*International Journal of Geology, Agriculture and Environmental Sciences*
*Volume – 6 Issue – 2 April 2018*
*Website: www.woarjournals.org/IJGAES* *ISSN: 2348-0254*

# Implication of Landscape Characterization Integrating Spatial Knowledge and Socio-economic Valuation for Landscape Management in Teknaf Peninsula, Bangladesh

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**Abstract:** ***In many developing countries, landscape management decision based on according to the administrative boundary and considered political documentation as a crucial element instead of the record of features and elements of landscapes. In this research, we applied and developed an integrated landscape characterization approach to enhance spatial knowledge for managing and conserving landscape in the context of Teknaf peninsula, Bangladesh. Aimed at the study was to characterize landscape by using physical characters and find out socio-economic relation with the characterized landscape. The characterization was based on combining multiple data of the watershed area, landform, vegetation, (physical character) occupation type, income from each occupation type and duration of living time in the current area of households (socio-economic characters). Physical character data sets were generated from Digital Elevation Model, 2015 and Landsat 8 image, 2013 respectively. Socio-economic data were collected by using a structured questionnaire during August 2015-July, 2016. After analyzing physical character data, a map was prepared that showed Teknaf peninsula is divided into 4 landscape character area (LCA). Then calculated socio-economic data for each LCA and made a table presented dominated occupation type, average income, and duration of living time of each LCA. Another map and table were prepared to show a socio-economic relation with particular watershed units among the four LCA. With this results, we found a spatial pattern of landscape and local people's relation with them that assists to decide which area is used mostly by local people and the status of required conservation and can be used as a potential source of income for livelihood. We concluded that landscape characterization approach in the context of Teknaf is highly potential for managing landscape as well as natural resources.***

**Keywords:** Landscape characterization, Watershed unit, Landscape character area, Socio-economic valuation**.**

## 1. Introduction

It has been contended that a good understanding of landscapes is essential for its assessment, protection, planning and sustainable management [1]. Landscapes can be understood as the nexus of human-nature relations, interactions, and dependency which leads to multiple lands use as well as continuous changes and degradations of the landscape [2]. Mainly, in rural areas, people are highly dependent and use natural resources available in their local landscapes for their daily needs [3], [4], [5]. According to World Bank (2015), natural resources still account for 26 % of the total wealth in low-income countries whereas in developed countries only 3 % of the wealth is provided by natural resources. Those demands for natural resources, such as fuelwood from forest, expansion of agriculture has resulted in large-scale habitat loss, several environmental changes, forest degradation and loss of biodiversity [7], [8], [9], [10]. A sustainable landscape management plan helps to the conservation of the existing natural settings as well as the environment overall and local people's livelihood also [11].

However, a common situation especially, in the developing countries is that operative approaches to gathering and representing nature and human-induced phenomena and their relationships are lacking [2]. Thus, many decisions on landscape management are currently made on the basis of incomplete knowledge. Therefore, in this situation, we need a landscape management plan by integrating physical and cultural factors of the landscape [12].

Landscape characterization is an attractive and essential answer to create spatial data supporting planning and resource management of rural and protected areas. It is a well-established method for systematically identifying, classifying and describing the landscape, recognizing it as a continuous system that does not adhere to administrative boundaries the essence or special character of a particular place can be revealed, explored and understood [13]. Furthermore, the rationale behind this method is that particular combinations of physical and cultural factors occurring in different areas result in similar landscapes can be identified and would possible to make decision plan [12].

Many considerable studies have been done by using this method such as for forest management [2], [14], territorial planning [12], [15], [16], [17], landscape conservation [13], highway planning [11].

On the other hand, like other developing countries, Bangladesh has total 19 protected areas those are considered as precious assets for natural resource and biodiversity [18] and for conserving those areas, Bangladesh government took many initiatives like announcing reserve area, partnership activities. Although, such systems displayed some hopeful impacts, but still there remain inadequacies and degradation of the forest as well as landscape [19]. Teknaf peninsula, located in Southern part of Bangladesh and there is a protected forest area known

as Teknaf Wildlife Sanctuary covering 11,615 ha [20] and a unique combination of the coastal-hilly landscape. Recently the landscape is highly degraded due to anthropogenic activities, natural disaster and over-exploitation of natural resources [21] that is an area of great concern. Therefore, we wanted to apply landscape characterization method for conserving landscape of Teknaf Peninsula which will help to evaluate and describe its landscape's character and inform the uniqueness for any planning decisions thus possible to give emphasis on the identity of an area that needed conservation or can be used as a potential source for livelihood.

Though European landscape conversion center provides an outline for using this method in the context of the European landscape. However, in the context of Teknaf and at the local scale, we integrated physical and socio-economic factors to evaluate and describe its character and uniqueness.

The aim of this study is to characterize landscape through the spatial pattern of landform and vegetation types using the watershed unit and find out local people's socio-economic relation with the characterized landscape.

The applying method of this study adopted watershed area as a unit of landscape management planning in spite of administrative boundary. Since landscape character is associated with the watershed area and people's livelihood is linked with the character of the landscape. So, it is essential to ruminate about decision planning according to the watershed unit.

## 2. Material and Methods

### A. 2.1 Study area

The study was carried out in the Teknaf peninsula belonging to Cox's Bazar district (Figure 2.1). It has an area of 388.68 km sq. [20] and is located in the southeastern corner of Bangladesh bordering Myanmar on the east and facing the Bay of Bengal on the west and in between 20.8667°N latitude and 92.3000°E longitude. The area is characterized by a subtropical climate with a temperature range between 15 and 33°C during winter (January) and summer (May), respectively and the mean annual rainfall is around 4000 mm which enables to support a wide biological diversity making it an attractive as well as ecologically important place. It comprises 5 unions, comprising 147 villages with 265717 populations [20]. 39% (15000 ha) of the total area of the peninsula is covered by forest. among the forest area, 11,610 ha area is declared as Teknaf Wildlife Sanctuary (TWS) [20]. This area can be identified as a unique place of enriched biodiversity with stunning scenic beauty.

On the other hand, most of the population in the area living under very low income by collecting forest resources, fishing, farming activities which leads to deforestation, biodiversity loss, landscape degradation.

### 2.2 Data source

A Digital Elevation Model at a scale of with 5-meter resolution was prepared by NTT DATA Corporation in September 2015 from the satellite of ALOS images taken from 2006 to 2011 was used to watershed and landform map.

A vegetation map was prepared from Landsat 8 images taken from October to March 2013 by using NDVI (Normalized Difference Vegetation Index) method. This map represents the distribution of vegetation density and used to make a map by vegetation category.

Spatial data sets gathered and processed in ArcGIS 10.4.1 and TNTmips and for statistical analysis SPSS and Excel software. Data on different social factors were collected by questionnaire survey. The population was sampled by selecting 10% household from each village. The total sampled household was 4150. The Questionnaire survey was held in August 2015- July 2016.

### 2.3 Generation of base data

*2.3.1 Watershed data from DEM*

Watershed analysis operation in TNTmips software was conducted and two features such as flow paths and basins were separated. Those separated layers required some correction for matching the ground. Therefore, Google Earth 2016 image was used as a base map for modifying flow paths and basins. The resulting map shows 35 watershed area in Teknaf peninsula

*2.3.2 Landform data from DEM*

Hammond method was followed used to make landform map from DEM. In this method three types of data layers' extract from DEM. These are slope based on 3-km neighborhood, relief based on 6 km neighborhood, and profile based on 6-km neighborhood. The last step is to overlay the combination of these three characteristics and create a map showing the distribution of elevation of Teknaf.

*2.3.3 Vegetation data from Landsat 8 image*

3 categories were identified from the distribution of vegetation density of existing map: Grassland, Mosaic land which is considered water body, fallow land with bushy vegetation, and road and High vegetation land that combining all forest (social and natural), homestead garden and betel leaf field. The satellite images were almost 3 years back and various high vegetation groups were in one category, therefore, Google Earth, 2016 image was used to digitize of betel leaf field, social forest and homestead garden into a vector layer. This layer was converted into raster grids (cell size 15m × 15m). This was combined with the existing vegetation map and this vegetation map depicts 6 categories of vegetation: betel leaf area, grassland area, mosaic area, homestead garden area, natural forest and social forest area (Fig. 4).

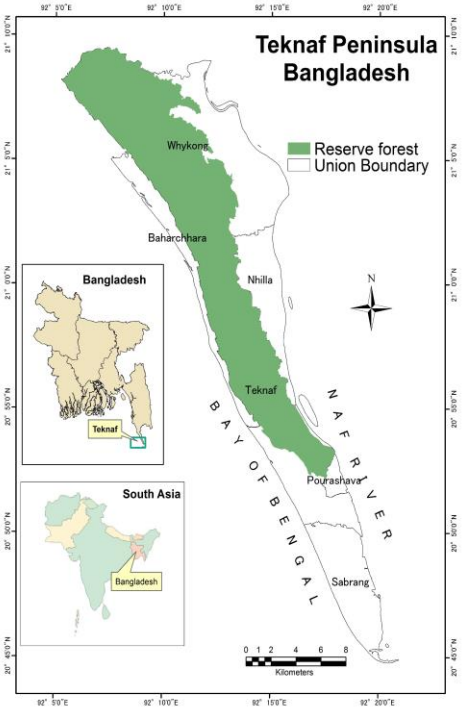



**Figure 2:1:** Study area

### 2.4 Data Analysis

To identify landscape character area, data of watershed area was used as landscape unit but vegetation categories and landform types were used as character variables. The percentage of the character variables were calculated for each watershed area and factor analysis was employed to reveal data sets consisting of correlated variables. As a data reduction technique, PCA was applied to successively reduce amounts of data into components and make groups by evaluating the spatial relations between vegetation and landforms types.

After making spatial character area, socio-economic data was calculated for each area and quantitative descriptive data analysis for the variables of occupation and living time and one sample t-test for income variable were conducted to compare the differences between all spatial character areas. Then a hierarchical cluster analysis was implemented to identify cluster groups of the similar occupational watershed unit.

## 3. Results

### 3.1 Result of physical character of landscape

Landscape characterization is the process that involves identifying, mapping, classifying and describing landscape characters and informs a range of different decisions [22]. In this study, three landscape characters were used to characterize the landscape.

Watershed map of Teknaf represents 35 watershed areas or units. Among this 35 watershed area, 2300 hector is the largest and 106 hector is the smallest watershed. On the basis of area, the watershed is divided into 3 groups: large, medium and small (Figure 3.1).

Landform map shows that land elevation of Teknaf peninsula can be categorized into four types: plain land (0-30m), plain land with relief (31m-90m), high land (91m-150m) and high mountainous land (151m-300m) (Figure 3.1).

Vegetation map showing 6 categories of vegetation: betel leaf area, grassland area including agricultural field, mosaic area which indicates lack of vegetation in mountainous area, homestead garden area where fruits (mango, jackfruit, banana, supari), wood (Akasia, eucalyptus), natural forest and social forest area (Figure 3.1).

### 3.2 Result of Statistical Analysis

Betel leaf area, grassland, mosaic area, homestead garden, natural forest and social forest area's distribution pattern differ in terms of particular land types such as plain land, plain land with relief, high land and high mountainous land.

Principal Component Analysis (PCA) produced a scree plot estimate with eigenvalues associated with the number of components, a table of showing a correlation between variables and component, a biplot graph that express the data structure of the first two components, and an outlier plot which represents the watershed areas position according to first two components.

The analysis showed us that, PCA extracted the first two components, explaining more than 77% of the total variances. From table 3.1, it is elicited that, the first component has a large positive association with natural forest and high land; the second component has a large positive association with homestead garden and plain relief area but grassland and plain land are negatively associated with both components. Proceedings with these components, character variables were analyzed and an outlier plot graph was generated (Figure 3.2) where the first component (F1) sensed as high land, natural forest variable and the second component (F2) as plain land, plain relief, grassland, and homestead garden variable.

### 3.2 Landscape characterized area (LCA)

According to PCA, watershed units are gathered in the four-character area (Figure 3.3). These are identified as plain grassland (PGLA), plain relief homestead garden (PRHGA), high land forest (HLFA) and mixed land mosaic area (MLMA).

Plain grassland area located on the north-east side of the study area and the largest landscape character area comprising 41% of total area. PGLA area is formed by 10 watershed unit where 5 units are large, 3 are medium and 2 are small. It is characterized by large plain area (0-30m) on east boundary followed by plain relief, high land and high mountainous land (Figure 3.4) on east to west boundary. It is grassland (identified as agricultural land) dominated area. 38 villages located here and total number of household is 13439 with 76477 populations.

Plain relief homestead garden is located in the south-west side of the study area and the smallest landscape character area comprising 13% of total area. 2 medium and 8 small watershed units made PRHGA. It is characterized by large plain relief area (31-90m) and high mountainous land (151-300m) (Figure 3.4). It is homestead garden dominated area but also enriched with forest area (Figure 3.5). 23 villages located here and total number of household is 5310 with 30647 populations.

High land forest area located on the south-east side of the study area and comprising 14% of total area. HLFA area is formed by 7 watershed unit where 1 is large, 1 is medium and 5 are small. It is characterized by large high land area (91-150m) followed by high mountainous area (Figure 3.4). Almost 65% area is covered by natural and social forest (Figure 3.5). 13 villages located here and total number of household is 4387 with 24141 populations.

The mixed land mosaic area located on the south-west side of the study area and the second largest landscape character area comprising 32% of total area. 1 large, 4 medium and 3 small watershed units made MLMA. It is characterized by mainly high land and high mountainous area (Figure 3.4). Natural forest and mosaic area dominate this character area. 7 villages located here and total number of household is 4288 with 25264 populations.

### 3.3 Socio-economic valuation for LCA

For conservation management planning, it is important to know not only the spatial distribution pattern of landscape character but also how local people value their surrounding landscape. To understand people's relation with landscape, we considered people's dependency on landscape and duration of living time in the current area.

The numbers of the samples used in this analysis were 1343 households, 7647 persons in PGLA, 531 households, 3064 persons in PRHGA, 438 households, 2414 persons in HLFA and 428 households, 2526 persons in MLMA.

Among the total population, major occupations were identified as farmer, betel leaf farmer, fisherman, labor, fuelwood collector, business, service and working abroad. For each LCA, average households were calculated by using total household of all occupation types. In table 3.2, the symbol ">" and "<" indicates total number of each occupation type is more and less than average respectively.

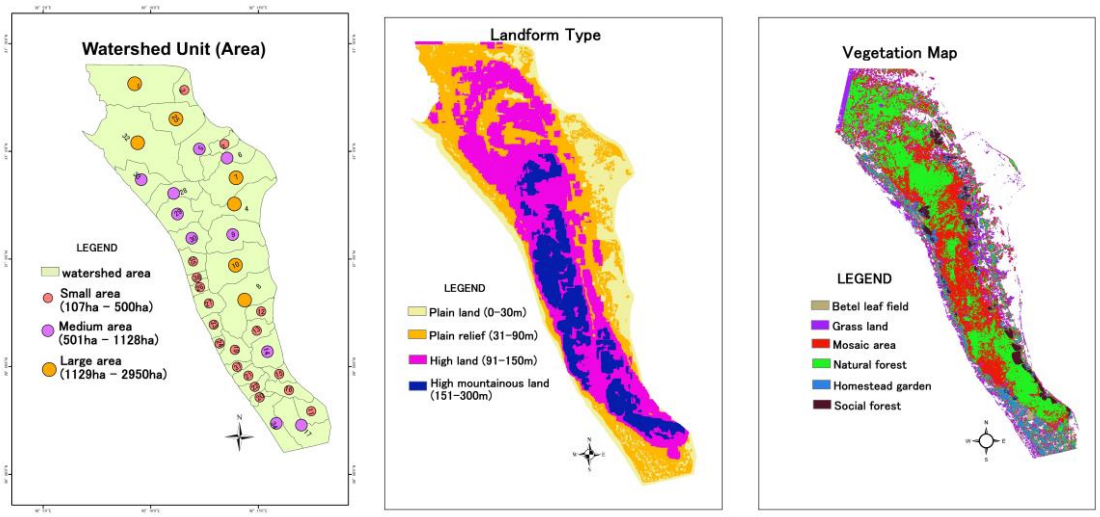



**Figure 3.1:** Watershed, landform and vegetation distribution over Teknaf Peninsula

**Table 3.1:** Correlations between variables and factors

| Variables | PC1 | PC2 | PC3 |
|---|---|---|---|
| Grass land | -0.813 | -0.494 | 0.019 |
| Natural forest | 0.838 | -0.161 | 0.279 |
| Homestead garden | -0.159 | 0.849 | -0.383 |
| Plain land | -0.714 | -0.629 | -0.023 |
| Plain relief | -0.482 | 0.579 | 0.641 |
| High land | 0.828 | -0.364 | 0.016 |

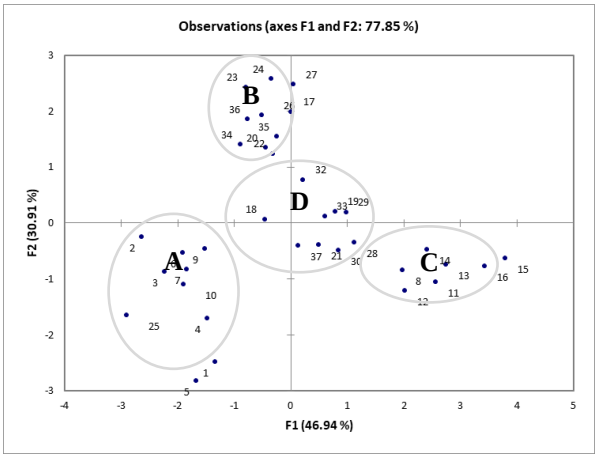



**Figure 3.2:** Watershed unit position with two components

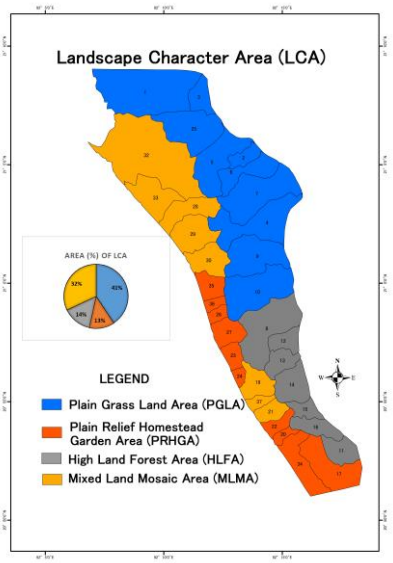



**Figure 3.3:** Landscape Character Area (LCA)

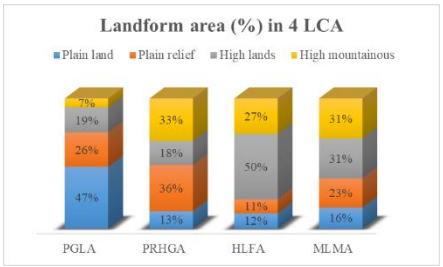



**Figure 3.4:** Landform types among LCA

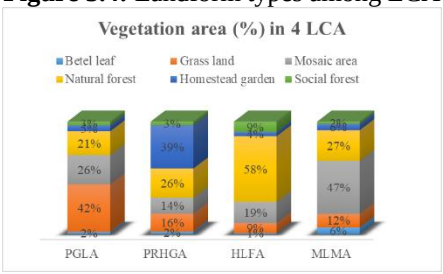
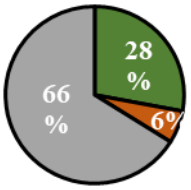
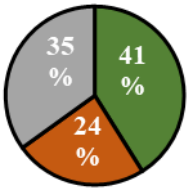
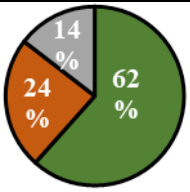
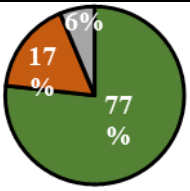



**Figure 3.5:** Vegetation types among LCA

From table 3.2, it is elucidated that, in PLGA farmer, fuelwood collector, labor, and business occupation persons are more than total average and betel leaf farmer, fisherman, service and working abroad occupations are less than average. In PRHGA, betel leaf farmer, labor, service, and business households are more than farmer, fisherman, fuelwood collector and working abroad households. In HLFA, fuelwood collector, labor, service, and business houses are more than farmer, betel leaf farmer and working abroad houses. In MLMA, betel leaf farmer, fisherman, fuelwood collector and business occupations are more than average and farmer, labor, service and working abroad are less than average.

Average income from all occupation types for each LCA was calculated and independent t-test was conducted to compare income differences between those 4 LCAs. Average income from farming is higher in PGLA (table 3.2) and has significant difference ($t=6.63$, $p<0.01$) with other LCAs. Average income from betel leaf farming is higher in PRHGA (table 3.2) and has significant difference ($t=5.89$, $p<0.01$) with other LCAs. Average income from fishing is higher in MLMA (table 3.2) and has significant difference ($t=3.30$, $p<0.01$) with other LCAs. Average income from fuelwood collection is higher in HLFA (table 3.2) and has significant difference ($t=3.23$, $p<0.01$) with PGLA, PRHGA but no difference with MLMA. Average income from labor is higher in PRHGA (table 3.2) and has significant difference ($t=11.4$, $p<0.01$) with other LCAs. Average income from service is higher in MLMA (table 3.2) but there is no significant difference between them. Average income from business is higher in PLGA (table 3.2) and has significant difference ($t=11.63$, $p<0.01$) with other LCAs. Average income from working abroad is higher in MLMA (table 3.2) but there is no significant difference between them.

**Table 3.2:** Socio-economic relation with LCA

| | | **Plain grass land (PLGA)** | | **Plain relief homestead (PRHGA)** | | **High land forest (HLFA)** | | **Mixed land mosaic (MLMA)** | |
|---|---|---|---|---|---|---|---|---|---|
| | Occupation | Household (> more, < less than avg.) | Avg. income | Household (> more, < less than avg.) | Avg. income | Household (> more, < less than avg.) | Avg. income | Household (> more, < less than avg.) | Avg. income |
| Occupation & Avg. Income from each category | Farmer | > | 90546 | < | 37434 | < | 34394 | < | 51010 |
| | Betel leaf farmer | < | 67950 | > | 112450 | < | 0 | > | 88045 |
| | Fisherman | < | 118233 | < | 213750 | < | 136433 | > | 183348 |
| | Fuelwood collector | > | 33987 | < | 10675 | > | 38800 | > | 18020 |
| | Labor | > | 90354 | > | 97357 | > | 86808 | < | 48098 |
| | Service | < | 77612 | > | 68959 | > | 74124 | < | 121823 |
| | Business | > | 193954 | > | 169653 | > | 135505 | > | 146998 |
| | Abroad | < | 323309 | < | 228473 | < | 197026 | < | 371062 |
| Living period in current area | (< 30years)<br>(31 to 60 years)<br>(> 60years ) |  | |  | |  | |  | |

Duration of living time expresses the period of settlement exist there. On the basis of the time, households were divided into three groups: recent (up to 30 years), intermediate (31 to 60 years), and long (above 61 years). From table 3.2, we can see that the ratio of recent time households is higher in MLMA (77%) followed by HLFA (62%), PLHGA (41%) and PGLA (28%). The Ratio of household duration time between 31 to 60 years is smaller for all LCAs. Only 6% households from PLGA, 24% from PLHGA and HLFA, and 17% from MLMA living that particular area for more than 30 years but less than 60 years. In PLGA, about 66% household living there for more than 60 years where only 6% in MLMA and 14% in HLFA but 35% in PRHGA.

### 3.5 Occupation Distribution Over Watershed Units

From the section 3.4, we can see there the relation between LCA and people's socio-economic status. On the other hand, individual watershed units among particular LCA have different occupational profile. After hierarchical cluster analysis of occupational data of each watershed units, we found 11 occupational categories of watershed units (Figure 3.6) and categories were named according to the more than average number of occupation types. These are: I- farmer, fuelwood collector, labor, II-farmer, labor, business, III- farmer, fuelwood collector, IV- fuelwood collector, labor, service, business V- fuelwood collector, labor, service, VI- fuelwood collector, labor, business, VII- Betel leaf farmer, fisherman, labor, business, VIII- farmer, labor, working abroad, IX- betel leaf farmer, fuelwood collector, X- betel leaf farmer, fuelwood collector, business, XI- fisherman, fuelwood collector, business. From figure 3.6, we can see, in PLGA I, II, III, IV; in PRHGA IV, VIII, VII, X, IX; in HLFA I, III, IV, V, VI and in MLMA VI, IX, X, XI categories are prominent.

## 4. Discussion

Our findings show 4 unique landscape characterized area with distinctive socioeconomic status. PGLA is quantified with higher amount of plain land and grassland as well as agricultural field where most of the households' economic activities related with farming, fuelwood collection, day labor and business such as shopkeeping, salt business but highest average income coming from fishing and business sector. Another important fact about PGLA that here most of the households' have longer duration of living status that means here land capacity is higher. PRHGA is quantified with higher amount of plain relief land type and homestead garden where most of the households' economic activities related with betel leaf farming, day labor, service and business of the material from homestead garden but highest average income coming from fishing and business sector. Here, lots of long and intermediate living time houses exist but recently living houses also increasing which indicates, this area is suitable for living. HGLA is dominated by high and high mountainous area with reserve and social forest. Here, fuelwood collector, day labor, service and business occupation households are more than other occupations and highest average income coming from fishing, business mainly shopkeeping and working abroad sector. In this area, long living houses are very few comparing with recent living houses that means this area is not suitable for living but because of some reasons such as increasing population, flexibility to enter this area etc. people moving here. In MLMA, high and high mountainous area is huge with small portion of plain and plain relief area and this area is dominated by mosaic and reserve forest. Betel leaf farming, fuelwood collector and business occupation households are more than other occupations and highest average income coming from fishing, business of shopkeeping, materials from homestead garden etc. and working abroad sector. Recent living houses dominated this area followed by intermediate and long period of living.

Furthermore, particular watershed unit relation with occupation provides an outline of area-specific condition for each LCA.

Table 4.1, represents occupational categorical similarities of particular watershed units among 4 LCA. From table 3.3, we can see, category I (farmer, fuelwood collector, labor) is found in watershed unit 1,6,7 of PGLA and 16 of HLFA. So, those units can be characterized as near to forest having agricultural land. Category II (farmer, labor, and business) for unit 2, 3, 4 of PGLA indicates those units have lots of agricultural field with other opportunities for income. Unit 5,10 and 25 of PGLA are dominated by farmer and fuelwood collector (III) where agricultural land and forest area extensively used for livelihood. Unit 9, 17, 11, 14 have similar occupational category (IV) in spite of belonging to different LCA. Category V is found in unit 8 and 12 of HLFA which indicates that those areas are in the forest and having limitations for other occupations. Unit 13, 15 of HLFA and 33 of MLMA are in forest area but have some homestead garden because category VI is prominent here. In PRHGA, unit 22, 27 and 34 are dominated by betel leaf farmer, fisherman, labor, business (VII), so those are far from the forest but near to fishing port and having betel leaf field and homestead garden. Category VIII (farmer, labor, working abroad) is found in unit 20, 26, 36 of PRHGA. Unit 35 of PRHGA and 21, 29 of MLMA are dominated by category IX (betel leaf farmer, fuelwood collector) so, those areas have only betel leaf field with forest. Betel leaf farmer, fuelwood collector, business (X) category is found in 23, 24 of PRHGA and 19, 37 in MLMA. Category XI (fisherman, fuelwood collector, business is found in 28, 30, 32 of MLMA. Those units can be characterized as near to fishing port and forest with homestead garden.

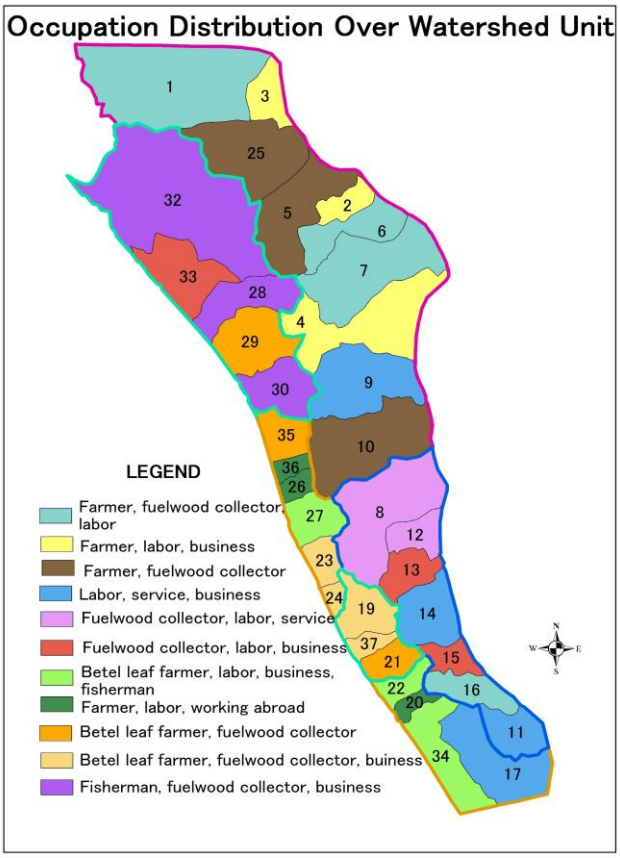



**Figure 3.6:** Occupation distribution over watershed unit

After the interpretation of results and discussion, it can be said that this integrating characterization method by using watershed unit helps to identify the most exploited area for conservation regarding potential area that can be managed for better livelihood.

For conserving and protecting landscape and natural resources many developed and developing countries adopted the landscape characterization approach [12], [15], [16], [17] but in this approach they used many physical character data such as vegetation, soil type, land use, land cover etc., historical and cultural data whereas we used 3 major physical character data sets and socio-economic data because of limitations of collections and sources data.

Furthermore, there is scope for further studies on details land use analysis of particular watershed unit to better development of this method.

## 5. Conclusion

In this paper, we have shown how landscape characterization could move beyond the socio-economic data and be a source of different ways of knowing of the landscape. This kind of local-scale spatial data illustrating the human-nature interaction can be regarded a crucial medium to facilitate sustainable land management, particularly when different small-scale planning decision needed. Therefore, we foresee that, this methodology could be used as a strong framework for a bottom-up approach of landscape management planning.

**Table 4.1:** Household number of occupation in particular watershed area among 4 LCA

| LCA | Watershed Unit | Farmer | Betel leaf farmer | Fisherman | Fuelwood collector | Labor | Service | Business | Abroad | Category |
|---|---|---|---|---|---|---|---|---|---|---|
| PGLA | 1 | **48** | 5 | 5 | **137** | **62** | 22 | 24 | 38 | I |
| | 2 | **65** | 0 | 0 | 5 | **17** | 3 | 5 | 5 | II |
| | 3 | **47** | 0 | 5 | 10 | **33** | 15 | **25** | 18 | II |
| | 4 | **64** | 0 | 20 | 25 | **82** | 40 | **69** | 42 | II |
| | 5 | **99** | 0 | 0 | **112** | 16 | 18 | 34 | 32 | III |
| | 6 | **42** | 0 | 6 | **53** | **58** | 11 | 21 | 15 | I |
| | 7 | **146** | 0 | 16 | **89** | **103** | 42 | 58 | 57 | I |
| | 9 | 46 | 2 | 22 | **52** | **58** | **97** | **70** | 49 | IV |
| | 10 | **144** | 0 | 18 | **115** | 56 | **69** | 60 | 47 | III |
| | 25 | **172** | 9 | 22 | **114** | 57 | 52 | 62 | 39 | III |
| PRHGA | 17 | 13 | 27 | 32 | 8 | **96** | **110** | **133** | 39 | IV |
| | 20 | 0 | **13** | **9** | 1 | **13** | 6 | 5 | **8** | VIII |
| | 22 | 2 | **6** | **12** | 1 | **8** | 5 | **8** | 1 | VII |
| | 23 | 2 | **14** | 5 | 0 | 4 | 5 | **6** | 4 | X |
| | 24 | 2 | **14** | 5 | 0 | 4 | 5 | **6** | 4 | X |
| | 26 | 1 | **8** | 1 | 0 | **4** | 1 | 3 | **7** | VIII |
| | 27 | 1 | **8** | 2 | 0 | **5** | 4 | **6** | 4 | VII |
| | 34 | 6 | **28** | **36** | 1 | **24** | **29** | **27** | **24** | VII |
| | 35 | 2 | **12** | **10** | 0 | 3 | 4 | 4 | 2 | IX |
| | 36 | 1 | **7** | 0 | 0 | **5** | 2 | 2 | **5** | VIII |
| HLFA | 8 | **43** | 0 | 2 | **65** | **49** | **39** | 29 | 27 | V |
| | 11 | 0 | 0 | 2 | 8 | **30** | **69** | **46** | 16 | IV |
| | 12 | 2 | 0 | 0 | **9** | 5 | **7** | 2 | 0 | V |
| | 13 | 0 | 0 | 3 | **17** | **8** | 4 | **7** | 2 | VI |
| | 14 | 3 | 0 | 6 | **40** | **15** | **20** | **23** | 8 | IV |
| | 15 | 0 | 0 | 3 | **17** | **8** | 4 | **7** | 2 | VI |
| | 16 | **29** | 0 | 7 | **14** | **12** | 5 | 4 | 6 | I |
| MLMA | 19 | 5 | **24** | 5 | **43** | 3 | 6 | **15** | 8 | X |
| | 21 | | **14** | 3 | **21** | 7 | 5 | 7 | 6 | IX |
| | 28 | 4 | 12 | **21** | **69** | 10 | 11 | **25** | 6 | XI |
| | 29 | | **10** | 4 | **21** | 3 | 2 | | 4 | IX |
| | 30 | 3 | 12 | **20** | **44** | 10 | 6 | 11 | 4 | XI |
| | 32 | 18 | 45 | **72** | **138** | 57 | 31 | 66 | 39 | XI |
| | 33 | 15 | 11 | 14 | **44** | **24** | 12 | **22** | **27** | VI |
| | 37 | 5 | **24** | 5 | **43** | 3 | 6 | **15** | 8 | X |
| Bold number indicating households are more than average | | | | | | | | | | |

## Acknowledgement

This study was supported by JSPS grant for scientific research (Grant # 15H02612), Japan.

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