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Naoufel Mzoughi

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Naoufel Mzoughi
INRA, UR 767 Ecodéveloppement
Domaine Saint-Paul – Site Agroparc, 84914 Avignon Cedex 9, France
Tel: + 33 4 32 72 25 94 – Fax: + 33 4 32 72 25 62
E-mail: nmzoughi@avignon.inra.fr

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Farmers Adoption of Integrated Crop Protection and Organic Farming: Do Moral and Social Incentives Matter?

Abstract: We use survey data to provide some empirical information about considerations regarding moral and social incentives among a sample of French fruit-growers and vegetable producers (N=243). Our results show that, beyond the strong role played by economic incentives, a significant number of respondents give high importance to moral and social incentives. We also examine how these behaviors matter according to different crop protection strategies, that is, conventional farming, integrated crop protection (IP) and organic farming (OF). Using a multinomial logistic regression, we find that (1) social incentives (*e.g.*, showing to others one's environmental commitment) drive both IP and OF adoption, (2) moral incentives (*e.g.*, do not feel guilty about one's choices) increase the probability of organic farming adoption only, and (3) farmers who give high importance to economic considerations (*e.g.*, cutting production costs) are less likely to adopt OF.

Key-words: farmers, incentives, integrated protection, organic farming.

JEL classification: L15, L59, Q13.

Farmers Adoption of Integrated Crop Protection and Organic Farming: Do Moral and Social Concerns Matter?

1. Introductory remarks and related literature

Agricultural policies in several countries are experiencing a strong trend to become more ecologically-friendly. The mainstream model of production, based on intensive use of chemical inputs for crop protection such as pesticides, has been increasingly challenged at the political (*e.g.*, through WTO prescriptions), economic and social level because of its environmental damages (*e.g.*, water pollution, harm to biodiversity, etc.) and the negative impacts on consumer and producer health (for example, the carcinogenic effect of some agrofood components). In response to the increasing demand for sustainable agriculture, several technical and institutional alternatives have been developed. Adoption of integrated crop protection (IP)[2] and organic farming (OF) are two such alternatives. IP refers to crop protection techniques and practices which satisfy economic, ecological and toxicological requirements, while encouraging the use of natural pest control (Boller *et al.*, 1998). OF refers to the non-use of chemical inputs in the farming process in order to provide consumers with foodstuffs respecting natural life-cycle systems (European regulation EC 834/2007).[3] Beyond the use, or not, of chemical inputs, IP and OF differ on two other crucial issues. First, there is no official standard for IP, despite some attempts notably in the French fruit growing sector (Codron *et al.*, 2003 ; Bellon *et al.*, 2006). On the opposite, organic farmers have the possibility to signal their efforts using the French label, denoted *AB*, and more recently the European label as defined by the regulation EC 834/2007. Second, farmers receive public financial support to adopt OF and not for IP adoption per se.[4]

A growing and relatively large literature is devoted to the adoption of IP (*e.g.*, Harper *et al.*, 1990; Fernandez-Cornejo *et al.*, 1994; Fernandez-Cornejo and Ferraioli, 1999; Chaves and Riley, 2001; Maumbe and Swinton, 2003; Mauceri *et al.*, 2007) and conversion to OF (*e.g.*, De Cock, 2005, Anderson *et al.*, 2005; Genius *et al.*, 2006; Parra-Lopez *et al.*, 2007; Cristoiu

[2] Also referred to in the economic literature as integrated plant protection (IPP) or integrated pest management (IPM).

[3] Available at : http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:189:0001:0023:EN:PDF.

[4] As far as we know, only Swiss farmers receive subsides to adopt IP. Moreover, big farms are those who benefit from these direct payments.

et al., 2007; Musshoff and Hirschauer, 2008).[5] Nevertheless, these scholars have mainly focused on the technical determinants of adoption and the economic incentives to switch toward more ecologically-friendly practices. By analyzing the determinants of IPM adoption among rice producers in the US (N=117), Harper *et al.* (1990) found that education has a significant effect on adoption. Fernandez-Cornejo *et al.* (1994) surveyed vegetable producers in the US (N=528) finding that labor availability, credit or debt ratio, farm size and farmer's age are significant drivers of IPM adoption. Similar findings have also been reported by Chaves and Riley (2001) who surveyed coffee producers in Colombia (N=392). According to Mauceri *et al.* (2007), access to information and household size are the main drivers of IPM adoption by potato growers in Ecuador (N=109). Moreover, in their analysis of the determinants of adoption of organic horticultural techniques in the UK (N=237), Burton *et al.* (1999) state that an individual's characteristics, mainly age and gender, and access to information are of paramount importance. They also argue that farmers concerned about environmental issues are more likely to adopt organic farming. Anderson *et al.* (2005) surveyed 175 farmers growing fresh-market produce in California and found similar results.

Despite their interest, social and moral incentives have been largely neglected in the economic literature devoted to the adoption of integrated crop protection strategies and organic farming. Moral incentives are those related to individuals' (intrinsic) ethics. Social incentives are those which make the individual someone liked in his reference group, for example, the other farmers in the same region. In other words, while neoclassical economic theory considers (extrinsic) economic motivations, behavioral economic literature (*e.g.*, Rabin, 1993; Frey, 1994) assumes that individuals have intrinsic and extrinsic motivations, including economic incentives. Intrinsic motivations are reasons for action that come from within the individual, such as pleasure or personal satisfaction. An intrinsically motivated person performs an activity even when he or she receives no apparent reward except that derived from the activity itself. Extrinsic motivations are imposed on individuals from the outside. They can take the form of social recognition or monetary rewards to adopt a given behaviour or threats of punishment for failing to comply with a prescribed behavior.

[5] It should be noticed that a large literature is devoted to the adoption of innovations, broadly defined, in agriculture such as the following literature reviews (*e.g.*, Feder *et al.*, 1985; D'Souza *et al.*, 1993; Feder and Umali, 1993 and references therein).

This paper investigates empirically the role of moral and social incentives in farmers' decision making. Recent contributions (*e.g.*, Carlsson *et al.*, 2007) show that farmers are not only driven by monetary considerations but also change their behavior in reaction to moral and social incentives. The desire for distinction or belonging to a group and status considerations are such social considerations. Several studies support the idea that farmers switched to intensive farming (Green Revolution) not only as a profit maximizing decision, but also because of the status benefits tied to the changes under consideration (*e.g.,* the French '*club des 100 quintaux'* in the 1980s which includes corn producers who produce more than 100 quintal/ha). Lanneau (1967, see also Bessière, 2002) argues that the purchase of a tractor or huge equipments was also explained by the desire to progress in the social hierarchy.

Given the preceding discussion, this paper explores two hypotheses:

- ✓ H1: Moral and social incentives matter in farmers' decisions.
- ✓ H2: Moral and social incentives matter more when considering integrated crop protection and organic farming than conventional farming. Moral and social incentives are likely to play a more important role for methods which are not the most attractive economically.

The remainder of the paper is organized as follows. Section 2 presents the data and methods. A multinomial logistic regression is specified to investigate the incentives to adopt integrated protection and organic farming by 243 French fruit-growers and vegetable producers. Section 3 discusses the results. Section 4 concludes and highlights policy implications.

2. Data and methods

Between December 2008 and March 2009, we conducted a mail survey of 1286 fruit-growers and vegetable producers located in the French areas of *Alpes de haute provence*, *Hautes-Alpes* and *Vaucluse* (the whole population in these areas). All respondents were asked to indicate the crop protection method they use the most, *i.e.*, conventional, integrated protection or organic farming, and then to answer a question formulated as follows: *'How important is this factor to you in the choice of your crop protection method?'* A 5-point Likert scale has been used to measure the importance of economic, moral and social incentives. We received 243 useable responses (19%); 134 from conventional farmers, 71 from farmers using IP and 38 from organic farmers. It should be noticed that the questionnaire was elaborated after direct

interviews of about two hours each with experts in the agricultural field and 7 farmers which allowed us to better identify the factors they take into account when choosing their crop protection method. In order to improve its readability, the questionnaire was pre-tested on 15 farmers from another area.

To investigate empirically the incentives of farmers' adoption of IP/OF, we specify a multinomial logistic model (Greene, 2003):

$$\Pr ob\left(Y_i = j\right) = \frac{e^{X_i \beta_j}}{\sum_{k=1}^{3} e^{X_i \beta_k}} \text{ with } j = 1,2,3.$$

where Y_i , the dependent variable, represents the protection method used by the farmer and takes the values of 1, 2 and 3 if the farmer uses conventional methods, integrated protection and organic farming, respectively. Here conventional farming is used as the base category. X_i represents a vector of explanatory variables and encompasses economic (cutting production costs, satisfying customers' demands, diminishing the risk of output loss, differentiation from other farmers, benefiting from public financial support), moral (doing the right thing, do not feel guilty about own choices) and social (satisfying other landscape users' demands, being perceived the best by the other farmers, showing to others one's environmental commitment) considerations, and, a set of control variables (age, gender, education, and main activity). β_i represent slope coefficients to be estimated.

The odds ratios associated with the multinomial model are defined as:

$$\ln\left[\frac{P_{ij}}{P_{ik}}\right] = X_i\left(\beta_j - \beta_k\right) = X_i \beta_j \; if \; k = 1.$$

3. Results and discussion

The variables used in estimation and sample statistics are indicated in Table 1. No problem of multicollinearity has been detected.

[Insert Table 1 around here]

Several results can be drawn from the simple statistics in Table 1 which confirm our hypotheses. First, moral and social incentives matter among the surveyed fruit-growers and vegetable producers along with economic incentives. Indeed, more than 76% of the respondents indicated that doing the right thing is an important factor when choosing the crop protection method, just behind satisfying customers' demands (80%), but before reducing

risks (73%) and cutting production costs (57%). Do not feel guilty about own choices, showing to others one's environmental commitment and satisfying landscape users' demands are also important, since 55%, 48% and 39% of respondents, respectively, stated they are important factors. An unexpected result relates to being perceived the best by other farmers, with only 16% of respondents considering this as an important factor. Second, economic, moral and social incentives matter differently according to the protection method used by the farmer. The Wilcoxon test shows that except showing to others one's environmental commitment (*SHOW*), there is no significant difference between conventional farmers and those using integrated crop protection, while the behavior of organic farmers is significantly different from both. For instance, organic farmers give significantly less importance to reducing production costs and risks (economic incentives) compared to the rest of the population, but give significantly more attention to doing the right thing and guilty feelings (moral incentives). This result can be partly explained by the fact that organic farming is a standardized model and thus there are less problems of comprehension in relation to its principles among farmers. However, IP still lacks a rigorous definition and farmers may confuse it with other methods. So, some farmers may have mentioned they use IP while their practices correspond more to conventional ones, as argued by several studies (*e.g.*, Bellon *et al.*, 2006; Bonny, 1997). Third, organic farmers are mainly female, and, fruit-growers are more concerned by IP than vegetable producers, probably because there are less technical possibilities for integrated crop protection in the vegetable production.[6]

Moreover, to analyze the incentives of IP or OF adoption with more control, we present the results of the multinomial logistic regression (Table 2) together with goodness-of-fit measures (Maximum Likelihood estimation). These findings support the results reported above. The R2 of 0.17 indicates that unobserved individual heterogeneity is still relatively important in the data. Moreover, the negative intercepts for IP and OF may reflect the positive respondents' preferences for the reference mode.

[Insert Table 2 around here]

The desire to cut production costs (*COST*) and reduce the risk of output loss (*RISKS*) decreases the probability of adopting OF, but has no effect on IP adoption. This result can be explained by the fact that conversion costs and risks are generally higher for OF than for IP.

[6] One can also argue that, from consumers' point of view, looks may be more important for fruit which is often eaten 'as is' than vegetables which are cut up and cooked.

Moreover, farmers who wish to differentiate from their competitors (*DIFFERENTIATE*) are less likely to adopt IP. Differentiation may depend on dimensions other than environmental considerations, for example, the level of production or equipment. While organic farmers receive subsidies for their conversion and production, getting support from public authorities (*SUPPORT*) increases the probability of IP adoption. Two facts can explain this result. First, since farmers can receive public funds for several environmental investments, such as the adoption of good agricultural practices, IP can constitute a leverage to this financial support. Interestingly, this point was raised by a fruit-grower interviewed before the survey. The grower stated that he was willing to introduce an integrated crop protection technique, namely mating disruption, in 2009, in order to benefit from funds from the plant plan for the environment (plan végétal pour l'environnement).[7] Second, subsidies for organic farming remain relatively low and the profitability relates mainly to the price premium paid by consumers to purchase organic products. Moreover, the variable *CUSTOMERS* (satisfying customers' demands) is not significant either for IP or OF adoption. This result confirms the Wilcoxon test (Table 1), that is, farmers rank this factor as highly important, whatever the crop protection strategy. Furthermore, showing to others one's environmental commitment (*SHOW*) increases the probability of IP and OF adoption. However, not feeling guilty about one's choices (*GUILTY*) only increases the probability of adopting organic farming. This result might be explained by the fact that, contrarily to OF, IP combines natural and chemical inputs. The variables *USERS* (satisfying landscape users' demands) and *PERCEPTION* (being perceived the best by other farmers) are non-significant.

As for control variables, fruit-growers (*ACTIVITY*) are more likely to adopt IP than vegetable producers. In addition, gender effects (*GENDER*) are significant only for farmers using integrated protection, education (*EDUCATION*) has only a significant impact on organic farming adoption, and younger people (*AGE*) are not more likely to adopt IP/OF than older ones.

Finally, we re-run the analysis by using composite factors (*i.e.*, economic, moral and social) instead of using the individual ones (*e.g.*, cutting costs, do not feel guilty, showing to others, etc.). The results (Table 3) confirm those in Tables 1 and 2, and show that social incentives

[7] The plant plan for the environment is a part of the French rural development plan (2007-2013) aiming at to helping farmers in their environmental investments.

drive both IP and OF adoption, moral incentives increase the probability of organic farming adoption only, and farmers who give high importance to economic considerations are less likely to adopt OF.

[Insert Table 3 around here]

4. Concluding remarks

This paper provides a better understanding of farmers' decision to adopt ecologically-friendly practices. We have shown that beyond the role played by economic incentives, moral and social concerns matter amongst French fruit-growers and vegetable producers and are significant drivers of integrated crop protection and organic farming adoption. These results suggest that only focusing on economic incentives may be useful but partial. Ignoring these aspects can lead to flawed considerations. For instance, farmers are likely to adopt ecologically-friendly practices to show their commitment to others. Regulators may take into account such aspects by making farmers' efforts more visible, for example, through awards to those who protect the environment the most.[8] Recent behavioral economics work (*e.g.*, Frey and Neckermann, 2009) stresses that awards can constitute a more effective policy tool that monetary compensations. Even innovations that are both profitable and environmentally-friendly may suffer from a low diffusion rate because their capacity to confer moral and social benefits has been ignored. More precisely, increasing the non-economic benefits of socially desirable innovations, such as IP and OF, may be a complementary and more efficient way of promoting them among potential adopters. Moreover, our results show that guilty feelings are important for farmers. Consequently, creating a state of cognitive dissonance among farmers, *i.e.,* an incoherence between their intrinsic values and their actions, can push them to adopt ecologically-friendly farming to be relieved. Furthermore, while several scholars argue that less chemical inputs are likely to reduce the costs incurred by farmers, and although public authorities often use these input gains to encourage farmers to reduce the use of chemicals, we have shown that farmers who wish to reduce production costs and risks are less likely to adopt ecologically-friendly practices, maybe because they do not perceive these predicted benefits. As such, this finding suggests that those public policies may be ineffective.

[8] One may argue that as the number of farmers who wish to show their environmental commitment increases, this factor may become less important for them. This issue deserves more attention in future research.

Furthermore, economic, moral and social motivations matter differently according to the protection method used by farmers. This result suggests that public authorities should take into account not only the multiplicity of motivations but also the way these motivations can be combined. This issue recalls the debate concerning the crowding in/crowding out situation. Extrinsic motivations are said to crowd out (crowd in) intrinsic motivations because they undermine (reinforce) self-determination and self-esteem. In the crowding out situation, the individual feels pressured by an external force, and therefore feels over justified in maintaining his intrinsic motivation rather than complying with the will of the source of the extrinsic reward. Moreover, extrinsic motivations cause an individual to feel that his internal motivation is rejected, not valued, leading him to reduce his self-esteem and thus to reduce effort (Frey and Oberholzer-Gee, 1997 ; Gneezy and Rustichini, 2001). Although difficult to capture, taking into account these issues is a crucial step toward more efficient and effective policies, and an important topic for future research.

Nevertheless, our study has some limitations that should be taken into account in future research. First, the number of observations remains relatively low to gather rigorous information regarding moral and social concerns. Increasing the sample of surveyed farmers may allow us to have more clear-cut conclusions. Second, we have ignored in our estimation a set of exogenous factors that are likely to generate adoption, such as regulation, the distance between a farmer's house and farm, etc. Taking into account these factors is a challenging topic for future research. It would be also interesting to consider the date of adoption and the conversion process followed by farmers, that is, whether they moved directly from conventional to organic farming or took a step by step approach starting by adoption of IP. Third, our study focuses on fruit-growers and vegetable producers in three French areas. Covering more activities and areas is likely to generate fruitful results. A cross-country comparison also would constitute an interesting extension of our work.

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Table 1: Variables description and sample statistics

Variable	Definition	All farmers (N=243)		Conventional (N=134)		Integrated (N=71)		Organic (N=38)		Wilcoxon test[a]		
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	C/IP	C/OF	IP/OF
Dependent variable												
PROTECTION	Protection method Categorical variable (=1 if conventional; =2 if IP; =3 if OF)	1.604	0.744	1	0	2	0	3	0	-	-	-
Independent variables												
AGE	Farmer's age Dummy variable (=1 if under 40)	0.205	0.405	0.231	0.423	0.183	0.389	0.157	0.369	ns	ns	ns
GENDER	Farmer's gender Dummy variable (=1 if female)	0.172	0.378	0.126	0.334	0.197	0.400	0.289	0.459	ns	***	ns
EDUCATION	Level of education Dummy variable (=1 if high school level)	0.456	0.499	0.417	0.495	0.492	0.503	0.526	0.506	ns	ns	ns
ACTIVITY	Main activity Dummy variable (=1 if fruit-grower)	0.580	0.494	0.544	0.499	0.732	0.445	0.421	0.500	***	ns	***
COST	Cutting production costs as an important factor Dummy variable (=1 if important)[b]	0.576	0.495	0.619	0.487	0.647	0.481	0.289	0.459	ns	***	***
CUSTOMERS	Customers' demands as an important factor Dummy variable (=1 if important)	0.806	0.395	0.791	0.408	0.845	0.364	0.789	0.413	ns	ns	ns
RISKS	Reducing risks as an important factor Dummy variable (=1 if important)	0.732	0.443	0.798	0.402	0.802	0.400	0.368	0.488	ns	***	***
DIFFERENTIATE	Differentiation from others as an important factor Dummy variable (=1 if important)	0.246	0.432	0.261	0.440	0.169	0.377	0.342	0.480	ns	ns	**
SUPPORT	Public support as an important factor Dummy variable (=1 if important)	0.292	0.455	0.268	0.444	0.366	0.485	0.236	0.430	ns	ns	ns
RIGHT	Doing the right thing as an important factor Dummy variable (=1 if important)	0.761	0.427	0.708	0.455	0.732	0.445	1	0	ns	***	***
GUILTY	Do not feel guilty as an important factor Dummy variable (=1 if important)	0.559	0.497	0.537	0.500	0.521	0.503	0.710	0.459	ns	**	*
USERS	Satisfying landscape users as an important factor Dummy variable (=1 if important)	0.390	0.488	0.350	0.478	0.394	0.492	0.526	0.506	ns	*	ns
PERCEPTION	Being perceived the best as an important factor Dummy variable (=1 if important)	0.168	0.375	0.171	0.378	0.197	0.400	0.105	0.311	ns	ns	ns
SHOW	Showing one's commitment to others as an important factor Dummy variable (=1 if important)	0.485	0.500	0.410	0.493	0.549	0.501	0.631	0.488	*	**	ns

[a]: The test compares conventional farmers (C), farmers using integrated protection (IP) and organic farmers (OF). [b]: the factor is important if the farmer checked 4 or 5 on the Likert scale. (*), (**) and (***) stand for parameter significance at the 10, 5 and 1 percent level, respectively.

Table 2: Multinomial logistic estimates of IP/OF adoption

Variables	Integrated protection		Organic farming	
	Estimate	**z-value**	**Estimate**	**z-value**
INTERCEPT	-1.846***	-3.19	-1.127*	-1.77
AGE	-0.300	-0.71	-0.812	-1.26
GENDER	0.749*	1.65	0.553	1.04
EDUCATION	0.562	1.60	0.908*	1.83
ACTIVITY	0.999**	2.77	0.167	0.36
COST	-0.188	-0.53	-1.540**	-3.12
CUSTOMERS	0.097	0.22	-0.317	-0.56
RISKS	0.121	0.29	-1.664***	-3.63
DIFFERENTIATE	-1.091**	-2.38	0.671	1.28
SOPPORT	0.649*	1.75	-0.216	-0.40
GUILTY	-0.509	-1.45	0.918*	1.87
USERS	0.347	0.95	0.224	0.45
PERCEPTION	0.268	0.59	-0.956	-1.37
SHOW	0.663*	1.86	1.182**	2.44
Pseudo R2	0.1734			
Log likelihood	-196.41559			
LR Chi2(26)	82.42			
Number of observations	243			

(*), (**) and (***) stand for significance at the 10, 5 and 1 percent level, respectively. The variable *RIGHT* (doing the right thing) has not been used in estimation since all organic farmers stated it was an important factor.

Table 3: Multinomial logistic estimates of IP/OF adoption (using composite factors)

Variables	Integrated protection		Organic farming	
	Estimate	**z-value**	**Estimate**	**z-value**
INTERCEPT	-1.472***	-2.95	-2.016***	-2.86
AGE	-0.503	-1.23	-0.392	-0.71
GENDER	0.618	1.46	0.711	1.43
EDUCATION	0.535	1.59	0.538	1.24
ACTIVITY	0.955***	2.77	-0.227	-0.53
ECONOMIC	-0.034	-0.24	-0.757***	-3.66
MORAL	-0.183	-0.85	1.180***	3.21
SOCIAL	0.301*	1.71	0.504**	2.11
Pseudo R2	0.1180			
Log likelihood	-209.58324			
LR Chi2(14)	56.08			
Number of observations	243			

(*), (**) and (***) stand for significance at the 10, 5 and 1 percent level, respectively.