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Analysis of Intended Farmers' Response to CAP Scenarios: Environmental considerations

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Abstract

This research is a result of the CAP-IRE project which objective is the understanding farmer's reactions under CAP scenarios by 2020. In particular this research aims to analyze the role of the current CAP design on the farmer's decision process focusing on several environmental issues. The analysis is based on 2,360 observations of household farmers across 11 cases study in 9 EU countries. Intended responses of farmers to the CAP reforms are analyzed by logistic model regression. According to the results CAP scenarios would influence farmer's decision on fertilizers and pesticides, as well as water use, while the highest effect is found for decisions on number of animal rearing on the farm. Factors determining reaction to the CAP scenario are monetary and non-monetary, as well as structural and spatial. CAP role appears to be non univocal and strongly case-specific, as it substantially differs across regions according to their socio-economic structure.

Keywords: Environmental sustainability, Farmer's intended behaviour, Logistic regression, Agricultural policy

JEL classification: Q18

1. INTRODUCTION

The application of large amounts of mineral and organic fertilizers in intense agricultural regions of Europe contributes to excessive nutrient loads in soils, ground, and surface water bodies. Nitrogen leaching from agricultural land is a common problem in many European countries with intensive agricultural production. The contribution of agriculture to nonpoint source pollution of surface waters is estimated to be 55% for the European Union (Volka et al., 2009). Average fertilizer consumption in the EU-15 is 174.1 kg ha year^{-1}. This high application rate of fertilizers, combined with its often inappropriate use, generates a surplus of nitrogen in the soil of 83 kg N ha year^{-1} (OECD, 2008). Consumption in Western Europe is still far above the early 60ies levels and in Eastern Europe rates are slightly increasing during the last decade (Baldock et al., 2002).

As a consequence of the intense crop and livestock production high quantities of nitrogen and phosphorus enter in the environment from agriculture, causing a threat for water bodies. Intensive livestock production is an important source of nitrogen pollution and anthropogenic sources of the greenhouse gas methane (Tilman et al., 2002), specially where pig and poultry production is concentrated. Cost-effective management to minimise the environmental risk from the excess nitrogen produced is a major concern of the European Union (Brower et al., 1999).

The Background paper produced by the Secretariat of the Strategic Steering Group on Agriculture of the WFD (WFD and Agriculture, 2006), based on reviews of WFD (Article 5) indicated as main pressures on water bodies the diffuse pollution from nutrients, nitrogen and phosphorus. Furthermore, the danger of pesticide pollution in both surface and groundwater is listed. Drainage and irrigation are reported to cause impact on the water balance and irrigation as part of intensive agriculture might cause over exploitation of available water resource.

Continuing increase in irrigation area and the introduction of less adapted crop species are both responsible for the unsustainable pressure coming from agricultural water use in Europe (Massarutto, 2003). This can reach as much as 80% of total water use in Mediterranean river basins (Dworak et al., 2007; Berbel et al., 2007).

In contrast, other regions experienced decreasing agricultural intensity in recent years (EC, 1998; Zebisch, 2002; Westhoek et al., 2006). Such trends are not only influenced by general driving forces like macroeconomic developments and demographic changes but also by policy instruments such as Common Agricultural Policy (CAP) with also the support of agro-environmental measures (Rossing et al., 2007), national and regional landscape development plans, or by the implementation of environmental programs such as the European Environmental Directive (e.g. Nitrates Directive 91/976/EEC, Water Framework Directive 2000/60/EC).

The CAP can be seen as a set of policies aimed to the economic sustainability of agriculture in Europe. However, the evolution of the CAP since the Mac Sharry reform in 1992 has gradually augmented the contribution of the CAP to the ecological and social dimensions of sustainability. The new core of the first pillar is decoupled single farm payment (SFP), which is conditional on cross-compliance with certain environmental, public health and animal welfare standards (Statutory Management Requirements). The solution proposed, in economic theory, is lump-sum transfers, which would not give rise to welfare losses, as opposed to the effects of price support or input based subsidies (Andersson, 2004).

The idea of decoupling is to make the subsidies to farming by direct payments received independent of crop production, therefore it is likely that overall intensity of farming will decrease as there is less economic incentive to produce high-yield crops. However, while the agricultural policy has changed from the production orientation into the forms of payment decoupled from production, there is a little evidence that the attitudes of farmers also have adjusted (Gorton et al. 2008). Nevertheless, contributions have been made by some authors such as focused in the farmer's attitudes about CAP 2003 at macro-regional level (Dos Santos et al., 2010) or at country level including the new States Members (Gorton et al. 2008).

Where the causes of environmental change associated with agriculture are understood, usually they can be traced to changes in farm management and input use. These include the use of new or larger quantities of inputs, changes in the farming practices employed, variations in the numbers, distribution and methods of rearing livestock, and alterations in cropping patterns and landscape features (EAA, 2006).

The issue of how farmers react to external pressures in general, mainly to policy changes, is a valuable area of study. This paper has the objective to gain a better understanding of the farmers' behavioural intentions and consequently to generate insights into likely responses to the policy change. This paper emerges out of a more comprehensive research developed in the context of CAP-IRE project (Assessing the Multiple Impacts of the Common Agricultural Policies (CAP) on Rural Economies, 7th Framework Programme, www.cap-ire.eu).

In particular this research aims to analyze the CAP role on the farmer's decision process focusing on agro-chemical use (i.e. fertilizers and pesticides), water use and number of animals rearing on the farm. Objective of the research is weighting the influence on farmer's decisions of the current CAP normative by 2020 perspective. The broad objective is the understanding farmer's reactions under CAP scenarios, pointing out the role of CAP about farmers' decisions from an environmental point of view.

Analysis is based on the survey of farm-households to provide direct information about intended response under different CAP scenarios. The research includes 11 case study regions in 9 EU countries. From data surveyed an *intended response* to changes in CAP is obtained by using logistic model regression.

The remainder of paper includes description of materials and methodology in the next section, then main results are showed, and finally some concluding remarks are stressed.

2. MATERIALS AND METHODS

This section aims at providing general description of sample and developing a comprehensive framework analysis of intended farmers' responses to CAP scenarios.

2.1. Data source and collection

In the spring season of 2009 questionnaire to farm-household across nine member states of the EU was applied and a dataset of 2,363 interviewed was collected. The choice of countries incorporates a mixture of EU-15 (9 cases) and NMS (2 cases). Questions were about planned activities in the post CAP 2013 reform and farmers were asked to state their intentions under two wide-ranging CAP scenarios.

Firstly, 'Baseline scenario' was defined by asking farmer to state the expected changes in household and agricultural holding assuming that prices, employment opportunities and other conditions remain stable (January 2009 level) and CAP would continue as it is currently planned (SFP, RDP, other instruments such as milk quotas, cross-compliance). Secondly, farmer was asked to consider the hypothesis that all CAP payments received (including RDP), and all other CAP instruments (e.g. milk quotas, cross-compliance) would be removed starting in 2014. Except for CAP, all other conditions (prices, etc) would remain the same as in the first scenario. This second hypothesis was called No-CAP scenario.

Previous analysis (e.g. IEEP, 2002) has shown that it is difficult to distinguish the specific effects of the CAP on the driving forces internal to agriculture (i.e. changes in input use, land use, farm practices, specific regional trends in the agriculture sector) from that of other factors (technological change, change in market demand, other policies, etc). As a consequences and taking into account aim of project on the assessment of the current CAP role on farmer's decision, an alternative 'No-CAP' scenario was drown in order to isolate CAP effects from other economic drivers (technology, market prices, etc). The hypothesis for the research methodology was that the survey design would make more cost-effective by simplifying the questionnaire, and we would get more in detail about the expected reactions.

Data were collected through face to face interviews, as well telephonic and postal survey. A minimum of 150 and a maximum of 300 questionnaires across the eleven cases study were conducted.

Farms and households affected by the CAP was the target of sampling. According to this criterion, farmer sampling was based on the public list of beneficiaries of the CAP payments. For the EU-15, random sample, proportionally stratified by location (mountains, hill, plain) and by amount of payment received in 2007 (higher or lower of the average), was carried out. Against in the NMS, a random sample was proportional stratified by location (mountains, hill, plain) and by production specialisation. Mainly, it focused on rural farm households. The draw was done in order to be representative of the main regional farm specialisations.

Primary data were collected on intentions to exit from or stay in agriculture as well as intentions to change the amount of several inputs, among others water resource, and number of livestock. The questionnaire was pre-tested and discussed with in-depth face-to-face surveys. The questionnaire was divided into following sections a) Information about the household, b) Information about the farm, c) Reaction to scenarios and, d) Open questions about 'policy demands'. Information about cross-compliance or any specific measure was not asked and the time horizon for farm decisions was defined in year 2020.

The survey questionnaire was developed in order to compare farmers' intentions subject to CAP scenarios while rest of driver factors being constant.

Objectives of the survey were: a) to determine what farmers intend to do as consequence of CAP reform; b) to understand the reaction patterns and underlying motives; c) what factors explain differences in farmer intentions regarding CAP reforms, d) to assess qualitatively the environmental effect of the reforms.

Although the vast majority of farms (54%) were classified as specialist livestock and, mixed crop and livestock, the group of arable farms dominates the sample (20%), while the second largest is specialized dairy (13.7%). When sample is compared with official statistic (Eurostat, 2007), the sample over-represents livestock farms and under-represents more specialised cereals or permanent cropping farms. The mean size of holding in the sample is larger than that based on census data, but values vary across regions showing the lowest farmland size for the Greek region. Mean of farmer's age is 48 years. Youngest farmers are for Polish case with on average 35 years old, while Italian case covers the oldest farmers with on average 59 years.

2.2. Modelling farmer's responses

The empirical information about household behaviour under the two scenarios is collected by way of a survey and is hence based on stated intentions. The use of stated reactions as a good indicator of actual behaviour can be questioned. However, available literature corroborates the idea that stated intentions reveal the actual behaviour in a majority of cases (see (Bougherara and Latruffe, 2010 for a short review of this issue).

The main dimensions of change detected by the survey and used for exploring determinants of farmer's responses include: a) chemical input use (e.g. in terms of fertilisers and pesticides); b) water use and c) number and composition of animals rearing.

The questions to which the variable are associated, was formulated as a close qualitative question, where each household was asked, under each scenario, if they expect to have decrease, increase or no change in the relevant item.

Once the common data base with the mentioned 2,363 observations was available, Pearson's chi-square test as a test of independence (i.e. *Ho* hypothesis that farmer's decisions are independents on CAP scenarios) has been performed. It assesses whether observations on two variables expressed in a contingency table are independent of each other. To understand the direction of the relationship we compared the expected frequency under baseline with the observed under No-CAP scenario. The significant associations cannot be used to infer a causal relationship between the two scenarios, but should rather be interpreted in a weaker way, as indicating the potential connection of two CAP modalities.

This above test together a descriptive statistics procedure, yield an overview of the potential impact of the change in policy based on farmers' stated intentions. However it should be reminded the main research objective is the analysis of the factors behind the intended decisions in order to understand which factors are recurrent and which factors vary with adjustments to policy.

The method to determine statistical relevant factors is a logistic regression formula with the dependent variable being the farmer's decisions about the three environmental pressures (i.e. chemicals and water use, number and composition of livestock) within the next seven years of post 2103 CAP reform.

Let us put Farmer's Decision= f (x_1, x_2,…, x_n) where x is a factor explaining farmer's response. Given a set of factors $\{x_i\}$, the corresponding predicted value is

$$\log \frac{p}{1-p} = \beta_0 + \sum_{i=1}^{n} \beta_i x_i \quad [1]$$

where p is the probability of observing an event, and the βi , i=0 … n (the standardized logit coefficients) are obtained by an appropriate fitting procedure.

Logistic regression can be used to predict a dependent variable on the basis of continuous and/or categorical independents and to determine the effect size of the independent variables on the dependent; to rank the relative importance of independents; to assess interaction effects; and to understand the impact of covariate control variables. The impact of predictor variables is explained in terms of odds ratios. Logistic regression applies maximum likelihood estimation after transforming the dependent into a logistic variable (the natural log of the odds of the dependent occurring or not). In this way, logistic regression estimates the odds of a certain event occurring. Logistic regression calculates changes in the log odds of the dependent, not changes in the dependent itself.

In the context of the study of farmers' behaviour, the objective of the modelling process is to obtain models which can be used both to predict farmers' reactions to external events and to target information and policy initiatives effectively (Austin et al, 1998).

For the purpose of this paper, intended behaviour was defined in terms of a dichotomous outcome. The idea consists of highlighting 'Invariant behaviour' under both scenarios. This category covers those farmers which response is independent on the CAP scenarios (farmers would not modify their decision under both scenarios). Farmers who would modify their decision according to the CAP scenarios are accounted for a change in behaviour group. In this sense, two groups of farmers' response are built, namely 'Invariant behaviour' and 'Changing behaviour'. In this manner we attempt to understand the role and influence of CAP in the farmer's making process.

According the above framework binary and multidimensional logistic regression models (Greene, 1997), were fitted to identify the polled features for Model I) the CAP roles to change farmer's behaviour; and Model II) the invariant side in agriculture regardless of the CAP supports. Table 1 reports the framework analysis and models ran in the case of stated intention of chemicals use.

Table 1: Logistic Regression Models

Model I- Changing behaviour			**Model II-** Invariant behaviour		
Stated intention	*Dependent variable*	*Logistic regression*	*Stated intention*	*Dependent variable*	*Logistic regression*
Farmers who would change their behaviour	0= 'NO' 1= 'YES'	Binary model	Farmers who would not modify their inputs use regardless of CAP scenarios	0= 'no change' 1= 'increase' 2= 'decrease'	Multidimensional model

Source: own elaboration

The first model takes into account the Changing farmers behaviour group, and tries to predict the probability that farmers modify their decision when the current CAP is completely removed. Instead the second one accounts for the Invariant behaviour group and allows analyzing the pattern of environmental pressures regardless of the CAP reforms. In this way the first approach makes sense to analyze the influence of current CAP normative on the farmers' decision. On the other side, invariant behaviour is an important aspect concerning the indifference of farmers towards reforms of current normative. They stated increase, decrease or no change the amount of variables regardless of the current CAP supports.

This approach is different to a scenario impact analysis where the simplest variation of variables under two scenarios should be assessed and quantified.

3. RESULTS

Follow sections report main survey results and behavioural models fitted to analyze intended farmers' responses to the CAP scenarios. From the initial sample of 2,363 observations, the analysis is carried out taking into account only the sub-set of stated intention to continue in the agriculture by 2020. Farmers who declared to exit for agriculture are taken apart. In addition farmers whose responses was not stated (they did not answer and, they did not know what would do) are split from the sample.

3.1. Fertilizers and pesticides use

The global view of intended decision on chemicals use is summarized in Table 2.

Table 2: Intended farmer's response on chemicals use (% of interviewed; N= 1128)

Farmers' response to the CAP scenarios		Intended behaviour	% group	% total
		Increase	14%	3 %
Changing behaviour	25 %	No-change	34%	8 %
		Decrease	52%	13 %
		Increase	10%	7 %
Invariant behaviour	75%	No-change	71%	54%
		Decrease	19%	14%

As the table 2 shows, 25% of farmers interviewed would change their behaviour under the No-CAP scenario and, generally farmer's decision in the alternative scenario goes to 'no change use' and, mainly to 'decrease use' (respectively 34% and 52% out of 277 farmers who would change their behaviour). The smallest frequency is reported for 'increase use' (14%) accounting for 3% of total sample. On the other side, the most frequent behaviour is 'Invariant behaviour' where farmer's decision is independent on the CAP scenarios (75%). The most frequent answer in this group is 'no change' in use that accounts for 71% of responses, while 19% of farmers declared an intention to decrease chemicals use on the farm. Finally in this group, the smallest value is accounted for increase use (10%).

Differences in farmer's decisions under different CAP scenarios are significant (Pearson's chi-square test) therefore it can be concluded that No-CAP scenario implies an intended reduction in fertilizers and pesticides use on the farm Results revealed a long-term trend to maintain current use of chemicals (54% is the most frequent response), although intention to decrease is also reported (14% of total sample). The smallest frequency is shown for farmer's intention to increase chemicals (7%). Globally under No-CAP scenario, frequency of farmers with intention to decrease fertilizers and pesticides increases by 93% compared to the baseline.

Afterward logistic regressions were performed and factors fitted into models are shown in the Table 3 and Table 4 where only significant variables are reported ($p<0.05$), respectively for the Changing behaviour and Invariant behaviour group.

Table 3: Logistic regression models on chemicals use

Model I- Changing behaviour				
Factors	*β*	S.E.	*p*-value	Exp(β)
Organic farming (dummy)	-1.862	.522	.000	.155
Revenue <10% (dummy)	-1.285	.482	.008	.277
Farm size (Owned Land, ha)	.190	.052	.000	1.209
Age	-.319	.140	.022	.727
Constant	-.990	.281	.000	.372

Source: own elaboration
Rate of -2 Log likelihood= 922.306; Nagelkerke's R squere = .104; Cox & Snell R Square= .70

In the Model I the dependent variable was assigned "1" if the farmer declares intention to change his behaviour and "0" otherwise. Due to the small number of stated intention to 'increase' chemicals use (3% of total sample, i.e. 38 observations), this item was removed from the analysis. Accordingly to Table 2, main intention of changing behaviour group under No-CAP scenario is reduction in chemicals use. Therefore it might conclude that major likelihood of reduction in fertilizers and pesticides on farm would occur in larger farm size (Farmer with larger owned land). Minor probability of change in behaviour is revealed for farmer's age, which shows negative effect on the intention to change chemicals use. In addition two categorical factors show minor probability to change, and they refer to organic farming and share of farming revenue under 10% of total revenue. Farmers under organic production and farmers with less than 10% of revenue from agriculture have less likelihood of change their behaviour if the current CAP would be abolished.

Next the invariant behaviour pattern is analyzed. Intended farmers' behaviour is modelled by multinomial logistic regression to detect factors determining higher likelihood of increase and decrease chemicals use, with respect to no change in use. Latter stated response is based as reference category "0" instead "1" is assigned for increase and "2" for decrease stated intention. Table 3 below reports the model findings.

Model II for invariant behaviour shows that there is major likelihood of chemicals increase for Bulgarian farmers. The standardized logit coefficients β reaches the highest value for this factor stressing that in this region farmers would have a long-term intention to increase fertilizers and pesticides use by 2020. However according to the stated responses in Table 2 a larger frequency of farmers declare intention to decrease their current use of chemicals regardless of CAP reforms. Factor explaining major likelihood of the intention to decrease is pertinence to Agri-Environmental Schemes (AES), membership to farmer's union and, farmers without owned land. All of these features enlarge the probability to reduce chemicals use independently on the CAP scenarios.

Table 4: Logistic regression models on chemicals use

Model II- Invariant behaviour					
	Factors	*β*	S.E.	*p*-value	Exp(β)
Increase	Organic farming (dummy)	-1.786	1.045	.087	.168
	AES (dummy)	-.257	.437	.557	.773
	Farmers Union (dummy)	-.242	.292	.408	.785
	Region (dummy) (Bulgaria)	2.858	.328	**.000**	17.426
	Without Owned Land (dummy)	.340	.364	.350	1.405
	Intercept	-2.517	.237	**.000**	
Decrease	Organic farming (dummy)	-.859	.336	**.011**	.424
	AES (dummy)	.967	.200	**.000**	2.631
	Farmers Union (dummy)	.977	.215	**.000**	2.657
	Region (dummy) (Bulgaria)	.722	.377	.055	2.059
	Without Owned Land (dummy)	.663	.291	**.023**	1.941
	Intercept	-2.311	.200	**.000**	

Source: own elaboration
Rate of -2 Log likelihood= 115.883; Nagelkerke's R squere = .275; Cox & Snell R Square= .218; McFadden=156

3.2. Water resource use

The global view of intended decision on water use is illustrated in Table 5.

Table 5: Intended farmer's response on water use (% of interviewed; N= 1135)

Farmers' response to the CAP scenarios		Intended behaviour	% group	% total
Changing behaviour	18%	Increase	14%	3%
		No-change	45%	8%
		Decrease	40%	7%
Invariant behaviour	82%	Increase	10%	9%
		No-change	85%	70%
		Decrease	4%	3%

As the table 5 shows, 18% of farmers interviewed declare intention to change their behaviour in No-CAP scenario, generally to 'no change use' and 'decrease use' (respectively 45% and 40% out of 201 farmers who would change their behaviour). The smallest frequency is reported for 'increase use' accounting for 3% of total sample. On the other side, the most frequent group is 'Invariant behaviour' where farmer's decision on water use is unaffected from the CAP scenarios. Yet the most frequent answer under this group is 'no change' in use that accounts for 70% of total responses, meanwhile, in same group, result indicates that 9% of total farmers declared an intention to increase water use on the farm. Finally in this case, the smallest value is accounted for decrease use (3%).

Differences in farmer's decisions under different CAP scenarios are significant (Pearson's chi-square test) therefore the No-CAP scenario implies an intention of slight reduction in water use on the farm. At the same time results revealed a long-term invariant pattern to maintain current use of water, with intention of slight increase.

Logistic regressions were performed and factors fitted into models are shown in the Table 6. In the Model I the dependent variable was assigned "1" if the farmer declares intention to change his behaviour and "0" otherwise. Due to the small number of stated intention to 'increase' water use (3% of total sample, i.e. 29 observations), this item was removed from the analysis. Accordingly to Table 6 we can infer that major likelihood of reduction in water use would occur: a) in New Member States that gets the highest β value; b) in larger farm size (Farmer with larger owned land); and c) for Farmers who receive larger Single Farm Payment (SFP). Minor probability of change in behaviour is revealed for farmer's age, which shows negative effect on the intention to change water use.

Table 6: Logistic regression models on water use

	Model I- Changing behaviour*				**Model II –** Invariant behaviour**			
Factors	β	S.E.	*p*-value	Exp(β)	β	S.E.	*p*-value	Exp(β)
Region (dummy) (New member)	1.593	.235	.000	4.920	3.806	.408	.000	44.976
LFA (dummy)					-.776	.265	.003	.460
Farm size (Owned Land, ha)	.217	.064	.001	1.242	.442	.101	.000	1.555
SFPayment	.165	.071	.021	1.179				
Age	-.019	.008	.025	.981	-.049	.011	.000	.952
Constant	-2.356	.503	.000	.095	-1.646	.614	.007	.193

Source: own elaboration
*Rate of -2 Log likelihood= 786.581; Nagelkerke's R squere = .151; Cox & Snell R Square= .89
**Rate of -2 Log likelihood= 441.908; Nagelkerke's R squere = .329; Cox & Snell R Square= .162

The group of the 'Invariant behaviour' is analyzed in the Model II focusing on the explanatory independent variables by logistic regression to stress farmers and farm features which show major likelihood of increase current water use regardless of CAP scenario. The dependent variable was assigned "1" if the farmer would 'increase' water use, while 'no change use' was based as reference category "0". Due to the small number of stated intentions to 'decrease' water use (3% of total sample, i.e. 42 observations) this item was removed from the analysis.

Model II for invariant behaviour shows that there is major likelihood of water increase according to the β coefficient for a) Bulgarian farmers; and, for b) Larger farms, meaning that size of owned land enlarge probability to increase water use by 2020 regardless of the CAP support. On the contrary, variables whose effects are reverse (reducing the likelihood of increase water use) are c) Farmer's age, as older farmers have minor likelihood of increase water use on the farm; and d) Farmer whose farm are located in LFA (Less Favourable Area).

3.3. Number of animals rearing

This section reports main survey results and behavioural models fitted to analyze intended farmers' responses to the CAP scenarios in the case of animals rearing. The analysis includes only farmer's enrolled in animals rearing activities. Although livestock covers 54% of overall sample, following findings are exclusively reported taking into account valid answers. It worth remarks farmers with unclear intention on farm decision amount to 19%.

Accordingly to the framework analysis, sample is divided into Changing behaviour and Invariant behaviour groups; Table 7 shows a summary of results. The first group account for 33% of farmers, and decision in the alternative scenario goes to mainly 'no change use' and, to 'decrease use' (respectively 48% and 32% out of 214 farmers who would change their behaviour). The smallest frequency is reported for 'increase use' (20%) accounting for 6% of total sample.

Table 7: Intended farmer's response on number of animals rearing (% of interviewed; N= 652)

Farmers' response to the CAP scenarios		Intended behaviour	% group	% total
		Increase	20%	6%
Changing behaviour	33%	No-change	48%	16%
		Decrease	32%	11%
		Increase	41%	28%
Invariant behaviour	67%	No-change	51%	34%
		Decrease	8%	5%

However the mostly behaviour is 'Invariant behaviour' where farmer's decision is independent on the CAP scenarios (67%). The most frequent answer in this group is 'no change' that accounts for 51% of responses, but in this case a larger percentage of farmers (41%) declared an intention to increase numbers of animals on the farm. Finally, the smallest value is accounted for decrease (8%).

Differences in farmer's decisions under different CAP scenarios are significant (Pearson's chi-square test) and therefore No-CAP scenario implies an intention of reduction in numbers of animals rearing. Direction of changes moves toward a general reduction of animals rearing on the farm (i.e. Farmers' changes move from 'increase' to 'no change' and, from 'no change to 'decrease' respectively under the baseline and No-CAP scenarios).

At the same time results revealed a long-term pattern to maintain current numbers of animals (34% is the most frequent response), if else a long-term intention to increase is also reported (28% of total sample). The smallest frequency is shown for farmer's intention to decrease (5%). Therefore independently on the current CAP support, farmer's intention within next ten years would be to maintain constant and to increase the numbers of animals rearing.

Logistic regression is performed to detect relevant factors; Table 8 shows results for “Changing behaviour” and “Invariant behaviour” group.

In the Model I the dependent variable was assigned “1” if the farmer declares intention to change his behaviour and “0” otherwise. Due to the small number of stated intention to ‘increase’ numbers of animals (6% of total sample, i.e. 42 observations), this item was removed from the analysis. Although this is a modest percentage, this behaviour should be deeper analyzed. This issue represent a valuable future improvement of this research.

Table 8: Logistic regression models on numbers of animals rearing

	Model I- Changing behaviour*				**Model II –** Invariant behaviour**			
Factors	*β*	S.E.	*p*-value	Exp(β)	*β*	S.E.	*p*-value	Exp(β)
Region (dummy) (New member)	1.441	.280	**.000**	4.226				
Specialist (Reference: dairying)			.152				.181	
(Cattle fattening)	.699	.284	**.014**	2.012	-.641	.373	.086	.527
(Grazing)	.372	.296	.209	1.451	-.228	.355	.522	.796
(Crops&grazing)	.123	.334	.713	1.131	-.824	.384	**.032**	.439
(Mixed livestock)	.114	.341	.737	1.121	-.366	.329	.265	.693
Farm size (Owned land, ha)					-.668	.190	**.000**	.513
SFPayment			**.010**		.793	.160	**.000**	2.210
(5000-20 000 EUR)	.562	.270	**.037**	1.754				
(20 000-50 000 EUR)	.178	.400	.656	1.195				
(>50 000 EUR)	1.371	.448	**.002**	3.941				
Age (Reference: <40 years old)							.014	
(41-65)					.602	.254	**.018**	1.826
(>60)					-.545	.568	.337	.580
Constant	-2.004	.330	.000	.135	.410	.430	.340	1.507

Source: own elaboration
*Rate of -2 Log likelihood= 597.110; Nagelkerke’s R squere = .130; Cox & Snell R Square= .92
**Rate of -2 Log likelihood= 430.016; Nagelkerke’s R squere = .191; Cox & Snell R Square= .143

Accordingly to Table 8 major likelihood of reduction in numbers of animals would occur a) in New Member States that gets the highest *β* value; b) for Farms specialized in Cattle fattening; and c) for Farmers who receive larger Single Farm Payment (SFP). As regards, the relation is not log-linear continue, as a consequence several ranges of SFP payments emerge to be significant. However more importantly, the highest value *β* is found in the case of SFP amount superior of 50 000 EUR.

Finally, the ‘Invariant behaviour’ group is analyzed in the Model II focusing on the explanatory independent variables to stress farmers and farm features which show major likelihood of increase current numbers of animals regardless of the CAP scenario. The dependent variable was assigned “1” if the farmer would ‘increase’ numbers, while ‘no change’ was based as reference category “0”. Due to the small number of stated intention to ‘decrease’ (5% of total sample, i.e. 34 observations), this item was removed from the analysis.

Model II for the invariant behaviour shows that there is major likelihood of increase according to the β coefficient for a) Farmers receiving larger payment via SFP; and, for b) Farmer's age, as farmers ranging from 41 to 65 years old have major likelihood of increase. On the contrary, variables whose effects are reverse (reducing the likelihood of increase) are c) Larger farms, meaning that size of owned land diminish probability to increase animals rearing by 2020 regardless of the CAP support; and d) for mix cropping and grazing farm specialization.

4. DISCUSSION AND CONCLUDING REMARKS

The scope of this research was to anlyze the influence on farmer's making process of the current CAP schemes in a long-term perspective by 2020. As regards, farmers' stated intention was collected under the hypothesis of removing CAP support since 2013. Three farmer's decisions related to major environmental pressures in agriculture were taken into account, namely the fertilizers and pesticides use, water use and numbers of animals rearing on the farm.
The analysis was supported by a logistic model regression to clarify the factors determining farmer's intended behaviour. According to the framework analysis proposed here, two main behavioural reactions have been underlined.

The most relevant group consists of the farmers who are sensitive to policy shift, as their decisions would change according to the policy scenarios. There is large regularity in the direction of change, and essentially farmer's intention goes to reduction of chemicals use and water, as well numbers of animals. The magnitude of change varies from the smaller effect in the case of the water use to the larger one in case of the numbers of animals.

Regarding factors explaining this behaviour, the logit models show certain homogeneity and key variables in decisions to reduce inputs and numbers of animals on farm are monetary and non-monetary, structural and spatial. The main monetary factor is the amount of the CAP payments via SFP, where findings stresses that the higher likelihood of decrease water use and numbers of animals would occur for farmers with larger amounts. Farm size in terms of owned land emerges to be significant as a consequence larger farms would be more willing to reduce their inputs. Among non-monetary factors there is farmer's age which is negatively linked with the reduction. Finally spatial patterns are also shown, being the New Member States more sensitive to the CAP abolishment than the EU-15 members.

The other group is "Invariant behaviour" where farmers who would not modify their decisions, and they would carry on with the same decisions regardless of the CAP reforms.
From this group the invariant pattern of environmental pressures are traced showing as a whole a long-term reduction in the fertilizers and pesticides use, though for the NMS increase is also shaped; meanwhile the water use would maintain constant and in the case of animals rearing the intention of increase is revealed.
Although the current CAP normative appears to have no effect on their intended decisions farmers in this group are more numerous than previous one, as a consequences this group are also relevant for policy design and should be analyzed with more detail in the future.

Finally, it should mentioned that some results of our research agree with the effects of the removal of policy income support evaluated in Bonfiglio (2011) with reference to the use of fertilisers and pesticides. In that research farmers' responses are modelled trough a neutral network for a region in central Italy, assuming two policy scenarios similarly covered here. Results of observed values are expressed as kg per hectare and, reduction in the use of fertilisers and pesticides are estimates of 20% under current decoupled payment meanwhile complete removal of direct payments as an alternative to decoupling regime would produce a decrease in the consumption of fertilisers and pesticides of more than 40%. The effects are relatively higher in larger farms. These results are in agreement with those found here, where farmer's responses frequency is taken into account. However logistic regression provides deeper understanding on the socio-economic features (i.e. age, share of farming revenue, membership of farmer's union, farming approach as organic farming and agri-environmental measures) being important in the farmer's making process.

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