



Towards predicting the pro-environmental behaviour of wheat farmers by using the application of value-belief-norm theory

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Abstract

The current study's objective was to present a conceptual model that using the Value-Belief-Norm theory, could forecast the behaviour of wheat producers in the West Azarbaijan Province. This study showed that the egoistic variable has a non-significant and negative correlation with pro-environmental behavior and the new environmental paradigm. In addition, environmental beliefs had a mediating effect on pro-environmental behavior, while norms and values had a straight effect on pro-environmental behavior. This shows that norms and values are more effective than beliefs. Moreover, personal norms, beliefs, biosphere, and altruistic values are considered to be significant predictors of pro-environmental behavior. According to the results, norms and values are more effective than beliefs, which can be helpful for future policymaking. The results further suggest that environmental behavior can be strengthened by emphasizing altruistic and biospheric values, enhancing environmental awareness, increasing the ascription of responsibility, and strengthening personal norms for reformative actions. The application of the value-belief-norm theory in the context of Iranian farmers is supported by this study, which improved understanding of the factors influencing farmers' environmentally friendly behaviour. It also helps agricultural policymakers and decision-makers develop their policies for sustainable agricultural development by providing a better understanding of farmers' decisions and behaviours.

Keywords Altruistic values · Biospheric values · Egoistic values · Environmental conservation · Environmental issues · Eco-friendly behavior

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1 Introduction

Today, the world is facing critical eco-problems including global climate change, natural resource depletion, inadequacy of safe drinking water (Benjamin et al., 2016; Komatsu et al., 2020; Lange & Dewitte, 2019; Ravindra et al., 2020; Steg et al., 2014), and biodiversity loss (Quinn & Burbach, 2008); these environmental problems have been threatening the sustainable future of the world (Steg & Vlek, 2009). The supply of ecosystem products and services, such as (a) fiber, water, and food; (b) the management of services influencing climate, flood, soil, and water quality; and (c) assistance services like soil production, photosynthesis, and nutrient cycling are all necessary for long-term sustainability (Keshavarz & Karami, 2016). Direct or indirect change in ecosystem services and goods occurs as a result of natural or human-caused factors in nature. Climate change, changes in animal habitat (changes in land use and physical management of natural resources), population increase, over-exploitation, technological change, invasive species, and pollution are all examples of these changes (Anwar et al., 2020; Kaiser et al., 2014; Price & Leviston, 2014; Quinn & Burbach, 2008; Steg & Vlek, 2009; Steg et al., 2014; Takahashi & Selfa, 2015; Thondhlana & Hlatshwayo, 2018). These behaviors can change the environment in the short and long term (Quinn & Burbach, 2008); therefore, they can be supervised by substituting conscious behaviors to reduce their effects. Agriculture and the environment are closely related.

Agriculture takes place within the context of the environment, and the two are intimately connected. The practice of unsustainable agricultural production is one of the biggest threats to a healthy ecology (Foley et al., 2005; Meier et al., 2015; Miani et al., 2023; Price & Leviston, 2014). Agriculture's detrimental environmental repercussions will have a severe impact on social and economic stability (Merante et al., 2015; Shirzad et al., 2022). Production techniques of traditional agriculture are among the important factors in the destruction of the earth (Price & Leviston, 2014). Many of these negative effects stem from inappropriate agricultural activities, which result in the loss of valuable topsoil, inefficient use of nutrients, and damage to natural resources (Mullendore et al., 2015). Eco-friendly agricultural activities reduce pollution and increase environmental quality in the agricultural sector. Farmers' behavior should be taken seriously in order to achieve more sustainable farming systems so that their behavior in support of conservation and environmental sustainability is essential (Adnan et al., 2017; Zeweld et al., 2017). Environmental preservation is critical, and it is regarded as a public obligation to preserve the quality of life for current and future generations. Today, most protection aims across the world have been implemented by people in their local region, such as farmers, whose survival depends on dependable natural resources (Buijs & Elands, 2013; Lafreniere et al., 2013). The traditional top-down strategy, which overlooks the concerns of local stakeholders, appears to be thwarting conservation efforts (Engelen et al., 2008; Larson et al., 2015). Therefore, activities that protect the environment are essential to reduce pollution problems and develop sustainability (Paillé & Boiral, 2013).

Agriculture has been the most important part of the supply of food materials and products, and its role and importance in human life are very obvious. That is why those involved in this sector are trying to produce more products by using new technologies, pesticides, and chemical fertilizers (Ahmadi et al., 2019). In the field of agriculture, as well as industrial activities, attention must be paid to its environmental aspects. Unfortunately, this issue has not received much attention in Iran so far. Agricultural activities can have many destructive effects on the environment (Mohammadi et al., 2018). Air pollution, pollution

of soils and surface and groundwater, and change in soil properties are among the destructive effects of agricultural activities on the environment in Iran. Ghorani-Azam et al. (2016) showed that 10% of annual deaths in Iran are due to air pollution, and 15% of this pollution is caused by agricultural activities. Emissions of greenhouse gases due to agricultural activities, especially near industrial areas, play an excessive role in harming human health. Excessive use of pesticides and fertilisers, irrigation with untreated wastewater, and the usage of manure and sewage sludge containing antibiotic-resistant bacteria and heavy metals damage soil in Iran's agricultural and animal sectors (Aghlidi et al., 2020). Doabi et al. (2019) argued that each year, the negative impacts of inappropriate agricultural methods, such as erosion and desertification, are responsible for most of the density and contamination of soil and water in Iran. Pollution from fertilizer and pesticide leaching, as well as the intrusion of seawater into aquifers, have a negative impact on the environment.

There is a growing concern about environmental degradation due to agricultural activities (Nathaniel et al., 2020). Although large agricultural businesses are generally involved, smallholder farming is often blamed (Keshavarz & Karami, 2016). Small-scale agriculture is characterized in many developing nations by a complete failure to sufficiently re-establish soil fertility, make soil conservation investments, and enhance irrigation efficiency in order to sustain the quality of agricultural land (Schubler et al., 2019). There is a correlation between the acceleration of environmental problems and human behavior (Kim et al., 2019). As a result, implementing environmentally friendly techniques requires farmers to change their ways despite significant levels of uncertainty (e.g., climate diversity and drought). While farmers are under increasing pressure to continue to help with environmental protection measures, the factors that influence their environmental competency are yet unknown (Fleming & Vanclay, 2010; Sulemana & James, 2014).

Studies focusing on human-environmental relations and identifying effective elements in applying treatments that have minimal damage to the environment and natural resource conservation are increasing. Farmers' communal and spiritual features are the main criteria in agricultural variations. Previous studies showed that farmers' psychological and social characteristics towards natural environment conservation will affect their environmental behavior (Best, 2010; Howley et al., 2015; Kormos & Gifford, 2014).

It is increasingly understood that environmental manner is related to people's perspective regarding the environment (Tian & Robertson, 2019). Concentrating on positive behavioral drivers helps simplify changes in an environmental manner (Mills et al., 2017), though the absence of a proper theoretical framework restricts research into the pro-environmental behavior (PEB) of farmers (Keshavarz & Karami, 2016). The significance of human motives in environmental conservation is frequently overlooked by general theories of environmental behavior (Lafreniere et al., 2013; Price & Leviston, 2014). Yet, studies on psychological features revealed that the psychological aspects of farmers are central to the adoption of preservation practices (Rezaei & Ghofranfarid, 2018). Despite the increase in adverse effects of human behavior on the environment, PEB change has been measured in the domain of ecological mindset (Sawitri et al., 2015). Farmers' societal and perceptual characteristics are the main keys in changing farming practices, and studies have shown that PEB has caused natural environment conservation and has reduced undesirable impacts on the environs (Best, 2010; Price & Leviston, 2014). The theory of planned behavior, the norm activation model, the theory of conservation motivation, and the value-belief-norm theory are only a few examples of environmental psychology theories (Ajzen, 1991; Rogers, 1983; Schwartz & Howard, 1981; Stern, 2000). VBN is used in this study to discover the primary elements that influence farmers' environmental support behavior. VBN environmental theory assumes that values influence environmental behavior through

environmentalists' beliefs and personal norms (PNs). In fact, a PN is a moral obligation for someone to do or to refrain from doing certain behaviors. In contrast, stronger hedonistic values and, to a lesser extent, stronger selfishness were associated with less powerful anti-environmental beliefs and norms (Hiratsuka et al., 2018).

While the existing literature has provided insights into factors influencing environmental degradation, there remains a noticeable gap in understanding farmers' eco-friendly behavior. The shortcomings are twofold: lack of a robust theoretical framework and a skewed focus on demographic characteristics rather than communal disciplines. Firstly, the absence of a suitable theoretical framework hampers the study of farmers' eco-friendly behavior. Past works (Bayard & Jolly, 2007; Price & Leviston, 2014) have pointed to this deficiency, underlining the importance of developing a theoretical lens that comprehensively addresses the intricacies of farmers' interactions with the environment. Secondly, the existing empirical literature predominantly concentrates on demographic characteristics, neglecting the broader spectrum of social and psychological factors influencing environmental behavior. Human conduct significantly impacts the environment, necessitating a more comprehensive approach that encompasses communal disciplines (Mascia et al., 2003; Quinn & Burbach, 2008). The need to explore the effects of psychological and social factors on farmers' environmental behavior has been underscored (Bayard & Jolly, 2007).

Environmental behaviors are multifaceted, occurring in various situations and contexts. Evaluating values alongside these behaviors is crucial. Studies have shown that there is a direct relationship between values and environmental behaviors (De Groot & Steg, 2010; Howell, 2013). Altruistic (ALT) and biosphere (BIO) values positively correlate with eco-friendly behaviors, while egoistic values exhibit an adverse correlation. However, previous studies have not comprehensively assessed the overall (direct and indirect) consequences of PEB. Therefore, the current study seeks to bridge these gaps by utilizing the Values-Beliefs-Norms (VBN) theory to predict the environmental behavior of wheat growers. The research aims to answer the following key questions:

1. What is the correlation between biospheric, ALT, and egoistic values and the new environmental paradigm (NEP)?
2. What is the relation between BIO, ALT, and egotistic (EGO) values and PEB?
3. Is there a significant relationship between the "NEP" and "awareness of consequence," "ascription of responsibility," and "PNs" and PEB?

This study innovatively addresses the direct and indirect effects of PEB, contributing to a more nuanced understanding of the factors influencing farmers' eco-friendly behavior.

2 Literature review

Extensive studies have been carried out on improving agricultural practices and environmental protection; however, most of them explain attitudes (Poppenborg & Koellner, 2013; Selfa et al., 2008), motivations (Jambo et al., 2019), or decisions about specific agricultural practices (Lundström & Lindblom, 2018) that do not completely predict behavior. Most of these studies show that socio-psychological factors affecting farmers' behavior have been ignored (Li et al., 2017), and a slight combination of the communal disciplines in the agrarian literature has been adopted to explain farmers' PEB (Fang et al., 2018). However, it is difficult to identify the factors behind the adoption of environmentally friendly farming

practices (Price & Leviston, 2014). The psychological and social characteristics of farmers are central not only to changing agricultural practices but also to shaping environmental behaviors (Best, 2010) and conservation practices (Quinn & Burbach, 2008). This lack of attention has led to the lack of a theoretical framework suitable for studying the PEB of farmers. To help facilitate the change in farmers' behavior, it is better to pay more attention to social and psychological factors. It is also possible to increase the predictive power of behavior by applying other psychological variables.

Many studies have emphasized that farmers are driven by circumstances or situational factors (such as interpersonal connections, pricing, and policymaking) that may inhibit or facilitate PEB, but research in recent decades has shown that factors linked to farmers, such as attitudes, norms, perceptions, and values, are determinant factors of PEB (see Table 1). Different theories and ideas have been offered to explain PEB in the field of psychology and social sciences, which have been widely used to examine PEB. In this context, the VBN theory is the most frequently used model in the field of eco-friendly psychology (Klößner, 2013). Stern et al. (1999) expanded a theoretical basis intended for the investigation of sustainable internal factors, called the VBN theory of the environment, to explain why people decide to participate in a range of PEBs. Interviews conducted with community members have shown that the VBN theory is appropriate when managing sustainable resources (Seymour et al., 2010). Analyzing latent variable paths of the VBN theory provides further improvements in the field of measurements and theoretical understanding of variables in this model. In this paper, the focus of the research was exclusively on environmentally friendly farming practices. Environmental protection methods were in a common theme in PEB review via the VBN model (Steg & Vlek, 2009); however, this model may be unable to measure a wide range of diversity-related environmental actions.

2.1 Pro-environmental behaviors

PEB refers to a behavior that is as detrimental to the environment as possible or even advantageous to the environment (Ertz et al., 2016). According to Kollmuss and Agyeman (2002), PEB is defined as measures that lessen the undesirable influence of humans on the environment. Stern (2000) explained that PEB is the degree to which an activity alters the supply of resources or energy from the climate, the environment, and processes, or the BIO itself (Stern, 2000). PEB's voluntary actions ensure that the best performance is accurate (Zhang et al., 2014). In this study, PEBs are measures taken by farmers that have the least negative impact on the environment and even promote regeneration of the environment in the long run.

Previous studies (e.g., Amoah & Addoah, 2021; Ting & Cheng, 2017; Yusliza et al., 2020) in developing countries have focused on environmental behaviors. According to Amoah and Addoah (2021), African countries, particularly Ghana, are now experiencing significant environmental difficulties with health consequences. Environmental knowledge is widely recognized to impact people's behavior in the environment and development literature. This understanding explains PEB in a positive and statistically significant way. Changes in PEB are also influenced by environmental knowledge (internal variables) and socioeconomic (external) factors. Yusliza et al. (2020) also discovered that environmental commitment, environmental consciousness, green lifestyle, and green self-efficacy all had a beneficial impact on PEB, adding to the current research on environmental sustainability in Malaysia. Variations in PEB intentions are explained by social-psychological conceptions and socio-demographic characteristics, with management implications for

Table 1 Prior research on environmental behavior

References	Variables	Findings
Lemke et al., (2010)	Protective practices, protective tillage, financial incentives	Measures, including one-on-one visits by landowners, local seminars, and different visits, can enhance the acceptance of protection practices in addition to specialized and economic assistance being the main incentive for farmers to adopt these environmental practices
Wang and Yin (2010)	Income, hometown, environmental knowledge, environmental policies	Demographic features such as gender, age, and mean years of schooling level are important elements that have an impact on ecofriendly actions. In addition, income and hometown have a significant impact on profound environmental behavior
Price and Leviston (2014)	Self-concepts, social influences and attitudes, behavioral norms, perceived behavior control, concern for outcomes, awareness of threats, skills and abilities acquired, environmental constraints	Biosphere standards, points of view, and norms have been identified as important predictors of PEB
Keshavarz and Karami (2016)	Perceived vulnerability and severity, self-efficacy and response	The findings showed that output of response, perceived frequency, expense of response, perceived weakness, self-efficacy, employment, and social climate significantly influenced farmers' environmental actions under drought
Floress et al., (2017)	Awareness of consequences to water quality, farm-as-business attitudes	Awareness of consequences and attitude have an affirmative and meaningful effect on the willingness to behave
Wang et al., (2018)	Awareness of the consequences, attitude indicators, economic-indicators, intentions, norms, and 'perceived behavioral control'	Age and intention had a direct and significant effect on environmental behavior of farmers and attitude, and subjective norm and perceived behavior control had a positive effect on behavior
Fang et al., (2018)	Social and moral expectations, including "perceived regulation of behavior"	Social and personal norms influenced environmental behavior through perceived behavioral control
Shi and Song (2019)	Environmental attitude, social science perception, environmental perception, and natural environment comprehension	This study confirms the heterogeneity in the correlation among social and demographic variables and environmental behaviors. Considering the environment has a definite effect on eco-friendly behavior. Eco-friendly attitudes have a significant impact on green behavior. Results showed that social environment has no significant effect on environmental behavior

Table 1 (continued)

References	Variables	Findings
Rezaei et al., (2020)	Attitude, perceived usefulness, perceived ease of use, social influence, result's ability to display, compatibility and self-efficacy	The findings found that self-efficacy had a major positive impact on "perceived ease of usage" and had no influence on "perceived utility"

marketers who want to exploit students' engagement to encourage environmentally friendly behavior. Environmental quality, according to Shafiei and Maleksaeidi (2020), is greatly influenced by human activity patterns. Developing scientific information about what motivates people to act pro-environmentally is a major problem with practical implications for a sustainable future. PEB was directly impacted by environmental attitudes, self-efficacy, perceived PEB costs and perceived intrinsic and extrinsic rewards of current ecologically unfriendly actions, whereas rewards were indirectly influenced by environmental attitudes and response costs. Furthermore, through self-efficacy, response efficacy had an indirect effect on PEB. Another research has revealed that the underlying causes may prevent PEB (Stern, 2000). In addition, Steg and Vlek (2009) hypothesized that the correlation between the underlying factors and PEB may be mediated by intra-psychological factors such as beliefs, values, and attitudes.

PEB involves various types of operational behavior, such as recycling behavior (Mak et al., 2019), waste management (Tekler et al., 2019), energy saving (Berardi, 2017; Li et al., 2019a, 2019b), and green purchase behavior (Cheung & To, 2019). People can protect the environment with their daily personal effort (time and energy) (Li et al., 2019a, 2019b). The common agreement in the ecological literature is that the worth of overall attitudinal actions is uncertain when putting on a specific background, together with forecasting certain ecologically accountable behaviors (Cleveland et al., 2005). Due to the problems caused by lack of awareness about the environment, human activities are often the main reasons for these problems; people often do not choose behaviors that help reduce their impact on the environment (Halpenny, 2010). Therefore, PEBs are considered the protective acts taken by people to keep the world sustainable by sympathizing with the environment and ecological issues (Lee et al., 2013). In this regard, the Iranian government has explained some general PEB policies. According to Sabzehei et al. (2016), the Iranian government's policies include the establishment of an integrated national environmental system, coordinated and systematic management of vital resources, criminalization of environmental degradation, preparation of a country's ecological atlas, strengthening environmental diplomacy, expansion of the green economy, and institutionalization of environmental culture and ethics. Climate change management and response to environmental threats such as desertification, dust, drought, and microbial and radioactive infectious agents, as well as the development of foresight and awareness of emerging environmental phenomena and their management of other Iranian government policies have all been prioritized in recent years (Jokar et al., 2020; Savari et al., 2021).

2.2 VBN theory

In fact, the behavioral model can be considered as a schematic model that, using various theories and other effective results of research, provides the requirements for a better understanding of the subject and easier and more accurate achievement of the expected results (Glanz et al., 2008). Studies have described the decision-making mechanisms of farmers for environmental behavior to some extent, but the physiological limitations to farmers' adaptation to these changes, particularly in developing countries, have often simply been overlooked (Below et al., 2012; Gebrehiwot & Veen, 2015). Accordingly, several models and theories have been introduced to predict the behaviors, tendencies, and attitudes of members, such as the VBN theoretical theory.

The VBN model "focuses on ideals and moral standards and represents the common environmental principles, views, and standards that characterize particular PEBs" (Choi et al.,

2015; Kaiser et al., 2005; Price & Leviston, 2014; Stern, 2000). Stern et al., by combining “value theory”, NEP, and the norm activation model, offered the VBN theory. This model is eagerly expanded in the context of the natural environment, human behavior, and psychology to predict PEBs (Zhang et al., 2014). The VBN theory defines relations between “beliefs, norms, values, and actions” in a series of reciprocal partnerships. In the VBN theory, norms encourage behaviors. The “standard” of an entity is caused mainly by “beliefs” about environmental problems, their consequences, and the responsibility of the person to act correctly, and public values produce “belief” (Stern, 2000). “Value” describes a view that contains different components comprising and providing directions for the selection and assessment of definite actions, in relation to their comparative significance, which directs to pleasing conditions or behavioral impacts.

As “value” redirects a person’s character, it is strictly related to the idea of the ego, in addition to the ethics that influence one’s behavior (Choi et al., 2015). In this theory, environmental orientations consist of three different classifications. Members who underscore the importance of the environment for the benefit of themselves have an egoistic orientation. People who pay attention to the importance of the environment and its conservation for humans have an ALT orientation. Finally, those who believe in the intrinsic values of the environment and ecosystem have a BIO orientation (Imran et al., 2014). Generally, these value orientations guide the behaviors of members towards the protection of the environment.

The VBN theory presumes that the ecologically friendly purposes and actions of the citizens (Stern & Dietz, 1994) are demonstrated by the norms of the pro-environmental adults, and these adults’ norms derive from the linear evolution of “values, modern ecological models, and perception of adverse effects” (Klößner, 2013; Stern, 2000). The model contains a causal chain of values, beliefs, and norms that influence environmental behavior; in other words, each variable in a sequence affects the next variable.

Values, on the other hand, are considered a lasting individual factor and can, therefore, affect a wide range of behavior. The importance of values as a predictor of behavior lies in the belief that they represent what is of fundamental importance to a person and, in this way, may affect behaviors in several contexts (Gatersleben et al., 2014). In general, the study questions are as follows:

Is the VBN model capable of explaining the PEB of wheat farmers?

Which one of the studied variables has the greatest impact on the PEB of wheat farmers?

Do values affect PEBs?

On this basis, in this study, the following hypotheses have been defined and examined based on the VBN theory:

H1. Biospheric, ALT, and EGO values and the NEP have a significant effect on the PEB.

H2. There is a significant relationship between biospheric, ALT, and EGO values and the PEB.

H3. There is a significant relationship between “NEP”, “awareness of consequences”, “ascription of responsibility”, and “PNs” and the PEB (Fig. 1).

3 Research methodology

3.1 Area of study

The research area was Bukan County located in West Azarbaijan Province (Fig. 2). Bukan is the largest city in the south of West Azarbaijan Province. Its urban population

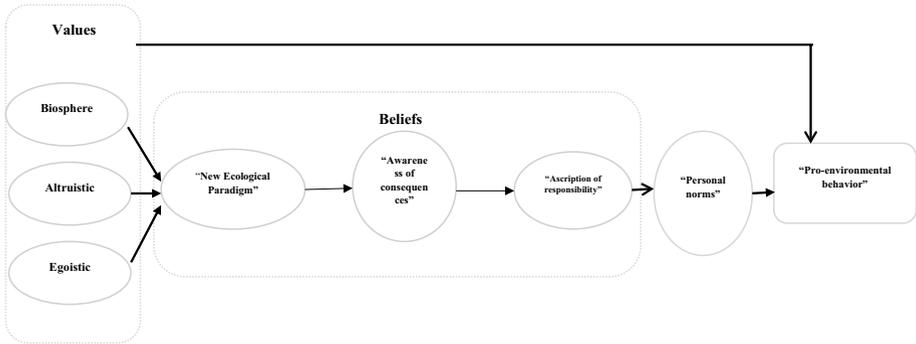


Fig. 1 The extended VBN-theory. (Adapted from Stern, 2000)

is 193,501 (2016 census). The area of this city is more than 12 square kilometers and is one of the flattest cities in the region. The city of Bukan is located at 36° N 31° N and 46° N 12° E above the Greenwich meridian and is 1370 m above the sea level. Bukan’s climatic zone is commonly well-known as cold and dry, with an average rainfall of 300–400 mm per year (West Azarbaijan Meteorology Department, 2013).

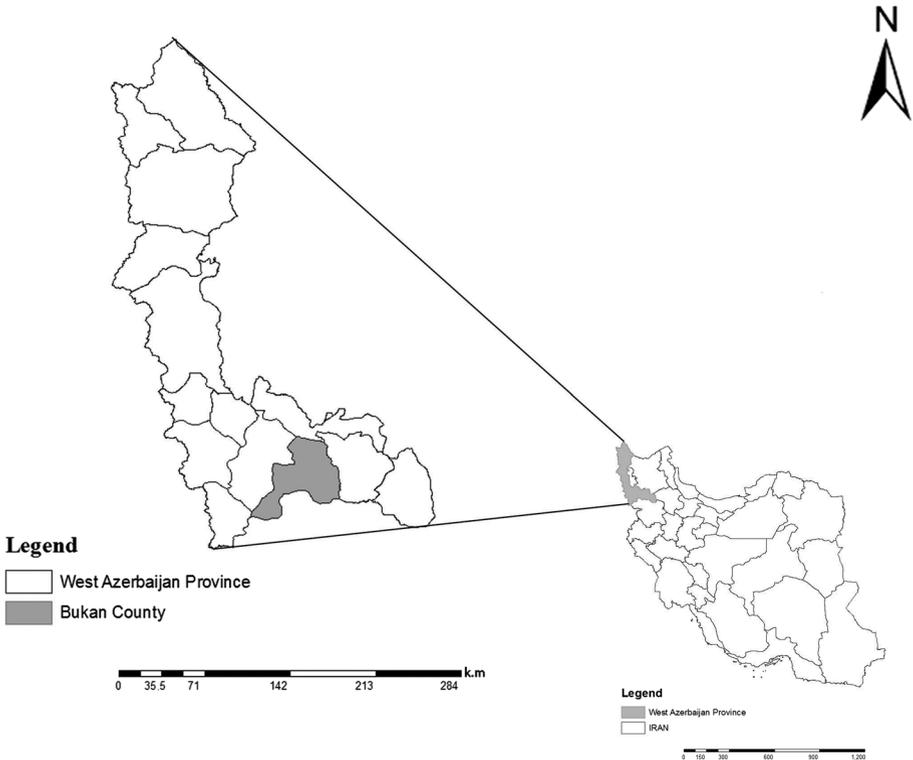


Fig. 2 Location of the studied area

This city is one of the main centers of wheat production in Iran due to the amount of cultivated area for wheat production. Given that West Azarbaijan Province has significant importance in producing agricultural products in Iran and that its main products include wheat, barley, sugar beet, sunflower, and cotton (5.6% of total production), it has an important role in the country's GDP (IRNA, 2018). Therefore, a better understanding of the role of farmers' behavior may encourage agricultural producers to take actions that have less harm to the region and resources.

3.2 Sampling and data analysis

The population of this study includes all wheat growers in Bukan County (N: 5473). The sample size was estimated at 357 wheat growers using the proportionate stratified random sampling method and Krejcie-Morgan (Ahmad & Halim, 2017). Data were collected by using a structured questionnaire (Arabatzis & Malesios, 2013) that assessed wheat farmers' environmental knowledge and active participation in the community, regardless of socio-economic situation. In addition, everyone who took part in the data collection process did so voluntarily. All the questionnaire's elements were adapted from previously accessible indices, and their legitimacy and long-term viability were confirmed. For each section, respondents were asked to score each item on a Likert five-point scale ranging from 1 to 5 (strongly disagree to agree). Tables 2 and 3 shows the descriptive statistics for the samples.

The data were analyzed using SPSS22 and LISREL8.80. A two-step manner offered by Anderson and Gerbing (1988) was used. Both analyses resulted in a framework confirmed in the second phase, in which the SEM method was used. Regarding SEM, Byrne (2013) notes that it is a mathematical technique that applies a confirmatory approach instead of an exploratory one. This is an efficient tool for multivariate research. The SEM applies a two-step procedure: a) the causal correlations and b) the fundamental relations, which can be shown explicitly in the shape of a diagram to explain the concept (Rodríguez-Barreiro et al., 2013). According to Rodríguez-Barreiro et al. (2013), SEM is not just a statistical method; it is a research process too. In SEM, the entire theory can be tested successfully by utilizing the "structural equation simulation." This methodological approach is especially useful when analyzing a theoretical model, which involves a variety of variables close to the present analysis (Han et al., 2018).

Variables of the current model were evaluated by different items in the Likert measured scale. By computing the items of each construct, the desired variable was calculated, and a structural analysis was performed (Asadi et al., 2012). The maximum likelihood method in LISREL was used.

3.3 Structural equation modeling confirmatory factor analysis

SEM is widely accepted and used to validate different models, but the model and context presented are very pristine. Other methods have lower accuracy compared to SEM, so we had to use this technique.

In the model selection method, the researcher seeks to select a suitable model from competing or alternative models. Based on this approach, the researcher compares different models in the same statistical population and selects a model that has the necessary stability to explain the problem in different samples (Diamantopoulos & Siguaw, 2000).

We had to use this method because the purpose of this study was to select the most valid and sustainable model to explain the environmental behavior of wheat farmers. One

Table 2 Sample size based on stratified random sampling method

Township	Sub-counties	Total number of sub-categories	Total number of villages	Total number of wheat farmers	Proportioned number of samples in each sub-categories	Total number of samples
Boukan	Akhtachi, Eastern Akhtachi, Mahali Akhtachi, Ale Timur, Ale Gavork, Dehbikri, Fezalahbaigi	7	175	5473	51	357

Table 3 Variables of the research

Construct	Number of Items	Items	CR	AVE	Cronbach's α	Source
Pro-environmental behavior (PEB)	6	I use new irrigation methods Cultivating more tolerant crops Using crop rotation Restoring crop residues to the soil Weeds control of the farm Methods of using pesticides on the farm	0.903	0.609	0.814	Yazdapanah et al., (2015) and Salehi and Imam Gholi (2012)
Personal norm (PN)	4	I consider it my moral duty to reduce the human impact on the agricultural environment I consider it my moral responsibility to safeguard the world If I do not maintain the ecosystem, I will feel bad Regardless of others' opinions, I consider myself morally responsible for PEB	0.873	0.632	0.774	Van Riper and Kyle (2014)
"Ascription of responsibility" (AR)	4	I am responsible for encouraging my neighbors to use their environmental farming techniques Everyone must be responsible I feel that the environmental degradation is due to inappropriate agricultural activities I have a small share in PEB	0.869	0.625	0.748	Van Riper and Kyle (2014)
"Awareness of consequences" (AC)	5	Environmental protection is beneficial for all of us Global warming is a serious problem for humanity Thousands of species will vanish in the next decade Environmental measures will lead to a more beautiful world PEBs advance my quality of life	0.875	0.639	0.735	Van Riper and Kyle (2014)

Table 3 (continued)

Construct	Number of Items	Items	CR	AVE	Cronbach's α	Source
New ecological Paradigm (NEP)	5	The earth is no longer able to support more population Human behavior has had catastrophic consequences for the earth All species have the right to live The earth's resources are limited Nature's balance is easily upset	0.886	0.609	0.798	Stern et al., (1999) and Dunlap et al., (2000)
Biosphere (BIO)	4	Unity with the earth Admiring the planet earth Safeguarding the surroundings Preventing pollution	0.848	0.582	0.809	Nordlund and Garvill (2002), Schultz and Zelezny (1999); Van Riper and Kyle (2014)
Altruistic (ALT)	4	Responsiveness: Act for the prosperity of the others Equivalence: Specify the same chances for all Common fairness: Consider the weak Peace: No-war or conflict	0.846	0.578	0.821	
Egoistic (EGO)	3	Authority: Dominance Prominent: Leadership Prosperity: Assets, Belongings	0.798	0.569	0.770	

of the novel aspects of this study was the selection of the best model after comparing other models. The current research enriches the literature on behavioral models and points to the undoubted effect of values on PEB, directly and indirectly, which has not been studied so far. Confirmatory factor analysis (CFA) was used in this study to test the validity of the research tool and to determine whether the observed variables explain the latent ones. While these abstract ideas may lack precise measures or units, statistical methods can deduce their values from other connected variables. To estimate latent constructs, SEM employs confirmatory factor analysis. The latent variable or construct is not included in the dataset since it is a derived common component of other variables that might show the cause or effect of a model. SEM was employed to test the study hypothesis after validating the (Average Variance Extracted) and (Composite Reliability). CFA is a theory-driven confirmatory approach in general. As a result, the theoretical connections between observed and unknown variables influence analytic planning (Fan et al., 2016). While conducting a CFA, the researcher estimates a population covariance matrix using a postulated model, which is then contrasted with the observed covariance matrix. The aim of the researcher is to minimise the difference between the estimated and observed matrices. SEM is frequently referred to as a combination of multiple regression analysis and exploratory component analysis (Phakiti, 2018; Schreiber et al., 2006). Similar to CFA and multiple regression, SEM is a confirmatory strategy but can also be applied for exploratory purposes. SEM, which was used in this study, consists of two parts: (a) a measurement model (basically the CFA) and (b) a structural model, which, in contrast to CFA, allows for higher correlations among latent variables (Frey, 2018).

4 Results

In this study, we used the VBN theory to explain wheat farmers' environmental behavior. This model contains several components, and the correlation between these components was considered in the current research hypotheses. Thus, we used SEM to test and confirm the hypotheses, which is the most powerful statistical method (Davvetas et al., 2020). Overall, the research hypotheses were examined based on the results of the model fit and the study of the correlations between model components. Therefore, there was no need for bootstrapping in this study due to the large sample size ($n=357$) and the use of covariance-based software. Bootstrapping is usually used for a study with a small sample size, with an abnormal distribution, and in the direction of variance-based approaches (Lavrakas, 2008).

4.1 Descriptive statistics

The results show that 284 of the respondents were males (79.6%) and 73 were females (20.4%); 37.8% of them were 17–30 years old, 26.9% were 30–40, 18.2% were 40–50, and 17.1% were 51 years and older (Table 4). In addition, the majority (71.8%) were living in rural areas, 9.6% in the city, and 18.6% in both cities and villages. Half of the survey sample had private ownership (77.6%), and 20.2% had rental ownership. The average age was 35.44 ($SD=11.03$), and the number of members per family was 5.06 ($SD=1.60$). The average salary per month was between 150 and 1350 US dollars. The average of their experience in farming was 14.36 years. About 87% of the participants were dependent on farming as their major profession.

Table 4 Socio-demographic types

	Frequency	Percentage
<i>Gender</i>		
Male	284	79.6
Female	73	20.4
Total	357	100
<i>Age</i>		
≤ 31	135	37.8
32–41	96	26.9
42–50	65	18.2
≥ 51	61	17.1
Total	357	100
<i>Level of education</i>		
Lower	132	36.9
Middle	151	42.3
Upper	74	20.8
Total	357	100
<i>Income</i>		
€ ≤ 530	79	22.1
€ 531–760	205	57.4
€ 761–900	29	8.1
€ 901–1025	30	8.4
€ ≥ 1026	14	3.9
Total	357	100
<i>Experience</i>		
≤ 5	58	16.2
6–10	69	19.3
11–15	114	31.9
16–20	30	8.4
≥ 21	86	24.1
Total	357	100

4.1.1 Descriptive analysis of variables of the model

Using a Likert scale of 5 points, the descriptive analysis showed (Table 5) that the mean score of PEB was 3.12 (SD=0.799), and the ascription of responsibility (AR) regarding the PEB among wheat farmers was 3.25 (SD=0.785). The mean score for the awareness of consequence (AC) was 3.14 (SD=0.823). The mean score for the NEP was 3.14 (SD=0.746). In addition to the BIO, ALT and egoistic values were respectively as follows: (Mean=2.99, SD=0.726), (Mean=2.83, SD=0.662), and (Mean=2.94, SD=0.686). In reviewing wheat farmers for PN to use PEB, the results revealed that they have a favorable PN to use PEB (Mean=3.28, SD=0.760).

Table 5 Means and normal deviations for both factors and associations

Con- structs	Mean	SD	1	2	3	4	5	6	7	8
1 PEB	3.12	0.799	1							
2 PN	3.28	0.760	0.483**	1						
3 AR	3.25	0.785	0.478**	0.489**	1					
4 AC	3.14	0.823	0.426**	0.324**	0.323**	1				
5 NEP	3.14	0.746	0.454**	0.248**	0.318**	0.445**	1			
6 BIO	2.99	0.726	0.473**	0.299**	0.325**	0.326**	0.568**	1		
7 ALT	2.83	0.662	0.469**	0.299**	0.257**	0.354**	0.421**	0.512**	1	
8 EGO	2.94	0.686	0.384**	0.260**	0.187**	0.319**	0.328**	0.426**	0.731**	1

** $p < 0.01$ (two-tailed test)

PEB pro-environmental behavior, PN personal norm, AR ascription of responsibility, AC awareness of consequence, NEP new ecological paradigm, BIO biosphere, ALT altruistic, EGO egoistic

4.2 Measurement model

The Pearson correlation test was used to look into the relationship between the variables. The results revealed a significant correlation between PEB, PN, AR, AC, NEP, BIO, ALT, and EGO as presented in Table 5. The table results indicate that the variables representing environmental values exhibit a positive and significant correlation with beliefs, particularly in relation to the NEP. This suggests that as the level of environmental values increases among farmers, there is an expected elevation in their beliefs regarding environmental conservation.

A confirmatory factor analysis was used to evaluate the model. In addition, the measurement model sufficiently fit the data and offered a foundation to define each construct's validity and reliability. The fit indices for the measurement model were also calculated ($\chi^2 = 111.98$, $df = 54$, $RMSEA = 0.055$, $CFI = 0.99$, $NFI = 0.98$, $IFI = 0.99$, $SRMR = 0.040$) (Table 6). After checking the fit indices, it was found that the indices have acceptable values for the adequacy of the structural model to examine the research hypotheses. Figure 3 shows the structural model of the research based on factor loadings.

The convergent validity was approved due to the considerable factor loadings (Fig. 3). The durability of the composite was evaluated to determine the internal accuracy of the structures, both values being higher than the proposed threshold of 0.6 (Bagozzi & Yi, 1988). The reliability analysis was evaluated by Cronbach's alpha and all the values were above 0.7. In addition, it should be mentioned that the construct validity confirmed that all

Table 6 Summary of fit indices

	χ^2/df	RMSEA	CFI	IFI	NNFI	SRMR	NFI
Measurement model	2.37	0.062	0.99	0.99	0.98	0.040	0.98
Structural model	1.378	0.033	0.99	0.99	0.99	0.093	0.97
Recommended ^a	≤ 3	≤ 0.07	≥ 0.90				

^aVan Riper & Kyle, 2014 and Ahmad and Halim (2017)

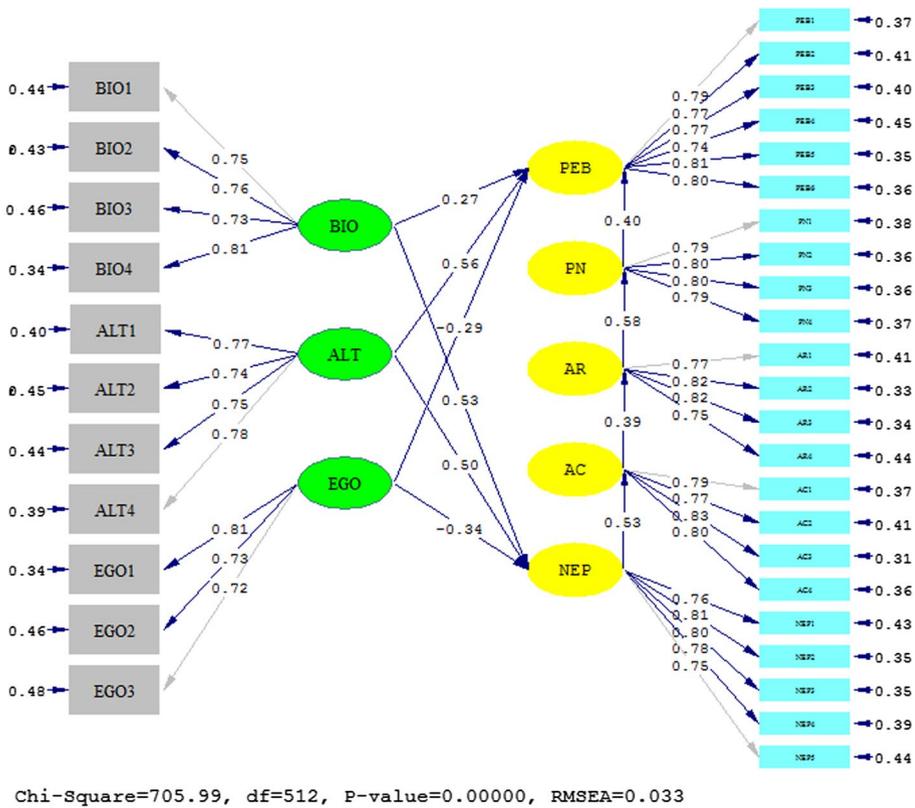


Fig. 3 Results from the study of the value-belief-norm theory in a latent variable direction

AVEs (average variance extracted) were greater than 0.5 (Valentini & Damasio, 2016) (see Table 3).

4.3 Results of structural equation modeling

This study used SEM to analyze the assumed correlations among PEBs (Anderson & Gerbing, 1988). As shown in Fig. 3, PEB, PN, AR, AC, and NEP were dependent whereas biospheric, ALT, and egoistic values were independent latent variables.

SEM was operated on 357 cases and the missing data was substituted by the series mean. All the fit indices were appropriate for the Measurement and Structural Model. A total of ten paths were investigated in the SEM.

The results revealed that there was a major and positive correlation between “BIO and altruism values” and the NEP, while there was not an important connection between “egoistic values” and the NEP. Moreover, there was a substantial and affirmative correlation between “BIO and altruism values” and the PEB, whereas there was not a significant correlation between “egoistic values” and PEB. The verified model showed a distinction among the biospheric, ALT, and egoistic values. Therefore, the three values used in this study were relatively distinct from each other.

According to the results, there was a strong and affirmative association with the PEB between NEP and AC, AC and AR, and AR and PN (Table 7). The findings of assessing the proposed hypotheses are outlined in Table 7, where Hypotheses H1a, H1b, and H1c delved into examining the influence of environmental values on NEP. Hypothesis H1a investigated the significant positive impact of BIO on the NEP of wheat farmers concerning the adoption of PEB. This hypothesis was confirmed ($\beta=0.53$; $t=6.75$). H1b was confirmed ($\beta=0.50$; $t=2.08$), focusing on determining whether ALT reflects more NEP among wheat farmers or not. H1c ($\beta=-0.34$; $p=1.49$) was not confirmed, meaning that EGO does not significantly influence NEP. Following that, H2a, H2b, and H2c delved into examining the impact of environmental values on PEB. H2a, examining the influence of BIO on PEB, was confirmed ($\beta=0.27$; $t=3.78$). H2b, with the assumption that an increase in ALT enhances PEB, was also confirmed ($\beta=0.56$; $t=2.30$). The influence of EGO on PEB was not significant among wheat farmers. The study's results rejected this hypothesis (H2c) ($\beta=-0.29$; $t=-1.30$). Additionally, it was revealed that NEP significantly influences the AC of wheat farmers ($\beta=0.53$; $t=8.54$), supporting H3. Additionally, the AC of farmers significantly impacted AR ($\beta=0.39$; $t=6.41$), confirming H4. H5, examining the impact of AR on PN, was confirmed ($\beta=0.58$; $t=9.27$). Finally, it was evident that PN ($\beta=0.40$; $t=7.53$) significantly influences the PEB of farmers, supporting H6. According to the results, it can be said that the wheat farmers pay attention to the environment.

Given the increasing experience about ecological protection and the demand for environmentally friendly products, agricultural development, especially understanding the decision-making process has become an important area with regard to the psychological aspects affecting the behavior. To investigate the decision-making process of agricultural producers and also according to the principles provided by Stern et al. (1999), the VBN theory was tested. However, this theory is less used in agriculture and in the behavior of farmers. Confirmatory factor analysis conducted on the environmental values of the model showed the distinction between the biospheric, ALT, and egoistic values. Therefore, the three values used in this study were relatively distinct from each other.

In general, the VBN theory could explain 35% of variance PEB. This indicates the applicability of the model in the field of agriculture, and other researchers for wider use of

Table 7 Results of the structural model

Directions			β	t value	Results
H1 _a : BIO	→	NEP	0.53	6.75	H1(+): ☺
H1 _b : ALT	→	NEP	0.50	2.08	H1(+): ☺
H1 _c : EGO	→	NEP	-0.34	-1.49	H1(N.S): ☹
H2 _a : BIO	→	PEB	0.27	3.78	H2(+): ☺
H2 _b : ALT	→	PEB	0.56	2.30	H2(+): ☺
H2 _c : EGO	→	PEB	-0.29	-1.30	H2(N.S): ☹
H3: NEP	→	AC	0.53	8.54	H3(+): ☺
H4: AC	→	AR	0.39	6.41	H3(+): ☺
H5: AR	→	PN	0.58	9.27	H3(+): ☺
H6: PN	→	PEB	0.40	7.53	H3(+): ☺

PEB pro-environmental behavior, *PN* personal Norm, *AR* ascription of responsibility, *AC* awareness of consequence, *NEP* new ecological paradigm, *BIO* biosphere, *ALT* altruistic, *EGO* egoistic, β standardized coefficient

this model will help future research. The results showed that VBN theory can be extended to other fields of behavior. Using structural equation modeling, “BIO”, “ALT” values, and “PNs” described 35% of the variance of PEB. In addition, the environmental beliefs had a mediating effect on PEB, while norms and values had a straight effect on PEB. This shows that norms and values are more effective than beliefs. In addition, PNs, beliefs, BIO, and ALT values are considered to be significant predictors of PEB. The results depict that there is a positive and significant correlation between biospheric and ALT values and PEB, which shows that wheat farmers who have higher levels of biospheric and ALT values engage in more PEBs.

5 Discussions

The obtained data from this study supported the correlation between the predicted BIO and ALT values and variables such as NEP, AC, AR, PN, and PEB, which were in line with the results of studies by Nordlund and Garvill (2002) Stage et al. (2005), and Choi and Tung (2015).

In this study, structural equation modeling with a psychological background was employed to investigate PEB. The findings of this study indicate that Stern’s (2000) VBN theory can be effectively applied to analyze the PEBs of wheat farmers and the influencing factors. The analysis of the data obtained from this study supports the positive and significant effect of BIO and ALT variables on NEP. These results were confirmed by research (Lee et al., 2023; Mahpour et al., 2023). Based on the structural model fitting results, only biospheric values (Chen, 2015; Choi et al., 2015; Hun, 2015; López-Mosquera & Sánchez, 2012; Nordlund & Garvill, 2002; Soure & Fischer, 2010; Vander Werff et al., 2013) and ALT values ($\gamma=0.50$, $t=2.08$) (Chen, 2014; De Groot, 2008; Ibtissem, 2010; López-Mosquera & Sánchez, 2012; Nordlund & Garvill, 2002; Schwartz, 1992; Soure & Fischer, 2010; Steg et al., 2005; Stern et al., 1999; Zhang et al., 2014) had significant impacts on NEP, while egoistic values (Ibtissem, 2010; López-Mosquera & Sánchez, 2012; Van Riper & Kyle, 2014) had no impact on the NEP, which was not consistent with the findings of studies by Zhang et al. (2014) and Schwartz (1992). NEP was under the positive and direct impact of biospheric and ALT values while having a non-significant and negative relationship with egoistic values. These relationships have been investigated in various studies on the PEB and environmental protection theories (Abrahamse et al., 2007; De Groot, 2008; Ibtissem, 2010; Steg et al., 2005; Stern et al., 1999; Van Riper & Kyle, 2014). Therefore, the biospheric and ALT values have been caused strengthening of the NEP otherwise, egoistic values had a non-significant and negative impact on the NEP which may be because of lower egoistic values between people evaluating NEP in this research. Values of the BIO may lead to changes in the behavior of wheat farmers towards the environment, guiding them toward new and sustainable strategies and approaches in agriculture. It may also enhance the sense of responsibility among wheat farmers regarding environmental protection, urging them to participate more actively in conservation activities. Furthermore, the acceptance of eco-friendly values may steer wheat farmers toward adopting more sustainable agricultural methods, encouraging them to optimize processes and utilize natural resources efficiently. Additionally, wheat farmers who understand and embrace eco-friendly values may establish better connections with their environment and engage in more effective conservation measures.

The fitting results showed that BIO and ALT values had a positive and significant effect on PEB, while selfish values did not have a significant effect on PEB. Zhang et al., (2014) in their research on the prediction of PEB of residents in tourist places found that ALT values had a positive and significant effect on NEP, which is consistent with the results of this research. In another study, Han et al., (2018) showed that BIO values among museum visitors had a positive and significant effect on NEP, which was in line with the results of this research. The findings of this study indicate that BIO values can influence a shift in the consumption pattern of natural resources and lead wheat farmers to adopt more sustainable agricultural methods. This impact may be linked to an increased sense of responsibility toward environmental protection, thereby encouraging greater active participation in conservation and environmental activities. Additionally, embracing ALT values may strengthen individual connections with the environment, motivating individuals to take actions that optimize processes and the utilization of biological resources in agriculture. These positive connections can drive favorable changes in environmental practices within the agricultural sector, positively influencing the PEBs of wheat farmers.

The study results showed the important and positive impact of NEP, AC, AR, and PN on PEB. These findings were in line with those of Gärling et al. (2003), Han et al. (2018), Nordlund and Garvill (2002), Schwartz (1977), López-Mosquera and Sánchez (2012), Jansson et al. (2010), and Zhang et al. (2014). NEPs were incorporated into the model as macro components to assess individual attitudes and values regarding environmental issues. The results indicate that these paradigms significantly influence people's awareness of the consequences associated with environmental issues. Individuals with a higher level of awareness regarding environmental consequences demonstrate more positive inclinations towards protective measures and active participation in environmental activities. Furthermore, the research findings reveal that wheat farmers with a heightened awareness of environmental consequences exhibit a greater sense of responsibility toward environmental protection. Assigning responsibility to the environment emerges as a key factor contributing to an elevated level of personal standards among wheat growers. These factors play a positive role in promoting environmentally friendly practices and protective measures in agriculture and related activities. Lastly, personal norms, defined as individual beliefs and values across various aspects of a person's life, are identified as influential factors shaping decisions and behaviors in agriculture and the environment. The results highlight that wheat farmers holding positive personal norms aligned with environmentalist values participate most actively in environmental agricultural activities. This positive correlation underscores the significant impact of personal norms in fostering environmentalist behaviors among farmers. These results emphasize the importance of promoting positive personal norms consistent with environmental values among wheat farmers to enhance environmentally friendly agriculture practices. These results can provide insights for shaping policies and initiatives designed to promote impactful environmental practices within the agricultural sector.

Our results showed that the VBN theory can be extended to other fields of behavior. The findings of this research showed that PEB may be enhanced by emphasizing ALT and biospheric values, and individual norms. Scholars in different fields (Chen & Tung, 2014; De Groot et al., 2007; Han et al., 2018; Kim et al., 2013a, 2013b; Zhang et al., 2013) have also measured the adequacy of each inquiry (Bamberg & Moser, 2007; Bamberg et al., 2007; Harlan et al., 2010).

In this study, a variety of structural modeling measures were used to illustrate how a theoretical framework combined biospheric benefit, ecological worldview, bad consequences for key objects, ascribed responsibility, and a sense of commitment to adopt

pro-environmental actions. Therefore, this model can be widely used for advances in theory and models in environmental contexts. Moreover, the theoretical framework in this study gives a clear understanding of the environmental decision-making process of members. The results of this study can be useful for farmers, policymakers, and agricultural planners because, with the help of this model, they can identify environmentally PEB and take action to provide and use useful solutions. The findings of this study may not generalize to the formation of pro-environmental decisions or behaviors for all farmers and may be influenced by their culture or nationality. Environmental behaviors of members can vary in national cultures. Future studies should examine the influence of national culture on the intended theoretical framework. There may be no moral pressure on survey participants to declare an interest in the environment when filling out the questionnaire, as there are many studies on pro-social or environmental actions that are ultimately beneficial to society and the environment. As a result, the survey's results should be carefully analyzed and generalized. Random samples from one location were chosen for the current investigation. This means that the samples do not fully represent the whole population of Iran. Therefore, it should be remarked that this study included limitations of sampling. Future research should have more indexes to precisely assess the attractiveness of options. Finally, the suggested theoretical model includes the expandable VBN theory. Other prominent structures in the context of PEB may not be included in this model. Recognizing these factors and putting them together in our proposed theoretical framework would be a substantial addition to this research. Because of the status of eco-friendly worldviews, personal values, opinions, and norms in environmental decision making and behavior of wheat farmers, strategies and programs need further studies on the impact of psychological factors on environmental behavior as well as the awareness of the method to increase ecological farming. The impact of political measures, especially agricultural extension plans, on the environmental manner of farmers can also be analyzed in future research.

In general, the result showed that the VBN theory could explain 35% of the variance of PEB. Furthermore, the total effects of independent variables on PEB show that among different predictors of wheat farmers' PEB, ALT values had the highest total effect on PEB, PNs were the second effective factor, and the third was biospheric values (Table 8)—showing that norms and values are more effective than beliefs, which can be very helpful for future policymaking.

Table 8 Results of the total effects of independent variables on PEB

Dependent variable: PEB	
Independent variables	Total effect
BIO	0.29
ALT	0.58
EGO	NS
NEP	0.05
AC	0.21
AR	0.09
PN	0.40

NS not significance

6 Conclusion

In this study, we investigated the PEB of wheat farmers through the VBN theory. The results showed a better understanding of the environmental behavior of wheat farmers. The VBN model showed that ALT values were the main predictors of PEB. The present study provided further evidence that environmental values, especially ALT values and biospheric values, are important predictors of environmental beliefs and PEB. Among the model components, only environmental beliefs had a mediating effect on PEB, while norms and values had a direct impact on PEB.

According to the current study, there was a significant positive correlation between biospheric and ALT values and PEB, which indicates that most wheat farmers are concerned about environmental values. The result of this study suggests that environmental behavior can be strengthened by emphasizing ALT and BIO values, enhancing environmental awareness, increasing ascription of responsibility, and strengthening PNs for reformative actions.

Overall, the findings of this investigation provided strong support for the key assumptions underpinning the VBN hypothesis. The findings revealed that model components such as biospheric and ALT values, a NEP, knowledge of consequences, attribution of responsibility, and PNs explain PEB variation. Furthermore, the study's findings have practical ramifications for planners. According to the findings, if planners want to enhance wheat farmers' environmental behaviour, they should tailor their services to their values, beliefs, and personal standards. According to these results, we can conclude that the biospheric and ALT values can be effective as a values cluster on PEBs. Given the importance of environmental worldviews, personal values, beliefs and norms in environmental decision making and behavior of wheat farmers, strategies and programs need further study on the impact of psychological factors on environmental behavior as well as the awareness of the method to increase ecological farming.

In this research, we investigated the PEB of wheat farmers through the VBN theory. The results revealed a more reliable understanding of the environmental behavior of wheat farmers. The VBN model showed that ALT values were the main predictors of PEB. The present study provided further evidence that environmental values, especially human values and ecosphere values, are important predictors of green beliefs and PEB. Among the model components, only environmental beliefs had a mediating effect on PEB, while norms and values had a straight effect on PEB.

According to the research, there was an important affirmative connection between biospheric and ALT values and PEB, which indicates that most wheat farmers are concerned about environmental values. The outcome of this research indicates that environmental behavior can be strengthened by emphasizing ALT and BIO values, enhancing environmental awareness, increasing social responsibility, and strengthening individual norms for reformative actions.

Generally, the outcomes of this research extensively maintained the main assumptions underlying the VBN theory. The results showed that components of the model, including BIO, ALT, NEP, AC, AR, and PN, explain the PEB variance. According to these results, we can conclude that the BIO and ALT values, as ideal clusters, can affect PEBs.

6.1 Limitations and suggestions for future studies

This study has several limitations that need to be considered in future research. Most obstacles to accountability are financial costs, and as a result, response costs and the time and financial constraints associated with assistance are significant. If the objective is to increase the adoption of these formative measures, it appears that financial assistance for farmers' livelihoods, who are reluctant to take safe steps without specific incentives, is a requirement for broad acceptance. In addition, the results cannot be generalized to all farmers at every level, because farmers display different behaviors under different conditions and for different crops. In addition, data has been collected using surveys over a period. Thus, these data may not reflect the contribution of all the farmers to the changing environmental values, beliefs, norms, and behaviors in the future. Finally, Iran, as one of the large countries in the Middle East, with a high population, is witnessing unprecedented pressure from environmental degradation. As a result, the impact of its cultures and values on the beliefs, attitudes, and PEB of local people could be very diverse, which would lead to more theoretical and practical findings. It is advised that research studies should use this theory as a framework to analyze the PEB of various social groups and comprehend factors influencing these behaviours given the significant role that various social groups, such as farmers and consumers, play in environmental protection on the one hand, and the evidence that demonstrates the importance and effectiveness of the VBN on the other.

This work contributes to the existing body of knowledge by expanding on the VBN hypothesis. The VBN theory provides a solid description of the causes of the overall proclivity towards PEB. This study also supports the incorporation of social norms in VBN since it increases the theoretical framework's predictive power in determining PEB. This research solely looks at environmentally friendly practices. In order to better understand and address environmental challenges, future research should investigate the underlying causes of negative behaviors among farmers, especially those that have a detrimental impact on the environment. This study uses social norms to expand VBN theory, although additional factors should be included when evaluating PEB. Future studies could examine the factors such as environmental knowledge and concern into the conceptual framework to boost the model's explanatory power. Furthermore, further empirical research on the antecedents and influencers of each PEB should be conducted since the findings demonstrated that societal norms and PNs impact each PEB with varying degrees of strength. This study employed purposive sampling; therefore, the results may not be generalizable to the full population. This study might be replicated in the future utilizing probability sampling. It is also advised that future studies should investigate combining qualitative and quantitative methodologies to acquire a better understanding of the varied PEB.

6.2 Policy, managerial implications and suggestions

Finally, according to the results of this study, the following policies and management implications are proposed:

- If planners want to enhance the environmental behaviors of wheat farmers, they must provide their services based on the ethics, opinions, and specific norms of wheat farmers.

- Participatory initiatives that help farmers, enhance their abilities, and increase their sense of control over the environment and its effects are critical.
- Agricultural development organizations may help the environment by implementing several economic and social incentives, as well as social learning initiatives.
- Occasions for farmers' participation in cooperative progress and making a proper decision may strengthen a sense of control, technical skills, and social networking.
- Highlighting the extent of environmental degradation due to the unsustainable use of resources of water and soil is expected to increase the adoption of conservation methods.
- In addition, it is useful to describe practical solutions for the sustainable utilization of natural resources.
- Farmers' attitudes toward pro-environmental acts can be influenced by supporting them to execute behaviors for the first time, which increases the possibility of recurrent PEB.

From a policy standpoint, these findings can lead to a variety of suggestions. First and foremost, there is a pressing need to strengthen the infrastructure supporting PEB. This might be one of the most crucial components in addressing environmental concerns. Second, there must be a more profound shift in rural society's views and values. In this context, information campaigns, education programs, media efforts, and leadership aimed at influencing farmers' attitudes might be highly useful. Finally, measures to promote PEB should be tailored to certain demographic groups. There are several explanations for this. Primarily, various farmer groups may react to these schemes in different ways. This would necessitate tailoring the substance of programming so that it reaches the target audience. In addition, different farmer groups perform differently in terms of PEB. Lower-performing groups, such as younger individuals, and those with very low and very high incomes could be given greater weight. Although promising results were found for agricultural managers and planners, one must be cautious about the generalization of the results. While the present research included a group of wheat growers in Iran, it should not be assumed that the same results would be obtained elsewhere. However, since our results are in line with other PEB studies that use VBN theory, we believe this study expands the scope of the predictive power of VBN theory in other regions with similar conditions.

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Availability of data and material Raw data were generated at Tarbiat Modares University. We confirm that, the data, models, or methodology used in the research are proprietary, and derived data supporting the findings of this study are available from the first author on request.

Declarations

Conflict of interest We have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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