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Enhancing the Sustainability of Agroforestry Systems

Lessons Learned from Agroforestry Activities in the Districts of Malinau and Kapuas Hulu (North and West Kalimantan, Indonesia)

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Enhancing the Sustainability of Agroforestry Systems

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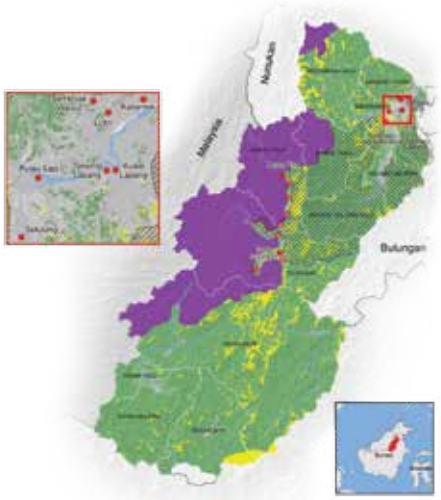
CONTENTS



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1. BACKGROUND

Growing trees and agricultural crops on the same land - sometimes also together with wild and domestic animals - is an ancient practice used by farmers in Indonesia and worldwide. For more than four decades, agroforestry, a term that summarises these manifold ways of managing diverse annual and perennial plant species together, has been promoted by international research institutions and development agencies to support smallholder producers (Steppler and Nair 1987). As a result, agroforestry is now widely recognised as a sustainable land-use method. It allows farmers and forest communities to produce agricultural, timber and non-timber forest products (NTFPs) and to diversify their income opportunities, while protecting and rehabilitating the ecosystem functions and services of their land (Jose 2009).

Despite the long history of agroforestry in Kalimantan, its practices have not yet been systematised and upgraded. In order to encourage more farmers to adopt agroforestry practices on their land, the national, provincial and district government institutions have started to strengthen initiatives to meet the institutional, technical and economic challenges in the agroforestry sector. Since 2011, the FORCLIME programme has supported these efforts by promoting sustainable agroforestry activities in its pilot districts Kapuas Hulu, Malinau and Berau in West, North and East Kalimantan, respectively (FORCLIME 2018).

FORCLIME's support is based on the dynamic (or successional) agroforestry approach. This entails production systems that imitate diverse and stratified forests that offer multiple environmental services, such as soil-fertility restoration and pest control (Milz 2012, Milz et al. 2016). Dynamic cocoa agroforestry systems in Bolivia and Côte d'Ivoire, for instance, were shown to be similarly or even more productive than monocrop plantations, while – in contrast to monocultures – also providing income diversification and environmental protection (Andres et al. 2016). FORCLIME interventions range from capacity building in agroforestry concepts and methods, advisory service for governmental institutions and farmer groups, to organisation-building of extension services for agroforestry development in the recently established Forest Management Units (FMUs; in Indonesian: Kesatuan Pengelolaan Hutan, KPH; (Djajono and Siswanty 2011). In addition, FORCLIME facilitates agroforestry networking at the provincial level to improve local stakeholders' access to knowledge and resources and to coordinate activities among them.

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This report documents FORCLIME's years of lessons learned from supporting local agroforestry activities. As important outcomes, for instance, 14 agroforestry demonstration plots covering a total area of 12 hectares have been established in Kapuas Hulu (Figure 1). In Malinau, FORCLIME has supported a group of local extension workers in their efforts to establish the independent organisation *Ikatan Penyuluh Agroforestry Malinau* (IPAMA) aiming to multiply agroforestry knowledge and practices among local farmer groups (Figure 2).

Figure 1: *Agroforestry demonstration plot with cocoa, banana, leguminous trees and other plants in Mataso, Kapuas Hulu, West Kalimantan (Photo: Brandt 2017)*

The goal of our report is to analyse the impacts and shortcomings of agroforestry activities and to provide recommendations for improving the programme's performance in the future. In addition, we want to inform the FORCLIME partner organisations and further interested stakeholders about the advances in agroforestry activities within the programme. The local voices and experiences are also suitable sources of information to further develop agroforestry activities in the field and to adapt the agroforestry training curricula of public officials who engage in the development of KPHs.

Figure 2: *Agroforestry extension workers' group Ikatan Penyuluh Agroforestry Malinau (IPAMA) (Photo: Brandt 2017)*

3. STUDY AREAS

We conducted the lessons-learned exercises in several villages of the districts (*kabupaten*) of Malinau and Kapuas Hulu in Kalimantan (Figures 3 and 4), where FORCLIME carries out agroforestry activities.

Figure 3: FORCLIME agroforestry sites (in red) in the district of Malinau (North Kalimantan), divided into activities conducted by FORCLIME TC (Technical cooperation by Deutsche Gesellschaft für Internationale Zusammenarbeit, GIZ) and FORCLIME FC (Financial cooperation by Kreditanstalt für Wiederaufbau, KfW). Agroforestry sites (FORCLIME TC) shown in submap (in red). Agroforestry sites (FORCLIME FC) numbered as follows: 1. Long Berini, 2. Long Kemuat, 3.Long Tebulo,4. Long Uli, 5.Long Paliran, 6. Long Aran, 7.Long Jelet (Map: Weterings 2018).

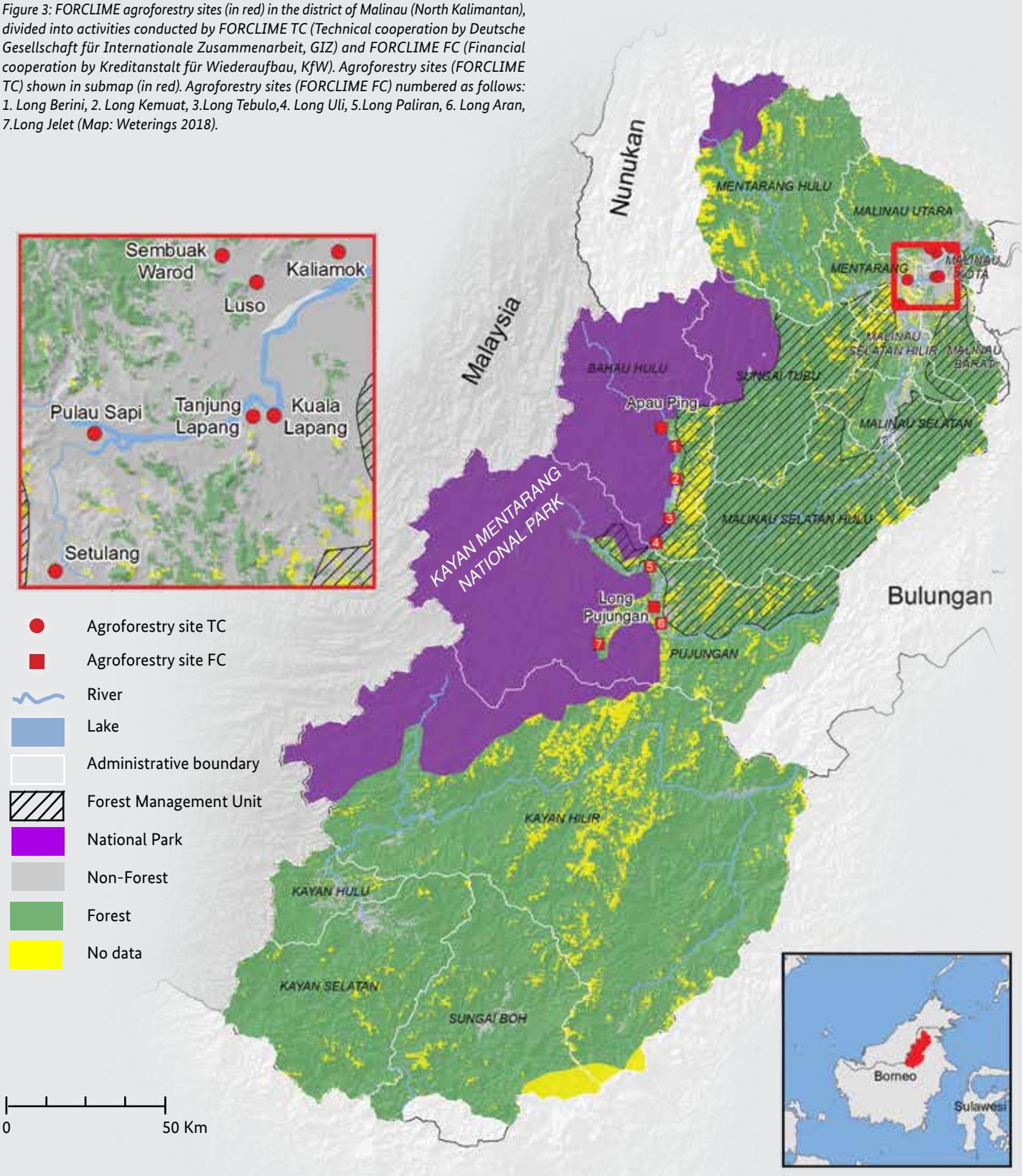
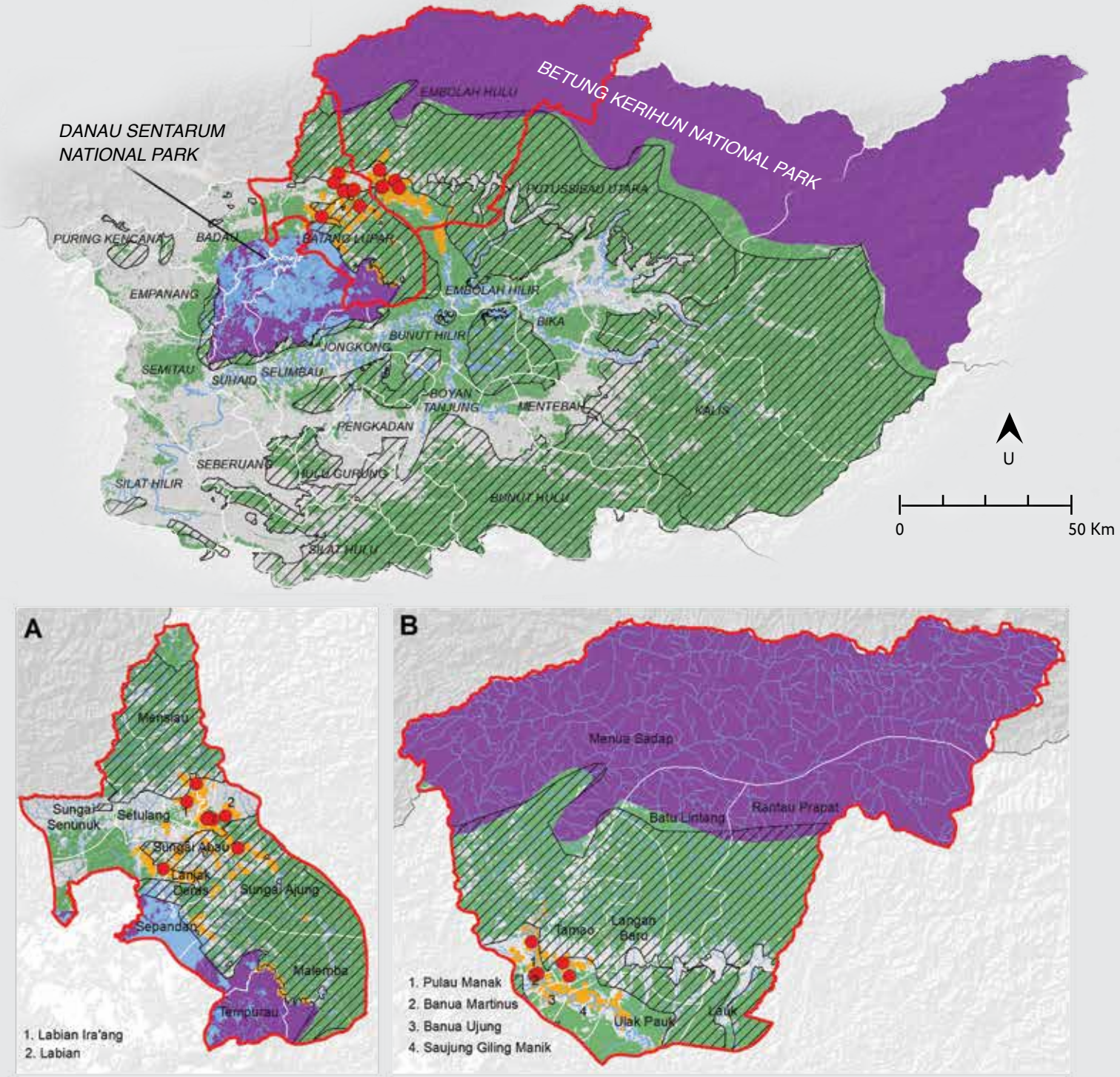


Figure 4: FORCLIME agroforestry sites (in red) in the district of Kapuas Hulu (West Kalimantan), divided into activities conducted by FORCLIME TC (Technical cooperation by Deutsche Gesellschaft für Internationale Zusammenarbeit, GIZ) and FORCLIME FC (Financial cooperation by Kreditanstalt für Wiederaufbau, KfW) (Map: Weterings 2018)



3.1 MALINAU

Malinau is one of five districts in North Kalimantan province, which was divided from East Kalimantan Province in 2012. Malinau borders Malaysia and covers an area of around 40,000 square kilometres. The district capital, also called Malinau, is in the downstream area of the Malinau/Sesayap River.

Originally, Malinau district was populated by the Tidung ethnic group. Since the 1970s, people from different ethnic groups in Kalimantan (e.g., Lundayeh, Kenyah, Punan) as well as from Java, Sulawesi and other regions of Indonesia have migrated into the area. Population increase has been accompanied by economic development, especially through large-scale exploitation of natural resources (e.g., coal mining, timber logging) (Moeliono et al. 2009). Today, Malinau district has 15 subdistricts (*kecamatan*) and comprises a total of 109 villages. The latest available data indicates for the whole district a total population of around 80,000 people (54% male, 46% female) (counted in 2016 by the Central Statistics Agency, *Badan Pusat Statistik*; see BPS 2019).

Many people living in Malinau are farmers (42%). Rice is the main agricultural commodity, while hunting and fishing provide additional income. Some 43% of the district's inhabitants are service providers in the public and private sectors. Only 15% work in the mining sector, construction and industry, even though the latter sectors deliver together 66% of the district's gross regional domestic product (GRDP) (calculated in 2015, see BPS 2019).

Malinau district is part of the Heart of Borneo (HoB) initiative, which was started in 2007 by Indonesia, Malaysia and Brunei to conserve the remaining rainforests in Central Borneo (HoB 2018). More than 90% of Malinau's total area is officially designated as state forest land. This surface includes the 1 million hectares of the Kayan Mentarang National Park, which is extraordinarily rich in biodiversity (Moeliono et al. 2009). To promote sustainable development in line with forest protection, the Malinau administration has built several partnerships at the national and international levels (e.g., CIFOR, WWF) including FORCLIME, and declared itself a Conservation District. Together with the Village Development Movement (*Gerakan Desa Membangun*, GERDEMA) that aims to empower village authorities in terms of local governance, the local administrative context provides a promising framework for promoting green-economy activities, such as agroforestry (Sulchan 2014).

Today, Malinau district has 15 subdistricts (kecamatan) and comprises a total of 109 villages. The latest available data indicates for the whole district a total population of around 80,000 people (54% male, 46% female).

Kapuas Hulu district in the province of West Kalimantan covers an area of almost 30,000 square kilometres. Its administrative centre Putussibau is located on the banks of the Kapuas River, which is among the longest rivers in Indonesia. Kapuas Hulu's population consists of around 255,000 people (51% male, 49% female, as counted in 2017) distributed over 23 subdistricts (BPS 2019).

Kapuas Hulu's population is culturally diverse, with inhabitants mostly from the Malay and Dayak ethnic groups (the latter can be divided into around 20 subethnic groups) (Shantiko et al. 2013). Most people (58%) are employed in the agricultural and forestry sector, despite its low economic importance according to GRDP (23%). In comparison, only 13% of people work in the mining sector, construction and industry, which deliver together around 42% of the GRDP (estimated in 2017) (BPS 2019).

The Kapuas Hulu district is also part of the HoB initiative (HoB 2018) because of its exceptional natural resources and ecosystems. The latter can be found, for example, in the Danau Sentarum and Betung Kerihun National Parks, which cover around 30% of the district area. Like Malinau, Kapuas Hulu has been designated a Conservation District. However, the expanding population, the increasing cultivation of oil palm and environmentally damaging gold-mining activities are among the critical factors for forest conservation (Shantiko et al. 2013).

To face the challenges of environmental protection and economic development in Kapuas Hulu, the four subdistricts Batang Lupar, Embaloh Hulu, Embaloh Hilir and Putussibau Utara were selected to implement FORCLIME activities of sustainable forest management and agroforestry.

Kapuas Hulu's population consists of around 255,000 people (51% male, 49% female, in 2017) distributed over 23 subdistricts.

Figure 5: *Participatory diagnosis of management problems in a cocoa garden in Mataso, Kapuas Hulu (Photo: Brandt 2017)*

4. DATA COLLECTION AND ANALYSIS

In Malinau, we collected data through semi-structured interviews and focus group discussions with key informants in July 2017 to record the interviewees' knowledge, views and experiences related to agroforestry (Figure 6). Prior to data collection, the potential interviewees were identified and grouped into smallholder subsistence agroforestry farmers (n=6), professional agroforestry farmers (n=1), agroforestry extension workers (n=7), technical experts and field mentors of the FORCLIME FC programme in Malinau (n=6), as well as government officials of KPH Malinau (n=3). Questionnaires were elaborated and adapted to the respective interviewees, and a checklist was drawn up for the KPH personnel to identify the key elements of partnership success.

In Kapuas Hulu, we collected data by participatory observation during field activities and farmer-to-farmer knowledge exchange (9 local farmers, 5 village facilitators) in March 2017 (Figure 5).

In addition, we used data from participatory observations during FORCLIME field activities (2015-2017) from Malinau and Kapuas Hulu as well as internal reports. We analysed the responses to understand the context-specific benefits and shortcomings of current agroforestry activities in the study areas and to learn from the gathered experience.

Figure 6: *Focus group discussion with key informants in Malinau (Photo: Brandt 2017)*

In Indonesia, agroforestry has always been employed as a traditional and diverse land-use method transferred from one generation of farmers to the next. In response to changing domestic needs and market demands, smallholder farmers have constantly adapted their agroforestry systems and also integrated exotic cash crops by mixing them with food crops or by cultivating them in the secondary forests on fallow land (Feintrenie et al. 2010).

In Malinau and Kapuas Hulu, agroforestry is also a well-known land-use practice. However, the term "agroforestry" is often misunderstood, because the smallholder farmers interviewed also defined mixed agricultural cropping systems on shifting cultivation land as "agroforestry". Even rice paddies were named "agroforestry". This shows that they did not differentiate between agricultural production and agroforestry systems. However, most of the farmers interviewed also have experience in managing mixed home-gardens and secondary forests, which can be defined as agroforestry systems (Figure 7). In the pilot areas, the term "agroforestry" was introduced by FORCLIME and programmes of other institutions as a collective name for land-use systems, in which woody perennial plants (fruit and leguminous trees, palms, etc.) grow together with agricultural crops (see Steppler and Nair 1987).

We found a variety of native and exotic species integrated into the different layers of agroforestry systems in Malinau and Kapuas Hulu, such as cocoa (*Theobroma cacao*), coffee (*Coffea robusta*), rubber trees (*Hevea brasiliensis*), leguminous trees (e.g., *Parkia speciosa*, *Leucaena leucocephala*, *Gliricidia sepium*), fruit trees such as durian (*Durio* spp.) and cempedak (*Artocarpus integer*), fast-growing banana (*Musa* spp.), crops like rice (*Oryza sativa*) and maize (*Zea mays*), cassava (*Manihot esculenta*), spices like chilli (*Capsicum* spp.), ginger (*Zingiber officinale*) and lemongrass (*Cymbopogon citratus*), as well as agarwood (*Aquilaria* spp., locally known as *gaharu*) (Figure 8). Oil palm (*Elaeis guineensis*) grown together with other plant species was also observed, and black pepper (*Piper nigrum*) is also increasingly popular as a crop.

In response to changing domestic needs and market demands, smallholder farmers have constantly adapted their agroforestry systems and also integrated exotic cash crops by mixing them with food crops or by cultivating them in the secondary forests on fallow land.

Figure 7: *Traditional home-garden with fruit trees (e.g., cempedak) in Setulang village, Malinau (Photo: Brandt 2017)*

Figure 8: *Products (cocoa, coffee, lime, etc.) from a home-garden in Setulang village, Malinau (Photo: Mundt 2016)*

Since the 1980s, traditional home-gardens and other agroforestry systems in Indonesia have been widely converted into monoculture plantations, especially oil palm (Figure 9) or rubber (in Sumatra and West Kalimantan). The intensification of agriculture is combined with increasing agricultural expansion into the forests and a loss in biodiversity (Feintrenie et al. 2010). This trend can also be observed in Malinau and Kapuas Hulu. Therefore, FORCLIME has supported its district and provincial governmental partners in encouraging more local farmers to value their traditional home-gardens, to employ more sustainable land-management practices and to understand the favouring and hindering factors for marketing of agroforestry products, as further illustrated in the following sections.

Figure 9: *Smallholder oil palm plantation (4 hectares) in Setulang village, Malinau (Photo: Brandt 2018)*

5.1 BENEFITS FROM AGROFORESTRY

When farmers from Malinau were asked to list the main objectives and benefits of the agroforestry programmes in their region, they emphasised that agroforestry practices were a good way of producing food while protecting the environment, as they helped to keep the soil healthy and to increase shade. The farmers also positively appreciated the continuous flow of diverse products and income opportunities throughout the year. The interviewees' statements thus agreed with the argument that agroforestry systems can enhance rural self-reliance, food security and the economic resilience of smallholder farmer households through the diversification of production. The latter is of special importance in case of environmental (e.g., extreme weather events, sudden infestation of pests and diseases) or market changes (see Altieri et al. 2012, Lin 2011). All interviewed farmers stated that they were proud of their home-gardens and that they liked to work in them. These positive views about agroforestry were also shared by the personnel of KPH Malinau, who aim to implement more community-based agroforestry demonstration plots within the KPH area.

In Malinau, the most important agricultural commodities produced by smallholder farmers for the subsistence needs of households and for local markets are rice, cassava, banana and other fruits (e.g., durian, cempedak). Some farmers also cultivate, for instance, cocoa, coffee, rubber, oil palm and agarwood in monoculture or mixed plantations, which are destined for sale on local, regional and national markets.

A "cocoa boom" started in Malinau in the 1980s and was supported by district and national governmental programmes. However, it collapsed in the 1990s, mainly as a result of the inadequate way of cultivating cocoa in monocultures without shade and input of organic matter from other trees. Thus, the cocoa trees showed low vitality and were affected by high stress from weeds and diseases (Milz 2012). Today, most of the cocoa farmers to whom we talked are not motivated to grow cocoa anymore. They have either made other use of their plantation lands or abandoned the plots altogether.

In Kapuas Hulu, natural rubber production is a dominant agricultural sector, in which many smallholder producers are involved. Cocoa production is less important. It started in the early 1970s. While some old cocoa plantations are still running, management problems like those in Malinau can be observed. There are some initiatives from the district government of Kapuas Hulu to revitalise local cocoa production (Milz 2012). However, they do not seem to be very profitable so far.

For most of the farmers we interviewed in Malinau, growing timber trees in their home-gardens is less important, since they are still available in the surrounding forests and on shifting cultivation land. However, a few farmers have experimented with growing ironwood (*Eusideroxylon zwageri*) and meranti (*Shorea* spp.) as a strategy to overcome potential limitations on the availability of high-quality timber for construction.

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5.2 LAND TENURE AND SOCIAL FORESTRY

Only secure land rights can guarantee long-term investments such as planting trees. In Malinau, land tenure is in most cases not secure and land titles or any other officially binding documents are usually not in place. Many local farmers are in possession of a formal letter issued at village level only. They have inherited their cultivated land from their ancestors, and farming activities are based on customary law. In general, customary land rights are recognised by the Indonesian Constitution. However, they are often not considered in land planning and in the issuing of permits for industrial plantations (e.g., oil palm) or mining activities. In addition, local communities are rarely provided with information and thus excluded from decision-making. In Kalimantan, tenure-related social conflicts between neighbouring villages, such as in the case of Setulang village, are common (Pramova and Locatelli 2013). Many conflicts also increasingly occur between plantation companies and communities caused by the lack of recognition of customary land rights (Colchester and Chao 2011).

That is why local interviewees in Malinau were not satisfied with the way landownership issues are handled. The tenure is secure only when their plots are located inside an authorised village forest, such as *hutan desa,* in which the community is legally granted land-use rights by the national government (Banjade et al. 2016). Inside a *hutan desa,* local farmers can thus manage their land and resources in accordance with the regulations for a defined period. The farmers interviewed from a village that received a license to manage its *hutan desa* highly valued their use-rights over the village forest.

The national tenure reform on social forestry, including the *hutan desa* scheme, which aims to allow local communities to manage 12.7 million hectares of state-owned forest areas across Indonesia (2015-2019) is therefore an important step in increasing the local use-rights to forest land and resources and to defend them from extraction companies. However, the allocation of forest-management licenses to village communities is a major challenge and is still lagging behind its goals (Ompusunggu 2018).

5.3 PRODUCTION, PROCESSING AND MARKETING OF AGROFORESTRY PRODUCTS

In agroforestry, income is generated from diverse and ecologically sustainable production. The income level depends on the size of the cultivated plot, the production volume and the market value of products. The average size of smallholder agroforestry plots in the study areas is about 1 hectare per household. Larger farms can manage an agroforestry area of up to 5 hectares per household, which also seems to be the threshold at which farmer households can start making a reasonable living from agroforestry activities.

Because of a lack of financial capital, a stable flow of income into the household is important for smallholder farmers. That is why in their home-gardens, smallholders usually mix fast-growing cash crops, such as banana and maize with long-term perennial plants (e.g., fruit trees, cocoa and coffee) (Figure 10), which only yield profits after a couple of years.

Some interviewees complained about the inappropriate market situation and the low prices of their commodities. The price levels and corresponding incomes from agroforestry crops are influenced by various factors. Fruit is usually produced for local consumption and not processed but sold fresh on local markets. Since the purchasing power of residents is low, fruit prices are correspondingly low as well. One informant told us that the producers sometimes do not even harvest their products (e.g., banana) because of a surplus of fruit in the local markets. Fruit price fluctuations are also common. Our informants told us that the fruit quality is generally good, and there are no complaints from the consumers. They also said that the production and

consumption patterns have changed over time. Fruit and vegetables have become more important, while in former times the focus was on rice production only. The diversification of products from agroforestry can provide diverse income opportunities for smallholder farmers throughout the year. However, the commonly low incomes for the producers are a serious limitation.

The processing of fruit (e.g., by drying) from agroforestry can help local farmers to store their products in order to guard against price fluctuations and to increase their market values. In some villages of Malinau, home-industries for dried fruit (e.g., banana, papaya) and chips of tuberous roots (e.g., sweet potato, cassava) as well as for handicraft made of rattan (climbing palms) and palm leaves for own consumption and sale can be found (Figure 11). They are partly supported and promoted through district governmental programmes.

There are also local buyers for coffee, cocoa, rubber and agarwood in Malinau, but the prices for some products, like natural rubber, are too low to cover the high transportation costs, especially if harvested in remote areas. Agarwood has a high economic potential and can be sold at high prices. However, the uncertain quality of cultivated agarwood, which may or may not have the desired aroma, makes this investment rather risky. Cocoa and coffee are usually sold as dry beans without further processing because there is no specific local market, for instance, for fermented cocoa beans. However, the general long-term market prospects for the latter are promising. Since fermented beans can be stored for up to one year, their sale is more flexible. At the time of our study, fermented cocoa from Malinau was directly sold (in limited quantities) to a high-quality chocolate manufacturer in South Sumatra. While this was a promising pilot project in direct marketing to a chocolate company, our informants also pointed out that it was challenging without external support (e.g., from FORCLIME) given the high transportation costs for products at small volumes and because of the high-quality standards required.

In our view, an important step towards overcoming these obstacles would be to support the building of producer organisations at the local and regional levels in order to increase the quality, quantity and efficiency of their production and processing, and to enhance the producers' power in marketing.

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Figure 10: *A banana plant provides shade to juvenile cocoa trees and short-term profit to a farmer's household (Photo: Brandt 2017)*

Figure 11: *Traditional buckets and hats from Setulang village, Malinau (Photo: Mundt 2016)*

5.4 ASSESSMENT OF AGROFORESTRY

When we asked our interviewees how important agroforestry was in comparison to other land-use forms in Malinau, we received varied responses. Based on a scoring system, rice paddies were assessed as the most important land-use category for local smallholders. This result is understandable since rice is the main food staple for local people. Rice cultivation is a measure for securing livelihoods. In comparison, agroforestry systems were rated as less important on average.

A reason for the relatively low importance of agroforestry might be that, in general, agroforestry is less promising in terms of profitability compared to monoculture cash crops, such as oil palm, which is among the most popular among local farmers. The economic benefits and the reduced labour requirements are the main drivers of agricultural intensification (Feintrenie et al. 2010). Usually, people's concerns about conservation and development are contradictory, because even if they are aware about the environmental benefits and higher resilience of agroforestry systems, they will convert them into economically more promising monocultures, if they have the possibility to do so (Therville et al. 2011). To motivate the farmers to conserve and manage their agroforestry plots, it is therefore necessary to support them in increasing their productivity and profitability, while reducing the financial risks, costs and labour input. Farmers' capacity building in production, post-harvesting and marketing of agroforestry products by efficient extension services, therefore, plays a crucial role.

5.5 CAPACITY BUILDING IN AGROFORESTRY

Regarding capacity building in agroforestry, some farmers from Malinau emphasised the need for more technical knowledge about raising and planting tree seedlings. Likewise, effective tree management and harvesting techniques (e.g., for coffee) were not sufficiently known or applied. In the demonstration areas of the FORCLIME FC programme, the farmers complained of a general lack of technical guidelines in tree seedling production and management. In contrast, one farmer with a higher education told us that he learned new techniques in training courses and independently by reading and applying the acquired knowledge in his own garden. As a result, at the time of our study he had successfully developed a cocoa agroforestry garden and was maintaining its productivity through regular tree pruning, weeding, organic fertilisation and pest control.

Apart from transferring new and exchanging existing agroforestry knowledge, we also identified the need for using more participatory training methods and practical exercises in the field to increase the learning success. For instance, the participatory agroforestry training conducted shortly before our study by local extension workers (in cooperation with FORCLIME) was evaluated by one beneficiary smallholder farmer group as very motivating and helpful (Figures. 12 and 13). In this case, the training programme was planned together with the participants and adapted to their needs and interests. The programme consisted of a series of regular training sessions (once per month) over a period of more than half a year (with the option to extend). The training sessions were mostly conducted in the field (inspired by the "farmer field school" approach, see FAO 2016). During the training, the focus was on stimulating participants to actively discuss among each other. This helped the participants to relate new theoretical knowledge input with their own practical experience. Presentations and discussions were always connected with practical group exercises in the field to increase the farmers' interest and motivation. Each training session finished with summaries of lessons learned from the participants' perspectives and with feedback rounds. This helped the trainers to identify knowledge gaps and to adapt the follow-up training sessions to the participants' needs and interests.

Figures 12 and 13: *Participatory farmers' training in organic pesticide elaboration and terrace construction against soil erosion in Setulang village, Malinau (Photo: Brandt 2017)*

Agroforestry demonstration plots, like those recently set up in Kapuas Hulu under the support of FORCLIME, are suitable sites to conduct practice-oriented participatory training. In addition, they can serve as models to experiment with innovative agroforestry methods and to promote them among other farmers. From our experience, many farmers only trust in the applicability of new methods and integrate them into their production systems, if they actually observe that they are effective.

Some farmers point out that the FORCLIME programme is not yet well enough known at the grassroots level because little has been done to popularise its activities. From the farmers' point of view, FORCLIME should provide more information material (e.g., calendars, posters, information sheets) to spread the concepts and methods of agroforestry among the rural population and local governmental institutions.

5.6 EXTENSION SERVICE FOR AGROFORESTRY

Efficient local extension services are preconditions for successful capacity building in and implementation of agroforestry practices on the ground. The extension workers (known locally as *penyuluh*) conduct training courses in production and postharvesting methods, and they facilitate knowledge exchange among farmers. They also motivate them for local experimentation and adaptation of new methods and give technical advice for implementing agroforestry practices. Additionally, extension workers have important functions as mediators between governmental and research institutions, development agencies, and the farmers who adopt and apply agroforestry methods.

The smallholder farmers of our study identified several aspects to be improved concerning the existing extension service of the district plantation and agricultural services. Among these aspects were the lack of practical experience of many extension workers. They also cited training that did not meet the farmers' needs and the distribution of material (e.g., seeds) but without corresponding instructions on how to effectively use it. This shows that while theoretical knowledge in agriculture and forestry is an essential precondition for extension workers, it is not enough to be able to conduct effective farmer training. From our observation, a lack of practical experience among, for instance, very young extension workers can be compensated by forming teams of extension workers with different knowledge levels, in which the less experienced can learn from the more experienced. A good formation in specific agroforestry knowledge and mentoring skills (e.g., use of participatory methods) is a further precondition for being good agroforestry trainers.

5.7 GRASSROOTS MOBILIZATION FOR AGROFORESTRY DEVELOPMENT

One of FORCLIME's achievements in Malinau has been the mobilisation of a group of young extension workers to establish the independent organization Ikatan Penyuluh Agroforestry Malinau (Organization of Extension Workers for Agroforestry in Malinau, IPAMA).

The idea of forming an organisation of extension workers arose during the discussions that followed FORCLIME agroforestry training in 2015 to multiply the concepts and methods of sustainable agroforestry. The strategic organisational planning and the process of obtaining the status of an officially recognised group were finalised in 2016. IPAMA currently consists of 11 active members (four women, seven men). All of them are still or were previously engaged in the extension service of the district plantation/agricultural service. IPAMA's main tasks can be summarised as advisory work and service provision related to agroforestry activities.

When we asked the members of IPAMA about their motivation for joining the group, the answers ranged from "developing, promoting and sustaining agroforestry practices in Malinau" to "creating our own jobs and income". All members are convinced that diverse agroforestry systems are more environmentally sustainable than monocrop systems. This conviction is also reflected in the vision of IPAMA, which is to optimise farming methods with agroforestry practices to improve the income opportunities of local farmers while conserving soil and biodiversity. Therefore, IPAMA wants to enhance the local farmers' agroforestry-related capabilities, give technical guidance and facilitate knowledge exchange and networking among agroforestry-related stakeholders.

For IPAMA, the following organisational principles are of importance:

- Mutual solidarity and trust among the group members.
- Strong motivation to work together and regular communication.
- Open discussions ("a good atmosphere is important").
- Identification with the organisation and ownership ("it is OUR organisation").
- Election of key persons and definition of their roles.
- Decisions taken in a participatory and democratic way.
- Goals achieved in a step-by-step manner ("slowly but surely").

Figure 14: *Cocoa is processed for fermentation and sale in Pulau Sapi, Malinau (Photo: Brandt 2017)*
Figure 15: *Organic material from tree pruning is used as organic fertiliser (Photo: Brandt 2017)*

Figure 16: *Strategic planning of a roadmap to strengthen the organisational structure and administration of IPAMA in Malinau (Photo: Brandt 2017)*

In 2017, IPAMA started providing agroforestry training in cooperation with FORCLIME. The farmers appreciated IPAMA's commitment and the participatory methods used in the training.

Recently, IPAMA acquired a cocoa agroforestry demonstration plot, which is used as a production site for cocoa to be fermented and sold (Figure 14), and as a research site to experiment with agroforestry methods and non-traditional crops. Successful outcomes are expected to serve as models for other land-users. So far, IPAMA has experimented with methods of organic farming. The goal is to use and promote organic fertilisers and pesticides instead of chemical products. Organic material from tree pruning or weeding, for instance, is accumulated around the trees and crops to serve as natural fertiliser (Figure 15). In addition, IPAMA has studied the effects of fermented compost (*bokashi*) and natural pesticides by using aromatic plants. With these methods, IPAMA wants to provide safe, effective and environmentally friendly alternatives to the widespread use of chemical pesticides and fertilisers.

Despite IPAMA's achievements, it is a challenge to run a new organisation. So far, IPAMA does not have its own office facilities. Consolidating internal structures, coordination and benefit-sharing are further tasks in the ongoing organisation-building process, which is still facilitated by FORCLIME (Figure 16). IPAMA's biggest constraints are the lack of financial resources and uncertain future income opportunities. Fundraising and performing advisory and/or consultancy work are therefore priority actions. IPAMA's networking and communication with external partners (e.g., governmental and private institutions) need to be established, since they are potential clients for consultancy work. Additionally, promoting IPAMA's advisory services by, for instance, social media and informative factsheets, is crucial. Moreover, IPAMA can gain additional income from increasing its production and collection of cocoa beans for fermentation and sale.

IPAMA is the first group in Malinau to promote agroforestry activities as a sustainable way of production. Despite many challenges and limitations, it is already recognised as a local partner of FORCLIME and the governmental institutions associated with the project at district and provincial levels in North Kalimantan (e.g., KPHs). In view of Indonesia's social forestry programme and the implementation of KPHs, there is an increasing demand for experienced technical staff, such as IPAMA, to support local communities in implementing agroforestry activities. Taking IPAMA as a model, it is therefore an important task of governmental institutions and development agencies in Kalimantan´s rural areas to promote grassroots mobilisation for sustainable farming and forestry activities.

5.8 KEY LIMITATIONS AND CHALLENGES

A major problem for many farmers with respect to long-term investments like tree planting is the unclear and insecure nature of land tenure. Local disputes over land tenure issues take place between neighbouring villages. They are also likely to become more frequent in the future between businesses (e.g., timber, oil palm, mining) on the one hand, and local villagers on the other hand.

Many farmers lack important technical knowledge, such as about seedling/tree management and harvesting/post-harvesting techniques, and farmer organisations are rare.

There are many complaints about the unsatisfactory market access and the fluctuating and low prices for agroforestry products. A lack of buyers, long distances and high transportation costs between the production sites and the local or national markets are also among the common constraints.

A challenge for governmental institutions is the adequate and timely allocation of annual funding to conduct the scheduled activities in the field. With respect to this issue, planning and promising to conduct activities with villages often create expectations that are then difficult to meet.

6. LESSONS LEARNED

Land tenure

At provincial and/or national level, it is of the utmost importance to ensure that farmers have permanent access and use-rights over their land. This is because the issuance of local letters at village level alone does not ensure legally binding land-use rights. Land titles would secure long-term investments like agroforestry and increase the farmers' incentives to manage the land in a sustainable way. In addition, the governmental social forestry programme can also provide opportunities for forest communities to ensure the use-rights of their forest resources.

Extension service

A functional and efficient agricultural extension service is crucial to spread new technologies and knowledge to farmers, and to enable them to manage and innovate their land-use systems, including agroforestry. Educating and enabling farmers through extension services is a worthwhile investment to ensure food security, eradicate rural poverty and to support rural economic development. To improve the professional formation of students, who plan to work as *penyuluh* in agricultural/forestry extension services, we recommend adjusting and extending the existing modules of the training curricula during their formation, e.g. by adding agroforestry-related topics and participatory training methods. Mobilising grassroots organisations, such as IPAMA, and promoting their partnerships with governmental institutions can complement the existing extension services in order to meet the demand for technical experts in the field.

Capacity building

To increase the learning effects from capacity building, there is a need to apply more participatory training methods and practical exercises in the field. Stimulating the participants for active discussion and farmer-to-farmer knowledge exchange as well as relating theoretical knowledge with practical experience are important to increase the farmers' motivation and success in learning. The participants' feedback should be documented and used to identify knowledge gaps and to adapt follow-up training. Each village has its own calendar of field activities, with rice cultivation as the most important activity. It is important not to overlap but to harmonise the training with the farming activities.

Soil fertility

A crucial topic in farmer capacity building must be the maintenance and restoration of soil fertility by using agroforestry methods. Tropical soils, except for volcanic and fluvial soils, are usually

deeply weathered, acid and poor of minerals. Humus obtained from the organic matter of forests is the most important source of plant nutrients. If the forest is cleared, the humus degrades, and the remaining nutrients are leached out quickly. Using chemical fertilisers is usually not effective, because the acid soil is barely able to absorb and store the minerals. Burning organic matter is also an inadequate fertilisation method, because the ash is easily washed away, leaving behind a depleted soil. In poor tropical soils, maintaining a permanent and diverse vegetation cover, such as forests and agroforestry systems, and using the organic matter from weeding and pruning as mulch are key actions in closing the nutrient cycles and sustaining the fertility and productivity of soils.

Demonstration plots

The establishment and management of agroforestry demonstration plots can serve as showcases for interested farmers, because farmers are reluctant to adopt new methods if they have not seen any evidence regarding their effectivity. Demonstration plots are suitable starting points for conducting technical, practice-oriented and participatory training that embraces all local agroforestry-related stakeholders, such as agroforestry farmers, technical advisers/extension workers and KPH personnel.

Environmental and market surveys

Before starting agroforestry programmes, environmental surveys and market studies should be conducted, because it is of little use to promote commodities that are not environmentally adapted or for which there is little local or national demand. In general, smallholder agroforestry systems should yield diverse products to be more resilient against market uncertainties and environmental risks. In addition, training in basic administrative principles of income-outcome estimation (e.g., production and income, costs and labour) can help the farmers to analyse and effectively manage their smallholder businesses.

Promotion and marketing

Agroforestry can improve rural households' economies. Market access in many rural areas, however, is sporadic and unpredictable. The lack of infrastructure, such as farm-to-market roads, hampers the delivery of agroforestry products to markets. Local authorities should also provide better access to accurate information on fair market prices. National and provincial agencies should bridge the structural gaps to overcome obstacles between farmers and markets. The private sector should also invest more in fair and direct partnerships with farmers. Supporting the smallholder producers to meet national quality standards, to receive product certificates (e.g., organic, fair trade) and to add local activities along the value chains of products (e.g., cocoa fermentation, home-industry of fruit chips) would be further important contributions. Promoting high-quality agroforestry products on a national and international level would increase the economic profitability and sustainability of smallholder farmers' agroforestry systems.

Farmer organisations

Apart from small informal farmer groups on village level, no larger agroforestry farmers' organisations have been established until now in Malinau or Kapuas Hulu. However, empowering farmers by helping them to establish producers' organisations and broader networks would be a crucial step in increasing market access and power for negotiating prices. Transportation costs for the sale of products can also be reduced, since the product volumes would be larger, resulting in lower costs per unit. Furthermore, the farmers could benefit from the knowledge exchange among the members of the organisation. It is also easier for a farmers' organisation than for individuals to receive public or private funds and support services. Maintaining a producers' organisation is not free of costs and requires additional work and time for communication, coordination and financial administration. However, the benefits of membership in a farmers' organisation and in broader producer networks can overcompensate these costs.

Political and financial commitment from local authorities

So far, agroforestry development in the pilot areas is still supported by FORCLIME. In a long-term perspective, political and financial support from the local and/or provincial government will be needed to upscale agroforestry as an approach of rural economic development and forest conservation in

the recently established KPHs. It is therefore important to link agroforestry programmes with, for instance, local governmental development platforms, such as GERDEMA in Malinau.

Cross-sectoral approach

To promote local production, processing and marketing of agroforestry products, cross-sectoral cooperation between the local/provincial governmental departments is needed, because the technical assistance regarding the different issues is located within different departments (e.g., forestry, agriculture, industry, trade service). A prompt planning and communication system to harmonise the activities between the technical staff on the ground and the financial public officials and a reduction of bureaucratic hurdles could help to achieve the goals.

Partnership

Key elements of success for effective partnership between farmer groups, extension workers, governmental institutions and also private companies are, for instance, a clear understanding of shared objectives and of the corresponding roles and responsibilities. To set up a regular and transparent communication system is a prerequisite for trust-building among the relevant stakeholders and for shared learning from each other. FORCLIME can perform an important role as facilitator to establish local platforms of effective partnerships.

Public relations

Finally, the achievements of effective partnerships on the ground should be published by distributing, for example, educational posters and technical guidelines/manuals to set good examples for other projects and share the lessons learned.

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