Geographical Analysis on the Impact of Land Cover Changes on Socio-economic Conditions in Bawlakhe District, Kayah State in Myanmar: A Case Study of Four Villages

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Abstract

The purpose of this paper is to analyses how land cover changes affect the socio-economic conditions of four select villages in Bawlakhe District, Kayah State, Myanmar. This study used both qualitative and quantitative tools in data collection and analysis. Interviews were conducted with 270 villagers in the study areas. Geographical mapping tools such as the GIS and RS technologies were used to analyse the changes of land cover through satellite images. GIS and RS technologies were able to provide the needed data in analyzing the land cover conditions in 1995, 2005 and 2015.

According to field survey, questionnaires and satellite image analysis, land cover conditions of this area have dramatically changed from 1995 to 2015, especially after 2010. This study is one of the first to report on how land cover changes affect the socio-economic conditions of local people in Bawlakhe District. This paper suggests that local and regional decision makers need to produce and provide accurate information to the public to be able to understand the advantages and disadvantages of land-use changes which require a much needed set of guidelines for a sustainable land management of this area.

Keywords: land cover, livelihoods, Thanlwin River Basin, Bawlakhe District, Kayah State
Introduction

Geographical analysis on the impact of land cover changes on socio-economic condition of Bawlakhe District describes the role of land cover in understanding the livelihood activities of villages. The study area is located in Thanlwin River Basin which is one of the four major watershed areas in Myanmar, namely: Shan State, Kayah State, Kayin State and Mon State. In Kayah State, Thanlwin River flows from North to South and it is a home to local ethnic people and is rich in biodiversity (Hla Tun Aung, 2003). Local ethnic people depend on this watershed area for their survival such as food, water, security, fuel and income. Moreover, the main economy of this area is agriculture, forest extraction, and mining. Land cover protects from soil depletion and soil erosion, pollution of air, water, and soil, sediment deposition in streams and rivers, forest depletion, decline and loses of biodiversity. There were several attempts to measure socio, economic and environmental change of study area.

Bawlakhe District is located at the Southeastern part of Myanmar. It is composed of three townships: Bawlakhe, Hпасaung and Mese Townships. It has an area of 1994.77 square miles (5166.45 square kilometers). There are 20 village tracts and 86 villages in this district.

Land cover conditions of this area dramatically changed from 1995 to 2015, especially after 2010 as the peace situation in Kayah State improved. Before this period, Kayah State was not easy to access as conflict was present in this area. This state has become a popular place to work and so many people from others areas come for forest production. Due to lack of plan for forest conservation and management, challenges regarding forest depletion have been observed which inevitably impacts the livelihood of the villagers.

This paper, therefore, will answer the following research questions:

- What are the current livelihoods in the four villages?
- What have been the landscape changes from 1995 to 2015?
- Why has land cover changes occurred in Study Area?
• How has land cover changes affected on socio–economic conditions in Balakhe District?

• What is the current land cover governance and how could it be strengthened to support local livelihoods?

Methodology

This paper used quantitative and qualitative methods of collecting and analyzing data. To be able to analyses the land cover changes of Thanlwin River Basin, images captured by the Global Information System (GIS) and Remote Sensing (RS) technologies were importance evidence for the study. Primary and secondary data were also collected in the study area. Secondary data were retrieved from government offices such as the District Administrative Office, Land Records Department and the Meteorology Department. Field surveys and interviews were conducted to collect primary data from the villages to capture people’s perspectives and diversity of viewpoints on the land issue. All the data at hand have undergone the four stages: preparation stage, processing and description stage, mapping and analysis stage, and evaluation and reporting stage.

1. GIS\(^1\) Analysis of land cover change

The approach used in this study to classify satellite images and change detection was based on Satellite images (Landsat 7 ETM +/- 1995, Landsat 7 ETM (2005) and Landsat 8 ETM (2015)). The images undergo classification and time series analysis. Satellite images were extracted using remote sensing software (ENVI or Environmental Visualization Images) version 5.0 and vector visualization from the ArcGIS 10.2 software. Both the overall and feature wise changes in the different land use types from the period 1995-2015 have been discussed in the following analysis stages.

\(^1\) GIS stands for geographic information system. It is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface. GIS can show many different kinds of data on one map. This enables people to more easily see, analyze, and understand patterns and relationships.

http://www.nationalgeographic.org/encyclopedia/geographic-information-system-gis/
Arc Map10.2 is one of a group of time series analysis in GIS analysis with the land cover classification using remote sensing software (ENVI or Environmental Visualization Images) version 5.0. In this classification process, images of three different years can be used to detect the change of the land. This is one of the most dedicated processes in time series analysis. It produces separate maps for each village and shows the changes of the year to year image. In this paper, four selected villages: Bhuku, Wanpla, Wanaung and Hose villages are analyzed.

2. IBM SPSS Statistic 19 Sampling Method

Four villages were chosen using the SPSS Method with these four criteria: 1) near the Thanlwin River; 2) far from the Thanlwin River; 3) located in a dense forest area; and, 4) located in a less dense forest area. Bhukhu Village is located far from the Thanlwin River and is in a less dense forested area. Hose Village is located in a dense forest area and is far from Thanlwin River. Wanpla and Wanung are near the Thanlwin River but forest cover of Wanaung Village is less dense and Wanpla Village located in dense forest area (Figure 1). The main portion of the research deals with the socio-economic impacts in the study area and its relationship with environmental change.

Figure 1. Overlay of forest area and selected village areas in 2015

Source: Landsat 8 ETM (2015)

3. Village interviews

Villagers who were selected for interviews were grouped according to their period of residency in the study areas: living for more than five years, 10 years
and 15 years. They were asked about the land cover and economic condition. A survey questionnaire was conducted in all four villages located within Bawlakhe District. It covered a total of 260 households which were randomly selected for the study (Table 1). Selection samples ensured representation of residents in the study area whereby number of households selected ensures 30 per cent of all households in every respective village. Respondents were selected on the basis of their experience in the area and their age (above 18 years). Gender balance was also considered to ensure the equal representation of both males and females. Participants for household interviews were selected with the assistance of village elders and village leaders.

In every household, the head and family members of the household were interviewed. When the need arises, translators (research assistants from the villages) would explain the questions in their respective ethnic languages. Focus group discussion was also conducted and was composed of seven participants, comprising of village members who were aware of the history and patterns of settlement in the village.

Table 1. Summary of Interviews per Village

<table>
<thead>
<tr>
<th>Village Name</th>
<th>Total Number of Households (HH)</th>
<th>Total Population</th>
<th>No. of HH in the Survey Questionnaire</th>
<th>No. of Individual Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wanaung</td>
<td>93</td>
<td>493</td>
<td>70</td>
<td>35</td>
</tr>
<tr>
<td>Wanpla</td>
<td>87</td>
<td>268</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Bhukhu</td>
<td>49</td>
<td>266</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Hose</td>
<td>265</td>
<td>1096</td>
<td>75</td>
<td>30</td>
</tr>
</tbody>
</table>
Photos: Household survey in the select four villages

(Photo credits: Khin Sandra Aye)

Photos: Focus group discussion with villagers

(Photo credits: Khin Sandra Aye)
Photos: Activities in the four villages
(Photo credits: Khin Sandra Aye)
Discussion of Findings

Livelihoods of Villagers

The main economy of the villagers is timber extracting, agriculture and livestock breeding. Considering that male population is more than female numbers in the villages, the former usually work in forest extracting, mining and other labor from neighboring areas. In this area, majority of land use is the forest land. Major cultivation crops are rice, maize, sesame, green gram, sunflower, pulses, chili and garlic. Before 2000, forest products such as honey, orchids, medicinal plants and fuel wood can be easily collected from the forest near the village. At present, timber extraction areas are shifted away to another forest area and fuel woods are collected far from the village. The main fuel is fire wood. Charcoal production is another source of livelihood in this area. Because of the good quality of woods that are used to produce charcoal in this area, people from Kayah State tend to work here.

Most of the villagers have around two acres of cultivated land while some households have more. The main economy of these areas depends on forest production. The main agriculture is shifting agriculture and it is also subsistence agriculture. In this area, women and children work in agriculture and in housekeeping.

There are also some similarities and differences between the villages, including regarding ethnicity, particular livelihoods and geography as shown in Table 2. The location of the four villages with respect to Thanlwin River is shown in Figure 2. It should also be noted that the educational level of the three upland villages are quite low with around half of the population having no formal education.
<table>
<thead>
<tr>
<th>Village</th>
<th>Location/Geography</th>
<th>Ethnicity &amp; Dominant Religion</th>
<th>Livelihood</th>
<th>Occupation</th>
<th>Education &amp; Migration</th>
</tr>
</thead>
</table>
| Wanaung | Mountain area; located at the Eastern bank of Thanlwin River; river-dependent      | Shan Tribe Buddhism           | • Depend on forest resources as the main source of livelihood  
• Grows sesame | • Forest production, crop cultivation, charcoal selling and livestock keeping   | Over 35% of people have not attended formal education, and over 45% reached primary level |
| Wanpla  | Mountain area; located at the Western bank of Thanlwin River                        | Shan Tribe Buddhism           | • Depend on forest resources as the main source of livelihood  
• Grows sesame and corn | • Forest production, crop cultivation, shifting agriculture, charcoal selling and livestock keeping | Over 50% have not attended formal education; 45% reached primary school level  
Small families have more educational percentage than big families |
<table>
<thead>
<tr>
<th>Bhukhu</th>
<th>Mountain area; is far from Thanlwin River</th>
<th>Kayah Tribe</th>
<th>Buddhism corpus, forest</th>
<th>Bhukhu Mountain area; is far from Thanlwin River</th>
<th>Kayah Tribe</th>
<th>Buddhism corpus, forest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>32% have not attended formal education; over 45% reached primary school level</td>
<td>32% have not attended formal education; over 45% reached primary school level</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Hose | Plain area; located near Thai-Myanmar Border Area; far from Thanlwin River; connected by roads to other parts of Kayah State | Tribes: Kayah, Shan, Bamar Christianity | Main crops: garlic, sesame and cardamom | Hose | Plain area; located near Thai-Myanmar Border Area; far from Thanlwin River; connected by roads to other parts of Kayah State | Tribes: Kayah, Shan, Bamar Christianity | Main crops: garlic, sesame and cardamom |
|      |                                                      |                                          |                                        |      |                                                      |                                          |                                        |
|       |                                                      | 32% have not attended formal education; over 45% reached primary school level |                                        |      |                                                      | 32% have not attended formal education; over 45% reached primary school level |

Table 2. Socio-Economic conditions of four villages
Land Use Change

Deforestation and dropping quality of timber have been key changes in the area over the past 20 years. This in turn has changed the lives of the communities. This section details the changes that have occurred, and the socio-economic implications to the villages.

Classified satellite images for the years 1995, 2005 and 2015 were analyzed to describe the landscape changes from 1995 to 2015. Results from image interpretation and field observation show that changes have occurred particularly on the land use category. Here the changes occurred gradually and the forest land area getting less day by day.

Figure 3a, 3b and 3c show the time series maps for Bawlakhe District. Land cover change has become a major factor in current conditions for natural resources management and environmental change. Remotely sensed data like satellite imageries are undoubtedly the most ideal data for extracting land use and land cover change information. Obtaining satellite images is a good way of getting data for different periods of time. The approach used in this study to
classify satellite images and change detection is based on Satellite images produced by Landsat 7 ETM +/-(1995), Landsat 7 ETM (2005) and Landsat 8 ETM (2015).

Figure 3a: Land cover conditions of Bawlakhe District in 1995

![Figure 3a](source: Landsat 7 ETM +/-(1995))

Figure 3b: Land cover conditions of Bawlakhe District in 2005

![Figure 3b](source: Landsat 8 ETM (2015))
Source: Landsat 7 ETM (2005)

Figure 3 (c): Land cover conditions of Bawlakhe District in 2015

Based on these data, land cover types are classified by the geographical point of view. There are three types of forest in Bawlakhe District: sub-tropical hill savanna forest, tropical wet evergreen forest and sub-tropical wet hill forest. According to the maps data, it is evident that significant changes have been taking place in the Bawlakhe District where degraded forest and status of settlement are seen (Figures 3a, 3b, 3c). This is important in terms of identifying features of a particular area.

Time series analysis of satellite data in the meantime provides information regarding temporal changes of land. Uses of remote sensing techniques are recommended for better planning and sustainable management of land cover area in Bawlakhe District. Using the images, remarkable changes of the land use classes have been registered between 2005 and 2015.

The most significant land use change can be seen in the central part of the Bawlakhe District due to its accessibility to villagers for (re)settlement and forest
production. This area is well connected by a road network and has administrative functions in the district.

Table 3 shows in detail that change of land cover types in Bawlakhe District. It should be noted that changes do not only pertain to the decreasing land cover but also the increasing coverage of land types in Bawlakhe District from 1995 to 2015. Sub-tropical hill savanna forest, paddy land, and fallow land have dramatically decreased since 1995 while tropical wet evergreen forest and sub-tropical wet hill forest have registered a tremendous increase in their land coverage. Fallow land has been decreasing because of the higher demand of the villagers to earn a living by producing cash crops. Box 1 describes the land cover types in the district.


<table>
<thead>
<tr>
<th>Land cover types</th>
<th>1995</th>
<th>2005</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sq. Km.</td>
<td>Sq. Km.</td>
<td>Sq. Km.</td>
</tr>
<tr>
<td>Sub-Tropical Hill Savanna Forest</td>
<td>3066.891</td>
<td>639.335</td>
<td>444.518</td>
</tr>
<tr>
<td>Tropical Wet Evergreen Forest</td>
<td>740.004</td>
<td>3847.849</td>
<td>1596.29</td>
</tr>
<tr>
<td>Sub-Tropical Wet Hill Forest</td>
<td>940.765</td>
<td>251.204</td>
<td>2795.88</td>
</tr>
<tr>
<td>Paddy Land</td>
<td>212.754</td>
<td>199.735</td>
<td>99.998</td>
</tr>
<tr>
<td>Fallow Land</td>
<td>162.410</td>
<td>149.671</td>
<td>89.387</td>
</tr>
<tr>
<td>Water body</td>
<td>22.285</td>
<td>20.761</td>
<td>18.394</td>
</tr>
<tr>
<td>Settlement</td>
<td>20.891</td>
<td>57.445</td>
<td>121.523</td>
</tr>
</tbody>
</table>

Source: Landsat 7 ETM +/- 1995, Landsat 7 ETM (2005), and Landsat 8 ETM (2015)
Box 1. Descriptions of land cover types

Sub-tropical hill savanna forest
Sub-tropical hill savanna forest is found along the Shan Plateau and ridge tops with heights between 2500 and 5000 feet. In 1995, these situations are found on the Western part, Northern part and Eastern part of the Bawlakhe District, and Northern central hill area are found this forest type. In 2015, this forest type area is only found in the Eastern and South-Eastern part of the study area.

Tropical wet evergreen forest
Tropical wet evergreen forest occupies central Kayah area. In 1995, this type of forest is found in the lower area of the Sub-tropical hill Ssvanna forest area. However in 2015, this forest occupied the central part of the area.

Sub-tropical wet hill forest
Sub-tropical wet hill forest is not fully known. In 1995, Sub-tropical wet hill forest is found on the central food hill area.

Agriculture land
Cultivated land is composed of net sown area and fallow land. Agricultural land type is found in wide range of central parts of Bawlakhe District. In 2015, cultivated land area has decreased. Fallow land is sandy soil and without plant cover. It is usually located along the streams where there is access to water for agricultural use. However, in 2015, water level in streams has also been decreasing.

Water bodies
Water bodies involve rivers, lakes, streams, inn, canals, dams and reservoirs. In 1995, these water bodies were still abundantly located around the Thanlwin River.

Settlement area
Settlement area includes urban settlement and village areas. These areas are found in all parts of the Bawlakhe District.
Bhuku Village

Table 4 and Figure 4a, b, c and d show the time series maps for Bhuku Village. From 2005 to 2015, the sub-tropical wet hill forest area increased in this village. Cultivated lands occupied the eastern part of the village area in 1995 and after 2005 this area decreased in this area. Compared to the forest areas, fallow land is small but has been cultivated since 1995 when it was only seen as involves sand area without any vegetation. Located on the hilltop, Bhuku Village does not have water bodies so it relies on rain for its agricultural activities. Since this village is in the upland and is not accessible to many, settlement is rather small especially way back in 1995. It takes three hour to access by motorbike in the dry season and only by foot in the rainy season. However, in 2005 there was a huge increase in land area as people from Hpasaung Village moved to Bhuku.

Table 4. Land cover changes in Bhuku Village (in square kilometers)

<table>
<thead>
<tr>
<th>Land cover types</th>
<th>1995 Sq. Km.</th>
<th>2005 Sq. Km.</th>
<th>2015 Sq. Km.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Tropical Hill Savanna Forest</td>
<td>3326.29</td>
<td>6.13</td>
<td>0.01</td>
</tr>
<tr>
<td>Tropical Wet Evergreen Forest</td>
<td>2918.49</td>
<td>6466.35</td>
<td>6.73</td>
</tr>
<tr>
<td>Sub-Tropical Wet Hill Forest</td>
<td>220.94</td>
<td>6.08</td>
<td>6480.90</td>
</tr>
<tr>
<td>Paddy Land</td>
<td>13.38</td>
<td>5.54</td>
<td>1.05</td>
</tr>
<tr>
<td>Fallow Land</td>
<td>11.71</td>
<td>0.21</td>
<td>0.15</td>
</tr>
<tr>
<td>Water body</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Settlement</td>
<td>0.12</td>
<td>6.62</td>
<td>2.09</td>
</tr>
</tbody>
</table>


2 Color coding of the table assists you in locating the land cover types in the time series images in Figure 4. This scheme also applies to Figures 5, 6, and 7.
Wanpla Village

Table 5 and Figure 5 show the time series maps for Wanpla Village. Sub-tropical hill savanna forest is found at the hill tops at heights between 2500 and 5000 feet. In 1995, these situations are found on the Eastern, Northern, and central part of the Wanpla Village. In 2015, this forest type has diminished in size. On the other hand, in 1995, tropical wet evergreen forest is found in the lower area of sub-tropical hill savanna forest area. In the same year, sub-tropical wet hill forest is found at the central food hill area. In 2005, it covered half of area which is a huge decrease in land cover since 1995. However, in 2015, this forest went on a dramatic increase from 90.46 sq.km. to 6,510 sq.km. In 2015, Wanpla Village, water body's area decreased but this area is located on western bank of Thanlwin River. Wanpla Stream passes through the village and enter to Thanlwin River. This stream is located in the mountainous stream and it flows all year round.

In terms of settlement, there was a registered increase in residents in this village from 1.89 sq.km. in 2005 to 16.04 sq. km in 2015. The reason to this increase is that the government has built new houses in this village in accordance to the Greening Project in Myanmar. Forest area has changed because their livelihoods

3 Greening Project is …..
are mainly forest production. With this forest degradation, people have to travel far away to earn income.

Table 5. Land cover changes in Wanpala Village (in square kilometers)

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>1995</th>
<th>2005</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Tropical Hill Savanna</td>
<td>2066.55</td>
<td>674.95</td>
<td>99.00</td>
</tr>
<tr>
<td>Forest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tropical Wet Evergreen Forest</td>
<td>4633.46</td>
<td>6518.43</td>
<td>658.76</td>
</tr>
<tr>
<td>Sub-Tropical Wet Hill Forest</td>
<td>545.83</td>
<td>90.46</td>
<td>6510.27</td>
</tr>
<tr>
<td>Paddy Land</td>
<td>2.96</td>
<td>8.83</td>
<td>1.74</td>
</tr>
<tr>
<td>Fallow Land</td>
<td>25.87</td>
<td>0.49</td>
<td>0.34</td>
</tr>
<tr>
<td>Water body</td>
<td>21.19</td>
<td>4.45</td>
<td>13.35</td>
</tr>
<tr>
<td>Settlement</td>
<td>3.64</td>
<td>1.89</td>
<td>16.04</td>
</tr>
</tbody>
</table>


Figure 5. Land cover conditions of Wanpla Village in 1995, 2005, 2015

Wanaung Village

Sub-tropical hill savanna forest area is not found in Wanaung Village. While tropical wet evergreen forest located at the Eastern part of Thanlwin River is literally gone in 2015, it had a land cover of around 5000-6000 sq.km. in 1995 and in 2005. However, there was a tremendous increase in land cover of sub-tropical wet hill forest from 1995 to 2015. This land cover type is also located at the Eastern part of Thanlwin River.

Wanaung Village is located on both sides of the bank of Thanlwin River and depends on the river’s water. With its good location close to the river, settlement gradually increased over the last 15 years especially the Eastern part of the area. Government built new houses for village development which are divided into two groups: Yintalay ethnic group in the Western bank of the Thanlwin River and the Shan ethnic group in the Eastern bank. The Yintalays mainly depend on the forest while the Shans main livelihood is charcoal production. Based on Table 6, fallow land continues to increase over the last 15 years as villagers have not been able to cultivate crops in this area.

Table 6. Land Cover changes in Wanaung Village

<table>
<thead>
<tr>
<th>Land cover type</th>
<th>1995</th>
<th>2005</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Tropical Hill Savanna Forest</td>
<td>0.11</td>
<td>0.74</td>
<td>0.00</td>
</tr>
<tr>
<td>Tropical Wet Evergreen Forest</td>
<td>5797.97</td>
<td>6452.92</td>
<td>0.28</td>
</tr>
<tr>
<td>Sub-Tropical Wet Hill Forest</td>
<td>695.29</td>
<td>7.97</td>
<td>6480.90</td>
</tr>
<tr>
<td>Paddy Land</td>
<td>13.43</td>
<td>44.08</td>
<td>13.73</td>
</tr>
<tr>
<td>Fallow Land</td>
<td>4.12</td>
<td>4.71</td>
<td>6.56</td>
</tr>
<tr>
<td>Water body</td>
<td>21.19</td>
<td>13.26</td>
<td>18.04</td>
</tr>
<tr>
<td>Settlement</td>
<td>1.33</td>
<td>9.77</td>
<td>13.93</td>
</tr>
</tbody>
</table>

Figure 6. Land Cover Conditions of Wanaung Village in 1995, 2005, 2015


Hose Village

In Hose Village, sub-tropical hill savanna forest and tropical wet evergreen forest occupied the eastern part of this area. In 1995, the former had a land coverage of about 2000 sq. km. but in 2015 it went down to a staggering 3 sq. km. The same level of degradation was observed in the latter where land cover has diminished from around 4500 sq. km. in 1995 to 659 sq.km. in 2015. However, the fate of sub-tropical wet hill forest is much different than the former two types. From 540 sq. km in 1995, it flourished into a 6500-sq. km. forest cover. Agriculture land which is located at the Eastern part of the village decreased from 1995 to 2015, as it was observed by the villagers that water levels in the streams have been declining as well. People in this village depend largely on the Mese Stream for their agricultural activities.
Table 7. Land Cover changes in Hose Village

<table>
<thead>
<tr>
<th>Land Cover Types</th>
<th>1995</th>
<th>2005</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Tropical Hill Savanna</td>
<td>2066.69</td>
<td>714.37</td>
<td>3.28</td>
</tr>
<tr>
<td>Forest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tropical Wet Evergreen Forest</td>
<td>4551.06</td>
<td>6408.09</td>
<td>659.49</td>
</tr>
<tr>
<td>Sub-Tropical Wet Hill Forest</td>
<td>540.06</td>
<td>23.48</td>
<td>6507.28</td>
</tr>
<tr>
<td>Paddy Land</td>
<td>27.50</td>
<td>37.90</td>
<td>26.21</td>
</tr>
<tr>
<td>Fallow Land</td>
<td>17.06</td>
<td>5.01</td>
<td>11.14</td>
</tr>
<tr>
<td>Water body</td>
<td>21.19</td>
<td>13.26</td>
<td>13.35</td>
</tr>
<tr>
<td>Settlement</td>
<td>1.26</td>
<td>22.71</td>
<td>4.06</td>
</tr>
</tbody>
</table>


Figure 7. Land Cover Conditions of Hose Village in 1995, 2005, 2015

Summary

According to field surveys and image data analysis, there are some similarities and differences between the villages that describe the changes in the land cover types in Bawlakhe District. These are:

- Before 2010, access to Kayah State was difficult due to the absence of road networks and the presence of armed conflict in the area.
- The main economy in the four villages is timber extracting, agriculture and livestock breeding. Based on the changes in land type conditions, majority of land use is the forest lands. At present, timber extraction areas are shifted away into another forest area and fuel woods are collected far from the village. The main fuel is fire wood.
- In Hose Village, cardamom plant (a type of spices of Chinese) has replaced other cash crops for its high commercial value in the market. It has been found out that land use changes occur due to the gap of knowledge for environmental conservation. It can be argued that the level of formal education of people in the select four villages of this study has an effect to the degradation of forests in the said areas. Nearly 95% of the people are either non-educated or have only reached primary level. According to interviews, they have limited knowledge regarding forest conservation and management. There is a lack of planning for natural resource conservation and management in the study areas therefore unsustainable practices in land use are observed. This, in turn, affects the livelihoods of villagers whose economy is based on forest products and agriculture.

Land cover governance

Most of the cultivated lands are used for shifting cultivation (slash and burn) which contribute to the decreasing soil quality in the villages. Fallow lands which have been increasing in Wanaung and have been observed as the reason for villagers to move to another area every after three or four years.
As forest production and other agricultural activities are the main source of income for the villagers, it is argued that there is a strong link of these economic activities with the environmental degradation in the study area. It was found out that illegal extraction of timber, over cutting of fuel wood, and extension of agriculture to forest areas have occurred and have affected the status of land cover types in Bawlakhe District. Furthermore, the progressive change of human settlements due to population growth and the tremendous decline of wood resources for timber, firewood and charcoal has an impact to the decreasing change of land cover in the district. Reduction of wild animals and plant species has also been observed by many villagers who are dependent upon the animals and plants for their livelihood. While land-based resources are important to the villagers, education on forest land conservation has not been in place in the villages. Many local governments, communities and households also take land use decisions to consider the balance between productivity, environment, changing land uses and human welfare. This policy brief highlights some such impacts and provides policy recommendations for better land management not only in Bawlakhe District but in Myanmar as a whole.

Figure 8. Maintenance of environmental stability

![Diagram of Government, Local, NGOs and INGOs]

Source: Maintenance of Environmental Stability
Figure 8 shows that in order to manage the environment effectively, the government, local people and other institutions and organization should work together for this purpose. This study has found out that local people are not recognizing natural resources which have a strong influence on socio-economic development and relationship between changing land uses and their livelihoods. Local people have limited or no information about government programs and policies that exist about forest management. It is therefore important for the government to provide awareness on environmental conservation and land use development policy in the area for better development planning with the local ethnic people. The government should also consider establishing a community-based natural resources management in villages.

The basic principles of the forest management policy are maintenance of environmental stability for the preservation of permanent forest estates, preservation of natural heritage by conserving species and ecosystem diversity and the establishment of a system for protected areas, and ensuring sustainable utilization of the forest resources for direct economic benefit to the country and for the benefit of the present and future generations (Forest Department, 1991).

Due to historical degradation of forests which destroyed the natural habitat of wildlife, the Agriculture and Rural Development Corporation (ARDC) was founded and forest conservation work was carried out in 1954-55. In 1966, ARDC was reorganized and renamed as the Forest Department and Agricultural Corporation. In 1982, The Nature Conservation and National Parks and Wildlife Project was implemented in the area (Hla Tun Aung, 2003).

In November 1992, the State Law and Order Restoration Council (SLORC) promulgated a new forestry law known as the Law No.8/92. This law prescribes precise regulations and procedures for extraction of forest produce from Reserved Forest and Opened Forests with stiff penalties for violation, extension of Reserved Forest and Protected forests (Hla Tun Aung, 2003).

Moreover, under the guidance of the Chairman of the SLORC, then, the State Peace and Development Council, the greening of nine districts of dry region is being carried out beginning from 1994-95 under a three-year project. The project is extended to 13 districts (57 townships) as stipulated in the long term plan. The
Nature Conservation and Natural Parks and Wild Life Division was established and was renamed to Division of Protection of Wild Life and Wild Plants and Conservation of Natural Areas. Currently, this is called the Ministry of Environmental and Natural Resources Management. Forest Department undertook forest rehabilitation with the cooperation of local community.

**Conclusion**

In Myanmar, where populations are widely dispersed and where infrastructural challenges are experienced, there is a great need to enhance awareness of local people in terms of natural resources management so that their needs and aspirations in life are well aligned with public policies that are in place. It is in the spirit of facilitating and fostering such transmission of information and opinions, in as transparent a manner as possible, that we present the findings of this field research.

The main economy in Bawlakhe District is timber extraction and exportation. Agriculture has been another major economic activity and it has been contributing to the economy of the local people. Because of the high dependency on forest produce, the forest land cover has been steadily declining over the last 15 years, particularly for sub-tropical savanna forest and tropical wet evergreen forest. Change in settlement patterns and shift in livelihood activities that are geared toward timber extraction and firewood production have impacted the nature in many ways. Villagers accounted that flora and fauna have been decreasing over the last decade and that timber production is also becoming scarce as villagers need to shift to another area due to the degrading forest cover in Bawlakhe. While it is apparent that, sub-tropical wet hill forest is the only land cover area that is thriving since 2015, it should be noted that this type of forest cover is.

Land cover patterns reflect the character of a society’s interaction with its physical environment, economic and social systems occupying the same or similar environments. It is argued in this paper that human settlement patterns largely depend on the resources that the environment can offer. As data showed,
when settlement areas increase, there is a decrease in land cover of most of forest areas, paddy land, and water bodies. As shift cultivation is also widely practiced in the villages, fallow land also increases as crop cultivation has diminished due to the deteriorating quality of soil in the land.

These environmental changes in land cover types and their impacts to the socio-economic condition of the villagers in Bawlakhe have not been fully understood by the villagers. The low education status of the villagers contributes to lack of information and awareness on sustainable environment management and conservation in all of the villages. Results of the survey questionnaire showed that villagers are not aware of the changes that have been physically occurring in their communities.

This study therefore recommends that an awareness raising program should be done with the villagers so that a sustainable practice on forest resource management and conservation can be put in place. Local and regional policies and guidelines for sustainable development of this area should be established so that all stakeholders including local people, decision makers are guided with the accurate information in understanding the advantages and disadvantages of land use changes and their impacts to local people especially on their livelihoods.

The Government made a plan to draw a policy on the border region. To uplift the living standard of hill region, the government draws a plan and gave aids to villages that are the difference become narrowly between urban and rural. The government and local organizations co-operated to raise funds and support aids to solve the poverty alleviation. And state local government built housing, roads, dams’ schools and hospitals to fulfill the requirement of the local villages. Government’s policy plays a major role to do development with the settlement of town and villages.

As this paper is considered as the first to report in detail the impact of land cover changes to socio-economic conditions in Bawlakhe District, this shows that the findings of this study contributed to the larger knowledge base in terms of interpreting the relationship between the local people’s lives and the environment.
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