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Agricultural Climate Information Use: An Application of the Planned Behaviour Theory

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ABSTRACT

Despite considerable effort in developing climate information and demonstrating the potential benefits available to farmers, use of the climate information by farmers in farming decisions has not changed. The present research employed the theory of planned behaviour (TPB) as a theoretical framework to analyze the antecedents of agricultural climate information use behaviour. Fars Province wheat growers (n= 314) were administered a questionnaire survey that measured standard TPB constructs. The data and hypotheses were examined using structural equation modeling (SEM) by AMOS 7. Results from the maximum likelihood estimation showed that attitude was positively related to farmers' climate information use in farming decisions. Thus, greater attitude (instrumental and affective) toward use of information in farming decisions was associated with stronger intention to engage in behaviour. Chi-square tests and fit indices indicated good fit for the final structural models. The results of this study demonstrated that the modified theory of planned behaviour provided a significant improvement on the model fit by adding a direct causal path linking attitude to behaviour. Applicability of the theory of planned behavior for measuring levels of wheat growers' climate forecast use and the implications for future research are discussed.

Keywords: Climate information use, Farming decisions, Structural equation modeling, Theory of planned behaviour, Wheat growers.

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INTRODUCTION

Climate information has been recognized as a basic production factor affecting agricultural systems (Harrison and Williams, 2007), particularly in response to water deficit as a major limiting factor in crop production (Pasban Eslam, 2009). Although the related information may be perceived of value to agricultural users (Ingram *et al*., 2002) and despite significant improvements in the climatic information production in the last decade (Subbiah *et al*., 2004; Ziervogel *et al*., 2005; Hu *et al*., 2006; Artikov *et al*., 2006), farmers, as users of this system, have not altered management decisions to take advantage of these information (Artikov *et al*., 2006; Hu *et al*., 2006; Nazemos'sadat *et al*., 2006). This could be due to a number of reasons ranging from limitations in modeling the climate system's complexities (e.g. such information can only be probabilistic, have coarse spatial and temporal resolution due to the chaotic nature of the atmosphere, not all relevant variables can be predicted, the skill of this information is dependent on region and time of year, is not well characterized or understood, contradictory information may coexist), to procedural, institutional, and cognitive difficulties in receiving or understanding climatic information, and in the capacity and willingness of decision-makers to modify actions (McIntosh *et al*., 2007; Pulwarty *et al*., 2009). Accordingly, the lack of use of climate information can be analyzed at least in terms of two major aspects. The first

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creative aspect emphasizes the generation, extension, transformation and exchange of agricultural climate information as a system. The second aspect of agricultural climate information system (ACIS) is the interactive facet that is concerned with the question: "who should do what in the ACIS, or who is actually doing what in the system?" (Ropelewski and Lyon, 2002; Jagtap *et al*., 2002; Ziervogel, 2004; Ziervogel and Downing, 2004; Linger and Aarons, 2005; Ziervogel *et al*., 2005; Harrison *et al*., 2007). Farmers as essential components of this second aspect (Hammer *et al*., 2001; Jagtap *et al*., 2002; Nelson *et al*., 2002; Ziervogel and Downing, 2004; McIntosh *et al*., 2007; Thomas *et al*., 2007) play an important role in development of the system and also their lack of adoption has long been an impediment to the success of ACIS (Davis, 1993). Therefore, the essential objective of this research is to focus on this challenge to find appropriate answer to the question: why are farmers reluctant to use agricultural climate information?

Related literature reveal three streams of approaches in “use component” of information systems, which are borrowed from psychological, sociological, and organizational change theories: macroeconomic approaches, firm level approaches (examining relationships between information technology expenditures and firm performance), and approaches examining determinants of usage at the individual level (Celuch *et al*., 2007).

Within individual level approaches, understanding the influence of information in social life is complex, no matter what lens is adopted to study it (Pozzebon *et al*., 2009). However, behavioral approach, especially attitude-based models, which focus on the identification of the determinants of behavioral intention i.e., attitudes, subjective norms, perceived control, have been viewed as useful means of understanding determinants of information usage. The origins of the behavioral approach extend back to the economic models that dominated in the 1950s (Burton, 2004). In the mid-1970s, behavioral approaches received a considerable boost with the development in social psychology of the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975)—the first model that reliably demonstrated a link between attitudes and behaviour. According to the TRA theory, the attitude towards the specific behaviour and the subjective norm are expected to causally precede the behavioural intention. The theory suggests that someone's intention (motivation) towards behaviour is a reliable predictor as to whether or not they will perform the behaviour (Kaufmann *et al*., 2009). In the causal chain, the attitude toward behaviour is the person’s favourable or unfavourable feeling of performing that behaviour and is determined by behavioural beliefs about the outcome of the behaviour and evaluation of the outcome (Adrian, 2006; Fen and Sabaruddin, 2008). Subjective norm refers to the individual’s perceptions of social pressure in performing or not performing a given behaviour and is determined by normative beliefs and the motivation to comply with the specific referents (Kaufmann *et al*., 2009). According to Ajzen as stated by Lam (2006), “despite its usefulness, the TRA was developed explicitly to deal with purely volitional behaviours”. There are many kinds of behaviours that cannot be assumed to be dependent only on volitional control (Ajzen, 2005). In this sense, the Theory of Planned Behaviour (TPB) extends TRA to the more realistic context of non-volitional behaviour by encompassing those individuals that require opportunities, resources, and specific knowledge (Do Valle *et al*., 2005). Therefore, Ajzen modified the theory by a new explanatory factor, Perceived Behavioural Control (PBC) and resulted in the theory of planned behaviour (TPB) (Ajzen, 1991; Karppinen, 2005).

The main components of the TPB are a person’s own attitude (e.g., affective attitude and instrumental attitude), subjective norms, perceived behavioural control, intentions, and behaviour (Ajzen, 2005) (Figure 1). The additional component of the modified model, PBC, is a multidimensional construct intended to reflect perception of factors that are both internal (e.g., knowledge, skills, will-power) and external (e.g., time, opportunity, cooperation of others) to the actor (Ajzen, 2005), consisting of two separate, but related, components (Kraft *et al*., 2005): self-efficacy and controllability, which reflects an individual’s external conditions that may

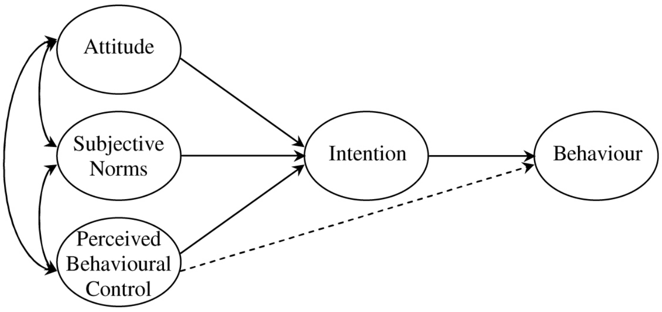

Figure1. Theory of planned behaviour (Ajzen, 1991).

augment or moderate his or her ability to adopt certain behaviour and an individual's perceived ability to carry out the behaviour (Do Valle *et al*., 2005).

The self-efficacy component of PBC deals with the ease or difficulty of performing behaviour (Karppinen, 2005) measured by two types of items: (a) perceived difficulty and (b) the degree of confidence of the actor in his ability to perform the behaviour if he wanted to. According to Ajzen (2005), the perceived control component of PBC involves people's beliefs that they have control over the behaviour. He suggests that this dimension is measured in terms of: (a) perceived control over behavioural performance, and/or (b what appears to us to be a locus of control (Armitage and Conner, 2001; Kraft *et al*., 2005). In line with this theory, the PBC construct predicts the specific behaviour directly and indirectly through intentions (Do Valle *et al*., 2005).

This theoretical framework is appropriate to study agricultural climate information use for two reasons. First, TPB provides a methodology for the elicitation of the farmers' cultural beliefs (Tolma *et al*., 2006), and allows for understanding factors affecting the actual farmers' behaviour regarding probable climate information. Secondly, agricultural climate information use behaviour is not fully under volitional control. It is mainly influenced by environmental factors, e.g., water stress and drought shocks that force farmers to search for climatic information. Thus, perceived behavioural control becomes a valuable theoretical construct.

There is an increasing body of work regarding many complex factors involved in the farmers' behaviour and motivational factors underlying their behaviour (Karami and Keshavarz, 2009; Beedell and Rehman, 1999). However, the number of studies that have considered farmers' attitudes towards weather/ climate forecast use (Artikov *et al*., 2006; Carbera, *et al*., 2006; Hu *et al*., 2006) is small. It is important to note that, the TPB application is not only restricted to simple behaviours of everyday life (Kaufmann *et al*., 2009). Increasingly, behaviours like technology adoption (Lynne *et al*., 1995), farmers' conservation behaviour (Beedell and Rehman, 2000), farmers' entrepreneurial and new business venture behaviour (Bergevoet *et al*., 2004; Krueger *et al*., 2000; Kolvereid and Isaksen, 2006), and pro-environmental and environmental sustainability behaviour (Bamberg, 2003; Karami and Mansoorabadi, 2007) or "ecological behaviour" (Kaiser *et al*., 1999) are across a range of more or less complex behaviours, which substantially affect the decision makers' future livelihood. In a similar vein, the theory of planned behaviour could be applied to the study of climate information use in farming decisions.

Thus, this study applies Ajzen's theory of planned behaviour to predict behavioural intention and actual behaviour of voluntary use of climate information forecasts in farming decisions. The contributions (objectives) of this paper are twofold. First, it provides an understanding of the determinant of climate information use in farming decisions from farmers' point of view. Secondly, the relationships between TPB predictors and agricultural climate information use will be addressed, justified, and empirically tested

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using structural equation modeling (SEM) technique.

MATERIALS AND METHODS

This study utilized survey methodology to examine underlying beliefs that may contribute to intention towards use of agricultural climate information in farming decisions of Fars Province wheat growers. This province is one of the leading regions in Iran's agricultural production, ranking first in wheat production of the country. The survey instrument was developed according to the methodology suggested by the founders of the theory (Fishbein and Ajzen, 1975). Also, focus group interviews were conducted to develop survey instrument. Results from the focus groups suggested that farming decisions (behaviour) could be categorized into four groups corresponding to different stages of crop production: (1) agronomic decisions through planting (including choice of crop type, planting density and date, planting scale), (2) growing season decisions (irrigation), (3) harvest decisions (including harvest date), and (4) economic decisions (crop insurance, optimizing costs). Findings from focus groups helped to understand seven farming decisions (behaviours) including: planting the best crop and variety; best planting density and planting date; best planting scale; optimal water applied (used); best harvest date; right amount of crop insurance; and lowest possible costs of production. Besides, indigenous knowledge of weather and climate forecasts, farmers' common decisions regarding climate information, and barriers of using climate information with respect to farmers' past experiences were also determined to enhance understanding of farmers' reasons for allowing climate information to influence their farming decisions.

Sampling Procedure

The unit of analysis for the research was individual wheat growers. A multistage stratified random sampling technique was followed to select the sample. In the first stage, the adjusted De-Marton classification index was used to identify the entire population as distributed by six climatic zones in the Fars Province (this climate variability highlights the importance of climate information for farmers' tactical decision making). In the second stage, two *Dehestan* (district or a collection of villages) encompassing a typical view of the climatic zone, and two villages from each *Dehestan* were determined randomly, from which wheat growers were selected. A simple random sample of wheat growers was selected from each stratum. The final sample consisted of 314 wheat growers. Data were collected between May and September 2009 by structural interviews through administering a standardized and structured questionnaire. The major questions addressed by this study were: How much farmers allowed the climate information to influence their farming decisions?, How did farmers perceive expectancies of the climate information?, What were their beliefs about the extent to which the climate information can help to achieve a variety of outcomes?, What norms helped farmers to allow climate information to influence their farming decisions?, and finally, what were the major obstacles that discouraged farmers in using the climate information and, thus, undermined the development of their ability to use this information effectively?

Measures

Behaviour

The behaviour (the dependent variable) was measured with a scale of 7 behaviours asking farmers to rate "the extent to which the various forecasts have influenced each of farmers' decisions during the farming season in 2009," on a scale ranging from 0 (no, it did not influence my decision) or 1 (yes it did influence my decision a little) to 5 (very much) assessing degree of agreement with the following statement: "I have used climate forecasts in my farming decisions."

Intentions

The related intention for each behaviour was assessed: 'I intend to perform "behaviour"

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over the next farming season. All items were responded to on 6-point Likert scales ranging from 0 (not at all), 1 (very unlikely) to 5 (very likely).

Attitude

According to the TPB, attitudes toward climate information predict use of the information, and farmers' attitudes toward the climate information use are the product of ease of use and usefulness of a behavioural decision (Kraft *et al*., 2005; Smarkola, 2008). Thus, examining farmers' attitude to use short-term climate information in farming decisions, a scale of seven items adopted from Artikov *et al*., 2006 and Hu *et al*., 2006, were used to assess the usefulness component of attitudes, asking farmers to rate the outcome value for each decision on a given scale (ranging from 0 for does not apply, 1 completely disagree to 5 completely agree), or importance of the various goals measured on the same 0-5 scale. Six items were phrased to reflect perceived ease of use to measure factors influencing the application of forecasts in farming decisions.

Subjective Norm

Two groups of questions measured influence of the subjective norms on short-term climate information use in farming decisions. The first seven questions measured farmers' expectancy that various persons/groups, e.g., emotional groups (spouse, children, neighbors and other farmers), experts (meteorological organization, rural production cooperatives, consultants and extension services), as well as news media (broadcastings and internet services), believed that forecasts and climate information should influence farming decisions. The second set of questions asked how much farmers valued the forecast-use views of each of those persons/groups.

Perceived Behavioural Control

In the present study, the perceived behavioural control construct as proposed by Ajzen (2002) clearly consisted of two different sub-constructs: perceived difficulty (PD) and perceived control (PC). Therefore, PBC was assessed by 17 indicators adopted from Kraft *et al*. (2005) and Hu *et al*.(2006), all measured by Likert-type rating scales. Six items made reference to how easy or difficult the performance of the behaviour was perceived to be for each decision: 'For me to perform behaviour would be difficult'. According to Ajzen (2002), the perceived control (PC) component of PBC is measured by two types of items. Seven items measured the confidence (CON) the respondent perceived that specific forecasts are applicable to achieve particular outcomes/goals, (e.g., the expected likelihood that short term forecasts can help determine optimum harvesting date, etc), four items measured how confident the respondent was that he would be able to successfully perform the climate information in farming decisions (behaviour), and the locus of control (LOC) type: 'If I wanted to, I would not have problems in succeeding to perform the behaviour, 'It is completely up to me whether or not I perform behaviour'.

Referring to Teguh Sambodo (2007), the results of the TPB survey should be tested for internal consistency prior to model development. This is a prerequisite for confirming that different questions in the TPB survey measure the same construct. This applies particularly to direct measures, such as behaviour, intention, attitudes, subjective norms, and perceived behavioural control. High internal consistency among questions relevant to each measure is preferred. The common benchmark is Cronbach's alpha (Bagozzi and Yi, 1988), in which the acceptable scale for high consistency is 0.7 or above, or 0.6 or above for exploratory analyses. The suitability of the data for this analysis was assessed using the Bartlett test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (Table 1). The results revealed that, the separate KMO indices ranged from 0.65-0.91 for different scales used in the study, which reflected sufficient sampling adequacy (greater than minimally accepted level of 0.5) (Pallant, 2005). The results of Bartlett's test of sphericity were significant (Table 1), therefore, the structural validity was assured. The reliability of the survey instruments used in this study was analyzed using Cronbach's α test through a pilot study of 34 respondents.

Table 1 presents the Cronbach's alpha for

Table 1. Reliability of the measurements.

Construct	Number of items	Cronbach's α	Kaiser-Meyer-Olkin measure of sampling adequacy	Bartlett's test of sphericity		
				Approx. Chi-square	df[a]	Sig.
Attitude						
- Perceived ease of use	6	0.82	0.89	1453.80	21	0.000
- Perceived usefulness	7	0.70	0.81	407.87	21	0.000
Subjective norms						
- Normative beliefs	7	0.74	0.75	286.77	21	0.000
- Motivation to comply	7	0.64	0.76	343.67	21	0.000
PBC						
- Perceived control	4	0.65	0.65	96.81	6	0.000
- Perceived expectancy	7	0.75	0.91	1209.85	21	0.000
- Perceived difficulty	6	0.75	0.81	502.05	15	0.000
Intention	7	0.96	0.90	865.82	21	0.000
Behaviour	7	0.75	0.85	863.45	21	0.000

[a] degree of freedom

the TPB variables, indicating a satisfactory internal consistency.

RESULTS AND DISCUSSION

The demographic research focused on location of the farm based on De-Marton climatic classification index, age and farming experience, education, farm size, access to climate information regarding how to conduct farm practices by means of governmental organizations' support, and physical attributes of the farm, such as type of water resources, which are presented in Table 2.

The respondents' age ranged from 17 to 90 years old (M= 50.76, SD= 16.21). Farming experience of the respondents ranged from 4-80 with mean of 31.19 (±18.09) years. In terms of education, 33.1 percent of the respondents were illiterate, 48.1 percent attended elementary and secondary school, and 18.8 percent had high school and higher degrees of education. About 9.24 percent of the respondents were employed in other jobs besides their farming, as baker, worker, teacher, driver, etc. Regarding the farm size, 36.9 percent of the respondents' farm size was bellow 5 hectare (ha), while the majority had a farm larger than 5 ha. Most of the respondents had ground water resources for irrigating their farms, and, while the climate information was available to almost all of the farmers through mass media, the majority of the respondents (88.6 percent) argued that they had no face to face consultation with extension agents regarding climate information use. The sources of climate information advice for those who had received related consultations were Agri-Jihad Organization (88.0 percent), mass media (4.8 percent), Water Organization (4.8 percent), and Meteorological Organization (2.4 percent).

The average values of the TPB components were calculated. Table 3 presents the means, and standard deviations for these variables. As illustrated by the table, farmers' attitude towards climate information was bellow the average of the items. A mean score of 2.08 (M= 2.08, SD= 1.10) was reported for this variable. As indicated by subjective norms, it

Table 2. Demographic profiles of participants.

Characteristic	Level	*N* [a]	%
Climatic location	Cold semi-arid	67	21.3
	Temperate semi-arid	77	24.5
	Cold arid	40	12.7
	Moderate cold	40	12.7
	Moderate arid	50	15.9
	Warm arid	40	12.7
Age	<30	33	10.5
	30-60	190	60.5
	>60	91	29.0
Education	Illiterate	104	33.1
	Primary school	88	28.0
	Secondary school	63	20.1
	High school	45	14.3
	Higher education	14	4.5
Off-farm employment	Yes	29	9.24
	No	285	90.76
Farm size (ha)	<5	116	36.9
	5-10	171	54.5
	>10	27	8.6
Source of irrigation water	Surface	78	5.1
	- Dam	24	
	- River	54	
	Ground	236	75.2
	- Qanat	19	
	- Deep well	150	
	- Semi deep well	92	
	- Spring	39	
	Surface and Ground	62	19.7
Consultation with change agents regarding climate information use	Yes	42	13.4
	No	272	88.6
Sources of climate information advice regarding farming practice	Mass Media	2	4.8
	Water Organization	2	4.8
	Agri-Jihad Organization	37	88.0
	Meteorological Organization	1	2.4

[a] Number of respondents.

Table 3. Means and standard deviations of the items used in the SEM analysis.

Measure	Mean [a]	SD
Attitude	2.08	1.10
SN	1.16	0.97
PBC	2.35	1.35
Intention	3.62	1.19
Information Use	1.05	1.18

[a] Mean scores in the present study are based on a 6-point scale (0 to 5).

is clear that farmers perceive very low social pressure to perform the climate information in their farm decisions (M= 1.16, SD= 0.97). However, results revealed that farmers' perception on power of control beliefs was almost high. This indicated that farmers may have felt they had complete control over their behaviour. In other words, farmers' perception of their control over various resources, and evaluations of the extent to which those resources constrain climate information use, was strong, suggesting that farmers perceived climate information as being under their volitional control. This assumption was supported by a relatively high mean score for perceived behavioural control.

The TPB variables were incorporated in a structural equation model (SEM) using AMOS 7 (Analysis of Moment Structure) software package. SEM, as a confirmatory approach to data analysis (Chang, 1998), is highly appropriate in the present context to test the measurement model and the path model simultaneously. The model fit was assessed by Chi-square and Normed χ^2/df value, coupled with other model fit indices like Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). The recommended cut off value for the goodness of fit indices was based on Hu and Bentler's (1999) recommendation.

In the first step, a series of structural equation path models were tested: (1) to determine the adequacy of the theory of planned behaviour in explaining the agricultural climate use behaviour (Model 1); (2) to test whether the direct causal path from attitude to behaviour improved significantly the fit of the data (Model 2, which is the modified version of Model 1).

That being said, the TPB is a theory of attitude–behaviour relationships that links attitudes, subjective norms, perceived behavioural control, behavioural intentions, and behaviour in a fixed causal sequence. Behaviour is deemed to be a direct function of intention and indirect function of perceived behavioural control. Intention, in turn, is a function of attitude, subjective norm, and perceived behavioural control (Figure 1). To substantiate the first model, structural equation modeling analysis was examined. SEM analysis indicated a poor fit for indices (χ^2= 31.6, df= 2, RMSEA= 0.21, CFI= 0.68, NFI= 0.71), and the chi-square test was significant (P< 0.01). Due to only a moderate fit, some modification was made to determine a model that better fit the data. Therefore, a modified version of the theory of planned behaviour, with a causal path linking attitude to behaviour, provided a significant improvement in model fit.

The criteria for evaluation of a good model should be assessed for goodness-of-fit. The literature suggests that, an acceptable ratio for χ^2/df value should be less than 3.0. Following the common practice, acceptable model fit is indicated by value greater than 0.90 for CFI, TLI and a value of less than 0.08 for RMSEA. However, a cut-off value close to 0.95 for TLI, CFI; and a cut-off value close to 0.06 for RMSEA are needed to support that there is a relatively good fit between the hypothesized model and the observed data (Hu and Bentler 1999). Since the results from this second model revealed that the structural model (Figure 2) demonstrated satisfactory model fit (χ^2= 2.11, χ^2/df= 2.11, P= 0.14, TLI= 0.94, CFI= 0.99, RMSEA= 0.06); therefore, it can be explained that the modified TPB model is a good fit model. Statistical comparisons of Model 1 and Model 2 revealed that Model 2 (modified TPB models) had a much better performance. Results revealed that 44% of the variance associated with agricultural climate information use was accounted for by its four predictors. The goodness-of-fit statistics for the modified TPB model are given in Table 4. Additionally, the overall modified TPB model is shown in Figure 2. Results of this figure shows that all hypotheses indicate causal relationships between (1) attitude and intention (β= 0.45, P< 0.001), (2) attitude and behaviour (β= 0.62, P< 0.001), (3) subjective norm and intention (β= 0.11, P< 0.001), (4) perceived behavioural control and intention (β= -

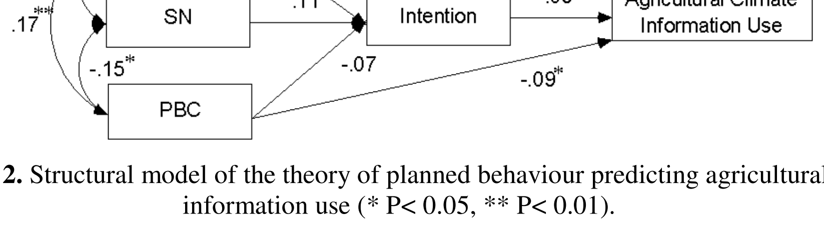

Figure 2. Structural model of the theory of planned behaviour predicting agricultural climate information use (* P< 0.05, ** P< 0.01).

Table 4. Goodness-of-fit measures for modified TPB composite measures model tests.

Model	χ^2	*p*	*df*	*CFI*[a]	*RFI*[b]	*RMSEA*[c]
TPB[d]	2.11	0.14	1	0.99	0.89	0.06

[a] Comparative Fit Index; [b] Relative Fit Index; [c] Root Mean Square Error of Approximation, [d] Theory of Planned Behaviour.

0.09, P< 0.001), and (5) intention and behaviour (β= 0.09, P< 0.001). Jointly, three predictor variables (attitude, subjective norm, and perceived behavioural control) explained 23% of the variance in meeting intention in TPB.

The fit indexes indicated that the modified TPB model adequately verified the data. An examination of the correlations among the factors indicated strong relation among the attitude and behaviour of climate information use.

In the second step, the direction, significance, and magnitude of the path corresponding to each hypothesis of the theoretical model were examined. The squared multiple correlations were examined to determine the proportion of variance that was explained by the exogenous constructs in the theoretical model. The relations among these variables are depicted in Figure 2. In this diagram, arrows symbolize direct effects. The measured or indicator variables are symbolized as rectangles and the measurement errors (associated with rectangles) are symbolized as circles. The numbers above the rectangles show the explained variances of the measured variables (indicator reliability). The numbers close to the arrows show the standardized regression coefficients (weights) of each causal relationship.

Results revealed that the ‘Attitudes’ had the highest standardized effect (regression coefficients, 0.45) on intention toward agricultural climate information use followed by ‘Subjective norms’ (0.11). The effect of ‘Attitude’ on ‘Climate information use’ was also relatively high (0.62). This observation confirmed the findings of Wauters *et al*. (2002) in other domains. The effect of ‘Attitude’ to ‘intention’ and ‘Behaviour’, and the effect of ‘Perceived behavioural control (PBC)’ to ‘Behaviour’ were highly significant ($p < 0.001$). Like Wauters *et al*. (2010), the results of this study revealed that intention was a significant predictor of the behaviour.

Findings revealed that attitude was a positive predictor of intention. There was also evidence that attitude itself was a stronger predictor of climate information use behaviour. In other words, participants with more positive attitudes toward agricultural climate information use also had greater intentions to engage in the behaviour. The results make sense theoretically (Fen and Sabaruddin, 2008) because instrumental attitude refers to perceived benefit associated with performing agricultural decision based on in-advance climate information, and affective attitude reflecting one’s feelings e.g., enjoyment, pleasure, and satisfaction towards agricultural climate information use. The more favourable one’s attitude (be either instrumental or affective) towards climate information, the greater the likelihood of that person to engage in performing decisions regarding agricultural climate information. It is worthwhile to mention that the final set of attitude items included both the instrumental and affective evaluations.

Table 5. Farmers' affective and instrumental attitude about climate information.

Farming decision	Applicability of information		Information usefulness	
	Mean[a]	SD	Mean[a]	SD
choice of crop type	3.10	1.29	2.74	1.19
planting date	3.05	1.28	2.96	1.26
planting scale	2.96	1.45	2.79	1.23
irrigation	3.40	1.19	3.19	1.18
harvest date	2.75	1.46	2.79	1.25
crop insurance	2.85	1.43	2.88	1.25
optimizing costs	2.83	1.36	2.82	1.11

[a] The scale for the mean is 1-5.

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Farmers' expectancies regarding climate information usefulness (instrumental attitude) and the applicability of the information to achieve particular farming outcomes (affective attitude) help to elaborate understanding of instrumental and affective (cognitive) attitude. Table 5 provides the mean and standard deviation for these measures. Results reveal that farmers' expectancies of applicability of agricultural climate information were placed in a medium status ($\bar{x}$ = 2.75 to 3.40). It is noted that, climate information applicability corresponds closely to the degree of opportunity that is provided by the information to tactical maneuvering at farm level practices based on the conditions that this information portraits in advance. Farmers believed that climate information had the potential to use for agronomic decisions through planting season decision (including choice of crop type, planting density and date, planting scale). However, the results indicated that information were perceived only as moderately useful to reach farming outcomes ($\bar{x}$ =2.74 to 3.19). The dissatisfaction with information usefulness was partly due to the past cost of decision making. This means that employing climate information as an input into decision making process by users hasn't resulted in incremental economic and/ or other benefits. Hansen (2002) also suggested that forecasts were only useful if they were skillful, timely and relevant to actions which users can incorporate into production decisions.

Results (Figure 2) suggest that attitudes exert a significant and direct effect on behaviour. This finding is consistent with other researchers' (Davies *et al*., 2002; Conner *et al*., 2003). Referring to Bagozzi and Yi and, as stated by Davies *et al*. (2002), when intentions are poorly formed, the mediating role of intentions is reduced and attitudes have a direct effect on behaviour. Poor intention, as suggested by Johnson and Boynton (2009), is related to the lag time between measuring the intention and performing the behaviour. Therefore, as time lag between intention and behaviour increases at the one year measurement point, the relation of intention to behaviour is actually smaller than the relation of attitude to behaviour. This issue affects both the main direct and indirect effects of attitudes and complexity behaviour.

In addition, Davies *et al*. (2002) argue that the extent to which attitude guides behaviour depends on the manner of its formation. Therefore, attitude–behaviour consistency is higher when the preceding sequence has been behaviour-to-attitude-to-behaviour, rather than simply attitude-to-behaviour. Thus, they suggested that attitude-behaviour consistency is higher when the preceding sequence has been behaviour-to-attitude-to-behaviour. This appears to be the case for agricultural climate information use. In other words, farmers' attitude formed directly from the experience of the past behaviour being measured (e.g., climate information use in farming decisions of past seasons). This is more likely to be predictive than if the attitudes were formed through indirect experience and subjective evaluation.

Results also reveal that behaviour is poorly mediated by intention, but attitude toward agricultural climate information use is the immediate determinant of the action. Elaborating the poor intention-behaviour correlation is clearly explained by a systematic intervention of different forces that takes place between intention and behaviour. According to Wong and Sheth (1985), the unexpected situational factors surrounding the specific act of behaviour, absence of facilitating conditions, personal differences (absence of private self-consciousness and low self-monitoring ability to manage situational cues to guide one's behaviour, and person's vested interests), and the absence of past opportunities to directly experience or contact with the behaviour contribute to the explanation of intention-behaviour discrepancy.

The results (see Figure 2) show that the agricultural climate information use can be explained with the modified TPB. The explained variance in intentions is about 23%. The model also explains around 44 % of the variation in the respondents' adoption behaviour.

CONCLUSION

Advances in the ability to predict climate information months in advance suggest opportunity to improve agricultural climatic risk management, but only if particular conditions are in place. This paper outlined factors affecting climate information use in farming decisions of

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Fars Province wheat growers from farmers' viewpoint. The purpose of this paper was two-fold: on one hand, it examined factors affecting climate information use; on the other hand, it sought to provide the use and efficacy of the TPB in this domain. Results suggest that this framework is an effective tool for the study of climate information use. Results show that farmers' attitude towards the practice of climate information is dominant determinant of the behaviour. In the prediction of intention, attitude also provided a high explanatory value. The study also suggests that the attitudinal belief had a significant and direct effect on farmers to actively bring climate information solutions into their farm practices. As agricultural climate information use correlates highly with attitude toward this information, promotion of the behaviour should begin by educating farmers about climate information, its related issues, and how it affects local agricultural production. Although these efforts take a lot of time and money, training programs enable farmers to acquire necessary skills to promote application of climate information.

Perceived behavioural control also provided a significant contribution in the prediction of intention and the behaviour. The inverse significant coefficients for these two concepts on the prediction of both behaviour and intention indicate that farmers believe they perceive the presence of some inhibiting factors or the absence of some necessary resources. Also, the perception of inadequate volitional control over performance of the behaviour contributes to significant coefficient for perceived behavioural control on the prediction of climate information use. As some of these behavioural control factors are internal to individuals and could be modified with training and experience, comprehensive efforts to promote level of awareness of user community could help remove some of these impediments. Active participation in training programs and allocation of specific budget to equip regions with related equipment will be an important starting point to help farmers to actively uptake of climate information and improve attainment of agricultural development objectives.

However, further research is needed to explore and elicit farmers' perceptions regarding factors underlying farmers' attitude towards climate information more deeply in order to prioritize information needs. Care must be taken in such studies to collect information on the nature of factors influencing the way farmers would apply the climate information. It is recommended to triangulate the results of such studies by including climate information producers and extension agents' opinions on how farmers' decision process of climate information use are affected by different factors.

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بکارگیری اطلاعات اقلیمی کشاورزی: کاربرد نظریه رفتار برنامه‌ریزی شده

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چکیده

علی رغم تلاش‌های قابل توجهی که در زمینه توسعه اطلاعات اقلیمی و نمایش منافع بالقوه این اطلاعات برای کشاورزان صورت پذیرفته است، بکارگیری اطلاعات اقلیمی در تصمیم‌گیری‌های زراعی کشاورزان به طور محسوس تغییری نکرده است. این پژوهش که با روش توصیفی و با استفاده از فن پیمایش به انجام رسید، بر مبنای نظریه "رفتار برنامه‌ریزی شده"، رفتار بکارگیری اطلاعات اقلیمی کشاورزی را مورد مطالعه قرار داد. گردآوری داده‌ها با استفاده از پرسشنامه صورت پذیرفت. گندم‌کاران استان فارس به عنوان جامعه آماری انتخاب شده که از بین آنها تعداد ۳۱۴ نفر با استفاده از روش نمونه‌گیری "طبقه‌ای چندمرحله‌ای" انتخاب گردیدند. داده‌ها و فرضیات پژوهش با استفاده از مدل معادلات ساختاری (SEM) از طریق نسخه هفتم نرم‌افزار آماری اموس (AMOS) مورد آزمون قرار گرفت. یافته‌های پژوهش نشان داد که نگرش به طور مثبتی با رفتار بکارگیری اطلاعات اقلیمی کشاورزان در تصمیم‌گیری‌های زراعی مرتبط است. از این‌رو، با بهبود نگرش (ابزاری و احساسی) نسبت به بکارگیری اطلاعات اقلیمی در تصمیم‌گیری‌های زراعی، نیت عملی برای بروز رفتار ارتقاء می‌یابد. آماره‌های برازش مدل و فی مربع، حاکی از برازش مناسب مدل تعدیل شده نظریه رفتار برنامه‌ریزی شده بودند. به عبارت دیگر، برقراری پیوند علّی بین انگیزه و رفتار بکارگیری اطلاعات اقلیمی کشاورزی برازش داده‌ها را به‌طور قابل قبولی بهبود بخشیده و شیوه مناسبی برای سنجش سطوح بکارگیری اطلاعات اقلیمی در تصمیم‌گیری‌های زراعی و انجام پژوهش‌های آتی خواهد بود.

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