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EX-ANTE EVALUATION OF AGRI-ENVIRONMENTAL SCHEMES:
COMBINING ELEMENTS OF PRIVATE AND PUBLIC DECISION
MAKING

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Paper prepared for presentation at the 107th EAAE Seminar "Modelling of Agricultural and Rural Development Policies". Sevilla, Spain, January 29th -February 1st, 2008

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Abstract

The objective of this paper is to set up a complete ex-ante evaluation procedure to support Decision Makers in designing more efficient and effective agri-environmental contracts, through an integrated modelling of elements of private and public decision making. Ex-ante comparison of policy design options in terms of overall effectiveness requires both simulations of farmers' behaviour and evaluation of the farms simulations outcomes. An intermediate step is the aggregation of single farms impacts at territorial level, in order to identify the aggregate impact of each alternative. Alternatives are several contract design, based on different levels of payments. Farm level analysis is based on a real options approach including in the simulations the timing of choice and the uncertainty in the future about price and decoupled payments. Aggregate policy impact is identified through the quantification of economic, social and environmental impacts at territorial level and the weights are elicited with Multiple-Criteria Robust Interactive Decision Analysis (MCRID). Simulations in the case study show that relevant opportunities to improve policy design are available. Multicriteria Analysis is then used to aggregate impacts of many criteria, including not only effects on the environment, but also economic and social impacts.

Key words: Agri-environmental schemes; Real Options; Investments; Decoupled payments; Uncertainty.

1. Introduction

The Agri-Environmental Schemes are starting their new programs for the period 2007-2013, under regulation 1698/2005. In this regulation the European Commission has confirmed the possibility for each Member State to design and implement agri-environmental schemes at national, regional or local level. The design step is a fundamental phase in the policy cycle and it is based on the definition of the type and the dosage of policy instrument, choice of the target, choice of addressees and choice of the regulation area (Latacz-Lohmann, 2001). Policy effectiveness has strong relationships with implementation and contract design phases (Latacz-Lohmann, 2001). Accuracy in the design and in the creation of policies can take into account the needs of all stakeholders involved and can guarantee an efficient and effective program. Furthermore the design of contracts for the production of agri-environmental goods has the meaning to generate participation and to invest in environmental goods, without generating distortive effects on the market (Swinbank, 2000; Latacz-Lohmann and Hodge, 2001; Dobbs and Pretty, 2004).

The objective of this paper is to develop a complete ex-ante evaluation procedure to support Decision Maker (DM) in designing more efficient and effective agri-environmental contracts, through an integrated modelling of elements of private and public decision making. Ex-ante comparison of policy design options in terms of overall effectiveness requires both simulation of farmers' behaviour and evaluation of the farms simulations outcomes. An intermediate step is the aggregation of single farm impacts at territorial level, in order to identify the aggregate impact of each alternative. Alternatives are several contract design options, based on different levels of payments for introduction and maintenance. Farm level analysis is realized using a land allocation model, based on a real options approach. The model is able to include in the simulations the timing of choice and the uncertainty about the future about price of agricultural products and decoupled payments. Public analysis is based on the evaluation of the aggregate farms' impacts of several contract alternatives based on interactive

multicriteria analysis, where weights are elicited using the Multiple-Criteria Robust Interactive Decision Analysis (MCRID) approach. The model is applied to a case study area in Ferrara Province (NUTS 3).

The structure of the paper is the following: in section 2 some background about common agricultural policy and agri-environmental schemes is provided; in section 3 the methodology is presented; in section 4 the case study and the model description are presented; results and conclusions are reported in chapter 5 and 6 respectively.

2. Common Agricultural Policy, markets and Agri-environmental schemes

The modelling of participation in agri-environmental schemes, indeed, is a function of many aspects: farm and farmer characteristics; amount of payments, lengths of contract and the commitments required. Furthermore the context on which farmer makes a decision and the information available and the expectations about the future of market trends and other future policy have strong relevance in the quantification of the uptake. Before dealing with the model itself, we briefly analyse the framework connecting such issues.

The linkage between common agricultural policy and agri-environmental schemes is emphasized either with the cross-compliance mechanism and the proposals for CAP revision under health check process. Cross-compliance represents a relevant topic in the EU agenda (Commission of the European Communities, 2007). The core content of cross-compliance is the definition of compulsory standards of environmental and health that each beneficiary of the single farm payment must be compliant with (European Commission, 2003). From the viewpoint of rural development programs, conditionality represents the baseline from which to quantify the cost of commitments required for agri-environmental schemes (Reg. 1698/2005). Furthermore, the single payments are included in the justification of the amount of payments as income foregone for landscape elements and for other AESs consuming lands. From the point of view of decoupled payments, agri-environmental payments are excluded from the quantification of number of rights and also from the identification of eligible surface, as well as from the calculations of the amount of single payments.

Investments in landscape elements can be seen as specific investments, due to zero salvage value that the goods can have outside the contract. Literature concerning specific investments is rather wide (see Williamson, 1996 for the formalization of specific investments linking to the transactions costs). Following Sanchez (2003), specific investments represent a strategy for obtaining competitive advantage in the present or in the future, but at the same time reducing the flexibility of the firm in front of uncertain situations. Furthermore, it exists a trade-off between investment in landscape elements and other agri-environmental schemes consuming area and the maintenance of enough surfaces for benefiting of the single payments. This trade-off increases when farmer's choices are concerned with long term investments, and are made under uncertain scenarios in both future policy and market prices. Increased uncertainty in price is expected as a consequence of indications of reductions of mechanisms of price support, which will expose farms to the international markets. At farm level, the timing on which realize investments is characterized by changing amount of information about the uncertain variables available at the moment of the choice. This may attribute a value to the choice of waiting to take decisions, when variability of decision parameters may be reduced over time.

3. Methodology

The objective of this paper is to develop an aggregate ex-ante evaluation of different contract design options, for facilitating the DM in the policy design phase. The methodology (Figure 1) is divisible in two levels: first, analysis of farmers' behaviours in front of new contract design options for the provision of landscape elements; second, public analysis of the choice, in order to identify dominated policy alternatives. Combining both elements of private and public decision making it is possible to outline strategies to improve the efficiency and effectiveness of agri-environmental contracts.

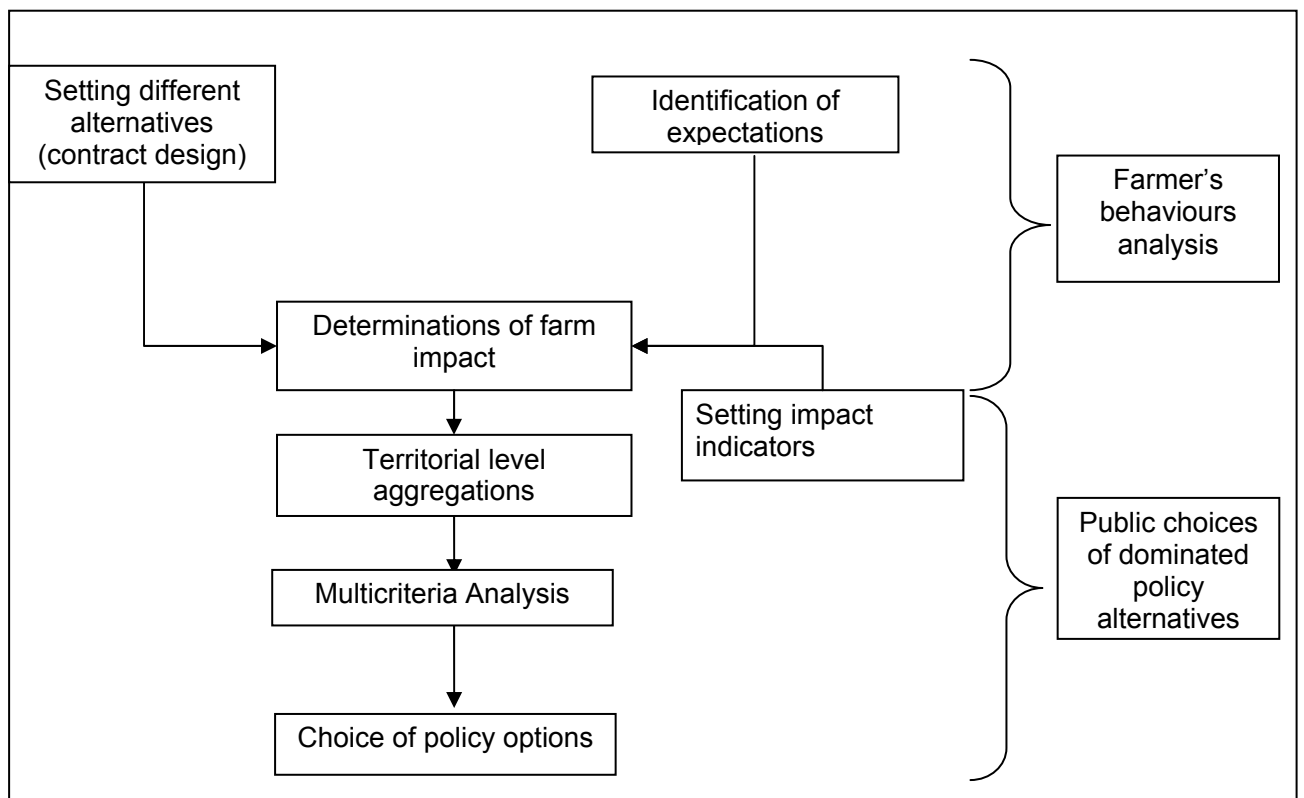


Figure 1. Methodology applied

Farmers' behaviours analysis has been developed using a land allocations model that determines the participation in front of new contracts for the provision of landscape elements. Alternatives considered are different ways to implements landscape contracts, changing the amount of payments for both introduction and maintenance phases.

Farmer's choice is determined by the maximum expected value synthesized in equation 1 (Mastens and Soussier 2002; Peerlings and Polman, 2004):

$$\begin{aligned}
 G^* &= G^l, \text{ if } V^l > V^a \text{ and} \\
 &= G^a, \text{ if } V^l < V^a .
 \end{aligned}
 \tag{1}$$

where

G^l = contract for provision of agri-environmental good;

G^a = better alternative to the contract provided;

V^l, V^a = expected value of transactions respectively of agri-environmental contracts (l) and to the better alternative to the production of agri-environmental goods (a);

G^* = farmer's choice.

Each farmer's choice (G^*) determines an impact vector i_{lh}^v , measured through economic, social and environmental indicators. For a generic alternative l the territorial impacts correspond to:

$$I_l^v = \sum_{h=1}^H i_{lh}^v s_h \quad (2)$$

Where:

i_{lh}^v = farms performance generated by alternative l ;

$h = 1, \dots, H$ farm type

v = economic (eco), social (soc) and environmental (env) criteria;

s_h = weights of farm h on the territory.

The utility value (u_l^i) is generated by the aggregation of weight w_i and impacts I_{il} , for each v criterion and for each l alternative (Guitouni and Martel, 1998). Impacts I derives from the weighted sum of all farm impacts (i_{lh}^v).

The methodology for eliciting weights, as expression of relative importance of objectives for the DM, is based on Multiple-Criteria Robust Interactive Decision analysis (MCRID) from Moskowitz *et al.* (1992).

The Multicriteria problem can be identified as an aggregation of the utility from single criteria based on the performance for each criterion v of one alternative a_j .

$$E[U(a_l)] = \sum_v^m w_v u(a_{lv}) \quad (3)$$

Where:

$l = 1, \dots, n$ alternative;

$v = 1, \dots, m$ criterion.

$u(a_{lv})$ = utility for the DM due to the impacts of alternative l on the criterion v ;

w_v = weight of the criterion v ;

In hierarchical MCA, weights play a central role. In fact, total utility function at k level comes from the aggregations of several utility functions at $k-1$ level (economic, social and environmental criteria). The impacts presented at level k , are measured through economic, social and environmental criteria. Each criterion presents a sub-set of indicators (level $k-1$). Indicators belonging to economic criteria are the farm profits, the payments by local administrations and the value of investments in landscape elements. Social indicators are both family and external labour and the numbers of beneficiary of the landscape contracts (participants). Environmental indicators are the hectares of the landscape elements created with AESs, differentiated in hedgerows, small woods and ponds. Adopting hierarchical MCA implies to pay high attention to the preferences inter-level and intra-level. Multicriteria approach used is based on an interactive process with the DM; the information collected from DM is able to reduce weaknesses during weights elicitation phases.

The key strategy of this methodology is in structuring the preferences expressed by the DM as a linear programming optimizations problem; in this way, it is possible to elicit the weight as an interval of maximum and minimum amount that can validate the DM choice (Hayashi, 2000). The minimization and the maximizations of DM' preference for each criterion can be interpreted as upper and lower bound values within which the value of the importance of each criterion can be considered consistent. Several other methods are used in literature for eliciting weights, basically those methods can be classify into interval point scale, or into ratio scale (Salo, 1995).

The methodology applies as follows. The first step starts asking to the DM the ranking of the importance for the criteria at k-1 level and the alternatives strictly preferred for the same criterion considered. Identification of dominant alternatives is based on paired comparison. The DM's preference can be formalized as:

$$w_v^{k-1} \phi w_m^{k-1} \text{ for } v \neq m \quad (4)$$

$$E[U(a_l)^{k-1}] \phi E[U(a_n)^{k-1}] \quad (5)$$

Where

w_v^{k-1} = the weight of criterion v at the k-1 level;

w_m^{k-1} = the weight of criterion m at the k-1 level;

$E[U(a_l)^{k-1}]$ = expected utility functions for alternative l ;

$E[U(a_n)^{k-1}]$ = expected utility functions for alternative n .

Structuring the identified preferences as linear programming model and through maximizing and minimizing the weight of each criterion, it is possible to identify the maximum and minimum value of the weights able to verify the structure of preferences revealed by the DM. Repeating the step for the other k levels, we are able to identify weights for each criterion present in the same level. Following Arrow (1951) the verbally expressed preferences can be rewritten as:

$$w_v^{k-1} - w_m^{k-1} > 0 \quad (4a)$$

$$\sum_{v=1}^m w_v^{k-1} [U(a_{v_l}) - U(a_{v_n})] > 0 \quad (5a)$$

With both maximization and minimizations of each weight of the same liner programming problem it is possible to identify the DM's local weight (level $k-1$) (Moskowitz *et al.*, 1992).

$$\max/\min w_i^{k-1} \quad (6)$$

subject to

$$A^{k-1} w_v^{k-1} < rel > b^{k-1}$$

$$D^{k-1} w_v^{k-1} \geq 0$$

$$w_v^{k-1} \geq 0$$

Where A is an $m \times n$ matrix containing the constraints, w_v is a n -dimension vector of weights and b is a m -dimensional vector of the right-hand sides for the k-1 level. D expresses the DM preference matrix. The aggregate utility at the k-level the impact is obtained through a weighted sum of utility of the impact at k-1 level. The aggregations is based on maximum (7) and minimum (8) weighted sum of the criteria

$$\overline{U}_I^k = \sum_{w_v \in S_k} \overline{w}_v^{k-1} u_I^{k-1} \quad (7)$$

$$\underline{U}_I^k = \sum_{w_v \in S_k} \underline{w}_v^{k-1} u_I^{k-1} \quad (8)$$

The maximum (\overline{w}_v) and the minimum weights (\underline{w}_v) are obtained from the minimizations and the maximization process. Restarting the second interactions with the DM (k level), the DM provides a new ranking of the criterion based on they importance and new identification of pairs of alternatives. The final score of the alternatives is based on the aggregations through weighted sum of the partial utility above calculated.

The choice among different alternatives is obtained comparing the total utility deriving from all impacts (Keeney and Raiffa, 1976). The DM choice is structured as a ranking of different alternative (several landscape contracts design).

4. Case study and empirical model

The case study is located in the Agrarian Region “Bonifica Ferrarese Occidentale”, in Ferrara Province (Northern Italy). The area includes the Municipalities of Argenta, Berra, Copparo, Formignana, Jolanda di Savoia, Masi Torello, Portomaggiore, Ro, Tresigallo and Voghiera. The entire Agrarian Region is in plain, with the surface of 70,713 hectares and a number of farms of 3.630. Average UAA per farm is quite high compared to other Italian areas (19.23 ha).

The objective of the simulations is the design of contracts for the productions of Measure 9 of rural development plans of Region Emilia Romagna (Introductions and maintenance of landscape elements). The present contract is characterized by 10 years of length with two levels of payment, 2000 €/ha in the first five years (introduction) and 1000 €/ha in the second five years (maintenance). Possible landscape elements that can be produced are: hedgerows; small wood and ponds (Emilia Romagna, 2000). In the Ferrara provinces the area under landscape contract was 1,070 ha in the years 2004 (Marchesi and Tinarelli, 2007).

Farmers’ behaviour analysis is based on simulation to 10 different farm types¹. The simulations model is based on real option approach that can include the timing on which farmers can decided to invest (Dixit and Pyndic, 1994) and that can consider uncertainty in the prices of the agricultural products and in the amount of decoupled payments (Peerling and Polman, 2004). The timing and the possible actions of the farmer (A) and Regional Administration (P) is presented in Figure 2.

¹ The farms were divided in 10 different types, crossing between crops specialisations (arable farming, fruit farming and vegetable farming) and farm surfaces (small, medium, medium-large, large).

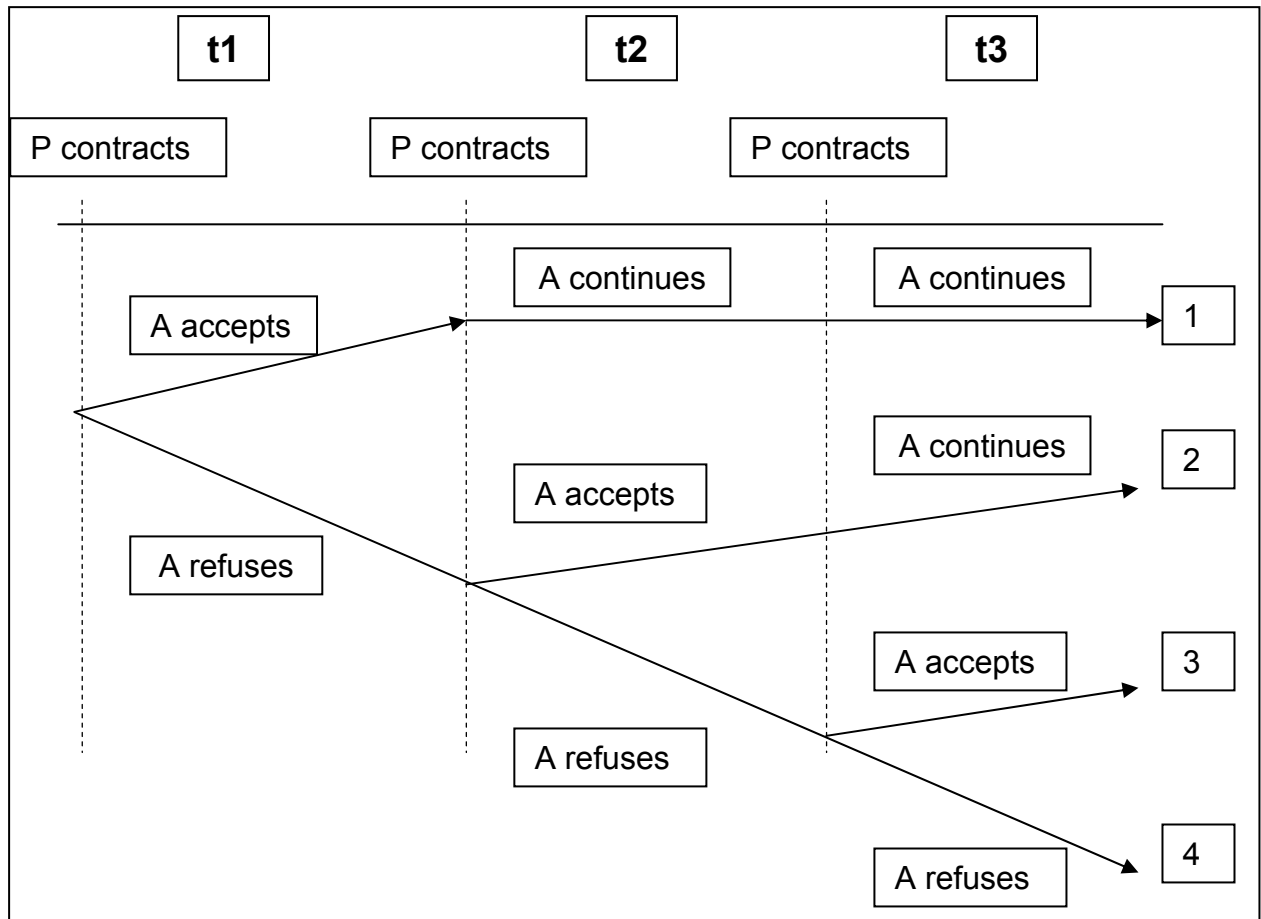


Figure 2. Timing of contract

The DM proposes a contract in the first (t1), in the second (t2) and in the third (t3) period. The contract is known by the farmers, and once revealed by P it maintains the same conditions. Periods 1 and 2 have a length of one and period 3 has a length of height years. The model is developed using two stochastic variables: commodities and fruit price, and decoupled payments. The prices are stochastic in the second and in the third period and the amount of decoupled payments only in the third period. Contracts for the provision of landscape elements represent a specific investment, outside AESs contract the salvage value is equal to zero. As shown in Figure 2, the possible farmer's choice can be four. Such a model can include the option to wait and to postpone the decision to invest in landscape elements in period t2 and t3. Situation one is generated when farmer realizes the investment in the first period and it keep the contract (possibly with lock-in) for both the second and the third, due to high specificity of investments realized. Otherwise the farmer can choose to wait and have more information about the future price before to invest in landscape in second period and remain looked-in for the third period (situation two). Finally the farmer can postpone the decision to the third period as a consequence of more information available about the future price and the amount of decoupled payments. If decisions to invest are realized in the third period its will generate situation three when the farmers accept to invest and situation four if the farmers do not realize the investment. The choice to invest in landscape elements is based on maximizing of the Net Present Value (NPV) of the expected cash flow of the three periods (t1, t2 and t3). Prices are known in first period, and are

stochastic in second and third period. Decoupled payments are know in the first and second period, but are stochastic in the third period.

Formally the NPV is presented in equation 10.

$$\text{Max } NPV_{hl} = -Inv - tc_h^{ea} + \pi_{hl,t=1}(\cdot) \frac{1}{(1+r)^{n1}} + \pi_{hl,t=2}(\cdot) \frac{1}{(1+r)^{n1+n2}} + \pi_{hl,t=3}(\cdot) \frac{(1+r)^{n3} - 1}{r(1+r)^{n1+n2+n3}} \quad (9)$$

With:

Inv = specific investment for productions of landscape elements;

tc_h^{ea} = ex-ante transactions costs, specific for the AES contract;

$\pi_{hl,t=1}, \pi_{hl,t=2}, \pi_{hl,t=3}$ = profits obtained in the first and second period.

$$\pi_{hl,t=1}(\cdot) = (p_{t=1}i_{t=1}) + pd_{t=1} + p_{c,t=1}^{aes} - le_{t=1} - lf_{t=1} - s_{t=1} - s_{c,t=1}^{aes} - tc_{c,t=1}^{ep} - le_{c,t=1}^{aes} - lf_{c,t=1}^{aes}$$

$$\pi_{hl,t=2}(\cdot) = (\theta p_{t=2}i_{t=2}) + pd_{t=2} + p_{c,t=2}^{aes} - le_{t=2} - lf_{t=2} - s_{t=2} - s_{c,t=2}^{aes} - tc_{c,t=2}^{ep} - le_{c,t=2}^{aes} - lf_{c,t=2}^{aes}$$

$$\pi_{hl,t=3}(\cdot) = (\theta p_{t=3}i_{t=3}) + \theta pd_{t=3} + p_{c,t=3}^{aes} - le_{t=3} - lf_{t=3} - s_{t=3} - s_{c,t=3}^{aes} - tc_{c,t=3}^{ep} - le_{c,t=3}^{aes} - lf_{c,t=3}^{aes}$$

Where:

p_t = commodities and fruit price in the first and second period;

$p_{c,t}^{aes}$ = payments for the productions of landscape elements (aes) under contract c;

$s_{c,t}^{aes}$ = implementations cost of landscape contract;

s_t = costs of commodities and fruit;

i_t = yield of crops

pd_t = single payment²;

θ = stochastic value;

$le_t; le_{c,t}^{aes}$ = external labour for the productions of commodities and fruit and for the provision of landscape elements under contract c;

$lf_t; lf_{c,t}^{aes}$ = family labour for the productions of commodities and fruit and for the provision of landscape elements under contract c;

$tc_{c,t}^{ep}$ = ex-post transactions costs;

r = discount rate = 2%;

$t = 1,2,3$ = period 1; period 2 and period 3;

$n1, n2, n3$ = length of period 1, 2 and 3.

Farmers decide to participate in AESs through the executions of investment in landscape elements when NPV generated from a specific contract design is higher than without contract. Empirical simulations are based on the use of three separated models, including in different ways the uncertainty of price and singles payments in the second period and in the third period.

The expected values of prices and payments have been drawn from a survey carried out in Emilia Romagna Region in 2006 among 81 farmers, concerning their expectations about the future and adapted to the rationale of this model (Table 1)³.

² Payments are guaranteed only if farmer maintain a number of right; landscape elements are not included in the rights and are competitive with the COP.

Table 1 Expected values of prices and payments.

	Scenario A	Scenario B
Prices of agricultural products		
Value in the of the scenario (actual=1)	1.06	0.81
Probability	0.86	0.14
Expected value (actual=1)		1.02
Decoupled payments after 2013		
Value in the of the scenario (actual=1)	1.00	0.30
Probability	0.52	0.48
Expected value (actual=1)		0.66

5. Results

Results are presented in the following way: first the results of the simulations of farmers' behaviour, expressed in terms of economic, social, and environmental impacts are shown in Table 2; secondly the weights of the DM obtained from the MCRID process are presented in Table 3; finally the value of utility obtained through weighted sum of all alternatives are showed in Table 4.

³ The survey was carried out as part of the project "Investment behaviour in conventional and emerging farming systems under different policy scenarios, CONTRACT 150369-2005 F1SC IT, call for tenders J05/13/2005, IPTS JRC Seville".

Table 2 Outcome of the farmers' behaviour simulations (impacts matrix for MCA)

Amount of Transaction costs	alternatives ⁴	Economics Indicators				Social Indicators		Environmental indicators ⁵	
		Profit	Investments	Payments	External labour	Family labour	Participants	Hedges	Ponds
		(€)	(€)	(€)	(hours)	(hours)	(#)	(ha)	(ha)
10% of the payments	L_L	1,124,245	574,342	278,675	37,005	113,488	1,704	166	716
	L_A	1,133,856	666,043	501,708	37,250	113,358	1,704	195	853
	L_H	1,148,838	1,095,819	1,078,523	37,332	113,440	1,747	214	1,471
	A_L	1,144,173	1,092,867	1,094,727	37,332	112,253	1,747	195	1,487
	A_A	1,160,523	1,135,157	1,400,510	37,347	112,221	1,747	214	1,508
	A_H	1,177,135	1,476,673	2,273,158	37,334	112,241	1,752	214	2,148
	H_L	1,172,687	1,579,575	2,399,294	37,347	111,910	1,758	214	2,244
	H_A	1,190,005	1,935,459	3,287,539	37,347	109,249	1,807	265	2,599
	H_H	1,207,678	1,935,459	3,738,913	37,354	109,243	1,807	265	2,598
20% of the payments	L_L	1,098,997	642,300	183,957	55,601	129,949	1,562	166	589
	L_A	1,103,616	854,826	412,239	55,884	130,254	1,605	195	840
	L_H	1,109,760	899,911	586,916	55,993	130,996	1,704	214	890
	A_L	1,108,389	1,074,421	744,643	55,993	129,916	1,747	195	1,074
	A_A	1,115,503	1,116,711	950,020	56,009	129,884	1,747	214	1,094
	A_H	1,122,985	1,500,543	1,765,248	55,917	129,585	1,752	214	1,774
	H_L	1,122,781	1,605,070	1,922,114	56,052	129,112	1,758	214	1,872
	H_A	1,130,467	1,706,451	2,401,882	56,052	129,051	1,758	265	1,988
H_H	1,138,683	1,926,200	3,025,645	56,084	126,552	1,801	265	2,195	

The results of simulations are presented for different scenario of private transactions costs, respectively 10% and 20% of payments. The Table 2 shows that changing contract design it is possible to generate different impacts for economics social and environmental criteria; however some indicators are more static than others, as both family and external labour and participants. With the higher payments, there is an increase in participation in landscape contracts, farms profits and the payments by local administration. Table 2 shows higher participation in landscape contract than the real participation. This is a consequence of the assumptions used in the model to maintain fix amount of private transactions costs for all farms simulated. Profit of the area is really sensible to the different contracts design options; changing contracts, it is possible to increase profit of the area more than 7% in the scenario of low transaction costs and more than 5% in the scenario with high transaction costs.

Table 3 presents the results of weights elicitation, based on applications of the MCRID method.

⁴ In this table is present the code of alternatives, the first letter corresponds to the level of payments for the introductions and second one for the maintenance: A corresponds to the actual level of payments, L corresponds to 1000 €/ha less than the actual and H corresponds to 1000 €/ha more than the actual.

⁵ In this table is omitted the column "Small woods", because in simulation no farmer invested in this environmental landscape. However three has importance for the DM and its importance is quantified and used in following MCA.

Table 3 Weights for the DM.

Indicator	W _{eco} (economic)			W _{soc} (social)			W _{env} (environmental)		
	W _{rn} (net income)	W _{in} (inv.)	W _{pa} (paym.)	W _{le} (extern. labour)	W _{lf} (fam. labour)	W _{df} (part.)	W _{si} (hedg)	W _{bo} (small woods)	W _{la} (ponds)
Minimization	0.0079	0.0067	0.0395	-	-	0.0541	-	-	0.8919
Maximization	0.0327	0.0311	0.1557	0.0363	0.0550	0.1100	0.1509	0.2434	0.1850
Central Value	0.0203	0.0189	0.0976	0.0181	0.0275	0.0820	0.0755	0.1217	0.5384

DM shows differences in the perceptions of importance among indicators. The indicators with higher relevance belong to the set of environmental indicators, within which ponds has a particularly high value. Other indicators with high importance are participation and the reduction of payments. Indicators with less importance are family and external labour, that are not important for the aim of agri-environmental programs.

The value of utility of the different contract designs for the DM is presented in Table 4

Table 4 Outcome of the farmers' behaviour simulations (impacts matrix for MCA)

Amount of Transaction costs	Contract	Minimum value	Maximum Value	Average
10% of the payments	L_L	0.1087	0.1980	0.1533
	L_A	0.1180	0.1941	0.1561
	L_H	0.1635	0.1894	0.1764
	A_L	0.1646	0.1889	0.1767
	A_A	0.1641	0.1806	0.1723
	A_H	0.1663	0.2087	0.1875
	H_L	0.1643	0.2154	0.1899
	H_A	0.1458	0.2377	0.1918
	H_H	0.1327	0.2343	0.1835
20% of the payments	L_L	0.0979	0.1956	0.1467
	L_A	0.1162	0.1929	0.1546
	L_H	0.1196	0.1898	0.1547
	A_L	0.1333	0.1881	0.1607
	A_A	0.1331	0.1812	0.1571
	A_H	0.1634	0.1797	0.1716
	H_L	0.1595	0.1862	0.1728
	H_A	0.1442	0.1909	0.1676
	H_H	0.1260	0.2022	0.1641

Different contract designs have very similar utility value. However, all alternatives in scenarios with low transaction costs have higher utility value than the same alternative in scenario with high transaction costs.

The actual contract design (A_A) represents an alternative with high relative utility in both scenarios. However higher utility can be obtained with different contract design among the two scenarios. In scenarios with low amount of private transactions costs (10%), utility for the DM can be higher (+12%), increasing the payments in the period of introductions (alternative H_A). In scenario of high

amount of private transaction costs (20%) utility greater of 7.5% can be generated by different combination of the payments between introduction and maintenance (H_L).

6. Conclusion

Combining a land allocations model with multicriteria analysis it was possible to set-up an exhaustive ex-ante evaluation able to simulate the impact of different contract design options and to create a ranking of such options. The results show that relevant opportunities to increase utility for the DM are available with new contract designs. Furthermore comparing the two scenarios of amount of private transaction costs, it was possible to identify relevant opportunity for increase efficiency of the contract acting on such parameter. The uncertainties about market price and the future of decoupled payments have strong relations with the realizations of landscape elements, emphasised by the specificity of the investments in landscape elements and the competitions in land use between decoupled payments and the agri-environmental schemes.

The option to wait and postpone the decision to invest, prerogative of real options models, allows to consider that it is possible to increase participation in agri-environmental schemes over time, as uncertainty about prices and policies conditions is reduced. Furthermore, the reduction of the private transaction costs represents an important way for increasing participation in agri-environmental schemes, which can be realized also with a process of learning by farmers.

Multicriteria analysis is used to aggregate impacts of many criteria, including not only the effects on the environment, but also economic and social impacts, in particular when there are important trade-offs between criteria. Through the weighing of criteria it was possible to quantify the preference of the DM and aggregate with a common metric the impact for the different criteria. This process allows to go beyond a simple evaluation of cost-effectiveness, potentially allowing a productive interaction with the DM.

7. References

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