Evaluation of environmental knowledge and sustainable behaviour of forest dwellers with reference to forest resource management in the Kashmir Himalayas

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Abstract

The study aims to ascertain the levels of environmental knowledge among forest dwellers in the Kashmir Himalayas as it exerts a strong influence on people's attitude and sustainable behaviour towards sustainable forest resource management. The study is based on primary data, which was analysed with the help of Descriptive Statistics and the Binary Logistic Regression Model (BLRM) in SPSS. The study reveals that environmental knowledge had a Weighted Average Index (WAI) and a Standard Deviation (SD) of 3.05 ± 1.38, indicating low levels of knowledge. The attitude registered a WAI and SD of 3.29 ± 1.33, followed by sustainable behaviour with a WAI and SD of 3.30 ± 1.33, signifying a low to moderate level of attitude and sustainable behaviour, respectively. The study indicates that forest dwellers displayed a positive attitude and desirable behaviour on issues pertaining to their livelihoods. Environmental knowledge pertaining to emerging global environmental issues such as the role of forests in combating global warming, greenhouse gas emissions, climate change, and ecological imbalance was found to be very low, primarily on account of low levels of education. In addition, the attitude towards wildlife conservation was non-congenial on account of increasing man-animal conflicts in the region. The study reveals that education, age, and gender were key determinants influencing people's environmental knowledge, attitude, and sustainable behaviour. Therefore, efforts should be made to enhance the environmental knowledge of forest dwellers through education and broad-based awareness programmes to inculcate a positive attitude and sustainable behaviour towards forest resource management in this fragile Himalayan valley.

1. Introduction

In many aspects of human life, natural resources are important and play a crucial role (Petrovic-Randelovic et al., 2020). In natural resources, forests are an important component (Marchi et al., 2018), which play a vital role in the livelihood of local communities' (Ghoochani et al., 2020). The excessive dependency of people on natural forests has been a contributing factor in the degradation of these limited resources (Babulo et al., 2009; FAO, 2016). Population pressure, urban sprawl, people's unawareness, and a lack of sound planning have all contributed to the loss of forests throughout the developing world (Onifade et al., 2021). We are living much beyond the means of the planet by continuously harvesting the earth's resources, and by the year 2050, for the population to exist, "we will need the equivalent of two planets' worth of natural resources" (UNEP, 2011; Bastianoni et al., 2020).

The loss of biodiversity, deforestation, global warming, air pollution, soil erosion, and loss of natural resources are all effects of forest degradation (Hasnat et al., 2018; Raeisi et al., 2018). As the actions of humans are at the center of many environmental problems, achieving sustainable development will eventually require a shift in human behaviour. According to Bell et al. (2009), people acquire a scientifically sound understanding of environmental issues through exposure to the media and their own personal observations. The perspective that people have on environmental issues seems to be of the utmost importance, given that they will eventually play a direct role in combating upcoming environmental issues through the delivery of knowledge-based solutions *(Bradly et al., 1999).*

However, the 'Intergovernmental Panel on Climate Change' (IPCC) and other UN organisations suggest looking into the place-based knowledge of local people to boost resilience in a world that is constantly changing around them (UNESCO, 2008; Burkett, 2013). The close relationship between local peoples and their environments has yielded rich Local Ecological Knowledge (LEK), which has been crucial in enabling communities to survive in a variety of conditions and adapt to social-ecological shifts (Reyes-Garcia, 2015; Axelsson-Linkowski et al., 2020; Akbar et al., 2022). Indigenous and LEK are beliefs, understandings, and practises that people acquire through time in response to their natural environment and alter and adapt in accordance with ecological and social changes (Leonard et al., 2013). Gomez-Baggethun et al. (2013) reveal in their study that the common trend presented in studies is 'hybridization', in which Traditional Ecological Knowledge (TEK), beliefs, and practises are blended with novel forms of knowledge and tools to produce a new kind of information. Basic knowledge as well as particular skills related to environmental challenges are often developed through the education system (Garcia-Valinas et al., 2010).

Since biological and cultural (biocultural) diversity are inextricably intertwined, the loss of either would have devastating consequences (Haider et al., 2020) and is important for both the health of ecosystems and people's ability to adapt to unplanned and human-caused changes in the environment (Levenhagen et al., 2020). More recently, environmental education has emerged as a topic of intense attention in the academic community. The sustainable management of natural resources highly depends on education (Masud et al., 2021). Studies of households throughout the world reveal that education can be a powerful deterrent to forest clearing (Stem et al., 2003; Mamo et al., 2007). Although environmentalists mainly tend to focus on biological concerns, future conservation approaches should encourage education initiatives that aim to influence people's knowledge, awareness, attitudes, and actions regarding natural resources (Esa, 2010; Bennett, 2017). Developing the knowledge, attitude, dedication, and competence necessary to safeguard the environment starts at an early age. This signifies that through the use of environmental education, educators can significantly contribute to the development of new knowledge, attitudes, and behaviours. (Pe'er et al., 2007; Zsoka et al., 2013).

Environmental education is important because studies on the relationships between knowledge, attitude, and behaviour show that an individual must have relevant environmental knowledge in order to hold a positive environmental attitude, which is a moderate predictor of behaviour (Yavetz et al., 2009; Yuriev et al., 2020). There is a widely held belief that attitudes are strong indicators of actual behaviour and may therefore be used to foresee people's behaviour, including their reaction, acceptance, or responses to conservation and development activities (Shibia, 2010; Cherian & Jacob, 2012). Therefore, attitudes are regarded as significant in influencing the behaviour and dedication of local people towards natural resource conservation and management, along with related contextual factors such as economic and social (Thakadu, 2005). The growing interest in participatory approaches eventually pulls local people into the mainstream as key actors in the management of natural resources. When it comes to the management of natural resources, the perception of the local community is different from that of external development agencies (Shackleton et al., 2002; Lawrence, 2007). It is essential to have effective policies and implementation strategies for resource management with the goal of promoting environmental,

economic, and social equity across generations in order to realise the goal of ensuring sustainability regarding natural resources and the environment *(*Blowers, 2013; Ladan, 2018*)*.

Kashmir Himalayas is an ecologically fragile in region. A significant aspect of its ecological balance and environment are its forests. Forest dwellers in the Kashmir Himalayas are spread across many small villages and hamlets. They are highly reliant on rain-fed agriculture and the nearby forest. In order to address the problems of extreme poverty and food insecurity, as well as to make the livelihoods that are already in place more robust and sustainable, a significant amount of focus must be placed on the enhancement of the value of these forest resources through the processes of development and value addition (Banday et al., 2019).

In order to build a plan for the security and promotion of livelihoods based on forest resources, it is essential to have a comprehensive knowledge of the biophysical and socio-economic characteristics of forest dwellers in the Kashmir Himalayas who make their living off forest resources. As a result, it is essential to have reliable information on the elements that influence local communities' participation in sustainable management and use of forest resources, as well as the ways in which these aspects are affected by the socioeconomic features of the population. (Cardona, 2005). To change the perception among forest dwellers, in which the forest is viewed mainly as a provider of non-timber forest products (NTFPs) and largely ignores its importance in combating climate change, reducing greenhouse emissions, and restoring ecological balance through the dissemination of environmental knowledge, is the need of the hour. The role of environmental knowledge in changing attitude and sustainable behaviour towards forest resource management in the Kashmir Himalayas is yet to be explored, and the present study is a novel attempt in this context. The findings of the study will help policymakers and planners develop inclusive forest management strategies, ensuring people's participation in such initiatives.

2. Material And Methods

2.1 Study Area

The Kashmir Himalaya constitutes a distinctive biospheric unit in the Northwestern Himalayas due to its biogeographically pivotal position *(*Rodgers and Panwar, 1988*)*. The study is focused on Kashmir Valley, located between 32° 22' to 34° 43' N latitude to 73° 52' to 75° 42' E longitude in the Northwestern Himalayas (Fig. 1). The region covers an area of 15,948 Km², and mountains make up close to 64% of the total land area. According to the projected 2021 census, the total population of the region is 82,38,615 persons, with a density of 516.59 persons/Km² *(*Census 2021*)*. The Kashmir Valley has an oval or bowl-like shape, and it is surrounded by mountain ranges of significant altitude on all sides; the Great Himalayan range in the north and east separates the valley from the Ladakh region, while the Middle or Lesser Himalaya, also known as the Pir Panjal Range, in the south and southwest separates it from the Jammu region. The main valley itself is at an altitude of between 1500 and 1800 metres (AMSL); however, the surrounding mountain ranges have an average height of between 3000 and 4000 metres,

with Kolahoi (5420 m) being the highest peak in the region *(Hussain, 2002).* The folding and faulting that took place during the Himalaya's uplift between the Indian subcontinent and the rest of Asia resulted in the formation of the valley of Kashmir. The "Karawas" are a notable geological feature of the area; they are plateau-like tablelands composed of clay, sand, and silt of lacustrine origin and created during the Pleistocene Ice Age (De Terra, 1934). The climate of the area, which is characterised by distinct seasonality, is analogous to that of mountainous and continental regions found in temperate latitudes. During the summer, the temperature ranges from an average daily maximum of 31 ˚C to a minimum of 15 ˚C, while during the winter, the temperature ranges from an average daily maximum of 4 ˚C to a minimum of -4 ˚C. It receives an average annual precipitation of 1,050 mm, mostly snow during the winter months *(*Qazi, 2005; Husain, 2006*).* The river Jhelum flows through the heart of the valley; it is connected to a large number of smaller rivers and serves as the region's principal irrigation source. The Valley exhibits a considerable amount of altitudinal, topographical, and climatic variation, which results in a significant amount of habitat diversity: springs, lakes, rivers, and nullahs; marshes and swamps; floating gardens; orchards and cultivated fields; Karewa lands; wastelands; gravel and rocky mountain slopes; forest lands; sub-alpine and alpine meadowlands; and permanent glaciers *(*Singh et al., 1998).

2.2 Sampling and Data Collection

The Kashmir Valley is comprised of three physiographic divisions: Mountains, Karewas, and Floodplains. Approximately 51% of its geographical area is covered by forests, and people who live both inside and outside of these forests are dependent on the resources of the forest for their means of subsistence. The study included a sample size of 600 forest dwellers and applied the single population proportion formula developed by Cochran (1977) for a 95% confidence level and ± 4% precision (margin of error) in Eq. (1). Six hundred households were selected from sixty villages for the interviews based mainly on two criteria: the level of forest resource use by local communities and proximity to the forests. According to Obua (1996), "Local communities living within a radius of five kilometres of a forest's edge are directly affect or are affected by the presence of a forest".

Both the villages and the respondents were chosen using random sampling. A structured and semi-structured questionnaire was used to interview the households. The Kashmiri language was mainly used to interview respondents that were easily understandable; however, Urdu and Pahari languages were also used to interview informants in tribal areas. The survey was carried out from March to August 2022. The interview schedule was divided into five sections: (i) information regarding socio-economic and demographical characteristics (ii) attitude towards forest resource utilisation (iii) environmental knowledge (iv) sustainable behaviour towards forest resource management and (v) sources of environmental knowledge. The socio-demographic and economic attributes, such as age, gender, marital status, education, main occupation, household size, housing status, and length of residency, were included *(*Venkataramaiah, 1990*).* The environmental knowledge, attitude, and sustainable behaviour of forest dwellers towards forest resource management were measured using a five-point Likert scale ranging from strongly agree- 5 to strongly disagree- 1. On a 5-point Likert scale, the respondents were asked to indicate how much they agreed or disagreed with each statement, viz., strongly agree- 5, agree-

4, neutral- 3, disagree- 2, and strongly disagree- 1. The above-mentioned methods have been used in previous studies of similar nature (Sreenath and Veerabhadraiah, 1993; Fan et al., 2015; Damalas and Abdollahzadeh, 2016; Rezaei et al., 2019; Sharifzadeh et al., 2019; Ali et al., 2020; Bondori et al., 2021; Ganaie et al., 2022).

$$\text{Equation-1} \quad n = \frac{Z^2 p(1-p)}{d^2}$$

where n = sample size; Z = is the Z-square value at 95% confidence level = 1.96; p = estimated proportion of population (0.5 = maximum variability); d = marginal of error (± 4% precision) = 0.04.

2.3 The Reliability Test of Scales

To determine the internal consistency of the questionnaire and each scale in the study, Cronbach's alpha coefficient was used. Alpha values for each scale are summarised in (Table 1). The environmental knowledge and sustainable behaviour scale has very good alpha values, whereas the attitude scale has registered a good alpha value.

Table 1
Cronbach 's alpha coefficient of the scales

Scales	No. of items	Alpha Value
Environmental knowledge	15	0.81
Attitude	14	0.76
Sustainable behaviour	11	0.85

2.4 Data Analysis

Descriptive statistics were mainly used in the study. In the first stage, the forest dwellers socio-economic and demographic factors were analysed using mean and percentage. The environmental knowledge, attitude, and sustainable behaviour of forest dwellers were assessed using a five-point Likert scale with a Weighted Average Index (WAI) and Standard Deviation (SD). A proper methodological framework is discussed in (Fig. 2). A Logistic Regression Model (BLRM) was used to find associations between socio-economic and demographic variables and scales related to environmental knowledge, attitude, and sustainable behaviour. In the final stage, to examine the relationship between environmental knowledge, attitude, and sustainable behaviour, Pearson's correlation was used, with $p < 0.05$ regarded as statistically significant. The WAI of the variables was calculated using Eq. (2).

$$\text{Equation-2} \quad \text{WAI} = \sum f_i^{iwi}$$

where f = response frequency; w = weight of each item; and i = score (for example, 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree).

3. Results

3.1 Demographic and Socio-economic Characteristics

The Kashmir region is comprised of a longitudinal valley surrounded by the Greater Himalayas on the North and the Middle Himalayas on the south, inhabited predominantly by agrarian communities along with scattered pastoral ethnic groups across the mountainous belts. The vast majority of the population relies on agriculture and other primary resources to sustain their livelihoods. The demographic and socio-economic characteristics of the sample households are presented in (Table 2). The study concludes that the mean age of forest dwellers was found to be around 47.74 years, indicating the predominance of middle-aged people with 4.76 years of schooling. Approximately (98.67%) were found to be married, with an average household size of 6.42 persons. The ethnic composition of the respondents was: Kashmiris (52.33%), mostly living on the periphery of forests; Gujjars (40.00%); and Bakarwals (7.67%), predominantly residing inside forests. More than half of the households were farmers (54.5%) with an average annual income of ₹ 49,707.5. In rural areas, the real earners are usually middle-aged people who are energetic, economically active, innovative, and hardworking *(Sinha et al., 2010).*

Table 2
Characteristics of Sampled Respondents in the Study Area (n = 600)

Variables	Frequency	Mean	Percentage/Standard deviation
Gender			
Male	498	-	83.00
Female	102	-	17.00
Mean Age	-	47.74	(14.09 standard deviation)
Marital status			
Married	592	-	98.67
Single	8	-	1.33
Education level (Years of Education)	-	4.76	(4.72 standard deviation)
Mean Household size	-	6.42	(1.93 standard deviation)
Mean Annual Income (₹)	-	49707.5	(75089.01 standard deviation)
Length of residency (Years)			
< 30	78	-	13.00
31−60	302	-	50.33
> 61	220	-	36.00
Ethnicity (Frequency)			
Kashmiris	314	-	52.33
Gujjars	240	-	40.00
Bakarwals	46	-	7.67
Mean Distance from forest (Km)	-	2.48	(1.59 standard deviation)

Emergent individualism results in living an autonomous life with personal assets and adequate housing is largely responsible for the frequency of large nuclear families and large family sizes in rural homes (Kumar et al., 2010). The primary reason for the low annual income (₹ 49707.5) for the majority of households can be attributed to limited number of working days for the labour due to distance from urban markets, coupled with lack of formal work opportunities and low farm yields.

3.2 Evaluation of Environmental Knowledge of Forest Dwellers

Numerous studies have demonstrated that both knowledge and lack of knowledge play crucial roles in the decision-making process. Values, attitudes, and knowledge were found to have an influence on people's environmental awareness and behaviours (Lynam et al., 2007; Chirenje et al., 2013). According to Kaplan (1991), "one's level of knowledge of an issue has a significant impact on decision-making". In particular, people dislike and avoid circumstances where they lack knowledge to direct their behaviour or where confusion is high (Kerney & DeYoung, 1995). In six European centres, the level of environmental knowledge was shown to be influenced by demographic factors, according to an in-depth analysis of the factors that affect understanding of scientific and environmental facts (Gendall et al., 1995; Burton, 2014). Specifically, men had a higher level of knowledge than women did; younger people had a higher level of knowledge than older people; and the level of education directly correlated with a higher level of knowledge.

The descriptive statistics of the environmental knowledge in the Kashmir Himalayas, which are summarised in (Table 3), reveal that the majority of forest dwellers perceive that forest-based livelihood options cannot be underestimated, with a WAI of 3.54 (SD 1.47) on a five-point Likert scale. It is found that forest dwellers in the study area typically have large families and are largely reliant on forest products to supplement their income. This is because forest dwellers in the area may find it difficult to acquire access to reliable sources of sustenance. They give preference to economic benefits over sustainable forest resource management, which is evident from the fact that approximately 70% of the respondents were in favour of using forest land for developmental projects, mainly due to a lack of environmental knowledge. Creating a balanced development that has minimum socio-ecological repercussions without compromising equality is the challenge of the new millennium (Kotze, 2018; Eisenmenger et al., 2020). More than half of forest dwellers with a WAI greater than 3 are in agreement with the construct that climate change-induced droughts are responsible for increasing forest fire incidents, and water security in mountainous areas is linked with forest sustainability. A detailed account of the constructs of environmental knowledge along with the levels of agreement is given in (Fig. 3).

The study reveals that a sizable portion of forest dwellers are critically lacking environmental knowledge pertaining to burning global environmental issues. Approximately two-third of forest dwellers did not comprehend that for curbing greenhouse emissions and reducing air pollution forest play an important role. The vast majority of respondents conceded that they lack basic understanding of environmental themes such as ecological balance, biological imbalance, soil erosion, greenhouse emissions, global warming, hydrology, and climate change (Haron et al., 2005). Probably low environmental knowledge among forest dwellers towards forest resource management can be attributed to low literacy as a result of unfavourable socio-economic conditions, insufficient educational facilities, a lack of infrastructure, and a general lack of interest in pursuing higher education (Pal, 2011). The findings of the study are validated by similar studies (Haron et al., 2005; Islam et al., 2015; Hussain & Loan, 2021), which confirm that due to low environmental knowledge, the levels of attitude and sustainable behaviour were recorded as low to moderate. It is evident from the results that less than 35% of people perceive that forests help with groundwater recharge and the maintenance of ecological balance, which is cause for concern. The

knowledge WAI score was 3.05 ± 1.38, representing low environmental knowledge in relation to forest resource management.

Table 3

Environmental knowledge, attitude and sustainable behaviour of forest dwellers (n = 600)

Statements	WAI	SD
Environmental Knowledge (Do you agree) (Cronbach's α 0.81)	**3.05**	**1.38**
Forests ensure the maintenance of ecological balance	2.87	1.36
Destruction of forests could cause a biological imbalance	2.99	1.34
Is it justified to use forest land for developmental projects	3.50	1.41
Forest based livelihood options cannot be underestimated	3.54	1.47
Over exploitation of forest resources are responsible for soil erosion	2.86	1.43
Forests are useful in reducing air pollution	2.83	1.38
Forest helps in ground water recharge	2.94	1.27
Forest helps in reducing greenhouse emission	2.59	1.42
Forests work as a windbreaker during gusty winds	3.12	1.42
Deforestation without sufficient reforestation resulted in damage to habitat, biodiversity loss, water scarcity, and aridity	2.94	1.33
Forests maintain and regulate environmental processes, i.e., soil erosion, hydrology, and climate	2.64	1.36
Expansion of forests will reduce the global warming problem	3.05	1.32
Climate change-induced droughts are responsible for increasing forest fire incidents	3.40	1.38
Water security in mountainous areas is linked with forest sustainability	3.28	1.42
Climate change and deforestation have severely affected stream discharge	3.17	1.40
Attitude (do you agree) (Cronbach's α 0.76)	**3.29**	**1.33**
Forests are exclusively government property	2.29	1.30
Forest dwellers have the right to use forest and forest products	4.29	0.93
Forest dwellers are satisfied with the management of forest resources by the forest department	2.82	1.47
Forest resources help forest dwellers to become self-sufficient in fuel wood, fodder, and other NTFPs	3.39	1.44
Forest resources provide employment and income opportunities to the forest dwellers at their doorsteps	3.85	1.32
The availability of forest resources halts the exodus of forest dwellers to urban areas for their livelihood	3.35	1.50

Statements	WAI	SD
Environmental Knowledge (Do you agree) (Cronbach's α 0.81)	**3.05**	**1.38**
The forests help in meeting the social, cultural, religious, and recreational needs of the people	3.31	1.33
Forests provide nutritious and healthy food items to forest dwellers	3.00	1.51
With the implementation of vibrant forest policies and programmes, forest area/cover have increased considerably	2.53	1.43
Due to overexploitation of forest resources, some plant and animal species have disappeared totally	3.02	1.30
With the degradation and shrinking of forest areas, man-animal conflicts are increasing	3.65	1.27
With the implementation of new forest laws and policies people have been restricted from collecting NTFPs	3.04	1.40
Training programmes from the forest department and NGO can increase the knowledge of forest dwellers about sustainable use of forest resources	4.14	1.05
Forest degradation is mainly caused by anthropogenic activities as compared to natural causes	3.34	1.43
Sustainable Behaviour (do you agree) (Cronbach's α 0.85)	**3.30**	**1.33**
For enhancing soil fertility, people should use the leaves/litter of forest trees as manure	3.42	1.24
Alternative energy, e.g., LPG or solar energy, should be utilised in place of firewood	3.33	1.37
Environmental protection should be the sole responsibility of the government only	2.55	1.33
We should help in cleaning and maintaining water bodies in the locality	3.66	1.31
Forest resources should be conserved for future generations	3.33	1.31
Wildlife protection should be considered the utmost priority	2.68	1.36
Conservation of plants and birds should form the core component of forest policy	3.42	1.26
Planting more trees around agricultural fields protects soil erosion	3.47	1.33
Solid waste (garbage) disposal should be strictly prohibited in or near the vicinity of forests	3.34	1.47
We should help in reforestation of degraded forest areas	3.44	1.40
Youth should contribute towards combating forest fires	3.64	1.29

3.3 Attitude of Forest Dwellers

The attitude of forest dwellers towards forest resource management was analysed using the fourteen constructs (Table 3). The study concludes that the majority of the forest dwellers are in agreement with the statements that forest dwellers have the right to use forests and forest products. There was also agreement on the fact that training programmes from the forest department and NGOs can increase the knowledge of forest dwellers about sustainable use of forest resources with a WAI score above 4 on a five-point Likert scale. Results reveal that forest dwellers largely perceive that forest resources can provide employment and income opportunities at their doorstep, as indicated by a WAI of 3.85 (SD 1.32). The other studies also confirmed that if the necessary efforts were taken to incorporate NTFPs as tradeable products, the incomes of the local communities might potentially increase by as much as 18 times (Peerzada, 2016). However, NTFPs can only attain their full potential if they are promoted as part of a diverse product line in a bioeconomy that supports sustainable usage of wild species, income generation, and promotes inclusive growth in a sustainable manner. There was high agreement among the respondents on the statement that degradation and shrinking of forest area have increased man-animal conflicts (WAI 3.65 & SD 1.27). A detailed account of the constructs of attitude along with the levels of agreement is given in (Fig. 4). Throughout the Jammu and Kashmir Union Territory of India, almost 60% of the population relies on NTFPs harvesting for their basic needs, including food, nutrition, fuel wood, medicine, income, and employment (Gangoo et al., 2017; Peerzada et al., 2021). With a WAI greater than 3, more than half of the forest dwellers confirmed that forest resources help people to become self-sufficient in fuel wood, fodder and NTFPs and the availability of forest resources halts exodus of forest dwellers to urban areas for their livelihood.

The significance of NTFPs in the economic well-being of poor communities can contribute to reducing inequality. Non-timber forest products (NTFPs) are harvested for both subsistence and income generation by communities living on the forest's periphery due to a lack of access to formal work opportunities and poor access to productive lands (Tugume et al., 2019). It is estimated that between 50 and 60% of the people in the region rely on the NTFP sector for their livelihoods and income generation, even if this fact is not widely acknowledged. It is estimated that at least 60% of the villagers in the outlying areas of Langate Forest Division in Kashmir are economically dependent on NTFPs for generating income (like Trillium govanianum, Morchella esculenta, Aconitum heterophyllum, and Saussurea lappa, etc.) (Peerzada, 2016). A similar study (Gangoo et al., 2017) revealed that in the Pulwama district of the Kashmir valley, it was found that NTFPs account for 66.97% of the household income for wicker workers (using species such as Salix viminalis, Salix triandra, Indigofera pulchella, Cotoneaster bacillaris, Parrotia jacquemontiana, etc.). The NTFPs play an incredibly significant role in assisting families in both meeting their fundamental needs and increasing their income. People who live in distant and inaccessible parts of Kashmir, where there are no organised markets, still acquire fruits, vegetables, mushrooms, medicinal plants, fuelwood, and fodder from the neighbouring forests to consume and sell (Matta, 2019).

The study revealed that 49.17% of the forest dwellers agree with the statement that forests provide nutritious and healthy food items to forest dwellers (WAI, 3.00). Food and livelihood security for forest people might be considerably improved with the implementation of a well-planned strategy for the management of a diverse array of NTFPs. The vast majority of plants and plant-derived products that are

subsequently consumed by animals and humans are harvested from forests. Whole plants, roots, leaves, fruits, nuts, and other plant parts are included in this category (Islam and Gangoo, 2016). Further analysis revealed that 57.33% of forest dwellers confirmed that forest degradation is mainly caused by anthropogenic activities as compared to natural causes. Consequently, the study reveals that more than half (53.33%) of forest dwellers were dissatisfied with the management of forest resources by the forest department. In recent decades, different forest laws and policies have been formulated to ban illegal green felling, and with different forest programmes, thousands of hectares of forest land have been rehabilitated. With the help of these programmes, new closures were formed, and a ban was put in place on the collection of NTFPs and the burning of fuel wood inside these closures. The WAI score of the attitude was 3.29 ± 1.33, which indicates a low to moderate level of attitude towards forest resource management.

3.4 Levels of Sustainable Behaviour

The sustainable behaviour of forest dwellers with regard to forest resource management was examined with the help of eleven constructs (Table 3). Analysis reveals that most of the forest dwellers displayed desirable behaviour pertaining to their role in solving the immediate environmental and ecological problems. High agreements were registered on the issues that forest dwellers should contribute to cleaning and maintaining water bodies in their locality (WAI 3.66), help combat forest fires (WAI 3.64) and plant more trees around agricultural fields to protect soil erosion (WAI 3.47). Around 62.17% of the respondents indicated that people should help in the reforestation of degraded forest areas. It implies that forest dwellers have a concept of common property resources (CPR) and that they collectively work for their local environment. The results revealed that people in the study area have decent levels of sustainable behaviour towards forest resource management. More than half (59.00%) of forest dwellers agreed with the statement that for enhancing soil fertility, people should use the leaves and litter of trees as manure to reduce the use of harmful chemical fertilisers. A detailed account of the constructs of sustainable behaviour along with the levels of agreement is given in (Fig. 5).

The majority of the forest dwellers with a WAI greater than 3 believe that alternative energy, e.g., LPG or solar energy, should be promoted and utilised in place of firewood, and forest resources should be conserved for future generations. More than two-third of forest dwellers disagreed with the statement that environmental protection should be the sole responsibility of government only, thereby acknowledging the concept of shared responsibility. Last but not least, more than half of the forest dwellers disagree with the statement that wildlife protection should be considered the utmost priority. Therefore, on the issue of wildlife protection, there is a lot of scope to convince people through awareness and outreach programmes about the importance of wildlife so that the negative perception is changed. The WAI score for sustainable behaviour was 3.30 ± 1.33, indicating that forest dwellers have a low to moderate level of sustainable behaviour towards forest resource management.

3.5 Sources of Environmental Knowledge

An attempt was made to analyse the various sources of environmental knowledge among forest dwellers, which are summarised in (Table 4). Most of the respondents (39.83%) revealed that radio was their principal informational source pertaining to the environment, followed by television (33.83%) and seminars or workshops (17.33%) (Fig. 6). The people living in the remote forest areas generally have low economic status and lack basic amenities, so their use of gadgets like mobile phones and the internet is restricted to a limited percentage of the population. There are several barriers to communication, and the introduction of new ideas, innovations, and technologies into these societies becomes difficult due to low levels of literacy.

Table 4
Sources of environmental knowledge

Source of information	Frequency	Percentage
Television	203	33.83
Radio	239	39.83
Internet	101	16.83
Newspapers	37	6.17
Personal sources (eg. from friends & relatives)	49	8.17
Magazines	00	00
Seminars/workshops	104	17.33
Books	13	2.17

3.6 Factors Influencing Environmental Knowledge, Attitude and Sustainable Behaviour

The BLRM were developed in order to explore the relationships between the socio-economic and demographic attributes of respondents and their environmental knowledge, attitude, and environmentally sustainable behaviour pertaining to forest resource management. These variables were found to be statistically significant across all three scales ($p < 0.001$) (Table 7). Overall, the model analysis reveals various insights regarding the variables that affect the knowledge, attitude, and sustainable behaviour of forest dwellers.

The BLRM shows that an increase in education (significant at ≤ 0.05), as well as an improvement in understanding, are important factors influencing environmental knowledge (scale 1). Education typically tends to increase a person's knowledge with respect to the value of natural resources and environmental services. As per the findings of this study, it can be said that educated people (who are usually younger) are more informed and confident about forest resource management than the uneducated population.

The findings of the model also indicate that age has a negative influence on the environmental knowledge of forest dwellers, with a significance level of (≤ 0.05). In other words, the probability of a forest dwellers environmental knowledge in relation to forest resource management decreases with age. Other factors, including gender, income, and length of residency, are also having a significant influence on the environmental knowledge of forest dwellers. As the length of residency increases, interaction with the environment increases, and traditional knowledge passes from old generation to new, consequently leading to an increase in environmental knowledge. The families with high income can afford information-providing gadgets like radio, television, mobile phones, and internet access, eventually enabling them to have the better environmental knowledge needed for forest resource management.

Table 5

Binary logistic regression of factors influencing knowledge, attitude and sustainable behaviour towards forest resource management

Variables	(Scale- 1)		(Scale- 2)		(Scale- 3)	
	Environmental Knowledge		Attitude		Sustainable Behaviour	
	B	Exp (B)/OR	B	Exp (B)/OR	B	Exp (B)/OR
Age	-0.99	0.37*	0.06	1.06*	0.04	1.04*
Income	1.78	5.93**	0.001	1.001	1.03	2.80
Education	1.45	4.28***	1.45	4.26**	1.25	3.49***
Gender	1.25	3.49*	1.25	3.49***	1.56	4.75*
Household size	-0.07	0.93	-0.05	0.95	-4.21	0.01
Marital status	2.25	9.48	-1.45	0.23	0.03	1.03*
Length of residency	1.45	4.26*	1.01	2.75***	-1.45	0.23
Distance from forest	-0.05	0.95	-0.37	0.69*	-0.32	0.73**
Ethnicity	-0.24	0.78	1.02	2.77	2.03	7.61
B- Coefficient, Exp (B)/OR- odds ratio Note: ***significant at p 0.001, **significant at p 0.01, *significant at p 0.05						

Education is a main factor that influences the attitude of forest dwellers, which has been found to be (significant at ≤ 0.05). Furthermore, distance from forests (significant at ≤ 0.05) negatively influences the attitude. It has been found that as one goes away from the forests, their attitude towards forest resource management decreases (Scale 2). Local communities that have been living in the same place for decades and are close to forests would have more interactions with the forests, and the income they generate from using non-timber forest products could positively influence their views towards forest

resource management. Our findings are consistent with those of other studies, which indicate that local communities that are located in close proximity to the sacred forest have a favourable attitude towards forest conservation (Chandrashekara & Sankar, 1998; Sekhar, 2003; Khan et al., 2008). Fear and respect for various forms of traditional ecological beliefs motivate local communities to refrain from harvesting resources from the sacred forest, which is a good indicator of the link between positive attitudes and obedience (Sinthumule & Mashau, 2020). Age, gender, and length of residency also have positive influences on the attitude of forest dwellers. In addition, income, household size, marital status, and ethnicity variables were not found to have a significant influence on the attitude of forest dwellers with respect to forest resource management.

The significance of knowledge and the effects of a lack of information are observed while analysing the attitude and sustainable behaviour of forest dwellers. An extremely significant association between gender and sustainable behaviour towards forest resource management (Scale 3) was found, demonstrating that gender is essential for certain facets of people's participation in the Kashmir Himalayas. However, the association between gender and environmental attitude was also found to be quite significant (Scale 2). Different circumstances affect male and female respondents in different ways, which in turn affects the degree to which they participate in forest resource management, such as rehabilitation of degraded forests, combating forest fires, restoring water bodies, and protecting wildlife. Generally, women's personal and domestic attributes limit their ability to take part in sustainable management of forest resources in the Kashmir Himalayas. Social, religious, and household obligations, as well as community-wide socio-cultural norms and values, might put women at a disadvantage and often present hindrances to their participation in sustainable forest resource management. Women in the Kashmir Himalayas are responsible for a variety of household responsibilities, such as the care of children, the fetching of water, the preparation of food, and the assistance in farming operations. In addition, women are not conventionally permitted to speak publicly, which prohibits them from participating in participatory initiatives aimed at achieving sustainable forest resource management. Thus, standards determine how work is divided by gender, and women's traditional role as caretakers and nurturers often prevents them from taking time away from home responsibilities to participate in forest resource management activities (Nuggehalli & Prokopy, 2009).

In addition, the respondents' marital status had a significant positive impact on sustainable behaviour in relation to forest resource management (Scale 3); consequently, it appears that married members were more enthusiastic about forest preservation and protection than their unmarried counterparts. The analysis revealed that education, age, and distance from forests are significant variables that influence forest dwellers sustainable behaviour towards forest resource management. Values, attitudes, and knowledge were found to influence environmental awareness and behaviour. Generally, it is noted that knowledge influences environmentally conscious attitudes, which in turn inspire ecologically or environmentally sustainable behaviour.

3.7 Correlation Between Environmental Knowledge, Attitude and Sustainable Behaviour

In order to examine the relationship between environmental knowledge and scales relating to attitude and sustainable behaviour, the Pearson's correlation test was conducted. Based on the findings of the correlation analysis, it appears that environmental knowledge is significant (p   0.01) and positively correlated with attitude and sustainable behaviour (Table 6). This means that as the environmental knowledge of respondents increases, so does the likelihood of having a positive attitude, ultimately leading to an increase in their sustainable behaviour.

Table 6
Correlation analysis

	Attitude	Sustainable behaviour
Knowledge	0.382*	0.498*
*Significant at the 0.01 level		

Even though the degree of association between knowledge and scales related to attitude and sustainable behaviour was low, it does imply that knowledge is an important element in promoting the appropriate environmental attitudes, increasing sustainable behaviour, and encouraging more participation from the forest dwellers. Therefore, more vigorous efforts on environmental education are required to promote pro-environmental behaviour. The findings reveal that environmental knowledge pertaining to emerging environmental concerns such as global warming, greenhouse emissions, soil erosion, and groundwater recharge is very low among forest dwellers. This could be improved through various government and non-government organisations conducting mass awareness programmes involving local communities and self-help groups, ultimately helping in promoting a desired attitude and sustainable behaviour among the forest dwellers, which could ultimately contribute to stabilising the fragile Kashmir Himalayan region.

4. Discussion

The purpose of this study was to examine levels of environmental knowledge, attitude, and sustainable behaviour among forest dwellers in the Kashmir Himalayas. It also attempts to ascertain the impact of environmental knowledge on the attitude and sustainable behavior of respondents, which play a vital role in forest resource management. The study confirms that environmental knowledge influences forest dwellers attitude and sustainable behaviour. Evaluation of the environmental knowledge of the forest dwellers has highlighted the key areas where interventions are needed to boost awareness so that desirable behaviour are inculcated among the forest dwellers in this fragile Himalayan region. These findings could be useful for planners and decision-makers in formulating viable forest conservation strategies (Fryxell & Lo, 2003; Savari et al., 2020).

Promotion of environmental knowledge for sustainable forest resource management is a critical step, especially when people are dependent largely on forest resources for daily sustenance and have no other reliable sources of income, coupled with low socio-economic status and apathy towards higher education

(Agrawal et al., 1997; Bixler, 2014). The vast majority of respondents conceded that they lacked a basic understanding of the environmental themes included in the survey. In fact, many of the concepts and terminology that are likely to be regarded as being reasonably common knowledge, such as ecological balance, biological imbalance, soil erosion, greenhouse emissions, global warming, hydrology, and climate change, were considered unfamiliar (Haron et al., 2005). This could be because these aspects are the least obvious in nature and the most imperceptible to people, which prevents them from being able to evaluate and understand the benefits of these aspects. A second explanation could be that most of the respondents in this present study had only completed primary education. The findings are also validated by the number of studies (Islam et al., 2015; Hussain & Loan, 2021) that show that due to low environmental knowledge, the levels of attitude and sustainable behaviour were low to moderate. The findings revealed evident that less than 35% percent of respondents are aware of the fact that forest helps in ground water recharge and forests ensure maintenance of ecological balance which is cause of concern. Diversion of forest land for development projects has been reported in various studies (Laurance & Peres, 2006; Corney et al., 2008), resulting in landscape fragmentation, biological imbalance, and other environmental impairments. The overwhelming majority of environmental problems may be traced back to a lack of holistic knowledge of the complex web of relationships that exist between humans and nature (Shobeiri and Mieboudi, 2013). Therefore, educating and teaching forest dwellers on sustainable forest resource management is important for optimising the use of natural resources (Jurin et al., 2010), whereas a lack of knowledge inhibits environmentally conscious attitudes (Berger & Corbin, 1992; Vicente-Molina et al., 2013; Rizos et al., 2016).

Attitude is another essential variable regarding sustainable forest resource management. A new focus in adoption and management should be on assessing the local people's attitude, listening to their demands and requirements, and respecting their opinions (Macura et al., 2011). The findings of the study indicate a low to moderate level of attitude towards sustainable forest resource management. It has been observed that attitude shows a significant association with age and education. This can be attributed to the fact that with the increase in age and education, perception towards sustainable forest resource management increases. The study's findings also indicate that forest inhabitants appear to be most concerned about the economic values of forests since these values are directly linked to their daily lives (i.e., availability of fuel wood, firewood, and timber for construction). As a matter of concern, environmental values that are linked with their life and health (such as hydrology, clean air, and climate change) are significantly less preferred narratives. The results of our study are in conformity with several other studies, including (Durai et al., 2005; Islam et al., 2006; Meijaard et al., 2013), which reveal that people who live in close proximity to forests place a higher priority on the economic benefits of forests than on their ecological benefits. However, other research has yielded contradictory results. For instance, Lee and Kant (2006) found that the aboriginal peoples, non-governmental organisations, and the forest industry all shared a common interest in recreation, the environment, and spirituality as three of the most prominent value themes. This happens because individuals will always perceive the importance of forests from their own unique perspective. According to the findings of the present study, the means by which forest dwellers make a living are heavily dependent on forest resources. These include the people's desire to cut down trees for

building houses, the collection of mushrooms and medicinal plants for the purpose of trade, and the use of firewood for heating and cooking. Therefore, the local people's preferences and perspectives and the way they value the forests are reasonable. Attitude is a fundamental aspect of improving sustainable behaviour towards sustainable forest resource management. An individual with an optimistic attitude recognises the importance of sustainable behaviour.

The prerequisite for sustainable behaviour towards forest resource management is attitudinal change. If concerted efforts are made to enhance the levels of environmental knowledge in this region, through awareness and training programmes, a positive change in the local people's attitude can be brought about, which will eventually lead to sustainable behaviour. Social psychologists argue that a sequence of factors, including values, beliefs, and norms, have a significant influence on pro-environmental behaviours. Some norms, values, and beliefs may also contribute to a reduction in environmental attitudes and have a detrimental impact on the behaviours that relate to such attitudes *(Stern et al., 1995)*. Particularly relevant factors include those of a cultural and economic nature, which can sometimes have dramatic effects *(Laroche et al., 2002)*. Environmental socio-psychology that evaluates the association between attitudes and behaviour came to the conclusion that attitudes are significant factors in determining environmentally conscious behaviours *(Ahmad et al., 2016; Ciocanea et al., 2016)*. The study of Haron et al. (2005) revealed that environmental knowledge is positively correlated with attitude and sustainable behaviour. Attitude and sustainable behaviour are significantly influenced by age and education. The results further revealed that people use forest products sustainably to enhance soil fertility. People use the leaves and litter of forest trees as manure, and to protect soil erosion in agricultural fields, they plant trees on field boundaries, but unfortunately, due to a lack of education, they are unable to fully utilise the forest products sustainably (*Jurin et al., 2010*). The results of the study reveal that education level is one of the variables that has a substantial influence on one's level of knowledge, attitude, and behaviour towards sustainable forest resource management, which is in conformity with the studies of (*Khoshmaram et al., 2020;* Ghoochani et al., 2020; *Khandker et al., 2020*), indicating that persons with higher education have a more comprehensive understanding of the impairments of forest loss, are more productive, have a greater capacity for implementing sustainable operations, and are more likely to advocate for ecologically friendly activities. Hence, the present study highly recommends the launch of environmental knowledge initiatives and training programmes that will enable forest dwellers to become stewards of sustainable forest resource management.

The present study reveals that the majority of forest dwellers believe that forest-based livelihood options cannot be underestimated. However, they are not well aware of the fact that overexploitation of forest resources is responsible for soil erosion and forest degradation, habitat damage, biodiversity loss, water scarcity, and aridity. Due to overexploitation of forest resources, some plant and animal species have disappeared (Meyer and Turner, 1994; Lindenmayer & Fischer, 2013*)*. Most forest dwellers disagree with the notion that forest area and cover have increased with the implementation of different policies and programmes, which raised questions about the credibility of these policies and programmes. Forest dwellers consider protection of the environment their duty, but on the issue of wildlife protection their opinion is different. The reason behind the unfavourable attitude towards wildlife protection may be the

deaths of people, livestock, and crop damage caused by wild animals. The studies of (Badola et al., 2012; Mir et al., 2015) validate our findings as they establish that 75 percent of respondents experience damage to crops and 23 percent report livestock causality from wild animals. It has also been observed that people in certain areas have negative attitudes towards the protection of biodiversity because of the fact that there are costs involved with conservation, such as livestock and agricultural losses caused by wildlife (Kideghesho et al., 2007; Kati et al., 2015).

It is strongly recommended that, for the purpose of enhancing the environmental knowledge of forest dwellers through education and awareness, conferences, seminars, and workshops be conducted on a regular basis by government agencies, NGOs, educational institutes, and other self-help voluntary organisations. There is a need to broaden the mental horizon of forest dwellers by providing them training and information pertaining to burning and emerging environmental issues such as the role of forests in maintaining ecological balance, combating climate change, protecting soil erosion, hydrology, and the systematic flow of NTFPs. The study indicates that respondents are largely unaware of these challenges. In addition, training programmes on making biofertilizers and biodegradable objects from forest products could generate income and strengthen their bond with the forest ecosystem. The study could be helpful in achieving desirable outcomes in forest management as the forests ensure maintenance of ecological balance, absorb greenhouse emissions, and provide income and employment opportunities right on the doorsteps of the forest dwellers.

5. Conclusion

Unplanned and unregulated development has damaged natural resources and made it harder for ecosystems to provide goods and services on a sustained basis. The attempts to mainstream forest dwellers without enhancing their environmental knowledge have made forest ecosystems more susceptible to further exploitation and degradation. The study concludes that the environmental knowledge, attitude, and sustainable behaviour of forest dwellers in the Kashmir Himalayas are low to moderate and need to be improved by policy intervention for efficient forest resource management. The local people's sustainable behaviour and participation in forest conservation initiatives are mostly influenced by economic considerations. The participation in various activities, such as the willingness to combat forest fires, rehabilitate degraded forest areas, and clean up local water bodies in the vicinity, is reasonably good as a result of the net benefits that accrue in the form of remuneration. While making forest dwellers stakeholders by allocating some portion of the forest revenue for forest rehabilitation work, the general level of participation in forest resource management activities might increase considerably. The study reveals that forest dwellers in the Kashmir Himalayas are largely unfamiliar with current environmental concerns such as greenhouse emissions, climate change, soil erosion, and the role of forests in groundwater recharge. It was also found that local people were highly enthusiastic about various development projects initiated on forest land by various agencies despite having high environmental ramifications and a poor rehabilitation record, implying that they are willing to compromise on environmental sustainability for economic benefits on account of inadequate environmental knowledge. Specifically, the study concludes that knowledge is positively correlated with

attitude and sustainable behaviour and is significantly influenced by age, education, and gender. Therefore, greater emphasis should be laid on promoting female participation in forest resource management by constituting women's organisations inside the community and giving them the responsibility of working on forest regeneration in lieu of financial assistance. Moreover, the involvement of marginalised communities in activities related to forest conservation and management has the potential to boost overall participation in those endeavours. The local organisations, self-help groups, NGOs, and educational institutions, in collaboration with the line departments (the forest department), shall conduct seminars, workshops, and training programmes on a large scale to impart environmental knowledge that would eventually inculcate a positive attitude and sustainable behaviour. Sustainable behaviour can be promoted if people's interdependent needs are properly recognised and valued, which in turn could exert an influence on the mainstreaming of their knowledge, the exploration of its upscaling possibilities, and the promotion of environmentally sound practises.

Declarations

Data availability

Data will be made available upon reasonable request.

Conflict of interest

The authors declare that they have no conflict of interest.

Ethical approval

All ethical standards were taken care of during this study.

Consent for publication

This publication is nowhere else under consideration for publication.

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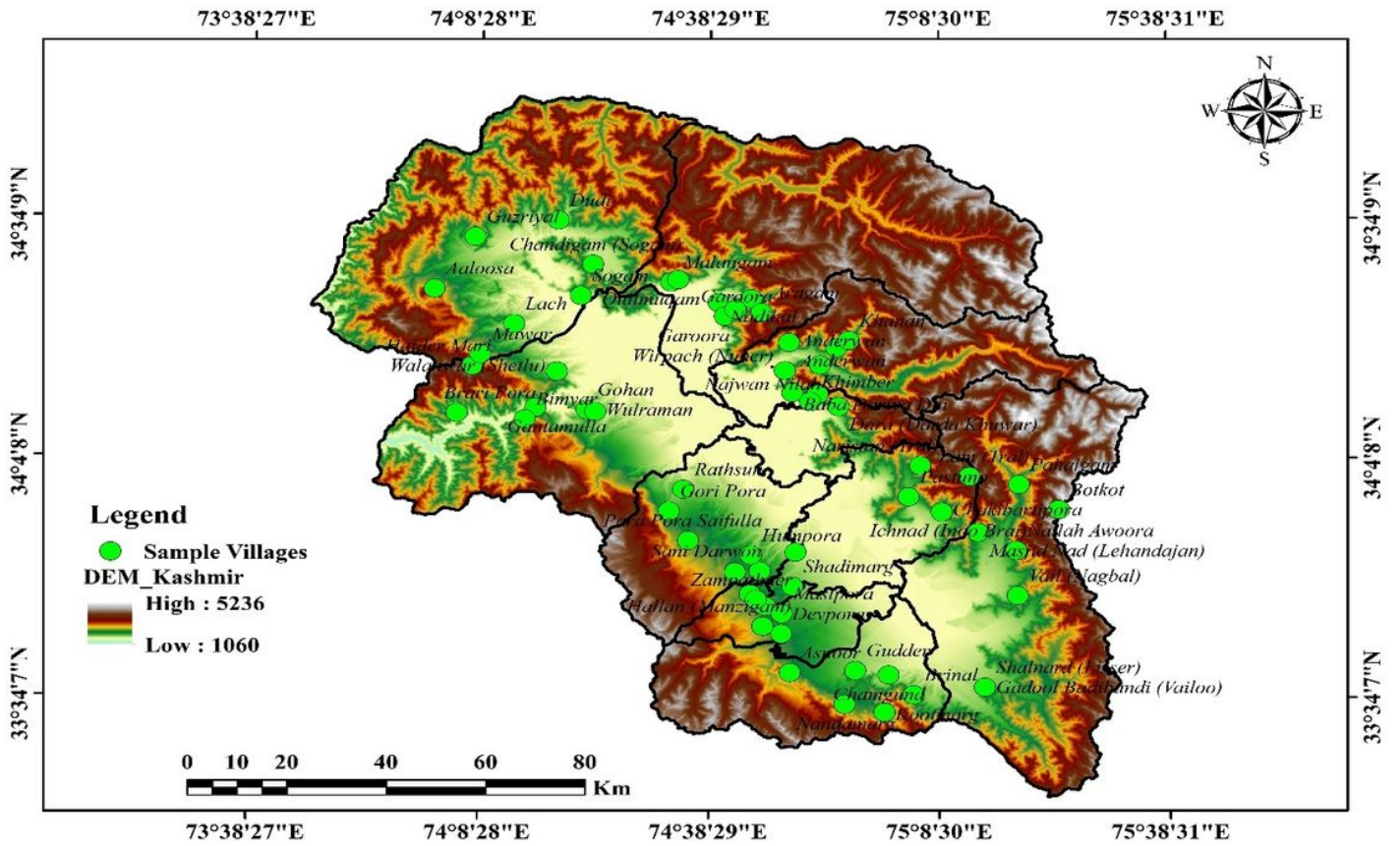
Figures

Figure 1

Map of Kashmir Valley showing surveyed villages. Source: Survey of India   toposheets, 1971; GPS &
ASTER-DEM

METHODOLOGY

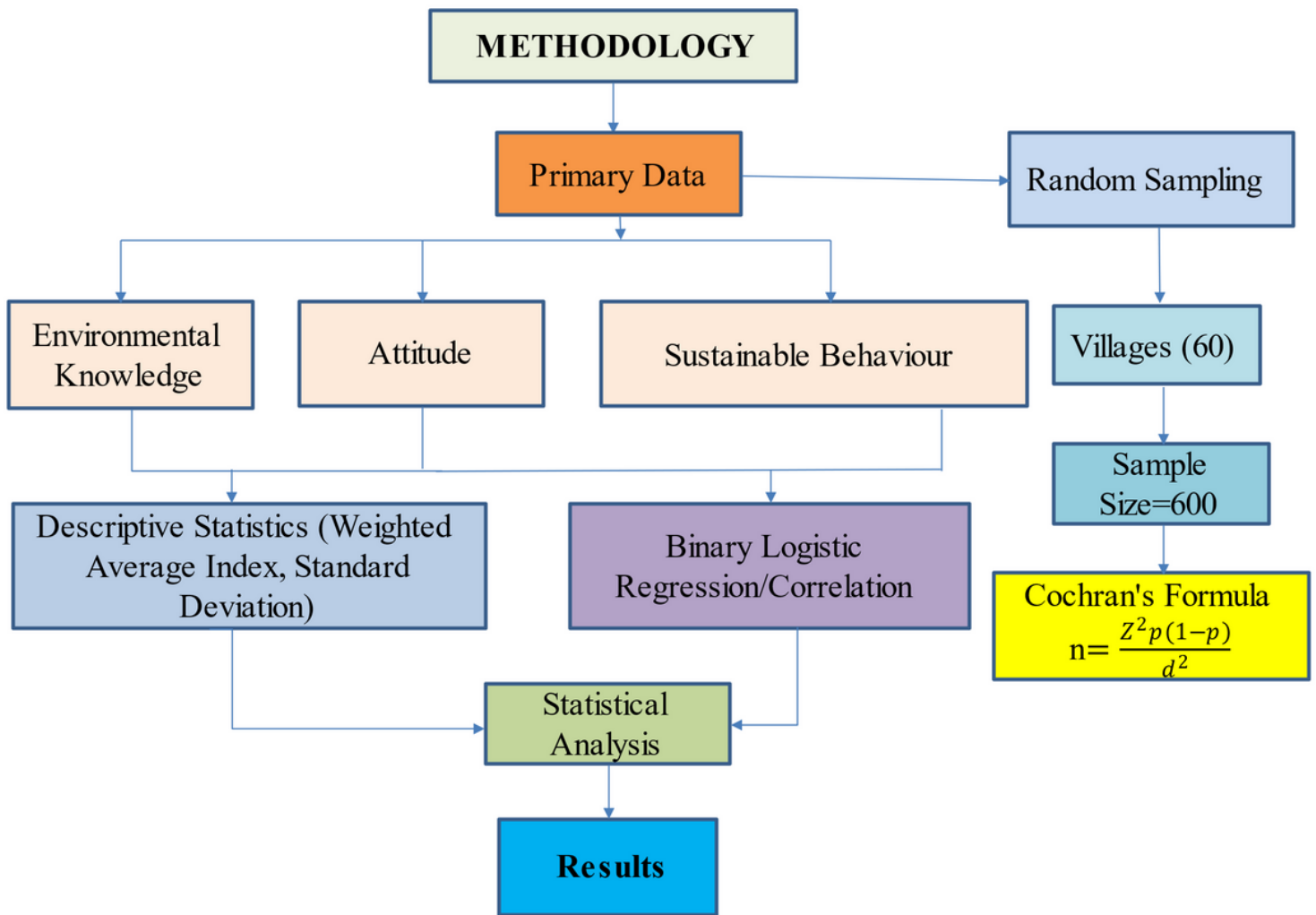Primary Data → Random Sampling

Environmental Knowledge

Attitude

Sustainable Behaviour

Villages (60)

Descriptive Statistics (Weighted Average Index, Standard Deviation)

Binary Logistic Regression/Correlation

Sample Size=600

Cochran's Formula

$$n= \frac{Z^2 p(1-p)}{d^2}$$

Statistical Analysis

Results

Figure 2

Methodological frame work of Study

The Environmental Knowledge of Forest Dwellers towards Forest Resource Management
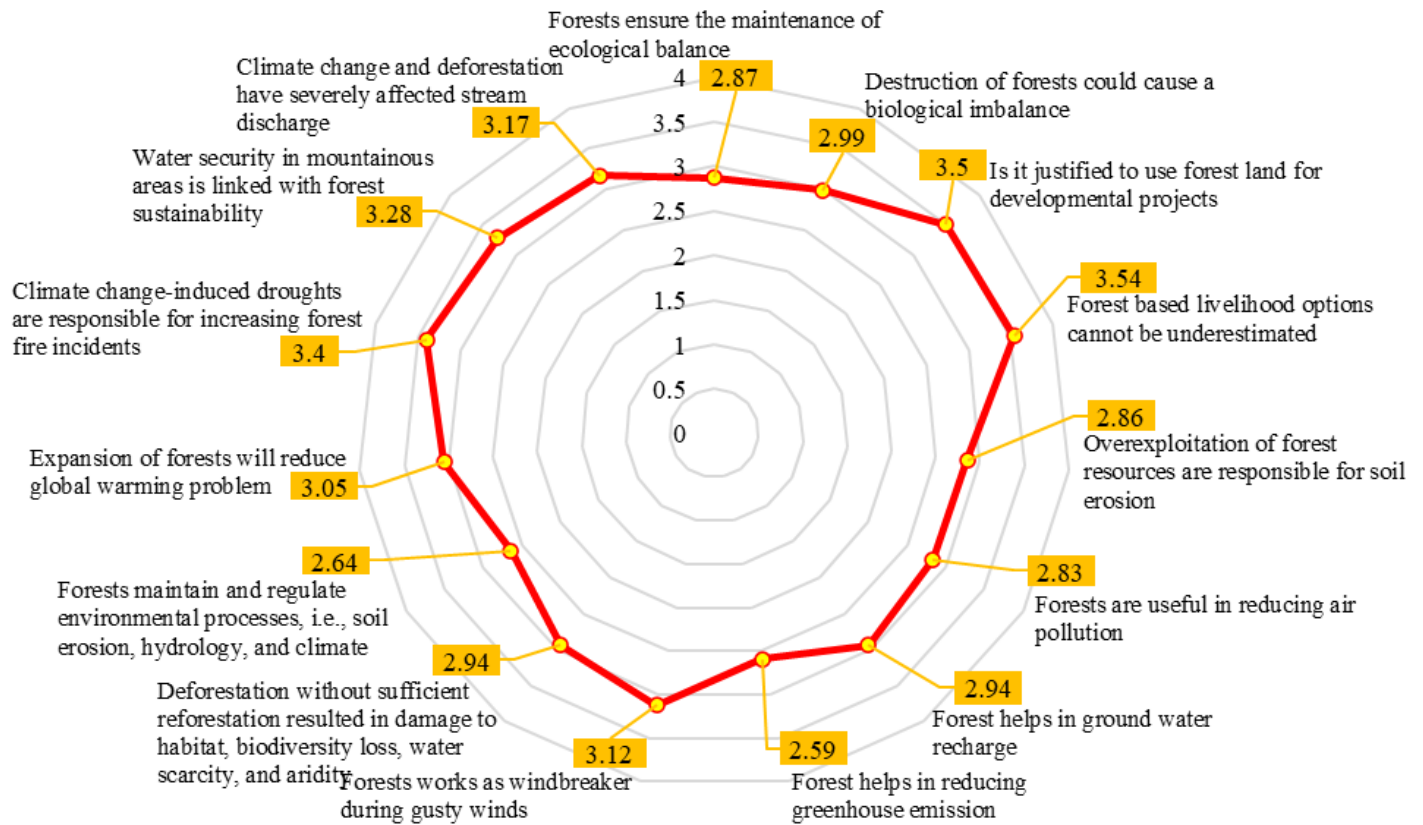
Figure 3

Radar Graph Showing Level of Agreements on Environmental Knowledge Constructs
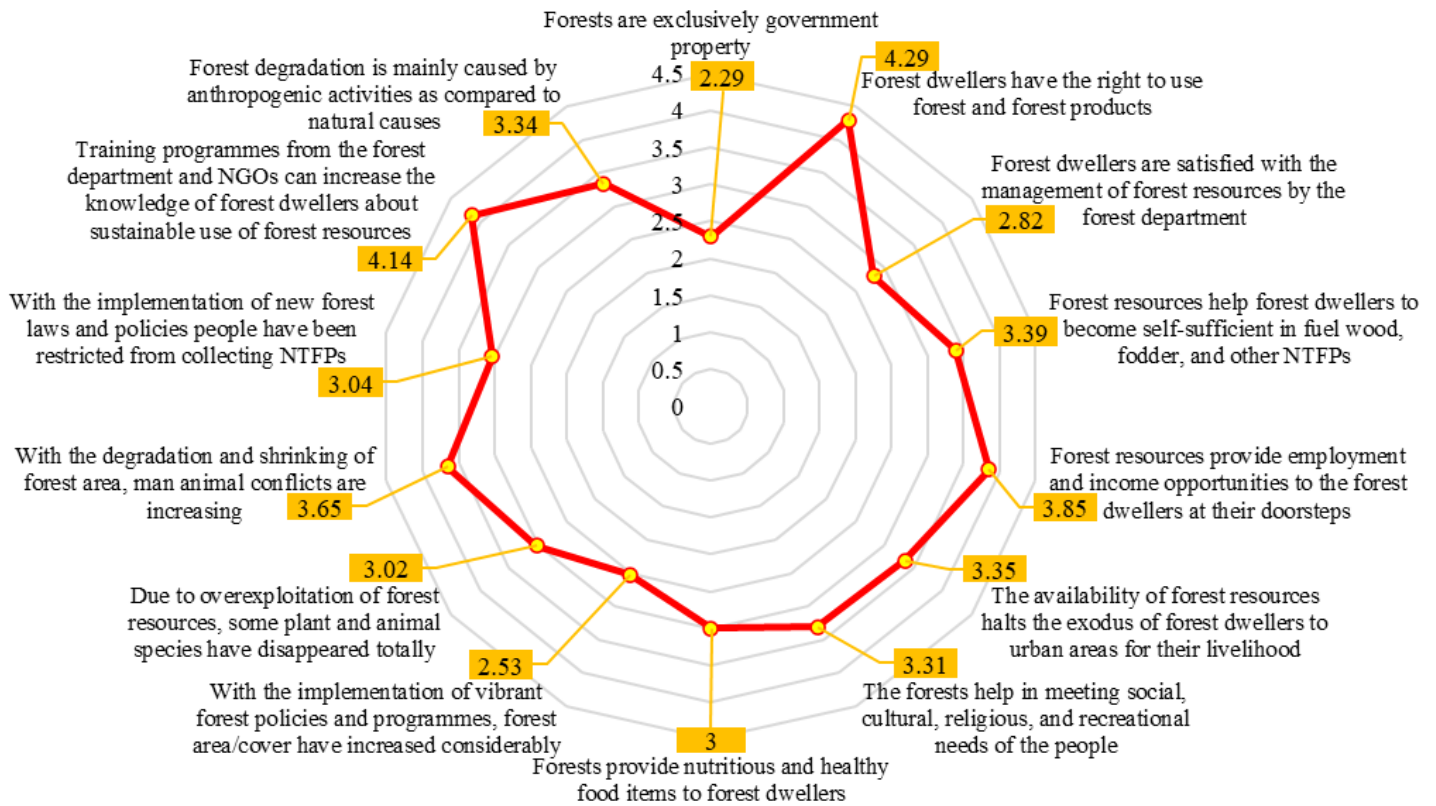
Figure 4

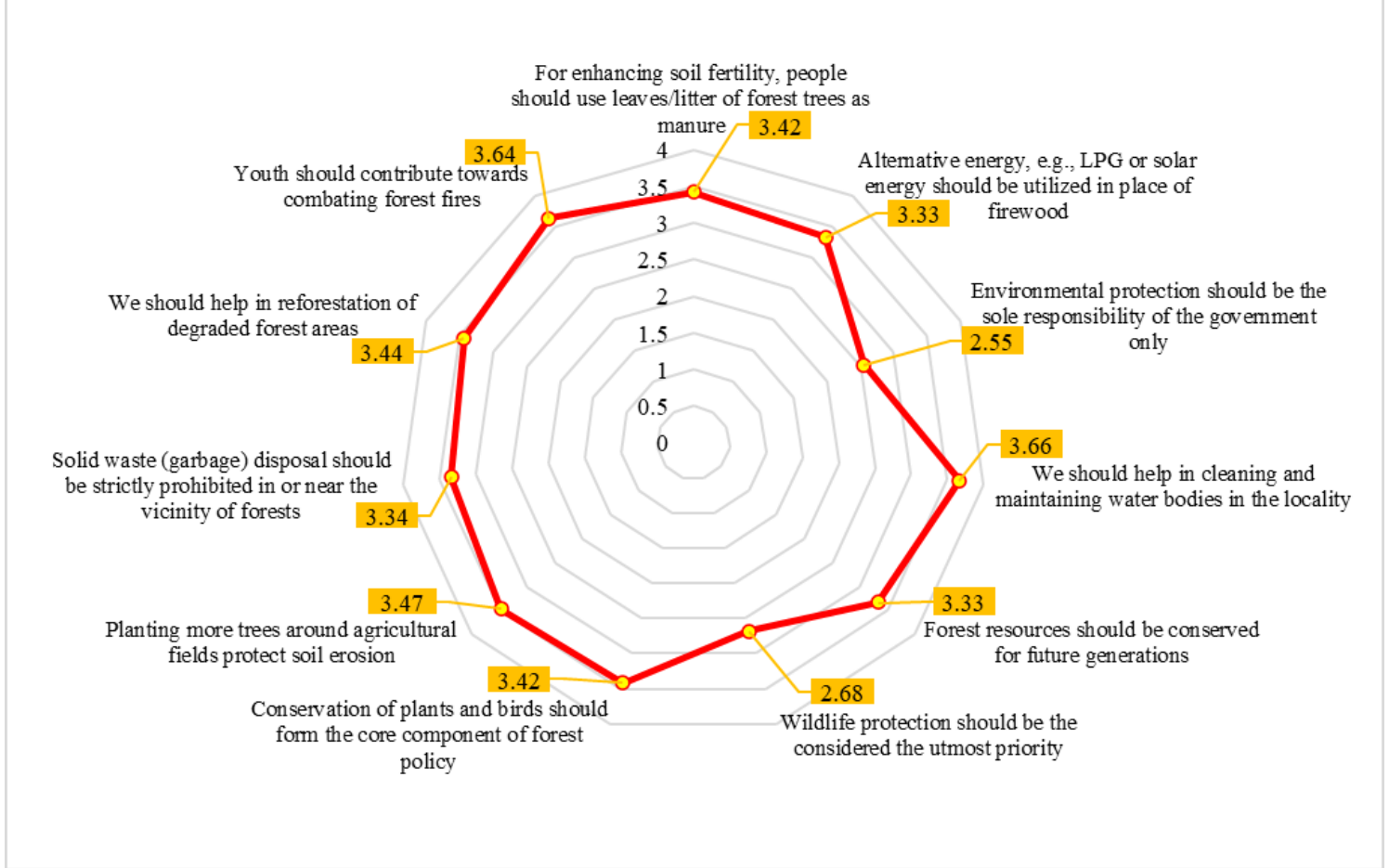Radar Graph Showing Level of Agreements on Attitude Constructs

Figure 5

Radar Graph Showing Level of Agreements on Sustainable Behaviour Constructs