

# **Comparative Analysis of Changes in Land Use/ Land Cover and Farming Systems in Three Areas in Myanmar**

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## **ABSTRACT (Summary)**

Information on land use/ land cover (LULC) changes and farming systems of different regions is important input for specific regional agricultural development planning. It is essential in developing countries including Myanmar, which are mainly dependent on agriculture. This research was conducted not only to analyze the LULC changes in the three areas in Myanmar, namely Nay Pyi Taw (NPT), Mandalay (Mdy) and Nyaung-U (NU) areas, over the last 14 years (2000-2014), 17 years (2000-2017) and 15 years (2001-2016), respectively, using Landsat imageries, but also clarify the changes in agricultural land use and farming systems of those three areas in a recent decade (2006-2016) by interviewing 120 farm households in each area.

In NPT area, settlements/built-up, water body and bare land increased by 28,902 ha, 2,249 ha and 569 ha, respectively, whereas agricultural land and natural vegetation decreased by 9,929 ha and 21,790 ha, respectively. The increase in settlements/built-up mainly came from the conversion of agricultural land (56%) and the natural vegetation (44%) during the study period since the administrative capital of Myanmar was established in that study area in 2005. In Mdy area, agricultural land decreased by 4,152 ha, while settlement/built-up increased by 2,192 ha. The increase in settlement/built-up mainly was from agricultural land near Mandalay city, which is the biggest economic center of upper Myanmar. It was mainly due to the urban expansion related to economic development and population increase by rural to urban migration. In NU area, agricultural land and natural vegetation increased by 7,054 ha and 13,737 ha, respectively. Bare land considerably declined to half, from 40,918 ha to 19,958 ha. Although settlement/ built-up was found slightly increased by 724 ha, the majority are still countryside areas.

Urban expansion of the three study areas had different increase rates. NPT area had the largest decadal change rate of 151%, whereas in Mdy and NU areas, the decadal

change rates were 6% and 3%, respectively. In general, urbanization has always been closely linked to the economic development and urban population pressure, which result in the infrastructure development and built-up area expansion. Unlike most of the large cities around the world, an urban growth rate in NPT area is very large and it was mainly caused by the government-induced municipal infrastructure development. On the other hand, in Mdy area, although an urban expansion rate was much smaller than that of NPT area, urbanization in Mdy area naturally occurred by rural to urban migration due to the economic development. In NU area, although settlements were found slightly increased, the majority are still countryside areas.

A decrease trend in agricultural land was found in NPT and Mdy areas, with the decadal change rates of -4% and -2%, respectively. In general, productive agricultural lands near the residential area are converted to non-agricultural use by urban expansions. However, in NPT area, the loss of agricultural land was mainly found in the center of NPT area because of the confiscation of agricultural land for the establishment of the Nay Pyi Taw capital. In Mdy area, the agricultural land near the Mandalay city was converted to settlement/built-up due to the steady urban expansion. In NU area, an increase trend was found in agricultural land with the decadal change rate of 2%, and the increase area of agricultural land came from bare land.

Regarding the natural vegetation cover, a decrease trend was found with the decadal change rate of -3% in NPT area. Reduction in natural vegetation in NPT was mainly caused by the conversion to the settlement/built-up, followed by agricultural land. Based on the change detection maps, the development of agricultural land was found near the edge of natural vegetation area of 2014. Some of natural vegetation areas were also converted to water body due to the construction of new dams. In Mdy area, there is no significant decline in natural vegetation. On the other hand, in NU area, the area of vegetation cover increased with the decadal change rate of 4%. Although the collaborative efforts of the Government, NGOs and local communities have improved gradually natural environment for the greening and rehabilitation in the Dry Zone, thin and sparse shrubs are still dominant.

Water body in NPT and Mdy areas increased with the decadal change rate of 31% and 9%, respectively, while in NU area, a decrease trend of water body was found with the decadal change rate of -2%. The main increment of the water body in NPT area was due to the construction of new dams in the areas of natural vegetation and agricultural land. The main reason for the changes of water body in Mdy and NU areas was the

changes of the course of the Ayeyarwady River, which is passing through these study areas.

In NPT and Mdy areas, lowlands are dominant, whereas in NU area, uplands are dominant. Based on the interviews with the 120 farm households in each area, the average land holding size per household was 3.1, 3.2 and 5.0 ha in 2006, and 2.1, 3.1, 5.1 ha in 2016 in NPT, Mdy and NU areas, respectively. In NPT area, average landholding size decreased by 1 ha since some sample farmers lost some of their farmlands due to the confiscation by the Government for the establishment of the Nay Pyi Taw capital, and some farmers sold part of their farmlands to others with a high price.

Major crops cultivated in these three areas were not changed during this decade (2006 and 2016). Major crops in NPT area are monsoon paddy, summer paddy and black gram, but the percentage of sample farmers who cultivated black gram dramatically declined, whereas those of summer paddy significantly increased in 2016. It was due to not only the influence of severe pest and disease occurrence on black gram but also improved availability of irrigation water for summer paddy. In Mdy area, major crops are monsoon paddy and summer paddy. Due to having good access to irrigation water, the majority of sample farmers grew summer paddy in both 2006 and 2016. In NU area, major crops are groundnut, sesame, green gram and pigeon pea. In both 2006 and 2016, the groundnut cultivated area was the largest, followed by sesame, green gram and pigeon pea. In sesame cultivation, late varieties were grown more extensively than early varieties. The cultivation area of sesame early varieties declined to a half in 2016 because of frequent crop failures due to the erratic rainfall at planting time. These upland crops are mainly cultivated as mono crops. Some sample farmers commonly practice groundnut based double cropping and pigeon pea based inter-cropping patterns. In addition, due to the increased access of irrigation water from dams and electric pumping, some farmers holding lowland cultivated summer paddy in 2016.

The increase trends in agricultural inputs such as pesticides, herbicides and chemical fertilizers were found in all the study areas, but farmers in NPT and Mdy applied more agricultural inputs than in NU. In 2016, the majority of farmers in NPT and Mdy areas mainly depended on the chemical fertilizers and rarely used farmyard manure. Farmers in Mdy area mainly depended on farm machineries most pronouncedly, followed by farmers in NPT, whereas farmers in NU area have some limitations in the utilization of farm machineries. For the utilization in farming activities, draught cattle are reared by 28% of sample farmers in NPT, 42% in Mdy and 83% in NU areas. Pigs are

raised mainly for extra income by 28% in NPT and 8% of sample farmers in Mdy areas. Twenty-five percent of sample farmers in NPT and nine percent in Mdy areas raised chicken mainly for home consumption. The major constraint faced by farmers in NPT and Mdy areas is labor shortage, whereas bad weather condition is the main problem in NU area.

In general, farming systems in the three study areas are mainly emphasized in crop production. Farmers in NU area face many limiting factors in the production of the crops, such as drought and erratic rainfall, predominance of sandy soil with low water holding capacity and low fertility, and limited irrigation facilities, leading to food insecurity. In all the three study areas, more chemical fertilizers were found to be used. Most of the sample farmers in NPT and Mdy areas mainly depend on the chemical fertilizers and rarely use farmyard manure, probably leading to soil degradation in near future. The majority of sample farmers in the three areas raised livestock such as draught cattle for the utilization in their farm activities, chicken and pig mainly for the domestic consumption. In order to improve farmers' income as well as to maintain soil fertility, an integrated farming system such as crop production with livestock rearing widely including dairy, poultry, piggery, goat raising, etc. should be encouraged to the farmers. Agroforestry is also as an alternative to get an extra income. Integrated farming with agroforestry may ensure the sustainable access to food, fodder and fuel.

By combining the findings of the interview survey on agricultural land use and farming systems with the information obtained from the analysis of LULC changes using synoptic views of large area provided by Landsat imageries, more significant information on the nature and extent of land resources and changes over time and past and present agricultural land use and farming systems are obtained. This information is essential for the improvement of the regional development plans in various areas including urban planning, agricultural development and environmental conservation. In this meaning, this study may greatly contribute to the future development of the three study areas.