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RESEARCH ARTICLE

Modeling farmers' responsible environmental attitude and behaviour: a case from Iran

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Abstract

There is an increasing concern over the environmental degradation caused by agricultural activities especially in developing countries which mostly linked to farmer's behavior. Thus, this study aimed to model the responsible attitude and behavior of Iranian farmers in respect to environment. The Theory of Planned Behavior (TPB) was used as a basis for identification of the main determinants of the farmers' responsible environmental behavior. A survey of 400 farmers in the Hamedan Province, selected through a multistage stratified random sampling method. Data was gathered using a questionnaire which its validity and reliability were confirmed by a panel of agricultural and environmental experts and calculated Cronbach's alpha ($0.65 \leq \alpha \leq 0.80$), respectively. Data were analyzed using structural equation modeling (SEM) to evaluate the strength of relationship between the constructs and test the overall model fit. Results of study showed that "using animal manure in the farms" was the most important behavior which farmers are responsibly doing to respect their environment but their least attention is given to "disposing cans and bottles after spraying." Also, the fitness indices of the model revealed that the TPB partially supported the farmers' responsible environmental behavior as perceived behavioral control and environmental attitude positively influenced the farmers' responsible environmental behavior but there was not observed any significant influence by subjective norm. Among the additional incorporated constructs, environmental awareness, ethical commitment, and environmental concern significantly had a positive influence on farmers' behavior by mediating role of the environmental attitude. The inclusion of new constructs in the TPB model was supported through improving the predictive power of the modified model in predicting farmers' responsible environmental behavior.

Keywords Responsible behavior · Sustainable agriculture · Environmental awareness · Farmers' attitude · Subjective norm · Perceived behavioral control

Introduction

There is a globally alarming concern for environmental degradation caused by agricultural practices (Sulemana and James Jr 2014). Many studies documented nature and extent of the environmental impacts of agriculture (Stoate et al. 2001; Glebe 2007; Hazell and Wood 2007; Westhoek et al. 2013). Although agriculture is the dominant source of livelihoods in developing countries (Van Pham and Smith 2014) but has been criticized for widespread environmental degradation (Moss 2007; Pretty 2007; Godfray et al. 2010), developing countries' agriculture is responsible for 74% out of 14% of global emissions represented by agriculture around the world (Smith et al. 2007). Among developing countries, dryland ecosystems and their agricultural production systems are of great significance since they globally occupy more than 3 billion ha and are home to 2.5 billion people (Haileslassie et al. 2016). Though many parts of dryland ecosystems like Iran are increasingly faced with natural resource scarcity, sustained overexploitation, and land degradation (Van Ginkel et al. 2013) and thus agricultural responsible environmental practices has become a major area of concern. To

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address these environmental impacts, agriculture in developing countries will need to change farmers' behavior towards irrigation water shortages, land scarcity, soil degradation, and biodiversity loss (Van Pham and Smith 2014).

The efforts are increasingly focused on responsible adoption practices by farmers to protect the environment (Mills et al. 2017; Mishra et al. 2018). Zeweld et al. (2017) believed that environmental friendly or sustainable practices are considered a win-win strategy for developing countries because of its potential to simultaneously improve food security and address environmental issues.

However, there is growing evidence that farmers' behavior in developed economies are becoming increasingly "conservation-oriented" (Burton and Wilson 2006), but in developing countries, they maintain traditional agricultural practices (Mwangi and Kariuki 2015) and behave irresponsibly towards the environment. The study on differences between farmers who maintain traditional agricultural practices and farmers who adopt environmental friendly practices revealed that farmers' environmental behaviors are related to some social, psychological, and environmental factors (Mishra et al. 2018).

Iran, a developing country with transitional agriculture, is a country where major parts of its area are arid and semi-arid (Fallah-Alipour et al. 2018). Many government expenditures are spent on agricultural development and improvement (Sharzeie and Majed 2014). But these achievements have been associated with many environmental problems and have various consequences such as soil erosion; biodiversity loss; land degradation; and pollution of water, soil, and air (Koocheki et al. 2014; Yaghoubi Farani et al. 2016). Most of the environmental threats and resource depletion are direct consequences of farmers' behavior. So altering the behavior could decrease environmental problems. Also, concerns regarding the depletion of natural resources have stimulated developing and implementing some policies aimed at changing farmers' behavior in terms of conserving environment but the success of these policies is depending on farmers' behavior through voluntary actions (Southworth 2009; Santangeli et al. 2015; Kolinjivadi et al. 2019). In this regard, understanding the effective factors on individuals' behavior would be the first step to adopt responsible environmental practices. Since, farmers' behaviors formed based on a complex process (Fornara et al. 2016), social factors can be exteremely helpful in underestanding and knowing farmers' behaviors in protecting the environemnt (Sovacool 2014).

Due to the geographical location of Iran in the earth, average rainfall is lower than the global rainfall average (Rezaei et al. 2018a). Also, Iran's agricultural system is heavily depend on irrigation (Nazari et al. 2018) as agriculture is responsible for over 90% of freshwater consumption (Samian et al. 2015). It means that farmers' behavior to conserve irrigation water should be more responsible. While evidences showed that average irrigation efficiency of Iranian farmers is less than 35%, only 5% of the farmed area is under pressured irrigation (Madani 2014) which is very low. Also, the crop pattern does not match the regional water availability conditions (Madani 2014). In addition, statistics show that soil erosion in Iran is high (Bijani et al. 2017) as some evidences reported that the extent of soil erosion in Iran is three times more than Asia's (Ghazani and Bijani 2016). One of the major reasons is the excessive consumption of fertilizers and chemical pesticides in agricultural sector as reports show that pesticides and chemical fertilizers (nearly 3 tons in each hectare) are used too much in Iran (Far and Rezaei-Moghaddam 2017). The overusing also lead to land degradation and environmental pollution (Mekonnen et al. 2016). This means that farmers' behavior in terms of soil conservation and chemical input use in Iran are not compatible to sustainability goals. Most of the conventional agricultural practices applied by farmers rooted in economical perspective thinking to reach maximized yield or minimal production cost (Adnan et al. 2019) not environmental ethics. Therefore, it can be said that farmers attitude towards environment can be effective on their responsible behavior. Environmental issues are mostly caused by human behavior (Oskamp 2000; Wang et al. 2018). However, changing farmers' behavior is an effective way to reduce environmental problems (Gifford and Nilsson 2014). To change farmers' behavior, understanding farmers' behavior regarding the adoption and use environmental practices is needed. There are popular and general theories about farmer's behavior and attitude developed by Fishbein and Ajzen (1975), the Theory of Reasoned Action (TRA) (Ajzen 1991) and the Theory of Planned Behavior (TPB) (Ajzen 1991), which represent a set of common factors influencing on farmers' behavior (Adnan et al. 2017). Also, there are some socio-psychological factors which are discussed and reported to influence farmers' behavior like farmers' awareness, ethical commitment, and environmental concern which have been less widely considered in studies. Burton (2004) believed that a large share of studies approach farmers' behavior merely from an attitudinal vantage point, without considering social or cultural factors or Howley et al. (2014) showed that there is a relationship between farmers' attitude and environmental concerns (Walder and Kantelhardt 2018).

The motivation behind this work is to focus on the responsible environmental practices adoption among the Iranian farmers because it helps them to conserve natural resources like soil, water, and energy for a long time and to ensure their own and community health through studying components involved in and influencing farmers' decisions to act responsibly against environment based on the generic framework of the TPB. In this regard, the responsible environmental practices in this study covered improving soil fertility or preventing soil erosion (Bijani et al. 2017), water conservation practices (Keshavarz and Karami 2016), and prevention of environmental pollution (Walder and Kantelhardt 2018).

Also, according to the TPB model, farmers' attitude towards environment, subjective norm, and perceived behavioral control are influencing the farmers' behavior which is going to be tested in this study. However, many searchers reported that the TPB is able to support farmers' environmental behaviors (Adnan et al. 2017; Wang et al. 2018). In addition, to improve predicting power of the TPB, by reviewing the previous studies, some additional constructs have been added which indirectly influence farmers' responsible behavior in respect to environment such as environmental awareness (Fu et al. 2018; Kite et al. 2018), ethical commitment (McCarthy et al. 2007), and environmental concern (Li et al. 2019).

Accordingly, this research aimed to model farmers' responsible environmental behavior based on the TPB through achieving the following objectives: (1) understanding the state of farmers' responsible environmental behavior; (2) analyzing the direct influence of perceived behavioral control, subjective norms, and environmental attitude on farmers' responsible environmental behavior; (3) investigating the indirect influence of ethical commitment, environmental concern, and awareness on the farmers' environmental behavior through mediating role of farmers' environmental attitude.

Literature review

Understanding farmer environmental behavior is complex (Mills et al. 2017). Hence, in order to figure out the environmental attitude and resulting behavior of farmers and to alter them, it is important to build on adequate and accurate behavioral models (Feola and Binder 2010). In recent years, many theories and models have been presented by different researchers and scholars (e.g., Ferns and Walls 2012; Zhang et al. 2015; Teng and Lu 2016; Yadav and Pathak 2016; Halder et al. 2016; Kiatkawsin and Han 2017) to studying people's attitude and behavior and identify the socio-psychological constructs and their antecedents with behavior. In this respect, one of the most popular frameworks is the Theory of Planned Behavior (TPB), which is being increasingly used in the broad range of fields, and more specifically, it has great contribution in the context of environmental behavior researches. Ajzen and Fishbein (1980) first developed Theory of Reasoned Action (TRA) and argued that individual's action depends directly on their intention. In this model, the intention is also generally influenced by individual attitudes and social norms. Ajzen (1991) further added the variable of perceived behavioral control to complete previous theory and developed the TPB model (Zhou et al. 2016). According to the TPB, people's behavior is a function of people's attitude towards the behavior, social norms, and perceived behavioral control (Ajzen 1991).

A literature review illustrates that the TPB has long been successfully applied to investigate a wide farmers' various behavior such as adoption of agricultural innovations (Adnan et al. 2017), understanding farmers' behavior regarding water conservation (Yazdanpanah et al. 2014), performing unsubsidized agro-environmental measures (van Dijk et al. 2016), applying sustainable practices (Menozzi et al. 2015; Zeweld et al. 2017), smallholder farmers' behavior about conservation agriculture (Lalani et al. 2016), farmers' environmental behavior for non-point source pollution control (Wang et al. 2018), engagement in on-farm food safety practices (Rezaei et al. 2018a), using pesticides (Bond et al. 2009), adaptation to climate change (Dang et al. 2014; Arunrat et al. 2017), and engagement in pro-environmental activities (Wauters et al. 2010; Meijer et al. 2015; van Dijk et al. 2016; Moradhaseli et al. 2017).

Lalani et al. (2016) stated that the TPB provides a valid model to explain farmers' adoption behavior of conservative agriculture practices. Their results illustrated that farmers' attitude and perceived behavioral control are the strongest predictors of farmers' behavior. Deng et al. (2016) found that the farmers' ecological conservation behavior was significantly affected by their intention, and their intention was influenced by attitude, the subjective norm, and perceived behavioral control. Wang et al. (2019) using the TPB model revealed that environmentally responsible behavior can be predicted by environmental attitudes, subjective norms, and perceived behavioral control. Meijer et al. (2015) also found that farmers with the high rate of adoption behavior had more positive attitude, subjective norms, and perceived behavioral control compared with farmers who had low rate of adoption.

Despite general usefulness of the TPB to identify and understand different behaviors of farmers, some of the studies have attempted to improve the predictive power of the TPB by including additional components such as social influence (Su et al. 2015), environmental concern (Bijani et al. 2017), environmental knowledge (McCook 2003), environmental awareness (Wang et al. 2015; Bob 2016; Mei et al. 2016), and external and economic factors (Adnan et al. 2017). However, adding more variables to this generic model should be logical and based on scientific sources. In this study, we focused on factors affecting attitude towards environment because it is believed that changing attitude towards environment conservation can lead to high adoption of environment-friendly practices among farmers (Baumgart-Getz et al. 2012). Hence, we tried to identify factors which can influence on responsible environmental behavior through changing attitude. Some studies reported that individual's environmental concern serves as a focal lens through which farmers form attitudes that impact their decisions (Thompson et al. 2015; Adnan et al. 2018). In other words, if the farmers have more concern towards the environment, they will have more attention towards adopting responsible environmental practices. According to Ajzen (1991), environmental concerns do not impact directly environmental

behavior; rather, it is indirectly impacting environmental behavior through other variables. Other studies also found that there is an indirect relationship between environmental concerns and environment-friendly behaviors (Klöckner 2013; Neo et al. 2017). Besides farmers' concern, their awareness about environmental importance and benefits help to make their positive attitudes towards environment and consequently influence on their responsible behavior (Kite et al. 2018). Robelia and Murphy (2012) found that environmental awareness was necessary and inadequate for environmental decision-making (Wang et al. 2018). Cheng and Wu (2015) concluded that higher levels of individual's environmental knowledge are associated with stronger environmental sensitivity which results in shaping positive attitude towards environment. In turn, attitude will influence on environmentally responsible behavior.

Another important factor shaping individuals' attitude and influencing their decisions and behaviors is ethical commitment (Sulemana and James Jr 2014). However, Cardoso and James Jr (2012) stated, "very little research exists examining the ethical frameworks of farmers and the extent to which ethical perspectives vary among farmers and affect the decisions they make." In addition, a shortcoming of the Theory of Planned Behavior is that it is based on an individualistic view of human behavior (Nigbur et al. 2010), and situational factors like ethical commitment are not embedded in the model (Sulemana and James Jr 2014). The authors therefore expanded the TPB by taking into account ethical commitment and find that it is positively and significantly correlated with attitude towards environment and engage in responsible environmental behavior. They also figure out that environmental concern and awareness positively and significantly influence on responsible environmental behavior through affecting environmental attitude (Fig. 1).

Research methodology

A survey questionnaire was developed to ask farmers about their demographic characteristics, farm characteristics and farming practices, attitudes towards environment, environmental concerns, environmental awareness, ethical commitment, subjective norms, perceived behavioral control, and responsible environmental behaviors. The validity and reliability of a questionnaire was confirmed through experts' panel opinions and calculating Cronbach's alpha ($0.65 \leq \alpha \leq 0.08$), respectively (Table 1).

The responsible environmental behavior of farmers was measured by 5-point Likert scales which are based on always done 5 and never done 1. The farmers' attitude towards environment was measured by using 5-point Likert scale items based on strongly agree 5 and strongly disagree 1. Moreover, the researchers have used 12 measurement indicators for measuring farmers' environmental awareness based on True/False/ I don't know responses. Farmers' environmental concerns were measured by 5-point Likert scales which are based on very much 5 and very low 1. In the following, ethical commitment, subjective norms, and perceived behavioral control were measured by 5-point Likert scales based on strongly agree 5 and strongly disagree 1.

The study population was all farmers of Bahar County, Hamedan Province, Iran ($N = 13542$). The 400 farmers were determined as a study sample by Cochran Formula and were selected through simple random sampling.

In order to analyze the data, a structural equation modeling (SEM) technique was used for estimating the causal relation applying a combination of statistical data and quantitative causal hypothesis. Researchers typically use two approaches to estimate structural equation models: covariance-based SEM (CBSEM) approach which is the more widely applied and variance-based SEM (VBSEM) or PLS (Sarstedt et al. 2016). Both complementary methods share the same basic aim but differ fundamentally in statistical conceptions and particularly in the way they treat measurement models of constructs (Jöreskog and Wold 1982). In this study, the covariance-based SEM (CBSEM) approach was used because the sample size was more than 250. The BSEM's parameter bias is small for a sample size of 250 and quickly diminishes for higher sample sizes (Sarstedt et al. 2016). Another reason is that our data's nature was common factor model because fit

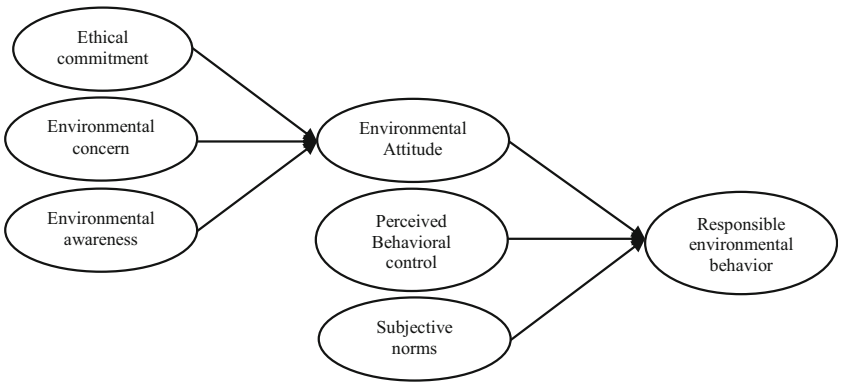

Fig. 1 Theoretical research framework

Table 1 The Cronbach alphas of the variables and sample items

No.	Variables	Number of items	α
1	Environmental ethical commitment	7	0.75
2	Perceived behavioral control	6	0.75
3	Subjective norms	6	0.65
4	Environmental concern	10	0.80
5	Environmental attitude	13	0.74
6	Responsible environmental behavior	18	0.80

measures such as the root mean square error of approximation (RMSEA) meets the required level of 0.08 and smaller (the study RMSEA = 0.052) (Fig. 2).

Research area

Bahar County, as one of the major counties of Hamadan Province (Khaniki et al. 2008), is located at the west of Hamedan. The geographical position of Bahar County is 34° 54′ to 34° 55′ north latitude, and 48° 27′ to 48° 25′ east longitude. Bahar County covers an area of 1339 km^2 in Hamedan Province (Rahmani et al. 2013). It has got a semiarid climate with a mean annual temperature of 11.3 °C and mean annual precipitation of 324.5 mm. The regional mean elevation is 2038 m above mean sea level (Rezaei et al. 2018b). Maximum rainfall occurs in winter and spring. Also, the area moisture regime is xeric and temperature regime is mesic (Asadi et al. 2007). The major source of water supply for the agricultural sectors in the region is groundwater, which is also used for drinking and domestic and industrial activities. As a result, the groundwater level has continuously reduced in recent decades (Balali et al. 2011). Bahar County is one of the most important poles of producing agricultural crops in Hamedan Province. Potatoes, barley, oilseeds, and wheat are the main products cultivated in Bahar County. Due to climatic conditions, a large area of the entire arable lands of the county are devoted to potato production. In fact, Bahar City has the first place for potato production in Iran, so the average potato yield in this county is more than 40 tons per ha (Naderi Mahei et al. 2015) (Fig. 3).

Results and discussion

Demographic Characteristics

The analyses of farmers' demographic characteristics showed that the majority of farmers were men (97% male and 3% female). The farmers' age average was 41.49 years (S.D. = 1.18) and the average land under cultivation of farmers was 8.46 ha. Education level of farmers showed that the majority of them (40%) had diploma degree. About 5.8% were illiterate and 13.6% had higher education level. From all, about 19% of farmers had been participated in extension and training courses related to environmental protection. This means that the participation rate of farmers in an educational program related to environment are not satisfactory.

The state of responsible environmental behavior

The eighteen environmental practices were used to measure the farmers' responsible environmental behavior. According to coefficient of variation (C.V.) scores, "using animal manure" is the most important agricultural practice which

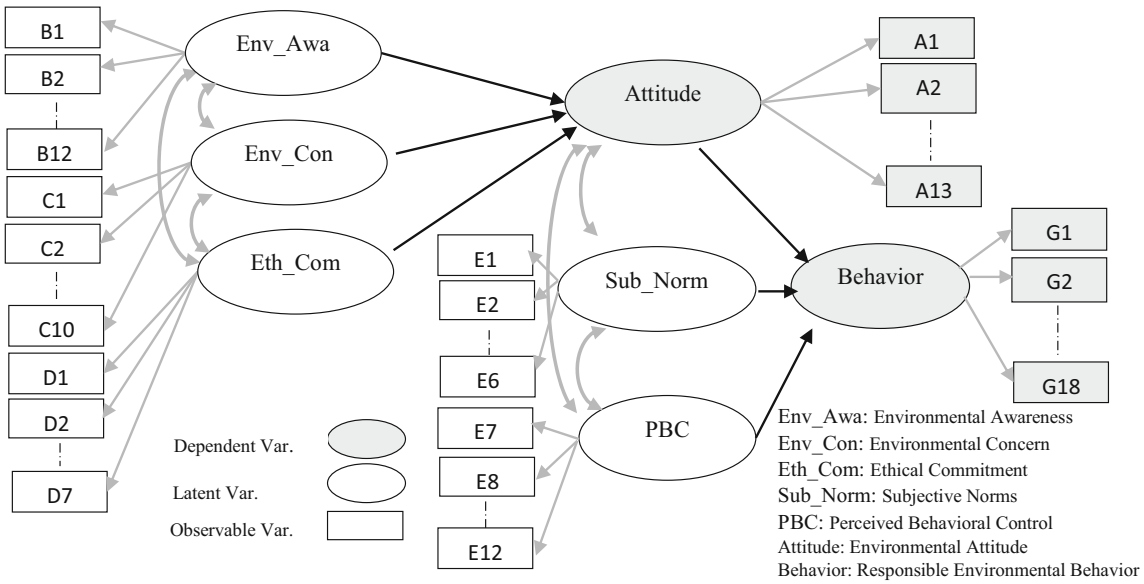

Fig. 2 LISREL path diagram of the study model

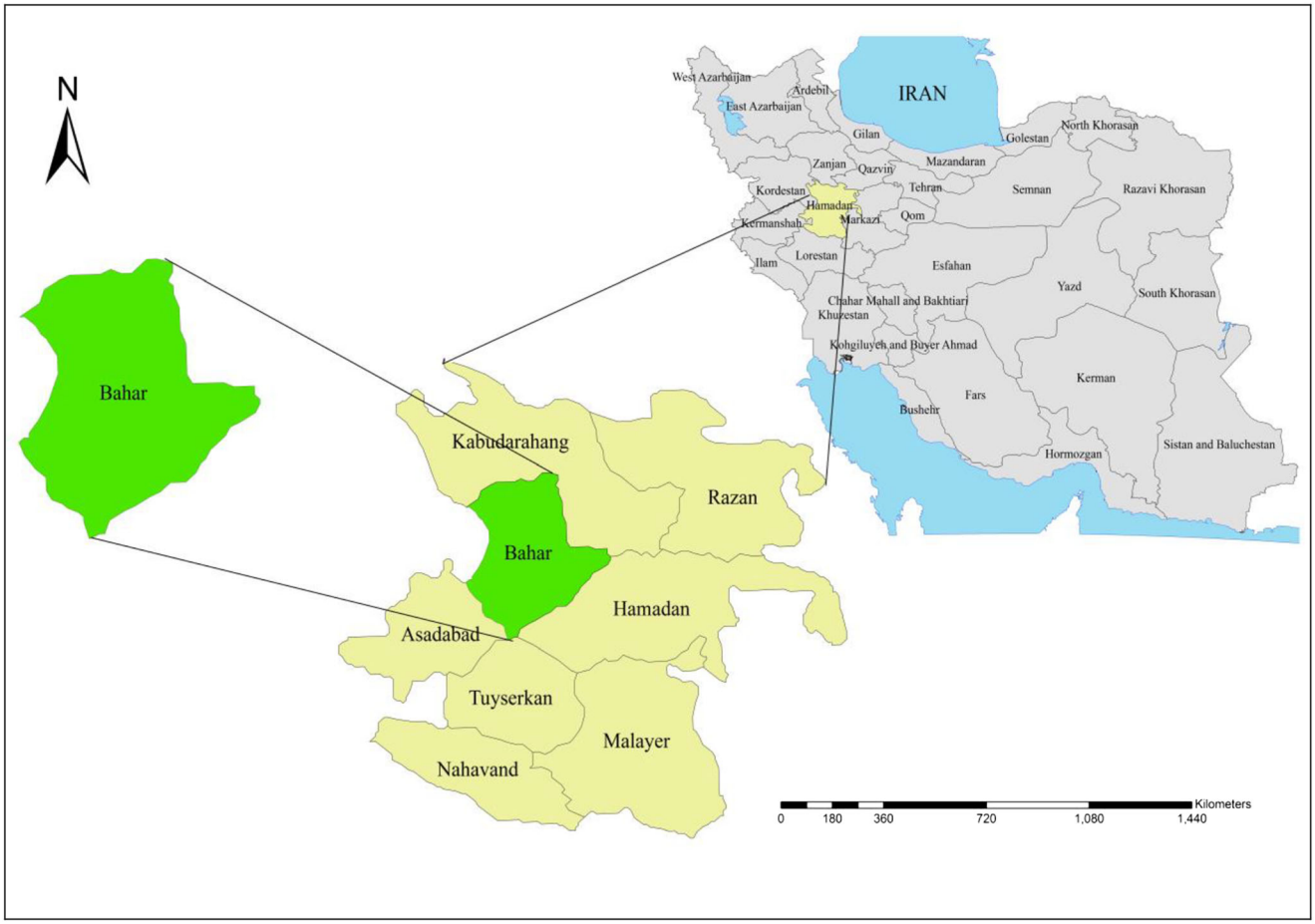

Fig. 3 Location of research area

farmers adopted in respect to environment. "Irrigating farm according to crop water need" was identified as the second important practices adopted by farmers. In turn, farmers preferred to cultivate their lands according to water quantity they have. It is noted that some practices like "hygienic burying of chemical bottles after use," "not-carried productions to market immediately after spraying," and "using biologic methods for pest control" were not adopted properly by farmers. It may be due to lack of farmers' awareness about harmful effects of chemical inputs on both their and community health (Table 2).

Measurement model estimation

In order to test validity, reliability, and fit of the model, the measurement model was estimated through the implementation of confirmatory factor analysis. According to the results, all of the standardized loadings of observed variables were significant (Fig. 5). Also, most of *AVE* calculated for all latent variables measured was less than 0.7 (Table 3). Hair et al. (2010) suggested that the value of *AVE* for each latent variable needs to be larger than 0.70. According to Fornell and Larcker (1981), if AVE is less than 0.5, but composite reliability is higher than 0.6, the convergent validity of the construct is still adequate (Huang et al. 2013).

Structural model estimation

Goodness of fit measures indicate how well the model fits the data and the paths in the analysis. Linear structural relations (LISREL) provided model fit measurements which included "relative chi-square" or "normal chi-square" (CMIN/DF), root mean square error of approximation (RMSEA), root mean square residual (RMR), goodness of fit index (GFI), incremental fit index (IFI), and comparative fit index (CFI). In general, the model had adequate goodness of fit measures (Table 4). Its ratio of chi-square to degrees of freedom was 2.06 indicating a good model fit (less than 5; Byrne 2016). The value of the RMSEA was 0.05 with a requirement of < 0.08 (less than 0.08 as adequate according to Byrne (2016)). The values of GFI and CFI were more than 0.9 indicating a good model fit. The measures of GFI and CFI should be more than 0.9. Also, the values of NNFI and AGFI were more than 0.8 indicating a good model fit. The measures of NNFI and AGFI should be more than 0.8 (Byrne 2016).

Table 2 Constructs of farmers' responsible environmental behavior

Items	Mean	S.D.	C.V.	Priority
Using animal manure inside the farms	4.26	0.71	0.167	1
Irrigating farm according to crop water need	4.22	0.71	0.168	2
Cultivating land according to available water	4.23	0.76	0.180	3
Reduced chemical fertilizer use	4.14	0.78	0.190	4
Using methods to increase irrigation efficiency	3.89	0.74	0.192	5
Irrigating farm at cool times	4.16	0.80	0.192	6
Applying low-danger chemical to control pest	4.00	0.83	0.208	7
Using crop rotation	3.41	0.78	0.228	8
Using drought-resistant crop variety	3.76	0.87	0.232	9
Applying minimum/no tillage	3.52	0.85	0.243	10
Weed control through crop rotation	3.34	0.84	0.251	11
Reading pesticides use instruction before use	4.02	1.07	0.267	12
Using mechanical methods for weed control	3.32	0.91	0.275	13
Using cover crop/green manure	2.86	0.85	0.299	14
Fallow management	3.01	0.93	0.310	15
Using biologic methods for pest control	2.62	0.84	0.322	16
Not-carried productions to market immediately after spraying	3.39	1.14	0.338	17
Hygienic disposing of chemical cans and bottles after spraying	3.22	1.25	0.389	18

According to the structural model, farmers' environmental attitude had positive and significant effect on their responsible environmental behavior ($\beta = 0.26$, $P < 0.000$). According to Chen (2016); van Dijk et al. (2016); Gao et al. (2017); and Li et al. (2019), environmental attitude is an influential variable in the Theory of Planned Behavior. Many other studies also concluded that there was a relationship between attitude and behavior (Deng et al. 2016; Borges and Oude Lansink 2016, Borges et al. 2016; Wang et al. 2018; Hyland et al. 2018). However, some research stated this was a weak relationship and even claimed such a relationship did not exist (Heberlein 2012). A person, who believes that valuable positive outcomes would result from performing the behavior, will have a positive attitude towards such behavior. From the overall model (Fig. 4), it can be seen that perceived behavioral control had its positive and significant effect on farmers' responsible environmental behavior ($\beta = 0.58$, $P < 0.000$). Empirical evidence for the effect of perceived behavioral control on behavior has been provided by several studies (Clayton and Griffith 2008; Mullan and Wong 2009; Phillip and Anita 2010; Shapiro et al. 2011; Mullan et al. 2013; Bamberg and Möser 2007; Hyland et al. 2018; Rezaei et al. 2018a). But, subjective norms did not have significant effect on farmers' responsible environmental behavior. The results of Adnan et al. (2018) also showed that there is no relationship between subjective norms and farmers' behavioral intension.

The squared multiple correlations (R^2) calculated for the farmers' responsible environmental behavior was equal to 48%. This implies that the constructs of environmental attitude and perceived behavioral control can explain 48% variance in the farmers' responsible environmental behavior.

According to the findings, environmental awareness had a direct, significant, and positive effect on the farmers' environmental attitude ($\beta = 0.48$, $P < 0.000$). It means that increasing farmers' awareness about negative consequences of unsustainable practices and appropriate methods for natural resource management will improve the farmers' environmental attitude. The results were consistent with the findings of numerous empirical studies such as Fishbein and Yzer (2003); Garayoa et al. (2005); Abbot et al. (2009); Burusnukul (2011); Khan and Damalas (2015); and Lim et al. (2016).

The results obtained in Fig. 4 support findings of other studies (Zaman 2012; Sabzehei et al. 2016; Karami Darabkhani et al. 2017) by illuminating a significant positive effect of environmental ethical commitment on farmers' environmental attitude ($\beta = 0.24$, $P < 0.01$). It can state that integration of environmental ethical considerations and commitment towards the natural environment into everyday farmers' practices, as well as giving them equal weight as other work considerations, is a critical move.

As illustrated in Fig. 4, the standardized path coefficient of environmental concern ($\beta = 0.30$, $P < 0.000$) is statistically significant for the farmers' environmental attitude in a positive direction. This finding is consistent with results of Bisconti (2000); Sulemana et al. (2016); Tam and Chan (2018); Cerri et al. (2018); and Helm et al. (2018). They believed that concern for oneself, health,

Table 3 Measurement items and reliability and validity tests

Latent variables	Observed variables	Standardized loading	AVE	CR	*t* value
Environmental ethical commitment	D1	0.53	0.31	0.75	9.51
	D2	0.45			8.44
	D3	0.47			9.02
	D4	0.48			8.25
	D5	0.72			14.28
	D6	0.69			14.14
	D7	0.53			10.24
Subjective norms	E1	0.49	0.22	0.62	8.78
	E2	0.42			7.52
	E3	0.51			9.28
	E4	0.56			10.28
	E5	0.36			6.16
	E6	0.45			8.18
Perceived behavioral control	E7	0.50	0.33	0.75	9.53
	E8	0.63			12.53
	E9	0.58			10.62
	E10	0.56			9.68
	E11	0.68			13.68
	E12	0.57			11.10
Environmental concern	C1	0.46	0.29	0.80	8.72
	C2	0.58			11.28
	C3	0.64			12.98
	C4	0.57			11.28
	C5	0.69			14.24
	C6	0.53			10.22
	C7	0.45			8.63
	C8	0.45			8.39
	C9	0.51			9.94
	C10	0.51			9.95
Environmental awareness	B1	0.20	0.11	0.58	2.42
	B2	0.35			6.07
	B3	0.43			7.41
	B4	0.28			4.77
	B5	0.35			5.95
	B6	0.33			5.57
	B7	0.10			1.74
	B8	0.30			5.05
	B9	0.41			7.12
	B10	0.39			6.71
	B11	0.46			7.98
	B12	0.29			4.97
Environmental attitude	A1	0.58	0.19	0.74	Fixed
	A2	0.52			8.10
	A3	0.51			7.94
	A4	0.36			5.99
	A5	0.44			7.09
	A6	0.49			7.72
	A7	0.41			6.66
	A8	0.35			5.78

Table 3 (continued)

Latent variables	Observed variables	Standardized loading	AVE	CR	*t* value
	A9	0.47			7.45
	A10	0.41			6.71
	A11	0.25			4.31
	A12	0.39			6.47
	A13	0.39			6.45
Responsible environmental behavior	G1	0.31	0.19	0.80	Fixed
	G2	0.25			3.61
	G3	0.51			5.12
	G4	0.30			4.04
	G5	0.46			4.94
	G6	0.54			5.19
	G7	0.49			5.05
	G8	0.50			5.07
	G9	0.54			5.20
	G10	0.53			5.18
	G11	0.26			3.74
	G12	0.30			4.10
	G13	0.54			8.19
	G14	0.54			8.21
	G15	0.40			4.69
	G16	0.51			5.12
	G17	0.33			4.29
	G18	0.37			7.53

life, others, and future generations caused changing individuals' attitude towards responsible environmental behavior. It means that differentiating various forms of environmental concern provides a nuanced view on individuals' attitude and responsible environmental behavior. Also, squared multiple correlations (R^2) calculated for the environmental attitude was equal to 57%. This implies that the constructs of environmental ethical commitment, environmental concern, and environmental awareness can explain 57% variance in the farmers' environmental attitude (Fig. 5).

Conclusions

Results of the present research suggested that farmers' environmental attitudes could be predicted by environmental awareness, environmental concern, and environmental ethical commitment of farmers. Of course, environmental awareness was the strongest predictor of farmers' environmental attitudes followed by the environmental concern variable and then by environmental ethical commitment. Certainly, the more the farmers' level of knowledge concerning the environment and its importance increases, the greater the change in their

Table 4 Goodness of fit indices of structural model

Test	Recommended value	Proposed model
Likelihood ratio chi-square (×2)	Insignificant ×2 ($P > 0.05$)	0.000
Normed chi-square (×2/df)	×2/df < 5	2.06
Root mean square residual	RMR < 0.05	0.04
Root mean square error	RMSEA < 0.08	0.05
Goodness of fit index	GFI > 0.90	0.74
Incremental fit index	IFI = values close to 1	0.90
Comparative fit index	CFI > 0.90	0.90
Non-normed fit index	NNFI > 0.80	0.89
The adjusted goodness of fit index	AGFI > 0.80	0.72

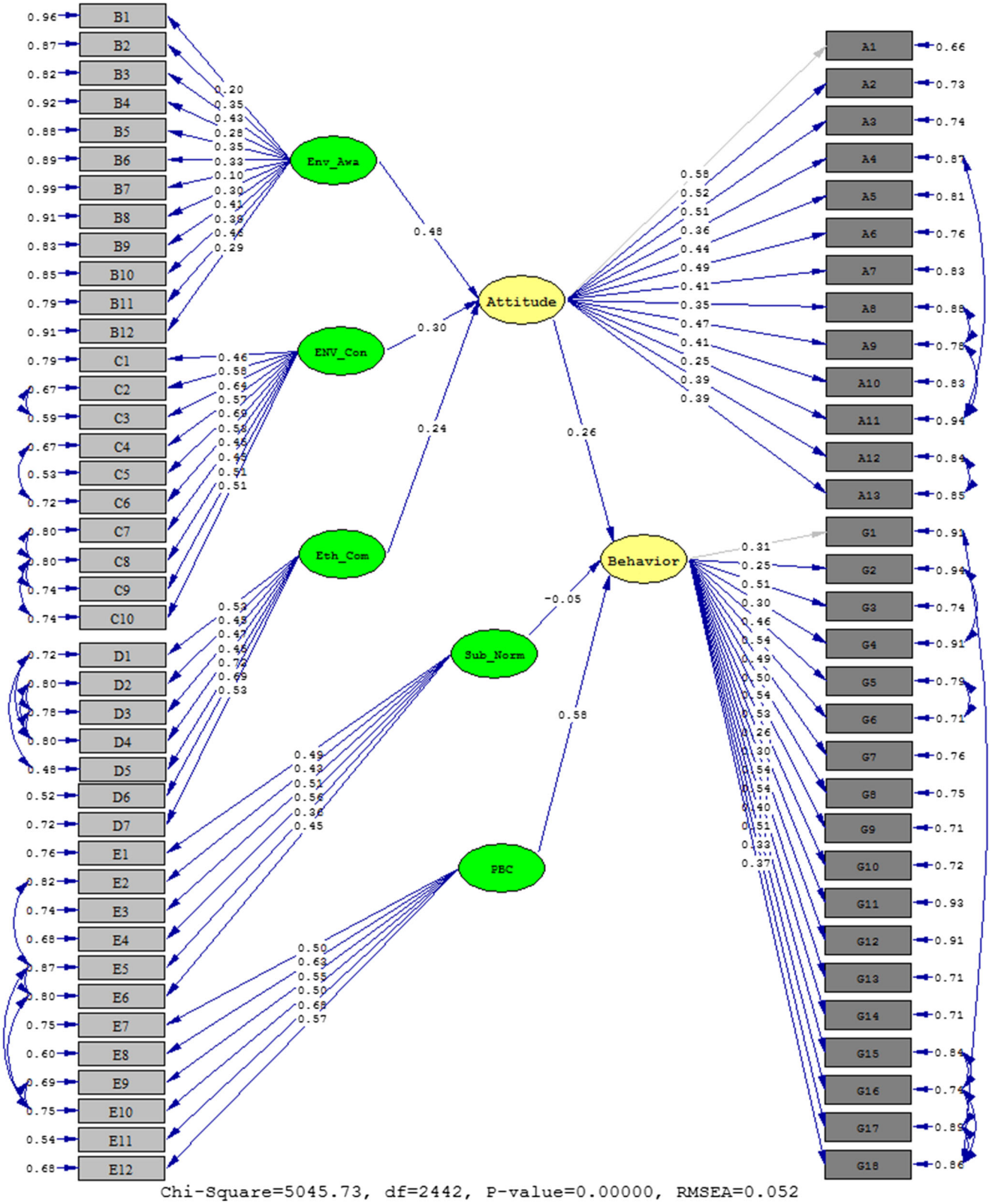

Fig 4 Structural model with standardized estimates

environmental attitudes will be. Environmental concern, feeling of environmental ethical commitment to preserving the environment, and increased awareness cause some kind of attitude to be developed among the farmers that they are responsible towards the environment. Therefore, attempts must be made to educate farmers and create awareness among them

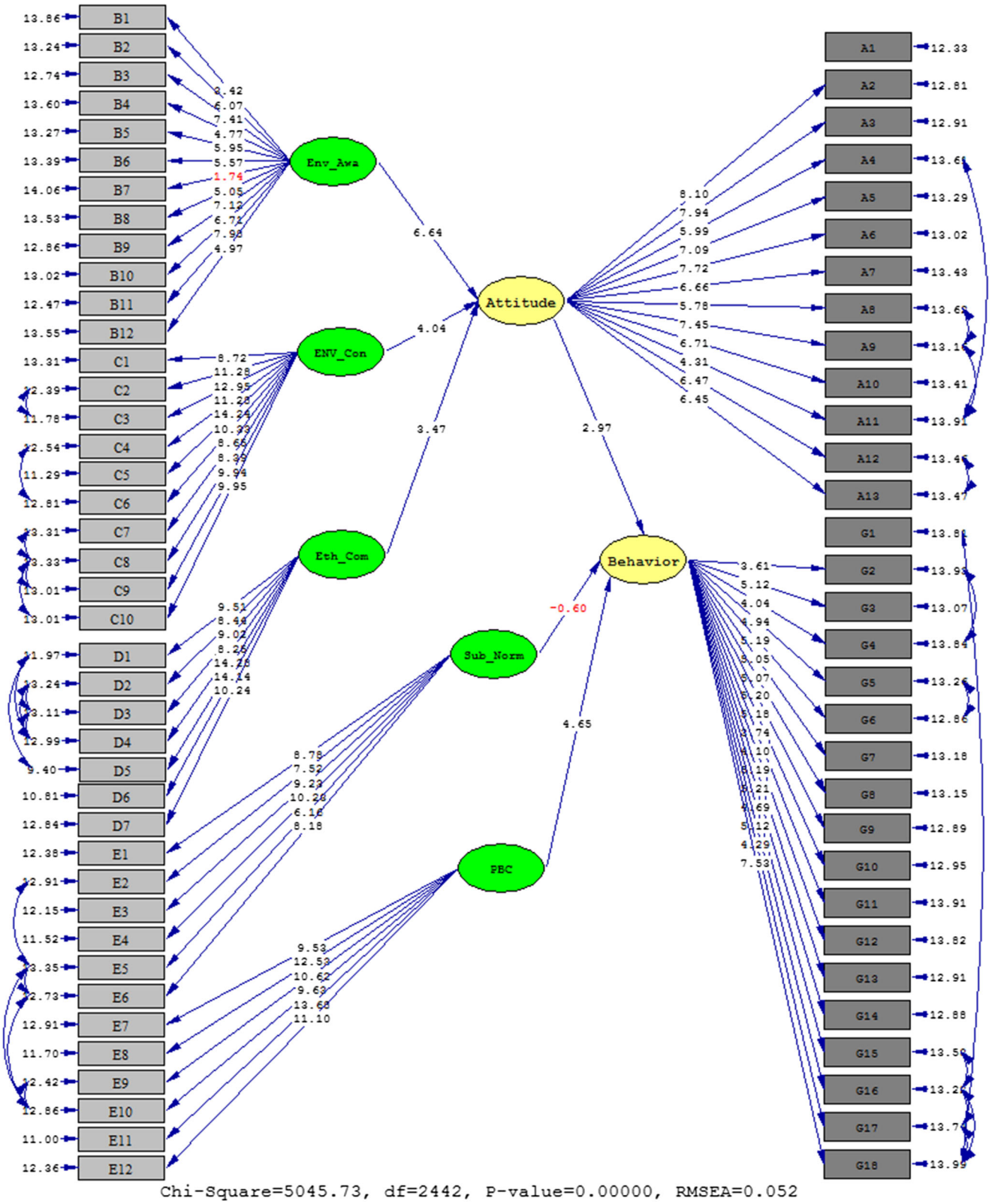

Fig. 5 Structural model with *t* value estimates

in order to develop a responsible attitude towards the environment because this type of attitude will help the development of responsible behavior towards the environment. However, some research stated this was a weak relationship and even claimed such a relationship did not exist (Heberlein 2012). Therefore, it can be said that, although attitude change does

not necessarily mean behavior change, no change in behavior can occur without changes in attitudes. Before people take any action, their mentality and belief towards it must change. Of course, results of this research indicated that (as in many other studies), in addition to farmers' attitudes, perceived behavioral control also influenced their behavior and was even a stronger predictor than farmers' attitudes in relation to changes in their behavior. This result indicates that having a positive and responsible attitude towards the environment cannot by itself be a factor in behaving responsibly to protect the environment, and therefore, the ability and power to behave are also very important. Farmers must have both the required knowledge for behavioral change and authority to behave responsibly towards the environment. This is even more important than their attitudes. In the present research also, farmers that possessed higher levels of perceived behavioral control exhibited more responsible environmental behavior, which was a sign of the importance this variable had in changing their behavior.

Although in many studies all three components of the Theory of Planned Behavior (i.e., attitude, perceived behavioral control, and subjective norms) affected behavior, but in the present research, the effect of the subjective norm variable on responsible behavior of farmers towards the environment was not confirmed. Subjective norms somewhat depend on the cultural context and internal values in any community and can therefore change from one community to another. People think and decide more independently in some communities; however, subjective norms are much stronger in other communities. The present research showed that the farmers decide more independently, and their behavior was not considerably influenced by subjective norms. Another reason for this may be related to the fact that, in the social structure of Iranian communities, subjective norm is based on patriarchy and men prefer to make the final decision on their own. Therefore, a change in a man's behavior is due to his weakness and his lower self-confidence, and this would be an obstacle to changing their behavior.

What the results of this study can illustrate and guide for future studies are how a culture of a society can affect the behavior of farmers in that area and how the environmental behavior of farmers really affected by the culture and subcultures in that area. In rural areas, as the main source of agriculture and farmers, especially in developing countries, it seems that, in addition to farmers' attitudes and awareness, subcultures such as patriarchy have an impact on changing or not changing the environmental behavior of farmers. Therefore, the future studies can specifically study the role of local culture on changing environmental behavior.

The results of this study can also be useful for policy makers and planners. According to the results of the study, farmers when they know (knowledge and attitude) and can (control of perceived behavior), they behave responsibly towards the environment. Therefore, policy makers and agricultural sector managers, especially in institutions such as agricultural Jihad, should do their utmost to raise awareness of farmers through extensional canals, educational courses, workshops, seminars, and conferences, so that farmers can better understand the importance of the environment and try to conserve it. Also, they should support farmers financially and technically, so that farmers can get the ability to carry out environmentally friendly practices on farms. These supports may include providing low-interest loans to farmers to purchase equipment or training skills to work with new equipment and techniques, such as new irrigation systems and biological control techniques.

A limitation of the study is that it did not cover all variables affecting farmers' behavior such as the socioeconomic characteristics of farmers in the research. Maybe after including these characteristics, the model's goodness of fit will increase. Another limitation is related to perception of other farmers' behaviors in the model. It seems this factor can influence farmers' environmental attitude and behavior despite the fact that they know the environment must be preserved. It is recommended that in the future studies among Iranian farmers, the factor of "perceived other farmers' behavior" be investigated. Because farmers believed that some resources like groundwater is a common good and when other farmers misuse this good, using them environmentally is not useful. Another factor for the future studies can be about motivations. Any behavioral change of farmers will depend on what they will gain financially or based on other supports.

The last but not least point is about the study contribution to the future studies and farmers' community. This study showed that some situational factors like ethical commitment can affect farmers' attitude and indirectly influence on their environmental behaviors which is a novelty of this study. Also, the results of the study showed that PBC is the most important predictor of Iranian farmers' behavior and if they feel confident and able to behave environmentally, they will adopt related practices. Hence, the government should focus on increasing knowledge, skill and ability of farmers to adopt environmental practices.

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