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ABSTRACT

The changing environment affects agriculture introducing sources of uncertainty. On the other hand, policies to cope with risks may have strong impacts on the environment. We evaluate the effects of public risk management programmes, such as subsidised crop insurance, fertilizer use and land allocation to crops. We implement a mathematical programming model of a representative wheat-tomato farm in Puglia, a southern Italy region. The results show that under the current crop insurance programmes, tomato productions are expected to expand and to require larger amount of fertilizer, whereas the opposite is true for wheat productions. Policy and environmental implications are discussed.

Keywords: uncertainty, risk, insurance, externalities, multifunctionality, environment

JEL classifications: C6, D81, Q51, R58

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Introduction

Farm business is the sector of production for which factors outside the manager's control most affect final outcomes. In particular agriculture is largely affected by weather fluctuations and climate changes [1]. These peculiarities have contributed to the development and acceptance of forms of public intervention aimed at reducing income variability that have no parallel in other sectors of the economy. In the United States, Canada and part of Europe, the attention of farmers and their representatives has focused on the potential offered by the involvement of governments in farm risk management programmes [2]. The environmental consequences of risk management policy, such as crop insurance, have been hotly debated [3-4]. In particular, the determinants of insuring decisions are still not clear cut. Moreover, whether or not the purchase of crop insurance induces farmers to reduce the use of potentially polluting chemical inputs (intensive margin), expanding the cultivated land (extensive margin) is an unresolved issue.

On one hand, chemical and fertilizer applications may increase or decrease yield and profit variance. On the other hand, crop insurance subsidies, and higher levels of transfer payments are given to comparatively higher-risk areas of production, inducing risk-averse farmers to expand productions.

In this framework, the Fischler reform represented a systematic attempt to reorient farm policy to place greater emphasis on environmental, landscape, food quality and animal welfare objectives. There are five key new elements in the reworked CAP framework; the introduction of decoupled payments, cross compliance, re-orientation of CAP support towards rural development policy by modulation, an audit system and new rural development measures. In this context, direct payments are conditional upon the respect of minimum environmental, animal welfare and food safety standards, and modulation of direct payments has been made compulsory, so that each Member State is forced to divert a (small) part of its direct payment endowments to the resources available for rural and regional development policies. The latest CAP reform acknowledged that increased mobility and leisure time, added to the relocation of population towards rural areas, have all acted to increase the marginal value of environmental amenity.

A new role has been attributed to the primary sector, namely production of environmental goods and food quality and safety. This new role may be explained in terms of multifunctionality, which means that agro-environmental policies promote non-commodity outputs jointly produced with agricultural commodity outputs [5].

At the same time, the new regulations arising from Health Check confer management autonomy on Member States for the first time, authorised to use up to 10% of the national maximum plafond, to supply specific aid in clearly defined cases. Among specific subsidies (Measure d: insurance), there is the possibility of using the first pillar for subsidising measures to cover the risk of economic losses caused by adverse weather conditions and by animal or plant diseases or parasite infestation (Art.70, EC Regulation 73/2009). In actual fact, “Measure d” allows financial contributions to be granted for payment of crop insurance premiums up to a maximum of 65% of the total premium in the form of EU co-financing (absolutely new in the history of the CAP in this context). This co-financing cannot exceed 75% of the national financial contribution.

In short, while both risk management and environmental policy have been specifically regulated, it remains unclear to date how such programmes might act together, without one offsetting the other.

Hence the main objective of this investigation is to clarify the relationship between risk management policy and environmental policy in the context of farmers’ agrochemical applications and land use. To our knowledge, this study is the first attempt of its kind in Europe, and the results may well bring about a review of Government risk management programmes, which undoubtedly introduces potential distortion into farm-level decision-making which could be affected at both the intensive (input use) and extensive (land use) margins. There could be a knock-on effect in terms of rural and regional policy, which currently represents for southern Europe, i.e. Italy, the driving force of development.

A large debate on risk management and environmental policies

A vast literature focused on the potential environmental impacts of government-sponsored risk management programmes such as subsidised crop insurance and crop disaster payments [6-9]. All such studies are limited to the United States. Since North America has experienced a long history of crop insurance, large datasets allow economists to consistently estimate crop insurance adoption patterns, chemical input use and crop acreage allocation. On the contrary, in Europe such data are unavailable, explaining why farmers' behaviour under uncertainty has been underinvestigated.

An underlying policy question is whether the benefits provided by government-subsidised risk management programmes are offset by the costs of such programs, including the costs of unintended environmental effects, and whether or not risk management programmes could offset environmental programmes e.g. as predicted by Fischler's reform.

Understanding the impacts of chemical inputs is of crucial importance in environmental and economic science [10]. Pope and Kramer [11] modelled production risks analyzing their effects on input use. They consider a stochastic production function, under CRRA assumption, and modelled risk as function of input use. They show that risk-averse agents tend to use more (less) inputs able to decrease (increase) risks.

Ahsan [12] investigated the relationship between crop insurance and input usage. They showed that full coverage crop insurance encourages investigate the relationship between crop insurance and input usage were: farmers choose inputs as if they were risk neutral. Quiggin [13] introduced the moral hazard problem: he found that crop insurance may lead to a reduction in input use.

One of the most cited contributions is the paper by Horowitz and Lichtenberg [6]. They pointed out that in many instances pesticides are more accurately viewed as risk-increasing. While the conventional wisdom is that pesticides are risk-reducing inputs, they found that their use may increase rather than decrease with crop insurance. Since Horowitz and Lichtenberg's [6] contribution was based on data prior to 1992, hence before the Reform Act came into force in US in 1994, some aspects of farmer behaviour may have changed in the meantime.

Smith and Goodwin [7] criticized Horowitz and Lichtenberg's [6] findings that multiple peril crop insurance could force farmers to increase chemical input use. They emphasized the strong linkage between increase in expected yield and increase in yield variance, if an input is considered as risk-increasing. The increase in variance positively affects the likelihood of an indemnity payment but the increase in mean yield offsets it. The net effect is ambiguous. Smith and Goodwin [7] doubted that the expected indemnity payment increased with input use for two reasons. First, chemical inputs increase production costs, and lower (increase) the expected profits (losses) when indemnity payments are made. Secondly, the critical yield that triggers an indemnity payment is determined by the farm's yield history.

Wu [9] found that crop insurance for corn in Nebraska caused a shift in production from hay and pasture to corn. In other words, crop insurance subsidies may also promote environmental degradation due to the increase in production which may result in increases in overall chemical use for crops. Importantly, this shift involves considering environmental externalities at the extensive and intensive margin. Wu [9] also pointed out that an increase in chemical application rates may be due to the 'moral hazard' created by crop insurance.

The Italian crop insurance system

In Italy, the Government's involvement in agricultural risk management is based on the wholly state-financed National Solidarity Fund (FSN), set up in 1974 with two main objectives: to compensate farmers for damage due to natural disasters and support the use of crop insurance. State contribution has constantly increased in nominal terms, although this is mostly due to the increased share of combined perils policies that benefit from higher public subsidy to premiums (80%). Tariffs show a significant reduction between 2007 and 2011 (Table 1).

< TABLE 1 ABOUT HERE >

However, until recently, access to disaster payments was open to all farmers, irrespective of the signing of insurance contracts. From 1981 through 2005, appropriations by the FSN have totalized about €9.4 billion; 72% of the amount spent has been directed to disaster payments, while insurance subsidies have absorbed the remaining 28%. Over the same period, disaster payments averaged €234 million per year, reaching a maximum of €522 million in 1990. The Italian system of compensation for natural disaster damage is mainly reactive, in the sense that the initial yearly endowment of funds received by the FSN can be integrated with *ad hoc* specific legislative measures, when necessary. In 2002, total appropriations for the FSN were €481 million. The law which established the FSN also authorized operation of farmers' associations at the provincial level (*Consorzi di Difesa*) which were assigned two functions: (i) collection of farmers' insurance demands (mainly for hail) and transferring them to the insurance companies; (ii) coordination and enforcement of common preventive measures. Despite subsidies of about 35% to 40% of actual premiums, the spread of insurance in Italian agriculture has been rather thin: the share of insured value on total crop production — mainly fruit crops and vineyards — has never exceeded 15%, reached in 1998 and decreasing in subsequent years. One likely reason is the possibility for Italian farmers to access compensation for natural disasters even without the signing of insurance policies. The Italian system has been modified in recent years with more emphasis on crop insurance, in an attempt to reduce the cost of ex-post compensation in the event of disasters. The main changes are the possibility for farmers to underwrite newly designed contracts for innovative multi-risk coverage directly with insurance companies, with premiums subsidised by up to 80%, and state-supported reinsurance. Eligibility for indemnity shall be determined by an income loss, taking into account only income from agriculture which exceeds 30% of average gross income or the equivalent in net income terms (excluding any payments from the same or similar schemes). Moreover, the amount of such payments shall compensate for less than 70 % of the producer's income loss in the year the producer becomes eligible to receive this assistance.

Theoretical model

For our empirical investigation we used a non-linear programming model (NLP). We develop a model for farmers decision-making able to capture the strategies when deciding to enrol in the Environmental Program (EP) under uncertainty. Moreover, whether their participation strategies could be offset by risk management programs, such as crop insurance.

In order to analyze the effects of the introduction of a subsidy on the premium of all-risk insurance on yields, we used the Italian Farm Accountancy Data Network (FADN) dataset of two samples of firms for the Apulia region. In particular, we considered wheat and tomato products to differentiate, in terms of expected variability of yields/revenue. Our analysis concerns two case studies of the same lowland/highland system.

The choice of wheat and tomato is due to their different yield variability (tomato yields generally show higher variability than wheat) and to different production characteristics. The database is extracted from FADN-RICA and include 1092 farms, observed over the period from 2003 to 2008. Theoretically, farmers' enrolment decisions in the EP mean dealing with various sources of uncertainty. The decision to participate in the EP must be made in the face of the well-known revenue uncertainty of agricultural production resulting from variability in output prices and crop yieldsi. Any expected utility model for risk-averse decision makers would suggest that subsidizing premiums would encourage farmers both to increase their level of production, and possibly increase it into riskier areas. The idea is that as a subsidy decreases, lower risk farmers would be less motivated to subscribe to crop insurance and riskier farmers could abandon their production (probably from marginal land).

By modelling it, we could assume a multi-output firm with a fixed amount of land L^* that can be allocated between *j* crops. The producer's problem is to select levels of *x* variable inputs for each of the *j* crops in the production plan and to allocate L^* hectares of land among these *j* crops. The modelled farmer is a price taker in the output and variable input markets. The farmer decides to subscribe an *all risk* (ARI) crop insurance contract guaranteeing yield losses up to 30% of average yield, with the following payoff: $\{I_j, M_j\} = 1, \ldots, \mathrm{I}$, where I_j represents the random (eventual) insurance indemnity and M_j is the non-random insurance premium for crop *j*. Moreover, at sowing time, the farmer could chooses to receive the environmental payments (decoupled payments), $\lambda \in \{0, 1\}$, by comply his crop practice with the CAP's rules. We are assuming that crop insurance and input decisions are made simultaneously. This requires that the planning processes underlying both decisions occur simultaneously, which would appear a logical consequence of assuming that farmer decisions are affected by the overall economic environment, i.e. government risk management programmes and environmental payments.

At sowing time, total farm revenue Π is plausibly based on the expectation made on price, yield and costs experienced in the previous season, such that: $E(p_i y_i) = p_i^e y_i^e + cov\,(p_i^e y_i^e) - c_i$ (1)

where $E(\cdot)$ is an expectation operator; p_j^e is the expected per quintal price of the *j*th crop; y_j^e denotes the expected yield per hectare of the *j*th crop; $cov\,(p_j \ \ y_j)$ denotes the covariance between price and yield and underlines the natural hedging mechanism between price and yield; c_i is the per hectare cost of production.

Per hectare revenue for crop *j* and farmers *I* when crop insurance is subsidised and environmental payments occur is:

$$\pi_{ij} = p' y'(x_j) - c_j - r' x_j + \vartheta EP_j + \Sigma_i(I_{ij} - M_{ij}) \quad (2)$$

where *p*' is the vector of the random price, *y*' represents the vector of the random crop yield per hectare as a function of the input levels x_j, c_i is the non-random variable cost, r is the price vector of inputs x_j, and *EP* represents the environmental payments (where ϑ is an indicator variable for participation in the environmental program; $\vartheta = 1$ if the farmer chooses to participate, 0 otherwise).

Income per crop could be identified as $S_j \pi_j$, where S_j is acreage planted to crop j, and total crop income π is the sum of income over all crops: $\pi = \sum_j S_j \pi_j$.

The representative farmer maximizes the expected utility of income, choosing the acreage allocation S_j, input use x_j, and participation in both environmental programme ϑ and insurance programme:

$$max_{A_j, x_j, \vartheta_j, i} \int u(\pi) dF\,(p_1, p_2, \dots, p_j, y_1, y_2, \dots, y_j) \quad (3)$$

The farmer's utility function $u(\bullet)$ is the Von Neumann-Morgenstern [16] $(u' > 0, u'' < 0)$, under the hypothesis of risk aversion, such that $\partial^2 U / \partial^2 \pi < 0$ (Pratt, 1964), and decreasing absolute risk aversion (DARA); $F(\bullet)$ identifies the joint distribution function of prices and yields.

The optimal acreage allocation and input use for each crop (S_j and x_j for all j), follows the constraints on acreage allocation $\left(S \geq \sum_j S_j \right)$.

In this way, as introduced by Seo et al. [8], the intensive margin effect of the availability of crop insurance and disaster payments for a crop could be identified with the difference in the optimal use of input x_j when the programme is available versus when it is not. Similarly, the extensive margin effect could be viewed as a change in optimal acreage S_j when the same programmes are available.

In our analysis we use a direct expected utility maximizing non-linear programming (DEMP), combined with simulation approach.

We utilized DEMP to maximize expected utility directly, by virtue of to using quadratic programming, recurring at Monte Carlo integration to simulate data mining from a sample of yield and price, under the hypothesis oh the distribution of these parameters. The approach allowed to estimate numerically the expected indemnity, in that the computation of the expected indemnity is unfeasible by using analytical approach. Farmer's choice of the nitrogen fertilizer rate affect indirectly the mean and variance of the yield distribution. For this analysis, the functions for the dependence of the mean and variance of wheat and tomato yield on the nitrogen application rate were estimated using data from experiments conducted between 2003 and 2005 in Apulia region, Foggia province. Nitrogen fertilizer rates were experimentally varied from 0 to 300 q/ha and correspondently wheat and tomato yields has been measured for each plot for a total of 53 observations. A quadratic equation identifies the final result for mean and variance with all estimated coefficients significant at the 5% level.

Empirical model

We develop a solvable expected utility maximization model which is (a) free of restrictions on the forms of the utility function, and (b) free of assumptions regarding the distribution of the uncertain parameters.[ii] The underlying assumption in the model implies that wealth effects could affect production decisions.

With negative exponential utility ($\nu(c) = -\exp(-\theta_c)$), the DEMP objective function for problem (3) is:

$$\sum_k [1 - \exp(-R\pi_k)], \qquad (4)$$

where k indexes each state (Monte Carlo random drawn), R is the coefficient of risk aversion[iii], and $\pi_k = \sum_j S_j \pi_{jk}$ is profit associated to the state k. Income from crop j in state k is:

$$\pi_{ijk} = p'_k y'_k(x_j) - c_j - r' x_j + \vartheta EP_{jk} + \Sigma_i(I_{ijk} - M_{ijk}) \qquad (5)$$

which differs from equation (2) in the index k that scored each random variable.

In this context, the ARI insurance indemnities for any state k and crop j could be represented as:

$$I_{ARI,jk} = PEF_{ARI,j} \max\left\{CVG_{ARI,j}\ y_j - y^*{}_{jk}, 0\right\}, \qquad (5a)$$

where y_j^* is the average yield used by ARI.

Given that we set the model at only one trigger level, the non-random insurance premium for each crop does not depend, unlike in Seo et al. [8], on several coverage levels. This makes it easier to calculate the expected net indemnity which is equal to the expected indemnity minus the actual premium, and better represents the Italian crop insurance market.

Since the integration required to obtain the expected indemnity is analytically intractable for the model, we used Monte Carlo integration. In agriculture, simulation models are routinely applied to biological system analysis (e.g., crop simulation or environmental models) and there is always some uncertainty present in the system, which can be modeled by sampling from appropriate probability distributions.

Given that an integral can be approximated by computing the sample average of a set of function values, we have interpreted the integral as an expected value. We then had to establish that the mean we were computing was finite. Our basic statistical result for the behaviour of sample means implies that, with a large enough sample, we can approximate the integral as closely as we like. The general approach is widely applicable in Bayesian econometrics and has begun to appear in classical statistics and econometrics as well[iv].

Consider the function $F(x) = \int_L^U f(x) g(x) dx$, where $g(x)$ is a continuous function in the range [L, U], and suppose that $g(x)$ is non-negative in the entire range. In order to normalize the weighting function, we assume that $K=\int_L^U g(x)dx$, is a known constant. Then *h(x)=g(x)/K* is a probability function in the range because it satisfies the axioms of probability. Let $H(x)=\int_L^x h(t)dt$. Then *H(L)=0*, *H(U)=1*, *H'(x)=h(x)>0*, and so on.

Then, $\int_U^L f(x)g(x)dx = K\int_L^U f(x)\frac{g(x)}{K}dx = KE_{h(x)}[f(x)]$, where we use the notation $KE_{h(x)}[f(x)]$ to denote the expected value of the function *f(x)* when *x* is drawn from the population with probability density function *h(x)*. We assume that this expected value is a finite constant[v].

Thus the expected indemnity is the average indemnity for each policy over all states $k:\sum_k I_{ijk}(PEF_{ij}, CVG_{ij})$. Since crop yields are known to fall in a range from 0 to some maximum possible value and their distribution can be significantly skewed either to the right or to the left and the beta distribution has such flexibility, we introduced into our analysis a random crop yield which follows a beta distribution, with mean and variance that depend on the dosage of applied nitrogen fertilizer. The model was solved using the non-linear program solver included in GAMS (General Algebraic Modeling System)[vi].

In particular, simulation for draw yields from the assumed distribution, and prices were carried out by Excel. The optimal fertilizer rate was determined as an integer variable by specifying fertilizer rates in 0.1 q/ha increments centered at the province mean for each crop; the fertilizer rate implied also the level of the mean and variance of the yields. GAMS interfaced with Excel by the GDXXRW program distributed with GAMS. GAMS sends the required means and variances to Excel, then Excel generates appropriately correlated yields and prices using the method of Richardson and Condra [14].

Results

To sum up, we have adopted a theoretical framework to model farmers' choices. The model has been calibrated by mean of data collected from the FADN database. Successively, we have solved a mathematical programming model to compute optima farmers' choices. The results are shown in Table 2.

With regard to the optimal fertilizer use and acreage allocation when the subsidized insurance program is available, unsurprisingly, we show that crop insurance generally has a positive effect on the optimal nitrogen fertilizer rate for both wheat and tomato. Depending on the crop and the farmer's level of risk aversion, the optimal rate increases by about 5 q/ha. Crop insurance has a large effect on the optimal acreage allocation. When ARI is available, optimal tomato acreage almost doubles, accompanied by an appropriate decrease in wheat hectares.

The results in table 2 also show that as farmer risk aversion increases, the optimal nitrogen rate decreases for all alternatives regardless of the crop because nitrogen is used as a risk-increasing input. In addition, optimal tomato acreage decreases and optimal wheat acreage increases, because tomato is the riskier crop. For the range of risk aversion levels explored, the optimal insurance coverage level slightly changed for tomato, but increased for wheat.

In our study, crop insurance positively affected both crops at the intensive margin. It would be inappropriate to compare our results with others reached in the past due to the different areas investigated.

Regardless of yield distribution, when crop insurance is available, farmers find it optimal to bear more risk and so choose fertilizer rates accordingly. Given our conditional yield distributions, this means an increase in the fertilizer rate. Once again, since our analysis was conducted in a different scenario, it would be prudent to avoid comparing it to others carried out in the past.

< TABLE 2 ABOUT HERE >

Conclusion

The environmental impact of farming continues to play a significant role in policy debates over the role of government in the agricultural sector of the economy. Some experts have argued that government policies aimed at reducing production risks may create potential incentives to undertake activities harmful to the environment. In other terms, agricultural subsidies may induce a hazardous behaviours. For example, the provision of state-subsidised crop insurance may encourage producers to bring economically marginal land into production: if this land is more environmentally fragile than land already farmed, this reduction in risk provided by state-subsidised crop insurance could lead to a reduction in environmental quality. In addition to crop insurance, the government has set up a myriad of other programmes designed, among other things, to provide income support and reduce income variability in the agricultural sector. Some of these programme payments are linked to the current production of a particular crop, while other programme payments are decoupled from current production.

While such programmes provide incentives to expand production on the extensive margin, they may also lead to reductions in environmental amenity and prejudice multifunctionality objectives. In addition to encouraging production on environmentally fragile land, farm subsidies and risk management policies provide incentives for producers to alter their crop mix, cropping practices (including input use) and conservation practices.

Unsurprisingly, the results of our investigation show that crop insurance generally has a positive effect on the optimal nitrogen fertilizer rate for both crops under consideration. Crop insurance has a major effect on the optimal acreage allocation for both crops considered and positively affected both crops at the intensive margin level. The results are in line with conventional wisdom [6-7]. Moreover, when crop insurance is available, farmers find it optimal to bear more risk [15]; hence they would choose fertilizer rates accordingly which, given our conditional yield distributions, would mean an increase in the fertilizer rate.

Although it would be prudent to avoid comparing our analysis to others carried out previously, it would appear clear that agricultural policy, and more specifically insurance subsidies, has the potential to alter land use, cropping practices and conservation practices, and may contribute to increases in soil erosion [16].

Moreover, it would seem that subsidising premiums could offset the benefits of environmental programmes, as foreseen by Fischler's reform of Europe's agricultural support system. In this sense, Government risk management programmes undoubtedly introduce potential distortion into farm-level decision-making which affect both the intensive (input use) and extensive (land use) margins. Southern regions in Europe, such as Puglia, which are greatly affected by regional development policy, could see their future patterns of development jeopardized. Finally it is worth noting that these results are of great interest also for Mediterranean Countries [17-18], lacking of policies for risk coping and characterized by similar farming systems to those observed in Southern Italy. Understanding how policymakers should plan efficient policies for risk management is a promising area of research.

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Notes

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[i] For clarity's sake, consider two farmers who farm in different regions. For unsubsidized insurance one farmer would pay £10 per £100 of liability; the other £20 per £100 of liability for the same insurance policy. In relative risk terms, the farmer paying £20 would have yields that are twice as risky for the same insurance policy. Given a 50 percent subsidy, the lower risk farmer receives a £5 per £100 of liability transfer and the higher risk farmer receives £10.

[ii] In Lambert, D.K. and McCarl B., 1985. "Risk Modeling Using Direct Solution of Nonlinear Approximations of the Utility Function". *American Journal of Agricultural Economics* 67 (4), p.847.

[iii] Values for R were chosen in accordance with the previous investigation carried out on the effects of the public subsidy at premium. In particular R=1 has been selected for low risk-aversion, and R=3 for high risk-aversion.

[iv] Used to estimate numerically the expected indemnity, Greene pp. 181-183.

[v] Used to estimate numerically the expected indemnity, Greene pp. 181-183.

[vi] Using the method of Richardson and Condra, as suggested from McCarl and Seo et al.

Tables

Table 1. Crop insurance market in Italy (2004-2011)

		2004	2005	2006	2007	2008	2009	2010	2011
Certificates	n°	212231	212445	211444	236922	264698	226177	208204	207762
Insured quantities	.000 t	14894	14837	14805	16329	20416	18218	20090	19872
Insured hectares	.000 ha	982	1074	1125	1051	1450	1355	1153	1164
Insured Value	.000€	3710212	3810222	3789132	4379809	5436140	5131045	5312829	6145146
Total Premiums collected (TP)	.000€	177.439	269124	265033	292888	338059	317210	285502	287461
Indemnities (VR)	.000€	152165	159984	149975	184626	272711	234781	169259	171534
Public Contribution *	%	56.80	65.90	66.62	66.78	66.34	67	66.41	66.12
Average tarifs	%	7.5	7.4	7.5	7.22	6.75	6.70	5.78	5.74
VR/TP	%	66.2	59.6	55.4	64	81	75	60	58

(*)premiums/insured value
Source: Ismea

Table 2. Farmer's choices under different scenarios

	Tomato		Wheat	
	Low risk-aversion	High risk-aversion	Low risk-aversion	High risk-aversion
	Selected nitrogen fertilizer rate (tonn/ha)			
Government programme				
Environmental Program	12.36	11.99	7.15	7.02
All risk and Environmental Program	12.88	12.51	7.63	7.49
	Selected acreage allocation (ha)			
Government programme				
Environmental Program	0.99	0.78	2.45	3.15
All risk and Environmental Program	1.49	1.27	2.11	2.87

The coefficients of absolute risk aversion are 4.0×10^{-6} and 7.0×10^{-6} for moderately and highly risk averse, respectively.