Farmers' stated responses towards the chemicals use under the CAP liberalization

Giacomo GIANNOCCARO, Julio BERBEL

Department Agricultural Economics and Policy, University of Cordoba, Cordoba, Spain

Abstract: The research aims to analyze the farmers' preferences towards the chemical input use in the case of the Common Agricultural Policy (CAP) being removed after 2013. The analysis is based on a survey of European farmers carried out in 2009. The intended responses of farmers to the CAP liberalization are analyzed by the logit model regressions. Although for the majority of respondents there would be no change in their intentions if the CAP were suppressed, about 20% would intend to decrease the amount of chemicals. The effects of the CAP liberalization appear not to be univocal and strongly case-specific, as it substantially differs across the European regions, farm locations and socio-economic structures.

Key words: Common Agricultural Policy, farmer's intended behaviour, logit regression, spatial heterogeneity

The Common Agricultural Policy (CAP) plays an important role in maintaining sustainable agriculture across the EU territory and in promoting environmentally friendly practices. This is particularly important as the modern farming puts many pressures on the environment and the animal and plant health. For example, the agriculture's contribution to the non-point source pollution of surface waters is estimated to be 55% for the European Union (Volka et al. 2009).

The evolution of the CAP since the MacSharry reform in 1992 has gradually augmented the contribution of policy supports to the ecological dimension of sustainability. The first pillar of the CAP is currently under decoupling. With decoupling, the link between direct payments and production has been removed reducing the farmers' incentives towards the intensive input use. Nevertheless, although European areas have experienced a decreasing agricultural intensity in recent years (EC 1998; Zebisch 2002; Westhoek et al. 2006), the consumption of chemicals is still far above the early 60's levels (Parris 2011). Whether the decoupling of the CAP has led agriculture towards a more sustainable and balanced chemical input use remains a controversial appraisal. For instance, the research carried out by Bonfiglio (2011) with the reference to the use of fertilizers and pesticides in a central region of Italy estimated a reduction in the use of fertilizers and pesticides of 20% under the current decoupled payment, while the complete removal of direct payments as an alternative to the decoupling regime would produce a decrease in the consumption of chemical input of more than 40%.

In this context, the objective of the paper is to consider the farmers' stated reactions to the CAP liberalization starting in 2014. The stated responses are analyzed in order to stress the influence of a change between the 2009 CAP continuity and the CAP removal on the farmer's decision to use more or less chemical inputs on their farms. The abolishment hypothesis, as a counter-factual scenario, provides an insight into the influence of the current policy on farmer's decisions. It helps us to prove whether the current decoupled schemes would affect the farmers' decisions on chemical inputs after 2013. In addition, the determinants of the farmers' stated reactions to the CAP liberalization are analysed taking into account some spatial, structural and socio-demographic variables. The determinants of the farmers' behaviour are assessed by the means of logit model regressions.

Primarily, an analysis of farmer' attitudes from a spatial dimension could be of interest in the context of the policy assessment given that non-neutral effects, with respect to the farm selection and changes, might also be revealed. Interesting remarks about this argument are passed by Léon (2005), who emphasizes the role of the polarization of space, and the relevance of the spatial dimension as an explicative element of the economics of rural areas. However, most available studies on the CAP's spatial influence refer to the structural changes and the farm-

household structural reactions (e.g. Douarin et al. 2007; Thomson and Psaltopoulos 2007; Lobianco and Esposti 2008; Notarstefano and Scuderi 2009). Basically, the influence of the CAP on the farmer's behaviour towards the chemicals use has received only a scarce attention. Here, the spatially explicit variables such as altitude, the Less Favourable Area (LFA) status and the sub-areas of the European Union are tested in the logit model regressions as determinants of the farmer's behaviour. However, this approach should be considered as the simplest spatial analysis, given that only three spatial elements are taken into account.

A relevant spatial aspect refers to the last enlargement of the European Union to the new Members States (NMSs), where the introduction of the CAP payments from 2004 constituted an important increase in the payments received by farmers (Douarin et al. 2007). While there has been some research on the attitudes of the key agricultural actors towards structural adjustments (Slangen et al. 2004), up-to-date analyses on farmers' attitudes and their behavioural intentions towards the chemicals use in the NMSs are still scarce.

This paper emerges out from a more comprehensive research developed by Giannoccaro and Berbel (2013) in the scope of the CAP-IRE[1] project that established a scenario hypothesis with two extreme states of the CAP policy by 2020: (i) a baseline scenario of the CAP framework in year 2009, that includes the latest *Health check* agreements, and (ii) a scenario assuming a complete abolition of all the CAP instruments.

The main motivation for the scenarios content is to consider all the effects of the CAP rather than those connected only with some selected policy parameters. Since the CAP is implemented in quite different ways across the EU, the two simplest scenarios are used to avoid the potential biases in the scenarios understanding. In fact, at the moment of surveying, farmers knew the policy in their regions and, in principle, understanding of the continuing vs. ending the CAP would be easier. Additionally, the information that can be gathered by a few in-depth questionnaires would be more cost-effective; indeed, by simplifying the questionnaire, we could get more reliable information about the expected reactions.

The material is a sample of 1328 farm-households located in 9 EU countries (the Netherlands, Scotland, Germany, France, Italy, Spain, Greece, Poland and Bulgaria).

MATERIAL AND METHODS

Spatial dimension of the current CAP design

In June 2003, a new reform of the CAP was agreed upon. Single farm payments were introduced and based on the average payments claimed over the three-year reference period of 2000–2002 and it was being paid per eligible hectare of land. The member states could also opt for a regional model or a "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).

Essentially, the main chapter of the CAP, the so-called Pillar I, now provides payments for income supports that are decoupled or partially decoupled from production. In principle, the decoupled policy does not influence production decisions by the farmers and permits a free market determination of prices. Although the payments were to be decoupled the from production decisions, they were effectively re-coupled to a basic land management requirement and so would continue to have an impact on the land management decisions and inevitably, production (Lobley and Butler 2010). In addition, the payments were previously set to reflect the past yields and have been allocated on an historical basis in several European Member States.

Although the systems outlined above appear easy, actually the CAP scheme is quite complicated across the EU members. Firstly, the Member States had the option to retain a certain share of support coupled with production. Such possibilities have in particular been foreseen in the area of arable crops and animal premium, where the concern with regard to the effect on production and decoupling could be the most pronounced. According to this system, one part of the aid is paid to farmers as a single payment, while the second part is paid as coupled payments for production. Among the sampled members here, Spain and France kept partially coupled systems for arable crops (25%) while the coupling provisions for the old livestock payments were adopted in various ways in Greece, France and the Netherlands. Secondly, in Germany a flat-rate basis payment per hectare was applied for arable crops and grassland, while the historic element for livestock was accounted for. Finally, although in most European countries (in our case Germany, Scotland and Italy) the 2003 reform was enforced since 2005, others such as Spain, Greece, France and the Netherlands adopted it one year later. In addition,

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

it should be worth to mention some sectors such as fruit and vegetables for which a sort of envelope for tomatoes and citrus processing was enabled. Similarly, there was the agreement on the sugar beet and cotton sectors. By contrast, in the NMSs (here Poland and Bulgaria), a flat regionalised payment per hectare has been applied, namely the Single Area Payment Scheme (SAPS), and there are no headage payments because the animal envelope has been added to the total amount of payments. Generally, the average amount given has been lower than for the farmers in the EU-15. However, despite the payments being only 25% of the EU-15 level in 2004, from the first year, the introduction of the CAP payments constituted an important increase in the payments received by farmers in some of the NMSs (Douarin et al. 2007).

Finally, the CAP support within the 1st Pillar is subject to cross-compliance according to the Statutory Management Requirements (SMR) and the Good Agricultural and Environmental Condition (GAEC). For instance, under the Nitrates Directive adopted by the European Union in 1999, member states had to establish the Nitrate Vulnerable Zone (NVZ) where the use of nitrogen as a fertilizer is subject to several restrictions. The same rationale is applied in the case of pesticides for which limited buffer zones are imposed. Therefore, their removal could trigger a change in the chemicals use for those areas currently under similar environmental restrictions.

The second component of the CAP, the so-called Pillar II is rather more complex. Firstly, it is composed of several tens of measures organised into three axes plus the Leader, with each measure having a specific territorial application. Secondly, some measures are designed to provide compensatory payments for the disadvantaged areas (LFA). Although the amount of payments for the disadvantaged areas is likely to be unimportant in many areas, their removal would be especially sensitive in the spatial terms. Thirdly, among other measures financed within the Pillar II, there are worth mentioning the agro-environmental schemes (AES) which include supports for organic agriculture. These measures might show great differences in the terms of scheme design and the application rate among Members States of the EU.

In spite of the existing differences, we will take into account these policy components together.

Data

Data collection was conducted in 2009 and a survey to farm-households across 9 member states of the EU was carried out. The data was collected by the means of a questionnaire through face to face interviews, as well as telephone and postal surveys. Farms and households receiving the CAP payments were the targets of the sampling. According to this criterion, the farmer sampling was based on the public list of the 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. In the NMSs, a random sample was proportionally stratified by location and the production specialisation. 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).

A huge, diverse and fragmented structure dominates the EU agriculture. In 2007, there were 13.7 million holdings and 11.7 million annual working units in the EU-27, and the most striking feature is the diversity of structures. The average farm in the EU-27 has 12.6 ha (22 ha in the EU-15 and 6 ha in the EU-12). At the same time, 6.4 million holdings (46.6% of all farms) had a negligible economic size while covering only 11 million hectares (6% of the total utilised agricultural area). Many of them in the EU-12 are subsistence and semi-subsistence farming, with more than one third of the EU-27 family farmers (36.4%) carrying out another gainful activity (apart from farm work). The demographic and education structure points to an issue of low levels of human capital. In about a third of all farms, the managers are of 65 years and above (in a further 20%, they are between 55 and 64).

The size, modality and the main features of the sample according to the cases study are reported in Table 1.

The main farm specialization covered by the sample was livestock with specialist livestock accounting for 39% and mixed crop and livestock for 17%; the group of arable crops reached 33%, while permanent crops covered only 8%. Finally a minority percentage of interviews could not be classified. According to the European regions, the main differences in specialisation are covered, with the prevalence of the livestock rearing systems in the Central and North areas, while in the South the permanent and arable crops prevail. The average amount of payment via the SFP/SAPS accounts for more than 22 000 EUR. Variability is also shown within the case studies where the Standard Deviation (SD) is sizeable for several cases. The sample accounted for around 3 million CAP payments via the SFP/SAPS and covered approximately 150 000 ha.

Compared with the official statistics, the sample over-represents livestock farms and under-represents more specialised cereals or permanent crops. The size is larger than the EU average, mainly for the EU-15. The average farmer's age in the survey is 46.8 years, slightly lower than the real values. Variability is also found with the Polish being the youngest farmers with an average age of 35 years, while the Italian farmers are the oldest with 58 years being the average.

The survey questionnaire was developed in order to compare the farmer's intentions subject to the CAP scenarios with the rest of the driver factors being constant. The questions were about the planned activities in the post-CAP 2013 and the farmers were asked to state their intentions under two extreme CAP scenarios. The question about the preferences towards the amount of fertilizer and pesticide use was formulated as a close qualitative question, where each household was asked, under each scenario, if they expected to have a 'decrease', an 'increase', or maintaining the constant' amount of the chemicals used.

The benchmark scenario was defined assuming *ceteris paribus* circumstances with prices, employment opportunities and other conditions remaining stable at the January 2009 levels and the CAP would continue as it is currently planned, especially with the Single Farm Scheme (SFS), the Rural Development Policy (RDP), other instruments such as the milk quotas and the cross-compliance. This first option was called the baseline scenario. Secondly, the 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 the CAP, all other conditions (prices, labour market, etc) would remain the same as in the first scenario. This second hypothesis was called the NO-CAP scenario.

The effect of the CAP liberalization can be assessed by comparing each farmer's answers in both scenarios. As a result, the intended behaviour can be classified in terms of a discrete outcome, namely the farmers who would modify their decision (i.e. those who are influenced by the CAP liberalization) and those farmers whose intended behaviour is not affected by the CAP scenarios. If the behaviour is conditioned by the CAP abolishment, the direction of change can also be assessed. Indeed, the effect of the CAP liberalization can be defined as 'change-decreasing' or 'change-increasing' when the farmer's choice moves respectively to a lower or upper level of use. Finally, the CAP changes induced more uncertainty for some farmers, who stated that they did not know what to do in the NO-CAP scenario, while in the CAP continuity, they had a clear preference. Table 2 shows the survey results of the farmers' stated preferences

Table 1. Main features of sample (N = 1135)

Case study	Sample size	Age (year)		Specialisation (%)			Land owned (ha)		SFP (EUR)	
		mean	D.S.	arable	permanent	livestock	mean	S.D.	mean	S.D.
Emilia-Romagna (Italy)	210	57.6	14.3	70	19	11	18.48	31.20	6 837	28 336
Noord-Holland (Netherlands)	173	47.9	10.3	25	0	75	37.28	33.01	19 837	21 536
Macedonia and Thrace (Greece)	40	47.2	8.0	67	3	30	12.73	11.25	11 945	24 092
Podlaskie (Poland)	212	34.9	7.0	17	0	83	20.83	14.39	2 859	2 055
North East of Scotland (UK)	132	54.8	11.6	11	1	88	184.62	255.76	42 690	71 332
Andalusia (Spain)	87	51.8	12.7	36	51	13	79.51	271.94	20 484	28 754
South-East Planning Region (Bulgaria)	172	46.0	13.0	44	3	53	9.28	35.44	25 000	84 629
Centre (France)	91	35.4	11.6	48	2		56.61	72.35	39 281	24 965
Midi-Pyrénées (France)	97	41.5	10.8	14	8	78	77.40	70.07	19 982	16 298
Lahn-Dill-District (Germany)	44	51.2	10.9	3	5	92	9.53	18.89	8 449	12 913
Ostprignitz-Ruppin (Germany)	70	48.6	10.0	29	3	68	135.19	277.37	97 103	184 569
TOTAL	1328	46.8	13.7	33	8	56	52.44	137.39	22 227	62 287

SFP = Single Farm Payment

Source: own elaboration from Giannoccaro and Berbel (2013)

Table 2. Definition of the farmers' behaviour (N = 1135)

Farmers' behaviours	% of respondents	CAP scenarios	
		baseline	NO-CAP
Invariant	69.4	increase	increase
		constant	constant
		decrease	decrease
Change-decreasing	20.4	increase	decrease
		increase	constant
		constant	decrease
Change-increasing	4.1	constant	increase
		decrease	constant
		decrease	increase
Undecided	6.1	increase	do not know
		constant	do not know
		decrease	do not know

Source: own elaboration

with reference to the level of the chemicals use under each CAP scenarios.

Inconsistent data and outliers were removed from the initial sample of 1328 observations. Indeed, 12.2% of farmers canvassed did not answer the relative question on the chemicals use meanwhile a tiny percentage of them gave unreliable answers. As a consequence, the sample on which the analysis was performed accounts for 1135 valid observations.

The general trend of the effect of the CAP removal is shown by the shares of the full sample in each category, as presented in the second column of Table 2.

Methodology

The empirical information about the household behaviour under the two scenarios is based on the stated intentions and collected through a survey. The main dimensions of change detected by the survey regarding the farmers' responses include the chemical input use in the terms of fertilisers and pesticides. In particular, the farmers' responses related to the declared intention of using more or less fertilizers and pesticides are analyzed.

According to the framework analysis of the farmers' behaviour (Table 2), for the first group of farmers, labelled 'Invariant', the CAP abolishment is considered to have no effect on their strategies. By contrast, the farmers who gave a different answer in both scenarios are those whose strategies would be modified by the CAP liberalization. Indeed, the farmers' decisions would change if the CAP support was removed. As a consequence, it makes sense of the influence of the current CAP normative on farmers' decisions. For those who declared to change downward, it might be argued that the chemicals use is still supported by the CAP, whereas for the farmers who change upwards, the policy is a sort of disincentive.

The determinants of the farmers' responses to the CAP liberalization are investigated to assess what are the main factors behind the decision and to understand which factors are recurrent and which factors vary with adjustments to the policy. The logit model regression (Greene 2003) was fitted to identify the key determinants of: (i) change-decreasing farmers' behaviour; (ii) change-increasing farmers' behaviour. Two empirical regressions were run to detect the factors determining higher likelihoods of decreasing behaviour (Model-I) and increasing (Model-II) with respect to the whole invariant group as a reference.

The variables considered as determinants are all of those derived from the questionnaire and are fully available in Viaggi et al. (2009). The full list of variables used, the main statistics and the way each variable was considered and coded is shown in Table 3.

The farm characteristic variables are related to the current farm size in the terms of owned land and land rented-in. Renting plays a major role in the land availability, particularly for annual crops and livestock; about 32% of farms rent-in some land. Since the land owned showed a strong variability, which in turn might have been opened to heteroscedasticity issues, it was converted into an ordinal variable with four size classes. Household workers account for the family labour availability focusing on the part-time worker. Farming specializations are split into six main systems, namely the COP, which accounts for cereals, oilseeds and protein crops, field crops and vegetable, permanent crops, dairying specialists, mixed livestock, mixed crop and livestock. The latter category covers both livestock and field crops and it is the largest agricultural system.

The spatial dimension takes into account three items. The first refers to the main European areas where the Central and North area covers the North East Scotland, the Centre and Midi-Pyrénées, the Noord-Holland, the Lahn-Dill-District and the Ostprignitz-Ruppin cases study. The South area envelops the Emilia-Romagna, Andalusia, Macedonia and Thrace. Finally, the East area accounts for the Podlaskie and the South-East Planning Region as the

Table 3. List of variables

	Code	Variable description	Coding	Mean	S.D.	Class distribution (%)
Farm features	Land owned	Total land owned (ha)	Four groups: ≤ 5 ha 5–20 ha 20–50 ha > 50 ha	–	–	 25 29 23 23
	Land rent IN (dummy)	Land rent-in	0 = no, 1 = yes	0.32	0.46	–
	Worker part-time (dummy)	Household worker part-time	0 = no, 1 = yes	0.45	0.50	–
	Specialist (dummy)	Main farm specialisation	1 = COP 2 = field & vegetable 3 = permanent 4 = dairying 5 = mixed livestock 6 = mixed crop & livestock	–	–	21 8 9 19 13 30
Spatial dimension	Region (dummy)	European regions where sample was selected	0 = Centre-North (UK, FR, NE, DE), 1 = South (IT, ES, GR), 2 = East (PL, BG)	–	–	43 26 31
	Altitude (dummy)	Location of the farm with respect to the altitude	0 = Plain, 1 = Hill/Mountain	0.38	0.48	–
	LFA (dummy)	Farm location belonging to the Less Favourable Area	0 = no, 1 = yes	0.55	0.50	–
Policy drivers	SFP/SAPS > 5 000 EUR (dummy)	Single farm payment/Single area payment scheme received in 2007 higher than 5 000 EUR	0 = no, 1 = yes	0.48	0.50	–
	Other payments (dummy)	Other payments received in 2007 by CAP measures	0 = no, 1 = yes	0.57	0.49	–
	Organic production (dummy)	Farm with organic production	0 = no, 1 = yes	0.06	0.25	–
	AES (dummy)	Farmer engaged in Agri-Environmental schemes	0 = no, 1 = yes	0.29	0.45	–
Farmer's features	Age (dummy)	Age of farm head	Age	46.2	13.7	–
	Education	Education level of farm head	Six different level: Elementary school primary school high school professional master degree and Ph.D.	–	–	 10 16 42 21 11
	Extension service (dummy)	Farmer assisted by an extension service	0 = no, 1 = yes	0.57	0.49	–
	Farmer union (dummy)	Membership of a farmer union	0 = no, 1 = yes	0.55	0.50	–
	Share Gross Revenue	Share of farm income from agricultural activity over total household income (%)	Six different level: less than 10% 10–29% 30–49% 50–69% 70–89% more than 89%	–	–	 9 7 11 17 16 40

Source: adapted from Giannoccaro and Berbel (2013)

new accession members to the EU. In addition, there are some spatial features related to the geographic characteristics such as altitude and location in the 'Less Favourable Areas' (LFA). In many European regions, often the LFA definition takes into account the altitude as the main discriminatory element. In this regard, the two variables show a significant correlation factor of 0.40 according to the Pearson test. Consequently, the variables were introduced separately into the regression models.

The variable used for the policy payment was the amount of SFP/SAPS received by the interviewees which they declared. Since the amount of first pillar CAP payments received by farms varies substantially across areas/specialization systems the sample resulted in a large variance. On average the surveyed farms receive 22 000 EUR per year even if the median value is around 5000 EUR. In order to avoid heteroscedasticity issues, a dummy variable was introduced where the sample was split into two groups of payments respectively inferior and superior to 5000 EUR 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 57% of those surveyed received some aid from Pillar II. In this case the dummy variable separates farmers with other aids from those without. Finally, organic production and agro-environmental schemes are dummy variables related to the policy drivers.

The remaining variables concern the age of the farm owner, his/her education level, the use of extension services and the membership of a Farm Union. Finally, there is the share of the 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 the intended farmers' responses to the CAP liberalization. The global view of the intended decisions on the chemicals use is shown in the Table 4. Table 4 reports the share of respondents according to their declared behaviour, with a special focus on the spatial variability. Indeed, the farmers' stated preferences are distinguished according to the spatial variables, namely the European region, the altitude and the LFA.

In Table 4, the most frequently stated behaviour is 'Invariant behaviour', where the farmer's decision is independent of the CAP ending (69.4%). With reference to the spatial features, a distinct pattern of general view is found among the European regions, with the South group showing the highest share of respondents (11% higher than the sample average).

As Table 4 shows, 30.6% (347 observations) of the farmers interviewed would change their behaviour under the CAP liberalization. Of those farmers who are influenced by the shift in the policy, the farmer's decision under the alternative scenario goes mainly to the 'decreasing' intention accounting for 20.4% of the total sample. A smaller frequency is reported for the 'increasing' intention at 4.1%. When the data is referred to the Changing Behaviour category as a whole, the percentage of the decreasing behaviour reaches 66.8% of the respondents while the increasing intention covers only 13.3%. The association between the plans for the next years and the extent to which these plans will be influenced by the CAP liberalization is statistically significant using Chi Square. The Chi Square value is 112.93 with a P value of 0.000.

Finally, 6.1% of respondents declared to be undecided about the strategy that they would choose if the CAP was suppressed. This group of farmers accounts for 19.9% (69 out of 347 respondents).

Table 4 also shows the spatial differences of farmers' reactions across the European regions, altitudes and the areas with less favourable conditions. Again, a relevant spatial differentiation is reported across the European regions. In the case of the change-decreasing behaviour, the East regions account for the biggest share of respondents (28.9%). On the other hand, the North-Centre case studies result in the highest value for the change-increasing response, while the East regions account only for three respondents. Finally, the undecided behaviour also prevails in the North-Centre regions with 76.8% of respondents within this class of farmers' giving this reaction to the CAP liberalization.

As a whole, the CAP liberalization findings revealed a long-term trend to maintain the preferences of the chemicals deployment (69.4% is the most frequent response over the total sample), although the intention to decrease is also reported (20.4% of the total sample). The smallest frequency is shown for the farmer's intention to increase the chemicals use (4.1%).

Afterwards, the regression models were applied to prove if the spatial and other variables are significant as determinants of farmer's response to CAP abolishment. We fitted logit models of the farmer's behaviours through a backward stepwise procedure.

In the Model-I, the dependent variable was assigned "1" if the farmer's declared intention was to change to decreasing the chemical inputs, while "0" was set for the whole invariant category. The results are shown in Table 5, where only the significant variables are reported ($p < 0.05$).

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-R^2 values and the percentages of correct predictions also suggested that the estimated model has a fairly good explanatory power. In addition, the probability of predicting the dependent "zero" and "one" found respective values of 0.265 and 0.735 with a standard error of 0.019. Finally, we checked the multicollinearity issues by calculating the Variance Inflation Factor. The value was 2.9. Therefore it lay largely under the acceptance limit.

The spatial features fitted by the regression as the major determinants of the decreasing behaviour are the European region and altitude variables. The Centre-North and South regions with respect to the East case studies show a negative sign related to a decrease. We can say that the East group would be more willing to decrease the chemical use if the current CAP was removed. At the same time, farms belonging to plain zones are less disposed to a decreasing use of chemical inputs.

The model also reports other determinants of the farmer's behaviour, such as the size of owned land. The larger the farm size, the higher the likelihood to be in

Table 4. Farmers' intended behaviour under the CAP liberalization (N = 1135)

			Farmers' behaviours				Total
			invariant	change-decreasing	change-increasing	undecided	
European region	North-Centre	observations	306	92	34	53	485
		% group	63.1	19.0	7.0	10.9	100.0
		% total	27.0	8.1	3.0	4.7	42.7
	South	observations	240	38	9	10	297
		% group	80.8	12.8	3.0	3.4	100.0
		% total	21.1	3.3	0.8	0.9	26.2
	East	observations	242	102	3	6	353
		% group	68.6	28.9	0.8	1.7	100.0
		% total	21.3	9.0	0.3	0.5	31.1
Belong to LFA*	No	observations	352	94	28	34	508
		% group	69.3	18.5	5.5	6.7	100.0
		% total	31.1	8.3	2.5	3.0	44.9
	Yes	observations	434	138	18	34	624
		% group	69.6	22.1	2.9	5.4	100.0
		% total	38.3	12.2	1.6	30.	55.1
Altitude	Plain	observations	496	130	37	46	709
		% group	70.0	18.3	5.2	6.5	100.0
		% total	43.7	11.5	3.3	4.1	62.5
	Hill&Mountain	observations	292	102	9	23	426
		% group	68.5	23.9	2.1	5.4	100.0
		% total	25.7	9.0	0.8	2.0	37.5
Total		observations	788	232	46	69	1135
		% total	69.4	20.4	4.1	6.1	100.0

LFA = Less Favourable Area

the change-decreasing class. Indeed, the average farm size for the 'Invariant' group is 44.90 ha, with 70.88 ha being the value for the change-decreasing. While the share of respondents for the change-decreasing group is close to 20% of the total sample, in the terms of the percentage of farmland this group reaches 34% of the total land covered by the sample.

Among the specializations, the COP and permanent crops have been found to be significant. These two farm specializations with respect to farms with mixed crop & livestock activities could be more disposed to reduce the amount of the chemicals used. While permanent crops are less widespread than other specializations, the COP is among the most relevant farm specialization of the EU agriculture.

With reference to the policy drivers, the amount of the SFP/SAPS superior to 5000 EUR per year emerges to be also important. It should be remarked that the other CAP payments are not significant in the case of a decrease in the chemical use.

On the other hand, a minor probability of decreasing behaviour (with respect to the 'Invariant behaviour') is revealed for organic farming and farms that rented land. Under organic farming, the deployment of fertilizers and pesticides is very low or absent. As a result, the influence of the CAP liberalization on

Table 5. Logit regression model of the Changing Behaviour: Model-I 'Change-decreasing'group[1]

	Factors	B	S.E.	Wald	Sig.	Exp(B)
Change-decreasing	constant	–1.660	0.285	33.983	0.000**	0.190
	land owned (ha)	0.455	0.097	21.893	0.000**	1.576
	land rent IN	–0.723	0.219	10.892	0.001**	0.485
	specialist			19.280	0.002	
	COP	0.605	0.264	5.246	0.022*	1.830
	field & vegetable	–0.540	0.459	1.382	0.240	0.583
	permanent	1.110	0.361	9.470	0.002**	3.034
	dairying	0.003	0.252	0.000	0.992	1.003
	mixed livestock	–0.193	0.290	0.442	0.506	0.825
	mixed crop & livestock (reference)	.	.	.	.	.
	region			28.514	0.000	
	Centre-North	–1.241	0.252	24.217	0.000**	0.289
	South	–1.065	0.287	13.761	0.000**	0.345
	East (reference)	.	.	.	.	.
	altitude (Plain)	–0.455	0.179	6.458	0.011*	0.635
	SFP/SAPS > 5000 EUR	0.639	0.214	8.933	0.003**	1.894
	organic production	–1.394	0.616	5.121	0.024*	0.248

Rate of –2 Log likelihood = 884.090

LR test = 0.000*

Nagelkerke's R^2 = 0.164

Cox & Snell R^2 = 0.108

No. of observations

Invariant = 718	Invariant = 79.6%
Change-decreasing = 209	Change-decreasing = 58.3%

Source: own elaboration

[1]All invariant behaviour category is the reference class "0"

*statistically significant at 95% level, **statistically significant at 99% level

the farmer's preference towards the chemical use was initially not relevant.

Among all available variables, the findings show that the features such as the farmer's age and education, the assistance of an extension service or the share of the farm income are not relevant in the farmer's decision process. It seems that the spatial elements, the farm structural factors and the amount of support under the Pillar I are more important than other social factors.

Finally, some considerations concerning the value of the constant should be stressed. In fact, it is significant and takes the value of –1.660 for the change-decreasing class, and 0.0 implicitly for the reference class.

Let us turn to the Model-II, for which the dependent variable was assigned "1" if the farmers' declared intention to change his/her behaviour turning to a rise in chemicals use while the full invariant category was set as the reference class (code "0"). In the first attempt, no satisfactory model result was obtained. Indeed, among all available variables, only the Region variable resulted in being significant. In addition, the goodness of model was not satisfactory and the number of correct predictions was extremely low. It should be stressed that the 'increasing' group is the smallest accounting for less than 5% of the total sample. The disparity in the size of the two sample groups may also have biased the classification in favour of the larger group. For these reasons, the stated intention of a change in increasing chemical use was rolled out of the analysis.

DISCUSSION

Although the sample might be biased according to the farm size and the farmer's age, the framework analysis has pointed out two main behavioural reactions to the CAP liberalization, namely the farmers who are sensitive to the policy shift and the farmers who are not.

Concerning the first category, the findings here prove that the current CAP would influence the farmer's decisions on the use of fertilizers and pesticides. In effect, farmers' intentions would move towards a reduction in chemicals if the current policy was eliminated. The findings here are in line with Bonfiglio (2011) who found a decrease in the use in the case of the CAP abolishment. However, the model's results point out that the influence of the CAP removal is not spatially neutral. Indeed, the CAP abolishment would have major influences on the farmers' decision processes in the new accession regions. This result agrees with other studies on farmers' reactions to the CAP normative in the last accession members (Douarin et al. 2007; Gorton et al. 2008). Additionally, the altitude would also influence the farmer's decisions. Generally, farms located in the plain zone are less likely to decrease their use of the chemical inputs in the event of the CAP abolishment.

We would stress that these spatial variables are the proxy of more complex spatial patterns in the European agriculture. In this regard, more attention should be also paid to the assessment of the CAP liberalization on other important areas such as the Natura 2000 and the Nitrate Vulnerable Zones.

Excluding the spatial variables, more classical factors emerge as the determinants, in the particular CAP payments via the SFP/SAPS. The findings stress a higher likelihood of decreasing behaviour if the current normative is removed for the farms receiving the total amount of payments higher than 5000 EUR per year. As a consequence, although the current aids under the 1st Pillar are mainly decoupled, the chemical use may still be influenced by larger amounts of payments.

At the same time, the structural factors are important in the farmer's decision process under the CAP abolishment hypothesis. Among the farm structural features, farm size in terms of the owned land should be mentioned. A larger land tenancy increases the likelihood of the decreasing behaviour. In the case of very small farms, which may have considerable alternative income sources, the NO-CAP scenario was, initially, likely to make a little difference to their plans. Finally, among the farm systems, the evidence arises on the COP and permanent crops for which the decreasing behaviour is more likely than for the other farm specializations.

Some additional consideration should be made concerning the variables which are not significant. Among the farmer's features, there are the age of the farm head and the share of the gross revenue. In this regard, the sample covered younger farmers with respect to the current statistics, while the variables such as the farm revenue are normally untrustworthy data. Finally, other payments are also not significant in the models, given that this variable would not be related to the farmer's decisions on the chemicals use.

It is worth mentioning that the most relevant category is the 'Invariant behaviour', where the farmers would not modify their decisions. Indeed, almost 70% of respondents declared they would maintain the same strategy concerning the chemical inputs use

for the next 7 years, whatever policy was in place. In this regard, some considerations may be made. Firstly, a close qualitative question was applied and the three easiest options were given, namely the increased, constant and decreased use of the related item. Surely, the CAP removal might imply other structural changes such as the quantity and modality of crop production. Secondly, the question was related to the amount of chemical inputs deployed at the moment of the survey. As a matter of fact, the level of use for each farm was not asked, therefore the deductions on the real impacts in terms of the final input use fell short of the research possibility. Finally, the result here refers to the number of respondents. Therefore, the final effects in the terms of farmland area might be different.

CONCLUSION

In this research, the farmers' intended behaviour towards the chemicals use on the farm were analyzed. The farmers' stated intentions were collected under the hypothesis of a full liberalization of the CAP from 2014. Some policy implications on the basis of our results might be discussed in order to address the environmental sustainability of the European agriculture. Nevertheless, environmental sustainability should be seen as a more comprehensive idea, of which the amount of the chemicals use is just a piece.

Basically, the results have found that the decoupled payments under the current CAP normative would influence the farmers' decision on the use of chemicals, and to some extent, it would contribute to strengthening of its deployment. However, the model regression has highlighted differentiated influences of the CAP removal on European farmers. Indeed, in the New Member States, where the chemicals use is initially lower than in the other EU-15 regions (Parris 2011), the majority of respondents would change the strategy downwards. As a consequence, in the EU-15, where the areas with the nutrient excess are mostly spread, a simple CAP removal does not seem to apply to this problem. In addition, an excessive use of the chemical inputs in agriculture also implies a spatial issue. In fact, the input overload is primarily dangerous in the so-called vulnerable zones. The current CAP normative recognizes special cross-compliance requirements for these areas. However, contrary to the expectations, a small number of respondents would react to the CAP liberalization and the relative environmental constraint abolishment by increasing the input use. Considering the fact that the current environmental requirements within the cross-compliance schemes are sufficiently restrictive towards intensive farming activities, it remains an open debate in the context of the CAP environmental assessment.

Moreover, the amount of the CAP payments via the SFP/SAPS has been found to be related to the farmers' decisions of change-decreasing. In this regard, it is worth mentioning the recent policy proposal by the European Commission (EC 2010) concerning the introduction of an upper ceiling for direct payments received by large individual farms ('capping') which may be a significant policy issue to improve the environmental target of the supports to agriculture. At the same time, there is a common awareness of the share of the budget between the first and second pillar, with the second being rewarded at a higher expenditure. A budgetary reduction of the Pillar I to support the second Pillar may well help strengthen sustainable agriculture. Indeed, according to the findings of this research, payments in the Pillar II do not seem to influence the farmers' preferences towards the chemicals use.

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Received: 29th April 2013
Accepted: 27th May 2013

Contact address:

Giacomo Giannoccaro, Julio Berbel, University of Cordoba, Dpt. Agricultural Economics and Policy, Campus de Rabanales, C5, 3º floor-14014 Cordoba, Spain
e-mail: es2gigig@uco.es