

Land Use and Livelihood Change in a Mountain Village of Sri Lanka

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Abstract Globally, mountainous areas are rich in biodiversity. They are habitats of many species of plants and animals, and even people. One-tenth of the world's population dwells in mountainous regions, and mountains contain useful resources such as water, timber, and minerals. However, mountains are also vulnerable eco-systems, and in recent years, they have faced serious environmental destruction. The term “vertical zonation structure” is often used to describe the environmental characteristics of mountain eco-systems. This vertical zonation structure frequently affects residents' land-use patterns, which makes it useful for determining the locals' livelihood. This study, which focuses on the mountain village P in Sri Lanka, researches changes in land-use patterns with respect to vertical zonation. Furthermore, changes in livelihoods will be discussed, including non-farm income.

Key words mountains, subsistence, land use, livelihood change, Sri Lanka

I. Introduction

Mountains are among the most diverse ecosystems on Earth. This diversity is influenced by differences in slope and altitude. For example, these result in variations in terrain with varying temperatures and rates of erosion, accompanied by varying accumulation of nutrients and sediments. Therefore, each slope surface provides a diverse habitat on all horizontal and vertical scales to different plant and animal species. Such environmental conditions of mountains are sometimes characterized as “vertical zonation.” In other words, each slope surface can be characterized by different environmental conditions, for example, soil layer, elevation differences, vegetation, and temperature.

Mountains play an important role in the lives not only of plants and animals but also of humans. Mountains cover one-fourth of the world's land area, where one-tenth of humanity lives. Given the importance of water, hydraulic power, timber, and mineral resources originating from the mountains, mountain environments likely play a role in the lives of most of the world's population.

The above-mentioned vertical zonation structures of mountain environment are often taken over to residents' land use (Guillet, 1983). For example, residents may change cultivated crops depending on slope surfaces, or perhaps they may select the usage of a slope surface either as cultivated land or as grazing land, which makes it possible to carry out subsistence complexes. However, mountain subsistence is also vulnerable to both natural and social influences (Nagakura, 2010).

Mountainous areas are currently facing an environmental crisis. Not only the melting of glaciers and landslides due to large-scale climatic change, but also soil erosion due to over-cultivation and over-grazing, lead to environmental disruption, which will eventually affect local residents. The 1992 Earth Summit of Rio de Janeiro—at which “Agenda 21” was adopted to protect and restore the global environment in the 21st century, and Chapter 13 was dedicated to the importance of protecting the mountain environment—raised awareness of this issue.

However, soil erosion in the hilly area of Sri Lanka has not been a recent phenomenon but has been recognized as a serious problem since the colonial time (Gunatilake, 1995). During the colonial period, Sri Lanka, to the south-east of India, was influenced by the environmental preservation policy of the Indian colony. For example, India sent forest management officials, and the Botanical Garden was established (Mizuno, 2006). It was in 1874, during the colonial period, that first documentation concerning soil erosion was recorded. Subsequently, soil conservation was incorporated into postwar development, and the Soil Conservation Law was enacted in the 1950s (Gunatilake, 1995).

As locals' livelihoods, in relation to land use, are closely related to mountain environments, it is important to determine how the local population's livelihood changes. The purpose of this study is to investigate the vertical zonation structure of land use in the mountain region of Sri Lanka, which has a long history of soil erosion, and to illustrate the changes in the population's livelihood. This should be the first step to consider sustainable use of the mountain environment.

II. Study Area

The survey was conducted in the village P, in Nuwara Eliya district of the Central Province, well known for its mountainous environment, reaching 2,500 m with Pidurutalagala, the highest point in the country (Figure 1).

The survey village is between 720 m and 1,250 m above sea level and is located on the eastern slope of the mountain. At the village's lowest altitude of 720 m, the river runs northeast, which also forms the eastern boundary with the neighboring village. The western boundary is located on the hillside, at an altitude of approximately 1,000 m, and above it is national land (Figure 2).

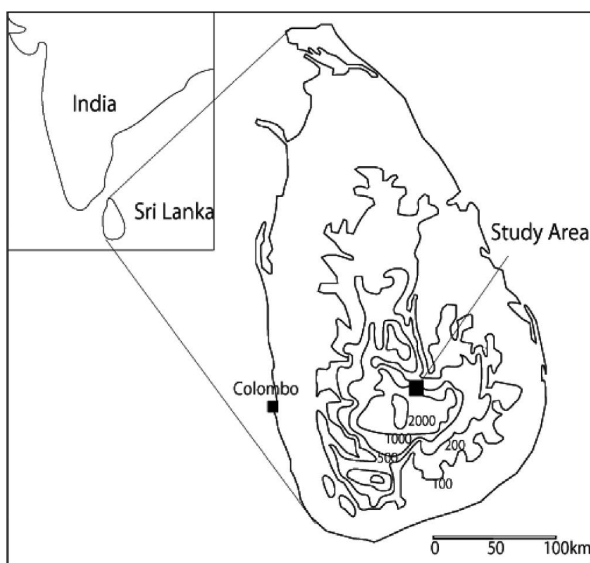


Figure 1. Map of Sri Lanka
Source: Made by the author, based on the atlas of Sri Lanka.

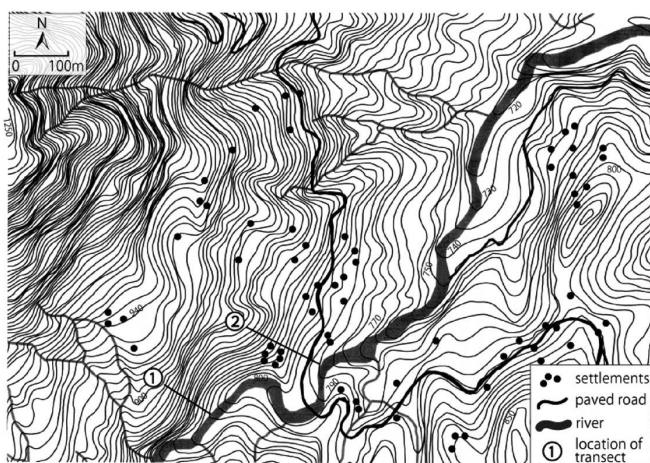


Figure 2. Topography of the survey village
Note: Contour line drawn every 5 m.
Source: Made by the author, based on the GIS data (62-17, Survey Department).

III. Methodology

A field survey was conducted from August 1st to 21st, 2019. The research mainly included land surveys and interview surveys. For the land survey, the slope of the land was measured using a rangefinder and a hand level to draw transect lines. Figure 2 shows the locations of the transect lines. Through transect surveys, maps on micro-topography (or cross-sections of terrain) were drawn. Subsequently, land use was plotted on the map.

In the interview survey, 19 out of 84 households were asked about their family composition, cash income, owned fields, and cultivated crops. Village officials known as “Grama Niladhari” (G.N.) and agricultural extension officers called “Agricultural Instructors” (A.I.) were interviewed, and statistical data were collected from them. These data include the population of the village and information about the welfare program.

IV. Results

1. Topography and land use

Figure 3 shows a cross-section of Transect 1, which is located on the eastern slope, where the altitude ranges from 810 m to 880 m above sea level. The total horizontal distance of the transect is approximately 100 m. If we begin at the bottom of the valley, there is a gentle incline up to about 20 m distance from the starting point. Up to this point, the average inclination is 19 degrees. This surface of the slope is used as a paddy field. The next 60 m in horizontal distance is dominated by a steep cliff with an average inclination of 42 degrees. The cliff has a vertical rise of approximately 60 m and was used for tobacco cultivation but has been left fallow for many years. The slope at the highest altitude of the transect stretches for

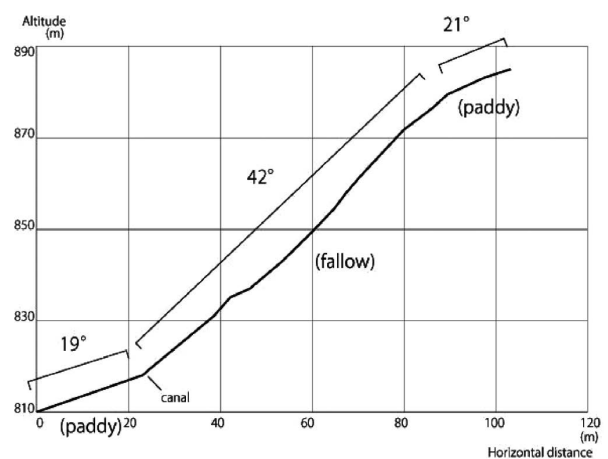


Figure 3. Cross-section of Transect 1
Source: Field survey data, Aug. 2019.

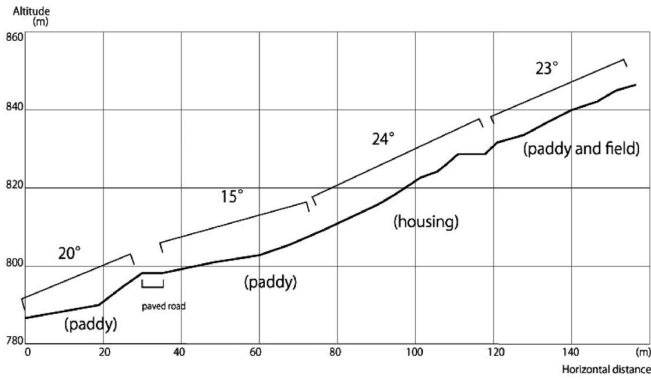


Figure 4. Cross-section of Transect 2
Source: Field survey data, Aug. 2019.

a horizontal distance of approximately 10 m, where the average inclination is 21 degrees. The slope is used as a paddy field.

Figure 4 shows a cross-section of Transect 2, which is also located on the eastern slope. Transect 2 stretches for a horizontal distance of approximately 160 m. As in Transect 1, from the bottom of the valley, there is a gentle inclination of 20 degrees on average, up to 30 m horizontal distance from the starting point. This surface of the slope is used as a paddy field. The inclination becomes gentler after that, where we can find terraced paddy fields up to 80 m horizontal distance from the starting point. The inclination of this slope was 15 degrees on average. Above the terraced paddy field, the inclination becomes fairly steep, at 24 degrees on average. This slope surface was used as a settlement. Above the settlements is the slope surface formerly used as either paddy or vegetable fields but currently left fallow. At 23 degrees, inclination does not change much from that of settlements. The slope extended further to the top of the mountain, but the survey could not be continued because there were many wild monkeys in the bush above this point.

2. Land-use patterns

The area of the village is roughly divided into three categories according to land use: 1) residential areas, 2) paddy fields, and 3) fields (Figure 5). Slope surfaces with gentle inclinations up to 23 degrees were used as paddy fields. A slope of greater than 23 degrees inclination was used for housing. A steep slope of inclination greater than 40 degrees was left fallow (Table 1). Vegetables were mainly cultivated around settlements, and little was cultivated on steep slopes. The villagers seemed to invest most of their efforts in paddy fields but not in vegetable cultivation.

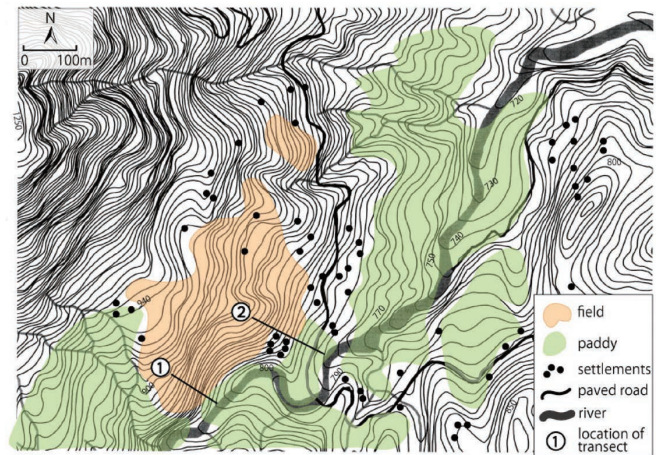


Figure 5. Land use of the survey village
Source: Made by the author, based on the field survey data.

Table 1. Change in land-use patterns

	1980s	2019
~23° (gentle slope)	tobacco field paddy field	paddy field
24°	housing	housing
42° (steep slope)	tobacco field	fallow

Source: Field survey data, Aug. 2019.

3. Changes in land use

Past land use was asked about in an interview survey to trace changes in land use. According to the survey, tobacco, which had been a large source of cash income, had grown on steep slopes until the 1980s. During the peak of production, every villager had engaged in tobacco cultivation, and some even turned paddy fields into tobacco fields. However, after the 1980s, the government did not recommend tobacco cultivation because it was said to cause heavy soil erosion. Since then, no household has continued to grow tobacco, and the steep slope has turned into fallow land. (Table 1).

Presently, the slope surfaces are mainly used as paddy fields or for housing, which indicates that the principal agricultural subsistence activity of the village consists of rice cropping. According to an interview conducted with 19 households, in 2019, 11 households owned paddies, and 8 did not. Of the 8 households with no paddies, 7 were engaged in rice cropping. Households that did not own paddies contributed to rice cropping by renting paddies from other households. Some households that do not own paddy fields are engaged in rice cultivation by providing wage labor for plowing and threshing work using buffalos. Only one household did not own or rent paddies for subsistence. It consisted of an elderly couple who could expect allowances from their daughters who

lived elsewhere (Figure 6). Rice is usually consumed by the household itself, but 4 households answered that rice is an important source of cash income.

No households engage in widespread cultivation of vegetables, for two reasons: the damage caused by monkeys and the low purchase price of vegetables. Certainly, wild monkeys bred on the land where the above-mentioned steep slope fields had been abandoned, and my survey was interrupted because I could not go further. In abandoned fields, vegetation was left overgrown with weeds and rooted plants that were once used as pillars when growing kidney beans, providing more habitats for monkeys (Figure 7). The increased number of monkeys eating vegetables in fields is a serious problem in the village. The villagers attempted to repel the monkeys by setting off firecrackers and threatening them, but temporary purging would have no effect. The national government provided subsidies to households that installed electric fences for protection against animals, but none of the households

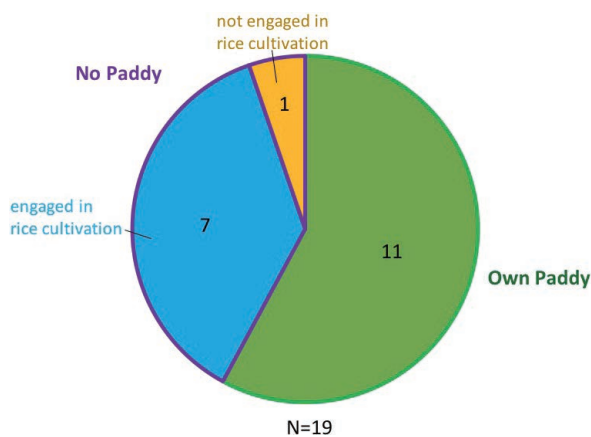


Figure 6. Proportion of paddy owners
Source: Field survey data, Aug. 2019.



Figure 7. Rooted plants that was once used as pillars when growing kidney beans. In the back, bushes spread, inhabited by wild monkeys
Source: Author, 14th Aug. 2019.

in village P used the subsidies. On the other hand, many households grow pepper in gardens around their homes, which seems to be a decent source of cash income.

4. Changes in livelihood and sources of cash income

i) Agricultural income As mentioned above, the main agricultural subsistence of the village is rice cropping. Rice is mainly self-consumed, but few identified it as an important source of cash income. Other sources of cash income were obtained by helping other households with farm work using domestic animals. Selling pepper grown in the garden is presumed to be somewhat profitable, but more research is needed to evaluate its proportion in cash incomes. Vegetables were not a major source of cash income because of animal damage and unstable purchase prices.

ii) Non-agricultural income Nine out of 19 households had at least one family member with steady income. They work in the nearest town to village P, for example, in police stations, banks, weaving mills, and stalls. Another 5 households had occasional income when they were hired, for example, in carpentry and construction, which all involve piece work.

In addition, there is a government welfare program for low-income earners called the “Samuldhi Program,” and some households receive monthly subsidies depending on the number of family members, whether there are wage workers, and the presence or absence of fields.

V. Conclusion

Despite the availability of several means to earn cash income, villagers’ characteristic livelihood consists of paddy rice cultivation. After tobacco cultivation was reduced, the steep slope was left fallow. This steep land could have been used to cultivate some cash crops other than tobacco, but it is not suited for agricultural work. Even if villagers dealt with steep slopes and damage from monkeys, the market would not guarantee the cost of the vegetables they paid to grow. It is more efficient to earn cash from wage labor because village P has a paved road leading to the nearest town. A.I. also said, “Everyone chooses wage labor, which makes it easier to make money, than trying to work in agriculture.” It can be presumed that the national policy in the 1980s of refraining from tobacco cultivation from causing soil erosion has spurred wage labor outside the village.

In this study, I focused on land-use patterns to discuss the livelihood changes of the mountain region in

Sri Lanka. In further studies, other perspectives, such as interviews on life history and socio-economic changes, will be considered to discuss the region's livelihood changes in detail.

Acknowledgement

I would like to express my gratitude to the people of village P, who warmly welcomed me and were very cooperative with my research. Mr. and Mrs. Mudunna helped me enormously not only in translating Sinhalese but also in teaching me Sinhalese culture. This research could not have been completed without their help. Finally, this work was supported by JSPS KAKENHI Grant Number 17J40062. I thank JSPS for their support.

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