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Irrigation Advisory Services: Farmers preferences and willingness to pay for innovation

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Abstract

Irrigation Advisory Services (IAS) are powerful management instruments aiming to achieve the best efficiency in irrigation water use. So far the literature on farmers' preferences for a specific scheme design of IAS' characteristics and the related willingness to pay (WTP) is scant. This study provides evidence on farmers' preference towards six attributes related to the IAS configuration by using a hypothetical choice experiment. Data were collected from an original survey among 108 farmers from Spain, The Netherlands, Italy, Poland and South Africa. Moreover, we investigated the interplay between these preferences and the individual risk attitude (elicited through a lottery task) as a novel contribution. On average, the results suggest a clear farmers' preference, especially for receiving weather forecasts from the service and for the feature related to water data recording; as the opposite, on average, crop water requirement seems irrelevant. Finally, we found that farmers' WTP for the different IAS services varies across countries and, in some cases, also according to the individual risk attitude.

Keywords

Decision support system, irrigation advisory service, mixed logit, risk attitude

Introduction

The irrigated areas are major contributors to the world's food supply (FAO, 2014). In fact, the differences between precipitation and irrigation water requirements are so profound that irrigation management nowadays represents a priority for the sustainable and economically profitable crops' production (IDAE, 2005; Navarro-Hellín et al., 2015). Accordingly, innovative irrigation practices can enhance water efficiency, gaining an economic advantage while reducing environmental burdens; at the same time, farmers' efficient use of irrigation technologies alone may not conserve water. In some cases, the necessary knowledge has been provided by extension services, helping farmers to adapt and implement viable solutions, thus gaining more benefits from irrigation technology (Levidow et al., 2014). Site-specific extension recommendations that are better adapted to the needs of individual farmers and fields, and enabled by digital technologies included on

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Decision Support Systems (DSS) tools, could potentially bring about yield and productivity improvements and water saving. According to Oyinbo et al. (2019), improving the design of extension tools to enable provision of information on the riskiness of expected outcomes and flexibility in switching between low-risk and high-risk recommendations can help farmers to make better informed decisions, and thereby improve the uptake of extension advices and the efficiency of extension programmes.

Against this background, Irrigation Advisory Services (IAS) are agricultural extension services and powerful management instruments to achieve the best efficiency in irrigation water use (Bonfante et al., 2019). These systems are often conceptually oriented to simulate or predict crop water demand, providing a set of options. Currently, many systems exist that can optimize farmers' economic profits by efficiently simulating/forecasting both water demand and crop yield, and estimating the percentage of agricultural area with specific water supply need and planted area constraints (Kuo et al., 2000). Others are DSS more general in managing irrigation schemes (Mateos et al., 2002). Such DSS are used in some part of the world, such as in Australia (IrriSAT) and Europe, IRRISA in France, IRRISAT and IRRINET in Italy (D'Urso et al., 2013; Rossi et al., 2004), BEWARE (Crete, Greece), Anglia river Basin (UK).

The irrigation scheduling can be transferred to the user in several forms and with different delivery systems such as internet services, mobile phones (Belmonte et al., 1999; de Santa Olalla Sanchez, 1999), online-bulletins. These solutions offer to the irrigation DSS the possibility of providing simpler and more suitable mobile decision support to farmers (Mannini et al., 2013).

Recent researches (Altobelli et al., 2019; Manhoudt AGE et al. 2002) showed that farmers have a positive preference and a higher related willingness to pay (WTP) for an environmental certification (EC) scheme (related to agricultural products) that guarantees an efficient water use. Nevertheless, so far farmers' preferences for a specific scheme design of IAS' characteristics and the related WTP are poorly understood. Indeed, the assessment of IAS related WTP is essential to determine farmers' likelihood to use these services and therefore to prefigure the development in the near future (Small and Svendsen, 1990). To this purpose, Altobelli et al. (2018) found that farmers' preferences are positively influenced by many attributes as the scale (i.e. entire area of the farm instead of single fields), the duration of the service delivering contract (i.e. 3 years); as opposite, they found that the impact of water saving on farmers' choice was poor.

In this paper, we present a structured survey carried out in five countries to understand the importance of technological innovation in agricultural water management and to identify farmers' preferences and willingness to pay for the IAS. In particular, we investigated which are the most preferred among six different IAS attributes. To do this, we apply a hypothetical choice experiment (CE), coherently with similar studies related to farmers' adoption of new technologies (e.g. Lambrecht et al., 2015). Furthermore, we elicit the individual risk attitude through a lottery game and use it to examine whether farmers' WTP changes among individuals with different risk attitudes. The results can inform both the agricultural research and extension programmes to consider farmers' preferences and accelerate this technology's adoption.

Materials and methods

Data collection

The research activity was carried on under the framework of the international project OPERA – Operationalizing the increase of water use efficiency and resilience in irrigation (ERA-NET Cofund WaterWorks2015 Call)

A structured survey was administered through direct interviews with a sample of 108 farmers from Italy, The Netherlands, Spain, Poland and South Africa between 2017 and 2019. As highlighted by Chèze et al. (2020) and Despotović et al. (2019) a rather small sample size is common when dealing with farmers, due to the recognized difficulty to reaching them, e.g. as opposite to consumers. Respondents were informed that the survey was implemented within an international project aiming at identifying the best IAS solution.

The questionnaire, written in each country's original language, was pretested on a small sample of farmers ($N = 20$) before the survey (Holmes et al., 2017). The questionnaire was divided into several sections, including questions on the choice experiment, the measure of farmers' risk attitude through a lottery-based experiment and, finally, farm and farmer's characteristics.

The choice experiment

This study uses a choice experiment that allows to eliciting farmers' preferences for specific IAS attributes in order to improve these tools following farmers' needs. Moreover, although relying on hypothetical market, CE are also useful to elicit the value that farmers assign to each investigated product/service characteristic, which is extremely useful for IAS since a fully functioning market does not yet exist and thus this can inform decisions on implementing more tailored tools. CE are stated preference methods that simulate the real choice (Hensher et al., 2005; Louviere et al., 2000): farmers are asked to choose among several multi-attribute IAS options their favourite one: behind the functioning of this method lays the assumption that individuals derive the value of a good by summing the value of its characteristics (Lancaster, 1966). Moreover, the respondents' choice is function of the probability that the utility of an option, that derives from the sum of the utility of its characteristics, is higher than the utility from the other alternatives in the same choice set, thus relying on the random utility theory (McFadden, 1974). According to this theory, the utility (U) that farmer i derives from a specific IAS configuration s is function of a deterministic part (V) and a stochastic unobservable element (e) of the farmer choice:

Table 1. List of the attributes and levels used in the choice experiment.

Attribute description	Code	Levels		
Weather forecasts (every 1, 2/3 or 4/5 days)	*forec*	1 day	2–3 days	4–5 days
Crop water requirement (every 1, 10 or 15 day)	*cwr*	1 day	10 days	15 days
Registration of water data and information (1, 2 or 3 times/month)	*regwa*	1 time	2 times	3 times
Crop monitoring (every 1/7 or 15 days)	*crom*	1 day	7 days	15 days
Contract duration (years)	*cont*	1 year	2 years	3 years
Price	*price*	5 €/ha	10€/ha	15€/ha

Source: Our elaborations.

$$U_{is} = V_i(X_s) + e_{is} = \beta_i X_s + e_{is} \quad (1)$$

where X_s represents a vector of observable characteristics of the alternative s, while β_i is a conformable parameter vector indicating the direction and magnitude of the statistical association between farmers' characteristics and the utility associated to the Irrigation Advisory Services' attributes and levels. By assuming the rationality of the individuals, it follows that the famer i chooses the alternative configuration of IAS s compared to the other options l in the choice set (namely, a finite set of alternatives, three in our design) if its utility (U_{is}) is higher than the utility he derives from the other alternatives (U_{il}) as follows:

$$U_{is} > U_{il} \quad \forall l \neq s \quad (2)$$

Parameter β_i are here considered as random parameters, varying across farmers. The distribution of each parameter follows across the sample a normal distribution N $\sim$ (μ, σ^2) allowing the possibility to investigate the heterogeneity of preferences across farmers explicitly for the different IAS characteristics: the greater (in case of statistical significance) the σ^2, the wider will be the heterogeneity of preferences across farmers. Finally, μ and σ^2 of β_i can be estimated through a mixed logit conditional model by maximum likelihood estimator.

Through the CE, farmers' preferences towards six attributes related to the IAS configuration was evaluated. These derived from the focus groups conducted among different stakeholders as farmers, farmers' associations, and land reclamation consortia in each country. Each attribute is characterized by three levels (Table 1).

The first attribute regards the time length of weather forecasts (*forec*). Weather forecasts provide key information for strategic farming management decisions. The second attribute regards the forecast of total water amount required by the crop (*cwr*), a relevant factor to consider from the sowing until the harvesting (Gowing and Ejieji, 2001; Memon and Jamsa, 2018). In particular, crop water requirement refers to a range of forecasting for 1, 10 or 15 days and represent the amount of water to provide by irrigation to the crops. More specifically, irrigation is necessary to compensate for the evapotranspiration (crop transpiration and soil evaporation) deficit. Accordingly to FAO, irrigation consumptive water use is defined as the volume of water needed to compensate for the deficit between potential evapotranspiration of the considered crop (kc*ET_0) on the one side and effective precipitation over the crop growing period and change in soil moisture content on the other side. It varies considerably with climatic conditions, seasons, crops and soil types. In this study, the irrigation consumptive water use is computed for each country on the basis of the irrigated crop calendar for a specific year, as the difference between the crop water requirement and the water balance under natural conditions.

The third attribute relates to the number of times (i.e. one time, two times or three per month) water information, in terms of irrigation dates and volumes applied, have to be recorded (*regwa*). The CE also considered an attribute describing crop monitoring (*crom*) in terms of the frequency of satellite data availability (1, 7 or 15 days). Furthermore, another attribute is the preferred duration of the IAS contract (*cont*) between annual, crop cycle-based or triennial option; indeed, according to the literature (Altobelli et al., 2018; Biswas and Venkatachalam, 2015), a long contract is more likely to be preferred because farmers recognize the positive impact of the service on crop production, due to an optimized irrigation management.

Finally, the attribute price (*price*) is linked to several aspects of IAS, such as the cost for training farmers and the cost of implementing the irrigation services: here, each level of price represents an average and indicative value based on evidence from a previous investigation among different irrigation services carried out within the considered countries (Altobelli et al., 2018); the amounts varied from 5 € to 10 € and 15 € per hectare.

Since a full factorial design consisting of all combinations of experimental attributes and levels would require 729 possible choice sets, an orthogonal experimental design was generated, generating a total of 24 choice sets that will be then aggregated into four blocks. Hence, each questionnaire presented six choice sets to each respondent, that is considered an acceptable number by the literature (Bech et al., 2011). In each choice set the individual could choose only once among three alternative options (A–B–C) and an opt-out option (no choice or alternative D); this latter (status quo) allows realism in choices (Adamowicz and Boxall, 2001). Each alternative from A to C was described by six attributes and represented a specific combination of attribute levels, as shown in the example in Table 2. Each attribute was explained in detail to respondents in order to avoid misinterpretation bias.

Table 2. Example of a choice set.

Which of the following alternative options (from A to D) would you prefer?				
	A	**B**	**C**	**D**
Weather forecasts (every 1, 2/3 or 4/5 days)	4–5 days	1 day	4–5 days	nothing
Crop water requirement (every 1, 10 or 15 day)	1 day	1 day	1 day	
Registration of water data and information (1, 2 or 3 times/month)	2 times per month	once per month	3 times per month	
Crop monitoring (every 1/7 or 15 days)	per day	per day	15 days	
Contract duration (years)	3 years	2 years	1 year	
Price	15 €/ha	5 €/ha	10 €/ha	

Source: Our elaborations.

Table 3. Gamble task.

Please, mark only one gamble with a X

Gamble	Roll	Payoff	Chances	Choice
1	low	560 €	50%	
	high	560 €	50%	
2	low	480 €	50%	
	high	720 €	50%	
3	low	400 €	50%	
	high	880 €	50%	
4	low	320 €	50%	
	high	1,040 €	50%	
5	low	240 €	50%	
	high	1,200 €	50%	
6	low	40 €	50%	
	high	1,400 €	50%	

Source: Own elaboration.

Risk attitude elicitation

In order to elicit the respondents' individual risk attitude, we proposed a lottery task inspired by Eckel and Grossman (2008) this elicitation technique has been already used by the literature investigating farmers' decision (see for instance Menapace et al., 2013; Giampietri et al., 2020) as it involves only few gambles and a single choice, thus resulting less complex than other techniques, e.g. the widely used lottery task by Holt and Laury (2002) (Dave et al., 2010). More specifically, respondents were asked to imagine having an amount of 560€ to play a lottery by choosing only one preferred gamble (only one) among six different alternatives (from 1 to 6) (Table 3). Besides, in addition, we added a contextual frame to the lottery by asking farmers to imagine that the payoff represented the net income (€/ha) they as farmers would gain from a hectare of cash crop (e.g., wheat). It is noteworthy that the use of this context setting that is very intuitive to farmers (i.e., the gambles are intended in terms of farmers' net income per hectare) made the lottery more easily comprehendible, thus minimizing errors in decision making (Menapace et al., 2016). Moreover, farmers were told to consider that each gamble had two possible outcomes (low and high roll) in terms of payoff (€) with 50% chance of occurring each, exception made for gamble 1 (no loss) that entails high-risk aversion. The choice in the gamble task represents the individual risk attitude, with the first gambles that are particularly chosen by more risk averse subjects while the last by risk seekers (Charness et al., 2013). Once elicited, farmers risk attitude is implemented to describe farmers' WTP related to the IAS attributes.

The coefficient of risk attitude is measured assuming constant relative risk aversion (CRRA) utility function for which the utility is defined as $U(x) = x^{(1-r)}/(1-r)$, with r representing the relative risk aversion coefficient and x representing wealth.

Results

The highest percentage of interviewees were from Poland (43%), followed from Italy (33%), Spain (16%), the Netherlands (6%) and South Africa (2%). The sample comprised 33 farmers over 50 years old, followed by 17 farmers aged 40–50 years, 17 aged 30–40 years, and 8 farmers that were less than 30 years old. From the total, 16 farmers did not answer. The youngest respondent was a 23-year-old Dutch man and the eldest a 71 years old Polish man. Most of the sample was made up of males (85%), while female respondents were the 15%: these latter were between 26 and 61 years old and a quarter of them had University degree, as opposite to men (16%). Family farms were the majority (63%), followed by professional-industrial farms (24%) and a mixed typology (13%). The farms were mainly specialized in the production of vegetables (68%), followed by livestock (14%). The utilized agricultural area (UAA) ranged between 0.5 ha (Polish farm) to 220 ha (South Africa farm), with 27% of farms having a UAA below 5 ha, 33% between 5 and 10 ha, 30% between 10 and 20 ha and 0.1% over 20 ha. In recent years, 50% of farmers invested in innovation at farm level (both product, technological innovation and on farm organization) and, due to this, 44% of respondents stated they had a 33% increase in production capacity. Nonetheless, investments in innovation have not resulted in increased exports, market share or overall employment.

Regarding the measure of risk attitude, Table 4 shows the range of CRRA (r) values for farmers choosing a specific gamble; we used the lower bound for the estimation (Menapace et al., 2013). Consistently with the literature (Iyer et al., 2020), most farmers show a significant level of risk aversion, while only a minority (6%) represent risk seekers.

Table 4. Intervals for CRRA measure of risk aversion and share of farmers choosing each gamble.

Gamble	Payoff (€)	Chances (%)	Expected payoff (€)	Standard deviation	CRRA	Farmers (%)
1	560	50	560	0	r > 2.6	27.5%
	560	50				
2	480	50	600	120	1.2 < r < 2.6	12.7%
	720	50				
3	400	50	640	240	0.8 < r < 1.2	30.4%
	880	50				
4	320	50	680	360	0.5 < r < 0.8	15.7%
	1,040	50				
5	240	50	720	480	0.1 < r < 0.5	7.8%
	1,200	50				
6	40	50	720	680	r < 0.1	5.9%
	1,400	50				

Source: Own elaboration.

Table 5. Mixed logit results.

Attribute	β Coef (μ)	std.err	t-stat	p-value
Price (euro/ha)	−0.089	0.022	−4.04	0.000
Weather forecasts (every 1, 2/3 or 4/5 days)	0.360	0.054	6.72	0.000
Contract duration (years)	−0.247	0.086	−2.86	0.004
Crop water requirement (every 1, 10 or 15 day)	−0.055	0.231	−0.24	0.813
Crop monitoring (every 1/7 or 15 days)	−0.034	0.013	−2.59	0.010
Registration of water data and information (1, 2 or 3 times/month)	−0.314	0.128	−2.44	0.015
No Choice	−0.541	0.411	−1.32	0.188
	β Coef (σ)	**std.err**	**t-stat**	**p-value**
Weather forecasts (every 1, 2/3 or 4/5 days)	−0.090	0.099	−0.92	0.359
Contract duration (years)	0.333	0.097	3.44	0.001
Crop water requirement (every 1, 10 or 15 day)	1.740	0.273	6.39	0.000
Crop monitoring (every 1/7 or 15 days)	−0.036	0.019	−1.91	0.056
Registration of water data and information (1, 2 or 3 times/month)	0.494	0.139	3.55	0.000
	WTP (€/ha)		**std.dev**	
Weather forecasts (every 1, 2/3 or 4/5 days)	4.11		0.28	
Contract duration (years)	−2.86		1.86	
Crop water requirement (every 1, 10 or 15 day)	−0.27		16.59	
Crop monitoring (every 1/7 or 15 days)	−0.38		0.16	
Registration of water data and information (1, 2 or 3 times/month)	−3.58		3.00	

Source: Our elaborations.

Concerning the CE, Table 5 shows the results obtained from the mixed logit conditional regression. The results concerning the estimated coefficients (random coefficients β) can be interpreted as follows: the economic intuition of the parameters μ is strictly based on the associated marginal utility of the corresponding attribute, while it can be statistically interpreted as proportional odds ratios like a usual logit regression. Estimated values of μ show that, excluding price, the IAS characteristics that generate greater utility or preference to farmers are (in order of relative importance): i) weather forecasts, ii) registration of water data and information, iii) duration of the contract, and iv) crop monitoring, while on average crop water requirement would seem irrelevant.

More in detail, by investigating the sign of the coefficients, the choices of the type of service seems depending positively from: a) time length of forecasts (*forec*): the more days available in the future, the more the service is chosen; b) need to record water information (*regwa*) (i.e. the longer the time interval farmers need to record information, the higher their willingness to accept the service). As opposite, a negative effect was found for: a) price: as the price increases, the probability for a farmer to adopt the service decreases b) duration of the contract (*cont*) (i.e. shorter contracts are preferred); c) frequency of crop monitoring availability (*crom*) (i.e. when the availability of monitoring changes from 1 day to 7 or 15 days the probability of choice decreases). The same conclusions can be obtained by calculating the monetary assessment of the preferences, namely, the farmers' WTP per hectare.

Table 6 shows the average values of the WTPs for the different attributes of IAS, expressed in euros per hectares

Table 6. Average WTP of IAS attributes for the different countries (€/ha).

	Italy	Poland	Spain	The Netherlands	South Africa	Total
Weather forecasts (every 1, 2/3 or 4/5 days)	4.10	4.09	4.05	4.32	4.27	4.11
Contract duration (years)	−2.67	−2.63	−3.50	−3.48	−4.01	−2.86
Crop water requirement (every 1, 10 or 15 day)	8.31	−4.04	−10.50	11.98	10.20	−0.27
Crop monitoring (every 1/7 or 15 days)	−0.37	−0.36	−0.45	−0.40	−0.38	−0.38
Registration of water data and information (1, 2 or 3 times/ month)	−3.94	−3.41	−4.25	−0.41	−5.28	−3.58

Source: Our elaborations.

Table 7. Average WTP of IAS attributes according the farmers risk aversion (€/ha).

	Weather forecasts			Contract duration		
	Risk seeker	Risk Averse	diff.	Risk seeker	Risk Averse	diff.
Mean	4.138	4.062	0.077	−2.509	−3.333	0.825**
std.err	0.039	0.036		0.271	0.202	
	Crop water requirement			**Crop monitoring**		
	Risk seeker	Risk Averse	diff	Risk seeker	Risk Averse	diff
Mean	6.214	−8.865	15.1***	−0.375	−0.391	0.016
std.err	1.681	2.518		0.023	0.020	
	Registration of water data and information					
	Risk seeker	Risk Averse	diff			
Mean	−3.160	−4.128	0.967*			
std.err	0.369	0.462				

Note: *** significant at 1% level, ** significant at 5% level, * significant at 10% level.
Source: Own elaboration.

for the different countries involved in the study. Farmers' WTP for the different IAS services largely varies across countries. For instance, as concerns, the weather forecast's length, Dutch farmers (4.32 €/ha) and those from South Africa (4.27 €/ha) are willing to pay a higher price per hectare than farmers coming from other countries. Spanish and Polish farmers show a negative WTP in relation to the need to receive information about crop's specific water requirements.

Finally, Table 7 shows WTP differences of for the considered IAS attributes according to farmers' risk attitude. More in detail, average values for risk seeker farmers' *vs* risk averse ones have been compared. In particular, risk attitude is able to explain positive WTP from those negative in terms of the attribute related to crop water requirement: indeed, while risk seekers are willing to pay for it (on average around 6 euros), risk averse farmers perceive this service as a disutility, thus associating a negative WTP (−8.9 euros). Generally speaking, risk averse farmers prefer both shorter contracts and a shorter crop monitoring period, and perceive a higher disutility in registering water data and information with a lower time frequency, compared to risk seeking farmers. As concerns the weather forecasts, the WTP of risk averse subjects is higher for a longer time interval, although this appears slightly lower than risk seekers.

Discussion and conclusion

Nowadays, an efficient and sustainable use of water for irrigation is essential. Accordingly, there is a plenty of studies showing that farmers are worried about irrigation water scarcity, especially during the summer, and the conflicts arising from the competitive water consumption (Alcon et al., 2014; Assefa, 2012; Aydogdu, 2019; Aydogdu and Bilgic, 2016; Aydogdu and Yenigun, 2016; Khan and Zhao, 2019). This makes farmers willing to support and adopt any lasting solution to irrigation water scarcity (Oremo et al., 2020). Water managers often rely on decision support tools, including hydrological models; however, water management also requires improving the efficiency of water use. In this context, the introduction of Irrigation Advisory Services (IAS) could advance irrigation practices and water efficiency in the near future, while providing an economic advantage for farmers: indeed, the adoption of this new irrigation management system can both increase farmers' income and reduce energy costs associated with water management consultancy. So far, the information on these devices is scarce among farmers and this represents one major obstacle to the adoption: it follows that the spreading of technical assistance is necessary. Moreover, a better understanding of the economic value that farmers attribute to IAS among policy makers is advocated. In line with this, this study provides an interesting framework for correctly understanding the potential of IAS. To do this, farmers' preferences were analysed using a choice experiment, which seems to be an effective method to estimate the non-market value of these innovative water use technologies. In particular, based on the trade-offs that respondents make between attributes, we were able to estimate the average WTP value (implicit prices for IAS) of the proposed IAS features for the whole sample. Further studies may use the WTP values estimated in this analysis in a future cost-benefit analysis of the IAS. Furthermore, in order to understand the level of importance of technological innovation in the agricultural water management, an analysis of the risk attitude of the farmers interviewed during the survey was carried out. Our results show that farmers are actually willing to pay to introduce an irrigation support system that translates into an economic advantage over their current situation. On the other hand, it has been shown that farmers' willingness to pay changes according to the attributes that characterize the service offered and according to the country of origin.

In line to the recent overall trends weather forecasting, tools for identifying pests and diseases and climate risks are perceived as useful by most European farmers, including those come from Italy and Germany (Altobelli et al., 2018; Bonke et al., 2018). Our results prove that the IAS functions that generate greater preference to farmers are mainly the weather forecasts, following by registration of water data and information, duration of the contract, while crop water requirement seems less relevant. Appreciation for wheatear forecasts confirm that farmers can benefit substantially from short to medium weather forecasts, which can help to optimize farming operations and deal more effectively with the adverse impacts of climate variability, including extreme weather events as water scarcity (Calanca et al., 2011). This brings out the need for additional efforts to increase the quality of the forecasts (decrease the associated uncertainty), as well as design appropriate operational tools and promote the dissemination of the outcome within the farmers community. Questions that need to be addressed are, whether the forecasts are in an appropriate form, predict the proper variables and refer to the relevant time scales (Garbrecht et al., 2005; Wilks, 1997). As reported in this work, by investigating the sign of the coefficients, the choices of the type of service seems to be mainly related to the time length of forecating (forec).

The possibility of monitoring the field variability through remote sensing raises a strong interest, but more at the level of the curiosity than as decision tool, since decision to be taken from such information is not straightforward. However, a control of the irrigation system and its management might be appreciated. Weather forecast, evaluation of the crop water need and water stress status are found interesting. The service should be reliable and directly delivered through Internet and/or mobile phone. However, there is not a panacea that will satisfy all farmers in all geographic areas (Burton et al., 2020).

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