# The Telaga-Telaga Biru Village Cluster, Gorontalo District, Gorontalo Province

This profile of the Telaga-Telaga Biru cluster is intended to provide a comprehensive overview of a cluster of villages consisting of Dulamayo Barat, Dulamayo Selatan, Dulamayo Utara and Modelidu, in Gorontalo District, Gorontalo Province, Indonesia. This profile was formulated on the basis of participatory assessment conducted with members of local communities and with representatives of local government institutions through focus-group discussions involving both male and female participants. In addition, a desk-based analysis of secondary data was conducted. This profile includes a demographic profile and a description of general conditions, of land use and land cover changes, of biodiversity, of water sources and issues affecting these sources and of the farming systems. It also includes a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis. This information is intended to serve as input for planning measures to achieve environmental conservation and to improve community livelihoods on the basis of the sustainable use of forest resources and agroforestry systems.

General conditions and demographic profile

The Telaga-Telaga Biru cluster consists of the villages of Dulamayo Barat (three hamlets), Dulamayo Selatan (three hamlets), Dulamayo Utara (five hamlets) and Modelidu (two hamlets). The village cluster covers an area of 8161 hectares and is located at altitudes between 250 to 1000 meters above sea level (Figure 1).
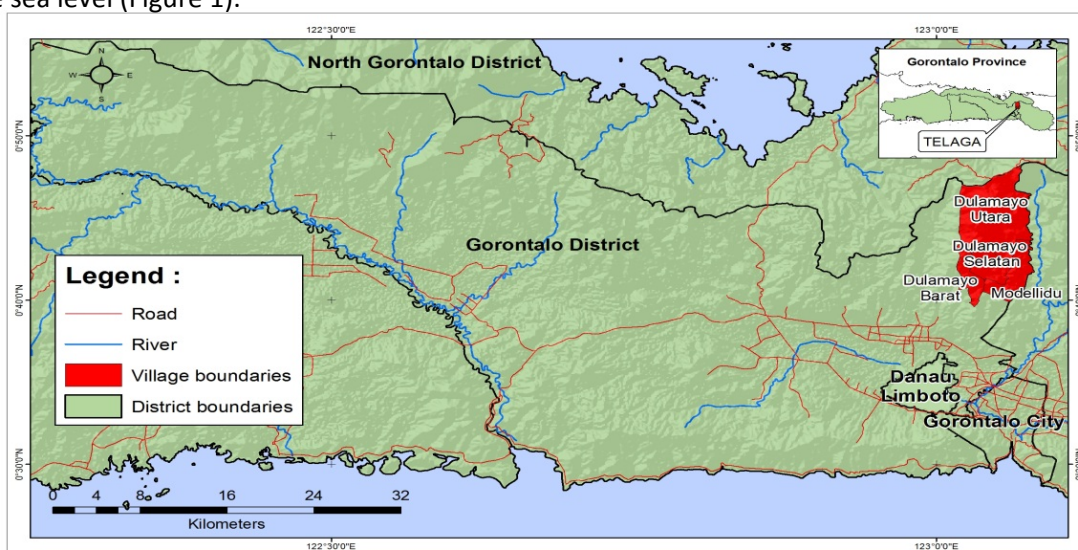
Figure 1. Map of the Telaga-Telaga Biru cluster region

According to the Forest Land Designation Map published by the Ministry of Forestry (2009), most of this region is classified as Protection Forest (PF), particularly the areas around the villages of Dulamayo Utara, Dulamayo Selatan and Dulamayo Barat. The cluster is located in the Bolango Watershed, which is intersected by two primary rivers, these being the Bolango River, which intersects the village of Modelidu, and Nanati River, which intersects the villages of Dulamayo Utara and Dulamayo Selatan. The cluster is located at a distance of 15 to 25 km from the subdistrict capital, while distances to the district capital range 24 to 38 km. Most of the villages and hamlets within the cluster are connected by gravel or dirt roads. Some of the roads, particularly in the vicinity of Dulamayo Barat, do not facilitate all-year passage by four-wheeled vehicles.

Educational facilities located within the cluster range in level from early childhood education (PAUD) facilities to junior high schools (SMP). The nearest senior high schools (SMA) are located at distances of 19 to 20 km.

The population consists of 5149 individuals, with a slightly higher proportion of males than females. There are 1593 households located within the cluster, with the proportion of these households eligible for a Certificate of Economic Disadvantage (SKTM)[1] standing at 17.4%. The proportion of households eligible for the Health Insurance for the Poor (ASKESKIN)[2] program stands at 63.6% (Figure 2).

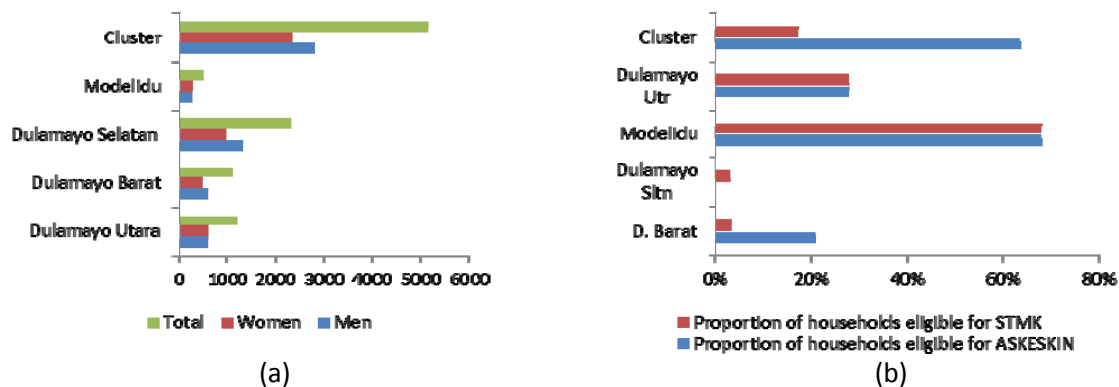(a)   (b)

Figure 2. (a)Population distribution in the Telaga-Telaga Biru Cluster: (b) proportion of households eligible for STMK and ASKESKIN programs

The majority of community members derive their livelihoods from agricultural sector, with the primary commodities being clove (*Syzygium aromaticum*), nutmeg (*Myristica fragrans*), and durian (*Durio zibethinus*). In addition, secondary economic activities are supported by the presence of a number of small industries, including food and timber processing and the production of brown sugar, bricks, coconut oil, woven crafts and fabrics.

Land uses, changes and driving factors

Primary and secondary forests cover 82% of the total area of the cluster. The majority of agricultural land use contains complex agroforests (17%), with multi-strata cultivation of perennial crops, mainly coconut, coffee and cocoa (Figures 3 and 4)

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[1] Surat Keterangan Tidak Mampu (SKTM)
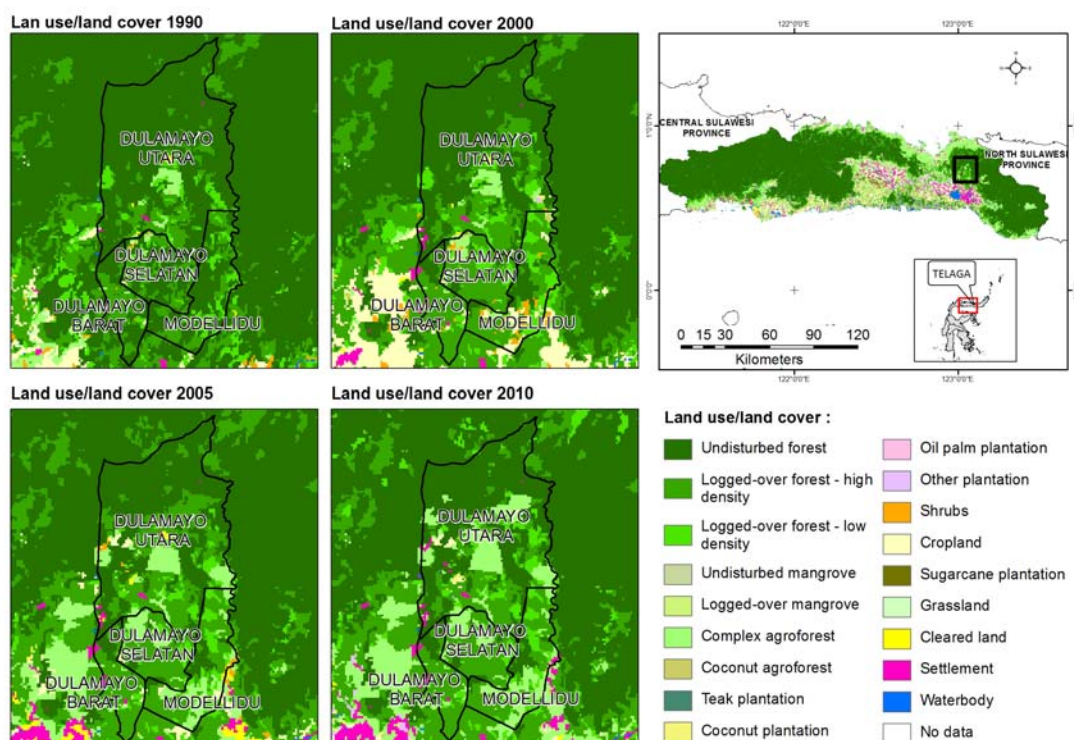[2] Asuransi Kesehatan Rakyat Miskin (ASKESKIN)

Figure 3. Land-use and land-cover map of the Telaga-Telaga Biru cluster (1990–2010)
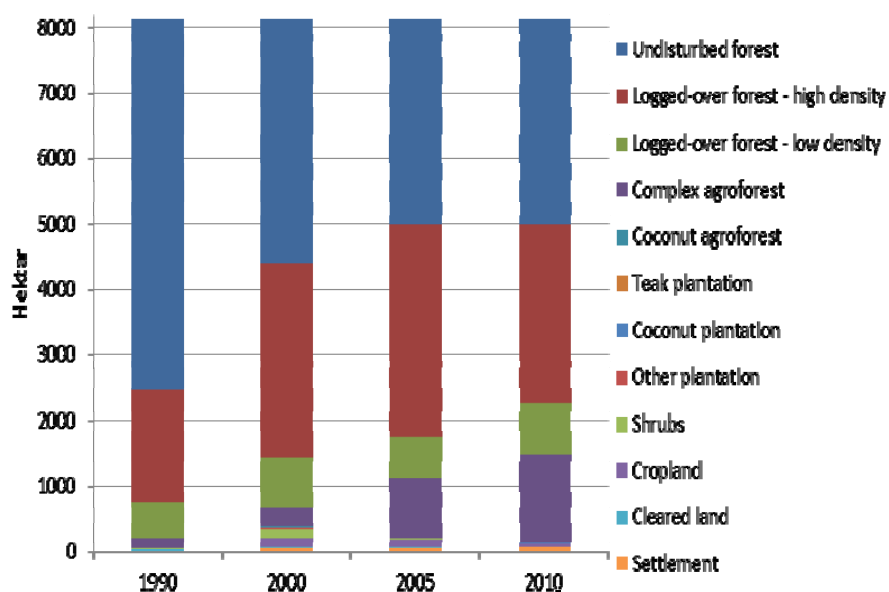

Figure 4. Extent of land use and land cover in the Telaga-Telaga Biru cluster (1990–2010)

In the period of 1992 to 2010, 39% of the total cluster area experienced changes to its land use and land cover, with most of these changes affecting forested areas (Figure 5). In this period, 16% of the total area of primary forest was degraded into high-density secondary forest while 2% of high-density secondary forest was degraded into low-density secondary forest. Changes also occurred to low-density secondary forests, shrubs and annual crops being mainly transformed into complex agroforests, as was noted for the period from 2000 to 2005.
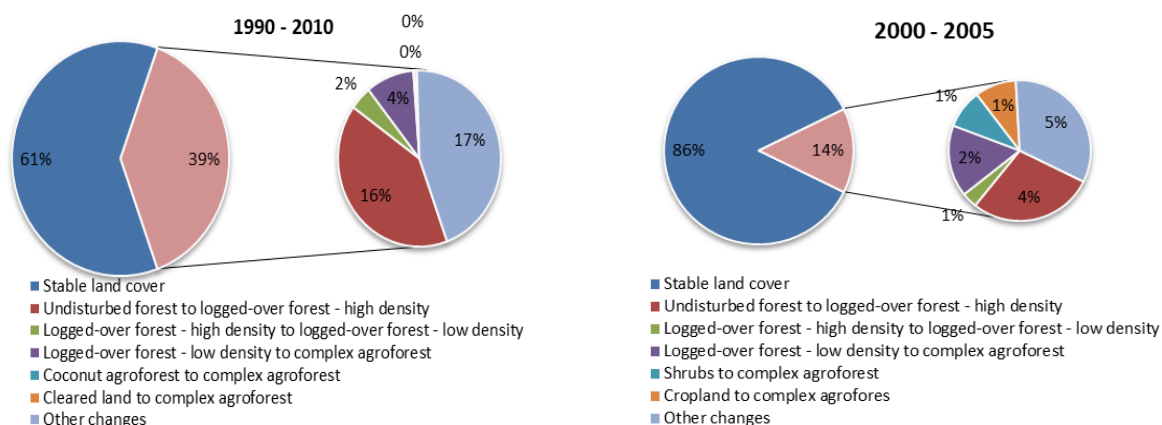
Figure 5. Changes to land use and land cover

Based on the discussions with members of local communities, there were three main factors contributing to the changes in land use and land cover: 1) increase in the market price of clove, 2) increased interest in the cultivation of crops requiring less effort and 3) an increase in the population of the area. Community members tended to cultivate crops in a multi-srata or multi-layer system, mainly involving the cultivation of clove and other agroforestry products, rather than the cultivation of seasonal crops (rice, vegetables and horticultural products). Factors contributing to this tendency were the relatively high price of clove and other cash crops, the relative ease of cultivating these crops and cultural factors. In addition, the hilly topography makes the cultivation of seasonal crops challenging, with agroforestry systems being more suited to local conditions. Participants in focus-group discussions stated that it was likely that current trends towards changes in land use and land cover involving the cultivation of mixed crops, particularly involving the cultivation of cloves with other crops, would continue at least for the next 10 years. On the other hand, they stated that the cultivation of teak was likely to decline owing to lack of farmers' interest in this crop because of the lengthy period of the trees to reach maturity.

Water sources and related issues

Issues affecting water sources and their causes

There was a difference of opinion between men and women regarding the primary issues affecting the sources of water that communities used for various purposes. According to male members of the communities, the most significant issue was the quality of available water (high sulphur content), which affects the

Table 1. Issues affecting water sources in terms of quality, quantity and technical issues, according to male and female respondents

Issue		Issue ranking	
		Female	Male
Quality	Cloudy water	2	4
	Sulphur content of water		1
	Iron content of water		2
Quantity	Lack of water availability	1	3
Technical issues	Pipe ruptures	3	

water in both the dry and rainy seasons (Table 1). According to female members of the communities, the most significant issue was the lack of water availability during the dry seasons. Male participants in the focus-group discussion stated that the poor quality of water resulted from the location of their villages being at high altitudes and from the nature of the soil in the region while the female

participants identified the cause of the limited availability of water as being the result of the low levels of rainfall and of land-clearing activities. However, all participants agreed that with the upstream location of their villages, the conservation of spring water and trees in the neighbourhood would effectively address the issue of the limited availability of water.

Consequences of water-related issues

Issues affecting water sources (water quality, quantity and technical issues) had an impact on daily domestic activities—with the most significant issue being the lack of availability of water for cooking and drinking—and for other domestic activities (Table 2). In addition, water-related issues also resulted in disturbance of the supply of electricity, which in turn negatively impacted agricultural activities, causing damage to community infrastructure, crop failures and other material and non-material losses.

Table 2. Consequences of water-related issues (quality, quantity and technical), according to female and male perceptions

Consequences	Final score[1]	
	Female	Male
Lack of availability of water for cooking and drinking	4	2
Disturbance of domestic activities	5	4
Disturbance of the supply of electricity	5	5
Disturbance of agricultural activities		5
Damage to community infrastructure		5
Crop failure		5
Material losses	3	
Non-material losses		√
No significant impact		√

1) 1=sangat ringan, 2=-ringan, 3=sedang, 4=berat, 5=sangat berat

Measures to address water-related issues and their causes and to manage the consequences of these issues

Long-term efforts to address issues affecting water sources (water quality, quantity and technical issues) include human resources improvement especially community awareness on the importance of conserving water sources, improvement of community infrastructure through the installation of filtration tanks and reservoirs and through the increased use of electricity supplied by the state electricity company (PLN) (Table 3). In addition, improvement of the quality of natural resources was also necessary, with these efforts involving the identification and use of alternative water sources. Strengthening of social capital is necessary to ensure the enforcement of regulations related to logging, inter-village cooperation in the area of water management and the establishment of agroforestry groups.

Table 3: Efforts needed to address water-related issues and their causes and to manage their consequences

Capital	Necessary effort	Female	Male
Human resources	Raising community awareness on the importance of conserving water sources	√	
Infrastructure	Installation of filtration tanks and reservoirs	√	
	Infrastructure improvements		√
	Use of alternative sources of electric power (PLN)	√	
Natural resources	Identification/utilization of alternative water sources	√	
Social	Enforcement of regulations on the use of forest resources and the involvement of communities and local government institutions		√
	Inter-village cooperation in the area of clean-water management	√	
	Establishment of agroforestry groups to manage land adjacent to forest areas		√

Biodiversity and its impact on livelihoods

When using the term 'biodiversity', a distinction is drawn between biodiversity in the context of community-cultivated land (agro-biodiversity) and biodiversity in the context of the natural ecosystem (natural biodiversity). In this assessment, natural biodiversity refers to biodiversity which can commonly be found in protection forests, community forests and agroforests while agro-biodiversity refers to biodiversity found in areas cultivated by local communities, particularly agroforests and land planted with seasonal crops.

All participants in the focus-group discussion were farmers and most female participants were also engaged in land-management activities. The dominant land use system was complex or multi-strata agroforest with various types of crops structured in layers, representing layers of agro-biodiversity.

In general, from the findings of the focus-group discussions with both male and female members of communities, the crops planted in the agroforest system can be categorized as follows: 1) seasonal food crops, which are generally planted at the lowest level of the layered crops, such as pineapple (*Ananas comosus*), 2) annual food crops, which are planted at the second-lowest level, such as cocoa and bananas, 3) fruit trees and other multifunctional plants placed at the third level, including mangosteen (*Garcinia mangostana*), clove, jackfruit (*Artocarpus heterophyllus*), mango (*Mangifera indica*), breadfruit (*Artocarpus altilis*), nutmeg, 'duku' (*Lansium parasiticum*), 'langsat' (*Lansium domesticum*), cinnamon (Cinnamomum spp), durian, coconut (*Cocos nucifera*), candlenut (*Aleurites moluccanus)* and sugar palm (*Arenga pinnata*), 4) timber trees, which formed the highest layer, such as mahogany (Swietenia *macrophylla*) and teak (*Tectona grandis*). In these agroforests, communities cultivate no less than 15 species of plants.

Sugar palm is a naturally-occurring plant that is found in different land use systems and status, including protection forests, community forests and agroforest, with birds and bats playing a significant role in spreading the seeds of this plant. Some members of the communities generate income from palm sugar harvesting. In addition, a small number of community members derive income from the tapping of pine resin*,* which is another naturally-occurring plant found in the region. Seasonal medicinal plants and spices, such as turmeric and ginger, are also planted in clove gardens. The degree of communities' dependence on natural biodiversity is quite low, given that agroforests provide the most significant source of income. Most of the information related to the use of products of natural biodiversity came from participants in the discussion groups who were over the age of 40.

The communities are not significantly affected by natural disasters or by political and social conflict. While landslides occasionally occurred, they tend not to significantly affect community livelihoods. The communities show low levels of awareness regarding the need for measures to mitigate climate change impacts and food scarcity. However, some participants stated that sago and sugar palm would be available as alternative sources of food in the case of droughts that prevented the cultivation of rice or corn.

Farming systems and preferences in alternative crops

Based on the discussions with farmers, it became clear that clove agroforest was the primary source of community incomes. In addition to agroforests, the cultivation of turmeric (*Curcuma longa*) and ginger (*Zingiber officinale* Roscoe) provided additional sources of income. The third and fourth most significant sources of income came from the cultivation of maize (*Zea mays*) and vegetables, respectively.

Some additional income was also derived from the collection of non-timber forest products, including honey, gmelina (*Gmelina* spp), dammar (*Shorea* spp) and pine (*Pinua merkusii)* resins, although the incomes derived from these sources were not high. Both male and female participants in the discussion groups stated that their selection of land use was on the basis of climatic conditions and the perceived economic value of the crops. Thus, clove agroforest formed the primary source of income for most farmers because they had significant experience with the cultivation of this crop and this crop has a relatively high economic value.

In terms of perennial crops, farmers stated that clove and candlenut contributed the most to the generation of incomes. In addition, female participants identified sugar palm as the third-most significant source of income, langsat as the fourth-most significant and nutmeg as the fifth-most. Male participants identified langsat as the third-most significant source of income, followed by sugar palm and duku as the fourth- and fifth-most significant, respectively.

Looking to the future, female farmers stated that clove would continue to be the most significant source of income, particularly in the context of current high prices. In descending order of significance, they identified langsat, durian, sugar palm and candlenut as additional future sources of income (Figure 7). Male farmers identified candlenut as the most significant future source of income followed by clove, durian, nutmeg and teak as other sources of potential future income, in descending order of significance. It is interesting to note that durian was identified as the third-most significant potential source of future income despite the fact that it has not previously been a significant source of income in the region.

Based on the experience of the farmers over the past 15 years, it was found that the various forms of crops had varying degrees of resistance to the impact of climate change. It is important for farmers to be aware of the impacts on a particular crop, particularly if they continue to use the system of agroforests that provide a high level of resistance to climate change and fluctuations in the market prices of commodities. By becoming more aware of the degree of resistance of a particular crop, farmers can integrate a variety of crops into their cultivation practices in anticipation of fluctuations in the price of commodities and the impact of climate change.

The farmers' level of knowledge on crop resilience to climate change can be improved through extension or education programs designed to generate a greater understanding of the risks on particular farming systems. Such programs can be seen as part of a climate-change mitigation strategy (Table 4). In addition, extension programs and additional facilitation are necessary to enable farmers to adapt to unfavourable conditions resulting from climate change, including droughts, crop failures and other natural disasters.

Table 4. Recommended forms of facilitation and/or intervention to cope with the risk of crop failure from climate change

Extraordinary events due to climate change	Recommended forms of intervention or facilitation
Landslides (as occurred in 2012)	• The establishment of village savings to facilitate revolving loan funds to meet households' needs in the case of crop failure • The rapid provision of the necessary equipment by the government to clear areas affected by landslides
Long drought season with six months or more without rain (as occurred in 2009)	Enterpreneurship training to provide alternative sources of off-farm income
Windstorm (as occurred in 2006)	Agricultural insurance to provide protection in the case of disasters resulting in crop failure

Strengths, weaknesses, opportunities and threats

Analysis of strengths, weaknesses, opportunities and threats (SWOT) was based on the information gathered through a focus-group discussion. The strengths and weaknesss were categorised into five capitals that form the basis of livelihoods in the area, namely natural resources, infrastructure, economic resources, human resources, and social. (Table 5).

Results of the SWOT analysis show that the principal strengths in terms of natural resources were 1) the availability of land suitable for the cultivation of high-value agricultural commodities, 2) the availability of water resources, 3) the potential for the development of tourism owing to the presence of waterfalls and 4) the availability of non-timber forest resources, including pine resin, honey and rattan (*Calamus* spp).

The highly developed social capital in the region was another source of strength, with active association of farmers' groups (Gapoktan) and strong village institutions (particularly the Community Empowerment Body and Village Representative Body), with these bodies functioning well and playing an active role in the dissemination of information to improve agricultural productivity. In addition, human resources were also a source of strength, with farmers having the necessary skills to market their produce and thereby to support their families.

On the other hand, identified weaknesses that had a negative impact on livelihoods included the lack of financial institutions, such as cooperatives and banks, with this lack acting as a constraint against access to financial services. In addition, the role of middlemen in the supply system often resulted in farmers receiving low prices for their produce. A decline in the availability of water and forest resources and the failure to maintain agroforests appropriately were identified as weaknesses in the area of natural resources. According to participants in the focus-group discussions, changes to forest functions were the main causes of the decline in the availability of water and deterioration in biodiversity. In terms of infrastructure, the primary weakness was the poor quality of connecting roads and bridges and the lack of piped water and electric power-generation systems.

The most significant identified threats derived from illegal logging and forest conversion, with these factors creating threats both for the forest and human settlements by exacerbating the impact of floods and reducing opportunities to develop village-based tourism. Other identified threats included those related to natural disasters, such as landslides, droughts, floods, pest infestations and diseases and to volatility in the prices of agricultural produce

Table 5. Strengths, weaknesses, opportunities and threats in terms of the five primary forms of capital forming the basis of livelihoods

Capital	Strengths*)	Weaknesses*)	Opportunities*)	Threats*)
Natural resources	• Non-timber forest products (honey, rattan, and pine resin) (3) • Potential for the development of tourism (3) • Abundant supply of clean water (springs) (3) • High-value agricultural commodities (candlenut, coconut, cloves, cocoa) (3)	• Decline in the availability of water (1) • Decline in the availability of forest resources (3) • Failure to maintain agroforests well (1)	• Further processing of agricultural commodities (3) • Investor opportunities (large-scale plantations) (4) • Potential for the development of eco- and agro-tourism (4)	• Natural disasters (landslides, droughts, floods, pest and disease) (3) • Illegal logging/changes to forest function (4)
Human resources	• Large proportion of population is of a productive age, industrious (4) • Creative, skilful farmers (4)	• Low levels of knowledge regarding the management of forest resources, including non-timber resources (3) • Low levels of knowledge of advanced agricultural practices (3) • Low levels of educational attainment (2) • Low levels of handicraft skills (3) • Those of a productive age/with higher levels of educational attainment often leave their villages (2)	• Development of micro-hydropower electric generation of (4) • Development of nurseries (3) • Intensification of marketing of agricultural produce (3)	• Volatility in the price of agricultural commodities (3) • Development of infrastructure on agricultural land (4)
Economy		• Limited access to financial institutions (cooperatives, banks) (4) • Low prices paid by middlemen (2) • Bonding system unfavourable to farmers (4)		
Infrastructure	• Adequate educational facilities (primary and junior secondary schools) (4) • Sufficient quantity of good markets (4) • Good village administration facilities (4)	• Lack of clean-water facilities (4) • Poor condition of village roads and connecting roads (4) • Inadequate supply and uneven distribution of lighting facilities (3) • Distant location of educational facilities (2) • Poor maintenance of community infrastructure (bathing, washing and toilet facilities; reservoirs; educational facilities) (3) • Limited availability of agricultural infrastructure (4)		
Social	• Active farmers' groups (Gapoktan) (3) • Active women's welfare groups and community health posts (3) • High level of mutual cooperation (3) • Active village institutions (BPD, LPM, PKBM) (3) • Active communication programs (4)	• Decline in the role played by customary institutions (3) • Non-active youth groups (4) • No facilitation provided by NGOs (2)		

*) : Scores within brackets ( ) are derived from average scores given by the groups in the focus-discussion groups; 4= highest, 1= lowest

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Summary of findings

- Over the period of 1990–2010, a significant proportion of primary forest in the area in question has been degraded to secondary forest while a significant proportion of secondary forest has declined in density and/or been transformed for use as agroforests. Agroforests cover 17% of the total area. The primary factor driving the transformation is the significant increase in the price of clove, the desire of communities to cultivate easy-to-maintain crops and the increase in population in the area.

- The primary sources of water for domestic and other uses are springs and rivers. The primary issues affecting the sources of water is the limited availability of water in the dry season and the water's high sulphur content.

- Extraction of non-timber forest resources, such as sugar palm and pine resin, has become a major source of income. Other sources of livelihoods include produce derived from agroforests, including clove, candlenut, sugar palm, nutmeg, duku, langsat, ginger, turmeric, pineapple, cocoa, bananas, mangosteen, jackfruit, mango, breadfruit, cinnamon, durian, coconut, mahogany and teak.

- The primary identified strength in the cluster is the production of high-value crops (candlenut, coconut, clove and cocoa). The primary identified weaknesses are the limited access to financial institutions (such as cooperatives and banks) and the lack of clean water facilities and their uneven distribution. Opportunities for future development include the potential for the development of agricultural commodity processing facilities, investments in large-scale plantations, the development of eco- and agro-tourism and the development of micro-hydropower facilities.

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Acknowledgements

Citation

Kow E, Wijaya CI, Khasanah N, Rahayu S, Martini E, Widayati A, Sahabuddin, Tanika L, Hendriatna A, Dwiyanti E, Iqbal M, Megawati, Saad U, Biahimo S. 2016. The Telaga-Telaga Biru Village Cluster, Gorontalo District, Gorontalo Province. Bogor, Indonesia. World Agroforestry Centre (ICRAF) Southeast Asia Regional Program.

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