Appraising Some Iranian Maize Growers' Ecological Behavior: Application of Path Analysis

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ABSTRACT

Understanding people's ecological behaviors and the impacts of human activities on natural environment is one of the most important concepts in ecological psychology research. The purpose of this study was to investigate causal relationship between factors and maize growers' ecological behavior concerning the application of external inputs such as water, fertilizers, chemical pesticides, and machineries based on the Comprehensive Action Determination model applied to the agricultural sector in Iran, for the first time. The ecological behavior in agriculture means cultivation with proper methods for conservation of soil, water, and other resources. Population of this study was all maize growers in Shiraz County (491 farmers). Through stratified random sampling method, 220 maize growers were selected. Results indicate that situational influences, normative processes, intentional processes, and habitual processes are effective factors on maize growers' ecological behavior. Based on the results, some recommendations are presented.

Keywords: Comprehensive action determination model, Ecological agriculture, Ecological behavior measurement index, Nature protection.

INTRODUCTION

Although the negative effects of human activities on environment have remarkably emerged during the last century, there is overwhelming evidence that this rate has created unprecedented ecological pollutions (Milfont, 2009). For instance, several researches have confirmed that ecosystem has been changed faster and more extensively over the last 50 years compared to any equivalent period of time in history (Millennium Ecosystem Assessment, 2005).

The negative outcomes such as global warming, the disappearance of the ozone layer, large-scale exploitation of natural resources like fossil fuels, water pollution by nitrogen and phosphorus, and accelerated soil erosion by wind or water can affect humankind's future existence all around the world (Magdoff, 2003). Therefore, the human impact on the natural environment and, thus, people's ecological behavior are matters of public concern all over the world (Kaiser and Wilson, 2000).

In dealing with the control or reduction of the negative effect of ecological pollutants, the concept of "Ecological behavior" has been developed and used by ecologists during recent years. Ecological behavior was defined by Axelrod and Lehman (1993) as "actions which contribute towards environmental preservation and/or conservation". A significant ecological behavior was defined by Stem (2000) as "The range of human actions or activities, all shaped by the intention to protect the environment or reducing its deterioration, besides the impact on the environment itself".

On agricultural aspect, people need to learn how to design farms and select farming system and landscapes to take advantage of inherent strengths of natural systems, using the

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minimum amount of external interventions - unwanted side effects- of conventional agriculture. In fact, they would like agricultural ecosystems to demonstrate characteristics of strong ecosystems-efficiency, diversity, self-sufficiency, self-regulation, and resilience (Magdoff, 2007). This system is ecological agriculture, which provides the ability of communities to feed themselves and ensures a future of healthy farming and healthy food to all people (Reyes, 2009). "Preliminary results from ecological agricultural projects include:(1) higher productivity and commodity output with less cost; (2) higher stability of the farm system during disasters; (3) more concern with the environment and ecosystem; (4) harmony among farmers and agricultural administrators; and (5) improved rural landscapes (Han,1989; Shi, 2002).

Because of behavioral consequences such as levels of pollution, resource savings and energy quantities, rather than human behavior, should be the prime targets in the environmental domain. Therefore, common behavior measurement approaches do not make systematic use of behavior difficulties in assessing a person's ecological behavior. They fail to acknowledge situational influences on ecological behaviors (Kaiser et al., 2003).

Understanding, explaining, and changing farmers' behavior are the main objectives of agricultural extension in general. One goal of agricultural extension is to understand what determines people's actions with regard to ecologically relevant domains. A number of different approaches have been proposed throughout the field's history. Many of them could be categorized under the generic term "action models" or "action determination models" (Klockner and Blobaum, 2010).

Also, measurement of ecological behavior across different domains has been troublesome. Its problems stem from the following two features of ecological behavior: (a) Some ecological behaviors are more difficult to carry out than others, and (b) ecological behavior is susceptible to myriad influences. Measurement of specific ecological behaviors is also problematic in that the specific behaviors are susceptible to a wide range of influences. As a consequence, people would seem to be inconsistent in their ecological behavior: what they do one day, they may not do on another (Kaiser, 1998).

Frajy and Martinez (2006) revealed that personality is a multifaceted concept, which is positively related to ecological behavior. Intention determined 51 to 52% of people's ecological behavior, which supports the claim of a strong attitude-behavior relation (Kaiser and Gutscher, 2003).

Gonzalez Lopez and Cuervo-Arango (2008) in their study focused on relationships among values, beliefs, norms, and ecological behavior and showed the ecological beliefs effect on ecological behavior. Environmental and altruistic values were shown to be related to moral obligation and a basic variable to understand behavior. Personal norm mediated the effects of values and environmental control on ecological behavior.

Many studies consider factors influencing ecological behavior and Comprehensive Action Determination Model (CADM) is one of them. The purpose of this study was to investigate causal relationship between factors and maize growers' ecological behavior concerning the application of external inputs such as water, fertilizers, chemical pesticides, and machineries based on CADM.

There are many action models like the Theory of Reasoned Action (Ajzen and Fishbin, 1977), Theory of Planned Behavior (Ajzen, 1991), Value- Belief- Norm Theory (Stern *et al*., 1999) and the Norm-activation Model (Schwartz and Howard, 1981), but none of them adequately represents the multi-determination of ecological behavior on its own and it seems that the Comprehensive Action Determination Model (CADM) (Klockner and Blobaum, 2010) can determine the ecological behavior in the best manner (Figure1).

"The first important assumption is that individual behavior is directly determined by influences from three possible sources: intentional, situational, and habitual" (Klöckner *et al*., 2003). The CADM model of ecological behavior that incorporates

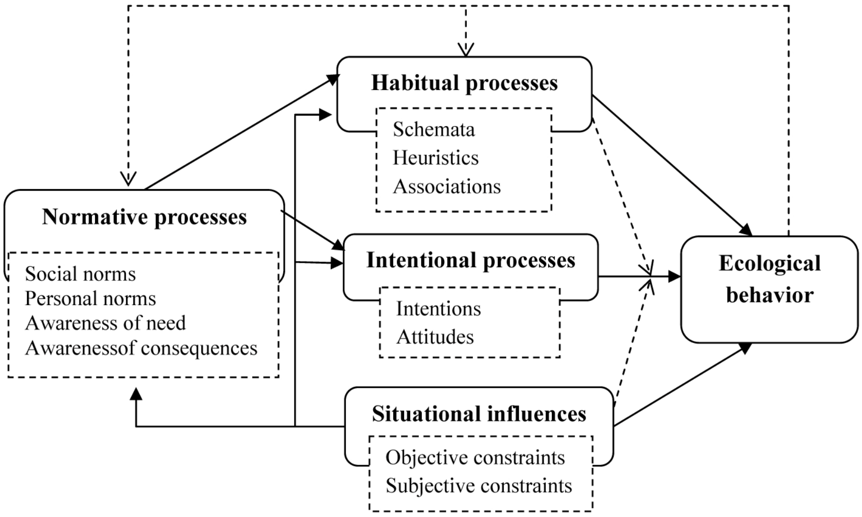

Figure 1. General sketch of the comprehensive action determination model (Klockner and Blobaum, 2010).

intentional, normative, situational and habitual influences on environmentally friendly behavior shows that the influence of personal norms on behavior is likely to be mediated by intentions (Klöckner and Blobaum, 2010).

There is still the possibility to deny responsibility and deactivate a personal norm, which would change their impact on intentions, but usually not the personal norm itself. This means that personal norms themselves are considered rather stable, what may vary between situations is their impact on intentions. Habitual and situational processes interfere with intentional processes and moderate the impact of intentions on behavior (Ajzen and Fishbein, 2005; Klockner and Blobaum, 2010).

Habitual processes are response dispositions that are activated automatically by the context cues that co-occurred with responses during past performance (Neal *et al*., 2006).Situational influences impact normative and intentional processes. In this study situational influences mean those situational variables which can control the maize growers' behavior like individual characteristics, location.

situation and objective constraints. Also, *ecological behavior* means maize growers' behavior, in consumption of inputs (water, fertilizers, chemical pesticides, and machineries) in order to make their behaviors compatible with ecological farming rules. *Social norms* mean measuring the range of the others' attitudes and actions importance on maize growers' cultivation behavior or knowing how maize growers' cultivation behavior patterns are affected by the others. *Personal norms* mean how much the maize grower's cultivation behavior derives from their values and beliefs. *Awareness of need* means assessing maize growers' level of awareness toward their farm actual needs. This variable is obtained from difference of maize growers' paradigm and experts' standards. *Awareness of consequences* means measuring the level of maize growers' awareness of the consequences of using more, not using, or using less input on the farm. *Schemata* means asking maize growers what is the correct usage of each input, if they have no limitation toward how to use the inputs. *Heuristics*_means how maize growers assess the inputs used to grow their crop. For example, they may say that using more inputs would lead to more production. *Association* means measuring the maize growers' level of participation in social groups and training classes. *Intention* reflects maize growers' decision in using inputs according to their situations and time. *Attitude* means maize growers' belief, which derives from their knowledge, it is general, and its result is predictable. *Objective constraint* means having or lacking access to equipment like fertilizer, machinery, and water. *Subjective constraints* mean farmers' subjective Lows which control his/her decisions and behaviors.

MATERIALS AND METHODS

This study was descriptive-correlative method and it was conducted by survey method. It was done in Shiraz County, in Fars Province (Figure 2).

Fars province is located in South- East of Iran. It has an important role in agricultural production in the country. Its major products include cereals, citrus fruits, dates, sugar beets, and cotton. Fars long-term average rainfall is about 290 mm. In recent years, during climate conditions, it have decreased, perceptibly and reached to about 274 mm in the farming year of 2012-13 (Fars Meteorology Department, 2013). Therefore, it seems that maize production is not suitable in this region because it has the Semiarid climate with many tensions like drought and the water resources are confronted to crisis in spite that maize is hydrophilic plant. But, maize is the second important crop in this county after wheat, and Fars has the first rank in maize production in Iran. Fars province produces about 25 percent of Iran maize production. Shiraz County is the center of Fars and most of maize crop is cultivated over there. Shiraz has a temperate climate with regular seasons. Therefore, maize growers cannot stop its production. Indeed, they should know all the correct rules about ecological agriculture and their behavior should be ecological in use of all inputs, especially water. Ecological agriculture means using minimum inputs with maximum management to have good productions and healthy ecology (Magdoff, 2007).

The population of this study consisted of all maize growers in Shiraz County (491 farmers). Sample size was 220 maize growers, who were selected through stratified random sampling method. Data collection instrument was questionnaire.

Pilot Test

Face validity of questionnaire was obtained through a panel of experts and reliability was obtained through pilot testing

Figure 2. Location of the study area.

30 farmers out of the studied sample by using Cronbach alpha test. Alpha coefficients are presented in Table 1 for each variable.

Analysis Method

Data were analyzed using $SPSS_{win18}$. Path analysis was used to examine the relationships among the variables.

RESULTS AND DISCUSSION

The socio-demographic characteristics distribution of the respondents showed that all the 220 maize growers were men and their age ranged between 26 to 68 years. The mean of respondents' age was 40.70 years. The range of annual income was 1,000 to 2,500 US Dollars. About 83 percent of the total respondents had annual income lower than 1,945 dollars. The mean of their experience in agriculture was 21.41 years. About 86 percent of the respondents depended on agricultural business as their main job. All maize growers used pumps to supply water and the mean of their well depth was about 140 m.

Ecological Behavior

The special index was worked out by authors as there was no index to measure or compare the ecological behavior. This index was worked out during three steps as follows:

Steps of Index Making

Consultation with maize field experts for preparing the index: Maize field experts helped to make a questionnaire about maize cultivation. In the questionnaire, some questions asked about maize seed, manner of seedbed preparation, weed and pest control, method and time of irrigation, and all standards during an ecological maize production method. They knew about all maize needs and had enough experience with its inputs needs. In the questionnaire or the index, a five point Likert-type response scale (from "one to five" or "never to always", and similar scales) was used for measurement.

Validation of the index by a panel of related specialists: A panel of related specialists validated the first draft of the questionnaire and their comments were considered by making some appropriate changes in the index as face validity.

Testing the reliability of the extracted index in the field by a sample of maize growers: The questionnaire reliability was obtained through conducting a pilot study with 30 maize growers out of the research population. The Alpha coefficient obtained for ecological behavior by using the index was 0.72 (Table 1) and, therefore, the index reliability was estimated. The index and its items are presented in Table 2.

Findings according to index revealed that the maize growers' mean ecological behavior was 105.7 (range was 79 to 123) and most of their grades were lower than the mean of the index. Therefore, if this trend continues, it will have bad ecological

Table1. Reliability coefficients.

Variables	Items	Alpha coefficient
Social norms	12	0.96
Personal norms	9	0.78
Associations	11	0.70
Heuristics	9	0.71
Objective constraints	13	0.89
Ecological behavior	37	0.72

Table2. The ecological behavior measurement index.[a]

N	Item	Range	Mean
1	Using subsoiler equipment	1-5	1.42
2	Returning some parts of crop stubble to the soil	1-5	3.36
3	Application for collecting some parts of crop stubbles	1-5	2.53
4	Manner of seed bed preparation	1-5	1.25
5	Using crop rotation	1-5	2.67
6	Kind of cropping pattern	1-5	1.09
7	Cereal/leguminous cropping pattern	1-5	2.09
8	Testing the farm soil in related laboratories	1-5	2.21
9	Compatibility between seed variety and farm condition	1-5	2.90
10	Use of aseptic seeds	1-5	3.59
11	Using no-tillage seeders machines	1-5	1.49
12	Method of measuring soil fertility	1-5	3.50
13	Use of manures	1-5	2
14	Use of micro fertilizers	1-5	3.86
15	Application rate of phosphorus fertilizers	1-5	4.1
16	Application rate of nitrogen fertilizers	1-5	3.39
`17	Applying fertilizer with irrigation water (fertigation)	1-5	4.42
18	Irrigation method	1-5	1.14
19	Length of irrigation plots/canals in the farm	1-5	4.3
20	Distance between plots/canals in the farm	1-5	3.9
21	Evaluation of farm wells water quality	1-5	1
22	Use of efficient irrigation methods	1-5	1
23	Time gap between seeding and the first irrigation	1-5	3.73
24	Irrigation intervals between planting and embryo emerge in the farm	1-5	4.35
25	Irrigation intervals between seedling emergence and flowering stage	1-5	3.97
26	Irrigation intervals between flowering and crop maturity	1-5	4.01
27	Duration between the last irrigation and harvesting	1-5	3.89
28	Weeds control on the farm	1-5	4.16
29	Method of weeds control on the farm	1-5	2.29
30	Duration of weeds control on the farm	1-5	3.99
31	Method of weeds control on the farm	1-5	1.95
32	Methods of pests control	1-5	2.12
33	Methods of using pesticides	1-5	3.59
34	Application rate of pesticides	1-5	2.47
35	Stages of using pesticides	1-5	2.6
36	Stages of using herbicides	1-5	1.11
37	Methods of determining harvesting time	1-5	1

[a] Respondent= 220 maize growers.

consequences. Most of them didn't use subsoiler at all and used fertilizer and water more than standard norms, which are incompatible with appropriate ecological behavior.

Amos20 was used to analyze the data in causal model, and the maximum likelihood was applied method to evaluate the measurement model and the structure model, to check whether the path coefficients of the considered variables were significant, and validate the hypothesis. The study employed the following six criteria to evaluate fitness of the model: Goodness of fit measures indicate how well the model fits the data and the paths in the analysis. Non-significant Chi-square statistics indicate a good fit; however, Chi-square statistics are sensitive to sample size, thus other goodness-of-fit methods are also often used. Three goodness-of-fit indices, namely, normed fit index (NFI), relative fit index (RFI), and comparative fit index (CFI), as shown in Table 3, indicated a good fit with values greater than 0.90 (Medsker *et al*., 1994, Hair *et al.*, 2009).

The variables correlation are presented in Table 4. Most of the correlation coefficients were significant.

Path analysis was used to estimate simultaneously the processes of influence of some variables on others, and the direct and indirect effects of all variables on ecological behavior (Figure 3). According to the CADM model, situational influences, intentional processes, and habitual processes had direct effect on ecological behavior, while normative processes had an indirect effect on ecological behavior through the habitual and intentional processes as mediator variables. Personal norms had a significant, direct and positive effect on maize growers' ecological behavior ($P< 0.01$, $\beta= 0.67$). This means that a maize grower who got the higher grade in personal norms, had a better ecological behavior.

Social norms exert a significant, direct, and positive effect on maize growers' ecological behavior ($P< 0.01$, $\beta= 0.53$). Awareness of consequences had a significant, direct, and positive effect on maize growers' ecological behavior ($P< 0.05$, $\beta= 0.12$). Kaiser *et al.* (2003) also have shown that awareness of consequences had a direct effect on ecological behavior. All these three factors have been considered under the title of normative processes, which had an indirect effect on ecological behavior through the moderate variables (intentional and habitual processes).

Although Klockner and Blobaum (2010) showed in their model (CADM) that normative processes did not have direct effect on ecological behavior, strong, direct, and positive effect of personal and social norms indicate that normative processes have direct effect on ecological behavior. Thus, a maize grower who got a high grade in those norms had better ecological behavior. Some other scholars (Kaiser and Gutscher, 2003; Klockner and Matthies , 2009) confirm it in their studies.

Table 3. Goodness of fit measures.

	Recommended values	Proposed model
Chi-square	*P*> 0.05	Chi-square= 0.2 Degrees of freedom= 1 Adjusted chi-square= 1.61 Probability level= 0.649
Normed Fit Index (NFI)	> 0.90	1
Relative Fit Index (RFI)	> 0.90	0.99
Comparative Fit Index (CFI)	> 0.90	1
Root Mean Square Residual (RMSEA)	< 0.10	0.000

Table 4. Correlation matrix of variables included in the path model.

	1	2	3	4	5	6	7	8	9
1. Ecobehavior	1								
2. Awareness of consequences	0.18**	1							
3. Attitude	0.55**	0.33**	1						
4. Intention	0.39**	0.32**	0.45**	1					
5.Objective constraints	0.17**	0.05	0.02	0.16*	1				
6. Heuristic	-0.50**	-0.37**	-0.67**	-.056**	0.042	1			
7. Age	-0.44**	-0.18**	-0.26**	-0.23**	-.011	0.14*	1		
8.Social norms	-0.12	-0.10	-0.07	-0.13	-0.34**	0.28**	-0.24**	1	
9.Personal norms	0.21**	0.15*	0.14*	0.17**	0.35**	-0.33**	0.21**	-0.95**	1

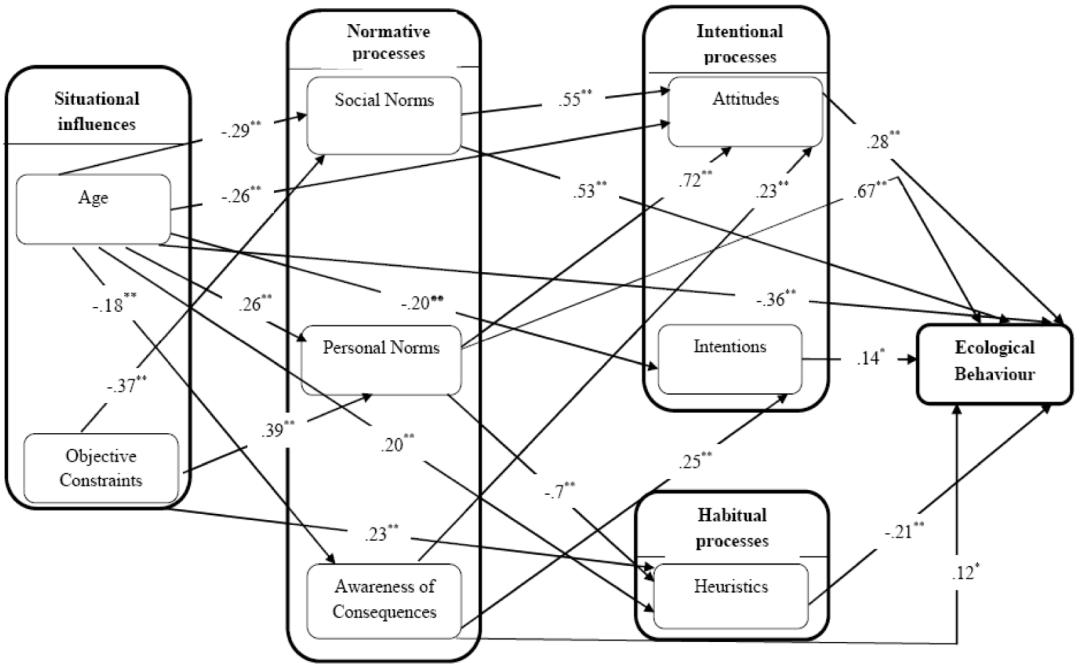

Figure 3. Path analytic model of the factors influencing ecological behavior.

Attitudes had a significant, direct, and positive effect on maize growers' ecological behavior (P< 0.001, β= 0.28). It showed that each maize grower who had better attitude toward ecosystem could have better ecological behavior. The direct and positive effect of attitudes on ecological behavior confirms that appropriateness of ecological attitude can be a good predictor of ecological behavior. Other studies (Carrus *et al.*, 2008; Yan and Chun_you, 2006; Stevenson, 2009; Milfont, 2009; Gonzalez Lopez and Cuervo-Arango, 2008; Malek-Saeidi *et al.,* 2012; Sharifzadeh *et al.*, 2012) confirm that attitude is the effective factor toward ecological behavior.

Intentions had a significant, direct and positive effect on ecological behavior (p<.01, β=.14). Both attitudes and intentions are considered under the title of intentional processes. Results show the significant direct and positive effect of intentional processes on ecological behavior and some previous studies (Carrus *et al.*, 2008; Klockner and Blobaum, 2010) confirm it.

Maize growers' age had a significant, direct, and negative influence on their ecological behavior (P< 0.001, β= -0.36). It means that younger maize growers had better ecological behavior. Age is a sub-group of situational influences. Significant direct and indirect effect of situational influences (through intentional processes) on ecological behavior showed that it could be the effective predictor for ecological behavior and it was emphasized in many previous studies (Hartig *et al.*, 2007; Carrus *et al.*, 2009; Yue and Bao Jingling, 2009; Milfont, 2009; Klockner and Matthies , 2009; Stevenson, 2009; Morris, 2009; Klockner and Blobaum , 2010; Oerker and Bogner, 2010; Davis, 2011; Tobler *et al.*, 2011).

Heuristic from habitual processes, which was guided by the idea that intuitive judgments occupy a position,had a significant, direct, and negative influence on ecological behavior (P< 0.01, β= -0.21). It means that if maize growers' judgment was good toward using more inputs, they would not have good ecological behavior. The significant, direct, and negative effect of heuristic from habitual processes shows that habitual processes are the affective factor in ecological behavior. Also, Klockner and Matthies (2009) and Klockner and Blobaum (2010) confirm that in their studies.

All these direct, indirect, and total effects are shown in Table 5.

CONCLUSIONS

Findings from the study of maize growers' ecological behavior, based on the index used in this study, showed the fact that maize growers ecological behavior is not satisfactory. Therefore, if trends of farm maize production continue as usual, there will be irreparable ecological consequences on the environment.

Overall, situational influences, intentional, habitual and normative processes were the direct affective factors that can affect on maize growers' ecological behavior. Also, normative processes and situational influences had indirect effects through intentional and habitual processes. Therefore, the younger maize growers, who had higher awareness of consequences and a positive attitude toward ecological behavior and less objective constraints, would have better ecological behavior. Based on the findings, the following recommendations are presented:

Whereas CADM is an applicable model that determine effective factors toward ecological behavior appropriately, and it has been used in agriculture sector of Iran for the first time, it can be applicable in the other sector and experts can localized it in Iran and use it in different sectors and different population.

An index was made and validated toward measuring maize growers' ecological behavior in this study. It can be applicable for other research related to maize growers' ecological behavior measurement.

Extension agents should recognize the roots and causes of maize growers' ecological behavior and encourage them to increase their good point and decreased their bad points in order to have better ecological behavior.

In spite of its theoretical basis, the proposed model tries just to explore, but not confirm anything. Regarding the limitations of this study, it should be noted that although it was carried out with a sample taken from common population, the results obtained would need to be verified using another populations. measuring ecological behavior, by using survey method, has its own limitations. Using larger sample for future studies in order to acquire more validity toward ecological behavioral measurement is recommended.

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Table 5. Relationships between the variables.

Variables	Direct effects	Indirect effects	Total effects
Objective constraints	0.08	0.04	0.12
Age	-0.36	-0.07	-0.43
Awareness of consequences	0.12	-0.13	0.01
Personal norms	0.67	0.36	1.03
Social norms	0.53	0.22	0.75
Attitudes	0.28	-	0.28
Intentions	0.14	-	0.14
Heuristics	-0.21	-	-0.21

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ارزیابی رفتار اکولوژیک برخی ذرت کاران ایران: از طریق بکارگیری تحلیل مسیر

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چکیده

درک رفتار اکولوژیک افراد و تأثیر فعالیت‌های انسان بر محیط طبیعی یکی از مفاهیم تحقیقات روانشناسی اکولوژیک است. هدف این مطالعه ارزیابی رابطه بین سازه‌های علّی و رفتار اکولوژیک ذرت کاران درمورد مصرف نهاده‌هایی مثل آب، کود و سموم شیمیایی و ماشین‌آلات بر اساس مدل جامع تشخیص عمل بود که برای اولین بار در بخش کشاورزی و ایران استفاده شد. رفتار اکولوژیک در کشاورزی به معنی کشت با شیوه‌های مناسب حفاظت از خاک، آب و منابع می‌باشد. جمعیت این مطالعه کلیه ذرت کاران شهرستان شیراز (۴۹۱ نفر) بودند. از طریق نمونه‌گیری تصادفی طبقه‌بندی شده ۲۲۰ ذرت کار به عنوان نمونه انتخاب گردیدند. نتایج نشان داد که سازه‌های موقعیتی، فرآیندهای هنجاری، فرآیندهای عمدی و فرآیندهای عادتی از عوامل مؤثر بر رفتار اکولوژیک ذرت‌کاران می‌باشند. در نهایت با توجه به نتایج، پیشنهادهایی ارائه گردید.