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Original Article

Spatial Analysis of the Ecological Footprint of the Rural Settlements (Case Study: Eslamabad-e Gharb County)

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Abstract

Purpose- Environmental issues such as the ecological footprint, are the product of intellectual, cultural, and economic factors. Therefore, it is necessary to know the variables effective on the amount of the footprint. The main objective of the present study is to investigate the factors affecting the ecological footprints of the rural settlements in Eslamabad-e Gharb County with a holistic and spatial approach.

Design/methodology/approach- The present study is an applied one regarding the objective and descriptive-correlational regarding the methodology. In terms of the data collection method, it is a field survey. The statistical population includes 25% of the villages in Eslamabad-e Gharb County (40 villages). The sample size was determined as 500 households based on the latent and observable variables. The Structural Equation Modeling (SEM) was used to analyze the data. Also, the Geographically Weighted Regression (GWR) was used to investigate the effects of the locative-spatial factors on the research variables.

Findings: The results of the Bootstrap test based on the T values indicated that the variables "ownership", "environmental awareness", and "consumerism" had the highest t-value and thus, were most correlated. The variable "ownership" in the economic structure is more correlated with the ecological footprint of the researched villages than other independent variables with a statistic of 26.053. overall, the analysis of the direct and inverse correlations in the SEM indicated that the variables "ownership" and "employment" were the most effective factors on the ecological footprint with coefficients of 0.874 and 0.575, while the "conspicuous consumption" was the least effective variable. Also, the results of spatial regression showed that the villages in the northwest of the county were more effective while moving towards the southeast and getting distant from the center reduces the effectiveness of the research variables on the ecological footprint.

Research limitations/implications- The high rate of employment in the agricultural sector, the weakness in environmental issues training, and the high rate of livestock and agricultural ownership among a limited number of people have created obstacles on the road to the ecological sustainability of the region.

Practical Solutions: Directing the residents of the researched villages towards non-agricultural employment by providing appropriate facilities and support, promoting an environment-friendly lifestyle, and training the residents to increase their environmental awareness by holding workshops in this field.

Originality / Value: The present study is the first to use the SEM and spatial approach to investigate the factors effective on the ecological footprints of rural settlements. The results obtained can aid the planners and decision-makers in the field of rural settlements to advance the goals of sustainable development.

Keywords: Ecological footprint, structural equations, geographically weighted regression, Eslamabasd-e Gharb.

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1. Introduction

The environmental crises are one of the largest threats to human beings' ecosystems, culture, economy, and health (Klemmer & McNamara, 2020). With the expansion of industries and technology and higher exploitation of nature, these problems were intensified (Soltani Bahram, 2015). Its onset can be the Industrial Revolution and the following population boom (Seif & Seif, 2021). In this period, the countries sought fast-paced economic growth unilaterally which led to a significant burden on the environment (Yang et al., 2022) as well as various crises. Among the environmental crises of the new century, a 40% increase in carbon dioxide emissions during the 2000-2017 period (UNEP, 2021) and the 36.8-billion-ton emission of greenhouse gases in 2022 (IEA, 2023) which has led to a 0.18-centigrade increase in the global warming in each decade (NOAA, 2022) can be named. Moreover, the annual destruction of 1 million hectares of jungles (Ritchie & Roser, 2021) as well as the 68% decline in global wildlife (Niemelä et al., 2000) indicate that the relationship between man and the environment is still inappropriate. These issues led to the introduction of the concept of sustainability into the development literature (Omisore, 2018). Sustainability denotes the fact that natural resources, as the collective heritage of humanity, should be used and protected in a way that meets the needs of future generations (Mehrara, 2016). In line with this paradigm, some theories such as the deep ecology (Cheney, 1987), environmental ethics (Taylor, 2011), and ecological citizenship (Dobson, 2006) were also proposed which all denied anthropocentrism and emphasized the necessity of paying attention to the environment to achieve the sustainable development.

On the other hand, since the environment is an absolute and constant phenomenon, and has a limited ecological capacity to be used by human beings (Alizade Aghdam et al., 2017), it requires the analysis of the way these resources are consumed. One of the appropriate means to perform such an analysis is the ecological footprint index. This index is a basis for the relationship between man and nature (Moodi et al., 2021). It seeks to answer the question of how much biocapacity regeneration is required for the regeneration of the resources used by a population, in a given period. (Venetoulis & Talberth, 2010). In fact, the amount of the footprint is compared to the region's biocapacity. Based on the Global Footprint Network, in 2018, human demand exceeded the regeneration capacity of all ecosystems on the planet by 70%. If this severe trend of environmental degradation continues, it will eventually lead to the depletion of resources (Aghayari et al., 2022). Therefore, the results of the ecological footprint are useful for the increase in the general and political awareness of human resources consumption by human beings (Bulte & Van Kooten., 2000). In addition to the importance of the analysis of resource consumption sustainability, the recognition of the effective factors in this field is also necessary because environmental issues such as the ecological footprint of rural and urban settlements are the outcome of the various intellectual, cultural, political, and economic factors (Bidhendi et al., 2014). Therefore, the recognition of the factors effective on the amount of the footprint helps the planners and decision-makers in the field of human settlements, especially the rural ones, with the advancement of the goals of sustainable development since the rural ecological issues are rooted in the economic and social aspects as well as people's lifestyle in such settlements. Therefore, investigation of these factors would provide a better and more precise understanding of the environmental conditions in rural areas.

Eslamabad-e Gharb Counrt, as a crop production hub in Kermanshah Provine, and also the second largest city in this province, has access to a huge volume of natural resources. The environmental issues from the past such as a 12-meter drop in the groundwater levels (Lashkari et al., 2009), failure to comply with the environmental principles by the agricultural enterprises (Motamedi Nia et al., 2013), water shortage due to a decade of drought, pastures and forest destruction due to human factors and fires, excessive use of chemical fertilizers, and pollution of Alvand River due to the waste from sugar and yeast factories necessitate the studies in this field. Therefore, the present study seeks to identify the factors effective on the ecological footprint and then, analyze the amount of the effectiveness of each factor in the rural settlements of Eslamabad-e Gharb County. In fact, the main research objective is to answer the question of "what the effective factors on the ecological footprint in the sample region are".

2. Research Theoretical Literature

2.1. Ecology

The term "ecology" is derived from the Greek 'Oikos' (meaning the settlement) and 'Logos' (meaning the science of studying) (Ataei et al., 2017). This term was first used by Earnst Heackl, a German biologist and

philosopher, in 1868 (Lawrence, 2003). Ecology is focused on the adaptability of living organisms to the environment. However, for human, who enjoys specific cultural and social structures, this adaptability is different from that of the plant and animal species (Alizade Aghdam et al., 2017). Therefore, ecology is a precondition by which the cities and villages can provide an appropriate environment for citizens to live in. In these environments, only those technological advancements that are associated with ecology can serve the citizens. The ecological city or village is a sustainable place that can provide the settlers with a meaningful life without destroying the ecological base it depends (Soltani Bahram, 2015). In this regard, human ecology is raised as a kind of analysis for the human-environment relationships (Park, 2012). This concept researches the mutual interdependence and grouping of the human beings in the place (space) (Omidpanah, 1985). It is generally divided as follows (Table 1):

Table 1. Different types of human ecology and its definitions

Social ecology	Social ecology seeks to understand the mutual relationships between the biophysical and sociocultural domains (Grove & Burch, 1997: 262). This type of ecology analyzes the relationships between the human community and the environment on the local, regional, national, and international scales. The urban and rural ecology are known as the pillars of social ecology (Moran, 2010).
Cultural ecology	Cultural ecology deals with the investigation of the mutual relationships between a cultural group with a shared material and spiritual lifestyle and the environment. The bases for cultural ecology are the anthropological studies of Julian Steward and the cultural geography of Carl Sauer. Steward has played an important role in the evolution of geography and anthropology by emphasizing the connection between nature and society through cultural adaptability (Motefakker Azad & Khorshid Doost, 2011)
Political-economic ecology	Political ecology, joined by economic ecology, determines how man uses the environment. Also, it analyzes the effects of capitalism on the development of communities. In other words, the political ecologist focuses on how the capitalism affects environment and human actions related to it. The economic ecologist on the other hand focuses on sustainable economic processes in the area of territory.

According to the aforementioned concepts, in ecological development, the cities and villages should be designed to promote health and quality of citizens' lives, and the related ecosystems should be protected. This type of development connects the citizens' decisions, public management, efficient ecological industries, people's needs and expectations, culture, and natural landscapes. Accordingly, nature, agriculture, and man-made environment can be practically interconnected in a coherent and integrated manner (Alizade Aghadam et al., 2017).

2.2. Sustainability and Ecological Footprint Index

The geographers, as those who research the relationship between man and nature, have been pioneers of environment protection theories. The scholars in this field found out that although the rapid extraction of human resources boosts the development trend of developing countries, the environmental quality of these countries will be disturbed due to inappropriate patterns in the use of these resources (Bekun et al., 2019). In fact, there is an inverse correlation between rapid economic growth and natural resources-based exploitation. It will intensify the environmental damage (Yin et al., 2022). It led many social pioneers and governments to recognize the existing unsustainability and direct their activities towards sustainability (Missimer et al., 2010). As a dominant environmental policy, sustainability refers to the relationship between consumer societies, environmental factors, and social policies (Bogert et al., 2022). The concept of sustainability has many interdependent dimensions, including ecological, economic, political, and epistemological dimensions, and requires a kind of participatory, comprehensive, and interdisciplinary approach for planning, implementation, and evaluation (Ukaga et al., 2010). The most acceptable definition of sustainable development is the one provided in the Brundtland Report. Based on this report, sustainable development is the one that meets the current needs of human beings without disturbing the future generation's ability to meet their needs (Hajian & Kashani, 2021). To enjoy sustainable development, the first step is to know about the status of region's sustainability so that if it is otherwise, the plans required for sustainable development are prepared and implemented. The ecological footprint index is a criterion for the investigation of environmental sustainability. This criterion analyzes the amount of consumption by human beings and the effects of such consumption on the environment (Jomepoor et al., 2013). Such analysis is performed through the measurement of the amount of consumption of the resources and waste production. The logic behind this method is based on the fact that

annually, a specified amount of resources can be consumed and a specified amount of waste can be produced. This amount is based on the earth's biocapacity. If the amount of resource consumption and waste production by human beings exceeds its biocapacity, i.e., the ecological footprint in a region, country, or earth exceeds its biocapacity, that region will be unsustainable (Hosseinzade Dalir & Sasanpour, 2006).

The ecological footprint index was first introduced by Rees and Wackernagel in 1996, in the book "Our Ecological Footprint: Reducing Human Impact on the Earth", University of British Columbia. This index was then developed (Rees & Wackernagel, 1998: Jin et al., 2009). The ecological footprint index is a sustainability index that analyzes the amount of human consumption and its effects on the environment (Wackernagel et al., 2004, 265). In this method, the supporting area of the human settlement is estimated and this estimation indicates how much of the ocean and land is capable of natural production to meet the vital needs of the inhabitants (Wang et al., 2012), i.e., it demonstrates how each society affect the nature as a result of their lifestyle (Wilson & Anieldki, 2004). Therefore, the ecological footprint is the outcome of the mutual relationship between man and the environment and the result of his actions and behaviors. Thus, various cultural, economic, and behavioral factors can affect the amount of an individuals' footprint. In the past few decades, due to the importance of investigating the effects of humans on nature, the ecological footprint of human societies has become the subject of new environmental studies. In addition to analysis of the human footprint in different consumption sectors, some researchers have sought to identify the factors that affect the ecological footprint. Ruini et al. (2010), in a study entitled "Is whatever good for you is also good for the environment?", have dealt with the relationship between people's lifestyles and how much they affect the environment. Their results indicated that preparing food at the lower levels of the food pyramid creates a smaller ecological footprint, and moving to the top of the food pyramid will increase the amount of the footprint. Also, Sheng and Chang (2016) dealt with the investigation of the effects of different income levels on the ecological footprint. Their results indicated that the GDP per capita varies with income levels. Also, the effects of urbanization on income levels were proven to be positive, i.e., the higher the urbanization in high- and low-income countries, the higher the ecological footprint.

Hassan et al. (2019) in a study entitled "Linking economic growth and ecological footprint through human capital and biocapacity", investigated the link between economic growth and the ecological footprint. This study indicated that economic growth leads to an increase in the ecological footprint and the destruction of the environment. The biocapacity also increases the ecological footprint and facilitates the destruction of the environment. However, using the causality method, the research indicated that there is no causal relationship between economic growth and ecological footprint. On the other hand, Özbaş et al. (2019), using a sociological approach, indicated that the percentage of ecological footprint is different for three various age groups (50+ age group). Also, ecological footprint values were investigated based on the education and income levels among both men and women. The results indicated that in all age groups, the ecological footprint of people with higher income is more than those with lower income. Also, the ecological footprint of men with the same income as women is higher than them.

The ecological footprint index has recently grabbed the attention of many researchers in Iran. Some of these studies which have been conducted in the two last decades are presented in the following:

Hosseinzade Dalir & Sasanpour (2006), in a study entitled "The Application of Ecological Footprints Method In Sustaining Metropolitan With Particular Emphasis Up On Tehran", dealt with the investigation of the ecological footprint of Tehran metropolitan and the factors effective on sustainability and unsustainability. The results indicated that the ecological footprint per capita of Tehran and Iran are 3.79 and 1.98 hectares, respectively. Compared to the global level, the footprint per capita of Tehran citizens is greater by 2.3 hectares. Hajilou (2013), in his thesis entitled "Sociological explanation of the ecological footprint and factors affecting it (case study: Tabriz City)", identified the social factors affecting the ecological footprint. It was a survey with Tabriz City being the case study. All citizens above 15 years old were chosen as the statistical population. The results indicated that the variable "lifestyle" was the most effective factor on ecological footprint. On the other hand, the variables "age", "education", "job", and "social and economic class" were effective on average ecological footprint. Also, Alizadeh Aghdam & Honarvar (2018) investigated the correlation between environmental attitude and environmental behavior. This research was a survey which was conducted in Tabriz City. Based on the results, there is a significant

and positive correlation between environmentally responsible behavior and people's attitudes towards the environment.

Soltani Bahram (2015), in his thesis entitled "Sociological study of ecological citizenship and its related factors (case study: Tabriz city)", investigated the effects of social factors such as lifestyle, spiritual intelligence, mass media, and cultural and economic capital on the ecological citizenship. The results indicated that ecological citizenship is significantly correlated with age, ecological concern, spiritual intelligence, and cultural and economic capital, however, it was not significantly correlated with the conspicuous consumption lifestyle and the mass media.

Based on the literature review, it can be said that environmental issues and pollution are grabbing more and more attention in various sciences. It can be proven by the number of environmental studies in recent years. These environmental concerns are mainly rooted in excessive load and exploitation of the regions' ecological capacity in the last two centuries, which have led to numerous environmental disasters worldwide. However, most of these studies have dealt with the investigation of economic effects on the environment. Another part also has been focused on its sociological explanation. In fact, a holistic and spatial approach is rarely seen in these studies. On the other hand, these studies have mainly focused on the effects of urban areas on the environment while the rural settlements, as a huge part of the world's population, have been ignored. Also, a review of the related literature indicates that no studies have been conducted on the ecological footprint of rural settlements in Eslamabad-e Gharb, and no answers to the present research questions have been found. Based on the literature review, three categories of ecological culture capital, conspicuous lifestyle, and economic capital have been identified as the factors affecting ecological footprint (Table 2):

Table 2. Factors investigated in the literature

Main factors	Secondary factors	Hajilou, 2013	Soltani Bahram, 2015	Mahdavi & Riahi, 2003	Aghil et al., 2009	Rafei & Amirnrjad, 2009	Saraei & Zarei Farshad, 2011	Alizadeh Aghdam & Honarvar, 2019	Salehi & Emamgholi, 2012	Aghayari Hir et al., 2023	Bani Fatemeh & Hossein Zade, 201	Craig & Allen, 2015	Gelissen,2007	Chen & et al, 2011	Gorus & et al, 2022	Huang, 2016	Jorgenson & Clark, 2010	Poortinga et al, 2004	Galli et al, 2010	Garigoryeva, 2010	Emine Ozmete, 2011	Simpson et al., 2000	Gorus & Karagol, 2022	Moore, 2015	Chen & Chang, 2016
Economic capital	Workforce quantity and quality																						*		
	ownership		*																					*	
	Income		*			*	*						*		*			*					*		*
	Improvement of production tools																	*							
Ecocultural and social capital	Social solidarity										*														
	Social trust (institutional and public)				*																				
	Environmental awareness			*					*																
	Environmental cognition	*	*																						
	Education level		*				*	*			*			*											
	Environmental beliefs	*	*					*	*							*									
	Environmental participation		*		*			*														*			

Main factors	Secondary factors	Hajilou, 2013	Soltani Bahram, 2015	Mahdavi & Riahi, 2003	Aghil et al., 2009	Rafei & Amirnrjad, 2009	Saraei & Zarei Farshad, 2011	Alizadeh Aghdam & Honarvar, 2010	Salehi & Emamgholi, 2012	Aghayari Hir et al., 2023	Bani Fatemeh & Hossein Zade, 201	Craig & Allen, 2015	Gelissen,2007	Chen & et al, 2011	Gorus & et al, 2022	Huang, 2016	Jorgenson & Clark, 2010	Poortinga et al, 2004	Galli et al, 2010	Garigoryeva, 2010	Emine Ozmete, 2011	Simpson et al., 2000	Gorus & Karagol, 2022	Moore, 2015	Chen & Chang, 2016
	Cultural dynamism and environmental movements	*																							
	Ecological literacy	*	*			*				*															
	Family size							*										*							
	Environmental NGO's				*																*				
	Environmental training					*						*	*								*	*				
Consumer lifestyle	consumerism		*																*			*	*	*	
	Media consumption															*									
	Conspicuous consumption		*																			*			
	Amount of consumption (responsible consumption)		*							*									*			*			
	Clothes selection pattern	*	*																						
	Food preferences	*	*																			*			
	Paying attention to buying	*	*																						
	Promotion of traveling and tourism		*																*					*	
	Avoiding extravagance		*																*						

Source: Related Literature (2023)

Based on the theoretical framework and literature review, as well as the analysis of the subject of the study, the conceptual model of the study is presented in Figure 1:

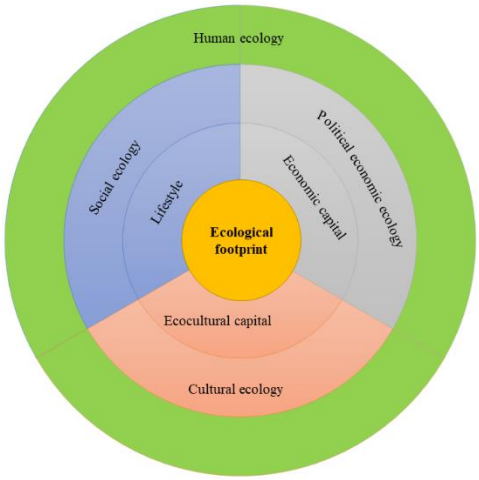

Figure 1. Conceptual model of the study (aimed at investigation of factors effective on ecological footprint)

3. Research Methodology

3.1 Geographical Scope of the Research

The statistical population of the study included all rural households in Eslamabad-e Gharb. The coordinates of the city are 34°6'47.47"N and 46°31'40.34" E (Figure 2). Based on the latest administrative divisions, Islamabad-e Gharb consists of two counties (Islamabad-e Gharb and Homeyl), two districts (Central and Homeyl), 7 rural districts (Hasan Abad, Howmeh-ye Jonubi, Howmeh-ye Shomali, Shiyan, Mansuri, Harasam, and Homeyl), and 161 inhabited villages. The population of the city is 140876 people in 40911 households among which 440 people (14031 households) live in rural areas and 9176 people (26880 households) live in urban areas (Statistical Center of Iran, 2016). In other words, 34% of this county's population lives in rural areas.

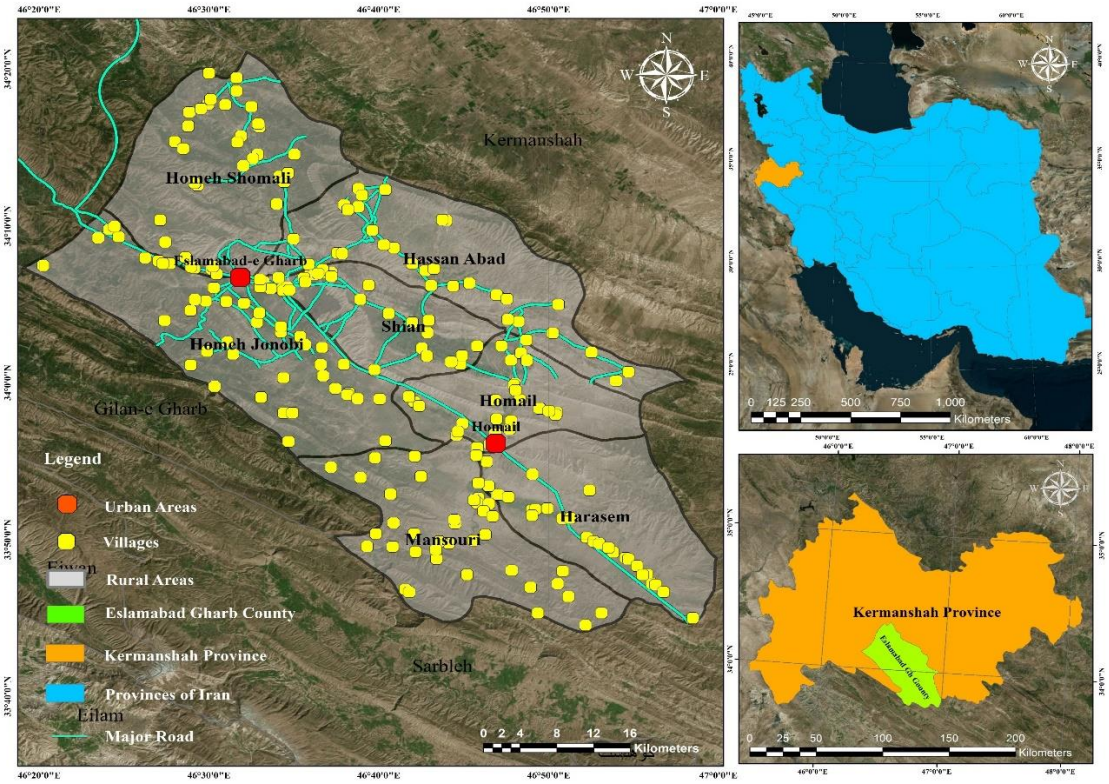

Figure 2. Location of the case study

3.2. Methodology

The present study is applied regarding the objective and descriptive-correlational regarding methodology. In terms of the data collection procedure, it is a field survey. The analyses have been done using the Structural Equation Modelling (SEM) or the causal model of Partial Least Squares (PLS). In the SEM, the sample size is determined based on latent and observable variables (Diamantopoulos, 2011; Hair, 2011). Therefore, in the present study, the Gamma-exponential Method was used to determine the minimum sample size. In this method, the number of latent and observable variables, desired statistical power level, and F-square (effect size) are considered. The effect size is an index that indicates the power level of independent variables. According to Cohen (1988), the value of this index is divided into weak (0.02), moderate (0.15), and strong (0.35) levels. The minimum level of 0.15 is considered for sample size calculation.

The power level is chosen to be between 80 and 90% (Hair, 2011). By inserting the effect size value, power level, and latent and observable variables into the G-Power software, the sample size was calculated as 420 people (householders) at a 95% confidence level.

The statistical population consists of 25% of the villages in Eslamabad-e Gharb (40 villages). The sample villages were chosen based on three features: distance from the city center, number of households, and location. The spatial dispersion of the villages over the whole city area was considered in selecting them. Finally, the spatial dispersion of the sample villages is presented in Figure 3.

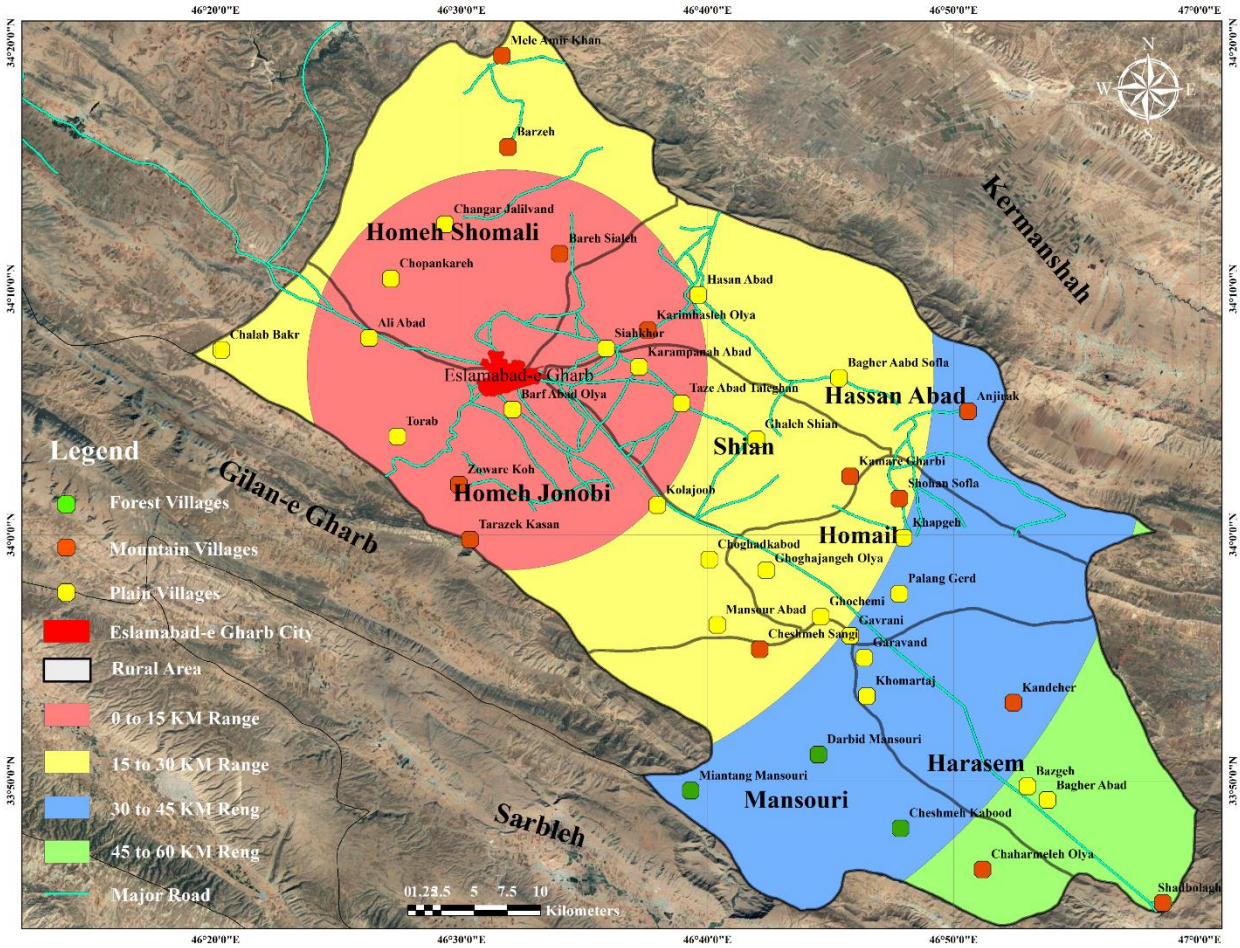

Figure 3. Location of the sample villages in Eslamabad-e Gharb County and their distance from the center

The total population of the sample villages was 20659 in 5966 households, based on the last census which was conducted in 2016. Since the number of families varies from village to village, proportionality constant with 10 samples as the base for each village was used for appropriate distribution. This value is added to the minimum sample size (420 people) and finally, 500 households were chosen as the sample size (Table 3). The households were also chosen by purposeful sampling.

Table 3. Share of each rural area from the number of samples

Rural Area	Hassan Abad	Howmeh-ye Shomali	Howmeh-ye Jonubi	Harasam	Homeyl	Shiyan	Mansuri	Total
Household	806	583	1896	749	528	801	602	5966
number of samples	59	55	143	75	41	65	62	500

To select the research variables, those used in the literature were indexed as the first step (Table 2). Then, those variables with the highest frequency were chosen and categorized into three ecological, lifestyle, and economic capital categories (Table 4). Finally, based on the selected variables, a questionnaire was designed using a 6-point Likert scale.

Table 4. Research constructs and variables

Construct	Latent variable	Observable variables	Number of elements
Ecocultural capital	Environmental cognition	The limited right to use nature for economic growth and welfare, belief in the protection of the environment, importance of environmental issues, belief in natural resources, belief in the limitation of natural resources, urbanism and industrialization as the reasons behind environmental problems, not preferring the economic considerations over the protection of environment, No need to take care of nature because of its ability to regenerate itself, priority of environment over other issues, concerns about environmental crises, concerns about destruction of jungles and pastures.	9
	Environmental beliefs	The role of participation of people and institutions in preserving the environment, the role of individual consumption patterns in preserving the environment, protection of natural resources as one of the signs of the progress of societies, the right to life for all living beings, responsibility towards nature, protection and support of Nature in all animate and inanimate parts, belief in the pristine life of animals in nature, the preciousness of the planet earth, the importance of the individual role of people in taking care of nature	10
	Environmental knowledge	Recognizing the most important environmental crises in the world, reducing biodiversity as an important environmental issue, being aware of the pollution of water resources,	3
	Environmental behavior	Practical action against the destruction of the environment, reduction of plastic items, sensitivity to the release of waste in nature, sensitivity to excessive consumption, practical cooperation with environmental associations, payment for environmental measures, action to reduce consumption In personal life	9
	Environmental awareness	Knowing the environmental problems of the place of residence, being aware of the priority of environmental problems, being aware of the separation of the environmental problems of the place of residence, and prioritizing the existing environmental problems.	5
Consumer lifestyle	Consumerism	Diversification in consumption, following fashion, desire to constantly change home appliances, desire to buy clothes seasonally, doing shopping as a hobby, not wanting to repair appliances for reuse.	5
	Amount of consumption	The amount of buying cosmetics, eating out, expenses for unnecessary activities	4

Construct	Latent variable	Observable variables	Number of elements
	Conspicuous consumption	The desire for decorations and luxuries at the party, the desire to change vehicles and residential houses, the desire to buy luxury appliances, a luxurious view of the home layout, accompanying the current models of household appliances and clothing, being cheap is equal to being of poor quality, buying from certain brands	6
Economic capital	Ownership	The type of residential house ownership, the approximate value of the residential house, the approximate value of the vehicle, the amount of ownership of agricultural land, the approximate value of real estate, the ownership of livestock and its approximate value, the ownership of agricultural tools	6
	Income	Average household income	1
	Employment	The number of active family population, the number of family workers	2

After the data were collected and categorized, descriptive and inferential statistics were performed using SPSS software. Also, the SMART PLS was used to extract the SEM and determine the effect size of the identified variables on ecological footprint. The ecological footprint of sample villages was extracted from Aghayari et al. (2023) (Table 5). The GWR was used to investigate the effect size of each variable on the ecological footprint of sample villages. Using this model, the patterns can be easily identified in a collection of data (Motesaddi Zarandi et al., 2021: 24).

Table 5. Amount of ecological footprint of sample villages in the consumption sectors

Name of the village	Ecological footprint	Food	Housing	Transportation	Consumer goods	Services
Karim Haseleh	5.29	4.4	0.45	0.06	0.37	0.02
Siah Khoor	3.14	1.46	0.46	0.01	1.2	0.01
Bagher Abad Sofla	5.029	2.54	0.4	0.01	2.04	0.04
Anjirak	4.032	1.75	0.43	0.01	1.81	0.03
Hasan Abad	5.9	3.27	0.48	0.02	2.09	0.04
Malleh Amir Khan	9.67	8.67	0.45	0.02	0.52	0.02
Barzeh	5.3	3.92	0.42	0.02	0.93	0.02
Bareh Sileh	5.401	3.98	0.37	0.02	1	0.03
Changar Jalilvand	5.474	2.98	0.45	0.01	2.01	0.03
Choopan Kareh	5.1148	1.76	0.44	0.02	2.86	0.04
Zavareh Kooh	6.873	4.41	0.56	0.05	1.5	0.35
Tarazak Kasan	4.13	2.49	0.45	0.03	1.13	0.03
Mansur Abad	3.039	2.3	0.02	0.02	0.69	0
Torab	4.058	2.37	0.45	0.03	1.19	0.03
Chalab Bekr	7.901	5.56	0.43	0.02	1.87	0.02
Kalleh Joob	3.908	1.74	0.34	0.02	1.77	0.04
Ali Abad	4.979	1.75	0.47	0.02	2.71	0.03
Chogha Kabood	5.029	1.2	0.5	0.01	3.29	0.03
Barf Abad Oliya	5.64	1.37	0.46	0.02	3.75	0.04
Choghajangeh Oliya	4.49	3	0.47	0.03	0.7	0.29
Bagher Abad	6.241	5	0.56	0.05	0.41	0.22
Bazgah	7.377	6.44	0.56	0.05	0.29	0.04
Khomar Taj	8.349	7.23	0.53	0.03	0.53	0.03
Shad Balagh	3.65	2.44	0.43	0.02	0.74	0.03
Garavand	4.342	2	0.5	0.02	1.8	0.02
Kondehar	5.379	2.69	0.47	0.02	2.17	0.04
Showhan Sofla	5.355	3.32	0.53	0.03	1.14	0.34
Khepgeh	4.295	2.32	0.49	0.02	1.45	0.02

Name of the village	Ecological footprint	Food	Housing	Transportation	Consumer goods	Services
Palangerd	5.139	3.06	0.48	0.02	1.53	0.04
Gardangah Quchmi	4.873	3.06	0.43	0.02	1.34	0.04
Tazeh Abad Taleghan	3.272	2.4	0.46	0.02	0.38	0.02
Kamareh Gharbi	2.791	1.66	0.47	0.02	0.61	0.03
Karam Panah Abad	3.76	2.54	0.48	0.02	0.69	0.03
Ghale Shiyan	5.365	1.52	0.48	0.02	3.34	0.01
Mina Tang Mansuri	6.1	4.46	0.04	0.04	1.55	0.01
Chahar Malleh Oliya	5.094	3.7	0.56	0.03	0.78	0.03
Cheshmeh Kabud	7.3542	5.34	0.48	0.03	1.46	0.05
Darbid Mansuri	6.636	4.31	0.52	0.01	1.69	0.1
Cheshmeh Sangi	5.095	3.3	0.53	0.01	1.2	0.04
Gavrani	4.713	2.84	0.5	0.02	1.31	0.05

Source: Aghayari et al. (2023)

4. Research Findings

According to the results obtained from descriptive statistics, among the 500 samples studied, 382 were male and 118 were female. In other words, 76.4% of the respondents were male and 23.6% of them were female. In terms of age, the average age of the participants was 34.26 with a standard deviation of 11.2. Based on the age categorization, 34.8% of the participants were categorized in the 24-28 age group and this group was the most frequent. Considering the marital status, among 500 samples, 62% were married while 37.7% were single. Regarding education level, the diploma was the most frequent (28.2% of respondents). Also, investigating the employment of the householders, it was revealed that those working in the agricultural sector were the most frequent (82.4%).

4.1. Descriptive Statistics related to the Dependent Variable "Ecological Footprint"

The ecological footprint variable, which is raised in the present study as the dependent variable, includes five main dimensions as food, housing, transportation, consumer goods, and services. The amount of ecological footprint of the sample villages in different sectors of consumption is presented in Table 5, per hectare. However, since a 6-point Likert scale has been used for the investigation of the three factors as lifestyle, cultural capital, and economic capital, the amount of ecological footprint of the villages has been categorized and valued in 6 categories. This categorization is as follows: Very large ecological footprint (code 1), large footprint (code 2), fairly large footprint (code 3), fairly small footprint (code 4), small footprint (code 5), and very small footprint (code 6). This coding was also performed for other sections of the footprint (Table 6). Based on the descriptive findings, 30% of the sample villages were categorized under the 'fairly large footprint' category.

Table 6. Evaluation of the value of the ecological footprint of sample villages

Ecological footprint dimensions	Very large footprint (code 1)	Large footprint (code 2)	Fairly large footprint (code 3)	Fairly small footprint (code 4)	Small footprint (code 5)	Very small footprint (code 6)
Food footprint	7.43 - 8.67	6.19 - 7.42	4.94 - 6.18	3.70 - 4.93	2.45 - 3.69	1.2 - 2.44
Housing footprint	0.47 - 0.56	0.47 - 0.56	0.29 - 0.38	0.2 - 0.29	0.11 - 0.2	0.02 - 0.11
Transportation footprint	0.051 - 0.06	0.041 - 0.05	0.031 - 0.04	0.021 - 0.03	0.019 - 0.02	0.01 - 0.018
Goods footprint	3.18 - 3.75	2.60 - 3.17	2.03 - 2.59	1.45 - 2.02	0.87 - 1.44	0.29 - 0.86
Services footprint	0.30 - 0.35	0.24 - 0.29	0.18 - 0.23	0.12 - 0.17	0.06 - 0.11	0.00 - 0.05
Total footprint	8.53 - 9.66	7.38 - 8.52	6.23 - 7.37	5.09 - 6.22	3.94 - 5.08	2.79 - 3.93
Percentage of villages in each class	2.50%	5%	30%	10%	27.50%	17.50%

Status of Ecocultural Capital of the Villagers- To assess the ecocultural capital of the sample villages, variables namely environmental cognition, environmental beliefs, environmental knowledge, environmental awareness, and environmental behavior were used with 36 items on a 6-point Likert scale. The data obtained from the questionnaire indicates that the ecocultural capital of the villagers was medium-to-low with an average of 3.92. Also, the environmental beliefs variable was the highest value among the villages with an average of 4.87, while the environmental participation was the lowest with an average value of 2.02. The average spatial distribution of ecocultural capital in the sample villages indicates that Kalleh Joob, Siah Khoor, and Kamareh Gharbi villages had the highest statistics with 4.2, 3.89, and 3.63, while Khomar Taj, Malleh Amir Khan, and Bazgah had the lowest statistics.

Status of Consumption Lifestyle of the Villagers- The variables consumerism, conspicuous consumption, and amount of consumption have been used to investigate the ecological lifestyle of households residing in the sample region. These variables were measured in a 6-point Likert scale using 15 items. According to the obtained data, the consumer lifestyle of the villagers is at a low level with an average of 2.8. Meanwhile, the amount of consumption is the highest value with an average of 4.1. The conspicuous consumption is the lowest value in the sample villages with an average of 2.8. Also, the spatial distribution of the consumer lifestyle in the sample villages indicated that Siah Khoor, Anjirak, and Choopankareh top all other villages in all variables with average values of 3.92, 3.76, and 3.25. The lowest statistics belonged to Ghale Shiyan, Choghad Kabood, and Barf Abad.

Status of the Economic Capital of the villagers- Variables such as ownership, income, and employment along with 9 items on a 6-point Likert scale were used to assess the economic capital in the sample villages. According to the obtained responses, the status of the economic capital in the region was middle-to-high with an average value of 3.41. Among the investigated variables, ownership was the highest with an average value of 3.9, while employment promotion was the lowest with an average value of 2.2. The spatial distribution of economic capital indicates that Ghale Shiyan, Kalleh Joob, and Garavand top other villages with average values of 4.1, 3.8, and 3.68.

4.2. Investigation of Effectiveness of the Independent Variables on Ecological Footprint:

The results obtained from the Pearson correlation coefficient (with the confirmation of the normality of data distribution) indicated that the correlation between independent variables (lifestyle, ecocultural capital, and economic capital) and ecological footprint is significant at $p<0.01$ (Table 7). Meanwhile, lifestyle and economic capital are directly correlated with ecological footprint, while ecocultural capital is inversely correlated with it, i.e., with the increase in ecocultural capital, the amount of ecological footprint is reduced in all sample villages. The spatial analysis of the correlation between the independent variables and ecological footprint as the dependent variable is mostly significant and high in most villages. However, in four villages of Chighajanga, Kandhar, Shohan Sofla, and Mansur Abad, there is no correlation between the studied variables. The statistics indicated that the highest correlation between the independent variables and the ecological footprint was observed in Hasan Abad and Kamareh Panah with values of 0.971 and 0.979.

Table 7. Correlation of research variables with ecological footprint

Independent / Dependent		Ecological footprint		
		Pearson's correlation coefficient	Significance level	Test result
Ecocultural capital	Environmental cognition	-0.792	0.000	Correlation is significant
	environmental beliefs	-0.655	0.000	Correlation is significant
	Environmental knowledge	-0.823	0.000	Correlation is significant
	Environmental awareness	-0.763	0.000	Correlation is significant
	Environmental behavior	-0.847	0.000	Correlation is significant
Lifestyle	Consumerism	0.895	0.000	Correlation is significant
	Conspicuous consumption	0.623	0.000	Correlation is significant

Independent / Dependent		Ecological footprint		
		Pearson's correlation coefficient	**Significance level**	**Test result**
	Amount of consumption	0.852	0.000	Correlation is significant
Economic capital	Employment	0.688	0.000	Correlation is significant
	Ownership	0.859	0.000	Correlation is significant
	Income	0.838	0.000	Correlation is significant

The Structural Equations Modeling (SEM) in the SmartPLS Ver.3 was used to test the conceptual model of the research and analyze the variables affecting ecological footprint, based on the theoretical foundation and what was mentioned in the methodology. In the SEM (with PLS approach), first, the measuring model fit should be investigated and then, the research question should be analyzed in this framework. The three criteria, namely reliability, convergent validity, and divergent validity, as well as the overall fit of the model, have been used for the investigation of the measuring model fit. Convergent validity refers to the degree to which the variables of a dimension can explain that dimension. Divergent validity is also indicative of the fact that the constructs of the research model should be more related to their questions than other constructs (Hulland, 1999, 195). The Composite Reliability (CR), Average Variance Extracted (AVE), and factor loading were used to test the reliability. If the value of CR is above 0.7, the value of AVE is above 0.5 (Magner et al., 1996: 41), and factor loadings are above 0.05 (on the condition of being significant), the reliability of the measuring model is confirmed (Amani et al., 2014). According to the results (Table 3), the constructs' AVE value is above 0.5, i.e., the latent variable has been able to explain more than 50% of the observable variables' variance. Therefore, the convergent validity of the questionnaire is also confirmed. Also, since the latent variables' CR and Cronbach's alpha values are above 0.7, the research reliability is confirmed (Table 8).

Table 8. Criteria for investigation of reliability and validity of research constructs

Variables	Items	AVE	CR	Cronbach's alpha	questions	Factor loading	t-value
Ecocultural capital	Environmental cognition	0.578	0.921	0.898	q1	0.814	304.41
					q2	0.834	379.46
					q3	0.85	29.57
					q4	0.836	37.57
					q5	0.844	833.64
					q6	0.72	452.64
					q7	0.699	189.3
					q8	0.285	616.24
					q9	0.804	690.7
	Environmental belief	0.596	0.936	0.923	q10	0.845	183.53
					q11	0.846	838.69
					q12	0.849	868.72
					q13	0.852	699.76
					q14	0.836	208.69
					q15	0.69	58.64
					q16	0.665	979.3
					q17	0.665	254.26
					q18	0.616	122.29
					q19	0.873	190.19
	Environmental knowledge	0.754	0.902	0.837	q20	0.869	391.75
					q21	0.863	680.69
					q22	0.205	617.66
	Environmental behavior	0.576	0.920	0.897	q23	0.81	854.3
					q24	0.834	167.59

Variables	Items	AVE	CR	Cronbach's alpha	questions	Factor loading	t-value
					q25	0.829	602.53
					q26	0.845	800.56
					q27	0.811	28.63
					q28	0.777	570.53
					q29	0.765	530.76
					q30	0.732	513.43
					q31	0.77	342.34
	Environmental awareness	0.517	0.840	0.771	q32	0.842	553.45
					q33	0.703	450.62
					q34	0.578	825.28
					q35	0.673	579.15
					q36	0.851	113.23
Consumer lifestyle	Consumerism	0.777	0.946	0.928	q37	0.919	656.53
					q38	0.911	222.109
					q39	0.834	841.82
					q40	0.89	656.63
					q41	0.914	148.94
	Amount of consumption	0.821	0.948	0.926	q42	0.93	167.95
					q43	0.937	243.135
					q44	0.839	358.143
					q45	0.881	928.58
	Conspicuous consumption	0.674	0.914	0.867	q46	0.91	249.7
					q47	0.915	504.115
					q48	0.899	114.108
					q49	0.888	110.92
					q50	0.07	519.71
					q51	0.749	403.1
Economic capital	Ownership	0.667	0.923	0.900	q52	0.847	229.32
					q53	0.819	963.56
					q54	0.855	628.43
					q55	0.807	907.57
					q56	0.819	583.41
					q57	0.001	764.48
	Income	1	1	1	q58	0.907	0
	Employment	0.791	0.884	0.738	q59	0.872	164.93
					q60	0.141	911.5
Ecological footprint	Food footprint	0.521	0.805	0.700	q61	0.817	590.1
	Housing footprint				q62	0.851	776.45
	Transportation footprint				q63	0.645	590.55
	Services footprint				q64	0.789	191.14
	Goods footprint				q65	0.814	504.29

After confirming the reliability and validity of the measuring model, the independent and dependent variables were inputted in the SEM as latent variables and in the form of a first-order factorial model, to measure the effects of consumer lifestyle, ecocultural capital, and economic capital on the ecological footprint of the residents in the sample villages (Figure 4).

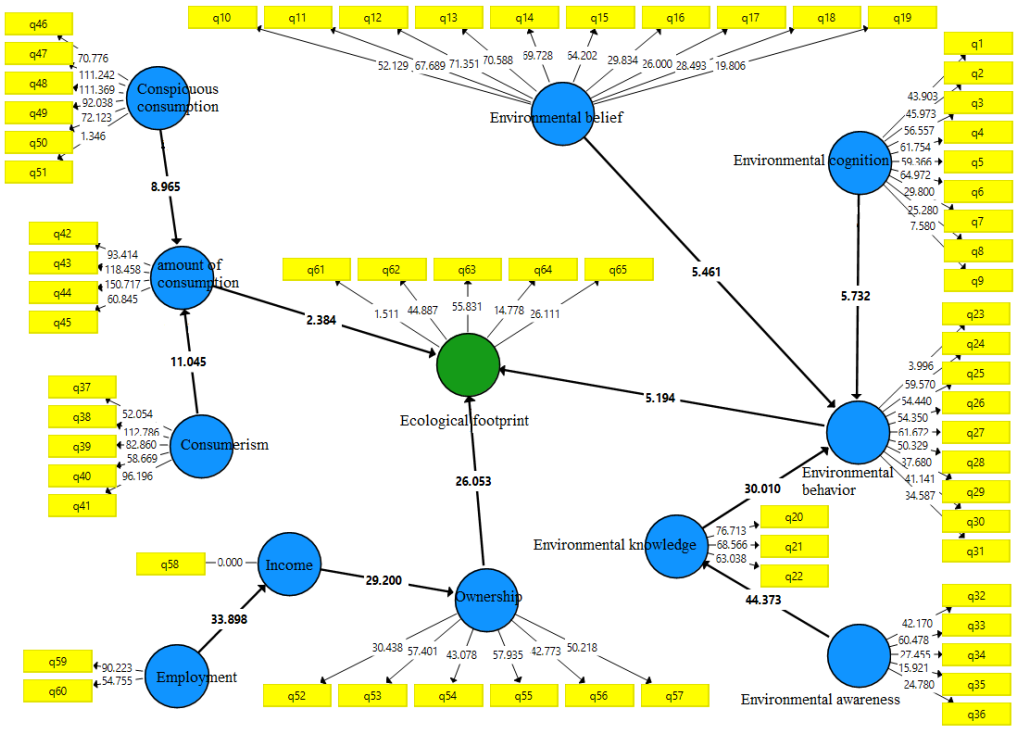

Figure 4. Structural model of the correlation between independent variables and ecological footprint

The t-values between the variables are obtained based on the Bootstrap test (Figure 4). In this test, which was performed at 0.05 significance level, the t-values (the numbers on the arrows) must be above 1.96 so that the significance of the correlations between the variables can be confirmed (Vinzi et al., 2010: 47). As seen in Figure 4, the t-statistics values between all independent variables as well as ecological footprint are above 1.96, and in fact, the correlation between the variables in the sample villages is confirmed with the significance level of 0.01. Also, for analysis of the significance of the path coefficient, it is required to determine the t-statistics values for each path (Table 9).

Table 9. Direct effects of research latent variables

	Standardized beta coefficient	T Statistics (|O/STDEV|)	P Values
Environmental awareness => environmental knowledge	0.017	44.373	0
employment => income	0.022	33.898	0
Environmental belief => environmental behavior	0.033	5.461	0
consumerism => amount of consumption	0.048	11.045	0
Environmental knowledge => environmental behavior	0.024	30.01	0
income => ownership	0.025	29.2	0
Conspicuous consumption => amount of consumption	0.047	8.965	0
Environmental cognition => environmental behavior	0.022	5.732	0
Environmental behavior => ecological footprint	0.029	5.194	0
Amount of consumption => ecological footprint	0.066	2.384	0.017
ownership => ecological footprint	0.029	26.053	0

The path coefficients are shown in Figure (5). The path coefficient here is the same as the standardized beta in the linear regression. Positive path coefficients are indicative of the direct correlations between the endogenous and exogenous latent variables, while negative coefficients are indicative of inverse correlations between them. According to the results obtained

from the analyses, it can be said all the correlations between the endogenous and exogenous latent variables are direct except that of environmental behavior and ecological footprint which was negative and thus inverse.

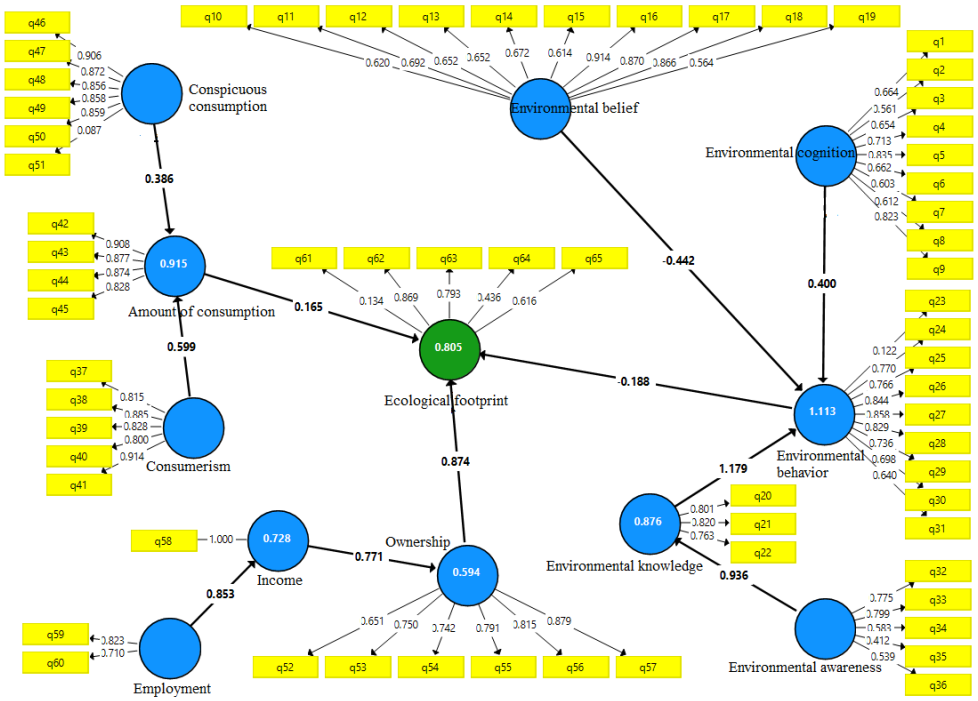

Figure 5. Evaluation of the structural model for independent variables and ecological footprint

The numbers inside the circles are indicative of the model's square (R^2) to which are connected the values of latent variables (arrows). These values do not indicate the removal of any variables for adjustment of other variables. However, what is worth noting is the significance value of the square. The results indicate that the square values of all latent variables are above the standard value of 0.621 except for the 'ownership', and thus, they can be described in the "significant" threshold. "Environmental behavior" is greater than other variables with a square value of 1.113. according to Figure 5, not all independent variables are effective on ecological footprint and there are some mediating variables to affect. Therefore, the correlation between the independent and dependent variables is inversely significant. Based on the R^2 obtained, nearly 80% of the ecological footprint in the sample villages is predicted by the independent variables of ecocultural capital, consumer lifestyle, and economic capital (Table 10).

Table 10. evaluation of the correlations between the research variables and ecological footprint and how they affect it

Variable	Mediating variables	Dependent variable	Coefficient of determination	Estimation					
				Total		Direct		Inverse	
				Effect	P	Effect	P	Effect	P
Employment	=>income=>ownership =>	Ecological footprint	0.805	0.575	0.00	-	-	0.575	0.00
Environmental belief	=>environmental behavior =>			0.083	0.00	-	-	0.083	0.00
Environmental cognition	=> environmental behavior =>			-0.075	0.00	-	-	-0.075	0.00
Environmental awareness	=>environmental knowledge =>environmental behavior =>			-0.208	0.00	-	-	-0.208	0.00
consumerism	=>amount of consumption =>			0.099	0.00	-	-	0.099	0.00

Variable	Mediating variables	Dependent variable	Coefficient of determination	Estimation					
				Total		Direct		Inverse	
				Effect	P	Effect	P	Effect	P
Conspicuous consumption	=>amount of consumption =>			0.067	0.00	-	-	0.067	0.00
Environmental behavior	=>			-0.188	0.00	-0.188	0.00	-	0.00
Amount of consumption	=>			0.165	0.00	0.165	0.00	-	0.00
ownership	=>			0.874	0.00	0.874	0.00	-	0.00

According to the results obtained from the analyses, it can be said that:

The consumer lifestyle, ecocultural capital, and economic capital predict 0.80% of the variance of the ecological footprint variable in total. Regarding the effect size and R^2, this value is considered to be "high", i.e., the independent variables are highly capable of determination of the variance of ecological footprint.

Environmental behavior, amount of consumption, and ownership are three independent variables that affect ecological footprint without any mediation. Meanwhile, the effectiveness of environmental variables is inverse while other variables affect ecological footprint directly.

The independent variables have affected the ecological footprint both directly and indirectly. This effectiveness is significant at a 95% significance level since $p<0.05$, i.e., with a 1-unit increase in the independent variables (compared to the R^2 coefficient), the dependent variable is also increased and vice versa.

Finally, based on the values of direct and indirect R^2 coefficient, the effectiveness of the independent variables on the ecological footprint of villages was considered to be positive and high. According to villagers, ownership and employment were the most effective variables on ecological footprint with values of 0.874 and 0.575, respectively. Also, conspicuous consumption was the least effective variable with a value of 0.067. Environmental behavior, environmental awareness, and environmental cognition inversely affected the ecological footprint with values of -0.188, -0.208, and -0.075, respectively, i.e., with the increase in these variables, the ecological footprint is reduced. According to the results obtained for the main research question, economic factors can be introduced as the most effective factor on ecological footprint.

In terms of the PLS, an indicator named goodness-of-fit is suggested. This model considers both measurement and structural models and is used as a criterion for investigation of the overall performance of the model. The outputs of the PLS model in the qualitative indices have been used to calculate the mean shared values of the variables. Results in Table 11 indicate that the model enjoys the goodness-of-fit and can be generalized.

Table 11. Model's goodness-of-fit

	Standard model	Estimated model
SRMR	0.126	0.131
d_ ULS	33.813	37.015
d_ G	n/a	n/a
Chi-Square	infinite	infinite
NFI	n/a	n/a

In the following, the degree of effectiveness of each of the variables as ecocultural capital, consumer lifestyle, and economic capital on ecological footprint is measured using the R^2 coefficient obtained from the GWR. The results indicate that the values of R^2 and adjusted R^2 in the sample region are 0.991 and 0.990, respectively. It is indicative of the proper accuracy of the model and confirmation of the correlations between the research variables. Since the correlation between the variables varies per the geographical unit in the GWR, where there are strong-weak correlations, it can be zoned in the form of a map. In this regard, the R^2 coefficients obtained for the sample villages

are zoned in the five categories as low, fairly low, fairly high, high, and very high. Zoning of the effectiveness of the ecocultural capital on ecological footprint (Figure 6-a) indicates that the value of this coefficient is decreased moving from the northwest to the southeast, i.e., the degree to which the ecocultural capital affects ecological footprint is higher in the northwestern villages. Also, the distribution of the R^2 coefficient of ecocultural capital indicates that the villages closer to the city of Eslamabad-e Gharb have a greater R^2 value, regardless of their natural position. In this regard, Barf Abad Olia, Hasan Abad, and Siah Khoor had the greatest R^2 values, while Cheshmeh Kabood, Khomartaj, and Shadbalagh had the lowest R^2 values.

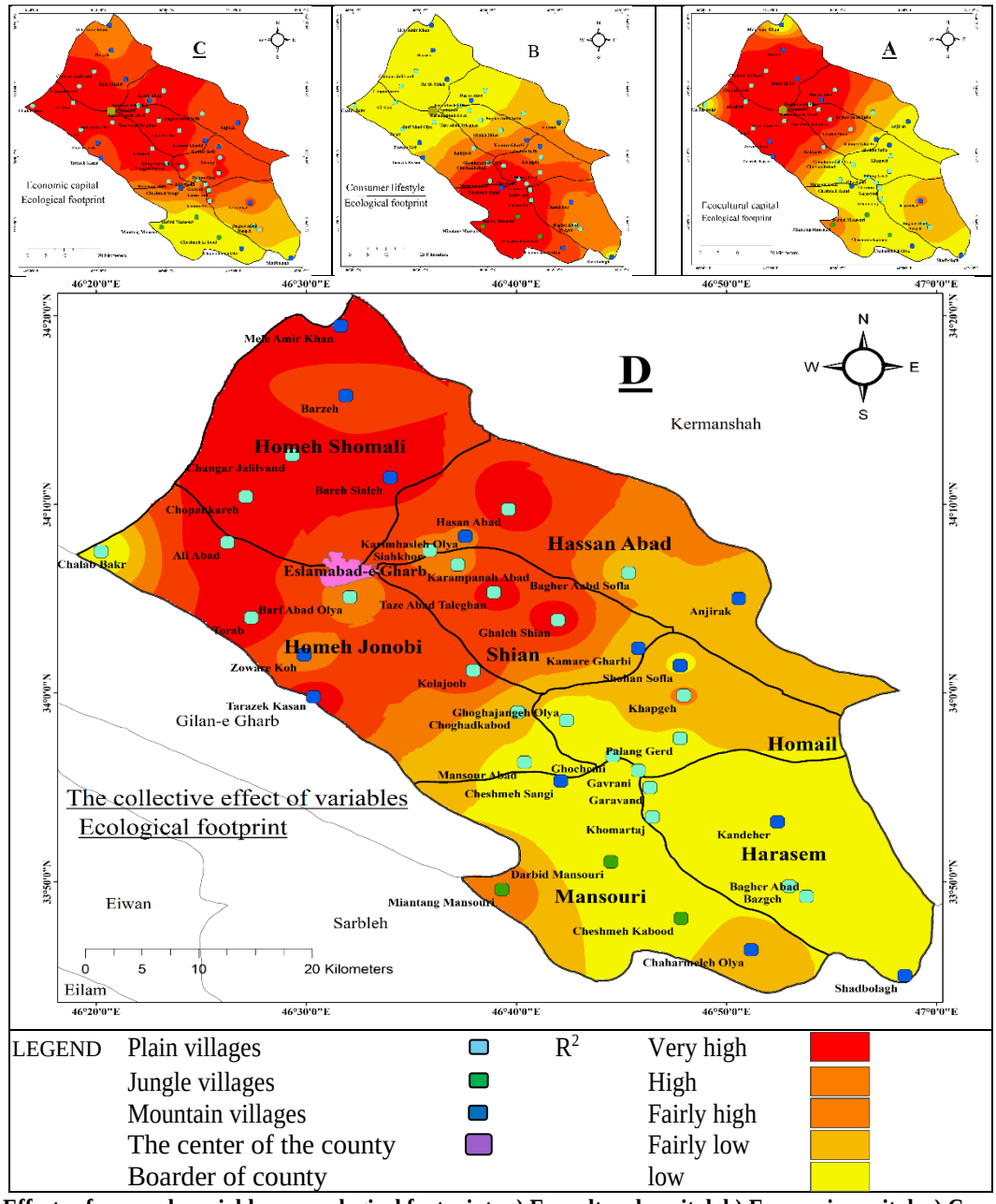

Figure 6. Effects of research variables on ecological footprint: a) Ecocultural capital, b) Economic capital, c) Consumerism, and d) collective effects of variables

In terms of economic capital also the situation is the same. The R^2 values are reduced moving from the northwest to the southeast with the only difference being that plain villages have greater R^2 values than jungle and mountain villages (Figure 6-b). Besides, the findings indicated that R^2 values of economic capital effects on ecological footprint are higher for Ghale Shiyan, Kalleh Joob, and Ali Abad.

Investigation of the zoning of the effects of consumer lifestyle on ecological footprint in the sample villages also indicates that the southern part of the county has had a greater R^2 and it has reduced moving towards the northwest. The reason can be the traditional lifestyle in the southern villages which are farther from the city and are more dependent on the natural resources. In this regard, Darbid Mansuri, Cheshmeh Kabood, and Cheshmeh Sangi had the greatest R^2 values while Barzeh, Malleh Amir Khan, and Ali Abad had the lowest R^2 (Figure 6-c). in the following, the overall status of distribution of R^2 in Eslamabad-e Gharb county was determined by putting together the zoning of each variable (Figure 6-d). Based on the obtained output, it was revealed that 'very high' zones are more located in the western parts of the city. Ghale Shiyah, Tazeh Abad Taleghan, and Hasan Abad were located in the 'very high' zone as island units. The effectiveness of the variables on ecological footprint was reduced moving towards the southeast.

5. Discussion and Conclusion

The limitation of natural resources and the biocapacity of the regions have made the necessity of the correct and optimal use of these resources more and more important. On the other hand, population boost, rapid development, promotion of consumerism, and technological advancements have brought about the increase in exploitation of resources and consequently, the outbreak of the environmental crises. Therefore, the authorities and planners should especially consider the environment on the path to development. The environmental challenges created are the outcome of the human-centered and materialist approaches from the past centuries, which have led to the introduction of sustainability in the development literature. Sustainability refers to the concept that natural resources, as the collective heritage of humanity, should be used and protected in a way that can meet the needs of future generations. In line with this paradigm, some theories such as environmental ethics, ecological citizenship, and deep ecology were also proposed which all emphasize the denial of anthropocentrism and the necessity of paying attention to the environment to achieve sustainable development. Meanwhile, ecological footprint assesses the sustainability of societies through the investigation of the consumption of resources. In this index, energy consumption, food consumption (agricultural, livestock, and aquatic products), water consumption, service consumption, types of goods, and transportation are examined. Considering the wide range of human uses in this index, it can be concluded that various factors can affect the ecological footprint of people and settlements. Therefore, the current research aimed to identify the factors affecting the ecological footprint using the structural equation model as well as the spatial analysis of these factors. As the main suppliers of food and direct users of natural resources, rural communities were chosen as the case study.

The results indicated that 30% of the sample villages had a 'fairly large' footprint (6.22-7.37 hectares). According to the respondents, the ecocultural capital is at a middle-to-high level in the sample villages with a mean value of 3.92. In this construct, the environmental beliefs had the highest mean, while the environmental participation had the lowest mean, which indicates that although the villagers have some environmental beliefs for the protection of the natural resources, these beliefs have not been fulfilled in practice and their environmental participation has been very low. In this regard, the highest statistics belong to Kalleh Joob, Siah Khoor, and Kamareh Gharbi. The consumer lifestyle construct is at a low level with a mean value of 2.3. The amount of consumption and conspicuous consumption have scored the highest and lowest mean values, respectively. Also, the spatial distribution of the lifestyle in the region indicated that Siah Khoor, Anjirak, and Choobankareh scored better than other villages in terms of the statistics. Economic capital is at a middle-to-high level with a mean value of 3.41. Also, the ownership scored the highest value in the sample villages. Pearson's correlation test indicated that there is a significant correlation between the independent variables (ecocultural

capital, lifestyle, and economic capital) and the dependent variable (ecological footprint) at $p<0.01$.

The results of SEM (with the PLS approach) indicated that the fit of the measuring model is approved based on the three criteria of reliability, convergent validity, and divergent validity. The reliability of the measuring model was confirmed using the CR, AVE, and factor loading of observable variables, and it was revealed that the observable variables of the research can explain their latent variable. The t-value-based results obtained from Bootstrap indicated that the correlations between the research variables are significant. In this regard, it can be claimed that the 'ownership' in the economic capital variable, 'environmental awareness' in the ecocultural capital construct, and 'consumerism' in the consumer lifestyle construct have the highest t-values and thus, are most correlated. The 'ownership' variable was more correlated with ecological footprint than other independent variables, with a statistic of 26.053. Also, the path analysis results indicated that the research constructs can predict 80% of the changes in ecological footprint, and the independent variables are highly capable of the explanation of the footprint's variance.

Overall, the evaluation of the direct and inverse correlation indicated that from villagers' point of view, the 'ownership' and 'employment' most affected ecological footprint with R^2 values of 0.874 and 0.575, respectively, while the 'conspicuous consumption' has been the least effective variable. Thus, it can be concluded that ownership in the region, which is mostly farm and livestock ownership, has managed to overcome the effectiveness of their lifestyle or environmental beliefs in terms of affecting the environment, i.e., the villagers are most effective on ecological footprint through their employment which is the exploitation of the farms and livestock. So, people's environmental attitudes and their consumer lifestyle are less effective in this regard. Also, the results of the spatial regression showed that the R^2 values of ecocultural and economic capital constructs are higher in the northeastern parts of the county. It can be due to the location of the city in this area, i.e., the villages closer to the center are more affected by the location and spatial factors. Overall, the northwestern villages have greater R^2 values, and this effectiveness is decreased moving toward the southeast, away from the center.

In terms of approval of the effectiveness of ecocultural capital and lifestyle on ecological footprint, the results of the present study are in line with those of Hajilou (2013), Soltani Bahram (2015), Alizadeh Aghdam (2016). In these studies, the effectiveness of the 'environmental behavior', 'environmental knowledge', and 'environmental belief' on ecological footprint has been measured and confirmed. Ruini et al. (2010) have emphasized the effects of the consumer lifestyle of households on the amount of ecological footprint, which was approved by the present study by the use of the SEM. Also, a positive and significant correlation between environmental belief and environmental behaviors has been confirmed in Alizadeh Aghdam and Honervar's study (2017), which is also in line with the results of the present study. Moreover, the results of the present study in terms of the effects of economic capital on the footprint are also in line with those of Alizade Aghdam et al. (2013)'s research.

Based on the results obtained, it is suggested that the dependence of the residents in the sample villages on the natural resources and their exploitation be reduced by creating occupational diversity, especially in the villages in which economic capital was more effective on ecological footprint. Also, further studies are needed for the identification and provision of strategies to increase environmental awareness and knowledge in the sample villages, to reduce the footprint of the residents residing in these regions.

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Authors' contributions

The authors equally contributed to the preparation of this article.

Conflict of interest

The authors declare no conflict of interest.

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Original Article

تحلیل فضایی عوامل مؤثر بر ردپای اکولوژیکی سکونتگاه‌های روستایی (مورد پژوهشی: شهرستان اسلام آباد غرب)*

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چکیده مبسوط

۱.مقدمه

محیط زیست پدیده‌ای ثابت و مطلق است و توان اکولوژیکی محدودی برای استفاده انسان دارد. لذا این ضرورت ایجاب می‌شود که نحوه مصرف منابع طبیعی، مورد ارزیابی قرار گیرد. یکی از ابزارهای مناسب در این زمینه شاخص ردپای اکولوژیکی می‌باشد. این شاخص مبنایی برای ارتباط بین انسان و طبیعت و به دنبال پاسخ به این سوال است که چه مقدار از ظرفیت احیاء زیست کره، برای تجدید منابع مورد استفاده توسط یک جمعیت، دردوره‌ای معین مورد نیاز است. از آنجاکه مسائل زیست محیطی من جمله ردپای اکولوژیکی انسان در طبیعت محصول عوامل فکری، فرهنگی، سیاسی و اقتصادی است از این‌رو شناخت شاخص‌های تأثیرگذار بر میزان ردپا ضرورت می‌یابد. هدف اصلی پژوهش حاضر بررسی عوامل مؤثر بر ردپای اکولوژیکی سکونتگاه‌های روستایی شهرستان اسلام آبادغرب با نگاهی گل‌نگر و فضایی می‌باشد و در پی پاسخ به این سوال است که عوامل تأثیرگذار بر ردپای اکولوژیکی منطقه کدامند؟

۲. مبانی نظری تحقیق

توسعه اکولوژیکی به دنبال این است که با درک و فهم کاملی از تعامل میان محیط، اقتصاد، سیاست و فاکتورهای فرهنگی - اجتماعی که بر اساس اصول بوم‌شناختی هستند، انسان‌ها را توانمند کند که در هماهنگی با طبیعت به شکوفایی رسیده و به توسعه پایدار دست یابند. در توسعه اکولوژیکی، شهرها و روستاها، باید با هدف ارتقای سلامتی کیفیت زندگی ساکنانش طراحی شوند و اکوسیستم‌های وابسته مورد حفاظت قرار گیرند. این نوع توسعه، تصمیمات شهروندی، مدیریت عمومی، صنایع کارآمد بوم‌شناختی، نیازها و توقعات مردم، فرهنگ و مناظر طبیعی را با یکدیگر پیوند می‌دهد. در راستای این رویکرد، شاخص ردپای اکولوژیکی، به بررسی پایداری زیست‌محیطی میزان مصرف انسان می‌پردازد و اثر این مصرف را بر محیط‌زیست ارزیابی می‌کند. این شاخص بازگوکننده آثاری است که هر کدام از جوامع در اثر سبک و شیوه زندگی خود در طبیعت به‌جای می‌گذارند بنابراین ردپای اکولوژیکی پیامد رابطه متقابل انسان با محیط پیرامون و نتیجه کنش و رفتار انسان است. از این رو عوامل متعدد فرهنگی و اقتصادی و رفتاری در میزان ردپای افراد تأثیرگذار است.

۳.روش تحقیق

پژوهش حاضر از لحاظ هدف‌گذاری در حوزه مطالعات کاربردی و از نظر روش‌شناسی، توصیفی از نوع همبستگی می‌باشد. نوع تحقیق از لحاظ روش گردآوری داده‌ها به صورت پیمایشی و میدانی است. جامعه نمونه را ۲۵ درصد از روستاهای شهرستان اسلام آباد غرب که معادل ۴۰ روستا است، تشکیل می‌دهد. روستاهای منتخب بر اساس سه ویژگی فاصله از مرکز شهرستان، تعداد خانوار و موقعیت طبیعی گزینش شده‌اند.

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۵۰۰ خانوار تعیین شد. نوع تحلیل یا شیوه تجزیه و تحلیل داده با استفاده از روش آماری مدل معادلات ساختاری (SEM) یا مدل‌یابی علّی حداقل مربعات جزئی صورت گرفت و اثراث سه سازه سرمایه فرهنگی بوم شناختی، سرمایه اقتصادی و سبک زندگی مصرفی بر ردپای اکولوژیکی به عنوان متغیر وابسته سنجیده شد. همچنین جهت بررسی اثرات عوامل مکانی- فضایی بر متغیرهای پژوهش از رگرسیون وزنی جغرافیای(GWR) استفاده گردید.

۴. یافته‌های تحقیق

نتایج نشان داد که ۳۰ درصد روستاهای مورد مطالعه دارای ردپای تا حدودی بزرگ هستند. وضعیت سرمایه فرهنگی بوم شناختی روستاییان با میانگین ۳/۹۲ در سطح متوسط رو به بالا، سبک زندگی مصرفی با میانگین ۲/۳ در سطح پایین و سرمایه اقتصادی منطقه با میانگین ۳.۴۱ در وضعیت متوسط به بالا قرار داشت. نتایج آزمون Bootstrapp براساس مقادیر t، نشان داد که روابط بین متغیرهای پژوهش با ضریب بیشتر از ۱/۹۶ معنادار هستند. از این نظر متغیر مالکیت در سازه سرمایه اقتصادی، متغیر آگاهی محیط زیستی، در سازه سرمایه فرهنگی بوم شناختی و تمایل به مصرف در سازه سبک زندگی مصرفی، دارای بیشترین مقدار t و در نتیجه دارای بیشترین میزان ارتباط هستند. متغیر مالکیت در سازه سرمایه اقتصادی با آماره ۲۶/۰۵۳ ارتباط بیشتری نسبت به سایر متغیرهای مستقل با ردپای اکولوژیکی روستاهای مورد پژوهش داشته است. همچنین نتایج تحلیل مسیر نشان داد که سازه های پژوهش می‌توانند ۰/۸۰ درصد از تغییرات ردپای اکولوژیکی منطقه را پیش‌بینی کنند و متغیرهای مستقل توان بالایی در تبیین واریانس متغیر ردپا دارند. در مجموع بررسی و ارزیابی روابط مستقیم و غیرمستقیم مدل معادلات ساختاری نشان داد که از نظر روستاییان متغیر مالکیت و اشتغال با ضریب اثر ۰/۸۷۴ و ۰/۵۷۵، بیشترین تأثیر را بر ردپای اکولوژیکی داشته و متغیر مصرف منزلتی کم‌اثرترین متغیر بوده است. همچنین نتایج مدل رگرسیون فضایی نشان داد که ضریب تأثیر سازه‌های سرمایه فرهنگی بوم‌شناختی و سرمایه اقتصادی در بخش‌های شمال شرق شهرستان بیشتر است. این امر را می‌توان ناشی از استقرار مرکز شهرستان در این قسمت دانست. به این معنی که روستاهای نزدیک به مرکز شهرستان تأثیر بیشتری از عوامل مکانی و فضایی گرفته‌اند.

۵. بحث و نتیجه‌گیری

شاخص ردپای اکولوژیکی با بررسی وضعیت مصرف منابع به ارزیابی پایداری جوامع می‌پردازد. در این شاخص مصرف انرژی، مصرف غذا، مصرف خدمات، انواع کالا و حمل و نقل مورد بررسی قرار می‌گیرد. با توجه به بررسی طیف وسیعی از مصارف انسانی در این شاخص، می‌توان نتیجه گرفت که عوامل مختلفی می‌توانند بر میزان ردپا اکولوژیکی افراد و سکونتگاه‌ها تأثیرگذار باشد. از این رو پژوهش حاضر، با هدف شناسایی عوامل موثر بر ردپای اکولوژیکی صورت گرفت و جوامع روستایی به عنوان تأمین‌کنندگان اصلی غذا و بهره‌بردارن بی‌واسطه از منابع طبیعی به عنوان مورد پژوهشی انتخاب شدند. براساس یافته‌های پژوهش، متغیر مالکیت و اشتغال بیشترین تأثیر را بر ردپای اکولوژیکی منطقه داشته است. لذا می‌توان نتیجه گرفت که مالکیت در روستاهای منطقه که بیشتر در زمینه مالکیت زمین‌های کشاورزی و دام است، توانسته بر تاثیرگذاری سبک زندگی یا باورهای محیط زیستی آنها در زمینه اثرگذاری بر محیط زیست چیره شود. به این معنی که روستاییان بیشترین تأثیر خود را از طریق شغل خود که بهره‌برداری از زمین و مرتع و دام است ایجاد می‌کنند و نگرش‌های محیط زیستی افراد و همچنین سبک زندگی مصرفی آنها تأثیر کمتری در این مسئله دارد. با توجه به نتایج بدست آمده از پژوهش، پیشنهاد می‌گردد با ایجاد تنوع شغلی در روستاهای مورد مطالعه به ویژه روستاهای که اثرگذاری سرمایه اقتصادی در آنها بر ردپای اکولوژیکی بیشتر بوده، وابستگی ساکنین این مناطق به منابع طبیعی و بهره‌برداری از آن کاهش یابد.

کلید واژه‌ها: ردپای اکولوژیکی، معادلات ساختاری، رگرسیون موزون جغرافیایی، اسلام آباد غرب.

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