Journal of Business Strategies, Vol. 15 No.1, 2021, pp 109–134 *DOI:10.29270/JBS.15.1(21).07*

CONTRIBUTING AGENTS FOR FOREST MANAGEMENT OF RURAL AREAS- AN ANALYSIS THROUGH SMART PLS METHODS

Dr. Talib Hussain, Hasan Abbas, and Dake Wang

ABSTRACT

Three main areas of focus were: strategic-level management, local-level management, and communication level-management. To provide a better way of confidence and to measure factors affecting sustainable forest management, this study applied the SEM approach and built a model that explained and identified the critical factors affecting sustainable forest management. A quantitative approach via smart-PLS version 3.2.8 was used for analysis. The aim was to find out the relationship between strategic level management, local level management and communication level management for sustainable forest management. The findings of the study discovered that the R^2 value of the model was scored at 0.653, which meant that the three exogenous latent constructs collectively explained 65.3% of the variance in sustainable forest management. In this study, the Goodness-of-Fit of the model was 0.431. The strategic level management factor was the most important of the three variables.

Keywords: *Sustainable Forest Management; Sustainable Forestry; Public Awareness; Strategic Level Forest Management; PLS-SEM.*

INTRODUCTION

The sustainable management of forestry is a worldwide concern (Berg & Lindholm, 2005). Community involvement in proper forest management has been deemed crucial (Buchy & Hoverman, 2000; Shackleton et al., 2002). Governments develop different policies to manage their countries' forests for a sustainable ecosystem (Shrivastava, 1995). Public involvement is considered an important part of improved forest management (Leach, Mearns, & Scoones, 1999). Local residents may see forestry as an important source of income and yet may use it without proper management: as a result, deforestation can quickly become unsustainable (Tanz, & Howard, 1991). Improper management of forest resources is a key issue in developing countries, posing a significant threat of damage to land and other natural resources (Pearce, Barbier, & Markandya, 2013). The impact of improper forest management is not only limited to directly affected countries but at length spreads to the whole world (Rametsteiner & Simula, 2003). A survey was conducted in areas of Gilgit-Baltistan, Pakistan and the views of various residents of mountainous regions were collected and analyzed. The outcomes of this research are not only beneficial for the local public, but it is also instructive for forest management study in this general socio-economic and natural setting. In light of the results and recommendations of this study, local as well as central governments can formulate policies regarding proper forest management for better natural resource utilization.

LITERATURE REVIEW

In the literature, forest management is considered a branch of forestry due to the administrative issues, economic concerns, and social impacts of forestry within and without scientific experiments, as well as regarding the regulations of forest policies (Davis & Johnson, 1987; Johnson, & Curtis, 2001). Forest management is a broader concept where different researchers include the management of aesthetics, fishery, recreational resources, urban values and outputs, water management, wildlife resources, wood products, forest genetic resources, etc. (Pritchett, 1980; Burton et al., 2003). Some other researchers believe that forest management may consider the conservation and economic forest management or a combination of conservation and economic output (Lindenmayer, Margules, & Botkin, 2000; Sheppard, & Meitner, 2005. Researchers indicated that forest management is a technical field which includes timber extraction, the planting of forestry and replanting of various species within a specific context, to look after the cutting roads and pathways within the forests, and so on (Jandl et al., 2007; Siitonen, 2001; Veríssimo et al., 1992). Some researchers argued that forest management includes all the techniques necessary for sustainable forest management and forest recycling (Bergsten et al., 1996; Von Gadow, Pukkala, & Tomé, 2012).

Public Sharing in Sustainable Forest Management

The role of the public and the local community is considered a key backbone for better forest management (Sheppard & Meitner, 2005; Kangas, 1994). Most research work on community forestry management suggests that local community people usually play a key role in better forest management (Beckley, Parkins, & Sheppard, 2006; Shindler, Steel, & List, 1996).

Reseracher believe that locals, who are basically the main benificieries of the forest, usually are the main cause of damage to natural resources such as forests (Davis & Johnson, 1987; Wells, Tigert, & Activities, 1971). Prior research shows two levels of forest management for public control, local level management and central government policy (Murray, 2007). The local level management consists of local community-based policies where people take part in policy formulation for the betterment of the forest and eco-enviromental protection (Nygren, 2005; Agrawal, & Bauer, 2005).

Government Sharing in Sustainable Forest Management

In previous studies, it was indicated that central and local governments are also fully responsible for better forest management by making policies and with the implementaion of regulations (Agrawal, & Bauer, 2005; Pagdee, Kim, & Daugherty, 2006). The public government sharing and communication of the forest policies to the public is also considered a key role of governments for the betterment of forest management (Klooster & Masera, 2000; Kumar, 2002). Previous studies showed that proper forest management for the longrun livelihood is considered the main goal of enviromental departments of the governments (Grieg-Gran, Porras, & Wunder, 2005). Governments use different channels to give more information to the public about forest management (Lewis & Sheppard, 2006). In any case, whether a pubic-private partnership or pure government policies for forest management, it is important to link forest management for sustainable and longrun management. Researchers described different views about sustainable forest management in different seetings. Here some recent and very famous studies are analyzed.

Sustainable Forest Management

In literature, sustainable forest management examines the main principles of sustainable development (Davis, & Johnson, 1987; Kates, 2018). Sustainable management is directly related to sustainable development (Whitmore, Laurance, & Bierregaard, 1997; Paluš et al., 2018). In other research it is also mentioned that sustainable forest management is the name of keeping balance among three areas, named; ecology, economy and socio-cultural settings (Wolfslehner & Vacik, 2008; Wu, Olson, & Birge, 2013). Sustainable forest management has a direct impact on the livelihood of the people by providing clean air, protecting the ecosystem, reducing rural poverty, and mitigating the effects of climate change (Jandl et al., 2007; Cao et al., 2018).

In the charter of the United Nations, proper forest management was considered a main obligation of governments at all levels: local, regional, and global (Spector, Sjöstedt, & Zartman, 1994). Keeping in view of the United Nations policies regarding forest managemnt, different countries are trying to protect the livelihood of the forest with some solid steps like formulating policies for cutting timber and using the forest for commercial purposes like renewable energy projects, etc. (Johansson et al., 1993; Sombroek, & Sims, 1995).

A universally accepted definition of sustainable forest management (Stupak et al., 2007) was provided as:

"The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems."

Current Forest Management Situation in Gilgit-Baltistan, Pakistan

Current forest management in Gilgit-Baltistan, Pakistan is not satisfactory (Akbar et al., 2014). Neither has remarkable research been done nor have steps been taken to know the current issues and problems for local forest management (Rizwan, 2018). The record shows that nearly 5.36% of Pakistan's total landmass is covered by forests of its total land with 15.7 (GNP), 0.2% (GDP) share on average per annum, according to 2010 calculations (Rizwan, 2018). While some other reports like FAO (Food and Agriculture Organization) statistics for 2009 show that the forest cover in Pakistan is hardly touching figures of 6%, with 2% natural forest and 4% covered by plantations and human-made gardens (Rizwan, 2018). The area of Gilgit-Baltistan, Pakistan encompasses an area of 7,040,000 hectares. With a forest-covered area of 950,000 hectares (13.4%) of its total area with province-wise Pakistan forest cover share of estimated 9% (Rizwan, 2018). The proper management of forestry also appears necessary from global scale data, where research showed that 12-15 million hectares of forest are lost each year (Siry, Cubbage, & Ahmed, 2010). Some studies have forecast that the deforestation rate in Pakistan is 0.2 percent to 0.5 percent annually, which is highest worldwide (Rizwan, 2018).

The Hypothesis of the Study

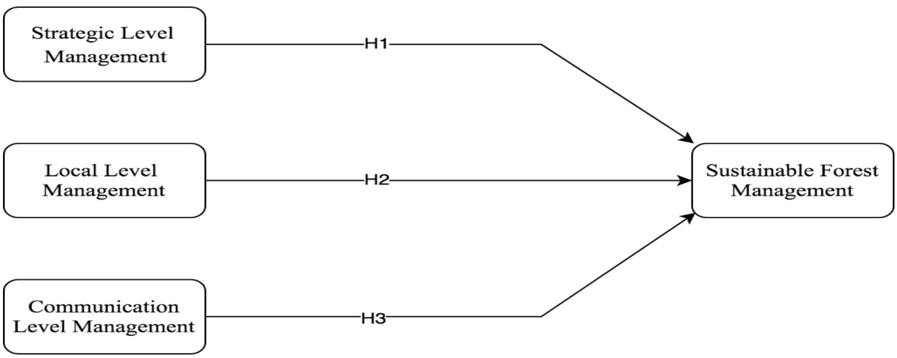
The study hypotheses are as follows:

$\mathbf{H_1}$: Strategic level management factor has a significant and positive effect on sustainable forest management.

H$_2$: Local Level management factor has a significant and positive effect on sustainable forest management.

H$_3$: Communication level management factor has a significant and positive effect on sustainable forest management.

Figure 1. Conceptual model.



METHODS

This study was undertaken in the area of Gilgit-Baltistan, Pakistan. A quantitative survey was conducted to know the views and practices of the locals about sustainable forest management of the region. There were a total of 255 respondents from different regions of Gilgit Baltistan, Pakistan. Figure 2 shows the districts of Gilgit-Baltistan where the study was conducted.

The area of Gilgit-Baltistan is totally natural, and forests are situated everywhere [50]. The study sample encompasses the eight districts of Gilgit-Baltistan, Pakistan: Gilgit, Skardu, Astore, Kharmang, Ghizer, Ghanchi, Hunza, and Nager. A probability cluster sampling method was used to collect the data. The whole province was divided into districts/clusters, and the data collected accordingly.

Preliminary List of Factors

To know the main factors affecting sustainable forest management researchers did a comprehensive and critical literature review and found three types of factors which are supposed to be the main factors affecting sustainable forest management. The questionnaire was divided into two sections; section one consisted of the demographics of the study and section two comprised the main variables for sustainable forest management. For better analysis and understanding section two was categorized into four sub-groups in accordance with the nature of the factors: The codes for variables were as: Strategic level management factor (STM_L), local level management factor (LOCL_M), Communication level management factor (COM_L) and sustainable forest management factor (FOR_M). Table 1 shows the constructs for the main dependent and independent variables of the study.

Table 1: The preliminary list of factors affecting sustainable forest management.

Code	Factors
	Strategic Level Management Factor (STM_L)
STM_L1	Central legislation
STM_L2	Check and control
STM_L3	Professional forestry planning
STM_L4	Protected forestry areas
STM_L5	Input opportunities and policy implementation
STM_L6	Protect aesthetic values
STM_L7	Security for forestry companies
STM_L8	Attention on timber resources
	Local Level Management Factor (LOCL_L**)**
LOCL_L1	Responsive to public concerns
LOCL_L2	The direct benefit for the local community
LOCL_L3	Instant economic benefit from forest
LOCL_L4	A fair share of locally generated government income
LOCL_L5	Environment sensitive initiatives for locals
LOCL_L6	Useful infrastructure for local forestry

	Communication Level Management Factor (COM_L)
COM_L1	Get information about the forest through media
COM_L2	Aware of current situations of the forest through local government bodies
COM_L3	Trusted information among forest managers and local people
COM_L4	Can post any problem with forest situation
COM_L5	Available a good information way toward misuse of forest resources
COM_L6	Take necessary actions on the news posted in mass media about any forest management issue
COM_L7	Available a good communication channel between central and local government for forest management
	Sustainable Forest Management Factor (FOR_M)
FOR_M1	Available a sustainable way of getting information about forest management
FOR_M2	A strong role of local community participation
FOR_M3	Seen long-term planning for sustainable forest management
FOR_M4	Overall seen a better and sustainable forest management problem solving techniques

Pilot Study and Questionnaire Design

To know the feasibility of the study and to test the relationship of the pre-study variables, a pilot study was conducted. The questionnaires were administered by the researchers to obtain instructions on the factors affecting sustainable forest management from the experts. Based on the significant pilot test results the final questionnaire was designed, and the study was conducted accordingly.

After conducting a pilot survey, certain minor adjustments were made to the questionnaire. The final questionnaire was split into two key sections for better questionnaire management. Section one contained the respondents' demographic profile such as educational qualification, income range, and material status, etc. Section two of the questionnaire consisted of the final list of the questions on a five-point Likert scale ranging from 1 to 5. The questionnaires were presented to the respondents in the field and data was collected accordingly.

Respondents' Demographics

Table 2 shows the demographic information of the respondents. The respondents were selected from a wide range of local community living in Gilgit-Baltistan. Table 2 shows different demographic segmentations.

Table 2: Demographic information of respondents on average.

Age	Percentage
Less 10	0.9
10-18	39.6
19-30	39.6
31-45	14.2
above 45	5.7
Total	100.0
Education level	
Under 10th Grade	22.6
10th Grade	10.4
12th Grade	17.9
Bachelors	22.6
Masters	25.5
PhD	0.9
Total	100.0
Income level	
less 8000	39.6
8001-15000	18.9
15001-30000	12.3
30001-45000	18.9
45001- and above	10.4
Total	100.0
Gender	
Male	46.2
Female	53.8
Total	100.0
Material status	
Married	30.2
Unmarried	68.9
Divorced	0.9
Total	100.0

Sampling and Data Collection

The data were collected through team members consisting of the researchers and forest experts. The sample unit was selected from different districts of Gilgit-Baltistan Pakistan. The sample was based on the list of the respondents living in Gilgit-Baltistan and actively involved in the factors related to social issues. The data was considered enough for analysis as the main variables were chosen from literature and the results area also relate to the main theme of the research. There was a total of 300 respondents who were supposed to be the sample for this study; among them, 255 responses were collected. The respondents had enough experience to understand the importance of the study conducting in the field.

RESULTS

The simulation work in calculating the effect of the observed variables and their latent constructs on sustainable forest management was drawn in smart-PLS version 3.2.8 (Ringle & Becker, 2015). Majority of the researchers use PLS-SEM for theory development in exploratory research (Bamgbade et al., 2018). Major applications of SEM contain path analysis, second-order factor analysis, confirmatory factor analysis, regression models, correlation structure models and covariance structure models (Lin & Jeng, 2017). Furthermore, the structural equation modeling technique permits the examination of the linear connections between the latent constructs and manifest variables. SEM has the ability to create accessible parameter estimates for the relationships between unobserved variables in the model. A collective data analysis facility is also available in a single model with various relationships instead of examining each relationship separately. The hypothesized model in Figure 1 for sustainable forest management was analyzed using Smart-PLS version 3.2.8 which has advantages over regression-based methods in evaluating several latent constructs with various manifest variables for sustainable forest management (Gefen, Straub, & Boudreau, 2000). Smart-PLS consists of a two-step procedure as recommended by Henseler et al. (Gefen, Straub, & Boudreau, 2000), which contains the evaluation of the outer measurement model and evaluation of the inner structural model. Furthermore, PLS-SEM is currently known and selected within social sciences studies as a technique that is the best appropriate method for multivariate analysis, like in the current study (Hair, Ringle, & Sarstedt, 2013; Peng & Lai, 2012).

At the end of the study, the appendix A shows a comprehensive explanation of the descriptive statistics of the study such as mean, standard deviation, kurtosis, and skewness, etc. The results of kurtosis and skewness (values lie between -1 and +1) results showed that the data were normally distributed to measure the sustianbel forest managemnt.

Evaluation of Outer Measurement Model

The outer measurement model is designed to calculate the reliability, validity and internal consistency of the observed variables, calculated through the survey method, together with unobserved variables (Ho, 2013). The consistency evaluations are based on construct reliability tests, and single observed while convergent and discriminant validity are used for the measurement of validity (Hair et al., 2012). In this model, a single observed variable reliability concludes the variance of an individual observed comparatively to an unobserved variable by evaluating the standardized outer loadings of the observed variables (Götz, Liehr-Gobbers, & Krafft, 2010). Researchers noted that observed variables with an outer loading of 0.7 or greater are to be greatly acceptable for predictions and model evaluations (Hair et al., 2012), whereas the outer loading with a value less than 0.7 is considered to be discarded (Chin, 1998). Nevertheless, for the current study, the cut-off value accepted for the outer loading was considered as, 0.7. Table 3 shows the outer loadings ranged between 0.759 and 0.909. For internal consistency checking, Composite Reliability (CR) and Cronbach's alpha were used in the construct reliability. Some researchers believe that composite reliability (CR) is a better way for measurement of internal consistency as compare to Cronbach's alpha because it maintains the standardized loadings of the observed variables in the model (Fornell, 1981). The results in this study show the values of Cronbach's alpha (COM_L=0.896, LOCL_M=0.910, STM=0.951, FOR=0.861) and composite reliability (COM=0.918, LOCL=0.931, STM_L=0.959, FOR_M=0.906) which indicates that the composite reliability and Cronbach's alpha values are greater than the minimum requirement of 0.70. For the measurement and verification of the convergent validity of the variables, the latent construct's Average Variance Extracted were measured [(Fornell, 1981). Previous studies show that the lowest 50% of the variance from the observed variable should be measured by the latent constructs in the study model and the AVE for all constructs should be more than 0.5. In this study, the results in Table 3 shows that all of the AVE values (COM=0.615, LOCL=0.691, STM=0.744, FOR=0.706) are more than 0.5 and valid for convergent validity measurement. The results also supported the argument that there are good values for convergent validity and good internal consistency for the measurement model of this study.

Further measurements were related to the discriminant validity of the latent variables. The discriminant validity describes that the manifest variable in any model is unique from other variables in the path model and its cross-loading value in the latent variable is more than that in any other variable (Hair Jr. et al., 2014). Some researchers used the tests like Fornell and Larcker criterion and cross-loadings to measure the discriminant validity (Fornell, 1981). Researchers suggested a standard for variables that a construct must not contain the same variance as any other construct that is more than its AVE value (Hair Jr. et al., 2014). Table 4 describes the Fornell and Larcker standard test of the study model where the squared correlations were compared with the correlations from other latent variables. Table 4 shows satisfactory discriminant validity that all of the correlations were smaller relative to the squared root of average variance exerted along the diagonals. These results also indicate that the observed variables in every construct show the given latent variable confirming the discriminant validity of the study model, while, Table 5 shows that the cross-loading of all observed variables was more than the inter-correlations of the variables of all the other observed variables in the study model.

Based on the study results it is confirmed that the cross-loadings measurements standards and show an acceptable validation for the discriminant validity of the measurement model. Over all the study results supports for an acceptable model with confirmation of adequate reliability, convergent validity, and discriminant validity and the verification of the research model for further implementations.

Table 3: Construct reliability and validity.

Main Constructs	Items	Loadings	Cronbach's Alpha	CR	AVE
Communication Level Management	COM_L1	0.770	0.896	0.918	0.615
	COM_L2	0.784			
	COM_L3	0.853			
	COM_L4	0.785			
	COM_L5	0.759			
	COM_L6	0.774			
	COM_L7	0.762			
Local Level Management	LOCL_M1	0.812	0.910	0.931	0.691
	LOCL_M2	0.810			
	LOCL_M3	0.815			
	LOCL_M4	0.860			
	LOCL_M5	0.880			
	LOCL_M6	0.808			

Strategic Level Management	STM_L1	0.837	0.951	0.959	0.744
	STM_L2	0.879			
	STM_L3	0.850			
	STM_L4	0.909			
	STM_L5	0.868			
	STM_L6	0.855			
	STM_L7	0.808			
	STM_L8	0.882			
Sustainable Forest Management	FOR_M1	0.825	0.861	0.906	0.706
	FOR_M2	0.815			
	FOR_M3	0.876			
	FOR_M4	0.844			

Table 4: Fornell–Larcker Criterion Test.

	COM	**FOR**	**LOCL**	**STM**
Communication Level Management (COM)	**0.784**			
Sustainable Forest Management (FOR)	0.554	**0.840**		
Local Level Management (LOCL)	0.243	0.559	**0.832**	
Strategic Level Management (STM)	0.204	0.582	0.256	**0.863**

Table 5: Cross-Loadings.

	COM	**FOR**	**LOCL**	**STM**
COM_L1	**0.770**	0.395	0.170	0.178
COM_L2	**0.784**	0.439	0.194	0.162
COM_L3	**0.853**	0.498	0.195	0.232
COM_L4	**0.785**	0.443	0.211	0.103
COM_L5	**0.759**	0.406	0.224	0.148
COM_L6	**0.774**	0.412	0.202	0.140
COM_L7	**0.762**	0.436	0.141	0.147
FOR_M1	0.472	**0.825**	0.459	0.457
FOR_M2	0.470	**0.815**	0.446	0.493
FOR_M3	0.474	**0.876**	0.484	0.501
FOR_M4	0.445	**0.844**	0.489	0.503
LOCL_M1	0.257	0.475	**0.812**	0.210

LOCL_M2	0.163	0.471	**0.810**	0.224
LOCL_M3	0.229	0.478	**0.815**	0.193
LOCL_M4	0.165	0.432	**0.860**	0.226
LOCL_M5	0.172	0.457	**0.880**	0.226
LOCL_M6	0.219	0.470	**0.808**	0.196
STM_L1	0.196	0.517	0.215	**0.879**
STM_L2	0.140	0.467	0.194	**0.850**
STM_L3	0.210	0.546	0.245	**0.909**
STM_L4	0.191	0.570	0.232	**0.868**
STM_L5	0.137	0.483	0.196	**0.855**
STM_L6	0.149	0.445	0.236	**0.808**
STM_L7	0.201	0.511	0.243	**0.882**
STM_L8	0.170	0.456	0.199	**0.847**

Evaluation of the Inner Structural Model

Previous results confirmed that the measurement model was valid and reliable for further analysis. After validation of the data and model, the next aim of the analysis was to measure the Inner Structural Model outcomes for this study. The purpose of this measurement is to observe the model's predictive relevancy and the relationships among the variables. The coefficient of determination (R^2), Path coefficient (β value) and T-statistic value, the Predictive relevance of the model (Q^2), Effect size (f^2), and Goodness-of-Fit (GOF) index are the key standards for evaluating the inner structural model.

Value of R^2

For the overall effect size, the coefficient of determination is used, and variance explained in the endogenous construct for the structural model, and it uses a model's predictive accuracy for the study. In the current analysis, the inner path model was 0.653 as shown in Figure 3 for the endogenous latent variable such as sustainable forest management. These results show that the three independent variables such as strategic level management factor, local level management factor and communication level management factor substantially explain 65.3% of the variance in the quality measurement, it further concluded that about 65.3% of the change in sustainable forest management was due to three latent variables in the model. Some researchers suggested that a value of R^2 0.75 is substantial, the R^2 value of 0.50 is considered as moderate, and R^2 value of 0.26 is nominated as weak value for model prediction. In this study, the R^2 value (0.653) is more than the required value and hence considered as moderate.

Assessment of Path Coefficients (β) and T-statistics

The results indicate that the path coefficients in the Smart-PLS and the standardized β coefficient in the regression analysis seemed the same. The purpose of measurement of the β is to know the expected variation in the dependent variable for a unit variation in the independent variable. In this analysis, the β values of every path in the hypothesized model were measured. The studies show that the more the β value, the best the substantial effect on the endogenous latent variable. Moreover, the T-statistics test is considered compulsory for the verification of the β value significance. The bootstrapping procedure was used to evaluate the significance of the hypothesis. To test the significance of the path coefficient and T-statistics values a bootstrapping procedure using 5000 subsamples with no sign changes was carried out for this study as presented in Table 6.

Table 6: Path Coefficient and T-Statistics.

Hypothesized Path	Standardized Beta	T-Statistics	*p* Values
Communication > Forest Management	0.382	10.870	0.000
Local > Forest Management	0.361	9.668	0.000
Strategic> Forest Management	0.412	10.737	0.000

For H1, the prediction was about the strategic level management factor, and it was supposed that the strategic level management factor is significantly and positively influence sustainable forest management. The values in Table 6 and Figure 3 confirmed that the strategic level management factor significantly influenced sustainable forest management ($\beta = 0.412$, $T = 10.737$, $p < 0.000$). Hence, H1 was strongly supported for this study. To check the influence of local level management for sustainable forest management (H2), the findings from Table 6 and Figure 3 shows that the local level management factor positively influenced sustainable forest management ($\beta = 0.361$, $T = 9.668$, $p < 0.000$). The influence of the communication level factor on sustainable forest management was also positive and significant ($\beta = 0.382$, $T = 10.870$, $p < 0.000$), with providing supportive evidence for H3. Moreover, Figure 4 shows the graphical representation of the path coefficient.

Figure 3: Assessment of the Structural Equation Model

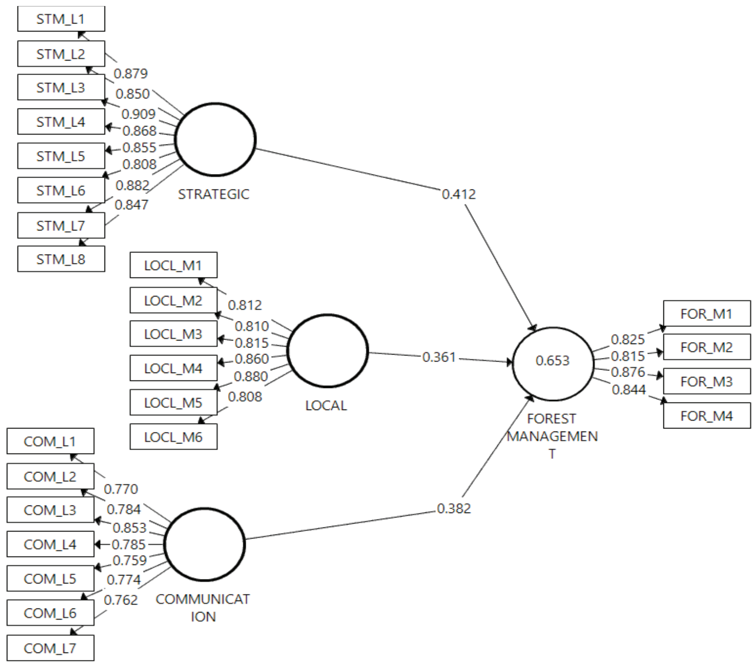


Figure 4: Graphical Representation of the Path Coefficient.

Measuring the Effect Size (f^2)

To know the single independent variable effect on the dependent variable, f^2 was used, it is the degree of the impact of each exogenous latent construct on the endogenous latent variables. To know the effect size of variables, there is need to remove latent exogenous variables and run the tests to check the changes in the value of the coefficient of determination (R^2) and defines whether the removed latent exogenous construct has a significant influence on the value of the latent endogenous variable or not. If the value of f^2 were 0.35 (strong effect), 0.15 (moderate effect), and 0.02 (weak effect) (Cohen, 1988). Table 7 shows the f^2 from the Structural Equation Model calculations.

As shown in Table 7, the effect size for strategic level management, local level management, and communication level management were 0.447, 0.337, and 0.387, respectively. Therefore, according to Cohen's findings, the f^2 of the communication level and strategic level exogenous latent variables on sustainable forest management had a strong effect, whereas local level management had a medium effect on the value of R^2. Furthermore, all the three independent latent variables in this study participated relatively to the greater R^2 value (65.3%) in the dependent variable (sustainable forest variable).

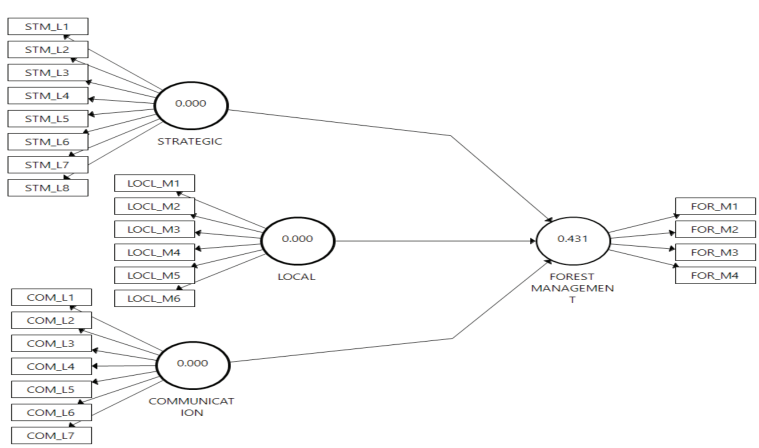
Table 7: Effect Size

Exogenous Latent Variables	Effect Size f^2	Total Effect
Communication Level Management	0.387	Strong effect
Local Level Management	0.337	Medium effect
Strategic Level Management	0.447	Strong effect

Predictive Relevance of the Model (Q^2)

Q^2 statistics are used to measure the quality of the PLS path model, which is calculated using blindfolding procedures (Tenenhaus, Esposito Vinzi, Chatelin, & Lauro, 2005) and cross-validated redundancy was performed. The Q^2 criterion recommends that the conceptual model can predict the endogenous latent constructs. In the SEM, the Q^2 values measured must be greater than zero for a particular endogenous latent construct. From Figure 5, it shows that the Q^2 values for this study model was equal to 0.431, which was higher than the threshold limit, and supports that the path model's predictive relevance was adequate for the endogenous construct.

Figure 5: Predictive Relevance of the Model.



Goodness-of-Fit Index

The Goodness-of-Fit (GOF) is used to check the complete model fit to know that the model sufficiently explains the empirical data in the study or not (Tenenhaus, Esposito Vinzi, Chatelin, & Lauro, 2005; Sheppard & Meitner, 2005). The Goodness-of-Fit- Index values which are between 0 and 1 are supposed to supportive, and the measurement values of 0.10 (small), 0.25 (medium), and 0.36 (large) indicate the global acceptance of the path model for the study. Researchers indicate that a good model fit recommended that a model is stingy and credible (Henseler, Hubona, & Ray, 2016). To measure the Goodness-of-Fit test geometric mean value of the average communality (AVE values) and the average R2 value(s) are used. The equation 1 is used to measure the Goodness-of-Fit test.

$$\text{GOF} = \sqrt{\text{Average AVE} * \text{Average } R^2} \quad (1)$$

With the values in Table 8, the Goodness-of-Fit test was measured and was 0.670. The results show that empirical data of this study fit for the satisfactory model measurement and has substantial predictive power in comparison with standard values.

Table 8: Goodness-of-Fit Index Calculation

Construct	**AVE**	R^2
Communication Level Management	0.615	
Local Level Management	0.691	
Strategic Level Management	0.744	
Sustainable Forest Management	0.706	
Average Values	0.689	0.653
AVE × R^2	0.4499	
GOF = √(AVE × R^2**)**	**0.670**	

The Standardized Root Mean Square Residual (SRMR)

The Standardized Root Mean Square Residual is an index of the average of standardized residuals between the observed and the hypothesized covariance matrices in a study model. The Standardized Root Mean Square Residual is a measure of the estimated model fit for the study. Previous studies suggested that when SRMR = <0.08, then the study model has a good fit and acceptable (Veríssimo et al., 1992), with a lower Standardized Root Mean Square Residual is considered a better fit. The results in Table 9 show that this study model's Standardized Root Mean Square Residual was 0.053, which shows that this study model had a good fit and applicable for further conclusions, on the other side the Chi-Square was equal to 1,486.720 and NFI equal to 0.740 was also measured, which also supports the study.

Table 9: Model Fit Summary

	Estimated Model
SRMR	0.053
d_ULS	0.900
d_G	1.282
Chi-Square	1,486.720
NFI	0.740

Furthermore, HTMT ratio of correlations was also computed, which is proposed by Henseler et al. (2016) and Jandl et al. (2007) as a new instrument for evaluating the discriminant validity of constructs involved in measurement models. As a rule of thumb, an HTMT value of more than 0.85 shows a potential issue of discriminant validity (Hair et al., 2017). All the HTMT values in the current study were less the benchmark of 0.85, which signifies that there is no problem of discriminant validity.

Table 10: HTMT

Exogenous Latent Variables	(COM)	(FOR)	(LOCL)
Communication Level Management (COM)			
Sustainable Forest Management (FOR)	0.629		
Local Level Management (LOCL)	0.268	0.630	
Strategic Level Management (STM)	0.218	0.640	0.274

Correlation Coefficient of Latent Variables

The results in Table 11 helped the researchers to know the latent variable correlation coefficient which shows that there was a strong correlation between the latent independent variables and the latent dependent variables.

Table 11: Latent Variable Correlation.

	(COM)	(FOR)	(LOCL)	(STM)
Communication Level Management (COM)	1			
Sustainable Forest Management (FOR)	0.554			
Local Level Management (LOCL)	0.243	0.559		
Strategic Level Management (STM)	0.204	0.582	0.256	1

Following with the complete analysis of the measurement models and structural model for this study it was concluded that both models were confirmed and supposed to be supportive of this study. The three hypotheses for this study were statistically significant and were all accepted. The results of this study show an exact picture of the factors affecting sustainable forest management.

DISCUSSION AND RECOMMENDATIONS

The main contribution of this investigation was to empirically reveal the constructs that affect sustainable forest management by using the PLS-SEM technique. The data analysis helped authors to elicit some relevant discussion about the current situation of the forest and issues related to sustainable management. The evaluation technique used here, i.e., PLS-SEM is a very effective technique for developing and analysis of complex frameworks, and also fruitful for future predictions. In this study, the conceptual paths were tested using SEM based on the smart-PLS methods. For more understanding descriptive analysis like the mean value, standard deviation, skewness, and kurtosis values were measured and codded. To know the normality of the data the results of the kurtosis and skewness values of the measurement model were measured as between +1 and -1. These values show that the data is normally distributed and acceptable for further date analysis (Appendix 1). Moreover, the results of this study proved that the Strategic Level Management, Communication Level Management, and Local Level Management, had a significantly positive effect on Sustainable Forest Management (R^2 = 0.653, p = 0.000), predictive relevance (Q^2 = 0.431), and a substantial GOF (GOF = 0.670). The final SEM results revealed that Strategic Level Management had the highest path coefficient (b = 0.447) with the overall influencing Sustainable Forest Management.

There were asked many questions about three levels of forest management, i.e., strategic-level forest management, local-level forest management, and communication level for forestry management. The results of the study revealed that all hypotheses were supported and the sustainable forest management was highly affected by all three exogenous constructs, i.e., strategic level management, local level management, and communication level management. The results in Table 7, shows that the path between all three latent independent variables with a dependent latent construct (sustainable forest management) has a positive relationship and was statistically significant. Therefore all the hypotheses proposed in this study were accepted. The results in Figure 3 show that the most important factors at strategic level management for sustainable forest policy are considered as; professional forestry planning (0.909

F-loading) and Security for forestry companies (0.882 F-loading). The main sub-constructs for sustainable forest management at local level management were highlighted as Environment sensitive initiatives for locals (0.880 F-loading) and a fair share of locally generated government income (0.860 F-loading). The main variables for sustainable able forest management via communication level management were highlighted as: Trusted information among forest managers and local people (0.853 F-loading) and "post any problem about forest situation" (0.785 F-loading).

Figure 3 also shows responses relating to overall sustainable forest management. The responses query attitudes about different strategies and techniques of the central government and strategic-level forest management. The overall responses show factors necessary for strategic level forest management. Among the highlighted factors for this study, the residence of Gilgit-Baltistan thinks that the strategic level forest management has a more significant impact as compared to other variables (Beta Coefficient= 0.412). It further explained that for sustainable forest management the strategic level planning is more beneficent and useful for better sustainable forest management. Keeping in view the results in Figure 3 it is highly recommended to the central government that the central policy formation and implementation should be supplied for other bodies' related to sustainable forest management.

CONCLUSIONS

This study concludes that for sustainable forest management the valid factors are strategic level management, local level management, and communication level management. Among these three constructs, the main factor which has a high impact is considered as strategic level strategic-level issues. The results of this study were drawn from SEM techniques using Smart-PLS software version 3.2.8. The inferential statically results show that sustainable forest management is possible if all three levels are covered and maintained properly. Keeping in view the results of this research, central and local government can formulate better policies to boost the proper forest management for a sustainable life by focusing on the strategic, local and communication channels to supply the valid and important information to the local community. In this study, the target was only to know local resident views about sustainable forest management. It was very limited with a small sample size. Future research may include more variables and more data related to the forest- and land-related issues and can conduct the study worldwide.

REFERENCES

Agrawal, A. & Bauer, J. (2005). *Environmentality: technologies of government and the making of subjects.* Durham, NC: Duke University Press.

Akbar, M. et al. (2014). Present status and future trend of chilghoza forest in Goharabad, District Diamer, Gilgit-Baltistan, Pakistan. *Journal of Biodiversity and Environmental Sciences, 5(5),* 253-261.

Bamgbade, J. A. et al. (2018). Does government support matter? Influence of organizational culture on sustainable construction among Malaysian contractors. *International Journal of Construction Management, 18(2),* 93-107.

Beckley, T.M., Parkins, J.R., & Sheppard, S. (2006). *Public participation in sustainable forest management: a reference guide.*

Berg, S. & Lindholm E. -L. (2005). Energy use and environmental impacts of forest operations in Sweden. *Journal of Cleaner Production, 13(1),* 33-42.

Bergsten, U. et al. (1996). Sustainable forest management. *Sustainable Forest Management, (578),* 213.

Buchy, M. & Hoverman, S. (2000). Understanding public participation in forest planning: a review. *Forest policy and Economics, 1(1),* 15-25.

Burton, P.J. et al. (2003). *Towards sustainable management of the boreal forest.* NRC Research Press.

Cao, X., et al. (2018). Dynamic Decomposition of Factors Influencing the Export Growth of China's Wood Forest Products. *Sustainability, 10(8),* 27-80.

Chin, W. W. (1998). The Partial Least Squares Approach to Structural Equation Modeling. *In Modern methods for business research (pp. 295–336).* Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Cohen, J. (1988). *Statistical Power Analysis for the Beharioarai Sciences.* Hillsdale, NJ: Lawrence Eribaum.

Davis, L.S. & Johnson, K.N. (1987). *Forest management.* McGraw-Hill Book Company.

Demirović, D. et al. (2018). Environmental and Community Stability of a Mountain Destination: An Analysis of Residents' Perception.

Sustainability, 10(1), 70.

Fornell, C. L. & D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *J. Mark. Res., (18),* 39–50.

Gefen, D., Straub, D., & Boudreau, M.-C. Structural equation modeling and regression: Guidelines for research practice. *Communications of the Association for Information Systems, 4(1),* 7.

Götz, O., Liehr-Gobbers, K., & Krafft, M. (2010). Evaluation of structural equation models using the partial least squares (PLS) approach, *in Handbook of partial least squares (pp. 691-711).* Springer.

Grieg-Gran, M., Porras, I., & Wunder, S. (2005). How can market mechanisms for forest environmental services help the poor? Preliminary lessons from Latin America. *World Development, 33(9),* 1511-1527.

Hair, F. Jr, J., et al. (2014). Partial least squares structural equation modeling (PLS-SEM) An emerging tool in business research. *European Business Review, 26(2),* 106-121.

Hair, J. F. et al. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science, 40(3),* 414-433.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2013). Partial least squares structural equation modeling: Rigorous applications, better results and higher acceptance. *Long Range Planning, 46(1-2),* 1-12.

Henseler, J., Hubona, G., & Ray, P. A. (2016). Using PLS path modeling in new technology research: updated guidelines. *Industrial Management & Data Systems, 116(1)*, 2-20.

Ho, R. (2013). *Handbook of univariate and multivariate data analysis with IBM SPSS.* Chapman and Hall/CRC.

Jandl, R. et al. (2007). How strongly can forest management influence soil carbon sequestration? *Geoderma, 137(3-4),* 253-268.

Johansson, T.B., et al. (1993). *Renewable energy: sources for fuels and electricity*. Island press.

Johnson, D.W. & Curtis, P.S. (2001). Effects of forest management on soil C and N storage: meta analysis. *Forest Ecology and Management, 140(2-3),* 227-238.

Kangas, J. (1994). An approach to public participation in strategic forest management planning. *Forest Ecology and Management, 70(1-3),* 75-88.

Kates, R. W. (2018). *What is sustainable development?*

Klooster, D. & Masera, O. (2000). Community forest management in Mexico: carbon mitigation and biodiversity conservation through rural development. *Global Environmental Change, 10(4),* 259-272.

Kumar, S. (2002). Does "participation" in common pool resource management help the poor? A social cost–benefit analysis of joint forest management in Jharkhand, India. *World Development, 30(5),* 763-782.

Leach, M., Mearns, R., & Scoones, I. (1999). Environmental entitlements: dynamics and institutions in community-based natural resource management. *World Development, 27(2),* 225-247.

Lee, C.-H. & Wang, C.-H. (2017). Estimating Residents' Preferences of the Land Use Program Surrounding Forest Park, Taiwan. *Sustainability, 9(4),* 598.

Lewis, J. L. & Sheppard, S. R. (2006). Culture and communication: can landscape visualization improve forest management consultation with indigenous communities? *Landscape and Urban Planning, 77(3),* 291-313.

Lin, C.-L. and C.-H. Jeng, Exploring Interface Problems in Taiwan's Construction Projects Using Structural Equation Modeling. *Sustainability, 9(5),* 822.

Lindenmayer, D.B., Margules, C.R., & Botkin, D.B. (2000). Indicators of biodiversity for ecologically sustainable forest management. *Conservation Biology, 14(4),* 941-950.

Manojlović, S. et al. (2018). Anthropogenic Impact on Erosion Intensity: Case Study of Rural Areas of Pirot and Dimitrovgrad Municipalities, Serbia. *Sustainability, 10(3),* 826.

Murray, L.T. (2007). Practices of assemblage and community forest management. *Economy and Society, 36(2),* 263-293.

Myers, N. (1996). The world's forests: problems and potentials. *Environmental Conservation, 23(2),* 156-168.

Nygren, A. (2005). Community-based forest management within the context of institutional decentralization in Honduras. *World Development, 33(4),* 639-655.

Pagdee, A., Kim, Y.-s., & Daugherty, P.J. (2006). What makes community forest management successful: a meta-study from community forests throughout the world. *Society and Natural Resources, 19(1),* 33-52.

Paluš, H., et al. (2018). Understanding Sustainable Forest Management Certification in Slovakia: Forest Owners' Perception of Expectations, Benefits and Problems. *Sustainability, 10(7),* 2470.

Pearce, D., Barbier, E., & Markandya, A. (2013). *Sustainable Development: Economics and Environment in the Third World.* Routledge.

Peng, D.X. & Lai, F. (2012). Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management, 30(6),* 467-480.

Pritchett, W.L. (1980). Properties and management of forest soils. *Soil Science, 129(6),* 389.

Rametsteiner, E. & Simula, M. (2003). Forest certification—an instrument to promote sustainable forest management? *Journal of Environmental Management, 67(1),* 87-98.

Ringle, C.W. & Becker, S. (2015). *J. SmartPLS 3*.

Rizwan, K. (2014). *Deforestation in Gilgit-Baltistan; a green annihilation or astorm in a teacup?* https://pamirtimes.net/2014/11/07/deforestation-in-gilgit-baltistan-a-green-annihilation-or-astorm-in-a-teacup/

Shackleton, S. et al. (2002). Devolution and community-based natural resource management: Creating space for local people to participate and benefit. *Natural resource perspectives, 76(1),* 1-6.

Sheppard, S.R. & Meitner, M. (2005). Using multi-criteria analysis and visualisation for sustainable forest management planning with stakeholder groups. *Forest Ecology and Management, 207(1-2),* 171-187.

Shindler, B. & Cramer, L.A. (1999). Shifting public values for forest management: Making sense of wicked problems. *Western Journal of Applied Forestry, 14(1),* 28-34.

Shindler, B., Steel, B., & List, P. (1996). Public judgments of adaptive management: A response from forest communities. *Journal of Forestry, 94(6),* 4-12.

Shrivastava, P. (1995). The role of corporations in achieving ecological sustainability. Academy of Management Review, 20(4), 936-960.

Siitonen, J. (2001). Forest management, coarse woody debris and saproxylic organisms: Fennoscandian boreal forests as an example. *Ecological Bulletins,* 11-41.

Siry, J.P., Cubbage, F. W., & Ahmed, M. R. (2005). Sustainable forest management: global trends and opportunities. *Forest Policy and Economics, 7(4),* 551-561.

Sombroek, W. & Sims, D. (1995). Planning for sustainable use of land resources: towards a new approach. *Background paper to FAO's Task Managership for Chapter 10 of Agenda 21 of the United Nations Conference on Environment and Development (UNCED).* FAO.

Spector, B.I., Sjöstedt, G., & Zartman, I. W. (1994). Negotiating international regimes: lessons learned from the United Nations. *Conference on Environment and Development (UNCED).* Graham & Trotman/ Martinus Nijhoff.

Stupak, I., et al. (2007). Sustainable utilisation of forest biomass for energy—possibilities and problems: policy, legislation, certification, and recommendations and guidelines in the Nordic, Baltic, and other European countries. *Biomass and Bioenergy, 31(10),* 666-684.

Tanz, J.S. & Howard, A.F. (1991). Meaningful public participation in the planning and management of publicly owned forests. *The Forestry Chronicle, 67(2),* 125-130.

Tenenhaus, M., Esposito Vinzi, V., Chatelin, Y.-M., & Lauro. (2005). PLS Path Modeling. *Comput. Stat. Data Anal, (48)*.

Veríssimo, A. et al. (1992). Logging impacts and prospects for sustainable forest management in an old Amazonian frontier: the case of Paragominas. *Forest Ecology and Management, 55(1-4),* 169-199.

Von Gadow, K., Pukkala, T., & Tomé, M. (2012). *Sustainable Forest Management, 1.* Springer Science & Business Media.

Wells, W.D., Tigert, D.J., & Activities, I. (1971). Opinions. *Journal of*

Advertising Research, 11(4), 27-35.

Whitmore, T., Laurance, W. F., & Bierregaard, R. (1997). *Tropical forest remnants: ecology, management, and conservation of fragmented communities.* Chicago: University of Chicago.

Wolfslehner, B. & Vacik, H. (2008). Evaluating sustainable forest management strategies with the analytic network process in a pressure-state-response framework. *Journal of Environmental Management, 88(1),* 1-10.

Wu, D. D., Olson, D. L. & Birge, J. R. (2013). Risk management in cleaner production. *Journal of Cleaner Production, 53,* 1-6.

Zain, O. F. (2010). A Socio-Political Study of Gilgit Baltistan Province. *Pakistan Journal of Social Sciences (PJSS), 30(1).*