

Influence of the Common Agricultural Policy on the farmer's intended decision on water use

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Abstract

This work is the result of the research under CAP-IRE (Common Agricultural Policies on Rural Economies) project where the effects of post 2013 CAP scenarios are investigated. The broad objective is the understanding of farmer's reactions under CAP scenarios taking into account a long-term perspective by 2020. The analysis is based on 1,328 observations of household farmers across 11 case study regions in nine EU countries. The stated responses are analyzed in order to stress the influence of the next CAP reform on the farmer's decision process of using more or less water resources on-farm. For this purpose the farmer's responses to the CAP reforms are analyzed by a logistic model regression. According to the results, farmer's behaviour would be slightly influenced by the CAP reform. However, significant regional differences are found according to the model regressions. Indeed, in the case of new member states, farmers would have a greater intention to decrease water use if the current CAP support was abolished. Yet factors such as the amount of CAP supports, farmland size, crop specialization, farmer's age and altitude, are significant determinants of reaction to the CAP reforms. Taking into account the depicted influence on water use opportunities for re-addressing next policy design emerge.

Additional key words: agricultural policy; farmer's intended behaviour; irrigation water; logistic regression.

Resumen

Influencia de la Política Agraria Comunitaria en las intenciones de los agricultores sobre el uso de agua

Este trabajo es un resultado del proyecto CAP-IRE (Política Agraria Comunitaria sobre la Economía Rural) que analiza los efectos de la reforma de la PAC después de 2013. El objetivo del proyecto es comprender las reacciones del agricultor tomando como horizonte la fecha de 2020. En particular el presente trabajo se centra en el análisis de las decisiones del agricultor en relación al uso del agua, es decir incremento o decremento en el uso del recurso hídrico. El análisis está basado en 1.328 observaciones de agricultores a través de 11 regiones en nueve países de la Unión Europea. Las respuestas a las intenciones de decisión en función de la reforma de la PAC se analizaron mediante regresión logística para investigar las variables socio-económicas significativas de reacción a los escenarios de la PAC. De acuerdo con los resultados una reforma de la PAC influenciaría muy poco las decisiones del agricultor sobre el uso de agua, si bien en alguna región cabría esperarse un decremento en el uso del recurso en un escenario de abolición total de las subvenciones. Entre otros factores que explican las diferencias de intención de uso del agua se hallan el nivel de subvenciones, el tamaño de la explotación, el tipo de cultivo, edad del agricultor y altitud. De los resultados de la investigación se derivan implicaciones para la mejora de la sostenibilidad de uso del recurso de cara al futuro de la PAC.

Palabras clave adicionales: agua de riego; intenciones de decisión del agricultor; política agraria; regresión logística.

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Abbreviations used: CAP (Common Agricultural Policy); EC (European Commission); EU (European Union); EU-15 (15 countries of Europe Union before last enlargement); LFA (less favourable area); NMS (new member states); RDP (Rural Development Plan); SFP (single farm payment); SFS (single farm scheme); WFD (Water Framework Directive).

Introduction

In European countries, statistical evidence shows increasing pressure on water resources and a decline in their quantity and quality over recent years. The European Commission estimates that irrigated land in Southern Europe has increased by 20% since the mid-1980s (SIWI, 2002) while agriculture occupies 44% of the EU territory and is by far the largest water user in Europe (Massarutto, 2003).

Under the current situation of strong competition for water resources among all sectors of society, reducing agricultural water demand is of the highest priority. Such an improvement must be based on an in depth knowledge of farmer's behaviour with respect to a large number of issues and constraints that they face under extreme weather conditions, be it related to water availability and cost or to changes in agricultural policies, such as those that have taken place through the Common Agricultural Policy (CAP) of the European Union (Leguen de Lacroix, 2004). Unfortunately, previous analysis (*e.g.* IEEP, 2002) illustrate that it is difficult to distinguish between the specific effects of the CAP and other driving forces internal to agriculture.

Decoupling was included as a key strategy in the last CAP reform (2003) in order to reduce incentives to increase production, however, while the agricultural policy has changed from the production orientation into the forms of payment decoupled from production, there is little evidence that the attitudes of farmers have also been adjusted (Gorton *et al.*, 2008).

There are various references regarding CAP and farmer attitudes. However regarding water, only Dos Santos *et al.* (2010) focus on the farmer's attitudes at a macro-regional level in Portugal. The authors claim that there are three factors that could distinguish the farmer's behaviour: structural characteristics, farmer's characteristics and the production orientation of these farms. The results of the analysis found that these types are very homogeneous farmers' clusters with regard to their attitudes toward the CAP because these variables were not significant as differentiating factors. This was justified because this group of farmers had quite similar production structures and production systems and all of them came from the same region.

Studies concerning the influence of 2003 CAP reforms on farm structural change (Douarin *et al.*, 2007;

Tranter *et al.*, 2007; Gorton *et al.*, 2008; Bougherara and Latruffe, 2010; Lobley and Butler, 2010) including investments and adoption of innovations (Gallerani *et al.*, 2008; Viaggi *et al.*, 2011) are available. As a whole, farmers' reactions to policy reforms emerge to be rather modest or at least more modest than expected. Essentially, an independent behaviour from the CAP reforms is related to farm size, tenacity of farm, specialist as some productive sectors receive little assistance from the CAP (*i.e.* pigs and poultry), farmer's age and membership of a farmers' union. At the same time, location in a LFA (Less Favorable Area), low level of formal education and farmers from the New Member States (NMS) recognize its dependency on CAP changes. However intention of farmer's behaviour on water use to CAP reform has received scarce attention.

The issue of how farmers react to external pressures in general, mainly to policy changes, is a valuable area of study. Indeed, at the time of the debate over the next reform this paper has the objective of gaining a better understanding of the farmers' behavioural intentions on water use and consequently to generate insights into likely responses to the policy change. Particular focus is placed here on insights into attitudes of farmers to water use and their responses to policy change. Determinants of farmer's reactions such as the change in the consumption of water resources (*i.e.* more or less) under different policy scenarios are evaluated. Other important issues such as moving out of agriculture or the adoption of innovation and new irrigation systems fall out of this research.

This paper draws on the CAP-IRE¹ project carried out during 2008/2010 that established a framework scenario hypothesis with two extreme states of CAP policy: i) a baseline scenario of the CAP framework in the year 2009, that includes the current (2009) level of payments plus the already planned measures such as milk quota abolition in year 2015, and ii) a scenario assuming a complete abolition of all CAP instruments. Except for CAP, all other conditions (prices, technology, water availability, labour market, etc) are considered unchanged.

The elicitation of the farmer reactions to hypothetical CAP withdrawal is based on stated behaviour.

The material is a sample of 1,328 farm-households located in nine EU countries. The methodology used is a logistic model regression, aimed at analysing the relationships between farm reactions to the CAP

¹ Assessing the Multiple Impacts of the Common Agricultural Policies on Rural Economies (www.cap-ire.eu).

scenarios and determinants explaining different stated behaviours, such as structural and personal characteristics.

Effects of the latest CAP reform (2003) and future CAP development

In June 2003, a new reform of the CAP was agreed upon. Single farm payments were introduced and based on average payments claimed over the three-year reference period of 2000-2002 and was being paid per eligible hectare of land (EC, 2003). Member states could also opt for a regional model or "hybrid model", where the reference period may be different (see Tranter *et al.*, 2007 for an outline of the main country variants to the default model).

In 2008 the Health Check finalized a long process of CAP decoupling and, a full decoupled payment across European Member States and agricultural sectors was reached. Such a fully decoupled policy does not influence production decisions by the farmers and permits free market determination of prices. In other words, a farmer who received a larger entitlement in the past for a particular type of production (*e.g.* for irrigated land) would no longer be obliged to continue with this intensity of production in order to take advantage of the higher payments. The farmer's decision on what to produce would be based more on the economics of the market rather than a CAP normative (Interwies *et al.*, 2006).

At this stage, scarce and non univocal knowledge at the European level on the effects on water use from decoupling is available. Gleyses (2006) makes an initial preliminary assessment in France concluding that full decoupling may lead to changes in farming practice, among others the use of irrigation, but on a regional basis and within specific catchments, decoupling could probably lead in some cases to more intensive practices, resulting in no reduction in water use.

A similar picture can also be obtained from a study analyzing the impacts of the Mid Term Review on water demand in the agriculture of four Mediterranean Members States: France, Greece, Italy and Spain (Scardigno and Viaggi, 2007). On the basis of the existing literature, possible effects of 2003 CAP implementation have only been identified on a regional basis in terms of reallocation of cultivated land area (*i.e.* cultivated versus non cultivated, irrigated versus non irrigated land, irrigated versus non irrigated crops) (Chinnici

et al., 2006; Bartolini *et al.*, 2007). The studies conclude that water demand management in the case studies analyzed is not a major concern of the CAP and, accordingly, CAP impact on water quality and – even more – water quantity issues are limited.

Although previous experiences with decoupling were expected to have slight effects on final water use, other examples, where policy packages including area payments unrelated to production decisions were implemented, reinforce the necessity to consider issues such as socio-economic farmer's features, institutional environment as regional policies, as well as farm assets or location for an understanding of farmers' responses on water use to policy changes (Dos Santos *et al.*, 2010). This is also important taking into account the last enlargement of the European Union to the NMS where the introduction of the CAP payments from 2004 constituted an important increase in the payments received by farmers (Douarin *et al.*, 2007). How farmers in the NMS view EU agricultural policy and the nature of their intentions is thus of great importance for predicting the future water use of an enlarged EU. While there has been some research on the attitudes of key agricultural policy actors in Central and Eastern Europe (Slangen *et al.*, 2004), to date evidence on farmers' attitudes and their behavioural intentions in the NMS has received little attention. Indeed, Gorton *et al.* (2008) studied the farmer's structural reactions to decoupling in five European States (France, Lithuania, Slovakia, Sweden and England) and found that the behaviour of farmers varies significantly between states in the enlarged EU due to the different historical traditions of farming and incidence of support. However, influence on farmer's decision concerning water use was not investigated.

In light of this, to evaluate the influence of the current CAP framework, a 'NO-CAP' scenario was drawn. The main motivation that arose from it was to consider all the effects of the CAP rather than those connected only with some selected policy parameters; the information that can be gathered by a few in-depth questionnaires would be more cost-effective; and finally by simplifying the questionnaire, we could get more reliable information about the expected reactions. It should be noted that the NO-CAP scenario is seen as an 'extreme' scenario, chosen to 'test what would be the maximum range of impacts the agricultural sector would be faced with over the medium term'. This implies that the NO-CAP scenario is not seen as a likely scenario for the future of EU agricultural policy.

Material and methods

Data source

In the spring period of 2009 a large questionnaire to farm households across nine EU members states was run. The project collected a unique dataset of farmers' intentions, regarding their planned activities in the post CAP 2013 reform in 11 case studies. The choice of countries incorporates a mixture of EU-15 (nine cases) and NMS (two cases). To understand the specific effects of the switch in policy, farmers were asked to state their intentions under two main policy scenarios.

Firstly, farmers were asked to state the expected changes in household and agricultural holdings assuming *ceteris paribus* circumstances, so that prices, employment opportunities and other conditions (including water availability and government allowances) would remain stable at the January 2009 levels and CAP would continue as currently planned (SFS, RDP, other instruments such as milk quotas, cross-compliance). Secondly, farmers were 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 (product and input prices, technology, water availability, labour opportunity, etc) would remain the same as in the first scenario. The first scenario was named Baseline and the second one "NO-CAP". Information about cross-compliance or any specific measures were not asked and the time horizon for farm decisions was defined as the year 2020.

Data was collected through face to face interviews as well as telephonic and a postal survey was conducted. The choice was related to survey confidence and budgetary constraints. The questionnaire was pre-tested and discussed with in-depth face-to-face surveys.

Farms and households affected by the CAP were the targets 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 samples, proportionally stratified by location (mountains, hills, plains) and by the amount of payment received in 2007 (higher or lower than the average), was carried out. Against in the NMS, a random sample was proportionally stratified by location (mountains, hills, plains) and by production specialisation. A decision at a global level was not to take into account farm size due to the heterogeneity of farmland size according to livestock, crops and mixed farming systems across the EU and, because the research was mainly focused on rural farm households. The choice was made in order to be representative of the main regional farm specialisations. A complete sampling procedure is available in Raggi *et al.* (2009).

As a whole, a data base of 2,363 farm-household has been collected across different European rural areas. Size, modality and the main features of sample according to cases study are reported in the Table 1.

The main farm specialization covered by the sample was livestock with specialist livestock accounting for 36% and, mixed crop and livestock 18%; the group of arable crops reached 34%, while permanent crops cov-

Table 1. Main features of sample

Case study	Sample size	Type of survey ¹	Specialisation (%)			Farm size (ha)		SFP ² per farm (€)	
			Arable	Permanent	Livestock	Mean	Median	Mean	Median
Emilia-Romagna (Italy)	300	T	64	17	11	18.63	10.00	6952	2000
Noord-Holland (Netherlands)	300	P	22	0	69	29.84	26.00	15890	12000
Macedonia and Thrace (Greece)	300	T/F	61	4	35	7.74	5.00	10576	8000
Podlaskie (Poland)	249	F	23	0	76	19.00	16.10	2651	2000
North East of Scotland (UK)	168	T	10	1	88	165.54	100.55	40906	19900
Andalusia (Spain)	201	F	45	41	13	66.13	12.00	18002	7500
South-East Planning Region (Bulgaria)	273	F	38	3	54	23.13	12	19794	4000
Centre (France)	140	F	46	1	52	52.16	19.50	42276	39750
Midi-Pyrénées (France)	155	F	17	5	78	76.27	58.00	20550	15000
Lahn-Dill-District (Germany)	117	P	12	3	78	9.17	4.90	9056	3600
Ostprignitz-Ruppin (Germany)	160	P	24	3	68	104.34	25.00	84155	18822
Total	2363		34	8	54	46.80	13.83	20202	6000

¹ T = telephone; P = postal; F = face-to-face. ² SFP: single farm payment. Source: www.cap-ire.eu.

ered only 8%. Finally a minor percentage of interviews could not be classified. The sample accounted for around 4 million of CAP payments via SFS and covered approximately 218,000 ha.

By comparing official statistics (Eurostat, 2007) the sample over-represents specialist livestock farms and under-represents more specialised cereals crops. According to the European regions, main differences in specialisation are covered, with prevalence for livestock rearing systems in the Centre and North areas while in the South permanent and arable crops prevail. The mean size of holdings in the sample is 46.80 ha, but values vary across regions showing the lowest farmland size for the Greek region. Variability is also shown within the case studies, where for several cases the mean and median values are sizeably different. The average amount of payment via SFS accounts for less than 20,000 EUR with a median value of 6,000. Finally the average farmer's age in the survey is 48 years old, and the youngest farmers are found in Poland with an average age of 35 years old, while Italy contains the oldest group with 59 years old being the average age (comprehensive description of sample is available in Raggi *et al.*, 2010).

The survey questionnaire was developed in order to compare farmer's intentions subject to CAP scenarios with the rest of driving factors being constant. Objectives of the survey were, however, not merely to establish what farmers intend to do but to understand reaction patterns and underlying motives. Do farms react differently depending on farm structure, region, farm financial performance, human capital, age etc?

The questionnaire was divided into four main sections: 1) information about the household, 2) information about the farm, 3) reaction to scenarios and, 4) open questions about 'policy demands'.

In regards to the section on reaction to the CAP reforms, the questionnaire was drawn according to the main steps of farmer's decisions on the farm. Primary data was collected on intentions to exit from/stay in agriculture. Farmers were asked whether they would continue in farming or exit from the sector under both hypotheses. If the farmer's answer was to exit from the sector, then questions on water use were skipped and the questionnaire went to the fourth section and finished. For those farmers who would continue, intentions to change the amount of water resources on farm were asked. The questions to which the variable is associated, was formulated as a cloze qualitative question, where each household was asked, under each

scenario, if they expected to have a decrease, an increase or no change in the relevant item.

Modelling farmer's responses

The analysis of the policy effects implies two steps: firstly it must be determined who is affected by the policy and secondly, the pattern of change due to policy implementation must be assessed.

Taking into account the aims of the research, we sought to underline only the CAP influence on farmer's decisions on water use. The analysis here is a qualitative exercise on the CAP influence and it is not a quantitative impact assessment of the CAP scenarios in term of water demand by the 2020 horizon. In particular farmer's responses, related to the declared intention of using more or less water are analyzed, given by farmers who have previously declared their intention to continue farming under both CAP scenarios. In both scenarios, the interviewed farmers who stated their intention to exit from agriculture are excluded from the analysis. In fact, over a sample of 2,363 farmers, the analysis here is based on 1,328 observations of household farmers. In this way deeper insight on how the CAP support would influence the farmer's decision process on water use can be gained. This framework analysis is in the scope of projects that focused on the farmer's behaviour rather than scenario impacts. Obviously the assessment of water demand as a consequence of CAP reforms embraces related concern as a change in farm size and cropping mix, adoption of innovations, land abandonment, and so on. The effects derived from the abandonment of the sector in terms of water use as well as the structural changes that would occur as a consequence of CAP change fall out of this research (for a comprehensive analysis see Giannoccaro and Berbel, 2010).

According to the aims of this paper, intended behaviour was defined in terms of a dichotomous outcome: (i) farmers who would modify their decision (*i.e.* those who are influenced by the CAP support) according to the CAP scenarios were labelled 'Changing behaviour'; inside this label, there are two groups, depending on direction of change either 'changing-decreasing' or 'changing-increasing' when farmer's intention moves respectively to a lower or upper level of water use; and (ii) those farmers whose intended behaviour is not affected by CAP scenarios, therefore farmers would not

modify their decision whatever the European agricultural policy in place. This category was labelled ‘Invariant behaviour’.

Figure 1 shows the applied framework to recognize the pattern of farmer’s reactions to CAP reforms.

Farmer’s reactions are grouped according to the above behaviours and responses are reported in terms of the shares of respondents. It allows for the underlining of the magnitude of behaviour changes induced by the change in policy.

Afterwards, the determinants of farmer’s responses under the different policy scenarios are investigated to assess what the main factors behind the decision are and to understand which factors are recurrent and which factors vary with adjustments to policy. This is done through a Logit model with the dependent variable being the farmer’s behaviours towards water use within the next seven years of post 2103 CAP reform.

In the context of the study of farmers, 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).

Let us put Farmer’s Decision = $f(x_1, x_2, \dots, x_n)$, 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 $\beta_i, i=0 \dots n$ (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 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.

Goodness-of-fit tests such as the likelihood ratio test are available as indicators of model appropriateness, as is the Wald statistic to test the significance of individual independent variables.

A logit regression model (Greene, 1997) was used to identify the polled features for Model I) the influence of CAP to change farmer’s behaviour; and Model II) the invariant behaviour regardless of the CAP reform.

The first model takes into account the ‘Changing behaviour’ category, and tries to predict the probability that farmers modify their decision when the current CAP is completely removed. On the other hand, Model II accounts for the ‘Invariant behaviour’ category and allows us to analyse pressures on water by 2020 regardless of the European agricultural policy. Therefore, the first approach makes sense of the influence of the current CAP normative on the farmers’ decision. On the other hand, invariant behaviour is an important aspect concerning the indifference of farmers toward reforms of the current normative.

We fitted the models of the farmer’s behaviours through a backward stepwise procedure. With the backward stepwise method the analysis begins with a full or saturated model and variables are eliminated from the model in an iterative process. The fit of the model is tested after the elimination of each variable to ensure that the model still adequately fits the data. The removal of a variable from the model is based on the significance of the change in the log-likelihood ratio test. When no more variables can be eliminated from the model, the analysis is complete. Finally, the model must be re-estimated without each of the eliminated variables as a result of a backward stepwise procedure.

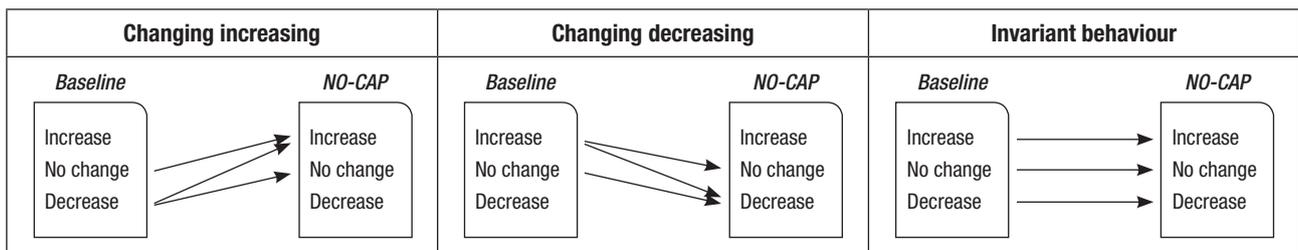


Figure 1. Framework analysis.

The variables considered as determinants are all of those derived from the questionnaire and are fully available in Viaggi *et al.* (2009) in which all stated reactions to the CAP scenarios were also collected. The full list of variables used, and the way each variable was measured, is shown in Table 2.

The farm characteristic variables are related to the current farm size in terms of owned land, land rented-in and, land operated as the sum of land owned plus land rented-in minus land rented-out. Renting plays a major role in land availability, particularly for annual

crops and livestock; about 32% of farms rent-in some land. Farming specializations are split into arable crop, permanent crop and livestock systems. The latter category covers both specialist livestock and livestock with field crops.

The region variable accounts for three main European areas. The Centre and North area covers North East of Scotland, Centre and Midi-Pyrénées, Noord-Holland, Lahn-Dill-District and Ostprignitz-Ruppin cases studies. The South area envelops Emilia-Romagna, Andalusia, Macedonia and Thrace. Finally

Table 2. List of variables used as determinants

Code	Variable description	Coding	Mean	Std. Dev
Land owned	Total land owned (ha)		52.45	107.40
Land rent IN (dummy)	Land rent-in	0 = no, 1 = yes	0.32	0.46
Land operated	Total land operated (owned + rented IN – rented OUT) (ha)		114.94	240.90
Specialist	Main farm specialisation	2 = arable crops, 1 = permanent crops, 0 = livestock systems	0.34 0.09 0.57	–
Region	European regions where sample was selected	0 = Centre-North (UK, FR, NE, DE), 1 = South (IT, ES, GR), 2 = East (PL, BG)	0.44 0.26 0.30	–
Altitude	Location of the farm with respect to the altitude	0 = plain, 1 = hill/mountain	0.39	0.48
LFA	Farm located belong to the less favourable area	0 = no, 1 = yes	0.55	0.49
Organic production	Farm with organic production	0 = no, 1 = yes	0.08	0.26
AES	Farmer engaged in agri-environmental schemes	0 = no, 1 = yes	0.30	0.45
SFP > € 5,000 (dummy)	Single farm payment/Single area payment scheme received in 2007 > € 5,000	0 = no, 1 = yes	0.49	0.50
Other payments (dummy)	Other payments received in 2007 by the CAP measures	0 = no, 1 = yes	0.54	0.49
Age	Age of farm head (year)	Age	46.83	13.7
Education	Education level of farm head	Six different levels from 'none' to PhD	–	–
Extension service	Farmer assisted by an extension service	0 = no, 1 = yes	0.55	0.49
Farmer union	Membership of farmer union	0 = no, 1 = yes	0.55	0.49
Share gross revenue	Share of farm income from agricultural activity over total household income (%)	Six different levels: < 10% 10-29% 30-49% 50-69% 70-89% > 89%	0.10 0.09 0.12 0.16 0.15 0.38	–

the East accounts for Podlaskie and the South-East Planning Region as the new accession members to the EU.

There are also some farm features related to the geographic characteristics such as altitude and location in a 'Less Favourable Areas' (LFA). Additionally, organic production and agro-environmental schemes are dummy variables related to farm characteristics.

The variable used for the policy payment was the amount of SFP received by the interviewee which they declared. Since the amount of the first pillar CAP payments received by farms varies substantially across areas/specialization systems the sample resulted in a large variance. Normally livestock systems receive much higher revenues from CAP payments, as a total amount per farm. However some exceptions occur, as in the cases of pigs and poultry. Permanent crop specialisations have lower payments, simply because most permanent crops receive no payments, therefore the payment only concerns the residual land cultivated with eligible crops. The main exception is the olive tree specialisation in Spain. In light of this, a dummy variable was introduced where the sample was split into two groups of payments, respectively inferior and superior to € 5,000 per year. This value also reflects the modulation criteria applied under the current CAP design. A similar rationale is applied in the case of the other payments where only 54% of those surveyed received some aid from the Pillar II. In this case the dummy variable separates farmers with other aids from those without.

The remaining variables concern the age of the farm owner, his education level, the use of extension services and membership of a farm union. Finally, there is the share of farm income with respect to the total household income accounting for six levels ranging from less than 10% to higher than 89%.

Results

The following section reports the main survey results and behavioural models fitted to analyze intended farmers' responses to the CAP scenarios. From the initial sample of 1,328 observations, the analysis is carried out by taking into account only the sub-sets of a valid stated intention. Farmers whose responses were not stated (*i.e.* they did not answer and, they did not know what they would do) are removed from the analysis.

Stated behaviour responses

Table 3 reports the stated responses of farmers according to the behavioural categories.

Firstly the 'Changing behaviour' category is reported as focusing on those farmers who would change their decision on water use if the current CAP was removed. Their decision concerns using more or less water on the farm. As Table 3 shows, 19% of farmers interviewed would change their behaviour under the NO-CAP scenario and, the farmer's decision under the alternative scenario goes mainly to the 'decreasing' intention accounting for 84.6% of those farmers who are influenced by the shift in policy. A smaller frequency is reported for an 'increasing' intention (15.4%). When the data is referred to the total sample, the percentage of the increasing behaviour covers little less than 3% of respondents, while the decreasing intention rises to 16.1%.

Despite the fact that stated intentions to water use would turn to reduction if the current CAP support was abolished, it should be noted that the most frequent stated behaviour is 'Invariant behaviour' where the farmer's decision is independent of CAP support (81%). This behavioural category shows the pattern of pressures on water by 2020 regardless of the European policy changes. In this category the most frequent answer is 'no change' in use which accounts for 84.2% of responses, while 11.2% of farmers declared an intention to increase water use on the farm. Finally the smallest value accounts for a decrease in use (4.6%). Results revealed a long-term trend to maintain the current use of water (68.4% is the most frequent response over the total sample), although intention to increase is also reported (9% of total sample). The smallest frequency is shown for farmer's intention to decrease water use (3.6%).

Finally some considerations concerning those farmers whose responses were not stated (*i.e.* they did not answer) should be stressed. In effect they represent an important share of respondents accounting for around 20% of the survey. Mainly German farmers refused to answer the question on water use because water does not concern a farmer's decision in the sampled regions.

Logit regressions were performed and factors fitted into models are shown in Table 4 and Table 5, respectively for the Changing behaviour and Invariant behaviour category.

In Model I for the Changing behaviour category the dependent variable was assigned "1" if the farmer de-

Table 3. Intended farmer's responses on water use

		Changing behaviour		Invariant behaviour		
		Changing-decreasing	Changing-increasing	Increase	No change	Decrease
Emilia-Romagna (Italy)	Observations	10	0	9	161	7
	% group	5.9%	0.0%	7.2%	22%	22.5%
	% total	0.9%	0.0%	0.7%	15.1%	0.8%
Noord-Holland (Netherlands)	Observations	4	20	20	107	5
	% group	2.4%	64.5%	20.6%	14.6%	12.5%
	% total	0.4%	1.9%	1.9%	10%	0.5%
Macedonia and Thrace (Greece)	Observations	1	0	0	37	0
	% group	0.6%	0.0%	0.0%	5.1%	0.0%
	% total	0.1%	0.0%	0.0%	3.5%	0.0%
Podlaskie (Poland)	Observations	71	0	8	130	0
	% group	41.8%	0.0%	8.2%	17.8%	0.0%
	% total	6.6%	0.0%	0.7%	12.2%	0.0%
North East of Scotland (UK)	Observations	16	1	1	102	3
	% group	9.4%	3.2%	1%	14%	7.5%
	% total	1.5%	0.1%	0.1%	9.5%	0.3%
Andalusia (Spain)	Observations	17	5	6	51	3
	% group	10.0%	16.1%	6.2%	7.0%	7.5%
	% total	1.6%	0.5%	0.6%	4.8%	0.3%
South-East Planning Region (Bulgaria)	Observations	26	0	44	34	6
	% group	15.3%	0.0%	45.4%	4.7%	15%
	% total	2.4%	0.0%	4.1%	3.2%	0.6%
Centre (France)	Observations	13	3	5	46	6
	% group	7.6%	9.7%	5.2%	6.3%	15%
	% total	1.2%	0.3%	0.5%	4.3%	0.6%
Midi-Pyrénées (France)	Observations	12	2	4	52	4
	% group	7.1%	6.5%	4.1%	7.1%	10%
	% total	1.1%	0.2%	0.4%	4.9%	0.4%
Lahn-Dill-District (Germany)	Observations	0	0	0	1	0
	% group	0.0%	0.0%	0.0%	0.1%	0.0%
	% total	0.0%	0.0%	0.0%	0.1%	0.0%
Ostprignitz-Ruppin (Germany)	Observations	0	0	0	10	0
	% group	0.0%	0.0%	0.0%	1.4%	0.0%
	% total	0.0%	0.0%	0.0%	0.9%	0.0%
Total	Observations	170	31	97	731	40
	% group	84.6%	15.4%	11.2%	84.2%	4.6%
	% total	16.1%	2.9%	9%	68.4%	3.6%

Note: % of interviewed; valid observations N= 1069 accounting for 80.5% of total survey. Source: www.cap-ire.eu.

clared an intention to change his behaviour turning to a rise in water use, and “2” in the case of a reduction in use. The full invariant group was set as the reference group. Anyway, in the first attempt, a no satisfactory model result was obtained. Indeed classical econometric parametric models tend to infer an average representative behaviour from an observed set, but whenever units show a clustered behaviour such estimates are not able to detect it properly. A simple logit model

is likely to be unrepresentative in some situations when multidimensional responses or polarization distribution is observed (Notarstefano and Scuderi, 2009).

In the sample, the ‘increasing’ group is the smallest one and a region bias is shown, the Noord-Holland case study being the largest one accounting for 20 to 31 observations. This result was supposed to be contingent with local conditions (*e.g.* compliance with environmental restrictions). As a consequence the stated inten-

Table 4. Logistic regression models on water use-Changing behaviour

Factors	Changing decreasing ¹				
	β	S.E.	Wald	Sig. ²	Exp(B)
Land owned (covariate)	0.335	0.118	8.102	0.004**	1.097
Land rent IN	-0.479	0.131	13.312	0.000**	0.619
Specialist			7.977	0.019	
livestock (ref.)	—	—			—
arable	-0.367	0.178	4.249	0.039*	0.693
permanent	0.742	0.263	7.934	0.005**	2.099
Region			28.291	0.000	
Centre-North (ref.)	—	—			—
South	0.032	0.262	0.015	0.902	1.033
East	0.808	0.213	14.454	0.000**	2.244
Altitude (Hill&Mountain)	0.206	0.099	4.333	0.037*	1.228
Single Farm Payment > € 5,000	0.251	0.128	3.838	0.050*	1.285
Other payments	0.289	0.146	3.921	0.048*	1.336
Age (covariate)	-0.019	0.009	4.385	0.036*	0.981
Constant	-2.064	0.894	5.334	0.021	0.127
LR test ³	46.03			0.000**	
Cox & Snell R ²	0.132				
Nagelkerke's R ²	0.211				
(No. of correct predictions)	overall = 81.8% no change "0" = 88.2 % changing decreasing "1" = 47.3 %				

¹ Invariant behaviour is the reference category "0". ² *: statistically significant at 95% level; **: statistically significant at 99% level.

³ Likelihood ratio (LR) test is used to test the null hypothesis that there is no relationship between the log of odds of changing decreasing behaviour and the set of independent variables included in the model. Source: Own elaboration.

tion of a change towards increasing water use was removed from the analysis.

In this context binary Logit regression was performed² and factors fitted into the model are shown in Table 4. In Model I the dependent variable was assigned "1" if the farmer declared an intention to change decreasing water use and "0" for the whole invariant category.

The log-likelihood ratio (LR) tests showed that the estimated model, including a constant and the set of explanatory variables, fits the data better compared with that containing the constant only. The pseudo-R² values and, hit rate (*i.e.* percentages of correct predictions) also suggested that the estimated model has a fairly good explanatory power. Finally the probability of predicting the dependent "zero" and "one" found respective values of 0.25 and 0.75 with a standard error of 0.021.

Table 4 shows the major likelihood of reductions in water use would occur in the case of larger farm sizes

(owned land), in the case of permanent crops, in the new member states (East regions), belonging to hill and mountain areas, for farmers receiving more than € 5,000 of the SFP and with other payments from the CAP. Diversely minor probability to change in behaviour is connected to farmer's age, farms with rented land and specialists in arable crops. These features show negative effects on a willingness to change water use on the farm.

The marginal effects of independent variables estimated by the logit equation are shown in the right side column [Exp(B)] of Table 4. These are the odds ratios for the predictors. They are the exponentiation of the β coefficients. An odds ratio of 1 implies that the event is equally likely in both groups. When the odds ratio is over 1, the odds of, say the changing behaviour, increases as the predictor increases. On the other hand, if the odds ratio is less than one, the odds of changing behaviour, decreases as the predictor increases.

² Another method when the dependent variable is a binary variable is the probit regression model. Unlike the linear probability model, the predicted probabilities under both logistic and probit approaches always lie between 0 and 1. Since both approaches are known to yield similar results, logistic approach is used in this paper.

Table 5. Logistic regression models on water use-Invariant behaviour

Factors	Increase ¹				
	β	S.E.	Wald	Sig. ²	Exp(B)
Region			36.519	0.000	
Centre-North (ref.)	—	—	—	—	—
South	0.429	0.387	1.232	0.267	1.536
East	1.780	0.303	34.419	0.000**	5.933
LessFavourableArea	-1.604	0.281	32.501	0.000**	0.201
Age (covariate)	-0.029	0.011	6.763	0.009**	0.972
Education (covariate)	0.560	0.137	16.815	0.000**	1.751
Share Gross Revenue (covariate)	0.239	0.088	7.291	0.007**	1.269
Constant	-3.682	0.909	16.424	0.000	0.025
LR test ³	36.42			0.000**	
Cox & Snell R ²	0.123				
Nagelkerke's R ²	0.238				
(No. of correct predictions)	overall = 89.2%				
	no change "0" = 92.6%				
	increase "1" = 52.3%				

¹ The option 'no change' is the reference class. ² **: statistically significant at 99% level. ³ Likelihood ratio (LR) test is used to test the null hypothesis that there is no relationship between the log of odds of increase behaviour and the set of independent variables included in the model. Source: Own elaboration.

Consequently, each unit of increase in the land owned increases the odds to express the changing decreasing behaviour by a factor of 1.097 given that the other variables in the model are held constant. So we can say for a one-unit increase in land owned, we expect to see about a 9.7% (1.097-1) increase in the odds of being in the changing decreasing class. This 9.7% increase does not depend on the value that land owned is held at. This shows that you can interpret the odds ratio in a couple of ways: i) for a one unit change in the predictor, the odds of a changing decreasing reaction increases by the odds ratio; ii) for an x unit change in the predictor, the odds of a changing decreasing increases by the odds ratio to the x power, odds-ratio ^{x} .

Following the interpretation of results we found for farmers with rented land, the likelihood to express intentions of water reduction decreases by 38% (1-0.619). As the specialization turns to permanent crops, the likelihood to express the intention of 'changing decreasing' increases by 110% (2.099-1). On the contrary, specialization in arable crops decreases the likelihood by 30.7% (1-0.693). For each farmer who belongs to the East regions the likelihood of water reduction increases by 124.4% (2.244-1). Each farm within a hill/mountain zone increases the likelihood to decrease water use by 22.8% (1.228-1). Yet for each farm with a SFP amount higher than € 5,000 the likelihood of changing behaviour increases by 28.5% (1.285-1). Similarly each farmer with

other CAP payments increases the likelihood of water reduction by 33.6%. Finally the effect of a one-unit increase in farmer's age (*i.e.* of being a year older) is 1.9% (1-0.981); therefore, the probability of them making a decision to change becomes smaller as farmers get older.

When we turn to the 'Invariant behaviour' category, a stated response of 'decrease' reaches the smallest number of observations. This class accounts for 40 respondents and 3.6% of the total sample. With the same rationale applied as before, we run the logit model without this small group. A logit regression to detect factors determining a higher likelihood of an 'increase' of water use with respect to 'no change' in use was performed. The latter stated response is based as reference category "0" whereas "1" is assigned for an increase. Table 5 reports the model findings.

The likelihood ratio test is applied to prove the goodness of the model. The pseudo- R^2 values and hit rate also suggested that the estimated model has a fairly good explanatory power. Finally the c statistic test on the probability of predicting the dependent "zero" and "one" found respective values of 0.22 and 0.78 with a standard error of 0.023.

Basically, with respect to the stated intention of no change in use, an increase in water use would occur with major probability in the East European regions (NMS), for farmers with a higher education level and farmers for whom agriculture is the main economic

activity. A negative relation is found for LFA where increased behaviour is less likely. Finally farmer's age shows negative signs, meaning that older farmers are willing to maintain their level of water use.

For NMS farmers, the likelihood to express 'increase' regardless of CAP reforms rises by almost 500% (5.933-1). Each unit of increase in educational levels of farmer per head increases the likelihood to express 'increase' by 75.1% (1.751-1). As the share of farm income from agriculture activity increases, the likelihood to state 'increase' grows by 26.9% (1.269-1). Each farm within a LFA decreases the likelihood of increased water use by 80% (1-0.201). Finally for each increase in unit of farmer's age, the likelihood to express 'increase' decreases by 2.8% (1-0.972).

To conclude, it should be mentioned that some independent variables were not selected in the equations estimated. These variables are land operated, farmer unions, extension services, organic production and agro-environmental schemes.

Discussion

This research tries to analyze the influence on farmer's behaviour of the current CAP schemes by 2020. The framework analysis has pointed out two main behavioural reactions to the CAP ending, namely farmers who are sensitive to the policy shift and farmers who are not. Nevertheless, the most important results of this research consist of the behavioural models, which can be useful in targeting the next policy initiatives effectively.

Using the full set of variables available, the main outcome for the first category is that regional factors are predominant in affecting choices in relation to water use. In this sense, farmers belonging to the new accessions are more sensitive to the CAP reform. This finding is in agreement with other expected changes in the NMS shown in Gorton *et al.* (2008). Excluding the regional variable, more classical factors emerge as determinants, in particular the age of the farm head, the size of farm, land renting, specialisation, together with policy-related variables (amount of SFP higher than € 5,000 per farm, and other payments related to the CAP). In the case of very small farms which may have considerable alternative income sources, the NO-CAP scenario was, initially, likely to make little difference to their plans.

The outcome confirms the importance of personal and structural variables in determining the impact of

CAP reform on farmer's behaviour, namely, water use. However spatial dimensions emerge as being very important factors related to the CAP influence.

On the other hand, according to the results the most relevant category is 'Invariant behaviour' where farmers would not modify their decisions. Indeed, the invariant pattern of water use is traced showing as a whole a constant water use, though for the NMS an increase is also shaped.

A relevant result is the finding that most of the farmers in EU-15 stated an intention not to modify the level of water use. There are structural factors that explain the large number of farmers declaring no change in water use. In some Mediterranean regions many of the irrigators are already under severe scarcity conditions; therefore water availability is actually under restriction. Similarly within LFA areas, several constraints for irrigated cropping such as slope, weather conditions or infrastructural deficiency, reduce the opportunity to have a change in water use. These elements could be related to the model results that predict a minor likelihood to increase water use for farmers located in LFA regardless of the CAP scenarios.

Most of the results shown here agree with the forecasted quantitative results for European agriculture by 2020 (Nowicki *et al.*, 2007 and 2009). Generally, it has been assumed that after decoupling the CAP's influence on farmers' decision-making processes will be very limited. Based on the stated responses, results in this research have confirmed these assumptions. However as expected, CAP normative would have major influences on farmer's decision processes in the new accession regions.

As a final conclusion, while the survey pointed mainly to inertia and an unwillingness to change at the farm level, CAP reform may also impact unevenly on the farm community. We may remark that the diversity of farmer's responses to CAP changes across the European regions according to their socio-economic structure and farm location.

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