



# Hierarchy of value orientation and beliefs in climate change influencing the farmers' extractive or non-extractive behavior on the farm

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## Abstract

Understanding drivers of farmers' extractive and non-extractive behavior regarding natural resources has become increasingly important in the face of anthropogenic climatic change, which is a major challenge in today's world. Non-extractive behavior on the farm refers to the use of natural resources to the extent that it is possible to renew the context and not harm nature and non-renewable resources. Extractive behavior on the farm is associated with the extensive extraction of natural resources without provision for their renewal such as digging deeper wells instead of using water optimally, using chemical fertilizers with more repetition and higher dosage instead of the bio-fertilizers, and as a later result more climate change. To successfully respond human-made climate change using a cognitive hierarchy model, the influence of values on belief and behavior was assessed by a survey method among farmers of Zanzan province, Iran. A representative sample of 265 farmers was surveyed using proportional randomized multi-stage sampling. The results revealed that value orientation significantly elucidated 21% of the variability in non-extractive behavior and 26% of extractive behavior variance in a direct way and through beliefs in climate change. The recommendations have been presented to increase farmer's efforts to reduce their ecological footprint in nature.

**Keywords** Pro-environmental behavior · Value orientations · Anthropogenic climate change

## 1 Introduction

The agricultural sector has a complex relationship with climate change which is both driven and influenced by it (Woods et al., 2017; Ghazali et al., 2021; Wheeler et al., 2021). Climate change in addition to the ecosystem transformation is one of the major threats to sustainable food security (Mase et al., 2017), which can cause widespread modifications in socioeconomic systems (Drolet & Sampson, 2017) and farmers' health risk management

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(Li et al., 2021). Rural communities are sensitive to climate change in terms of their economic dependence on climate-dependent agriculture (Austin et al., 2020). This is especially true for subsistence agriculture, which is inherently sensitive to rainfall and temperature patterns (Ghoochani et al., 2017). Farmers in general and subsistence farmers in particular are close witnesses to climate change, struggling to make a living in the face of these emerging disruptions (Karki et al., 2020). There are adaption strategies to reduce the impact of climate change on agriculture and subsistence farmers, and vice versa, but their success depends on the participation of the farming community, and this participation is usually influenced by farmers' beliefs (Wheeler et al., 2021). Thus, understanding factors influencing farmers' adaption strategies and beliefs is of importance (Arbuckle et al. Jr., 2015; Zamasiya et al., 2017; Azadi et al., 2019) considered in the current study.

Agriculture, forestry, and land-use activities are in charge of about 24% of the total anthropogenic greenhouse gas emissions universally (Zhang et al., 2020). The extraction of natural resources has played a major role in carbon emission and climate change (McCauley & Heffron, 2018; Mueller & Tickamyer, 2020). Reducing extraction behaviors that could lead to anthropogenic climate change require policy and behavioral reforms at individual, national, and universal levels (Mayer & Smith, 2019). Since behavior modification in communities starts from the individual level, encouraging non-extractive behaviors with natural resources in society requires understanding how individual behaviors are formed (Mueller & Tickamyer, 2020). Individual behavior is investigated in the present study using cognitive hierarchy based on cognitive values and beliefs. Meanwhile, there are some studies highlighting the threat appraisal as influencing protective behavior (Karami & Ahmadi, 2022) as well as the non-extractive behaviors like using renewable energies on farms (Badsar & Karami, 2021). Value orientations are the basis for the formation of behavior (Pitas et al., 2020). According to Manfredo and Urquiza-Haas (2020), value orientations have undergone changes in favor of anthropomorphism under the influence of modernization. But, it remains largely unknown whether people have anthropocentric or biocentric values, or if the current generation acts to mitigate climate change or not. This is basically due to the fact that they think it is the moral responsibility of previous generations who damaged the environment to make changes to mitigate climate problems (Sarrasin et al., 2022). These changes in values could be transmitted to beliefs and ultimately lead to behavioral intention and behavior. Therefore, to avoid misunderstandings about human behavior that can lead to ineffective or misguided policies, it is necessary to focus on psychological variables in the formation of behavior (Clayton et al., 2015). In this regard, the current study examined the cognitive hierarchy of farmers' extractive or non-extractive behavior formation.

## 1.1 Theoretical orientation

Agriculture is the main economic activity in rural areas, which is carried out at subsistence and commercial levels. Agriculture can be accompanied by indiscriminate extraction of natural resources, or it can be implemented using safe and less harmful methods for natural resources. To explain the rural people's extractive or non-extractive behavior on the farm, the cognitive hierarchy framework developed by Fulton et al. (1996) has so far been applied, which is used and confirmed by recent studies in the context of climate change (Paudyal et al., 2015; Mueller & Tickamyer, 2020). Cognitive hierarchy is a framework for understanding and predicting responses to natural resources usage and the formation of behavior based on cognitive values and beliefs in the field of social psychology (Zhang

et al., 2020). The cognitive hierarchy is mostly represented by an inverted pyramid with different levels (Koriyama & Ozkes, 2021). This model represents a linear structure that starts from value orientations and continues to patterns of beliefs, attitudes, behavioral intentions, and behaviors. Value orientations are limited and generally resistant to change in a deep-seated manner. In contrast, as we move toward beliefs, attitudes, and behavior, the variety and speed of change will be greater, and usually based on contextual conditions (Pitas et al., 2020).

Values and value orientations are limited in number, placed at the first level of cognitive pyramid, and can create specific and diverse patterns of beliefs even without individual awareness (Pitas et al., 2020). The importance of values that are widely shared by all members of a culture as fundamental bases to individual's identity and self-concept, indirectly lead to the belief, attitude, and behavior, is supported by studies (Paudyal et al., 2015; Hornsey et al., 2016; Whitley et al., 2018; Bouman et al., 2020; Manfredo et al., 2020; Zhang et al., 2020; Ballantyne et al., 2021; Wan Hussain et al., 2021; Sarrasin et al., 2022). The study of psychological values such as altruistic and biospheric showed that values are good predictors of a behavioral change focusing on reducing carbon emissions (Zhang et al., 2020). The biocentric and anthropocentric values are two core values related to climate change (Amérigo et al., 2007; Mueller & Tickamyer, 2020). Some researchers have worked on the biocentric value by defining it as the value of nature caring for its own sake (Bouman et al., 2020), and other scholars have worked on the anthropocentric value referring to the nonhuman world as provided for merely human use (Manfredo et al., 2020). A biocentric value was related to caring about nature and the environment. This was clearly proven in a study where value biocentric across 23 European countries positively influenced motivational emotions about climate change and personal climate mitigation behaviors (Bouman et al., 2020). Moreover, individuals with biocentric values are more likely to protect the environment (Hornsey et al., 2016; Whitley et al., 2018; Wan Hussain et al., 2021). Sarrasin et al. (2022) found that biocentric values underlie ecological beliefs among young people and were basically related to high schoolers' actual attendance to a local permaculture gardening activity, but not to a generic commitment to pro-environmental actions. An anthropocentric value assumes that the nonhuman world is provided for human use merely, which is associated with specific attitudes and behaviors (Manfredo et al., 2020). According to Amérigo et al. (2007), an individual whose cognitive structure is closer to the anthropocentric pole was less likely to engage in future ecological behaviors compared to the biocentric subject. The same line with the study of Mueller and Tickamyer (2020) showing that anthropocentric value is significantly associated with extractive behavior, and negatively associated with non-extractive behavior. Considering the anthropocentric values which guide humans in their efforts to dominate nature, Soyeux et al. (2009) found that the anthropocentric value orientation is significantly related to pro-environmental attitude and behavioral intentions among Russian samples, while these relations were not significant for the German sample by showing the cultural differences in the value orientation influences.

A belief is something about the world that an individual thinks to be true (Mueller & Tickamyer, 2020). According to value-belief-norm theory, when a condition threatens an abstract goal which is important in the person's life (such as climate change for farmers), action is activated by beliefs under the pressure of values (Stern, 2000). Investigating beliefs on climate change is a good starting idea for policymaking (Zobeidi et al., 2016). Belief in addition to value could be influenced by contextual variables like education, sex, subjective knowledge, and experience of extreme weather events (Hornsey et al., 2016). Belief in climate change is one of the prerequisites for adapting to climate change and

taking actions (Clayton et al., 2015; Zamasiya et al., 2017; Zhai et al., 2018). Although belief is not a definitive requirement for action on climate change, different environmental and supportive policies are requisite and influential, especially for farmers with financial constraints. For example, Wong-Parodi and Rubin (2022) found that subjective attribution amplifies a positive relationship with individuals' intentions to perform pro-environmental actions and to provision related policies such as carbon tax policy support. Studies showed different results about the impact of climate change beliefs on willingness and behavior: Some identified a weak relationship between beliefs on climate change influencing the extent to which people are willing to act in climate-friendly ways (Hornsey et al., 2016), and some found that belief significantly influences adaption behavior in Iran (Azadi et al., 2019). Another study showed that beliefs can meaningfully contribute to our understanding of the levels of both action and inaction in the environmental domain (Duchi et al., 2020). Ignell et al. (2019) found student education as slightly effective to change the beliefs about the possible collective action in response to climate change.

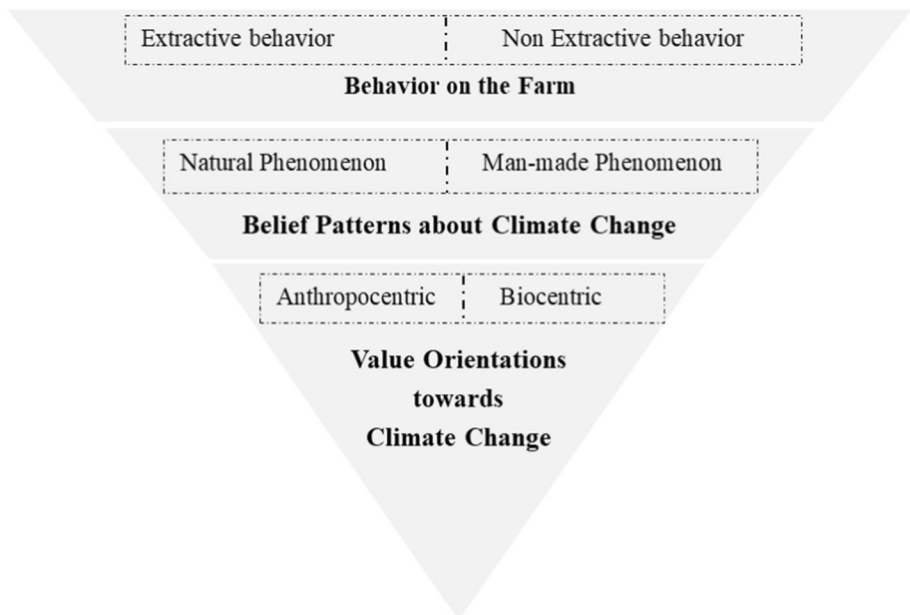
Whitley et al. (2018, p. 245) showed that "one's values matter in environmental decision-making, but those different values are associated with different behaviors." Local empowerment in environment conservation is crucial (Ghasemi et al., 2021) for both ways of dealing with climate change. The first way is to slow or stop climate change by mitigating greenhouse gas emissions, and the other is to try to adapt to new conditions caused by climate change (Gosnell et al., 2019; Wang & Zhang, 2020). Various strategies to cope with climate change have been introduced, including the adjustment of agricultural planting date, improving the farmland's ecological environment, adjusting crop variety, adapting new technology, exiting agriculture, purchasing agricultural insurance, building new infrastructures, increasing irrigation, increasing pesticide and chemical fertilizer input (Zhai et al., 2018; Hamidianpour et al., 2020). As mentioned earlier, most strategies are based on non-extraction and less damage to natural resources for adaptation to climate change, but some like the last two are different. That is why adaptation behavior is constructed by the amount of caring for extraction or non-extraction of natural resources. Mueller and Tickamyer (2020) have used extractive and non-extractive behaviors in testing a cognitive hierarchy of support for natural resource-related economic development in rural Pennsylvania. Extractive or maladaptive behavior in agriculture refers to extensive extraction of natural resources without provision for their renewal, which may be formed when one believes that climate change occurs as a natural process. That is a cyclical process not being the result of human actions (Austin et al., 2020) and humans have the right to dominate the rest of the natural world and the right to exploit natural resources without restrictions (Panu, 2020).

Non-extractive paralleling to adaptive behavior refers to using natural resources to the extent that it is possible to renew the context and not harm nature and non-renewable resources. Non-extractive behavior includes actions related to crop diversification (like adjusting the crop variety) (Zhang et al., 2022), soil (like soil conservation technique, use of organic fertilizers), water (like less use of ground water, rainwater harvesting), and change in cultural practices (like migration, change in occupation) (Chalisse et al., 2015). However, adaption strategies differ from farmer to farmer based on the causes of climate change in the specific geographical area. In Khyber Pakhtunkhwa (KPK) province of Pakistan, the strategies were non-farm activities, water harvesting, tree planting, early sowing, and terracing (Ali et al., 2021). Belief in biocentric value had a positive relationship with supporting non-extractive behavior (Mueller & Tickamyer, 2020) like the practice of energy-saving among Malaysian students (Wan Hussain et al., 2021). Ignell et al. (2019) revealed that a "biospheric value was positively associated with willingness to reduce personal consumption and to accept higher

price.” Ghanian et al. (2020) found that belief in climate change derived from timely information reduces farmers’ maladaptation intention which, in turn, affects the adaptation intention and behavior. The study of Marie et al. (2020) indicated that the older household head reducing the major problem of climate change was more likely to apply changing sowing period, mixed cropping, use of water and soil conservation techniques, and application of crop varieties resistant to drought, which are mostly non-extractive behaviors.

Furthermore, the interpretation of the cognitive hierarchy of behavior formation requires examining the background variables associated with extractive and non-extractive behaviors. Studies showed that older individuals to whom people and the earth are extremely vulnerable to (Corner et al., 2015) were environmentally oriented (Panno et al., 2018), while it was observed that young people who have to live with a lower share of carbon intending to less contribute to climate change disaster express more concerns about these changes (Hickman et al., 2021; Sciberras & Fernando, 2022). But do these concerns lead them to extracting less from natural resources? or do they think that it is the moral responsibility of the previous generation who created the changes, to alleviate the climate problems (Sarrasin et al., 2022)? Other relevant contextual variables include average annual income from agricultural activity, land size, participation in relevant courses on climate change and adoptive behavior, and agricultural work experience. It should be noted that due to the importance of the cognitive hierarchy test of behavior formation, according to the theory, contextual variables were not included in the model and their correlation with extractive and non-extractive behaviors was investigated separately for further interpretation.

Therefore, based on the theoretical orientation and the conceptual framework (Fig. 1), the following hypotheses formulated:



**Fig. 1** The conceptual framework of the study

**H1** Anthropocentric value has a significant effect on belief in climate change as a natural phenomenon.

**H2** Anthropocentric value has a significant effect on belief in climate change as a man-made phenomenon.

**H3** Biocentric value has a significant effect on belief in climate change as a natural phenomenon.

**H4** Biocentric value has a significant effect on belief in climate change as a man-made phenomenon.

**H5** Anthropocentric value has a significant effect on extractive behavior.

**H6** Anthropocentric value has a significant effect on non-extractive behavior.

**H7** Biocentric value has a significant effect on extractive behavior.

**H8** Biocentric value has a significant effect on non-extractive behavior.

**H9** Belief in climate change as a natural phenomenon has a significant effect on extractive behavior.

**H10** Belief in climate change as a man-made phenomenon has a significant effect on non-extractive behavior.

**H11** Belief in climate change as a natural phenomenon mediates the relationship between anthropocentric value and extractive behavior through.

**H12** Belief in climate change as a natural phenomenon mediates the relationship between anthropocentric value and non-extractive behavior through.

**H13** Belief in climate change as a natural phenomenon mediates the relationship between biocentric value and extractive behavior through.

**H14** Belief in climate change as a natural phenomenon mediates the relationship between biocentric value and non-extractive behavior through.

## 2 Methods

This is a correlational descriptive research which was conducted in a survey method using a questionnaire. The location of the study was Zanjan province which is in the northwestern part of Iran. Iran is one of the arid and semiarid regions in the climatic zoning of the world, and the predominant climatic type of Zanjan province is semiarid and cold. The study results of the Natural Climate Variability of Zanjan using the LARS-WG model showed that the temperature and precipitation of the Zanjan have changed during the past 30 years and is expected to change in the future (Khazaei et al., 2019). These results

confirmed the climate changes in Zanjan province and the importance of farmers' adaption to these changes.

The population of this study include farmers in Zanjan province. Zanjan province includes 8 counties namely: Zanjan, Abhar, Tarom, Mahnesan, Khodabandeh, Soltanieh, Khorramdareh, and Ijroud. Proportional multi-stage random sampling was performed to determine a representative sample from the population. In the first stage, four counties including Zanjan, Khodabandeh, Khorramdareh, and Abhar were randomly selected. The second stage was to choose the settlements in each county randomly. The number of villages in each county was determined based on the proportion of farmers in that county and the needed number of samples. Four villages in Khodabandeh, three in Zanjan, one in Khorramdareh, and one in Abhar were randomly selected. In total, nine villages in four counties were selected. In the last step, the respondents of the study in each village were selected using simple random sampling.

According to the 2021 Agricultural Census Report, Statistics Center of Iran 83,261, agricultural operators are working in 8 mentioned counties of the Zanjan province. Cochran's formula was used to determine the sample size as below:

$$n = \frac{\frac{t^2 pq}{d^2}}{1 + \frac{1}{N} \left( \frac{t^2 pq}{d^2} - 1 \right)} = \frac{\frac{1.96^2 * (0.5)(0.5)}{0.06^2}}{1 + \frac{1}{83,261} \left( \frac{1.96^2 * (0.5)(0.5)}{0.06^2} - 1 \right)} = 265$$

where  $n$ =required sample size,  $t$ =value for the selected alpha level of 0.025 in each tail=1.96 (confidence level at 95%),  $(p)$   $(q)$ =estimate of variance=0.25,  $d$ =acceptable margin of error for the proportion being estimated=0.06, and  $N$ =population size (83,261 farmers). The calculated sample size was 265, but to ensure the sample's adequacy, the number of distributed questionnaires was increased to 300 due to the possibility of non-response. The response rate was about 90% and by excluding the 5 questionnaires that were not completed the exact number of collected questionnaires reached 265.

A questionnaire with structured items surveyed the characteristics of farmers. The validity of the study instrument has been evaluated using the point of view of agricultural education experts, and specialists in the field of farmers' behavior. The reliability of the questionnaire was measured and confirmed through a pilot study conducted in a village of Zanjan County, which is among the study population and is outside the sample. Furthermore, based on the main data through conducting a measurement model, composite reliability (CR) was assessed and is reported in Table 1. The results of CR for the all constructs were equal or more than 0.70 indicating high internal consistency. In addition to demographic queries, the questionnaire included six variables: two variables of the value orientation, two belief variables about climate change, and two variables related to the extractive, non-extractive behavior. The research variables were measured based on a Likert-type scaling from (1) to (5) which is explained in Table 1.

The value orientations including biocentric value by 4 items and anthropocentric value by 4 items were measured. The scale was adapted from the study of Vaske and Donnelly (1999) which was used in a recent study (Mueller & Tickamyer, 2020).

The belief in climate change was conceptualized in terms of two variables, which have been assessed with 4 items obtained from reviewing the literature (Hornsey et al., 2016; Duchi et al., 2020; Ghanian et al., 2020). Belief in climate change as man-made was the first, and belief in climate change as a natural phenomenon was the second variable.

To develop the measure of extractive and non-extractive behavior, the strategies of climate change adaptation reported in the study of Ghanian et al. (2020), Hamidianpour et al.

**Table 1** First-order confirmatory factor analysis result (standardized factor loading)

Constructs	Measurement items	Mean	Standardized factor loading	t-value	AVE	CR	ASV	MSV
1. Anthropocentric value	The primary value of nature is to provide basic natural materials and resources for people who depend on it for their way of life (Anth.1) Nature is valuable only if they produce jobs and income for people (Anth.2) The value of nature exists only in the human mind. Without people, nature has no value (Anth.3) The primary value of nature is to generate money and economic self-reliance for communities (Anth.4)	3.15	0.742	(fixed)	0.54	0.72	0.08	0.18
2. Biocentric value	Nature caring for its own sake is above self-interests (Bio. 1) Nature and people have equal rights to live and develop (Bio. 2) Nature have value, whether people are present or not (Bio. 3) Nature have as much right to exist as people (Bio. 4)	4.12	0.742 0.854 0.687 0.833	(fixed) 13.25 10.73 12.99	0.61	0.86	0.11	0.31
3. Belief in Climate Change as a Natural Phenomenon	I believe climate change is a natural phenomenon (Item 1) I think climate change is a natural circle. Nature does whatever it wants to do, and what we do or don't do has very little effect (Item 2)	3.18	0.678 0.850	(fixed) 7.08	0.59	0.74	0.10	0.15
4. Belief in Climate Change as a Man-made Phenomenon	I believe that every single human being is responsible for climate change (Item 1) I believe it is the governments that caused climate change (Item 2)	3.90	0.679 0.772	(fixed) 7.22	0.53	0.70	0.12	0.31
5. Extractive behavior	Increasing pesticide and chemical fertilizer input (Extra. 1) Increasing the depth of well (Extra. 2) Using high-tillage techniques (Extra. 3) Building new infrastructures like digging a well for more irrigation (Extra. 4)	3.15	0.556 0.840 0.677 0.905	(fixed) 9.30 8.25 9.49	0.57	0.84	0.08	0.18
6. Non-extractive behavior	Using drought-tolerant native crop varieties (Non_ extra. 1) Using products with lower water requirements (Non_ extra. 2) Using low-tillage techniques (Non_ extra. 3) Purchasing agricultural insurance (Non_ extra. 4) Adjusting the crop variety (Non_ extra. 5) Adjusting the periods of planting (Non_ extra. 6)	3.56	0.772 0.691 0.581 0.683 0.867 0.781	(fixed) 11.34 9.36 11.20 14.61 13.06	0.54	0.87	0.07	0.16



(2020), and Zhai et al. (2018) were reviewed and categorized as in extractive (4 items) and non-extractive (8 items) behavior. To operationalize the items, farmers were asked to what extent they used any of the extractive or non-extractive strategies.

The data were collected by a trained interviewer to control the influence of the interviewers on participant responses with in-person interviews as most of the respondents were illiterate. On average, each interview lasted about an hour, and data collection was done in 30 days with three trained interviewers. Besides, since data collection was performed in January and February 2022, during the outbreak of COVID-19, health protocols and social distance were observed during the interviews and the completion of the questionnaire. The data were analyzed using the AMOS software for Structural Equation Modeling (SEM). SEM is a multivariate technique defined as a combination of factor analysis and route analysis that enables the analyst to simultaneously investigate a series of dependent connections between exogenous and endogenous variables (Ho, 2006, p. 281). The main SEM assumptions that have been met in the present study include independent observations, random sampling of respondents, and the linearity of relationships between exogenous and endogenous variables.

SEM provided a comprehensive means to validate the measurement model of latent constructs. Measurement model specifies the rules governing how the latent variables are measured in terms of the observed variables, and it describes the convergent and divergent validity and reliability properties of the observed variables. Then, the structural model is specified and it permits directional predictions among a set of independent or a set of dependent variables as well as modeling of indirect effects, either observed or latent (Ho, 2006). Furthermore, Pearson correlation test was conducted to estimate the correlated demographic variable with extractive and non-extractive behavior.

### 3 Results

This study's results are analyzed based on data obtained from 265 farmers in Zanjan province, Iran, with an average age of 41.2 (minimum 15 and maximum 82) and mean work experience of 22 years in agricultural work. The average cultivated land of the studied farmers is 4.8 hectares. Although more than 70% of the studied farmers have not participated in any course related to climate change adaptation strategies, the rest of the people have completed from one to seven related courses. In general, 17.7% of the respondents were illiterate, 38.5% were literate to the extent of limited reading and writing, 26.8% had a diploma, and 17% had a higher diploma degree. Considering that the study population was farmers and in Iran, the main responsibility for agriculture is often borne by men, most of the samples studied were men, except for 6 women who were heads of households. Wheat, barley, alfalfa, clover, beans, garlic, and vegetables such as tomatoes and potatoes are the primary crops in the study region. According to Table 1, the descriptive results of study variables which had been measured using five-point Likert scale showed that the study population apply the extractive strategies at a moderate level, while the use of non-extractive strategies was over than moderate. Furthermore, the respondents exposed an average level of anthropocentric value and belief in climate change as a natural phenomenon, while they report a higher level of biocentric value and belief in climate change as a man-made phenomenon.

The Pearson correlation results reported in Table 2 showed a significant positive relationship between respondents' usage of extractive strategies in the farm with age, average

**Table 2** The result of demographic variable correlation estimate

	Pearson correlation estimates	
	Extractive behavior	Non-extractive behavior
Age	0.175**	−0.071
Average annual income from agricultural activity	0.211**	−0.294**
Agricultural land size	0.207**	−0.355**
Participate in relevant courses	−0.433**	0.315**
Agricultural work experience	0.166**	−0.171**

Correlation significance: \*\* $p < 0.01$ ; \* $p < 0.05$ 

annual incomes from agricultural activity, agricultural land sizes, and agricultural work experience, while the relationship of the level of participation in relevant courses was negative and significant. Furthermore, the results of examining the correlation of these variables with non-extractive behaviors were all significant and in the opposite direction except age which was negative but not significant.

### 3.1 Confirmatory factor analysis (CFA): measurement model testing

The result of CFA model estimate indicates a relative good fit between the data and the proposed model after dropping two items of non-extractive behavior. The dropped items were “Increasing non-chemical fertilizers and biological control” and “adapting new technologies of precision farming.” It can be interpreted that the respondents were probably not even familiar with these strategies in order to be able to report their tendency to use. The results of investigated goodness-of-fit (GOF) indices are;  $\chi^2$  (194)=308.056,  $p=0.000$ ;  $\chi^2/df=1.588$ ; goodness-of-fit index (GFI)=0.908; comparative fit index (CFI)=0.955; incremental fit index (IFI)=0.955; Tucker–Lewis index (TLI)=0.946; root-mean-square error of approximation (RMSEA)=0.047; and standardized root-mean-square residual (SRMR)=0.0556]. The CFI, IFI, and TLI significantly pass its cutoff value of 0.90 (Ho, 2006; Hair et al., 2010). Furthermore, the RMSEA and SRMR were 0.047 and 0.0556, respectively, which both were less than 0.08 which is the recommended value quantified to provide an acceptable fit for the proposed model. The convergent validity assessment results showed that standardized factor loadings of all variables were significant at 0.001 alpha levels and exceed the recommended value of 0.5 (Table 1). To ensure convergent validity and satisfactory internal consistency between the measured items average variance extracted (AVE) and composite reliability (CR) had been investigated. Investigation of average variance extracted (AVE) declares that entire constructs exceeded the minimum criterion of 0.5, and also, composite reliability (CR) values for all variables exceeded the minimum criterion of 0.7 supporting satisfactory convergent validity and internal consistency (Table 1). Furthermore, the divergent validity assessed using comparison of AVE value against average shared variance (ASV as the mean of the squared correlation coefficients between latent constructs) and maximum shared variance (MSV which is the square of the highest correlation coefficient between latent constructs). Since the AVE value for each construct was higher than those of ASV and MSV in CFA model, thus discriminant or divergent validity of the constructs was confirmed (Table 1).

### 3.2 Structural model testing

The estimated structural model provided a satisfactory fit to data, based on the set of statistical goodness-of-fit indices consist of: the GFI (0.902), CFI (0.948), TLI (0.940), and IFI (0.949) which significantly pass the cutoff value (0.9). Further, the RMSEA (0.050) and SRMR (0.0652) with a value less than 0.08 show a strong fit (Fig. 2). The result according to the hypothesized structural model demonstrated the finding as follows:

The impact of anthropocentric value orientation on belief in climate change as a natural phenomenon ( $\beta=0.355$ , C.R=4.18,  $p=0.000$ ) and extractive behavior ( $\beta=0.338$ , C.R=4.18,  $p=0.000$ ) was positive and significantly different from zero at the 0.05 level. The influence of anthropocentric value orientation on non-extractive behavior ( $\beta=-0.183$ , C.R = -2.68,  $p=0.007$ ) was negative and significantly different from zero at the 0.05 level, whereas the impact of anthropocentric value orientation on belief in climate change as a man-made phenomenon was not significant ( $\beta=0.131$ , C.R = 1.80,  $p=0.072$ ) (Table 3).

The impact of biocentric value orientation on belief in climate change as a natural phenomenon ( $\beta=0.262$ , C.R=3.40,  $p=0.000$ ), belief in climate change as a man-made phenomenon ( $\beta=0.565$ , C.R=6.29,  $p=0.000$ ), and non-extractive behavior ( $\beta=0.293$ , C.R=3.22,  $p=0.001$ ) was positive and significantly different from zero at the 0.05 level, whereas the impact of biocentric value orientation on extractive behavior was negative and significantly different from zero at the 0.05 level ( $\beta=-0.139$ , C.R=2.02,  $p=0.043$ ) (Table 3).

The belief in climate change as a natural phenomenon significantly influences the extractive behavior ( $\beta=0.296$ , C.R=3.48,  $p=0.000$ ), and belief in climate change as a natural phenomenon significantly influences the extractive behavior ( $\beta=0.296$ , C.R=3.48,  $p=0.000$ ). In addition, the impact of belief in climate change as a man-made phenomenon on non-extractive behavior was positive significantly different from zero at the 0.05 level ( $\beta=0.210$ , C.R=2.10,  $p=0.036$ ) (Table 3).

Moreover, the result based on the estimated structural model showed that 21% of belief in climate change as a natural phenomenon, 35% of belief in climate change as a man-made phenomenon, 26% of extractive, and 21% of non-extractive behavior had been explained by the studied variables (Fig. 2).

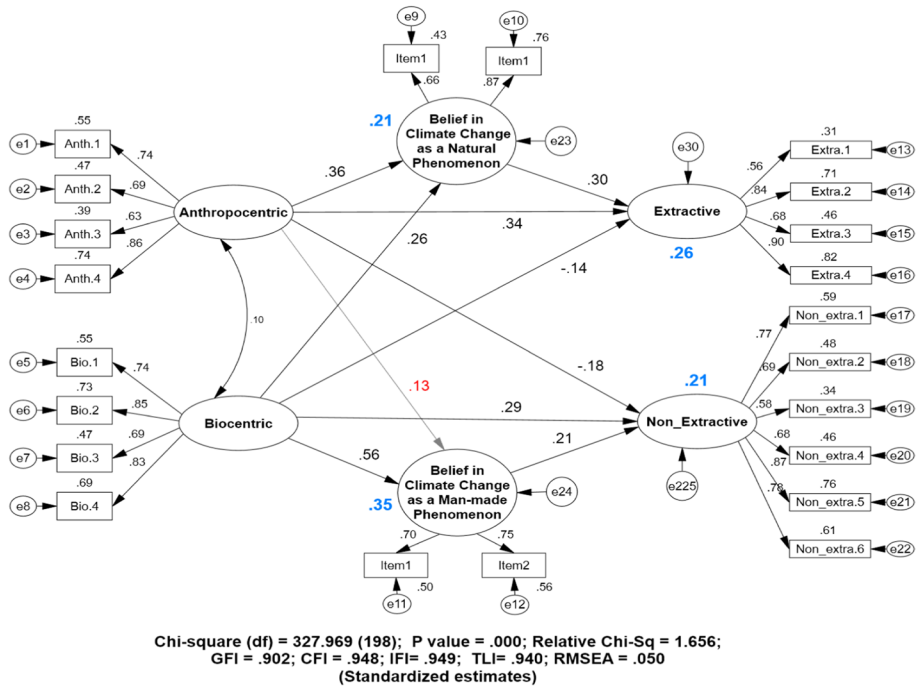
The indirect structural relationships between the anthropocentric and biocentric value on the extractive and non-extractive behavior were investigated using the “Bootstrap” approach. In order to do the bootstrap analysis as advised by Hayes (2009), 5000 bootstrap samples with a 95% percentile confidence interval were requested and randomly selected from the 265 case original data set. The findings revealed that anthropocentric value indirectly ( $\beta=0.105$ ) influences extractive behavior via belief in climate change as a natural phenomenon, whereas anthropocentric value indirect effects on non-extractive behavior via belief in climate change as a man-made phenomenon were not significant ( $\beta=0.023$ ) (Table 4). Moreover, the results revealed that the indirect effect of biocentric value on extractive behavior via belief in climate change as a natural phenomenon ( $\beta=0.078$ ) was significant; furthermore, the indirect effect of biocentric value on non-extractive behavior via belief in climate change as a man-made phenomenon ( $\beta=0.120$ ) was positive and significant (Table 4).

In a summary as shown in Table 5, anthropocentric value had a highest direct ( $\beta=0.338$ ), indirect ( $\beta=0.105$ ), and total ( $\beta=0.443$ ) effects on extractive behavior, whereas biocentric value had a highest direct ( $\beta=0.293$ ), indirect ( $\beta=0.120$ ), and total

**Table 3** The result of hypothesized path model

Path	Unstandardized estimate	S.E.*	Standardized regression weight	C.R.**	p
Anthropocentric value → Belief in Climate Change as a Natural Phenomenon	0.292	0.070	0.355	4.18	0.000
Anthropocentric value → Belief in Climate Change as a Man-made Phenomenon	0.090	0.050	0.131	1.80	0.072
Biocentric value → Belief in Climate Change as a Natural Phenomenon	0.293	0.086	0.262	3.40	0.000
Biocentric value → Belief in Climate Change as a Man-made Phenomenon	0.527	0.084	0.565	6.29	0.000
Anthropocentric value → Extractive behavior	0.217	0.052	0.338	4.18	0.000
Belief in climate change as a natural phenomenon → Extractive behavior	0.232	0.066	0.296	3.48	0.000
Anthropocentric Value → Non-extractive behavior	-0.146	0.055	-0.183	-2.68	0.007
Biocentric Value → Extractive behavior	-0.121	0.060	-0.139	-2.02	0.043
Biocentric Value → Non-extractive behavior	0.319	0.099	0.293	3.22	0.001
Belief in climate change as a man-made phenomenon → Non-extractive behavior	0.247	0.118	0.212	2.10	0.036

\*S.E.: standard error \*\*C.R.: critical ratio



**Fig. 2** Significance testing results of the main structural model path coefficient (based on standardized estimates)

( $\beta=0.413$ ) effects on non-extractive behavior. The results showed that the assumption of the “pyramid” that beliefs mediate the relationship between values and behaviors is partially supported since direct influence of values on behavior was greater than their indirect effects.

## 4 Discussion

This study examined how value orientations evoked the belief in climate change and related to different environmental behavior. The results showing anthropocentric value had a highest direct, indirect, and total effect on extractive behavior. Biocentric value had highest direct, indirect, and total effects on non-extractive behavior. Furthermore, it should be discussed that the hierarchy model of values, beliefs, and behavior was partially confirmed by the SEM since the assumption of the “pyramid” that beliefs mediate the relationship between values and behaviors was partially supported as direct influence of values on behavior was greater than their indirect effects.

This research breaks new ground by presenting a renewed classification of the related beliefs for different value orientations. The results showed that each value orientation appeared to contribute to a different belief on climate change. The orientation of biocentric value showed a positive and significant effect on the belief in climate change as a human-made and natural phenomenon with a stronger trend to human-made belief, which is in line with the study of Sarrasin et al. (2022) that found biocentric values underlie ecological

**Table 4** The results of estimating the indirect effect of anthropocentric and biocentric value on the extractive and non-extractive behavior

Indirect path	Point estimate standardized indirect effects	S.E.	Bootstrap		
			*BC Percentile 95% CI		
			Lower	Upper	Two-tailed significance (BC)
Anthropocentric Value → Belief in Climate Change as a Natural Phenomenon → Extractive behavior	0.105	0.044	0.035	0.215	0.002
Anthropocentric Value → Belief in Climate Change as a Man-made Phenomenon → Non-extractive behavior	0.028	0.023	-0.001	0.097	0.063
Biocentric Value → Belief in Climate Change as a Natural Phenomenon → Extractive behavior	0.078	0.039	0.020	0.177	0.002
Biocentric Value → Belief in Climate Change as a Man-made Phenomenon → Non-extractive behavior	0.120	0.064	0.020	0.278	0.027

\*BC = Bias-corrected confidence interval is 5,000 bootstrap samples that were requested

**Table 5** The results of estimating the direct, indirect, and total effect of anthropocentric and biocentric value on the extractive and non-extractive behavior

Relation	Direct	Indirect	Total
Anthropocentric value on extractive behavior	0.338	0.105	0.443
Anthropocentric value on non-extractive behavior	−0.183	0.028	−0.155
Biocentric value on extractive behavior	−0.139	0.078	−0.061
Biocentric value on non-extractive	0.293	0.120	0.413

beliefs. This study is also in line with the results of Bouman et al. (2020) who proved that across European countries there was a positive influence of biocentric value on the motivational emotion about climate change. Therefore, the people who consider caring for nature as their dominant value still consider climate change as part of the nature cycle although they believe that the humans have played a significant role to create climate change. Moreover, the results revealed that the biocentric value orientations directly and through beliefs in climate change as a man-made phenomenon significantly explain 21% of the variability in the non-extractive behavior of farmers by considering the negative influence of anthropocentric value. This result is in accordance with studies that found people with biocentric values are more likely to protect the environment (Hornsey et al., 2016; Whitley et al., 2018; Wan Hussain et al., 2021) and biocentric values are a good predictor of behavioral change focusing on reducing carbon emissions (Zhang et al., 2020). Besides, naturalistic value negatively contributes to the explanation of extractive behavior, which indicates the great importance that individuals with this dominant value attach to the proper preservation and use of natural resources. Based on Bouman et al. (2020), naturalistic value, in addition to guiding people to pro-climate behavior, can be effective in reducing the extraction of natural resources by arousing a sense of individual's responsibility. It is suggested that introducing and cultivating the biocentric values strengthen people's belief in their role in climate change, which could increase people's efforts to reduce their ecological footprint in nature.

Prior research has established the relationship between anthropocentric value and belief in climate change (Amérigo et al., 2007; Soyezy et al., 2009). The fact is that our finding consistently indicated that anthropocentric value has significant relation with belief in climate change only if considering it as a natural phenomenon. In contrast to previous research, the impact of anthropocentric orientation as valuing the environment just for human interests was examined based on two types of beliefs. The positive significant relationships of anthropocentric value with belief in climate change as a natural phenomenon and its non-significant relationships with belief in climate change as a man-made phenomenon had meaningful results. Respondents with dominant anthropocentric value believed that climate change was not a human-made change, but it was a natural cycle. Review of the literature on belief in climate change showed that it is a prerequisite for taking actions (Clayton et al., 2015; Zamasiya et al., 2017; Zhai et al., 2018). Consistent with the findings of Mueller and Tickamyer (2020), our findings indicated that the anthropocentric value and associated belief motivate farmers to strive to make the most of nature and extract more natural resources in order to attain pre-climate change agricultural crop yield. The preferred strategies of people with prevailing anthropocentric value were "increasing pesticide and chemical fertilizer input," "increasing the depth of well," "using high-tillage techniques," and "building new infrastructures like digging a well for more irrigation." Furthermore, the anthropocentric value orientation showed a significant and negative effect on the

non-extractive behavior indicating not willingness to adapt approaches such as using low-tillage techniques. It can be concluded that people with dominant humanistic values are trying to dominate nature and conquer nature. The suggestion of this study is to show past experiences of not needing to conquer nature, but rather to recognize nature as a mother which we could live in her lap without harming her with an emphasis on educating and promoting appreciation of nature.

The results of positive correlation of age and extractive behavior showed that the older farmers chose more extractive strategies for adapting to climate change significantly and this result was confirmed by the positive correlation of work experience with extractive behavior. This could be in line with the study of Panno et al. (2018) who proved that the younger individuals took more non-extractive approaches. Perhaps, the choice of extractive behaviors by older people is not because they do not pay attention to natural resources, but because they are either unfamiliar with the appropriate methods or do not have the financial ability to implement adaptive methods. As a result, they have to extract more resources for their livelihood. Therefore, holding training courses which showed a positive correlation with non-extractive behavior with the aim of introducing technologies compatible with climate change and providing the necessary technical and financial support is recommended. Moreover, as far as the results obtained of the positive and significant relationship between land size and income with extractive behaviors are concerned, it can be concluded that people with bigger farmland and higher income try to dominate nature more, which requires adopting controlling laws to preserve the natural resources and prevent further climate change.

## 5 Conclusion

According to the confirmation of the hierarchical model, it is concluded that understanding the cognitive components of belief, how values flow in people's beliefs, and their impact on behavior that can be associated with the extraction of more or less natural resources on the farm will undoubtedly lead to a better understanding of the relations between human and environment and provides ways to control man-made climate change. In general, these results would be beneficial for politicians to incorporate a culture of naturalistic values into macro-planning for reducing extractive behaviors. Furthermore, it is evident that respondents were unfamiliar with new technologies of precision farming and biological control. In addition to personal value orientation, as social cognitive theory asserts, there is a reciprocal relationship between personal and environmental situation with behavior, and therefore, agricultural extension systems should practically create a supportive and creative educational environment to share improved production techniques using non-extractive strategies. More specifically, the conclusion from the descriptive results is that the bio-centric value, belief in climate change as a man-made phenomenon, and non-extractive behavior or in general naturalistic orientation received nearly greater support than humanistic orientation, showing the easier entrance to the rural area for control the man-made climate change. But, politicians interested in facilitating transitions to more climate-friendly behavior should be aware that anthropocentric orientation and related behavior are growing among older, and more experienced farmers. Even farmers with bigger land size and more average annual income are more interested to dominate the nature which is a practical implication that represents an educational and legal gap that should be considered for specific clients.



## 6 Suggestions for future studies

This study worked on two ends of the value continuum including anthropocentric and biocentric. Future studies could consider three-dimensional structures of value and add egobiocentric dimension to the middle ground that values man in nature as a whole. A suggestion for future research based on the confirmed results of present study is to consider two types of belief, including the belief in man-made climate change and the belief in natural climate change, instead of examining only belief in climate change. The third suggestion for future studies of the adaptation behaviors to climate change is to bear in mind that behaviors associated with the extraction of more natural resources are by no means compatible, but rather are behaviors that lead to more climate change. Therefore, it is suggested to use non-extractive behavior in the conceptualization of climate change adaptive behavior.

The study is limited in terms of un-determining about three-quarters of the variability in extractive and non-extractive behavior, indicating that cognitive hierarchy alone is not sufficient to predict behavior in the field of climate change. Therefore, to further elucidate extractive and non-extractive behavior about climate change, the use of a combination of cognitive theories and sustainable livelihood frameworks is suggested.

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**Data availability** The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

**Ethical statement** The submitted work is original and not has been published elsewhere in any form or language (partially or in full).

**Consent to participate** Verbal informed consent was obtained prior to the interview.

**Conflict of interest** The author declares no conflict of interest with respect to the authorship or the publication of this article.

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