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Preferences, Norms and Constraints in farmers' agro-ecological choices

Case study using a choice experiments survey in the Rhone River Delta, France

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Abstract :

The aim of this paper is to elicit the sensitivity of farmers to payments for agro-environmental services in a context of strong agro-ecological and policy constraints. We present results from a choice experiment survey performed among the whole population of agricultural decision-makers (104) in the Camargue area. Several econometric models have been estimated, the most significant being the Latent Classes one. The estimated parameters of the utility function, together with the parameter associated with the monetary attribute provided the monetary value of each relevant agro-ecological attribute and the associated outcomes (average and risk yield).

Key words: Agricultural Technological Choices, Agro-environmental measures, Policy Instruments design, Choice Experiments, Sample Selection Model, Latent classes Model, Random Parameter Model, Rice production, Labelling, Organic farming

I. Introduction

Overall in the world the complex relationship between the technology of agriculture and the environment is placed under scrutiny. The motivations behind that interest are context-dependent, and pertain to market strategies, to strategies of international negotiation or to consumers demand for pesticides-free products. Moreover, the protection of the environment itself could be locally important, especially in areas with a great natural heritage value. In each case, balancing the economic efficiency and the preservation of the environment calls for a careful analysis of the farmers' motivations and preferences. Compensating payments could be in some cases necessary to motivate farmers to adopt environmental friendly technologies, but if this is done, they are not automatically undifferentiated. The individual rationality could be instead heterogenous, as Australian researchers in sociology have demonstrated (Vanclay , 1998) .

The general assumption of the paper is that farmers face several norms and constraints, but they have nevertheless a scope for expressing individual choices. To test that hypothesis, we used a choice experiment approach. Choice experiments are useful tools to measure eitther the willingness

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to accept or the willingness to pay for a set of attributes characterizing goods, services or technology. In this paper, we will present the results of the choice experiment survey performed among the whole population of agricultural decision-makers (104) in the Camargue area, Rhone River delta, France. Moreover, using suitable econometric models, such as Random Parameter Logit or Latent Class Models, it will be possible to asses and characterize the underlying heterogeneity in the farmers technology choices. More precisely, we would like to gain insights into the heterogeneity of farmers preferences regarding both the attributes of the technology and the related compensatory payments.

Our use of choice experiment to assess the farmer willingness to accept for specific attributes of agricultural technology with differentiated impacts on the environment is, according to the authors' knowledge of the literature, original. The results are useful inputs for the design of policy instruments, as long as the regulator is concerned for efficient use of public funds. Using differentiated payments for specific environmental services could be a beneficial consequence of our research[1].

The issue we are investigating is related to three different fields of the literature : agricultural household models, technology adoption process and choice experiments.

The first field is on the issue of separability between household decision making and farm management, and concerns the impact of the individual utility function of the farm manager on the choice of farming style and of production technology.

The second field of relevant literature concerns the technology adoption process, and how we can discriminate between individual factors and social influences and interactions pertaining either to collective action or to commercial relationships?

Finally, it is worth to examine how the question at stake has been investigated in the choice experiments literature.

In their choice of production technology, farmers have preferences not only regarding productivity or profitability, but also for various attributes of crops, animals or farming practices. Utility-based adoption models already provide evidence of the importance of the technology's perception by the farmers. Batz et al . show that the speed and the level of adoption of a specific technology depend on the level of the investment required, the risk involved, and the complexity and the difficulties of the task involved in the course of the implementation (Batz, 2003).

Adesina et al. draw attention to the lack of concerns about the farmers' perceptions of the characteristics of the technology. They use a Tobit model of adoption of new and improved rice

[1] This research is co-funded by the two Regional Government of Provence-Côte d'Azur and of Languedoc -Roussillon

cultivars in Sierra-Leone, and show that the characteristics of a cultivar that are taken into account are not only those related to yield or input use, but also those related to subjective traits (Adesina et aL, 1993).

In a context of subsistence farming, Dalton used a hedonic model of rice traits showing that yield is not a significant factor in the adoption, compared with the length of plant lifecycle, plant height, grain properties (colour, elongation, swelling and tenderness). (Dalton, 2004).

Birol and al. analyzed the valuation of agrobiodiversity by Hungarian small farmers in their Home gardens using a choice experiment. They rely on four components of the home-garden system (Richness of crop varieties and fruits trees, crop landrace, integration of crops and livestock production, organic production versus pesticides use). Preferences of small farmers who are oriented toward the satisfaction of the household's needs are described by the mean of the prefered choice sets, and translated into monetary terms (Birol, 2008).

Roessler and Scarpa use a choice experiment survey to assess the preferences of farmers breeding pigs in Vietnam. Based on the set of five attributes (growth, reproduction, disease resistance, feeding needs and physical appearence), they identified two types of breeders as folow : « resources driven » and « demand driven or market oriented » breeders. (Roessler, 2007).

Birol and al. presented a latent class approach for Mexican smallholders facing a choice between the use of the traditional « milpa » system, based on the conservation of genetically diverse maize, and the GM maize (Birol, 2006).

Dupraz and al. (Dupraz, 2003) stated that farmers' households are together producers and consumers of the environment they contribute to forging. They accommodate the multifunctionnality of the agricultural production in considering the technological flexibility of their environmental supply. Using a contingent valuation survey , they confirmed that farmers behaviour is influenced by environmental preferences. More precisely, Davies and Hodge found that two attitudinal factors, « stewardship orientation » and « technological beliefs » were by far the most significant in determining the acceptabilitiy of cross-compliance in the CAP implementation (Davies, 2006). As a consequence, structural and socio-demographic factors were considerably less important. They identified clusters of farmers according to their overall attitudinal orientation.

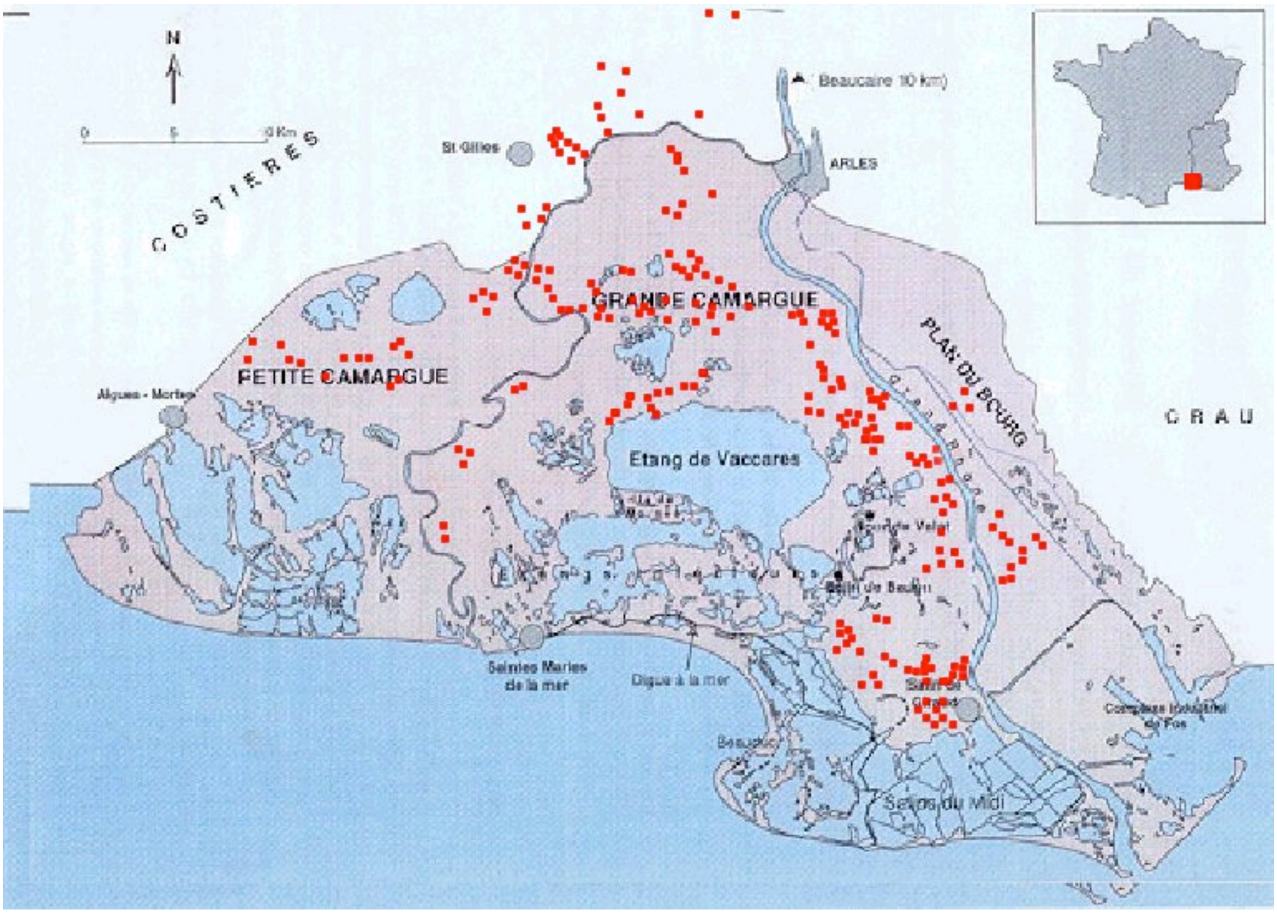
Finally, two main conclusions arise from this literature review. The first one is related to the importance of subjective factors and preferences in the choices of the attributes of technology (even if few papers are dealing explicitly with the implementation). The second is about the importance of the diversity of perceptions and farming styles or subcultures (the heterogeneity issue).

II. Local context

The Camargue is a large area made of intricate fields, marshes and lagoons in and around the Rhone River Delta (South of France). It belongs to the set of biodiversity hotspots around the Mediterannee Sea registered in the Ramsar convention and also in the European Framework « Habitat, Fauna and Flora ». The area has been recently accepted as part of to the « Man and Biosphere » reserves network. Several local institutional arrangements for managing water and biodiversity in the landscape have been finally designed in a context of conflicting interests (Water Local Commission, and Parc Naturel de Camargue).

Wheat production and cattle are the main agricultural activities, while various recreational activities, commercial hunting among them, provide high income to landlords. The agricultural production is very intensive, but the use of pesticides and herbicides is highly controlled by several administrative regulations and collective institutionnal arrangements.

Irrigated rice growing is used to flush salt from the rootzone after some years of dry farming. However the rice cultivars need to be adapted to the local weather conditions (low spring and autumn temperatures , wind). As a result, the production costs are high and the average yields low. In the current setting of the CAP, farmers are entitled to uncoupled compensatory payments varying from 400 to 1000 Euros/ ha.



III. Survey design and data collection

Before proceeding to the survey implementation, we gained the support of the main stakeholders in the Delta, the rice growers side (Centre Français du Riz, Syndicat des Riziculteurs de France et Filière, SRFF) and the Environmental and Landscape Agency side (Parc Naturel Régional de Camargue, PNR). That proved to be very important in securing a good stewardship of the survey and good conditions for the interviews. Interviews were managed by the authors and by 3 professional surveyors, each having charge of a specific area.

The attributes choosen to describe cropping technology should be credible and relevant. Nonetheless, the number of attributes is constrained by the cognitive burden involved in the choice tasks. We thus identified six attributes, assuming they are the main factors explaining the farmers technology choices (Table 1 below). Three of them are related to agro-ecological means ; the length of life cycle of rice cultivar, the weeds control technology and the type of crop-rotation. Two others concern outcomes ; the average yield over five years and the the yield variability. The final attribute is a monetary attribute, representing a compensating payment.

Weed control appears to be one of the main problems in irrigated rice cropping in the area. The technology chosen has implications in terms of workforce, use of herbicides, and impact on the biodiversity and environment. It is therefore important to define farmers' sensitivity about the choices of weeds control technology. The practices proposed in the choice sets are currently practised in the area, even if not very widespread, for instance, manual and mechanical weeding.

The choice of the rice cultivar, involving the length of the crop life cycle, is another relevant attribute insofar as it also has consequences on yield and risk.

The type of crop rotation on the same plot is constrained by the weed control and by the salinity of the root zone. When the weed control is not good enough, it is necessary to leave rice cropping for wheat or alfa-alfa. But after a few years of wheat cropping, it is necessary to go back to irrigated rice cropping, to flush salt from the root zone [2].

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[2] We are grateful to J.C. Mouret (INRA, UMR Innovation) and to C. Thomas (CFR) for their helpful advices and comments . Final choice of attributes remain our responsability.

Table I : Attributes description and levels

Attributes	Description	Levels
Weed control technology	Method of weed control	*1* : intensive chemical weeding (three applications or more) *2* : chemical weeding with one or two applications *3* : lines seeding and mechanical weeding *4* : counterfacted seeding and manual weeds removing
Cultivar choice	Rice cultivar characterized by a different length of life cycle	*1* : short cycle : 140-150 days, *2* : medium cycle : 150-160 days, *3* : long cycle : > 160 days
Crop Rotation type	Rice return time on the same plot It is the number of years of rice growing	*1* : long rotation (1 year of rice /5 years) *2* : "cereal" rotation (2 years of rice / 5 not necessarily consecutive years) *3* : "intensive cereal " rotation (2 or 3 consecutive years of rice)
Average yield over five years .	Average of the wheat yield for a five year period	*1* : < 2 tons *2* : [2 ; 5 t[*3* : [5 ; 7 t [*4* : ≥ 7 t
Yield variability	Frequency of yields below the average	*1* : 0 year *2* : 1 year, *3* : 3 years
Compensatory payment	Extra income offered either by the market, or by the CAP over the base margin created by the scenario	*1* : 0 Euro *2* : 400 Euros / ha *3* : 700 Euros / ha *4* : 1000 Euros / ha

We used a fractional factorial design to create the experiment structure. An optimal and efficient design is characterized by three properties, orthogonality, balance and minimum overlap (Huber et Zwerina, 1996). We generated it with SAS® software program, following guidelines by Kuhfeld (2004). The efficient choice task design resulted in 24 choice sets. In order to limit the number of tasks per respondent, we split them in two blocks. Two sets were discarded due to the lack of realism, so each rice grower faced 11 choice sets, each containing three options. We could not introduce a status quo alternative, given that each farmer has a different business. There were two alternatives and one opt-out option, in which the farmer choose to leave his land unexploited. This later option can provide null or even negative utility (Table II). The main interest of the opt-out option is twofold: not to force respondents to choose an unsatisfactory option, and being relevant, because the fallow is an option in the actual CAP.

Table II : example of a choice set

In the event where the following technical itineraries would be the only you face to produce, Which one would you prefer adopt ?

options / attributs	***Scénario A***	***Scénario B***	***Scenario C***
Weeds control technology	Fake seeding and manual weeding	Lines seeding and mechanical weeding	
Crop rotation	"intensive cereal"	"cereal"	
Varietal choice	Short cycle	Long cycle	
Average yield over five years	[5 ; 7 t [	< 2t	
Variability= risk over five years	1 bad year with respect to the average	1 bad year with respect to the average	
Margin differential	0 euros / ha	1000 euros / ha	**Leave the land unexploited**
	A /_ /	B /_/	C /_/

The questionnaire was organized in three parts. The first one is about the respondent's personal identity, with some opinion questions concerning their conception of the farmers' profession, and their sensitivity with respect to environmental preoccupations. The second one is the choice experiment exercise itself. The last part concerns questions about the description of the enterprise, for instance the size, the crops, the crop rotation, the suppliers, the customers, and the presence of marshes...

Starting from a list of 200 farming entities delivering rice to the rice processing industry, the final whole population of decision makers has been defined as a list of 104 managers involved in the economical and technological decision making process (often, the same manager is in charge of managing several farming units). One would remark that the list represents the entire population of the decision makers, and not simply a sample.

III.Model Estimations

The choice data were analyzed and estimated using LIMDEP 9.0 software program, and more precisely the package NLOGIT 4.0. We have four quantitative attributes (varietal choice, average yield, risk and monetary attribute), and two qualitative (weeds control technology and crop rotation) we have coded using effect coding. For the two scenarios proposed, the rice growers' indirect utility derived from the attributes of our choice experiment study takes this form :

$$V_{ij} = CV(Z_{\text{varietal choice}}) + RISK(Z_{\text{risk}}) + ROL(Z_{\text{long rotation}}) + ROC(Z_{\text{cereal otation}}) + AEM(Z_{\text{manual weeding}}) + ASM(Z_{\text{mechanical weeding}}) + ACHI(Z_{\text{intensive chemical weeding}}) + RDT(Z_{\text{yield}}) + PRI(Z_{\text{margin differential}})$$

and the following form for the third alternative, the opt-out one :

$$V_{ij} = ASC$$

We introduce here an Alternative Specific Constant (ASC) to take into account effects on utility which are not explained by the attributes, and the utility function takes such a form in this option because of the absence of attribute and level to describe it, given it is an opt-out alternative. This is a way to model these situations in choice experiment work. After having estimated a basic multinomial logit model, several others models were estimated to consider first the presence of the opt-out option (sample selection model), and then to better integrate the heterogeneity in the rice growers preferences (Random parameter model and latent class model).

a) The basic multinomial logit model

Table III : Estimates of the multinomial logit model

Variable	*Value*	*std error of β*	*p-value*
ASC	-0,6942	0,8667	0,4232 -
Cultivar choice	0,0078	0,0057	0,1675
"Cereal" rotation	0,1453**	0,0645	0,0243 -
Long rotation	0,2491***	0,0697	0,0004
Manual weeding control	-0,1135	0,0735	0,1228
Mechanical weeding control	-0,4751***	0,0777	0,0000
Intensive chemical weeding	0,1146	0,0787	0,1453
Risk	-0,1983***	0,0442	0,0000
Yield	0,0226***	0,0019	0,0000
Compensatory Payment	0,0011***	0,0001	0,0000
Number of observations	1144	*, **, *** means	
Number of parameters	10	statistically significant at	
Log likelihood	-1154,521	90%, 95% and 99%	
Rho-squared	0,14347	significance level	

For qualitative variables, we chose as reference levels those which are the most widespread among the current practices of the rice growers in Camargue.

The parameter attributes associated with levels "cereal" rotation, long rotation, mechanical weeding, and those for risk, yield and prime are all significant, at the 1% level of confidence (except "cereal" rotation, significant at the 5% level of confidence). We can note that long rotation and mechanical weeding are unfavorable to producers, whereas "cereal" rotation, higher yield and premium bring a greater utility to respondents. The parameter estimate of risk is found to be negative, as expected, that is an increasing risk is associated with a decreasing utility, signifying that farmers are adverse to risk. The ASC of the opt-out option is not significant, that can be explained by the fact that the hypothesis of Independence of Irrelevant alternatives (IIA) is violated, insofar as the choice of this option depends clearly on the two other scenarios proposed to the respondent. The IIA property was tested using the Hausman and McFadden (1984) test. The results are reported in table IV below. All the information must be included in the estimation, and that is not the case with the MNL model. Moreover, the non significance of attribute levels manual weeding and intensive chemical weeding can be the result of a too big heterogeneity in the

Table IV : IIA test

Alternative dropped	*χ2*	*Degree of freedom*	*Probability*
Scenario A	28,0554	10	0,001769
Scenario B	19,3113	10	0,036482

population of rice growers for these factors, and can reveal the presence of classes in which the preferences would be different. For all those reasons the MNL model is definitively not appropriate.

b) The sample selection model

The sample selection model is a two step model, in which we first estimate a probit model to explain the choice of the opt-out option, and then we use this information to find the value of attributes' parameter estimates with a selection. In the probit model, as well as the attributes characterizing the scenarios, we introduce instrumental variables, like the practice of additional recreational activities by the respondent, the presence of cattle or sheeps on the farm and the choice by the producer of the response "stop rice growing" to a question on his reaction to the possibility of a hypothetical ban on the use of chemical weedkillers. The table V presents the final results, those of the selection model.

Table V : Estimates of the sample selection model

Variable	*Value*	*std error of β*	*p-value*
ASC	0,6679***	0,0406	0,0000
Cultivar choice	-0,0040***	0,0003	0,0000
"Cereal" rotation	0,0297**	0,0142	0,0364
Long rotation	-0,0539***	0,0142	0,0002
Manual weeding control	-0,0308*	0,0159	0,0531
Mechanical weeding	-0,0815***	0,0165	0,0000
Intensive chemical weeding	0,0175	0,0173	0,3099
Risk	-0,0201**	0,0086	0,0192
Yield	0,0052***	0,0004	0,0000
Compensatory Payment	0,0003 ***	0,0000	0,0000
Number of observations	2415	*, **, *** means	
Log likelihood	-1411,562	statistically significant at	
Log likelihood (restricted)	-1730,990	90%, 95% and 99%	
Rho-squared	0,22893	significance level	
Chi-squared	638,86		
significance level	0,0000		

We can note that more variables are significant, and the global model is better, in terms of McFadden ρ^2, which is becoming here much better[3]. The ASC becomes significant and positive. The attributes "cultivar choice" and "manual weeding" become significant too and negative, as expected. Indeed, it is clearly possible to see the negative reaction to mechanical and manual

[3] According to Hensher and Johnson (1981) ρ^2 values between 0,2 to 0,4 are consider to be extremely good fits.

weeding, which are viewed by the respondents as costly practices, in time and money. The fact that the utility decreases as the length of the cultivar' life cycle increases is consistent with high risk aversion, because the longer the life cycle, the higher the risk[4]. The sign and the significance of the attributes parameters related to the crop rotation, risk, yield and premium are still the same. The attribute "intensive chemical weeding" is the only one not to be significant. Nevertheless, due to the existence of a significant group of farmers practicing organic farming, we decided to estimate two models taking into account this heterogeneity in the population, the random parameter model and then the latent class model.

c) The random parameter model

In the random parameter models, an assumption for the distribution of each of the random parameter (the density function f (β / θ) must be defined. In this paper, random parameters are specified to be distributed according to the Weibull distribution.

Table VI : Estimates of the random parameter model

Variable	*Value*	*std error of β*	*p-value*
Random parameters			
ASC	0,4957	1,6382	0,7622
Manual weeding control	-2,1191***	0,5925	0,0003
Non random parameters			
Cultivar choice	-0,0114	0,0071	0,1096
"Cereal" rotation	0,2291**	0,0923	0,0130
Long rotation	-0,4297***	0,1216	0,0004
Mechanical weeding control	-0,4755***	0,0992	0,0000
Intensive chemical weeding	0,1895*	0,1023	0,0638
Risk	-0,2079***	0,0626	0,0009
Yield	0,0312***	0,0043	0,0000
Compensatory Payment	0,0015***	0,0002	0,0000
Number of observations	1144	*, **, *** means statistically significant at 90%, 95% and 99% significance level	
Log likelihood	-1154,5208		
Log likelihood (restricted)	-1256,8125		
Pseudo Rho-squared	0,21752		
Chi-squared	546,7686		
significance level	0,0000000		

The model is still better than the basic MNL one. The manual weeding is now very significant, and this proves that this attribute level is indeed heterogeneous among the rice grower population. The attribute related to the length of the life cycle appears now to not be very significant. But the attribute "intensive chemical weeding" is now significant, with a positive

[4] A seed with a long life cycle forces the rice growers to sow earlier, and thus it can be risky if the weather is cold during the fertilization, that causes a bad rice rising. Alternatively, seeding at a normal date implies late harvest, and certainly more losses in case of adverse weather conditions.

influence on the farmers' utility. Nothing has changed for the parameters of the other attributes. As we know that heterogeneity exists in our population, we will thus determine how producers split into classes, and estimate attributes parameters for each of them. For that aim, a latent class model appears to be the most relevant.

d) The latent class model

Table VII: Estimates of the latent class model

Variable	*Value*	*std error of β*	*p-value*	*Probability of class*
Class 1 :				
ASC	-2,8230**	1,2450	0,0234	
Cultivar choice	-0,0103	0,0808	0,2037	
"Cereal" rotation	0,1156	0,0846	0,1715	
Long rotation	-0,3602***	0,0925	0,0001	
Manual weeds control	-0,0716	0,1095	0,5131	**0,601**
Mechanical weeding	-0,5858***	0,1032	0,0000	
Intensive chemical weeding	0,0124	0,1114	0,9113	
Risk	-0,1993***	0,0625	0,0014	
Yield	0,0237***	0,0026	0,0000	
Compensatory Payment	0,0011***	0,0002	0,0000	
Class 2 :				
ASC	4,7448***	1,6679	0,0044	
Cultivar choice	0,0172	0,0108	0,1121	
"Cereal" rotation	0,2292**	0,1132	0,0430	
Long rotation	-0,2603**	0,1172	0,0264	
Manual weeds control	-0,6429***	0,1110	0,0000	**0,289**
Mechanical weeding	-0,9825***	0,1635	0,0000	
Intensive chemical weeding	0,7706***	0,1329	0,0000	
Risk	-0,3188***	0,0725	0,0000	
Yield	0,0207***	0,0027	0,0000	
Compensatory Payment	0,0017***	0,0002	0,0000	
Class 3 :				
ASC	7,2709**	3,0883	0,0186	
Cultivar choice	0,0337*	0,0192	0,0792	
"Cereal" rotation	0,3280	0,2514	0,1920	
Long rotation	0,2996	0,2504	0,2315	
Manual weeds control	1,5099***	0,2550	0,0000	**0,110**
Mechanical weeding	1,4893***	0,3660	0,0000	
Intensive chemical weeding	-1,3358***	0,3262	0,0000	
Risk	-1,0427***	0,2444	0,0000	
Yield	0,0628***	0,0102	0,0000	
Compensatory Payment	0,0006	0,0005	0,1864	
Number of observations	1144	*, **, *** means statistically significant at 90%, 95% and 99% significance level		
Log likelihood	-1154,521			
Log likelihood (restricted)	-1256,812			
Pseudo Rho-squared	0,3089			
Chi-squared significance level	776,3506 0,0000000			

The first class involves 60 % of the population of decision-makers. Attributes having a negative effect on their utility are the long crop rotation, the mechanical weeding, and higher risk , whereas higher compensatory premium and yield increase their indirect utility. This class certainly encompasses farmers committed to the technological norms of the IGP "Riz de Camargue". That norm does not exclude the use of chemicals. One could consider that norm as a main or dominant farming subculture. In the estimates of that class, several attributes are not statistically significant. This can be either the consequence of the cognitive complexity involved by the management of a high number of attributes, the respondents focusing only on the main attributes they consider relevant for them, or by the direct influence of the norm on their responses.

Beside that core class 1, there are two opposites classes, one being characterized by the rejection of any agro-ecological practices (one third of the overall population), and the other characterized by their adoption (10%).

In class 2, all the attributes except the length of the cultivar's life cycle are significant. Crop rotation including more wheat and intensive chemical weed control are positively valued, while long rotation, and manual or mechanical weed control are negatively valued.

In class 3, the parameter of the length of the cultivar's life cycle is positive and significant, but the attributes characterizing the preferences for the crop's rotation are not. Indeed, manual or mechanical weeds control are valued positively, while intensive chemical weeding is negatively valued.

In both classes 2 and 3, the ASC are positive, a result contrasted with the negative ASC in class 1. One could interpret that by the difference in the relative frequency of the use of the opt-out option. Farmers belonging to class 2 or class 3 have each a strong and clear farming subculture, and do not use it frequently.

These results are in some ways surprising, because we have not anticipated the strength of the preferences for an intensive farming system. The remaining question is about the interpretation to be given to that observation. Is it really the expression of a strong farming subculture, or the simple expression of the existence of one strong agro-ecological constraint arising from the presence of salt in the underlying soils layers and aquifer ?

e) Estimation of the "value" of technology' attributes

The monetary value of each attribute, called implicit prices or part-worth, could be calculated from the latent classes estimates, using the following relationship:

$$\text{Implicit price} = (\beta_{\text{attribute}} / \ \beta_{\text{monetary attribute}})$$

This implicit price represents the marginal welfare variation for a change in any of the attributes. It corresponds to a compensatory payment that farmer are willing to accept (WTA) for adopting an attribute (or for a one unit improvement in the attribute level), in the case of negative values, or to give it up, in the case of positive values.

Table VIII : Technology' attributes implicit prices (Euros)

Variable	Class 1	Class 2	Class 3
Cultivar choice	- 9,51	9,92	54,37
"Cereal" rotation	107,05	132,47	529,10
Long rotation	-333,51	-150,46	483,31
Manual weeds control	-66,34	-371,64	2435,31
Mechanical weeds control	-542,37	-567,92	2402,03
Intensive chemical weeding	11,49	445,43	-2154,52
Risk	-184,49	-184,28	-1681,85
Yield	21,92	11,95	101,21

All the farmers in the three classes attached a positive value to the crops rotation including more cereals and to higher yields, whereas a negative value has been always attached to the risk attribute. Only the level of the implicit price for those attributes differs from class 1 and 2 to class 3. Class 3, which is certainly associated with organic farming preferences, exhibits a risk aversion considerably higher than the two others groups.

For all the remaining attributes, preferences are very different for class 3 compared with classes 1 and 2. For the latter, negative values are associated with agro-ecological practices, while positive ones are given to the intensive use of chemicals. For the "IGP Riz de Camargue" producers, mechanical weed control and long rotation (two characteristics of organic farming) are highly negatively valued. The aversion to manual weed control is more moderate, with a lower negative value. However, we can observe in the second class an important rejection of all organic agro-ecological practices, more especially manual and mechanical weed control, and a strong preference for the intensive chemical weeding. This class represents indeed an intensive farming subculture. Finally, the last class is the one with the highly contrasted values. All attributes related to the weed control and the level of risk are very important for these rice growers. They have a strong aversion to an intensive use of chemicals, and are willing to practise manual and mechanical weed control.

V. Conclusions and perspectives

Using a choice experiment survey, this research has elicited rice growers valuation of attributes describing their individual technology preferences.

With the help from experts and following several tests, we identified five relevant technology attributes, three related to agro-ecological means (length of life cycle of rice cultivar, weeds control technology, type of crop-rotation), two related to outcome (average yield and yield variability) and finally, a monetary attribute, representing a compensating payment in addition to the base gross margin. Choice sets have been proposed to the farmers, including one opt-out options, which was to leave the land unexploited.

The econometric analysis of the data demonstrated a great heterogeneity in the preferences among the decision-makers in the area. Random parameters logit and Latent Class Models helped to give a more precise view of that underlying heterogeneity.

Facing the cognitive difficulty of the task choice, respondents certainly used the references of existing collective norms in the Camargue area as benchmarks. The Latent Class Model identified a core class of responses corresponding to the standard of the "IGP Riz de Camargue", and a little one, corresponding to the "organic farming standard". Nevertheless, beside these well known standards, an important group of respondents, representing one third of the farmer population, expressed their preferences for a technology using more intensive cropping practices. The question about the interpretation to be given to that observation is still open. Is it really the expression of a strong farming subculture, or the simple expression of the existence of an strong agro-ecological constraint pertaining to the presence of salt in the underlying soils layers and aquifer ?

Whatever the interpretation would be, the results are worthwhile for the managers of the collective standards or of the corresponding marketing channels. Moreover, they have a great value for policy makers, because they identified and measured the diversity of values attached to the main components of the rice cropping technology in the area.

Estimates of the implicit prices show that breathing space exist to convince rice growers to adopt environmental friendly practices through market or public policies incentives. It is worth noting that the compensatory payment to give to farmers of class 1, the largest by number, is of the same magnitude as the current "bulk unconditional payment", the so-called "DPU" . Our results could help in designing targeted contracts by sub-area, conservation or environmental objectives.

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Annex

Empirical data on the surveyed farmers population

a) General description of the sample

In Camargue , the rice growers population is almost exclusively male and old, with more than half of farmers being more than fifty years old. Moreover, producers are relatively well educated, in general or with a special education in agriculture. With regard to the education in agriculture, the population split almost equally into those who don't have any particular education in farming, and those who have received one.

Table I : Socio demographic characteristics of the decision makers

Characteristics	Frequency
Age :	
- 18-35 years	14%
- 36-50 years	33%
- More than 50 years	53%
Sexe :	
- Male	98%
- Female	2%
General education :	
- No general education	10%
- Primary education	14%
- Short secondary education	31%
- Long secondary education	23%
- Higher education	22%
Education in Agriculture:	
- No general education	41%
- Primary education	2%
- Short secondary education	16%
- Long secondary education	12%
- Higher education	29%

The rice growing farms in Camargue have usually broadacre (more than 100 ha), and in particular the majority of them are bigger than 200 ha. Only a low percentage (2,5%) of exploitations are very little, that is a net farming area below 50 ha.

Table II: Characteristics of farms

Characteristics	Frequency
Net farming area :	
- < 50 ha	2,5%
- [50-100 ha[	23,5%
- [100 ha- 200 ha[	31%
- >= 200 ha	43%
Organic cropping :	
- A part of the whole surfaces in organic	22%
- All surfaces in organic	15%

b) A typology of rice growers with farming subcultures

We elaborated a typology of the decision makers with respect to the farm's characteristics and to personal conceptions of the profession.

Due to the importance of recreational activities in the Camargue area , we focused on the presence on the farm of pertinent criterion such as additional recreational activities (tourism, commercial hunting, bull race...), marshes (and more precisely swamps for hunting), cattle (belonging to the farm or not), and then we included also the average crop's yields.

We finally identified two main groups:

- the first one encompasses rice growers who focused only on the farming production. We call them "Entrepreneurs in agriculture" given that they have a "productivist" farming subculture and get highest yields. Indeed, only few of them (7%) are concerned by very lower yields ([2t-5t[). They don't manage any additional recreation activities nor natural spaces (no land for cattle or marsh). They represent 40% of the whole population.

- the second one encompasses "Multifunctionals Farmers" who integrate natural area into their management, while their conception of farming takes into account ecological considerations. They combine agricultural production, recreational activities, and manage cattle and marshes. A great part of them get agricultural yields in the range [5t-7t[, but with a greater dispersion than the "Entrepreneurs in Agriculture". They represent 60% of the population.

To complete this general presentation, we end up with linking the former typology to the personal conceptions about the farming profession. That resulted in the definition of two farming subcultures (Table III).

Table III : The farming subcultures among the rice growers

According to you, the farmer profession consists to:	*Frequency*
Overall population :	
- produce quality food products	66%
- produce raw materials for industry at the lower price	1%
- produce quality food products in controling negative impacts on Environment	33%
- produce recreational and environmental services	0%
“Entrepreneurs in Agriculture” :	
- produce quality food products	70%
- produce raw materials for industry at the lower price	1%
- produce quality food products in controling negative impacts on Environment	29%
- produce recreational and environmental services	0%
“Multifunctionals Farmers” :	
- produce quality food products	64%
- produce raw materials for industry at the lower price	0%
- produce quality alimentary products in controling negative impacts on Environment	36%
- produce recreational and environmental services	0%