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Case study: multidimensional comparison of local and global fresh tomato supply chains in France (task 3.5)

Agnès Bellec-Gauche, Yuna Chiffolleau, Camille Maffezzoli

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GLAMUR

Global and local food assessment: a MULTIdimensional performance-based approach



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GLAMUR

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Case Study: multidimensional comparison of local and global fresh tomato supply chains (Task 3.5)

Bellec-Gauche A., Chiffoleau Y., Maffezzoli C.

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Summary

Tomato is one of the most consumed vegetables in Europe. In South of France and Spain, tomatoes are produced, exported or imported, through a diversity of chains. This report presents the results of performance assessment of three contrasted chains representing main trends in those areas: one global chain, from Almeria, Spain, to South of France and involving producer organizations; two local chains, conventional and organic, in South of France. We first describe the context of the chains, and the research questions we designed from the main issues associated with these chains in the professional press. Then, we detail the final list of attributes, indicators and sub-indicators which we selected, in an iterative process between theory and practice, to respond to these questions, and cover the five dimensions of chains performance in the case study. Data have been collected or produced through literature review, interviews and a collective workshop. Results confirm that global and local chains are both globally performant, but at different levels and regarding specific indicators. While global chains tend to perform better in the economic dimension, local chains show better scores in the other dimensions (social, environmental, health, ethics); agricultural and governance models in each chain have nevertheless a strong impact, and unexpected results have been found. Further work has to be done to better compare results, and get feed-back to research questions and for practical implications, while accounting for the theoretical and methodological limits of the case study.

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2. Introduction

In this case study report, we present the results on the performance of local and global fresh tomato chains. This study is carried out by teams from INRA in France and UAB in Spain. Two local and two global chains are analysed. The local chains consider tomatoes produced in the surroundings of Barcelona or Montpellier, and sold directly to consumers, in local open-air markets or on-farm in the French case, in basket schemes in the Spanish case. The two global chains consider tomatoes produced in Almería, Spain, distributed through wholesale markets in Barcelona and Perpignan, and sold to consumers in supermarkets in Montpellier or Barcelona. The French team studies a global chain involving producer organizations, as representative of a major trend in global chains. In our analysis we consider all the stages from the production until the point of sale to the consumer.

This report is structured as follows: First, we identify research questions challenging both French and Spanish tomato chains regarding their performance in the five dimensions taken in account in the GLAMUR project. Those questions have been defined according to a review of literature, interviews of experts and primary data already collected by the teams. They also take into account the national challenges of France and Spain regarding food chain performances reported in the WP2 report: neoliberalism and food system sustainability in Spain, territoriality and global competition in France (Kirwan *et al.*, 2014). We designed the relations between those research questions and

specific attributes from the GLAMUR common list of 24 attributes. Following the systemic and analytic perspective of the GLAMUR project, indicators have then been selected and adapted from reference grids (notably SAFA), or proposed from other works, in order to cover the data needed to answer to the research questions on the one hand, and to assess and compare tomato chains performances regarding specific attributes on the other hand. This report presents the achieved work.

2.1. Structure of the report

In the following section, we first briefly present the French and Spanish tomato sector embedded in both national and international markets, secondly we present the background of our case studies through the distinction of “local” and “global” tomato chains, the scope of the value chains and a general presentation of the case study. In a second section, we present the research framework which includes the development of specific research questions and objectives, and the selection of concerned attributes within the common list of 24 attributes of the GLAMUR Project (Kirwan et al., 2014). Then, we present the first set of selected indicators, the modification we had to make after confrontation to data and experts, and the final list of indicators used in the study case. We show how we defined each indicator through several sub-indicators in order to contextualise, assess and benchmark the data collected to measure the level of performance.

2.2. Introduction to the French and Spanish fresh tomato sectors

2.2.1. The French fresh tomato sector

In France, tomato is one of the best examples (with wine) of “glocalisation”, that means the paradoxical co-existence of local and global chains. Tomato is both a consumer product (95% of French people consume tomatoes, either fresh or processed) and a “socio-political product” as far as the production or consumption of organic “ancient varieties” may be either a strategy of distinction (identity, social class) or one of the symbols of alternative food chains opposed to agro-industrial mainstream models (Medfel, 2012).

France is not self-sufficient regarding of production (600 000 t) and imports (400 000 t) mainly from Morocco and Spain. It exports to other European countries (140 000 t, among which imported tomatoes re-exported). The production is decreasing because of international competition. Brittany and South-East of France are the most important regions regarding production, followed by South West, Loire Valley and Languedoc-Roussillon. Regions differ in matter of production techniques and governance: in Brittany, almost all the production comes from glass greenhouses, warmed in most cases, and grow-bags, and producer organizations are very big. We propose to study the Languedoc-Roussillon region as far as the production conditions are quite similar as in Spain: i) tomatoes are mostly produced under cold shelters (non-warmed greenhouses or plastic tunnels); ii) there are both independent producers and producer organizations.

At the national level, production is very concentrated: almost 90% of tomato producers using shelters cultivate tomatoes on less than 0,5 hectare. A little more than 5% of producers cultivate tomatoes on more than 1 hectare and share 2/3 of the production surface of tomatoes in France. Tomato intensive production is a high financial activity, very dependent on the CAP payments (high investments are needed for glass greenhouses; 1 ha of glass greenhouse costs 1,5 million of euros). There is one national PDO (Protected Designation of Origin), a system of geographical

product indications, for tomatoes ('PDO France'). It is very different from other products for which PDOs are more regionally based.

Tomato trade is submitted to international regulation (WTO), which defines norms and standards of quality and traceability (HACCP). However, the tomato chain has been largely disturbed by the E.Coli crisis in 2011.

The tomato market is highly segmented: there are 30 types of tomatoes proposed to consumers; the basic round tomato is less and less produced and replaced by differentiated products: cluster, cocktail...

The role of producer organizations is crucial in fruits and vegetables chains in France: regarding the tomato sector, 70% of the French production is collected, packed and sold through producer organizations. These organizations tend to concentrate. The marketing channels of the remaining 30% are less known and include self-consumption. Producer organizations propose more and more packed tomatoes with their own trademark, along with the PDO or not, and negotiate directly with supermarket chains (via central buying services). They benefit from the interest for 'made in France' products. They also export directly to international markets. Supermarkets, catering and exports represent 90% of their production. The last 10% are sold directly by producers belonging to the producer organization.

Supermarkets are stricter than international requirements in matter of food safety, that is why producer organizations develop their own tool of mastering and control of quality and esp. residues in order to entry this market.

2.2.2. The Spanish fresh tomato sector

A detailed presentation of this sector is proposed in the UAB tomato case report. We just highlight here the main information to contextualise the global chain the French team focused on.

At European level, Spain produces one fifth of the European production of tomatoes with 10% of the agricultural land allocated to that purpose. Tomatoes account for about 20% of the total production of vegetables; one third of that is exported and more than half of the production is consumed internally. It has been the 5th-7th crop in terms of gross production value during the last lustrum.

Almeria is one of the most important regions of tomato production in Spain and thanks to its microclimate, production systems do not need to be warmed artificially. The production is based on an economic model of intensive agriculture: high level of capital investment and workforce, use of technology (26 800 hectares of tunnels, including 2 200 hectares soilless). The natural soil is poor in organic components and hence, tomatoes are planted in a mixture of sand and earth with manure. The average yield is 10 kg/m² during a winter cycle of 6 months. Small farms to big firms are involved in production. Strategies are based on price competitiveness due to international competition. A large part of Almeria production is exported, mostly in Europe: France, Germany and the Netherlands represent 95% of the market share.

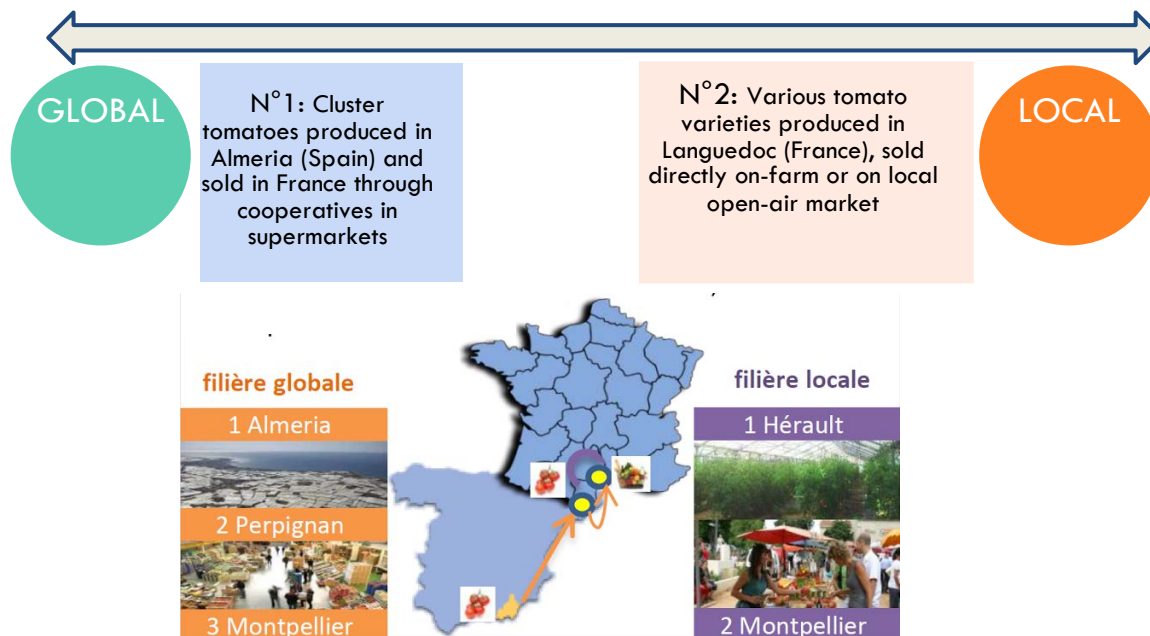
Moreover, Almeria is configured as an agro-industrial cluster: production is structured around farms, which present a high specialisation in tomato production, wholesale private firms, 'processing agricultural societies', cooperatives dedicated to export, inputs suppliers, and technical support providers.

3. Definition of the case study and boundaries

3.1. From major trends to study case definition

Regarding fresh tomato chains, two types, respectively in global and local markets, represent major trends in Southern Europe: we selected these two types for a performance assessment.

Figure 1: two major types of tomato chains in Southern Europe



Moreover, as 10% of the French farms involved in short food chains get the organic label (Agreste, 2012) and organic tomato consumption is increasing more than conventional (France Agrimer), we consider two different local chains: one conventional and one organic.

More largely, in matter of tomato consumption, in 2013, in France, 95,8% of households declared buying fresh tomatoes for home consumption. That represented, in 2013, a consumption of 15,3kg / year and household (Ministry of Agriculture) and 18% in volume of vegetables purchases (France Agrimer). The cluster tomato is the most consumed variety in France (46% of market shares in 2013; CTIF; Kantar World panel) but 'ancient' varieties are, according to experts, more and more consumed.

3.2. Distinction of "local" and "global" tomato chains

Referring to the GLAMUR framework, local and global chains can be differentiated by 4 main key-dimensions which are :

1. The physical and geographical distance between producers and consumers,
2. The type of governance and organization of the supply chain,
3. The kind of resources, knowledge and technologies employed,
4. The way supply chain stakeholders shape product identity with regard to the reference to the territory of production for food plays a relevant role or not.

In the case of fresh tomato local and global chains studied by the French team, these key-dimensions can be detailed as follows:

Table 1: distinction of local and global chains in the study case along GLAMUR criteria

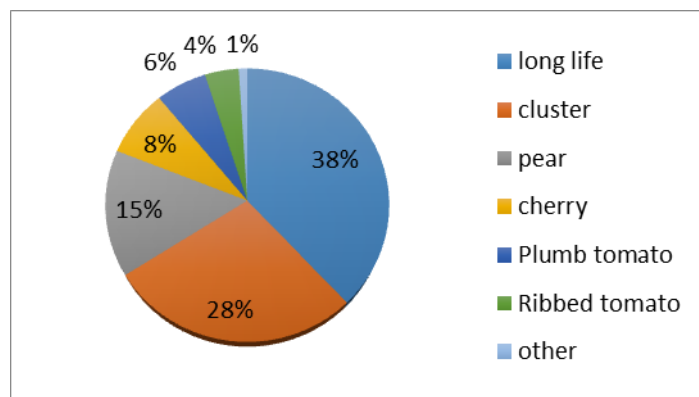
KEY-DIMENSION	LOCAL FRANCE (conv-organic)	GLOBAL SPAIN-FRANCE
PHYSICAL AND GEOGRAPHICAL DISTANCE	Producers and consumers are located in the same district or within a radius of 150 km in Languedoc-Roussillon Direct selling in local open-air markets or on-farm	Producers belonging to a 1st degree cooperative, integrated in a 2nd degree cooperative, in Almeria, Spain and consumers in Languedoc-Roussillon, France. Minimum 2 steps between farm and consumption. Tomato sold in supermarkets in South of France
TYPE OF GOVERNANCE AND ORGANIZATION	Moinly small producers and big producers diversifying their outlets Atomized production for most of them; some of them also belong to a producer organisation	Small producers, 1rst and 2nd degree cooperatives, Agro-industrial district in Almeria. Logistic and buying platforms in Languedoc-Roussillon.
RESOURCES, KNOWLEDGE AND TECHNOLOGIES	Both ancient varieties and hybrids Importance of human resources No subsidies	Hybrid varieties, generic round and cluster tomatoes. Technology for pakaging and transportation Collaboration with research to improve productivity and competitiveness; public subsidies dedicated to technological innovation
PRODUCT IDENTITY, LINK WITH TERRITORY	10% of farms = organic Few local varieties specific to a territory One of the main products of the Mediterranean diet	No label

The case study is defined by functional and structural limits: the functional unit is 1 kilo of marketed tomato and chains are analysed from producers to selling points. In most cases, we have not been able to take into account the challenges at the level of inputs suppliers or service providers, whereas access to resources is also a major issue for those actors. We were also not in a position to detail consumers' practices regarding tomatoes by primary data and thus, reduced our analysis of consumption to secondary data.

3.2.1. Characteristics of tomatoes marketed in the global chain

Global chains from Almeria propose 7 varieties, among which two represent the main part of market shares: “long life” and “cluster” tomatoes. The global chains impose criteria of functional quality that impact breeding, cultivation cultural and distribution systems (Bressoud, 2010): (i) homogeneous aspect of the product, (ii) resistance to shocks, iii) long conservation and maintenance of a good aspect in the shelves, iv) availability of product during a long period. Choice of varieties, cultural season, stage of maturity at harvest and modes of transportation and conservation is made regarding these quality criteria

Figure 2: Type of marketed tomatoes in season 2011/2012 in Almeria (Giagnocavo et al., 2012)



3.2.2. Characteristics of tomatoes marketed in local chains

In the local chains of Southern France varieties are very different from the ones imported, as far as quality criteria expected by consumers are not the same: taste, optimal maturity... Cultivation systems are based on a large range of varieties and often include ‘ancient’ or ‘rustic’ ones (Demarque, 2010).

Table 2: Characteristics of products according to the type of chain considered in the study case

	Local, conventional agriculture	Local, organic farming	Global, conventional agriculture
Type and range of varieties	Consideration of different varieties: hybrids and ancient. Selection for taste, rusticity, diversity of forms and colors		Focus on cluster tomato, the most consumed tomato in France, selected for productivity, firmness, homogeneity
Unit of product	1 kg of marketed tomatoes	1 kg of marketed tomatoes	1 kg of marketed tomatoes
Differentiation of products by production techniques	No	Organic agriculture	No
Period of availability for French consumers	Summer short cycle June - September	Summer short cycle June - September	Winter long cycle December - June

3.3. Study case presentation

3.3.1. Global fresh tomato chain from Spain to France : focus on cooperatives

A detailed presentation of Almeria province is provided in the Spanish team report. We just want to stress the importance of cooperative organizations in global chains coming from this province: they represent 65% of fruit and vegetables exports from Almeria and 70% of the total production (Giagnocavo et al., 2012).

We thus chose to study the case of a 2nd degree cooperative, gathering the production of 72 first degree cooperatives in Spain, among which 3 in Almeria. This cooperative is the Spanish leader in fruits and vegetables commercialization. It gathers different hybrid varieties of tomatoes (round, cluster, cocktail...), grown in non-warmed glasshouses. Tomatoes are exported to France from December to June (counter-season). In the case of the cooperative under study:

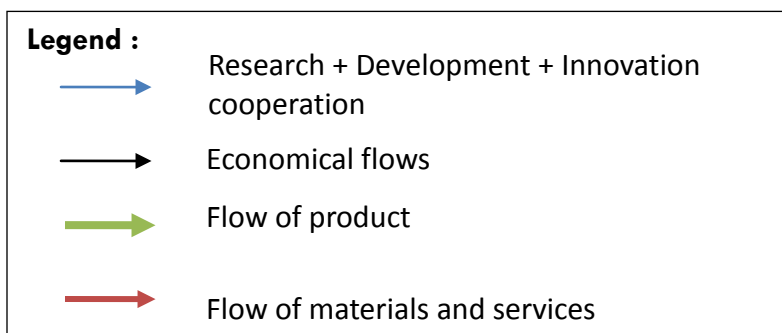
- Tomatoes are produced on small farms of an average surface of 2,4 ha, among which 6 200 m² of greenhouse.
- The produce is collected and packaged in Almeria by the 1st degree cooperative, then sent from Almeria to the logistic platform of the Spanish 2nd degree cooperative based in the Saint-Charles wholesale market in Languedoc-Roussillon, France: the distance is about 1 200 km and the road transportation is made by refrigerated trucks (temperature 7-8°C) which do not belong to the cooperative; cost of transport is 0,07 Euros/kg
- The logistic platform prepares the commands every day and sends them to buyers, among which supermarkets buying centres represent 65% of the market share; purchase is managed in tense flows: the



platform has a stocking capacity of 120 000 pallets and tomatoes have to stay less than half a day. 80 persons are employed at this stage;

- The produce is delivered from the 2nd degree cooperative platform to supermarkets buying centres: we selected the buying centre of Super U supermarkets, based in Montpellier periphery. The current trend is a centralization of demand with a lower number of buyers and a higher demand of quality products. Annual contracts are made with supermarkets. They require diverse qualities and suppliers have to deal with calendars of promotion.
- The produce is delivered from buying centres to supermarkets: we selected the case of Super U supermarket in Montpellier suburbs.

Figure 2 : Map of global tomato chain from Almeria to Languedoc-Roussillon





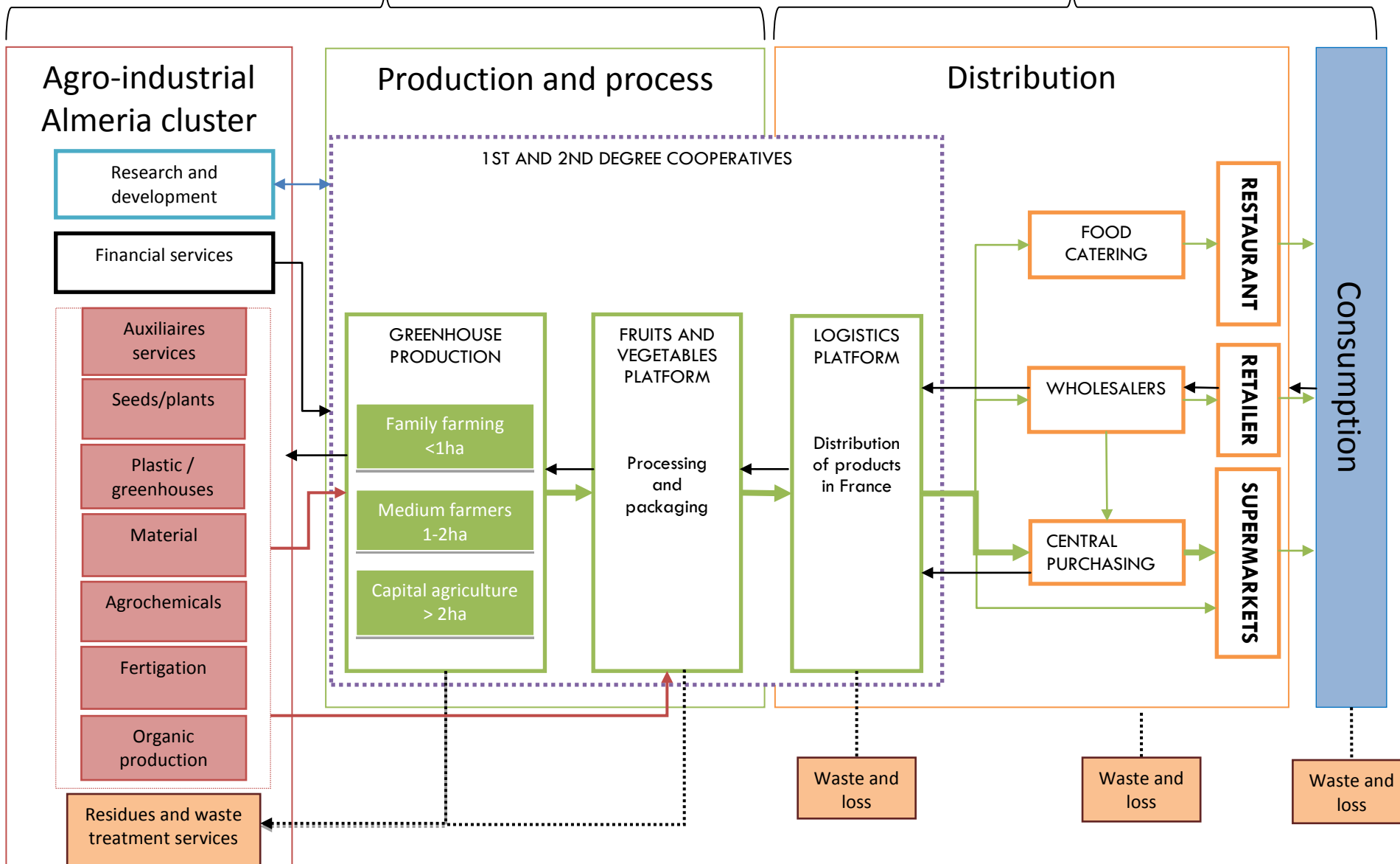
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SPAIN Almeria

FRANCE Languedoc



Source : Authors, from data in Ferraro Garcia, Aznar Sanchez, 2008; and García Martínez de San Vicente, 2012.

3.3.2. Local fresh tomato chain in France

The study case considers tomatoes produced in the Languedoc-Roussillon region, in Southern France.

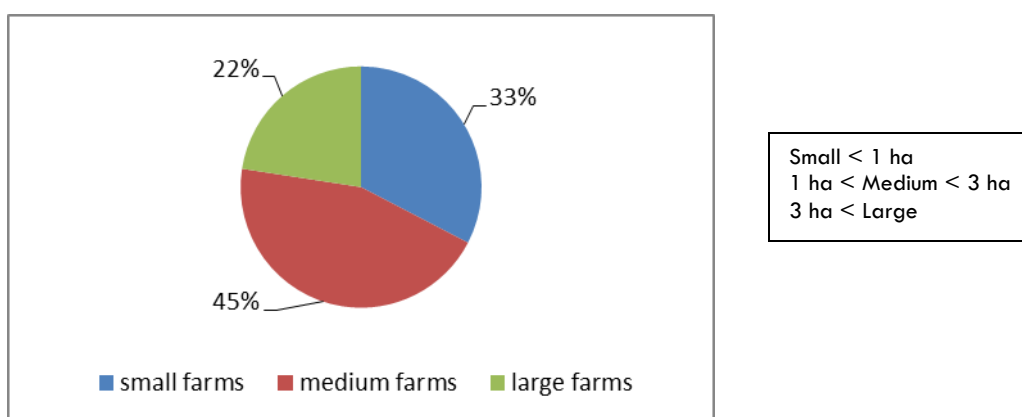
Vegetable production in Languedoc-Roussillon, France has been very affected by economic crises and European and Marrocco competition during the last twenty years. Vegetables surface decreased by 16% between 1979 and 2005. Historically, producers close to Perpignan, where there is a major wholesale public market, have been oriented towards exports. The situation has changed and today 75% of installations in vegetable production are linked with short chains. Access to land is a major constraint in this region. Organic farming or similar production techniques have been increasing during the last years and now represent 10% of the number of farms involved in short chains (while only 2% of farms involved in long chains; Agreste, 2012).

In 2010, in Languedoc-Roussillon, 886 farms were producing tomatoes on a total surface of 91 616 ares:

- 75% of these farms produce less than 0,5 ha of tomatoes, 11% between 0,5 and 1 ha, 7% between 1 and 3 ha; and 2% more than 3 ha.
- 73% of these farms produce tomatoes in open-field or under low shelters or tunnels, that represent 82% of the cultivated surface; production cycle is short and in Summer
- 19% of these farms sell a part to all of their tomatoes through short chains: 33% of those ones are small farms and 84% of those ones sell notably on-farm.

Source: National Agricultural Census, 2010

Figure 3: Size of farms producing tomatoes and selling them in short chains in Languedoc-Roussillon, France (Agreste, 2012)

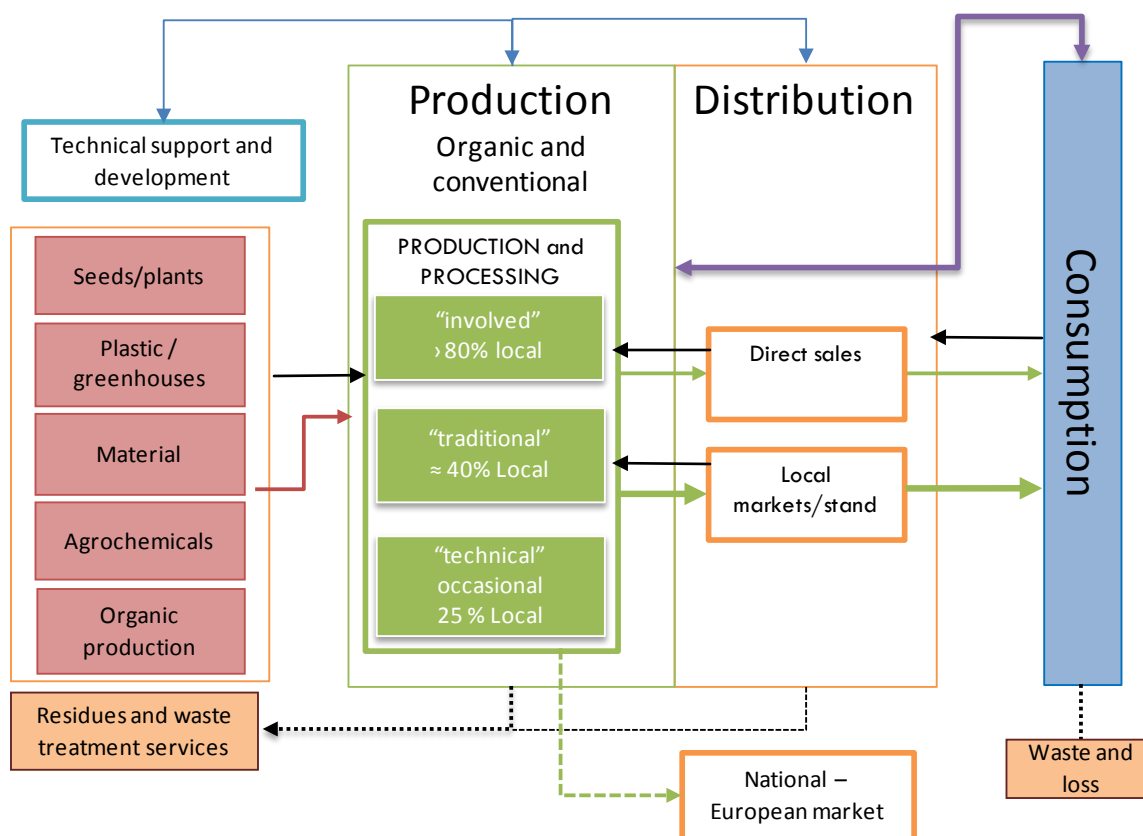


The local tomatoes chain will be assessed through a sample of diverse farms partly involved in “short and proximity circuits” and situated in Languedoc-Roussillon. On-farm and open-air markets are, in France, the most important outlets for farmers regarding short food supply chains (Agricultural Census, 2010). Farmers usually sell to the closest open-air markets, especially in fruits and vegetable production, so that this chain is

also local. We study local chains through two different samples. The first sample composed of about 30 farms in the South of France had been previously studied along the technical, economic, social and management dimensions. It represents 3 types of vegetable producers in short food chains in France (Gauche, Chiffolleau, 2015): 'involved', 'traditional', 'technical'. Those types have been defined according to farmers' objectives and (commercial, technical, social) practices, rather than according to farm size, farmer's skills or equipment level. Those types may be found all over France but, in order to make a relevant confrontation with Spain, only farmers in the South of France are considered. As in Spain production takes mainly place in plastic tunnels. This second sample had also been previously studied by our team, but more precisely regarding the social dimension of sustainability (Chiffolleau, 2009). It includes also about 30 farms in Southern France who produce tomatoes mostly for local chains and sometimes for global ones; 10 of them are still followed.

From these two samples, we observed an average transport of 1 600 km per year and per producer to sell tomatoes on open-air markets.

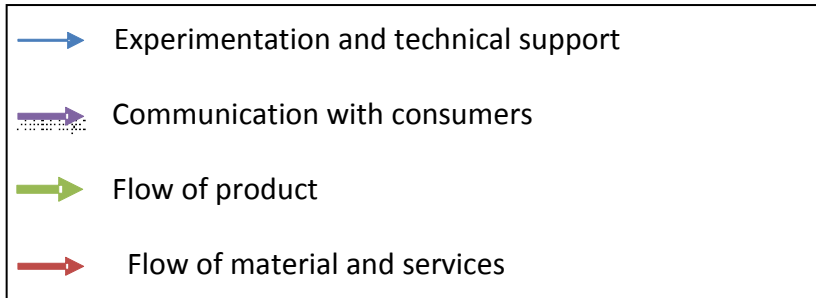
Figure 4 : map of tomato local chains in Languedoc-Roussillon



Source: authors



Legend



From an organizational perspective, local chains are characterized by:

- The absence of producer organisations;
- A low level of technical support regarding extension services

Selling on-farm is the less costly option for producers of the local chain. Selling on open-air market requires more time, may be limited by access to a place and is sometimes assessed as hard. This outlet remains the 2nd most important short chains for producers (in volume) but appears as a transition stage for many producers, which evolve towards farmers' shops or basket schemes.

3.3.3. Comparison between local and global production systems



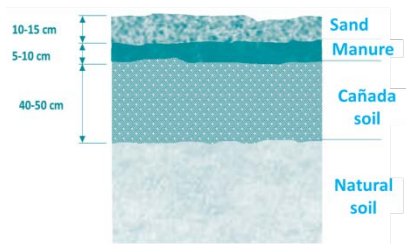
	France		Spain
Type of chain	Local, conventional agriculture	Local, organic farming	Global, conventional agriculture
Agricultural model	Specialization in vegetable production or association perennial crops/ vegetables		Specialization in tomatoes or solanaceae (green peppers...)
Size of farms	Small	Small	Small
Type of shelter	Plastic tunnel 8m	Plastic tunnel 8m	Cold greenhouses of type “plano” and “raspa y amagado”
Warming	no	no	no
Enrichment in CO2	no	no	no
Cooling strategy	bleaching	bleaching	bleaching
Range of vegetables surface under cold shelters (m2)	300 to 2 500		7 500 to 25 000
Type of soils	silt-sand-clay or clay-limestone	silt-sand-clay	“enarenado” (mixture sand-earth-manure)
Seeds and plants	Problems of procurement in plants Implementation of plant nursery on farm		Good supply in plants with technical advice
Date of sowing or transplanting	March	March	August-September
Plant density (plants/m2)	1,4 to 3		1,36 to 1,72
Engrafted plants	no	no	yes
Irrigation strategy	Drip	Drip	Drip
Fertilization strategy		Organic soil conditioners	Through irrigation (> 60% automate)
Average yield (kg/m2)	hybrids: 11 ,4 ancient: 6,4	hybrids: 9 ancient: 5,2	Hybrid cluster: 9-11
Processing / handling	No	No	Calibration in collection center (2 classes for cluster tomatoes), packaging
Equipment level	Low	Low	High
Number of salaried workers	1 to 2	1 to 2	2 to 4
Number of family workers	1 to 2	1 to 2	1 to 2
% of time dedicated to selling / total working time	Between 8 and 40		0

Table 3: characteristics of production systems according to the type of chain considered in the study case



The figure below represents the typical soil used in Almeria tomato production.

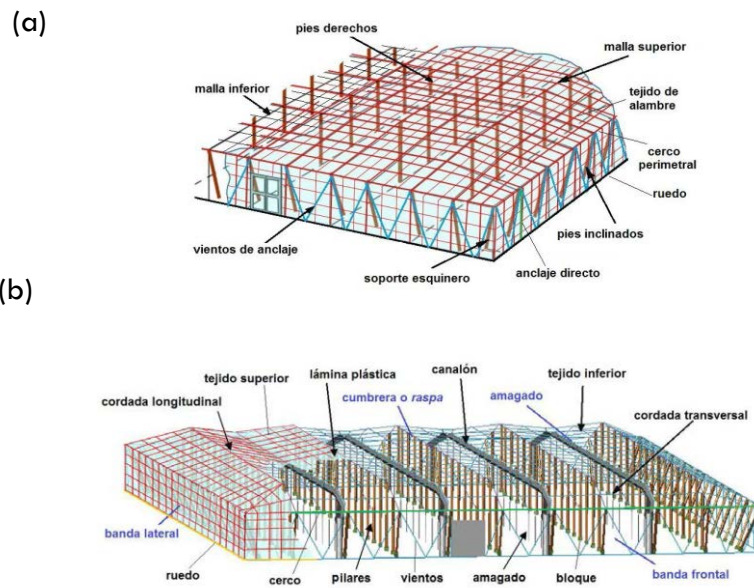
Figure 5: soil 'enarenado' used for tomato production under shelter in Almeria



Source : Cajamar caja rural, 2014

Figures 6 and 7 compare the shelters used respectively in Almeria and Languedoc-Roussillon for tomato production.

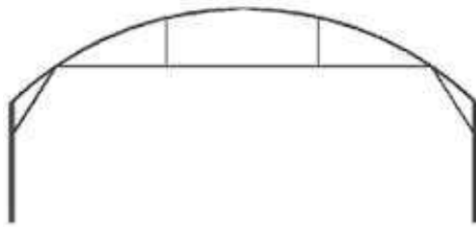
Figure 6 : Types of shelters used in Almeria : type *parral plano* (a) et type *raspa y amagado* (b)



Source : Cajamar caja rural, 2014



Figure 7 : type of shelters used in local chains in Languedoc-Roussillon



Height : 3 to 4 m

Width: 7 à 9.50 m

Source : Bouchaud, 2014

2.3. Main critical issues of the local and global chains

A first review of literature and interviews with experts during the GLAMUR quickscan, highlighted some critical issues in the fresh tomato chains, both in France and Spain. Those are useful for framing the case study, and will be discussed after data processing:

Price and distribution of added value: Price is the first buying criteria for most consumers. At the level of the global market there is a strong price competition between mediteranean producing countries. In the case of farmers involved in the global food chain, prices of inputs are an important component of production costs. Energy consumption and productivity of land are also important factors in this regard. Selling prices as well as volumes contribute to make the business profitable.

The number of intermediaries and the effect of competition tend to reduce the level of remuneration of producers and workers in the global chain. Central purchasing imposes low prices to farmers, who are faced with massive competition from imported products. Downstream distributors are looking to increase their margins, and consumers are finally buying a kilo of tomatoes three to four times more expensive than the price paid to producers.

Models of production: To provide tomatoes all the year at competitive prices, agro-industries choose models of intensive crop systems under greenhouse, in many cases soilless, to maximize yields and control plant nutrition parameters. This model may nevertheless be presented and even assessed as environment-friendly as inputs are under control and relation with the natural environment is reduced.

Pollution and environmental impacts: Tomatoes produced in Spain make long distance in refrigerated trucks to be sold in France and others countries. increasina GHG emissions. Almeria is located in a lot of



waste and residues tarps scattered around sites of production. However, the area has official landfills and recycling plans, but they are scarce and expensive, prompting farmers to burn their waste on site. Fertilizers and pesticides are also used in large quantities. They accumulate in soils and waters, disrupting the functioning of ecosystems.

Working conditions and labour rights: The search for economic competitiveness by tomato growers in Almeria is associated with a hiring strategy of foreign workers enabling companies to minimize labor cost. The respect of labor rights and decent living conditions are strong issues in this agricultural region. Moreover, workers are the first exposed to the effects of chemicals used in greenhouses. Local chains also appear, in some cases, as sources of moonlighting with difficult working conditions.

Workers and consumers health: While workplace exposure to pesticides has a direct impact on workers (production, processing crops, health programs, etc.), the population is exposed primarily through its food and its environment. Tomato consumption may be questioned as far as chemicals use may be important and little controlled, both in global and local conventional chains, beyond official regulations.



4. Research Design

4.1. Global design of research: an iterative process

We implemented an iterative process to get the final list of research questions, attributes and indicators of performance that will be assessed through the present case studies.

1. Definition of a first set of research questions regarding the main issues of global and local tomato chains in Spain and France from the quickscan reports, further discussions between the French and Spanish teams and a thorough literature review
2. Selection of relevant attributes regarding these questions
3. Mind map of the relations between research questions and attributes
4. Selection of indicators from available lists of sustainability indicators or from more focused works (especially in the social dimension)
5. Comparison of the selected indicators with the available data, experts' points of view and Spanish team objectives
6. Modification of research questions and adaptation of the list of relevant attributes
7. Definition of relevant and assessable indicators regarding the new list of research questions: different choices between the French and Spanish teams
8. Definition of sub-indicators for complex indicators
9. Characterisation of each indicator or sub-indicator considered as a chain descriptor
10. Benchmark of each indicator or sub-indicator of chain performance

4.2. Final list of Research Questions

1. How and at which stage does each chain create added value and how is this added value distributed among actors, including farms' employees?

This question is also a way to cross economy and environment: in what extent added value is created through environment preservation? (e.g. through ancient varieties, etc.)

2. How and to what extent do the two chains contribute to the national, sectorial, territorial economy, including employment?

This question leads to include taxes in the assessment.

3. How and to what extent are the two chains physically accessible, economically affordable and socially trustful?

A national enquiry in France showed that short chains are used by 42% of the French population but that their use remains limited because short chains are too difficult to access (lack of time, lack of visibility...) (François et al., 2014).

4. At which level and to what extent does each chain favour both autonomy and cooperation?



“Autonomy” and “cooperation”, often addressed in literature, are complex and highly discussed concepts that need innovative indicators: the GLAMUR project is an opportunity to deepen such important issues.

5. How and to what extent does each chain consume, preserve, deteriorate, reproduce or improve natural resources?

This question is more complex than the others as far as it needs a longitudinal approach. However, this is a crucial issues regarding the transiton of food chains towards sustainability. Our work may give some tracks, if not results.

4.3.Final list of attributes and indicators

4.3.1. Final list of selected attributes

As mentiones before, we made a first list of attributes and indicators related to our research questions based on a review of existing performance grids (notably, SAFA) and more focused research works. Comparison with the available data and experts’ points of view, discussions with the Spanish team and working sessions to prepare data collection led us to modify both attributes and indicators. However, we kept the ambition to cover the maximum of dimensions of performance, especially the social and ethical ones, even if there may appear more difficult to assess than the others. Some attributes are linked to different dimensions.

Table 4: Selected attributes of performance of the case studies (attributes are associated with the main dimension to which they belong but we put in brakets how they may also contribute to another dimension)

DIMENSION	ATTRIBUTE
Economic	1.Contribution to economic development 2.Creation and distribution of added value 3. Affordability
Environmental	4.Biodiversity 5.Pollution 6.Ressource use
Social	7.Information and communication 8.Connection 9.Territoriality (+ 2, 3, 11, 12, 13)



Health	11. Food safety 12. Nutrition
Ethical	13. Labor relations (+ 2, 3, 7)

4.3.2. Final list of indicators

The iterative process between research design and confrontation to data, experts and colleagues led to a final list of indicators, relevant to assess the research questions. However, the final list remains a working list: the GLAMUR project is an opportunity to test the relevance and the feasibility of the selected indicators in order to assess food chain performance. This test is a result in itself, as well as the redefinition of indicators. In available grids as SAFA for instance, indicators are still general or complex, and often difficult to assess directly. A more operational definition, focused on what has to be measured, scored or qualified, is needed to assess SAFA indicators.

From a first list of 13 attributes and 45 indicators, we consolidated a list of 13 attributes and 31 indicators, both quantitative and qualitative. The Spanish team chose to focus on a smaller list of indicators, mainly quantitative.

Note that some indicators are still a synthesis of other indicators: for instance, the 'GHG emissions' requires the implementation of a Life Cycle Assessment method to be calculated.

4.4. Contextualizing and benchmarking of the indicators

The process of definition and contextualization of each indicator has been implemented from literature review and collection of references in order to develop a set of benchmarks to score performance. We also mobilised experts from scientific and technical areas to support this process, either during individual interviews or through a collective workshop in Montpellier.

The table below shows the list of experts we mobilized in the process of indicators and benchmarks definition and validation.

Table 5: panel of experts mobilized in the study case

Name of the expert	Organization	Area of expertise
Martine Padilla	CIHEAM, research – FLONUDEP European project	Food Chain global approach, specialist in nutrition/consumers issues
Fatima el Haddad Gautier	CIHEAM / UMR MOISA, research	Governance of global value chain
Selma Tozanli	CIHEAM / UMR MOISA, research	Governance of LFC, of GVC
Dominique Grasselli	CTIFL Technical institute	Economic approach of tomato chains
Mireille Navarrete	Agricultural research INRA	Cropping systems
Zouhair Bouhsina	Agricultural research INRA	Economy and relations among chain actors, Fruit and vegetable specialist
Valérie Séné	INTERFEL, interprofesional organization	Governance and commercial relations in the vegetables chains
Benoît Jeannequin	Agricultural research INRA	Cropping systems, specialist of vegetable production in global chains
Marc Voltz	Agricultural research INRA	Soil mechanisms and interaction plant-soil
Alain Arrufat	CIVAM 66, farming development association	Specialist of vegetable production
Gilles Planas	Chamber of Agriculture 66, extension agricultural organism	Specialist of vegetable production

4.5. Final methological matrix

Attribute	Indicator	Unit	Method for assessment and resources	Sub-indicators	Benchmark	Benchmark ranking
Contribution to economic development	Net Income	EUR/FTE (farm)	Annual disposable income obtained by farmers	Compare the net income for farmers to the national average for the same type of crop system In France : 25400€ (2013)		High : France 28 000€ (Agreste, 2013); Spain 21662 € (MAAMA, 2013) Medium : France 14000€ ; Spain 10831€ Low : 0
	Contribution to employment	FTE/ha (Full Time Equivalent) 1 FTE = 229 working days/year, 1 607 h	Direct employment created at the level of the production. Both salaried and non-salaried work have been included			High : 2,5 national average for vegetable sector Medium : 1,25 Low : 0
	Access to market	Ordinal Four categories	Check factors that limit market access for producers and producers organization (global) Level of difficulty to enter the chain according to chain actors	1. installation costs 1.a. greenhouses (€/m ²) (except land, including subsidies) 1.b. agricultural land cost 2. degree of concurrency in the chain [check: number and type of operators for the same product, regulation barriers] 3. Application of specification / private voluntary standards (sanitary requirements, quality) 4. Implementation of strategies to enter the market (risks and flows rationalization, logistical platform, resource pooling, long winter crop cycles, engaging consumers)	1. score of 0 to 2 1.a. if > 10€/m ² (1 point) 1.b. if > 15 000 €/ha (1 point) 2. score between 0 and 4 3. score between 0 and 2 (check number of standards applied by farmers/organizations) 4. score between 0 and 2 (deducted)	High : 8 Medium : 4 Low : 0
Creation and distribution of added value	Added Value	EUR/kg	Check the amount of added value per kilogram of product sold	Calculate the added value created for one kilo of product and received by the farmers.		High : 1,8 Medium : 0,9 Low:0
	Economic Productivity	EUR/m ²	Measure the amount of added value per unit of productive land at the level of the farm.	Added value/m ²		High : 5,85 Medium : 2,93 Low : 0
	Share of farmer's price on retail price	%	Average annual price obtained by farmer/average annual price paid by consumer (%)	Compare the price paid to the farmers with the price paid by the consumer.		High : 100% Medium : 50% Low:25%
	Cash Position	Ordinal Four categories	Identify the trend of the net cash flow for the enterprise, the cash issues associated and the strategy to solve it	1.Level of Cash (possibility for the farmer to collect reasonable level of income throughout the year [local]) 2. Ability to finance current investments (small equipment, etc.) 3.Cumulated time during which cash position is negative or not sufficient 4. Debt ratio	1.score between 0 and 4 (1 is low and 4 is sufficient throughout the year) 2.score between 0 et 2 (2 if self-funding, 1 if self-funding + loans, 0 if no possibility to fund) 3. score between 0 et 2 (2 if positive cash position all the year, 1 if time < 4 months, 0 if time > 4 months) 4.score between 0 and 2 (2 if no debts, 1 if debt ratio < 30% of net assess, 0 if debt ratio > 30%)	High : 10 Medium : 5 Low:0

	Price decision-making	Ordinal	Qualitative indicator Focuses on the type of policies and practices of buyers which recognize and support two dimensions: primary producers' rights to fair pricing; and primary producers' rights to fair contracts or agreements. Assesses the rules of negotiation between producers and buyers. Proxy to assess how chains favour fair trade.	<ol style="list-style-type: none"> 1. access to relevant information for pricing 2.capacity to fix or negotiate the sale price 3.level of volatility of the market prices (eg differentiation of marketing channels) 4.long-term commitment with an agreed minimum price 5.availability of mediation systems / communication for negotiating prices and contracts 	<p>net assess)</p> <ol style="list-style-type: none"> 1.yes = 1 point / no 2.yes = 1 point / no 3. score between 0 and 2 (0 is high volatility, 2 is stable prices) 4. yes = 1 point / no 5. yes = 1 point / no 	<p>High : 6 Medium : 3 Low:0</p>
Affordability	Retail price	EUR/kg	Check the average retail price of the product for the considered period			<p>High : 4 Medium : 3 Low : 2</p>
Biodiversity	Soil management practices	Ordinal Seven categories	Assessment of the implementation of the best farming practices regarding the structure and the texture of the soil	<ol style="list-style-type: none"> 1. Limited area to produce under greenhouse 2. Crop rotation 3. Delay in return of culture 4. Addition of green manure in intercropping 5. Organic fertilization 6. Preference for practices to soil protection 7. Use of heavy machinery 	<ol style="list-style-type: none"> 1.yes / no (yes = 0) 2. yes / no (yes = 1) 3. delay<2 years = 0), between 2-4 years = 1, > 4 = 2 (excluding Solanaceae) 4. yes/ no (yes = 1) 5. yes / no (yes=1) 6. yes=1 7. yes / no (yes = 0) 	<p>High : 8 Medium : 4 Low : 0</p>
	Agro-biodiversity preservation practices	Ordinal Four categories	Assessment of the level of implementation of the best farming practices regarding functional and natural biodiversity	<ol style="list-style-type: none"> 1.Agricultural model: 2. number of tomatoes varieties cultivated on farm 3. Existence of practices to preserve biodiversity 4. Presence of traditional / non-hybrid varieties 	<ol style="list-style-type: none"> 1.specialized in solanaceous=0, polyculture<10 species=1, polyculture> 10 species=2 2. : 1<VarTo<5 = 1, 5<VarTo<10 = 2 3. ecological zone (flower strips, grass strips) = 1, integrated management pest = 1 point or biological control= 2) 4. yes/no, yes= + 1 	<p>High : 8 Medium : 4 Low : 0</p>
	Landscape management practices	Ordinal Three categories	Assessment of the worst farming practices regarding landscape	<ol style="list-style-type: none"> 1. Presence of visual waste 2. Degree of alteration of the natural landscape by intensification of agricultural activities [e.g. soil degradation, conservation of flora and fauna habitat, contribution of the activity to ecosystems connectivity and structural complexity of the landscape] 3. Modification of the landscape [geomorphological modification , degree of occupation of productive land by the considered agro-system] 	<ol style="list-style-type: none"> 1. yes/no (yes = 1 point) 2. score between 0 and 5 3. score between 0 et 4 	<p>High : 0 Medium : 5 Low : 10</p>
Pollution	Environmental pollution mitigation practices	Ordinal Nine categories	Sums the practices implemented to reduce pollution on air, water and soil	<ol style="list-style-type: none"> 1. Limitation and rationalization of phytosanitary products 2. Limitation and rationalization of fertilizers products 	<ol style="list-style-type: none"> 1. score between 0 and 2 2. score between 0 and 2 3. score between 0 and 2 4. score between 0 and 2 5. yes/no (yes =1) 	<p>High: 12 Medium: 6 Low:0</p>

				5. GHG mitigation practices [reflection of solar radiation, reduction of temperature] 6. preference for local-regional sourcing 7. effluent recovery equipment 8. preference for recyclable material 9. pressure on natural resources [water, land, natural]	6. yes/no (yes =1) 7. yes/no (yes =1) 8. yes/no (yes =1 point) 9. score between 0 and 2 (deducted)	
	GHG emissions	kg CO2 equivalents/kg	Evaluation of impact of Greenhouse effect 100 years (in tons of CO2 equivalent per unit of product). At the level of the production stages. LCA methodology			Wp4
	Material waste	Ordinal	Qualitative indicator to identify the expression of different sources and types of waste along the chain linked with actors practices. Checks the presence of each type of waste or wasting practice.	1. Production stage : [non used inputs, agricultural plastic used, residues of by-products of culture] 2. Packaging and distribution stage: [cardboards, papers, plastics] 3. Mitigation practices: [presence of recycling infrastructure in the production area, inputs collection chain, use of renewable material for the production and packaging of the product]	1. score between 0 and 3 (1 point per source of waste) 2. score between 0 et 3 (1 point per source of waste) 3. score between 0 et 3 (1 point per practice reducing waste)[deducted]	High : 6 Medium : 3 Low:0 Calculation method of the final score of performance = 1 - (score / highest value)
Resource use	Energy Consumption	MJ equivalent/kg	Assesses the non-renewable primary energy consumption at the production stage			WP4
	Loss of product along the chain	Ordinal Three categories	Assesses the expression of micro and macro factors impacting loss of product along the chain	1. Production stage : 1.a. product fragility 1.b. over-exploitation of primary production 1.c. calibration norms 1.d. valuing of non-sold or 2 nd category 2. Agro-food process and logistics stages : 2.a. number of steps in which product is handled 2.b. scale of marketing 2.c. packaging 2.d. warehousing 3. distribution stage : 3.a. product handling 3.b. time harvest-consumption 3.c. display rationalization 3d. product crushing	1. score between 0 and 4 1.a. yes/no (yes=1) 1.b. yes/no (yes= 1) 1.c. yes/no (yes= 1) 1.d. yes/no (no=1) 2. score between 0 et 4 2.a. if >2 steps= 1 2.b. if >100km=1 2.c. yes/no (yes=1) 2.d. yes/no (yes 1) 3. score between 0 and 4 3.a. yes/no (yes=1) 3.b. if time < 7 days=0, if >7 days=1 3.c. yes/no (no=1) 3.d. yes/no (yes=1)	High : 12 Medium : 6 Low: 0 Calculation method of the final score of performance = 1 - (score / highest value)
	Water consumption practices	Ordinal Four categories	Measure the water management practices used by the farmers and industry in the chain and assess the competition of agriculture to human water consumption.	1. technology and equipment do you use for irrigation 2. irrigation practices 3. technology and strategies for water preservation [sprinkler, mulching, watering in the evening / morning tighter crop hoeing] 4. Main source of water for irrigation use by farmers : [hierarchization of the sources of the most beneficial to the sustainable /	1. choice : drip (1 pt), sprinkler(0 pt), hose pipe(0 pt) 2. watering during the day (0 points), watering morning and / or evening (1 point) 3. yes/no (yes=1 point) 4. public network (1 point), river, rain water pumping ground water (1 point), water from a desalination plant(0 pt), no control of water use (0 pt)	High : 4 Medium : 2 Low:0

Information and communication	Transparency for consumer	Ordinal Seven categories	Assess the ability of chain actors to communicate and share information to consumers. Checks the number and nature of key information available for consumer	<ol style="list-style-type: none"> 1. environmental or social performance 2. geographic origin 3. production methods 4. harvest date 5. direct communication between producer-consumer 6. website available 7. In addition 1 point if other key information given to consumers : nutritional quality, ingredients... 	<ol style="list-style-type: none"> 1. yes/no (yes =1) 2. yes/no (yes =1) 3. yes/no (yes =1) 4. yes/no (yes =1) 5. yes/no (yes =1) 6. yes/no (yes =1) 7. yes/no (yes=1) 	High : 8 Medium : 4 Low:0
	Pedagogic contribution	Ordinal Three categories	Assess the capacity of chain actors to raise consumer awareness on topics related to the product, impacts, consumption, etc.	<ol style="list-style-type: none"> 1. pedagogic activities on farm 2. pedagogic/ Awareness-raising actions to food activities in selling point 3. actions to promote fruits and vegetables consumption 	<ol style="list-style-type: none"> 1. yes/no (yes =1) 2. score between 0 and 2 3. yes/no (yes=1) 	High: 4 Medium: 2 Low:0
Connexion	Relationships with suppliers	Ordinal Three categories	Qualitative indicator to measure the level of connection between producers or producer organization and suppliers	<ol style="list-style-type: none"> 1. Imposed relationship or chosen by the producer <ol style="list-style-type: none"> 1.a. choice of suppliers by producers 1.b. match between supply and demand 2. Quality of service <ol style="list-style-type: none"> 2.a. timely delivery 2.b. mutual communication and making producers informed on progress and developments 2.c. technical advice provided by the supplier 2.d. satisfaction with the existing advice and services 3. strategy to minimize the risk and diversify suppliers when it is more appropriate: stability and diversity of relations <ol style="list-style-type: none"> 3.a. fluctuations in the relations with suppliers 3.b. diversification of suppliers 3.c. integration in an association providing support and advice 3.d. facilities to change of commercial partner 	<ol style="list-style-type: none"> 1. score between 0 and 2 <ol style="list-style-type: none"> 1.a. yes/no (yes=1) 1.b. yes/no (yes=1) 2. score between 0 and 4 <ol style="list-style-type: none"> 2.a. yes/no (yes=1) 2.b. yes/no (yes=1) 2.c. yes/no (yes=1) 2.d. yes/no (yes=1) 3. score between 0 and 4 <ol style="list-style-type: none"> 3.a. yes/no (yes=0) 3.b. yes/no (yes=1) 3.c. yes/no (yes=1) 3.d. yes/no (yes=1) 	High : 10 Medium : 5 Low : 0
	Relations with customers	Ordinal Seven categories	Qualitative indicator to measure the level of connection between producers/cooperative and customers	<ol style="list-style-type: none"> 1. relation chosen by the producer/coop 2. diversification of customers 3. facilities to change of customers [capacity to substitute after customer leave] 4. relation formalized through a contract 5. prospect of customers 6. level of requirements of customers (specifications, complexity) 7. existence of a coordination device 	<ol style="list-style-type: none"> 1. yes/no (yes=1) 2. score entre 0 et 4 3. score entre 0 et 4 4. yes/no (yes=1) 5. yes/no (yes=customers not stabilized=0) 6. score between 0 and 4 7. yes/no (yes=1) 	High : 16 Medium : 8 Low : 0
					<ol style="list-style-type: none"> 1. score between 0 and 4 2. score between 0 (no advice) 	High : 14 Medium : 7

				<p>2. existence/regularity/usefulness of advice relations with peers</p> <p>3. implication of farmers in cooperative or collective actions management</p> <p>4. number of territorial actions implying producers and favouring their meeting</p>	<p>relations) and 4</p> <p>3. score between 0 and 4</p> <p>4. score between 0 and 4</p>	Low : 0
	Producer-end-consumer link	Ordinal Five categories	<p>Considered actor : local=producer, global=cooperative</p> <p>Assesses the capacity of a supply chain to strengthen links between producers and consumers, such as developing communication, sharing information</p>	<p>1. physical proximity between producer/coop and consumer</p> <p>2. sale on farm</p> <p>3. welcome on farm</p> <p>4. existence of a mediation between producer and consumer</p> <p>5. frequency of meeting between producer/coop and consumers</p>	<p>1. yes/no (yes=1)</p> <p>2. yes/no (yes=1)</p> <p>3. yes/no (yes=1)</p> <p>4. yes/no (yes=1)</p> <p>5. score between 0 and 4</p>	<p>High : 8</p> <p>Medium : 4</p> <p>Low : 0</p>
Territoriality	Contribution to territorial cohesion	Ordinal Three categories	Assesses socio-cultural relations and externalities linked with food chains, contributing to create social cohesion	<p>1. implication of chain actors in local life</p> <p>2. local social externalities: funding of social activities, social innovation...</p>	<p>1. score between 0 and 4</p> <p>2. score between 0 and 4</p>	<p>High : 8</p> <p>Medium : 4</p> <p>Low:0</p>
	contribution to territorial development	Ordinal	Measures the level of connection with the territory along the chain. Taking in account different ways to make links with the territory: identifies number and nature of links and score.	<p>1. Environmental links (landscape management, improvement of biodiversity)</p> <p>2. Economical</p> <p>2.a. direct employment contribution</p> <p>2.b. creation and distribution of added value for territory</p> <p>2.c. Involvement of enterprises in territorial project (Agrotourism project, patrimonial conservation)</p> <p>3. Cooperation</p> <p>3.a. Creation of partnership in the territory</p> <p>3.b. Diffusion of knowledge in the territory</p> <p>3.c. Local diffusion of technology and innovations</p>	<p>1. score between 0 and 2</p> <p>2. score between 0 and 5</p> <p>2.a. production contribution yes/no (yes= 1), packaging and distribution yes/no (yes = 1)</p> <p>2.b. creation yes/no (yes=1), distribution yes/no (yes=1),</p> <p>2.c. yes/no (yes=1)</p> <p>3. score between 0 and 3</p> <p>3.a. yes/no (yes=1)</p> <p>3.b. yes/no (yes=1)</p> <p>3.c. yes/no (yes=1 point)</p>	<p>High : 10</p> <p>Medium : 5</p> <p>Low:0</p>
Nutrition	Nutritional quality	Ordinal Five categories	Checks the influence of bio-physical parameters on the final quality of the product [antioxidants: lycopene, vitamin E, vitamin C and flavonoids]	<p>1. annual solar irradiation (ASI)(kwh/m2/year)</p> <p>2. Influence of temperature:</p> <p>2.a. heat episode > 30°C during growing period</p> <p>2.b. Cold episode with temperatures <10°C=1, during the growing period</p> <p>3. Harvest: ripening stage[green-yellow-green, red-orange to deep red]</p> <p>4. Number of steps between farm and consumption</p> <p>5. Freshness: Time between harvest and retail</p>	<p>1. if ASI<1700 = 0 point), if ASI>1700 (= 1 point)</p> <p>2. score between 0 and 2</p> <p>2.a. yes/no (yes=1)</p> <p>2.b. yes /no (yes=1)</p> <p>3. green-yellow-green (1), orange-red (0)</p> <p>4. score between 0 and 2 ; zero steps=0, < 2 steps=1, > 2 steps=2</p> <p>5. < 1 day=0, 1<T<3=1, >3=2</p>	<p>High : 8</p> <p>Medium : 4</p> <p>Low:0</p> <p>Calculation method of the final score of performance = 1 - (score / highest value)</p>

Food safety	Traceability System & Control Measures	Ordinal Five categories	Checks whether there are effectively processes to prevent and control food hazards and food contamination	<ol style="list-style-type: none"> 1. Application of standards on products [Organic Farming, Compliance Certification, Distributor specifications] 2. Implementation of auto-control device 3. Existence of control system between producers and consumer 4. Existence of quality management system along the chain [HACCP, ISO...] 5. Control and monitoring by third-party organisms 	<p>1. score between 0 and 4 [number of different standards]</p> <p>2. yes/no (yes=1) 3. yes/no (yes =1)</p> <p>4. yes/no (yes =1)</p> <p>5. yes/no (yes =1)</p>	<p>High: 8 Medium: 4 Low:0</p>
Labor relations	Workload	h/week	Calculate the average number of worked hour per day by the farmer (not workers)			<p>High : 40 (European legal average minimum) Medium : 50<x<60 Low : >70 hours/week</p> <p>Calculation method of the final score of performance = 2- (score/highest value)</p>
	Contribution to human capital	Ordinal Two categories	Assesses the contribution of the chain to strengthen skills [technical, organizational, marketing] of farmers and workers through in-service training	<ol style="list-style-type: none"> 1. Access to in-service training by managers 2. Access to in-service training by workers 	<p>1. score between 0 et 4 2. score between 0 et 4</p>	<p>High : 8 Medium : 4 Low:0</p>

Table 6: detailed methodological matrix of indicators used in the study case

5. Methods of Data collection and analysis

5.1. Plan for data collection

5.1.1. General Source of data

Data sources	Local chain in France	Global chain France to Spain
Primary data (quantitative and qualitative)	Local farmers (2 samples; 60 producers)	Director of the 2 nd degree cooperative platform in France Fruits and Vegetables coordinator for System U buying center
Secondary data	Databases and national statistics Regional department of Agriculture Articles Professional reports	Book keeping of cooperatives Reports from retail groups Articles Websites

Table 7: source of data

5.1.2. Method and source of secondary data

Tomato is one of the 'model plant' in national agricultural research (INRA): many data have thus been produced and many research and research-development projects have been implemented. A difficult and time-consuming job was nevertheless to gather all the available information, to look at the conditions in which data have been produced, to select the relevant sources. In parallel, technical institutes, professional organisations produced a lot of data on tomatoes. The GLAMUR project is an opportunity to build a specific data base on tomatoes: we coded all the available sources according to their relevance and to our list of indicators.



5.1.3. Collection of primary data

	Appropriate for	Strength of method
Focus groups	Identifying group norms Eliciting opinions about group norms Discovering variety within a population	Elicits information on a range of norms and opinions in a short time Group dynamic stimulates conversation, reactions
Interviews	Eliciting individual experiences, opinions, feelings Addressing sensitive topics	Elicits in-depth responses, with nuances and contradictions Gets at interpretive perspective, i.e., the connections and relationships a person sees between particular events, phenomena, and beliefs

Table 8: compared interest of focus group and interviews

The GLAMUR project is an opportunity to value previous interviews with farmers and traders of vegetable chains in South of France, already focused on sustainability issues (Chiffolleau, 2009, 2012; Bellec-Gauche, Chiffolleau, 2015). Some of them have been reinterviewed in order to update or get complementary and new actors have been enquired in the global chain.

5.2. Data analysis and ranking

We followed the SAFA approach and translated all quantitative and qualitative scores in percentage scores of performance.

PERFORMANCE	PERCENTAGE SCORES
● BEST	80-100 percent
● GOOD	60-80 percent
● MODERATE	40-60 percent
● LIMITED	20-40 percent
● UNACCEPTABLE	0-20 percent

5.3. Data quality check

5.3.1. For secondary data

Quality of secondary data requires to archive additional information with the data itself; information should at least include the study purpose, operationalization, data collection details (who, when, and where), entities being studied and sampling criteria, and any known biases (Hox, Boeije, 2005).



5.3.2. For primary data : Pedigree matrix approach

The criteria in controlling data quality are representatively, reliability and pertinence. In order to check the quality of data stability, equivalence and homogeneity, we used the pedigree matrix approach to measure the 'real' level of quality of data (Ciroth et al., 2015).

The data quality score (DQD) has to be calculated for each data so an automated calculation is necessary and then averages can be made to assess the overall data quality.

We considered an “adequate period” for the data collection. We wanted to ensure temporal correlation between our results and the situation observed. Although, some data were quite old and had to be verified/adjusted/updated, some of them were available for a period of 3 or 5 years, others only available for one year. So the quality of data we collect fluctuates and is function of the source: we tried to take it in account

.

Indicator	LOCAL CHAINS		GLOBAL CHAIN	
	Total DQD	Quality class	Total	Quality class
Price to consumers per unit of product	0,2	A	0,2	A
Soil management practices	0,2	A	0,8	B
Agro-biodiversity preservation practices	0,2	A	0,8	B
Landscape management practices	0,4	A	0,8	B
supplier relationship	0,2	A	0,4	A
customer relationship	0,4	A	0,4	A
Farmers cooperation	0,4	A	1,2	A
Producer-consumer link	0	A	0,8	B
Economic Productivity	0,2	A	0,4	A
Contribution to employment	0,2	A	0,4	A
Access to the market	0,2	A	0,4	A
Net Income	0,2	A	0,8	B
Share of farmer's price on retail price	0	A	0,2	A
Added Value	0,2	A	0,8	A
Cash Position	0,2	A	0,4	A
Price decision-making	0	A	0,4	A
Limiting factor in Nutritional quality	0,4	A	0,4	A
Traceability System & Control Measures	0,2	A	0,4	A
Pedagogic contribution	0,2	A	0,6	A
Transparency for consumer	0,2	A	0,6	A
Hourly wage	0,4	A	0,4	A
Workload	0,2	A	0,8	B
Contribution to human capital	0	A	0,4	A
Environmental pollution mitigation practices	0,2	A	0,6	A
GHG emissions	0,2	A	0,6	A
material waste	0,2	A	0,4	A
Energy Consumption	0,4	A	0,4	A
Waste and loss of products along the chain	0,4	A	0,4	A
Water consumption practices	0	A	0,2	A
Contribution to territorial cohesion	0,4	A	0,4	A
contribution to territorial economic development	0,4	A	0,4	A



6. Results: indicators of performance

6.1. Economic dimension

6.1.1. Attribute Contribution to economic development

Indicators and sub-indicators	Local chain	Organic local chain	Global chain
Economic Productivity (EUR/m²)	[2,8 - 4]=58% ●	[4,6 - 7,1]=100% ●	[2,2 - 3,2]=46% ●
Contribution to employment (FTE/ha)	[2,3 - 2,5]=96% ●	[2,2 - 2,5]=94% ●	[1,57 - 2,3]=77% ●
Access to the market	88% ●	75% ●	50% ●

Indicators and sub-indicators	Relevant indicator to differentiate Local from Global?	Comparison about performance of Local and Global	Comment
Economic Productivity (EUR/m²)	Yes	Local Organic > Local conv. > Global	We calculated added value/ha, at production level. Local chains perform better than global ones because of: a higher yield in conv., a higher price/kg. The highest value of benchmark = highest value of organic local
Contribution of production to employment (FTE/ha)	Yes	Local > Global	At production level, local chains represent more jobs/ha. We were not in a position to assess jobs for all the chains.
Access to the market	Yes	Local conv. > Organic Local > Global	Installation in global chains is costly and markets are very competitive.

Figure 8 : Economic Productivity -Added value per unit of land

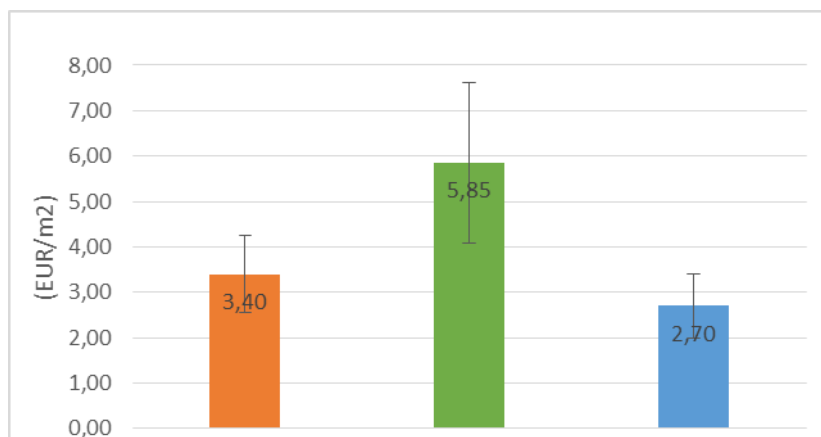




Figure 9 : Contribution of production to employment

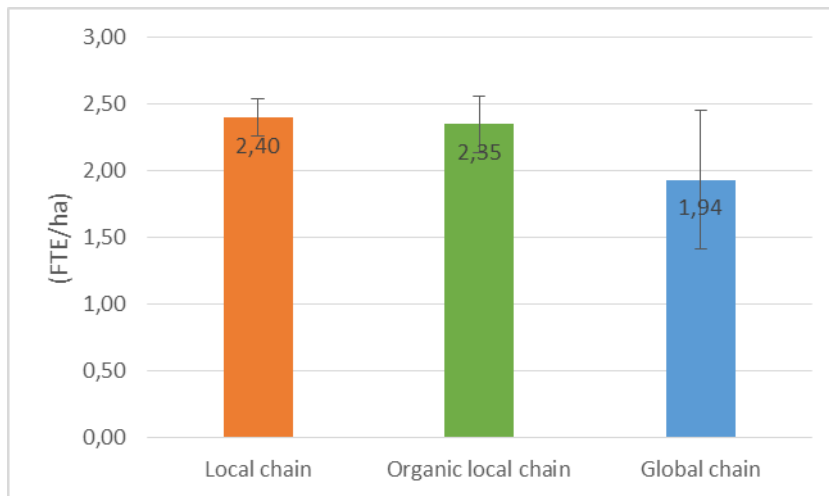
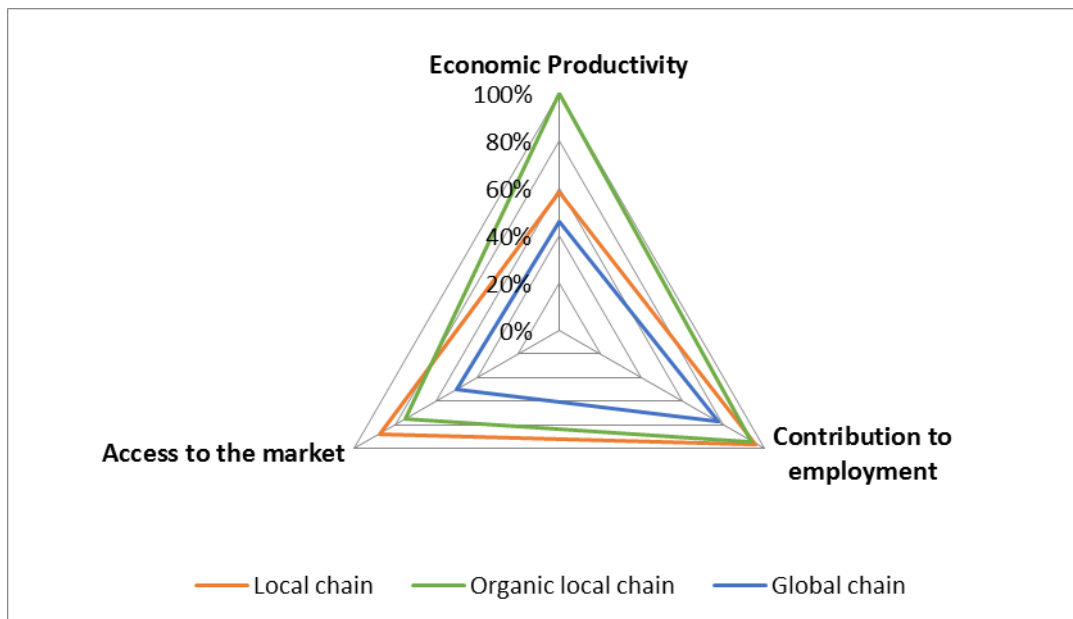


Figure 10 : chain performances for attribute Contribution to economic development





6.1.2. Attribute Creation and distribution of added value

Indicators and sub-indicators	Local chain	Organic local chain	Global chain
Net Income (EUR/FTE)	[10000 - 35000] 80%	[12 - 35 000] 84%	[17 000 - 35 000] > 100%
Share of farmer's price on retail price (%)	100%	100%	32%
Added Value (EUR/kg)	[0,21 - 0,8] 34%	[0,81 - 1,49] 77%	[0,22 - 0,42] 21%
Cash Position	40%	50%	50%
Price decision-making	50%	50%	33%

Indicators and sub-indicators	Relevant indicator to differentiate Local from Global?	Comparison about performance of Local and Global	Comments
Net Income (EUR/FTE)	No	Global>Local Organic>Local	Spanish producers in global chains receive a higher income than the average agricultural income in Spain. In France, the income of producers in local chains is 20% less than the average income in fruits and vegetables production in France. However, this indicator reveals large variations in each chain.
Share of farmer's price on retail price (%)	Yes	Local>Global	
Added Value (EUR/kg)	Yes	Organic Local> Local conv.>Global	
Cash Position	No	Local = Global	Qualitative indicator. Low to medium performance of the three chains.
Price decision-making	Yes	Local>Global	In local chains, producers are price-makers. In global chains, negotiation between cooperatives and supermarkets.



Figure 1 : Net annual income for famers

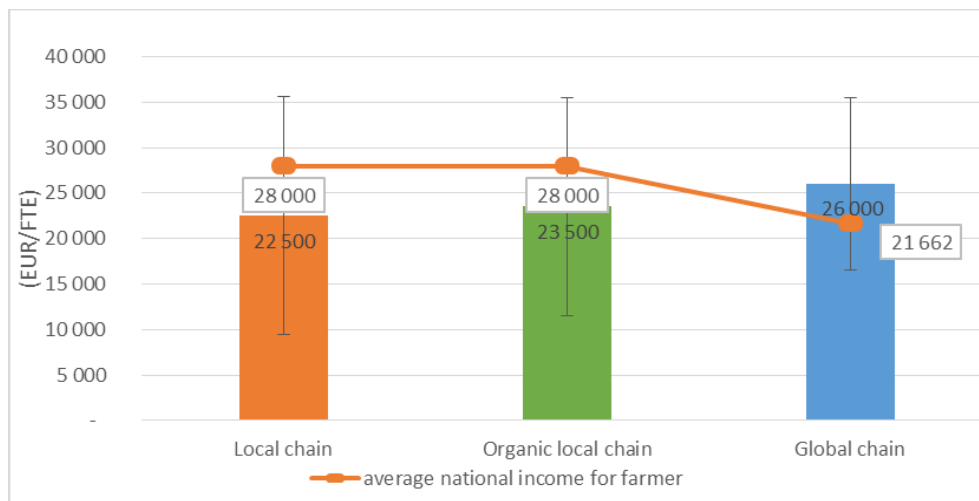


Figure 12 : Added value per unit of product

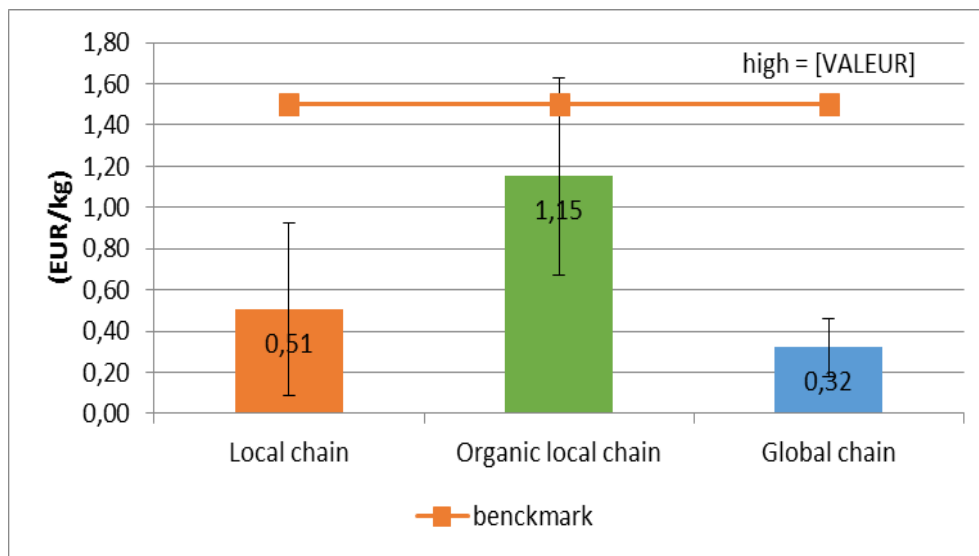
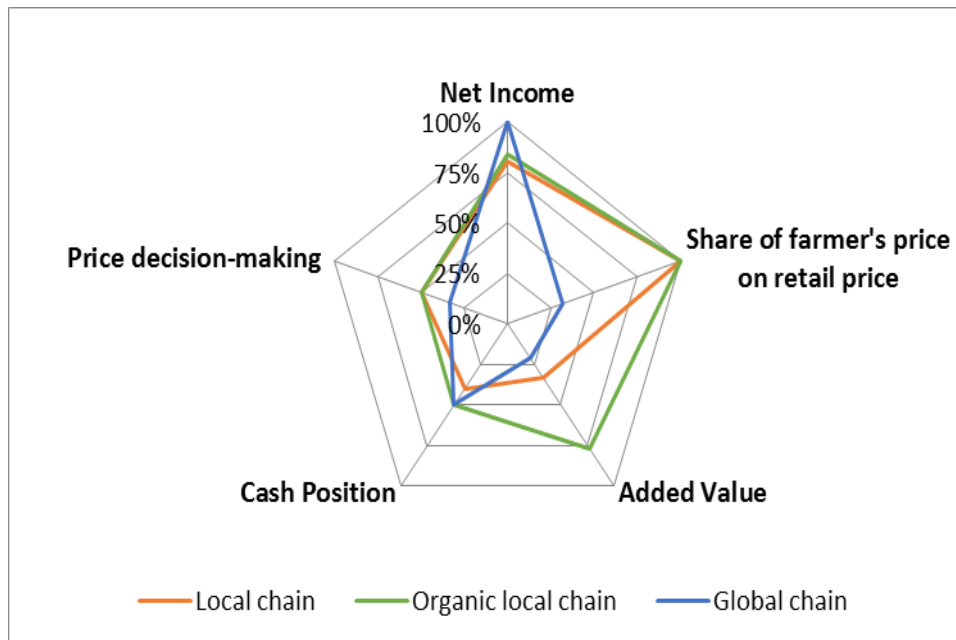




Figure 13 : Chain performances for attribute Creation and distribution of added value



6.1.3. Attribute Affordability

Indicators and sub-indicators	Local chain	Organic local chain	Global chain
Retail price (EUR/kg)	2,00	3,00	2,52

Indicators and sub-indicators	Relevant indicator to differentiate Local from Global?	Comparison about performance of Local and Global	Comments
Retail price (EUR/kg)	No	Local equivalent to global in these specific cases	Tomatoes from global chains from Spain are consumed in France in Winter, so that the price is quite high. This global chain cannot be compared to local ones regarding affordability. Tomatoes from other global chains may be found at 1,65 euros/kg in Summer. Price does not appear as a constraint for consumers buying tomatoes either in Summer or in Winter but low-budget consumers have a low consumption of fruits and



			vegetables (Insee).
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6.2. Environmental dimension

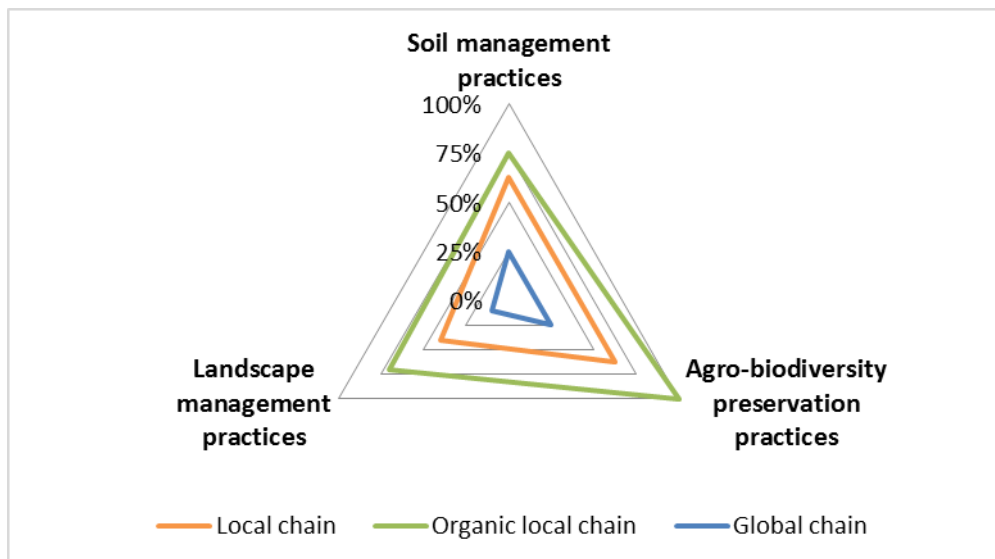
6.2.1. Attribute Biodiversity

Indicators and sub-indicators	Local chain		Organic local chain		Global chain	
Soil management practices	63%		75%		25%	
Agro-biodiversity preservation practices	63%		100%		25%	
Landscape management practices	40%		70%		10%	

Indicators and sub-indicators	Relevant indicator to differentiate Local from Global?	Comparison about performance of Local and Global	Comments
Soil management practices	Yes	Local Organic>Local Conv.>global	In both chains, producers face high constraints regarding soil management. Optimization of surface under shelter is the main concern. No crop rotations in global (chemical and thermic disinfection) and few in local because of small surface and lack of skills. Problems of soil-borne diseases in each chain.
Agro-biodiversity preservation practices	Yes	Local Organic>Local Conv.>global	Chains differ in matter of: i) agricultural models, ii) specialization degree, iii) marketing strategy (choice and range of varieties)
Landscape management practices	Yes	Local Organic>Local Conv.>global	Concentration of agricultural production in Almeria induces alteration of landscape. No awareness-action about landscape in this region. Welcome on farm favour landscape preservation. Organic farming values landscape as a production factor (systemic approach).



Figure 14 : Chains performances for attribute biodiversity



6.2.2. Attribute Resource use

Indicators and sub-indicators	Local chain	Organic local chain	Global chain
Energy Consumption	N.A (Non Available)	N.A	N.A
Loss of product along the chain	67% ●	67% ●	25% ●
Water consumption practices	75% ●	75% ●	50% ●



Indicators and sub-indicators	Relevant indicator to differentiate Local from Global?	Comparison about performance of Local and Global	Comment
Energy Consumption	Yes (hyp)	Local organic > Local conv. > Global	Energy consumption has not been assessed at this stage but qualitatively, local chains are supposed to perform better because of no mechanization, local inputs, no thermic practices, little transport for distribution.
Loss of product along the chain	Yes	Local > Global	In local chains, loss on harvests; unsold products often valued through processing or self-consumption. In global chains, higher loss due to heat spikes, pests. Loss globally assessed as 5% on the total of marketed product for global chains (CTIFL, 2010)
Water consumption practices	No (quant), yes (qual)	Local > Global	Both chains use the same irrigation systems which allow to save 30% of water. Systems are nevertheless more technified in Almeria (programmation). Local and global chains differ in matter of sources of water: Almeria use a lot of desalinated sea water, which is assessed as less sustainable. Consumption of water in global chains is also in competition with domestic consumption.

Figure 2 : Loss of product along the chain

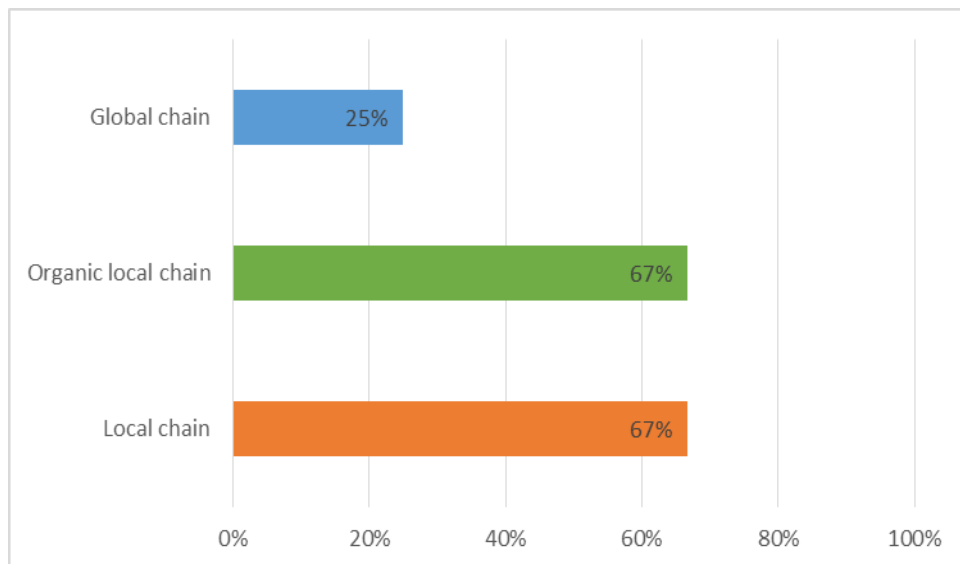
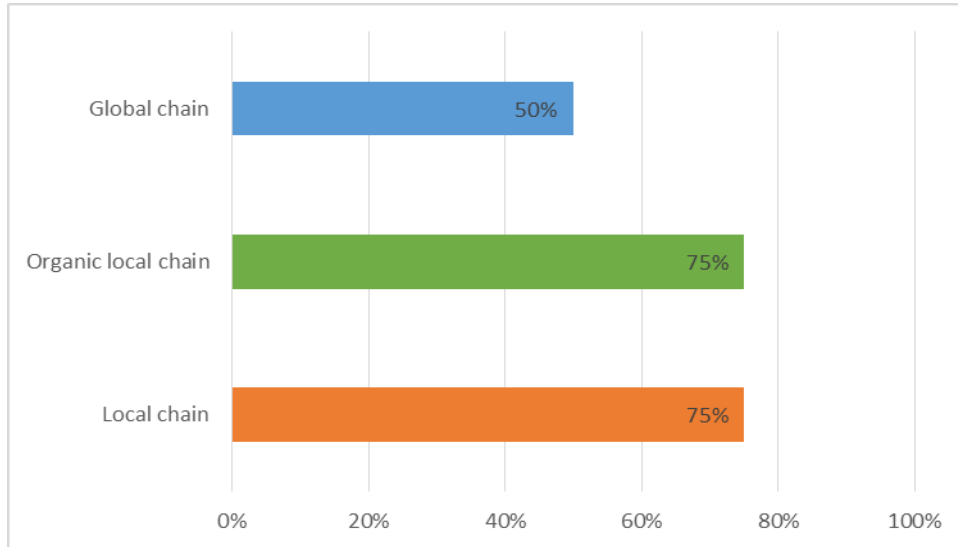




Figure 3: Water consumption practices



6.2.3. Attribute Pollution

Indicators and sub-indicators	Local chain	Organic local chain	Global chain
Environmental pollution mitigation practices	50% ●	92% ●	33% ●
GHG emissions (kg CO2eq)	N.A.	N.A.	N.A.
Material waste	67% ●	83% ●	33% ●

Indicators and sub-indicators	Relevant indicator to differentiate Local from Global?	Comparison about performance of Local and Global	Comment
Environmental pollution mitigation practices	No	Organic local > Local-Global	Assessed at production level including inputs. The difference of results is more linked to production models (organic vs. Conventional) and choice of inputs rather than to the type of chain. Organic farming perform better because of organic inputs, soil protection practices and biodegradable material. Nevertheless, implementation of organic or integrated pest management is in progress in global chains due to new market requirements.
GHG emissions	N.A.	N.A.	We only have secondary data for these



			indicator and they can not be compared as far as studied systems in each case are not the same. Further work on this topic will be done in the WP4.
Material waste	yes	Local Organic > Local conv. > Global	Both local and global chains produce material waste as threads and, every 3 to 5 years, plastic from shelters. Waste in global chains comes also from packaging. Local chains perform better in waste reduction practices and use of recycling material.

Figure 4 : Environmental pollution mitigation practices

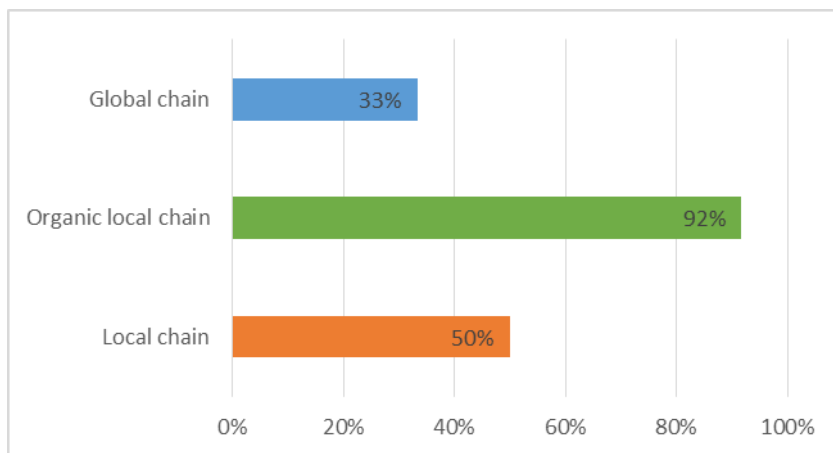
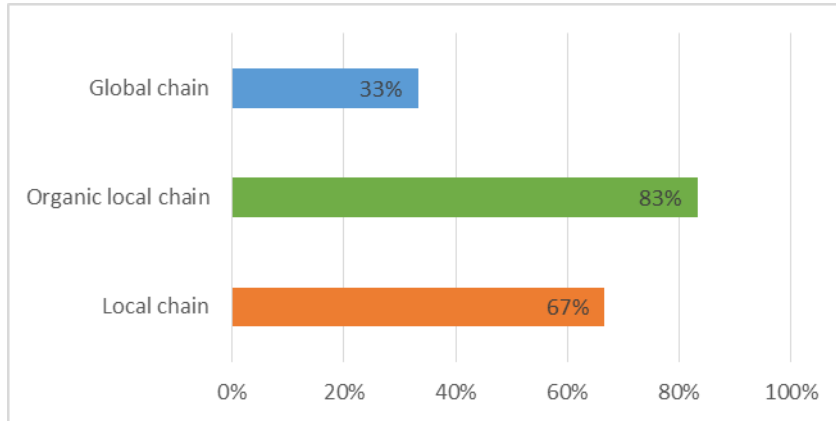




Figure 18 : Material waste



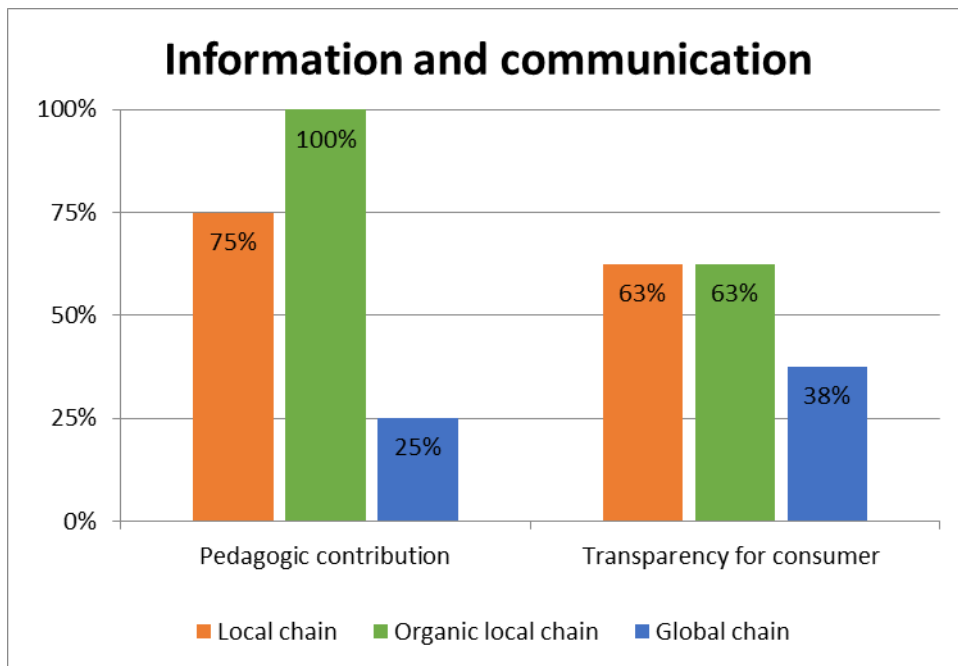
6.3.Social dimension

6.3.1. Attribute Information and Communication (Social and Economic Dimensions)

Indicators and sub-indicators	Local chain	Organic local chain	Global chain
Pedagogic contribution	75% ●	100% ●	25% ●
Transparency for consumer	63% ●	63% ●	38% ●

Indicators and sub-indicators	Relevant indicator to differentiate Local from Global?	Comparison about performance of Local and Global	Comments
Pedagogic contribution	Yes	Local>Global	Awareness actions about food (origin, impacts) in local chains. Marketing and institutional campaigns in global chains to promote fruits and vegetables consumption.
Transparency for consumer	Yes	Local>Global	Higher number of key information about products given to consumers in local chains, practice more undergone in global chains, proactive in local ones (RCC, 2013). Information in global chains remains confusing and selective according to chain actors themselves. We observe nevertheless some progress since sanitary crisis.

Figure 19 : Information and communication

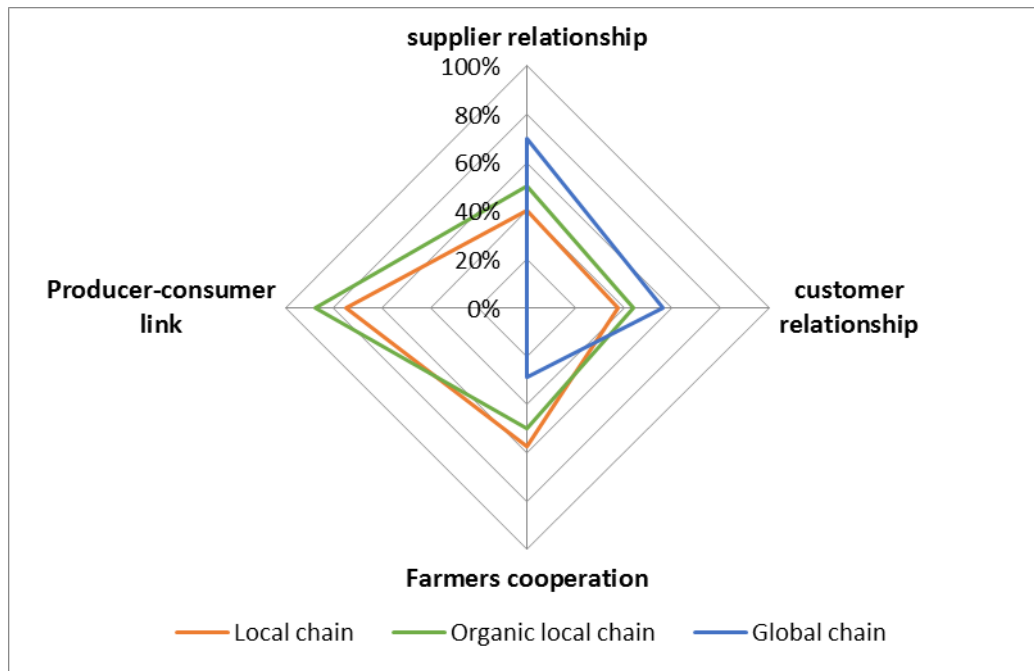


6.3.2. Attribute Connection

Indicators	Local chain		Organic local chain		Global chain	
	Value	Color	Value	Color	Value	Color
Relations with suppliers	40%	Yellow	50%	Yellow	70%	Green
Relations with customers	38%	Orange	44%	Yellow	56%	Yellow
Cooperation between farmers	57%	Yellow	50%	Yellow	29%	Orange
Producer-consumer link	75%	Green	88%	Dark Green	0%	Red



Figure 5 : Chain performances for attribute connection



Indicators and sub-indicators	Relevant indicator to differentiate Local from Global?	Comparison about performance of Local and Global	Comments
Relationships with suppliers	Yes	Global > Organic Local > Local conv.	In local chains, producers have difficulty in procuring good seeds and plants when not produced on-farm (seed self-production is forbidden in France). When contacted by small producers in local chains, plants suppliers tend to be less rigorous and the supply is often delayed and does not respect producers' choice in matter of varieties (Demarque, 2010). Moreover, services (esp. advice) proposed by suppliers are little adapted to local chains objectives as far as they are based on intensive agricultural models. In the global chain we consider, the supply is partly managed by the cooperative itself, and cooperative technicians are close to private suppliers in the Almeria cluster context.
Relationships with customers	Yes	Global > Organic Local > Local conv	In local chains, clientele remains mostly irregular. Tomato is a loss leader but producers have to propose a large supply to attract and make customers regular. Customers tend to be more regular in organic local chains. Relations are more regular in global chains, often supported by contracts. Concentration of supermarket brands makes



			producers more dependent of their customers. Diversification of customers appears in both chain as a way to reduce risks but may limit possibility of scale economy and induce over-work.
Cooperation between farmers	Yes	Local conv.> Organic Local >Global	<p>Cooperation between farmers may be professional dialogue or products exchange, joint work, collaboration. It is assessed through frequency and intensity of relations, according to their content.</p> <p>In global chains, farmers are a priori linked with each other through the cooperative but relations remain weak as far as the cooperative is more a logistics structure (Giagnocavo, 2012, Medfel, 2012). In local chains, 60% of farmers belong to an equipment exchange group, a collective trademark, trade union or an agricultural promotion network. Local chains may renew informal relations (esp. advice exchange) between farmers but in specific conditions (Chiffolleau, 2009). Cooperation between farmers remains limited either by concurrence, esp. when they propose the same produce (Chiffolleau, Gauche, 2015) or by the lack of time, as short chains are very time-consuming.</p>
Producer-consumer link	Yes	Organic Local >Local conv.>Global	In the global chain we consider in the study case, there is no direct relation between producers of Almeria and French consumers. The cooperative is supposed to transfer consumers' requirements. In local chains, the link may be moderated to strong esp. on-farm – less time in open-air markets - (high frequency, intensity, intimacy) and contributes to socially value farmers and the farming profession (RCC, 2013).

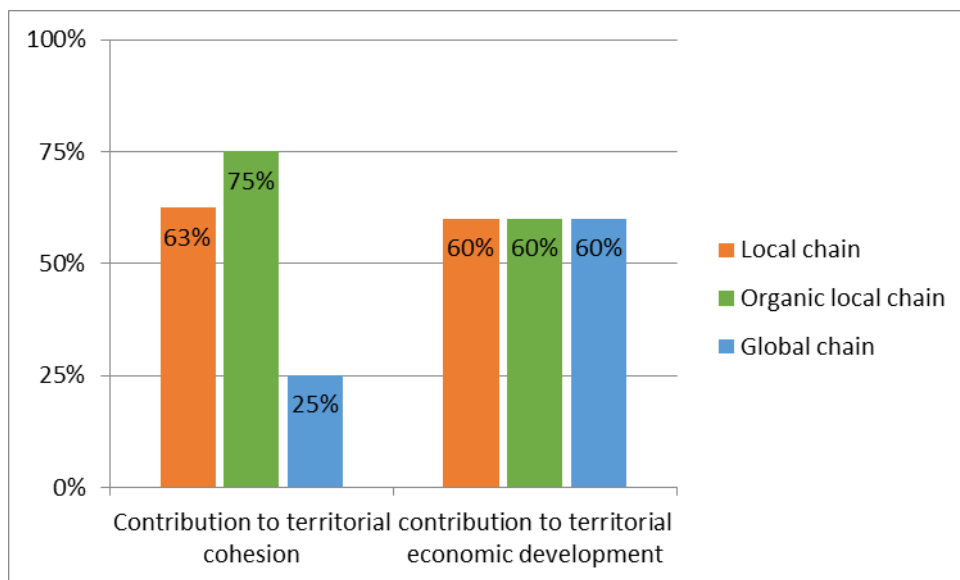
6.3.3. Attribute Territoriality

Indicators	Local chain		Organic local chain		Global chain	
Contribution to territorial cohesion	63%	●	75%	●	25%	●
contribution to territorial economic development	60%	●	60%	●	60%	●



Indicators and sub-indicators	Relevant indicator to differentiate Local from Global?	Comparison about performance of Local and Global	Comments
Contribution to territorial cohesion	Yes	Organic Local>Local conv.>Global	The local chains considered in this study case contribute to make urban consumers, neorural inhabitants, and farmers closer. Open-air markets are key vectors of collective local life both in rural areas and cities. In global chains, beyond a technical coordination between economic actors, there are locally too few social links and events to create social cohesion.
Contribution to territorial economic development	No (quant.), yes (qual.)	Local = same level as Global, but different trends	All chains perform at the same level but in a different way. Global chain in Almeria is a competitive pole attracting jobs, innovations, funds (CAJAMAR bank, etc.). Local chains considered in this report contribute to territorial economic development through their contribution to immaterial assets (image, reputation...) favouring notably tourism.

Figure 6 : Chain performances for attribute Territoriality





6.4. Health dimension

6.4.1. Attribute Food safety

Indicators and sub-indicators	Local chain	Organic local chain	Global chain
Traceability System & Control Measures	38%	50%	75%

Indicators and sub-indicators	Relevant indicator to differentiate Local from Global?	Comparison about performance of Local and Global	Comments
Traceability System & Control Measures	Yes	Global>Organic Local>Local	Global chains have made a lot of progress in matter of traceability since sanitary crises, notably E.Coli infestation of cucumber in 2011. (Medfel, 2012). Sanitary quality is a condition to access the market in global chains. Controls are made by producers themselves and third-party organisms (public and private). Local chains, despite their renewing in the late 90s is partly due to quest of reinsurance from consumers after ESB crisis, are more and more controversial regarding food safety and in concrete terms, are less controlled.

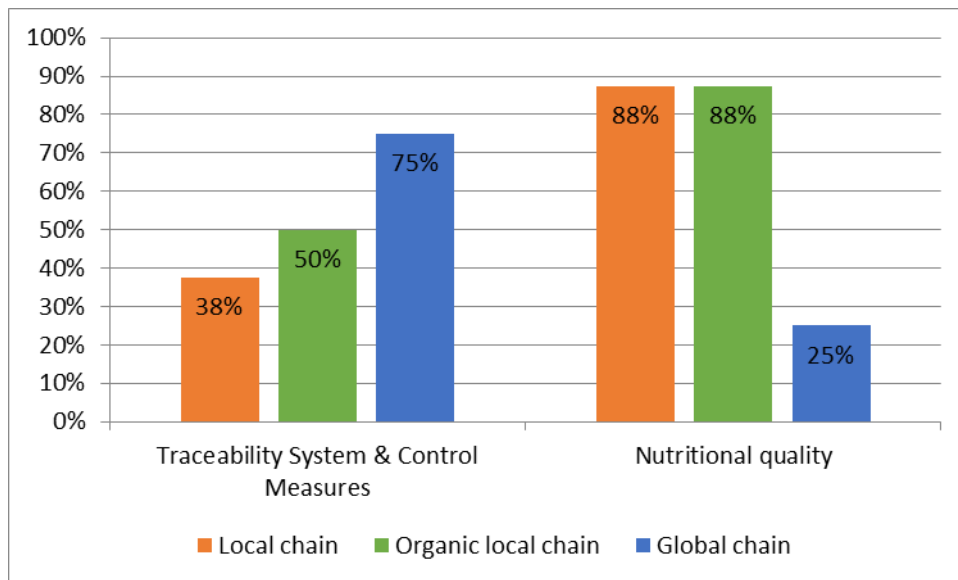
6.4.2. Attribute nutrition

Indicators and sub-indicators	Local chain	Organic local chain	Global chain
Limiting factor in Nutritional quality	88%	88%	25%

Indicators and sub-indicators	Relevant indicator to differentiate Local from Global?	Comparison about performance of Local and Global	Comments
Limiting factors in Nutritional quality	Yes	Local>Global	In global chains, tomatoes are harvested before maturity and stored in cold: cold reduces aromatic and Vitamin C potential from 20 to 30% (Bressoud, Pares, 2010). In local chains, tomatoes are harvested when mature and are not or just a little stored in cold.



Figure 22 : Food safety and Nutritional performances of local and global chains



6.5. Ethical dimension

Attribute Labour relations

Indicators and sub-indicators	Local chain	Organic local chain	Global chain
Workload (h/week)	[60 - 85] 19% ●	[62 - 80] 23% ●	[50 - 70] 50% ●
Contribution to human capital	63% ●	63% ●	50% ●

Indicators and sub-indicators	Relevant indicator to differentiate Local from Global?	Comparison about performance of Local and Global	Comments
Workload (h/week)	Yes	Global>Local	Assessed at producers' level. In local chains, producers have to deal with production and marketing activities, with a limited salaried or family workforce; stress due to workload esp. in marketing is a cause of giving up and reorientation to global chains. In the global chain considered here,



			producers are just in charge of production, the cooperative deals with the other tasks. Moreover, producers in global chains are more advised in matter of work organization.
Contribution to human capital	No	Local ± Global	In global chains, producers are trained and advised but more towards executive tasks rather than decision-making processes and big disparities have been observed, even if all master technicity. In local chains, farmers face many constraints which limit their capacity to be trained (esp. lack of time) and agricultural organisms do little training about short chains. Peer networks built from local chains increase farmers' skills (Chiffolleau, 2009).

Another important indicator of labour relations would have been irregular work, both in France and Spain (Gertel, Sippel, 2014). This indicator appeared too difficult to assess, and even to point out with interviewees. Production in Almeria is very dependent on workforce and while the average wage for a worker is 36 euros/day, some sources evoke a wage of 20 euros for 10h of work/day (The Guardian, 2011; Via Campesina, 2014). Competition with Morocco and Tunisia pressures production costs and workforce is an adjustment variable. In 2004, immigrant workers (7,5% of total agricultural workforce at the Spanish national level vs. 0,9% in France) were estimated at 20 000 in Almeria and the flow of those ones over-passed the number of available jobs, which allowed low wages (Desmas, 2010).

Conclusion

1. Synthesis of results per dimension

Local chains, especially organic ones, appear as performing better than global ones, at production level, in matter of added value per kilo of tomatoes and job creation, but not regarding the net income for farmers. Indeed, the net income in local chains remains lower than the average income in fruits and vegetables production in France while Spanish farmers in global chains receive a higher income than the average agricultural income in Spain. We have not been in a position to assess the economic dimension all along the chain: results may be different at the chain level, especially regarding job creation. We have been expecting more contrasted results between chains in matter of cash position and price-making (in favor of local chains) but situations are more complex than supposed. Regarding the environment dimension, our study has also been focused at the production level: local chains, especially organic ones, perform better than global ones. The good results of organic chains are mainly due its agricultural model but results also show how chains influence the choice of production systems. Nevertheless, an unexpected result concerns the strong constraint due to small surfaces in local chains, preventing farmers to make crop rotations and thus generating soil diseases. In the social dimension, results are more balanced between the chains: local ones perform better in matter of information and communication but are not so good regarding connexions, while this dimension is sometimes idealized in the literature about 'social embeddedness' in short chains (Chiffolleau, 2009): constraints of farmers and inherited past have to be taken in account. Global chains



appear as drivers of territorial development in a agro-industrial district perspective, contrasting with a local development tradition carried out by local chains and now crucial in peri-urban areas. Regarding health, expected results are confirmed: global chains are leaders of traceability while local ones favour nutritional quality. Ethical dimension has to take in account several indicators from the other dimensions but regarding labour relations, we have not been in a position to assess this touchy attribute exhaustively: the main data is that it is possible to discuss about this topic in local chains while not or not often in global ones.

2. Additional comments on performance of the chains considered in this report

This study case shows that chains performances are closely linked with their governance organization: following Gereffi typology of governance models (2005), the global chain considered in this study case appears to be based on the 'captive' model, driven by consumers, while local ones may be analysed as hybrids between the 'market' and the 'relational' models.

3. Response to research questions

A further work has still to be done to answer to our research questions by detailing the links between these questions and the final list of sub-indicators. Nevertheless, these questions have been useful guiding principles all along our study case as well as a way to keep in mind practical implications as far as these questions have been largely built on discussions with partners and professional journals review.

4. Theoretical and methodological limits of the study

Performance assessment through attributes and indicators remains a static approach even if the sub-indicators we chose are mainly qualitative and focused on practices, thus are a way to highlight strategies. Nevertheless, the final report makes little place for a more comprehensive approach of performance, in which factors, drivers of good results are detailed. The main critics at the current stage may concern the definition of benchmarks as far as those ones appear as different according to previous works or experts. For a large part of indicators, we have not been in a position to assess all the chains and focused on the farm level, and data on touchy issues have been difficult to collect, especially in the global chain we little knew before. A lack of cooperation with the Spanish team, partly due to a lack of time and of human resources, limited our capacity to go further but the next period may favour further exchanges.

5. First perspectives for public policies

This issue is going to be deepened in the next steps of the project but this study case already leads to stress several directions to support food chains performance: necessity to take in account diverse strategies, esp. in local chains, importance of collective tools, return on investments only after few years as other kinds of start-ups, big pressure of the access to land...



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Note that some of these references are not directly cited in the text but have been used to define some indicators.

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