the landscape which are created by man hand (such as wine cellar, vineyard, and restaurant) are more important to the consumer than natural ones (mountain, hill, landscape). In this context, management can control the first landscape elements and combines them successfully with natural resources. As a result, it achieves an attractive and competitive product. Also can be achieved second order effects such as the development of related industries, preserving local traditions and promotion of historic remains in the region.

The structure and composition of landscapes is determined by the interplay between landscape management and the biophysical characteristics of the environment. Often, landscape is the result of a coproduction of human and natural processes, where humans adapt their management to the spatial and temporal variation in the environment and the environment is modified by human intervention. Landscape structure and composition determine the landscape functions and, consequently, the potential supply of landscape services, which can add value to the wine tourism chain (Radev, Nikolov, Borisov, 2013). In relation to the touristic product, we know that consumers have requirements to the quality, which define their choice of product. As specifically concerns wine tourism, it has been highlighted that propensity to purchase can be influenced by four factors: region of production of wine, price and brand and aesthetical experience (Barreiro-Hurle, Colombo, & Cantos-Villar, 2008; Gil & Sanchez, 1997; Holleebeek, Jaeger, Roderik, & Balemi, 2007; Lockshin, Jarvis, d'Hauteville, & Perrouty, 2006; Maneva, 2012). We are going further to investigate all major factors, which define the perception of customers of quality of product. One of them are emotional and external for management like landscape composition (Veale and Quester (2008), and others are cognitive and internal for management like buildings, cellars, vineyards, barrels, restaurants etc. Achieving of good composition between those two groups of factors can boost competitive ability of organization in wine tourism sector.

The aim of this research is to be defined the consumer preferences to the landscape composition in wine tourism product in order to give guidelines for improving the competitive ability of wineries and to enhance the quality of product. As a basic method we use choice experiment (Berkel, Ribeiro, Verburg, Lovett, 2011). Survey is conducted in Pazardjik district in Bulgaria in 2013.

18.2 METHODOLOGY

We implemented the choice experiment into four steps:

(i) definition of landscape attributes, attribute levels and customisation;
(ii) experimental design;
(iii) choice of sample and sampling strategy;
(iv) execution of choice experiments.

These four steps should be seen as an integrated process with feedback. The development of the final design involves repeatedly conducting the steps described here, and incorporating new information as it comes along.

- **Definition of landscape attributes, attribute levels and customisation**

The **first step** in the development of a choice experiment is to conduct a series of focus group studies aimed at selecting the relevant landscape attributes. A starting point involves studying the attributes and attribute levels used in previous studies and their importance in the choice decisions. Additionally, the selection of attributes should be guided by the attributes that are expected to affect respondents' choices, as well as those attributes that are policy relevant. This information forms the base for which attributes and relevant attribute levels to include in the first round of focus group studies. The task in a focus group is to determine the number of attributes and attribute levels, and the actual values of the attributes of landscape. As a first step, the focus group studies should provide information about credible minimum and maximum attribute levels.

Customisation is an issue in the selection of attributes and their levels. It is an attempt to make the choice alternatives more realistic by relating them to actual levels. If possible an alternative with the attribute levels describing today's situation should be included which would then relate the other alternatives to the current situation. An alternative is to directly relate some of the attributes to the actual level.

- **Experimental Design**

Classic model - based on the assumption that the consumer has constructed view of the attributes of landscape. Each image of landscape is seen as a set of attributes and consumer evaluate each one according to how well they meet their requirements. The method required to fix the landscape attributes and the scale at which they will be assessed. Then each consumer gives his assessment of individual landscape attribute, they are added together and forms a generalization assessment expressing the opinion of the consumer for whole landscape composition. As assessment is higher, so the view of the consumer is greater in the landscape composition. It specifies that the consumer will be more attracted to the specific landscape composition. Assessment of landscape compositions can be used by the following formula:

$$A_{jk} = \sum_{i=1}^{n} B_{ijk}$$

n – number of attributes of landscape

B_{ijk} – assessment of consumer „к" about attribute „i" of landscape composition „j"

A_{jk} – summary assessment of consumer „к" about landscape composition „j"

- **Sample and Sampling Strategy**

The choice of survey population obviously depends on the objective of the survey. Given the survey population, a sampling strategy has to be determined. Possible strategies include a simple random sample, a stratified random sample or a choice-based sample. A simple random sample is generally a reasonable choice. One reason for choosing a more specific sampling method may be the existence of a relatively small but important subgroup which is of particular interest to the study. Another reason may be to increase the precision of the estimates for a particular subgroup.

- **Execution of choice experiments**

Participants in the choice experiments were 48 people. All of them are visitors at wineries in the region.

For estimation of landscape composition are used 10 attributes. The landscape attributes are:

1) vineyard;
2) hill;
3) mountain;
4) wine restaurant /enoteka/;
5) building of winery;

6) cellar with barrels;
7) traditions;
8) history
9) village
10) location /short destination/

Figure 1: Images of landscape compositions

Image 5 of landscape composition
WINE RESTAURANT

Image 6 of landscape composition
VINEYARDS + TRADITIONS

Image 7 of landscape composition
VINEYARDS

Image 8 of landscape composition
BUILDING OF WINERY

Image 9 of landscape composition
BUILDING OF WINERY + HISTORY

Each respondent give assessment to each attribute levels by using four rating scale as follow:

0 /not importance at all/;

1 /weak importance/;

2 /strong importance/;

3 /very strong importance/

Focus groups were conducted in two stages. The first is a questionnaire in which each participant assesses individual landscape attributes whether they meet his expectations related with sense of wine tourism. Thus assess the importance of each attribute. Participants form a summary assessment that gives an idea of preferred combinations of attributes (landscape composition). In the second stage are displayed images representing different combinations of the landscape attributes. Participants express the opinion what is the most attractive to them in a sense of wine tourism. Responses of each participant shall be reconciled with the questionnaires. Thus verifying the results sought. Gives an answer to the question of which elements of landscape stimulate the demand of wine tourism and how wineries use them.

18.3 Results

Participants in the experiment evaluated the degree of importance of each of the 10 attributes of the landscape. Based on these estimates we calculate average values (see Figure 2). As a result, the most preferred attributes are - the existence of an attractive building of the winery; nearby location of the winery; the availability of a cellar with barrels; the presence of a restaurant; local traditions and rich history. It is noteworthy that the majority of these landscape attributes are inner factors, which can be managed by winery. Nature landscape attributes have low scores, making them to have a weaker role in the attractiveness of the product wine tourism.

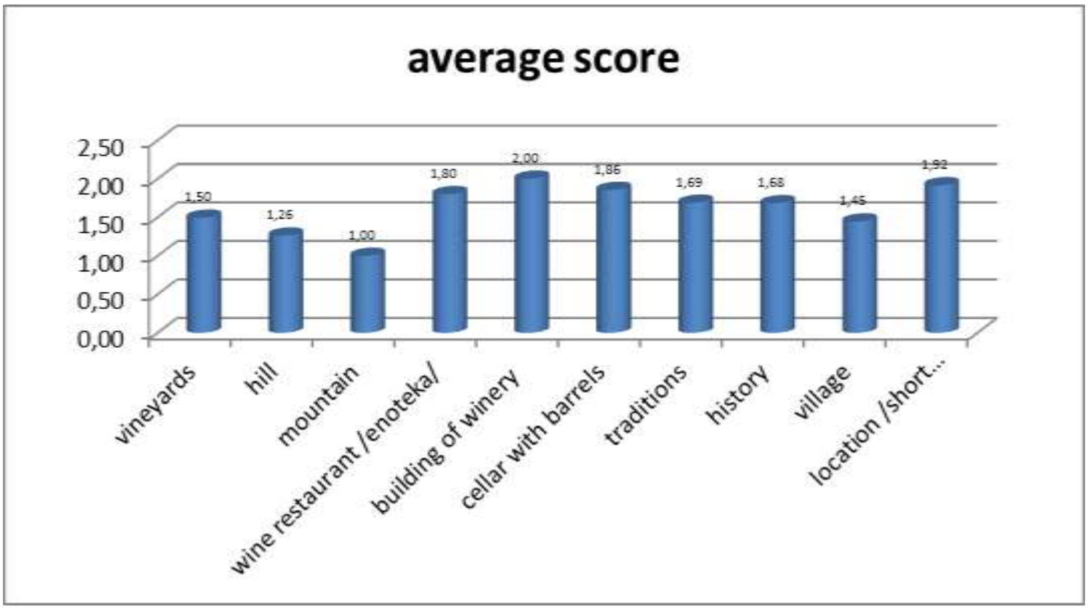


Figure 2: Preferences of landscape features /elements/

Each landscape attribute is evaluated in terms of its predomination in the images of landscape compositions. Figure 46 presents these values for each of the 9 images representing different landscape compositions. Based on these we determine the perfect model of landscape from the consumer's perspective. The perfect model consists of attributes, which have a relatively high value, and these values are close to each other. Thus, the composition is defined as a well balanced and preferred by the consumer. These are images depicting landscape composition - 1) vineyard + building of winery + hill; 2) vineyard + mountain.

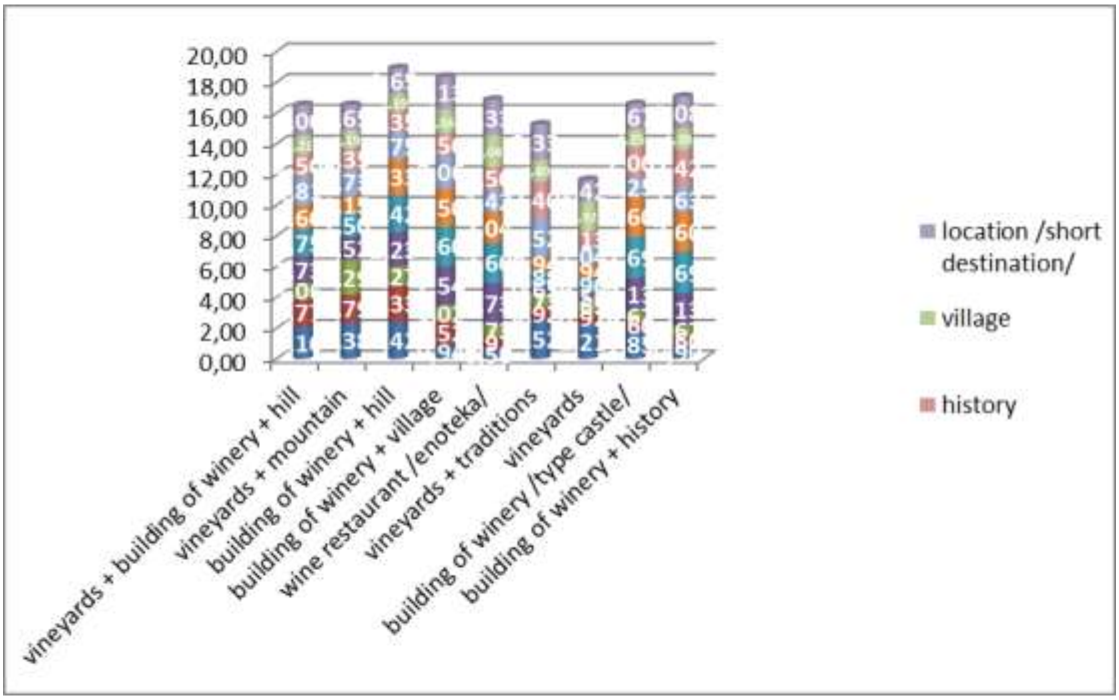


Figure 3: Contribution of each landscape element to the various landscape compositions

Figure 4 presents the cumulative evaluations of each shot landscape composition. Each respondent gives opinion by separate assessment of each attribute of the landscape, then scores is summarized to give a cumulative score for each shot landscape composition. Highest cumulative score has image Number 3 that represents the combination of an attractive building of the winery and hilly terrain. Image Number 4 receives high ratings and showing again building the winery, but located in the village. The least attractive is defined image of landscape composition consists of only vineyard in the landscape (see image number 7).

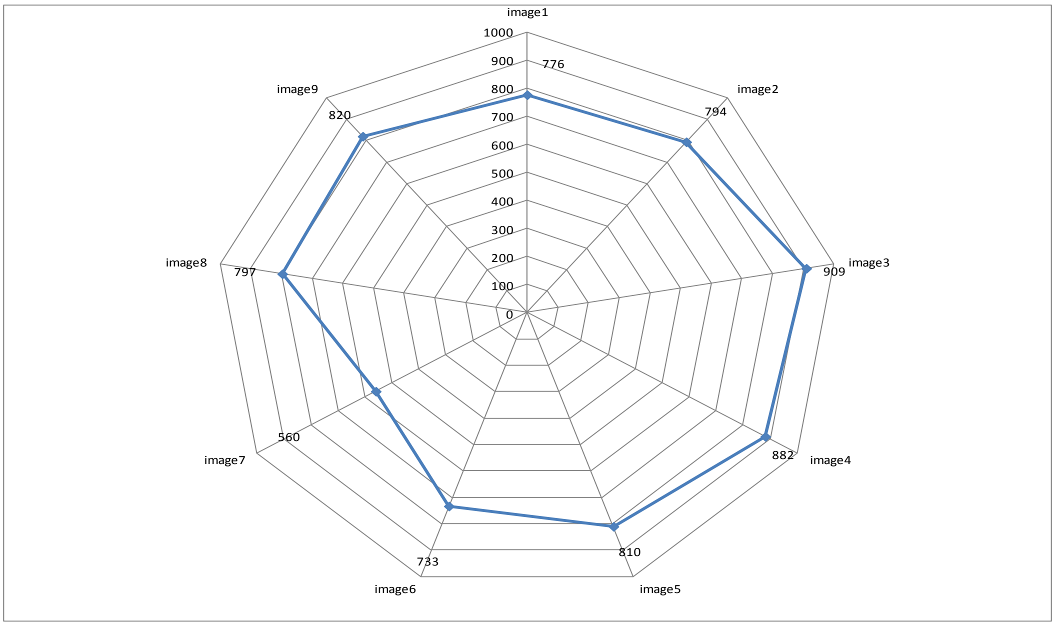


Figure 4: Total score of each image of landscape

Figure 5 shows the results of the choice experiment showing the most preferred landscape composition by respondents. The percentages show the distribution of images of landscape compositions based on the highest aggregate score from consumer's perspective. Image 3 (building of winery + hill) is the most liked landscape composition about 35% of the respondents. The next level of attractiveness of landscape composition is vineyard + mountain (see image number 2), following by landscape composition - building of winery + village (see image 4). Another preferred composition of landscape is captured in image number 3 (building of winery + history). The rest images of landscape compositions are not identified as attractive to respondents. Other images of landscape compositions are not defined as attractive to the respondents such as, combination of vineyards and traditions or even just vineyards.

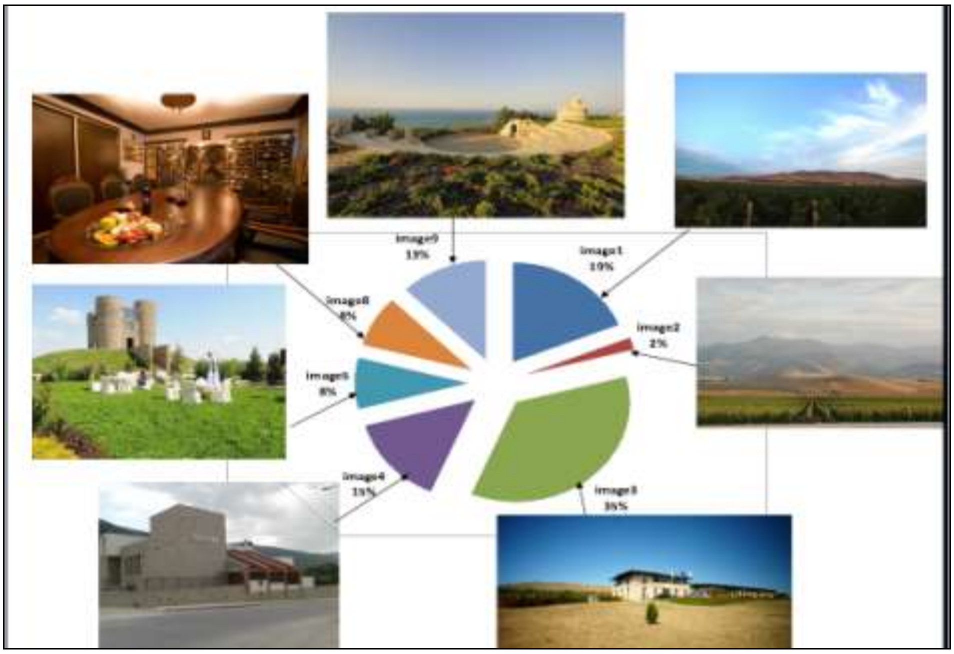


Figure 5: Preferences /number of the most liked image/ of landscape composition

18.4 Conclusions

In search of wine tourism product consumers expects the winery to be at close destination and considered there are attractive buildings and cellar. Landscape attributes that add value to the product wine tourism is the availability of mountain and hilly terrain near the winery. Thus the construction of new facilities must comply with the presence of these landscape attributes. Another attractive feature of the product from consumer's perspective is the availability of Enoteca and gourmet. These factors make visitors to stay longer in the winery. By offering wines and local foods visitor can touch to the local traditions and history. Landscapes combination of attractive wine cellar built, well located on a hilly terrain, giving views of the overall landscape is defined by consumers as perfect when the product is wine tourism. If the business sector complies with these requirements, it has a chance to sell a product with a high added value.

In conclusion, it can be noted that the elements of the landscape, which are created by man hand (such as wine cellar, vineyard, and restaurant), are more important to the consumer than natural ones (mountain, hill, landscape). In this context, management can control the first landscape elements and combines them successfully with natural resources. As a result, it achieves an attractive and competitive product. Also can be achieved second order effects such as the development of related industries, preserving local traditions and promotion of historic remains in the region.

References

Barreiro-Hurle, J., Colombo, S., & Cantos-Villar, E. Is there a market for functional wines? Food Quality and Preference, (2008) 19 (4), 360–371.

Derek B. Van Berkel, Synia Carvalho-Ribeir, Peter H. Verburg, Andrew Lovett. Identifying assets and constraints for rural development with qualitative scenarios: A case study of Castro Laboreiro, Portugal. Landscape and Urban Planning 102 (2011) 127– 141.

Gil, J. M., & Sanchez, M. Consumer preferences for wine attribute: A conjoint approach. British Food Journal, (1997) 99 (1), 3–11.

Holleebeek, L. D., Jaeger, S. R., Roderik, J. B., & Balemi, A. The influence of involvement of purchase intention for new world wine. Food Quality and Preferences, (2007) 18, 1033–1049.

Lockshin, L., Jarvis, W., d'Hauteville, F., & Perrouty, J. Using simulation for discrete choice experiments to measure consumer sensitivity to brand, region, price and awards in wine choice. Food Quality and Preferences, (2006) 17, 166–178.

Maneva, S. Opportunities for development of integrated regional tourism product within areas of Mirkovo, Chavdar and Chelopech municipalities. Agricultural sciences, 2012, vol. 4, Issue 9, 119-123.

Nikolov D., Radev T., Borisov P. Landscape as a driver for competitiveness of Pazarjik district in Bulgaria, Italian Association of Agricultural and Applied Economics (AIEAA), 2013 Second Congress, June 6-7, 2013, Parma, Italy

Veale, R., & Quester, P. Consumer sensory evaluation of wine quality: The respective influence of price and country of origin. Journal of Wine Economics, (2008) 3 (1), 10–28.

19 CSA9: Breeders' production choices in the area "Castagniccia" in Corsica

19.1 Introduction

In mountainous Mediterranean areas, one the objective of the CAP is to maintain livestock farming at a minimal level of stocking in order to either prevent land abandonment and over-grazing/over-intensification that both have negative environmental impacts (Enne et al, 2004; El Aich and Waterhouse, 1999). However, in the northern rim of the Mediterranean basin many of these areas (Fernández et al, 2004) such as Sierra de Grazalema (Fernández et al, 2004) and Sierra de Guara (Bernues et al, 2005) in Spain or Corsica (Said, 2001) in France, the level of vegetation increased. Meanwhile, the number of farms kept decreasing while the total number of animals was stable (Agreste, 2010) or decreased (Bernues et al, 2005, Fernández et al, 2004).

We show that in such situations of agricultural decline i.e. where land scarcity is low, CAP premium, attributed mainly according the number of hectares and the livestock size, lead farmers to opt for hyper-extensive systems, i.e. ranching, with actual stocking rates lower than CAP required minimum threshold given the absence of competitive land use. Consequently, the current policy is unable to favor a sufficient stocking rate to control biomass growth and to prevent from a closing over of landscape.

Thus, we analyze breeders' production choices in a central area of Corsica called "Castagniccia". This is done thanks to data on farms and premiums (survey data cross-tabulated with CAP farmers' declarations) and land-use data (remote sensing data).

In a first step we estimate the change in the state of vegetation during the last decades, change that we capture through a transition matrix;

In the second step we confront the evolution of actual farm (classified in types) and the areas that they are supposed to impact.

In a third step we estimate the role of CAP subsidies on the farm type choice by farmers.

19.2 First part: The evaluation of the vegetation growth in Castagniccia: a transition matrix between 1990 an 2012

19.2.1 Data and methodology

To analyze the spatio-temporal evolution of different vegetation type, we chose imagery SPOT ® provided since 1986 by the SPOT satellites 1-5.

In our study we worked on SPOT 2 and SPOT 4 models incorporating two possible acquisition modes : panchromatic mode (black and white) with a resolution of 10 meters and a spectral band multispectral color mode with a resolution of 20 meters has the ability to cut the electromagnetic radiation received in 5 spectral bands for SPOT 4 : green, red and near-infrared , infrared and panchromatic means (Table 2) and 4 spectral bands for Spot 2 (green, red, near infrared red and panchromatic) . Whatever the version of Spot, the spectral band PIR has a greater sensitivity for detecting vegetation.

In our study and with the aim to perform a credible detection of vegetation, the multispectral mode was selected because it provides color images unlike the panchromatic mode and thus it allows better differentiation of vegetation cover.

The SPOT material is very dense , it requires a selection, generally made on the basis of three criteria: resolution, range and seasonality of the observed phenomenon .
SPOT satellite provides images at five different resolutions: 20, 10 , 5 and 2.5 meters. We chose the resolution to 20 meters in the visible, which has the advantage of being informed without discontinuities about 20 years and correctly account for the evolution of the vegetation in the area Castagniccia . This will be our scale of analysis.

Furthermore, images must be chosen according to the observed phenomenon ; seasonality for example, when we observe the evolution of vegetation. But detecting different vegetation types requires the use of images where chlorophyll intensity is sufficient to differentiate , but not that much to erase differences between vegetation types. The choice of images in the catalog SPOTIMAGE are quite limited , every month of the year for a geographical point are not shown , and the month of August in the year 1994 and the month of June for the year 2012 have been retained.

19.2.2 Processing images and classification

Image processing and classification was performed from remote sensing tool Multispec . It has the advantage of being an open source software that allows you to implement many techniques; whether correcting images , the choice of the algorithm (by minimum Euclidean distance) , smoothing or removing information isolated pixels , or the spatial image display in false color.

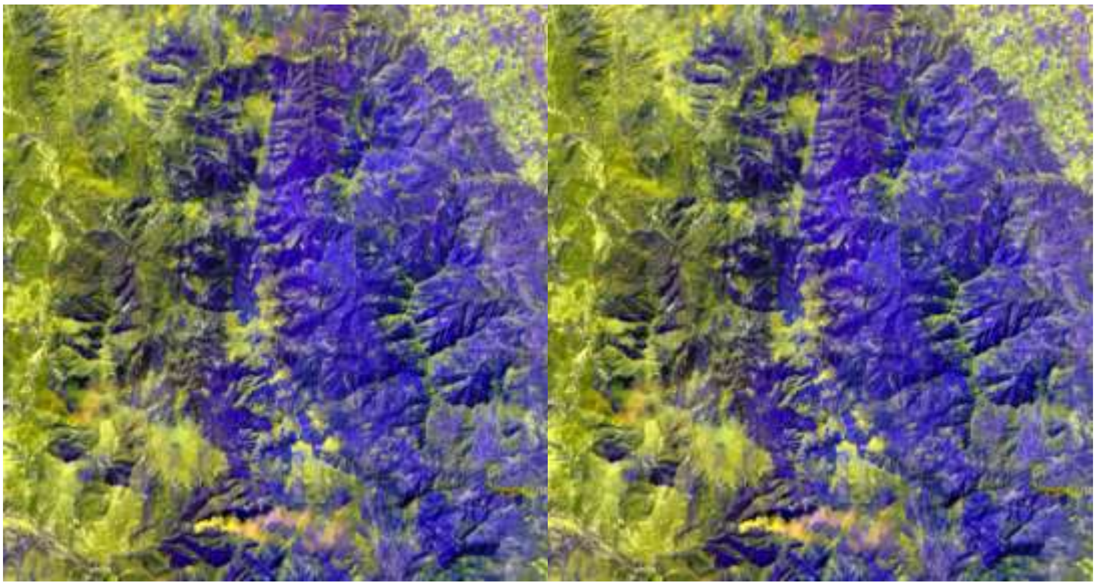


Figure 1: The false-color image

The first processing is the implementation of a false color image , that is to say, after a suitable choice of available channels to the nature of the images . For example , 3.2.1 combination was chosen this case study because it helps to describe the photosynthetic activity of the vegetation.

As an illustration, the SPOT images Castagniccia 20 meter resolution false color with the combination brings up blue (forest and Chesnuts orchards) , Yellow (low covers, scrubs, pastures).

Image Spot Image Spot August 1994 June 2012

- The supervised classification .

However, the false-color image is extremely complex to analyze , especially in an objective quantification and comparison. Grouping objects of land classes must be performed by supervised classification, ie by grouping maximum likelihood of each pixel landscape with user-defined classes. We selected a classification of the type of vegetation in six classes adapted to the spatial resolution SPOT images :

Class 1 Bare soil / structure.

Class 2 meadows/ pastures.

Class 3 Low maquis -majority cysts

Class 4 High maquis top majority of heather.

Class 5 deciduous forest : beech, alder , white oak, chestnut

Class 6 Forest persistent : pines and oaks.

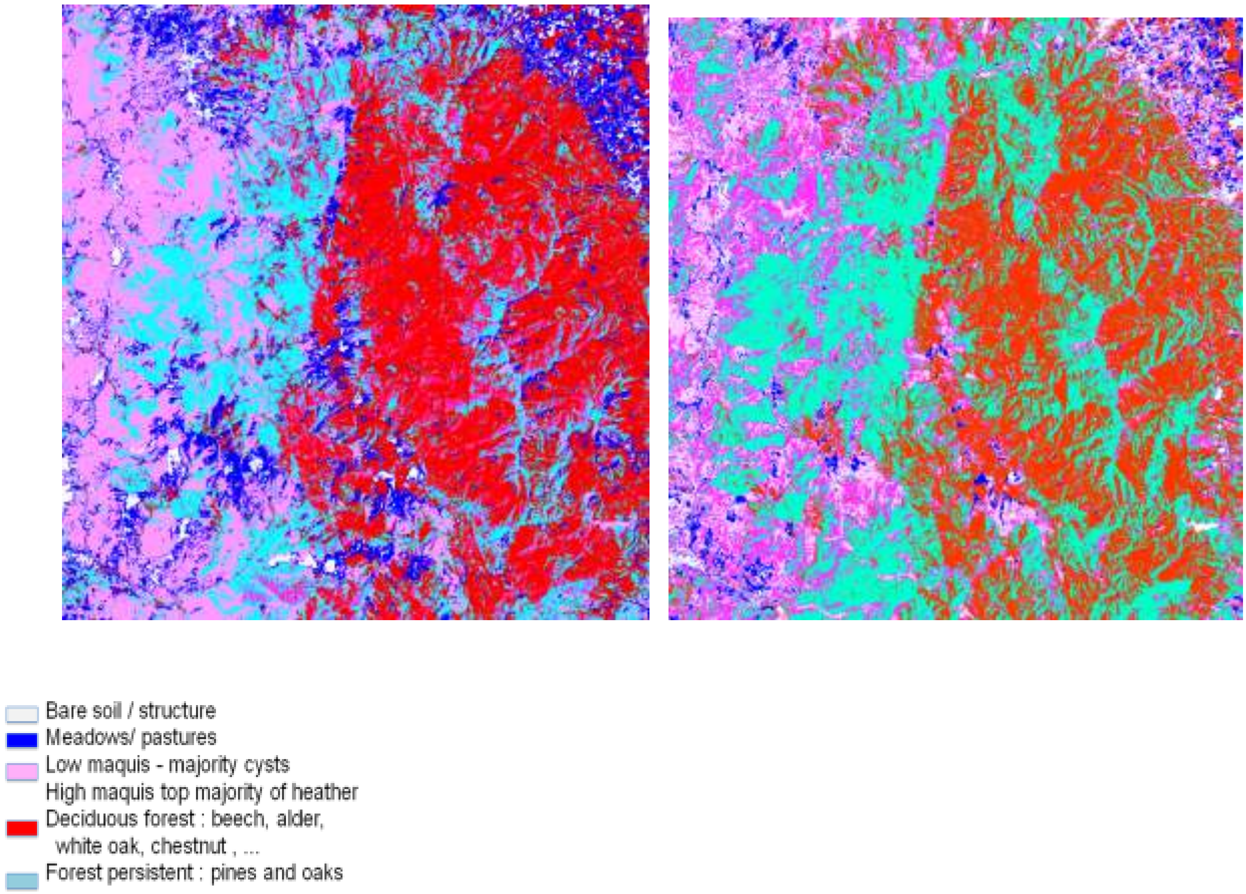


Figure 2: supervised classification. Left to right in august 1994 - June 2012

For the supervised classification of 1994 first we took the same points of reference in the classification of 2012, that is known at present and validated points. Then we compared the outcome and refined using the database of IFN Agripast SODETEG dating from 1980.

The result of the supervised classification of 2012 was corrected through a simplified soil map and their dynamics was validated by experts and in comparison to other geographical sources (Google Earth, aerial photographs , maps local occupancy vector soil) or by checking via surveys of land (Figure 3).

Figure 3: Survey of land over a hundred locations (here south Castagniccia) .

19.2.3 Transition of land cover

The landscape for a given date is then transformed into a matrix containing numerical values of pixels that represent the nature and arrangement of land classes. Each of these values (or land cover class) can change state between the two periods. The comparison between two different matrices dates reflects the changes of state which can then be integrated in a transition matrix. The latter matrix also has the advantage of allowing a consistency check of our supervised classification (see previous paragraph). In addition, the transition matrix can account for the spatio- temporal evolution of different land use on all sites sampled classes. At this stage, the R open source software is mobilized, through its raster library and resets an image form of the transition matrix . It allows a tabular of the change of state between the two dates (Figure 5.1).

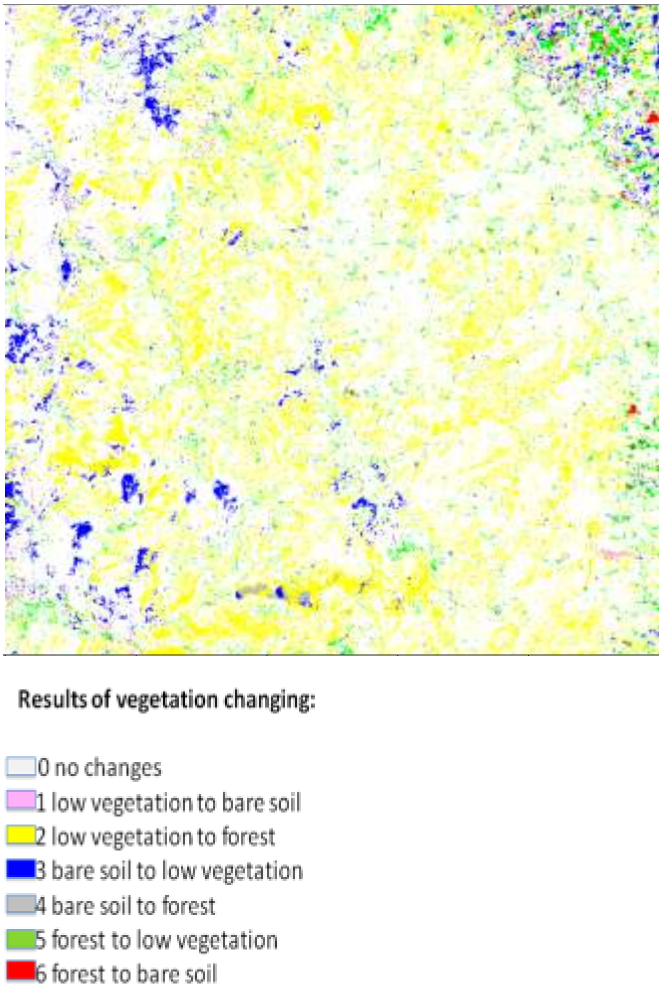


Figure 4: Results of vegetation change between 1994 and 2012

19.2.4 Conclusion

We assess a general vegetation growth even if the majority of space doesn't move at all (which is consistent with the nature of vegetation classes : for example forest generally stays as forest). The preeminent change concerns the growth of what we call law vegetation, i.e. maquis, scrubs and pastures toward the forest state (even quercus ilex, alders , pine). That means that particularly in the most mountainous part of the area the vegetation involves in a useless state for ruminants breeders and we suspect that the farms are unable to slow down this tendency.

19.3 Second part: The evaluation of the impact of farm types on vegetation and fire risk

19.3.1 Data

On this area we collected data of farms (survey data cross-tabulated with farmers' CAP declarations) in order to assess their location, productions, size, seniority and income. We also have land-use information thanks remote sensing data. Indeed data are hardly available in such areas because of difficulty to distinguish land cover classes that are quite fuzzy and pastured and non pastured parcels.

Concerning land use, we can consider percentage of 6 different land covers classes that are, as described in the first part, by growing level of vegetation : bare soil, grass, cistus, heather, "forest" (deciduous trees including chestnuts trees) and Pines and holm oak forest (evergreen species). Around each production sites given by the survey (holdings often have several ones; by production site we mean a parcel where there is a technical act like feeding point, stocking, milking, etc; or where livestock grazing activity is evident such as a natural meadow) we draw a buffer whose radius depends on the production, reflecting the area in which livestock is likely to graze and so to impact the vegetation. Thus according our expertise buffers are small around pork production sites (15 ha), intermediate around sheep production sites (70 ha), and large around goat and beef production sites (150 ha). Consequently, we can calculate percentage of the 6 different land covers around each holding.

Further more we obtained the areas burnt in summer (forest and scrub fires) for each year between 1992 and present time.

19.3.2 Results the relationships between land use and livestock production.

The direct survey permitted to collect all the farm sites for both the date 1992 and actual (table 5 1 and 5.2). Almost 240 sites of farming activity were spotted by this survey.

	1990		2012		Evolution 90-2012
	nb	%	nb	%	
Farms with pigs	74	32%	85	37%	+
Farms with ewes	25	11%	21	9%	-
Farms with goats	35	15%	39	17%	+
Farms with beef cattle	42	18%	42	18%	+
Farms with chestnut trees	53	23%	41	18%	-

Table 5.1 : Number of farms (based on surveys data) according to their productions in 1990 and 2012

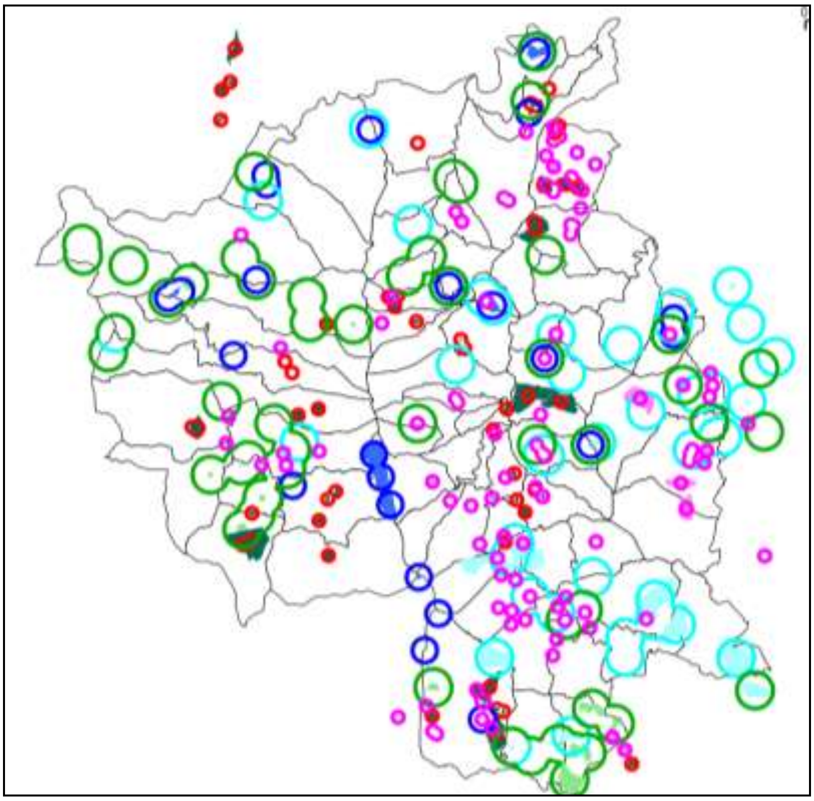


Figure 5.2: farming site and their buffer zone around (2012)

The buffer method allows us to estimate the actual land use that the farms do. When we cross this information with the transition matrix of change of vegetation (see part 1) we obtain results on both the land use for each farm type (table 6 and table 7, respectively for 1994 and 2012, showing results for cattle farms versus non cattle farms) , and for the potential impact of each type respect to the vegetation natural evolution (table 8). We assess that even if the high vegetation (maquis with heather, forests) is an important rate of the farm land in all the area and for all the farm types, the cattle farms present a more important rate of low vegetation state (grass and scrubs) than the average of the other farms. But the cattle farms are more unable to slow down the vegetation growth than those other types that doesn't have beef cows. That is certainly due to the fact that being larger than the other farms the beef farm gather more pasturable land particularly grass and cistus, but can not maintain them always in that state.

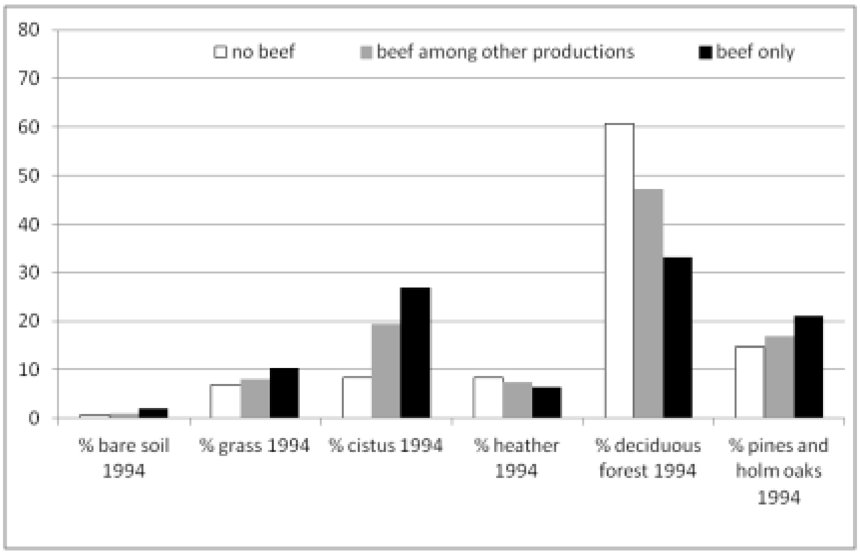


Figure 6: % of land covers classes accoding to farm types , 1994

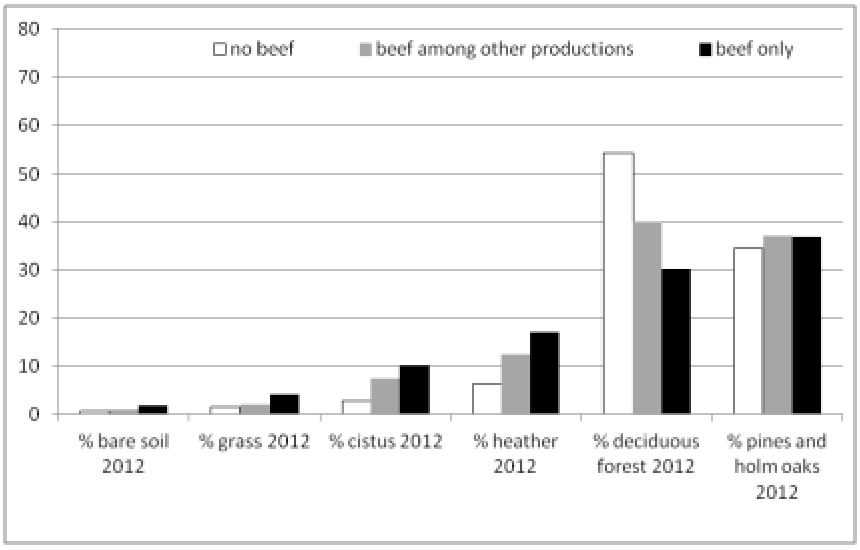


Figure 7 : % of land covers classes accoding to farm types , 2012

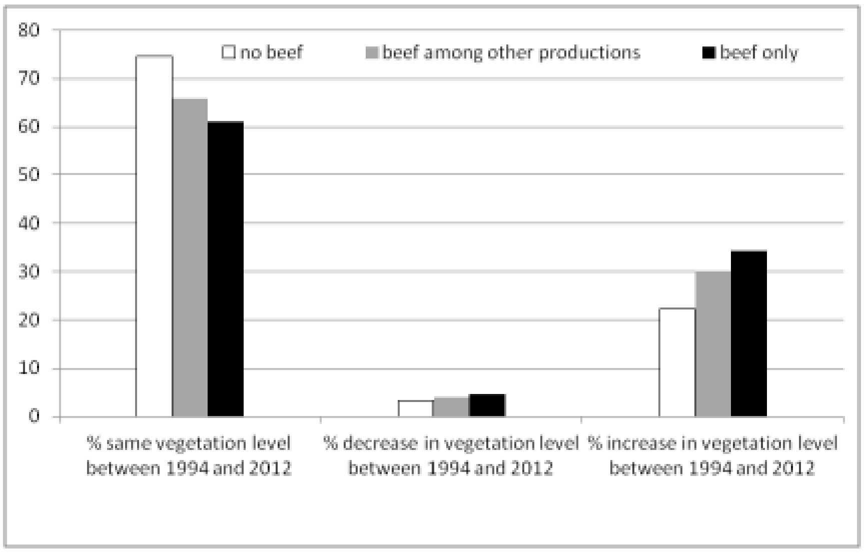


Figure 8: Evolution of vegetation growth according to farm type

19.3.3 Results the relationships between land use, livestock production and fires occurrence

We crossed then the buffer zone and the fires occurred during the period 1990-2010:

Table 9 : fire occurrence according to farming system type

Fire 1990-2001, farming system sites (FSS) in 1990	Pigs (15ha)	ewes (70 ha)	Goats (150ha)	Beef cattle (150ha)	Chesnuts (7 ha or real site)
Nb_fires	14	56	77	74	23
Medium size fire	13,64	19,97	12,73	19,59	22,10
Total area burnt/ total FSSs	190,98	1118,04	980,49	1449,77	508,24
Nb fires / FSS	0,19	2,24	2,20	1,76	0,43
Area burnt /nb FSSs	0,16	0,62	0,22	0,24	0,52
Feux 2001-2012, FSS 2012	Pigs (15ha)	ewes (70 ha)	Goats (150ha)	Beef cattle (150ha)	Chesnuts (7 ha or real site)
Nb_fires	17	20	64	36	3
Medium size fire	147,35	93,80	49,54	89,66	182,69
Total area burnt/ total FSSs	2505,00	1875,99	3170,56	3227,64	548,07
Nb fires / FSS	0,20	0,95	1,64	0,86	0,07
Area burnt /nb FSSs	1,84	1,20	0,55	0,47	0,66

The results confirm our assumptions that is a decrease of the number of fires (mainly due to the disappearance of pastoral fire, the strict control of prescribed fire) but an increase of the medium size of the fires along the period.

Concerning the impact of the single farm type the cattle farming systems show a huge increase of the medium size of fire. That is likely to be due to the vegetation growth in the area they use. The same result for the goat systems is consistent because these farming system has always located in high land cover. In other terms cattle and goat tends to use the same areas and land profile. The same can be said for pig systems. In anyways we can see except for ewes no significant impact on the prevention of fire risk.

19.3.4 Conclusions

The results on the vegetation impact of farm type shows a general inability of farms to contain the natural vegetation growth in the area. This inability seems to be particularly high for the cattle farms. While installed at the beginning in the lower vegetation units (pastures, grass and scrubs from cistus to heather - Erica scopea) the vegetation involves to high maquis or forests. We see no substantial difference from this point of view between the impacted (ie : the buffers) and the non impacted area.

As far as the fire risk is concerned, as we assumed from the beginning even if the risk of occurrence in terms of number of fires has generally decreased, the risk has increased in terms of dimension of the fires. We can't see any difference between the ability of the farm type to decrease the risk (except for Chestnut that are rarely touched and for the goats that are often touched) . The medium size of the fires has particularly increased for areas "impacted" by the beef cows.

19.4 Third part: The PAC measures and the farm type choice

19.4.1 2.4.1 Data and modeling methodology:

In this part propose a way to model farmers' choices given these characteristics. More specifically we analyze the farmers' decision to opt for beef cattle ranching, an activity that is known to mainly rely on PAC subsidy (in this context) while needing low labor (Bernués *et al.*, 2011; Le Carignon *et al.*, 1994, Paoli *et al.*, 2013) and is suppose to have less desirable impact vegetation growth control than small dairy ruminants (Gutman *et al.*, 2000).

We therefore complement existing economic literature on farmers'decision drivers, since this literature mainly consist in analyses of the determinant of intensification within a production (Caraveli, 2000; Sturato *et al.*, 2009) or in change between productions that requires an equivalent level of fixed inputs and technical know-how (e.g. replacement of a crop by another, see e.g. Just *et al*., 1983; Babcock *et al*., 1987; Coyle, 1993; Antle and Capalbo, 2001; Antle and Stoorvogel, 2006). However, analyses of livestock production choice, especially in scarce data environment but also in Mediterranean extensive livestock systems are rare.

Concerning agricultural holding characteristics, annual final income per active are calculated as the sum of the holding annual net added value and CAP premiums per active. (single payment entitlement: SPE, support of agriculture in less favored areas: LFA support and "livestock aid" based on the livestock type and size). The holding annual net added value is calculated according Lafitte (2012)'s works by taking into accounts systems specific fixed and livestock size dependant costs and benefits. As a part of the premiums are given according to the number of cattle (cows, goat and sheep), the amount of these premiums informs on herds size. As there is no "livestock aid" for pork production, number of pigs is given according to field survey information or, when this information is missing, set at a default value according to Lafitte works.

To build our economic model we based on expert saying and economic theory. According to this, farmers choose productions to maximize their profit under constraints. The profit is the actual annual income previously described. The main constraint is the open space available to free the animals since work is far less limitant than in the small ruminants farming systems. The percentage of premiums in beef cows farming systems is much higher than fort he small ruminants ones; even if for the subsidies per LU the difference is not that big . Hypothesis are the following: as long as small ruminants units or other small farms disappears the remaining farms convert themselves to beef cow production

We econometrically model this behavior. Given available data we choose a multinomial dependant variable which describes the production types of each holding regarding the presence of beef cattle production. Thus, holdings either "breed beef only", "breed beef among other productions" or "breed no beef. Given hypotheses previously described and data availability, we choose the variation of the number of exploitation, the evolution of local population, the % of low vegetation as explanatory variables.

19.4.2 About relationships between income, CAP premiums and livestock production.

Annual income, net value added and Cap premiums amounts were not included in the model for collinearity and endogeneity reason . However some interesting observations can be made on the relationships between this element and holding types. First of them the role of cattle activity to maximize both revenue and CAP subsidy uptake (see tables below, bold letters).

T

		mean	sd	min	median	max.	n
annual net value added per active (€)	no beef	**25123**	29798	-9627	23760	256632	102
	beef among other productions	**53016**	61413	-6408	28650	276775	33
	beef only	**1526**	1194	-3583	1825	2836	31
total amount of aid (€)	no beef	**5906**	8997	0	0	36896	106
	beef among other productions	**42219**	32160	6951	29432	178678	33
	beef only	**40057**	24994	10879	33670	121412	31
annual income per active (€)	no beef	**30406**	31453	-9627	23760	262538	102
	beef among other productions	**84605**	74468	25676	56174	360627	33
	beef only	**34928**	20213	13715	31280	117829	31
"livestock aid" (€)	no beef	527	1623	0	0	14796	106
	beef among other productions	12560	8612	3635	8927	43602	33
	beef only	11566	6240	2679	9325	33993	31
"livestock aid" for suckler cows(€)	no beef	0	0	0	0	0	106
	beef among other productions	11338	8048	3635	8489	41275	33
	beef only	11566	6240	2679	9325	33993	31
"livestock aid" for goats (€)	no beef	268	617	0	0	3278	106
	beef among other productions	430	722	0	0	2327	33
	beef only	0	0	0	0	0	31
"livestock aid" for sheeps (€)	no beef	134	537	0	0	3564	106
	beef among other productions	792	2117	0	0	8791	33
	beef only	0	0	0	0	0	31
SPE (€)	no beef	1789	3296	0	0	14494	106
	beef among other productions	16033	14563	1827	10360	74375	33
	beef only	18390	15500	2824	15346	59882	31
LFA support (€)	no beef	3590	5474	0	0	24987	106
	beef among other productions	13626	10589	0	10225	60701	33
	beef only	10101	5407	0	8910	27536	31
total aid as % of annual income per active	no beef	**20**	39	0	0	240	102
	beef among other productions	**49**	27	17	44	125	33
	beef only	**94**	4	79	94	103	31
total aid except SPE as % of annual income per active	no beef	**12**	20	0	0	96	102
	beef among other productions	**31**	17	9	29	75	33
	beef only	**55**	13	19	56	76	31
"livestock aid" as % of annual income per active	no beef	**2**	4	0	0	19	102
	beef among other productions	**15**	8	4	13	35	33
	beef only	**29**	6	15	28	44	31

correlation coefficients (Pearson)	annual net value added per active (€)	total amount of aid (€)	annual income per active (€)	"livestock aid" (€)	"livestock aid" for suckler cows(€)	"livestock aid" for goats (€)	"livestock aid" for sheeps (€)	SPE (€)	LFA support (€)	total aid as % of annual income per active	total aid except SPE as % of annual income per active	"livestock aid" as % of annual income per active
annual net value added per active (€)	1.00	0.23	**0.92**	0.23	0.19	0.22	0.14	0.17	0.26	-0.32	-0.31	-0.27
total amount of aid (€)	0.23	1.00	0.54	**0.95**	**0.92**	0.28	0.26	**0.96**	**0.88**	0.49	0.47	0.54
annual income per active (€)	0.92	0.54	1.00	0.54	0.49	0.28	0.23	0.48	0.50	-0.04	-0.03	0.03
"livestock aid" (€)	0.23	0.95	0.54	1.00	**0.97**	0.18	0.23	**0.90**	**0.77**	0.47	0.46	**0.63**
"livestock aid" for suckler cows(€)	0.19	0.92	0.49	0.97	1.00	0.07	0.09	**0.87**	**0.73**	0.46	0.45	**0.64**
"livestock aid" for goats (€)	0.22	0.28	0.28	0.18	0.07	1.00	0.06	0.20	0.44	0.14	0.17	-0.02
"livestock aid" for sheeps (€)	0.14	0.26	0.23	0.23	0.09	0.06	1.00	0.26	0.23	0.12	0.11	0.08
SPE (€)	0.17	0.96	0.48	0.90	0.87	0.20	0.26	1.00	**0.73**	0.48	0.38	0.49
LFA support (€)	0.26	0.88	0.50	0.77	0.73	0.44	0.23	0.73	1.00	0.43	0.51	0.39
total aid as % of annual income per active	-0.32	0.49	-0.04	0.47	0.46	0.14	0.12	0.48	0.43	1.00	**0.89**	**0.80**
total aid except SPE as % of annual income per active	-0.31	0.47	-0.03	0.46	0.45	0.17	0.11	0.38	0.51	0.89	1.00	**0.82**
"livestock aid" as % of annual income per active	-0.27	0.54	0.03	0.63	0.64	-0.02	0.08	0.49	0.39	0.80	0.82	1.00

In the following graph :

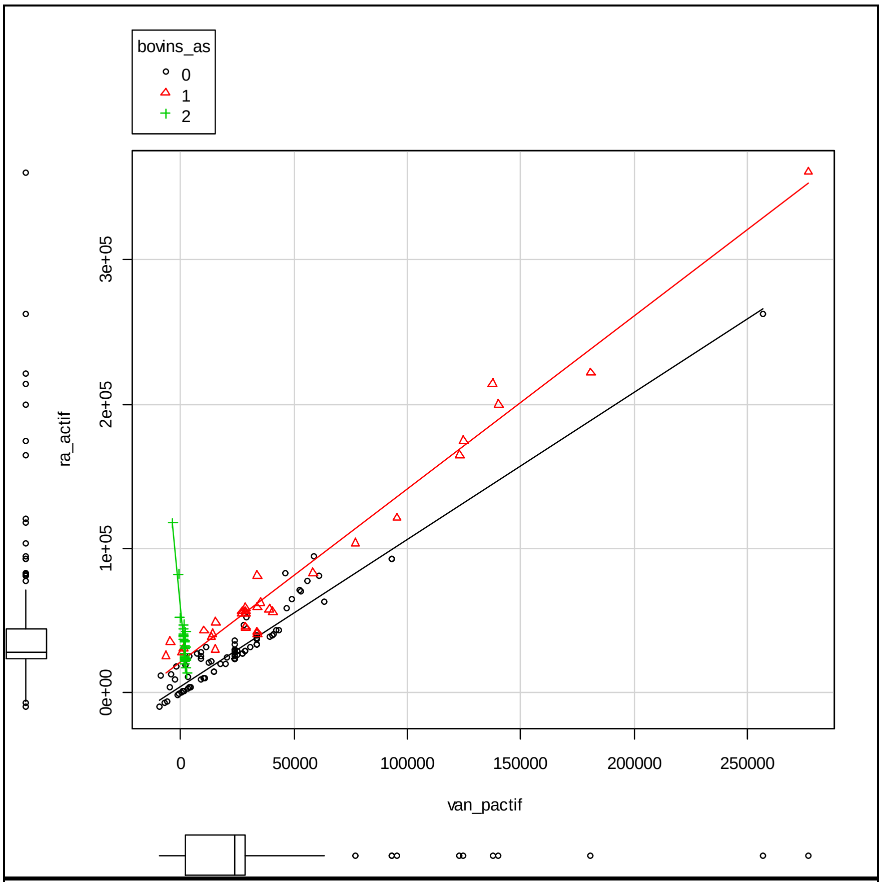
0 = no catlle

1= cattle and something else

2= only catle

Ra_actif= Net value added + subsidies

VAN_actif= valeur ajoutée nette par active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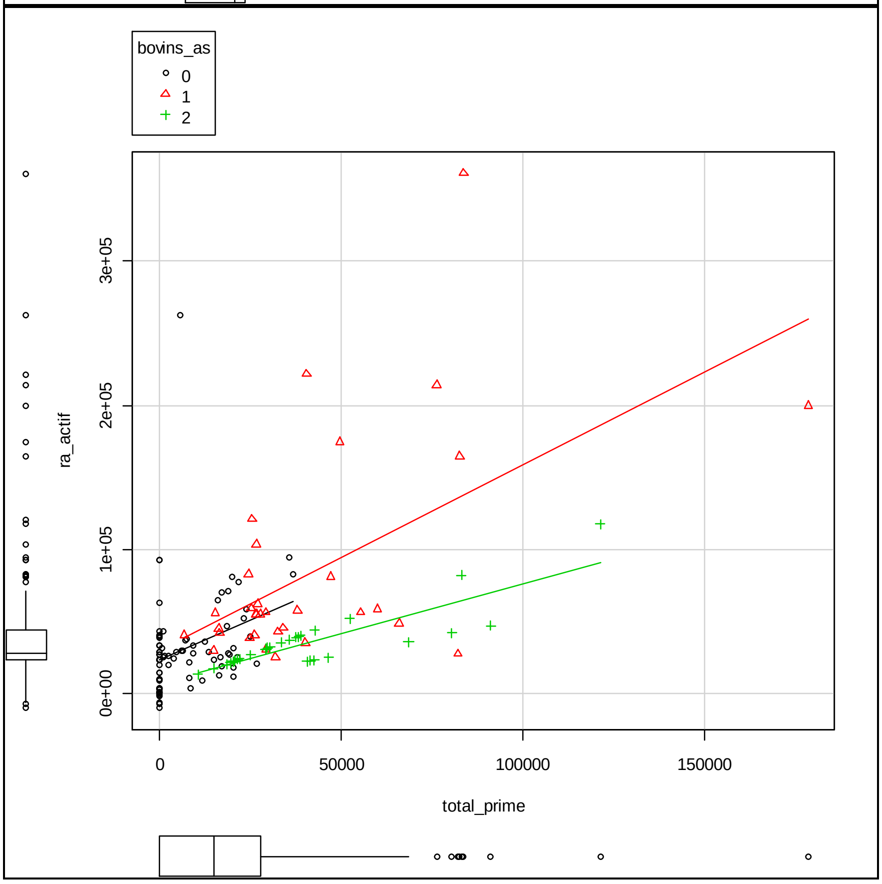
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1e+05
2e+05
3e+05
0
50000
100000
150000
total_prime

19.4.3 Regression results:

The following table gathers the result of a multinomial model :

Multinomial model	Resid. Dev.= 278.8812		AIC= 294.8812	
Coefficients:	(Intercept)	Z.p_varexp	Z.p_varpop	Z.p_pel1994
beef among other productions	-1.265239	-0.4879576	-0.2291149	0.06874637
beef only	-1.639947	-0.8962782	0.7897900	0.53540428
Std. Errors	(Intercept)	Z.p_varexp	Z.p_varpop	Z.p_pel1994
beef among other productions	0.2152717	0.2674383	0.2187457	0.2138271
beef only	0.2832310	0.3056693	0.2986920	0.2204474
P-values	(Intercept)	Z.p_varexp	Z.p_varpop	Z.p_pel1994
beef among other productions	4.167439e-09	0.068067221	0.294913803	0.74782811
beef only	7.032777e-09	0.003365883	0.008189349	0.0151523

The only variables with a significant effect are :

- P_varexp (the variation of the number of farms arround the farm, between 1992 and 2010) : negative effect on the probability of beef (alone or with something else). In other terms when the density increases there is less chance to produce beef.

-P_varpop (variation of the population density) : the probability of beef activity is high when the polulation encreases . That is due to the fact that pastures are concentrated in the western part of the area, the most influenced by urban sprawl.

-p_pel1994 -% lawn in buffers around farms) : there is a positive effect on probability to beef alone (rather than no beef).

19.5 Conclusions

The results are manly in accordance to what we expected. The main hypothesis that is the fact that farm disappearance leads to the increase of cattle farming is confirmed. Being our sample quite small we must confirm the results at a larger scale. Concerning the effects of CAP measures applied to livestock activity we must be cautious. What we can affirm is that CAP premiums (animal subsidies, LFA allowances) do not hamper the development of beef cattle farming systems, and that beef cattle industry is the way to maximize the uptake of these premiums in a context of land abundance. But results clearly show that the key problem is the disappearance of smaller farmer system based on ewes and goats. The prospect could be then to appraise the possibility to design CAP application aiming to maintain these later in order to make them more attractive for young farmers. We must note that, recording here the results of the second part that show the evolution of the landscape toward a non-pasturable state, the techniques and skills necessary to keep and exploit this kind of landscape (generally non-mechanisized land) can be part of the problem and not only the subsidies / farmers.

19.6 Consolidated conclusions and perspectives:

This study has been made up of a satellite images analysis (first part), a measure of landscape and fire risk impact of farming systems according to field direct survey and GIS data bases (second part), an estimate of drivers of farming systems dynamics, among which CAP farm subsidies (third part). The all study has been done in the Castagniccia mountainous area (North east of Corsica island)

In the first part of the study, we assess a general vegetation growth toward 1994 and 2012. The preeminent change concerns the growth of what we call law vegetation , ie scrubs with cistus and pastures toward the forest state (even quercus ilex, alders , pine). That means that the landscape involves toward a non pasturable state by the ruminants.

In the second part we showed a general inability of farms to contain the natural vegetation growth in the area. This inability seems to be particularly high for the cattle farms. While installed at the beginning in the lower vegetation units (pastures, grass and scrubs from cistus to heather - Erica scopea) the vegetation involves to high maquis or forests. We see no difference from this point of view between the impacted (ie : the buffers) and the non impacted area.

As far as the fire is concerned we can't see any difference between the ability of the farm type to decrease the risk (except for Chestnut that are rarely touched and for the goats that are often touched). The medium size of the fires has particularly increased for areas "impacted" by the beef cattle.

Concerning the effect of CAP on farm type dynamics among other drivers the results are manly in accordance to what we expected. The main hypothesis that is the fact that farm disappearance leads to the increase of catlle farming is confirmed. Being our sample quite small we must confirm the results at a larger scale. Concerning the effects of CAP measures applied to livestock activity we must be cautious. What we can affirm is that CAP premiums (animal subsidies, LFA allowances) do not hamper the development of beef cattle framings system , and that beef cattle industry is the way to maximize the uptake of these premiums in a context of land abundance. But results clearly show that the key problem is the disappearance of smaller farmer system based on ewes and goats. The prospect could be then to appraise the possibility to design CAP application aiming to maintain these later in order to make them more attractive for young farmers. We must note that, recording here the results of the first part that picture the evolution of the landscape toward a non-pasturable state, the techniques and skills necessary to keep and exploit this kind of landscape (generally non-mechanisized land) can be part of the solution and not only the subsidies / farmers.

If we focus now in the problem of the specific regulation service provided by the agriculture, that is fire risk prevention, the general tendancy leads to a non control of the biomass by the farmers. The CAP as it is doesn't change anything according to our results in that tendency. The only ones systems that seem to have an impact on risk are for very different reasons the chestnuts orchards and the dairy ewes systems. Concerning these later the fires used to be in their area more numerous but of smaller extension of today. It is to investigate if the use of controlled fires (prescribed fires) within the farm could be an efficient tool to control the biomass. Maybe a mixt of controlled fires or any traditional technique to control the vegetation growth in non-mechanized areas and intensive traditional cultivation as chestnuts or other orchards could be a way to promote.