Scaling up agroforestry’s impacts on livelihoods and ecosystem services

S Dewi*, E Martini, A Ekadinata, S Rahayu, Hendratmo and G Manurung
ICRAF, Jalan CIFOR Situ Gede, Bogor 16115, Indonesia
Corresponding email: s.dewi@cgiar.org

Abstract. In Indonesia and elsewhere, the minimization of trade-offs between economic and environmental benefits from agroforestry (AF) makes it attractive as rural development solutions that spread from forest margin to peri-urban areas. Lack of technology and skills to increase productivity sustainably, lack of market recognition of the ecosystem services as the co-benefit of AF management, and the dichotomy between agriculture and forestry in the government nomenclature that does not support agroforestry programs contribute to the disappearance of AF practice throughout the country. Due to the utmost diversities of AF management across highly variable local contexts, in scaling up AF’s impacts on livelihoods and ecosystem services, guidelines to identify best options of AF management are needed. The objectives of this study are: (i) develop a framework and a set of principles to characterize best options for AF at landscape level within the broader surrounding regions, under economic geography of peri-urban to forest landscape, considering demands for agroforestry production and ecosystem services; (ii) guide the development of integrated agroforestry-based business models that fit local context and preferences. The paper will illustrate landscape-level AF scaling up through our past green growth planning work that combines spatial and development plans in South Sumatra province.

1. Introduction
Agroforestry definition has been evolving. AF is often defined as plot-level farm management that combines tree species with annual crops, pasture, or fishery [1,2,3]. Most of the practice is conducted by smallholder farmers all over the tropics and also in temperate zones. In managing their agroforestry farms, farmers reap multiple benefits from harvesting multi-purpose commodities for cash, food, medicines, fodder, energy, building materials, and others, and ecosystem services such as soil conservation and micro-climate regulation. In addition, AF allows men and women to manage the farms together through different roles and promotes gender equality. The benefit does not stop in the households that manage the AF farms, but also for the broader society share the same landscape, e.g., through climate and water regulation. Compared to a monoculture system, risks of harvest failure and price drop are milder in AF.

More recently, AF is also defined as landscape management, of which multi-functionality and diversity of land-uses are key. AF encompasses the practice and science of the interface and interactions between agriculture and forestry, involving farmers, livestock, trees, and forests at multiple scales [4] including landscape scale. Land sparing and land sharing debates have also favored AF as a land-use type when land-sharing cannot be avoided [5]. A vast monoculture system has been well known to be prone to pests and diseases and other hazards.
Agroforestry as land management system where farmers grow trees and crops while tending cattle and aquaculture in the same parcel of land has been practiced widely across Indonesia. The dominant tree species under agroforestry management range widely from fruit-based, food export commodity species-based, non-food export commodity species-based, timber-based systems. The contributions of agroforestry to the income of farmers are quite significant, both as cash and non-cash. Agroforestry with trees outside forests delivers ecosystem services through the considerably high carbon stock retention within the system, water and soil management due to the diverse rooting systems and permanent canopy cover, and maintenance of (agro) biodiversity through the varieties of species managed, the sourcing of planting materials and low intensity of management. Under fluctuating annual rainfall and price shocks, maintaining multiple commodity species benefits farmers in terms of increased resilience through stabilizing harvests and incomes, even if they are not maximized. In managing multiple species, farmers can distribute labor more flexibly and create income over the year than managing one species. The diversity also allows better participation of women along the management and marketing chain. Because of the long-term nature of tree life, land ownership and use rights need to be more secure. Figure 1 summarizes AF’s multiple benefits.

Figure 1. Multiple benefits of AF management

In facing climate change, pandemic and other shocks that create fluctuations in price, productivity and livelihood needs, commodity diversification strategy in land use are among the best: it is systematically sound, on-target for resilience and adoptable/implementable. Figure 2 illustrates the annual profit fluctuation from rubber monoculture farming and AF farming on the same area unit when rubber price fluctuates yearly. The AF farming integrates annual crops in the system. Stabilizing income is more important than maximizing but fluctuating income for poor farmers with little of non-existing safety nets. Therefore managing more than one commodity exposes lowers risks.
In terms of areas and distribution, agroforestry in Indonesia has been quite extensive and distributed widely. In 1990, based on satellite interpretation (Figure 3), the extent was 19 Mha. However, the extend of AF country-wide shows a clear declining trend. In twenty year, agroforestry areas dropped to 12 Mha, or around 350,000 ha annually. Agroforestry is converted to more intensified agricultural practices or settlements. The reasons are mostly due to competition over land for other needs and those with higher economic benefit. Lack of technology and skills to increase productivity sustainably, lack of market recognition of the ecosystem services as the co-benefit of AF management and the dichotomy between agriculture and forestry in the government nomenclature that does not support agroforestry programs contribute to the disappearance of AF practice throughout the country.

Scaling up the impacts of AF for livelihoods and ES is necessary; publication on research about scaling up AF is numerous [6,7,8,9], with Africa and Latin America as the main focus. In adopting and operationalizing AF upscaling in Indonesia, a guideline on how best AF can be developed at scales is necessary. The guideline cannot be prescriptive, considering very diverse local biophysical and socio-cultural contexts within a broader political-economic context. This study aims to contribute to filling the gaps through providing:

(i) A framework and a set of principles that characterize best options for AF at the landscape level within the broader surrounding regions is necessary, along with the enabling conditions to make the options feasible;

(ii) Guideline to develop integrated agroforestry-based business models that fit local context and preferences.

Figure 2. Profit fluctuation of rubber monoculture and AF farming with rubber price fluctuation
Figure 3. Land use/cover maps of Indonesia in 1990's and 2010's, with agroforestry class separated from forest classes and non-tree cover classes (Source of data: ICRAF, 2011, Unpublished)
2. Agroforestry development at landscape level

With a gradient of forest cover, rural development can largely be seen as wicked systems, with the high complexity of local issues intertwined with broader societal issues. A high poverty rate is often associated with high forest cover in tropical countries, including Indonesia [10]. This robust and persistent association is largely due to the remoteness of such areas from economic growth poles that lead to low access to market and technologies, in addition to other livelihood capitals, such as access to credit, etc. The problem is magnified by the forest and land-use governance that have been extensively giving forest and land management licenses to large-scale companies starting from the 1970s in logging concessions, followed by industrial forest plantations and oil palm concessions. It was expected that economic activities involving local people and the community development programs will speed up rural poverty alleviation through such investment.

To some extent, the strategy worked but with high social and environmental costs. Environmental degradation that affects even broader communities, up to global communities, has been unprecedented, especially due to the unsustainable land management and land uses that do not match with the biophysical suitability of particular areas. Agroforestry, as an intermediate land-use intensity can minimize the problems of agricultural production and ES maintenance trade-offs in land-use development at the landscape scale, encompasses urban – peri-urban – rural – forested areas.

2.1. Theoretical background

Von Thunen’s work before industrialization in 1826 on the spatial arrangement of agricultural land uses surrounding a city has been used as the basis of economic geography [11]. The location of land uses chosen by farmers to maximize profit by minimizing transport and land costs in meeting the market demand. The model, of course oversimplifies the real systems and overlooks many factors, but has been very useful and empirically proven. The spatial arrangement and pattern of urban, peri-urban, rural to forest margin and forest areas are quite distinct. Some deviations are shaped by topography and anthropological processes during the urbanization and industrialization eras. By the end of twentieth century, local and global environmental issues have been pressing due to degradation and deforestation. Forest and land conversion for agriculture and settlement, and agricultural intensification for production to meet market demands have impacted ecological functions and integrity. Ecosystem services (ES) have been identified as a broader need of human population, beyond food and commodity provisioning [12].

More recently, ES mapping has gotten traction in identifying spatially the type of ES needed, the quantity, and the supply [13,14]. Such a method is necessary for designing sustainable development pathways concerning land uses. Further, the assessment is crucial in valuing the ES and internalizing them into the economy through payment or reward mechanisms of ES, especially when the areas within a landscape and those who steward them are pivotal to deliver a particular ES are distinctive from those who need and receive such ES.

As a land-use type that can deliver both livelihoods and ecosystem services, agroforestry has many facets and manifestations. The best locations of agroforestry management need to consider both agricultural productions’ supply and demands and ecosystem services provision and demand. Moreover, the options and types of agroforestry are also often tied to locations. Three key issues in AF scaling up are highlighted by [8], namely: (i) no silver bullet of best agroforestry options; heterogeneity of local contexts in biophysical, economic, social, and institutional factors matters; (ii) production increase through technology alone will not prevail without enabling institution and functioning market; (iii) knowledge management and co-learning by multiple stakeholders are necessary.

To scale up the impacts of AF on livelihoods on ES, we diffuse livelihoods and ES in applying von Thunen theory into agroforestry design at the landscape level. We also consider local contexts in developing the criteria of best options of AF in a particular zone within a generic Indonesia’s landscapes.
2.2. Framework to scale up AF location at the landscape level

According to von Thunen, there is a spatial arrangement of land uses surrounding the city center or concentration of demand for agricultural production in minimizing cost and maximizing profit. Due to the environmental degradation because of forest and land conversion and agricultural intensification, ecosystem services beyond provisioning, such as water regulation, air, climate, soil fertility, and biodiversity, are scarce. The ES degradation often magnifies the negative impacts of climate change, such as flood, drought, landslide, fire and pest and diseases. The economic loss, as well as social costs, are enormous. AF, which can deliver both agricultural commodities and ecosystem services, can be a win-win solution if scaled up properly at the landscape level, considering the supply and demand of commodities and ES.

A socio-ecological landscape is constructed of urban, peri-urban, rural and forest margins. AF is best placed in the three latter zones since the land cost is too high for a commercial AF to be viable in urban areas. However, city forests or green regions of the city can also be managed as AF, as public space rather than as land uses managed by economic actors. We, therefore, will focus only on the three zones and leave out the urban areas in the discussion. Several assumptions are taken:

(i) Land cost is higher in peri-urban areas than rural areas; and it is higher in rural areas than in the forest margin;
(ii) Population density is highest in peri-urban areas, followed by rural areas. Forest margin is least populated;
(iii) In peri-urban areas, sources of income are mixed between farm and non-farm, while in rural areas, the main source of income is farming. In forest margin, source of income is a mix between farm and forest income;
(iv) In forested areas, some have good access to a market where the companies that hold a license (for forest and estate crops) either develop road network or create demand for agricultural products;
(v) The variabilities of enabling factors in terms of policies and institutions are smaller within each zone compared to between zones and are common across Indonesia's landscapes.

Four components are looked into in selecting AF options in each zone: (i) farmers’ strategies and AF options to improve livelihoods and increase resilience; (ii) demand vs supply of commodities and ES; (iii) public policy and programs, and institutions; (iv) partnerships and financing options. The framework is summarized in Figure 5.

In peri-urban areas, where market access is high, meeting demand for commodities by urban populations is a priority of the farmer populations in these areas. Due to increased competition for land for multiple uses, the land cost is high; therefore, maximizing return to land becomes the foremost principle in choosing land use. Medium-scale traders and post-harvest processing of commodities mostly take place in these areas. AF has a relatively limited option in this area; however, in areas where land is marginal, the price of commodities fluctuates a lot and extreme weather events are frequent. AF serves as an excellent option as farmers need to adopt a diversification strategy to increase their resilience. When ES is scarce and in high demand in the surrounding areas, AF can offer a solution. The types of AF options should be determined by the local demands for commodities, land suitability, availability of agricultural inputs, accessible technology and farmers’ preferences. The option should also take into account the ES in demands and how it is valued. ES demand and valuation are linked to the broader institutions and enabling conditions the government must address. To improve Good Agricultural Practices (GAP) adoption, the government should promote extension programs to strengthen farmers’ capacity to manage AF in their lands and access to agricultural input. Regulation and institutions to operationalize payment or rewards for ecosystem services should be in place to make low-intensity land use options that deliver multiple functions attractive to farmers. Further, with Public-Private-People partnerships, market access and value chain improvement for AF products should be targeted. Ideally, the market should embrace ES valuation either as sustainability standards or environmental and social safeguards.

Further from urban areas, in rural areas majority of the population depends on farm income for livelihoods. Land cost is lower than in the peri-urban areas but can be considerably high. Typically,
farmers manage their land for cash and subsistence income. Farmers who own sufficiently large land areas usually aim for cash income by managing their farm intensively as monocultural systems, compared to those who own smaller farms. In general, farmers individually sell their products in raw or semi-raw forms. The price fluctuates a lot depending on seasons/supply, market, and traders; farmers have very little control. In many areas, extreme events, directly and indirectly, affect agricultural production, especially the annual crops. In areas where low road access, subsistence needs for food, medicine, fodder, and building materials are high. These areas have a high potential for scaling up AF, particularly for livelihoods. In marginal and sloping rural areas upstream of the watershed, targeting ES as a co-benefit is crucial. Farmers generally need to sustain high returns to land in these rural areas in selecting their land uses while increasing their livelihood resilience due to climate change and price fluctuations through diversification strategies, such as AF. As for the type of species to be managed in the AF—managed farm, local biophysical characteristics and local market access for specific commodities need to be considered, as well as farmers' preference and access to technology and agricultural input. These are linked to spatial land-use planning and agricultural policies to be developed inclusively by the government. Programs need to promote diversification of products at the landscape level to reduce the risk of pests and diseases and market bust while achieving economy of scale. The extension program, agricultural input subsidy, and institutions to improve market access and value chain need to be geared towards AF development. Post-harvest handling skills to match market requirements are better achieved in partnerships between farmer groups, government programs, and private sectors.

In forested areas, especially remote areas, population density is low, and land cost, in general, is low, if accessible. Farmers, in general, practice less intensified agriculture and less market access. The subsistence use of agricultural products is high. AF is a common practice to meet multiple needs for products. Generally, productivity is low. In these areas, the type of agroforestry to be practiced should maximize returns to labor. Because of labor scarcity, labor cost is high and more precious than land. The type of land use that is labor-intensive is least attractive.

The areas are usually high in conservation value and pivotal in generating ecosystem services need locally, regionally and globally. Those with good access often are of degraded state regarding ecosystem functions, while in remote areas are of the better, more conserved state. In the degraded areas, restoring ES, especially with the direct benefit to the farmers, such as soil fertility and buffering capacity of drained peat, should be considered in choosing the type of AF to be managed. In well-conserved areas, maximizing return to labor through sustainable land and water management to reduce hazards such as fire prevention is necessary. AF technology that needs minimum labor but is not capital-intensive to boost productivity is required; however, restoration programs and ES incentive mechanisms for stewardships might be a low hanging fruit if regulation and institutions are in place. Partnerships between farmers with private sectors that operate in the vicinity both along their business sustainability line or in complying with government regulation should be further strengthened. Government programs of social
forestry have recognized AF as the main tool; however, the implementation is yet to be sped up through capacity development of farmers and financing options at scale.

![Figure 4. Scaling up Agroforestry at the landscape level](image)

In selecting species and developing a local land-use plan, further fine-tuning of the above framework is necessary for the following:

a) Household and livelihood strategies based on local culture, access to land, skills and available technology;

b) Type of agroforestry and species selection based on land suitability, access to agricultural input and local market for commodities;

c) Farming practices regarding land and water management need to incorporate biophysical characteristics of soil and climate;

d) Broader conservation and development strategies such as spatial plan, medium-term development plan, green growth, low carbon development, payment for ES regulation and institution;

e) Potential partnerships, programs and financing options in the areas.

2.3. The application of the AF scaling-up framework in green growth planning for South Sumatra.

At the sub-national level, the Government of Sumatra Selatan and the World Agroforestry Centre (ICRAF) supported by IDH, developed the first provincial road map towards Green Growth in South Sumatra Province 2017-2030 [15]. The Green Growth in this province is driven by increasing the production and productivity of sustainable agriculture and forestry commodities to meet domestic and global market demands whilst protecting and restoring forests and peatlands to provide ecosystem services for its people. South Sumatra Green Growth is a homegrown initiative that emphasizes distinct local characteristics.

Amongst other factors, the 2015 South Sumatra forest fire and land fire, which was one of the worst fires in recent memory, was a major driving factor in pushing towards a commitment. In 2015, 11,609 hotspots were identified mainly between July and September, the highest number across Indonesia's provinces. Based on the field survey and analysis conducted by the Forestry Office of South Sumatra, 727,000 hectares were burned: almost two-third were from the natural forest (more than half of which was peat) and in the areas of pulpwood and rubber plantation. According to the World Bank, damages totaled 3.919 billion USD, including an environmental cost of 1.205 billion USD. A rough estimation of emissions due to the 2015 fire in South Sumatra is 130.45 Mt CO2e (ICRAF, unpublished).
Green Growth from land-based sectors: synchronizing spatial and development plans

Of all the medium- and long-term plan documents and the direction of the Governor of South Sumatra province in the 2013-2018 period, the five expected outcomes of GG above are very central. The scope of the GG that includes renewable resources, particularly the increase in economic growth through the land-based sector, namely agriculture, tree-crop plantation and forestry, contributes significantly to the provincial economy. Synchronization between the Development Plan and Spatial Plan re necessary, especially those closely related to land-based development. Breakthroughs and some fundamental changes as outlined in Presidential Decree 45/2016 on RKP 2017, which the region should consider are:

1. That the planning approach should be: (i) thematic-holistic: coordination between Ministries; (ii) integrated: related sectors must plan together in an integrated manner within the overall value chain; (iii) spatial: locations of planned activities have to be spatially explicit;
2. The new budgeting policy ties up closely the national RKP with that of provinces and districts.

In connection with GGP, this new breakthrough can be used to place GGP as a provincial priority program that is thematic and holistic, involving relevant SKPD in the process of integrated planning, budgeting, implementation and monitoring and evaluation. The spatial approach becomes critical since integrated activities should be planned in specified locations (co-locations). Therefore, RTRW is very important and directly related to RKPD.

Developing Green Growth Master Plan

Inclusive and equitable growth is one of the objectives of Green Growth aligned with national objectives BAPPENAS 2015. In developing Green Growth Masterplan, the overall data compilation, design of the Green Growth road map and the monitoring and evaluation (M&E) system should be consulted and prepared collaboratively by various stakeholders at the provincial and district levels.

Raising awareness and communicating the Green Growth road map is critical to achieving stakeholders’ shared vision, obtaining external and internal support, and establishing partnerships. During the road map preparation, interactions with various relevant local government units, land and forest business associations, academicians, NGOs, community groups, collecting traders, and some other stakeholders were carried out through forums including interviews, FGDs, seminars and public consultations. The primary technical tool that is instrumental to the process is LUMENS (Land-use planning for multiple environmental services) tool developed by ICRAF, which consists of framework and software. Further, the government of South Sumatra, as the engine of green economic growth, needs to develop a good communication strategy.

Scope of Green Growth

Green Growth covers the Renewable Resources sector in South Sumatra that underlines contribution increase of five of South Sumatra’s primary commodities, namely coffee, rubber, oil palm, rice, and pulpwood, to green growth.

Masterplan for South Sumatra Green Growth

The Masterplan for South Sumatra Green Growth comprises seven strategies:

1. Sustainable allocation and land-use planning to address gaps between land demand and supply;
2. Improve people's access to livelihood capital;
3. Increase productivity and diversification;
4. Improve value chain by ensuring fair distribution of benefits;
5. Improve connectivity and economic scale;
6. Restore degraded land and forests; and
7. Provide an incentive for ecosystem services and innovative funding for sustainable commodities.

Tree cover is one of the 17 indicators of the outcomes, which includes trees on the farm, beyond forests, largely managed as AF. The indicative intervention map was produced by fostering agricultural production and ecosystem services through the above seven strategies. AF is one of the major land-use types promoted to implement the seven strategies that embrace the scaling-up
framework of AF above. The intervention map (Figure 5) shows indicative land-uses with AF in the province to contribute to achieving GG outcomes, e.g., rubber revitalization with AF.

**GGP projection**

a. GGP can reduce 22% of gross emissions (ABG only, without fire emissions) by 2030 (Figure 6);

b. By 2030, net emission in production forest is negative (sequester) under GGP while it remains the largest source of emissions under BAU;

c. GGP can contribute to the maintenance of biodiversity at the landscape levels by increasing the degree of integration of dryland forest and mangrove forest. However, for swamp forest, GGP cannot contribute much to maintain its integration;

d. Total NPV of land-use systems (estimated by Spatial Cost-Benefit analysis) under GGP is more than doubled than that from BAU by 2030;

e. GRDP increased 4% under GGP from BAU by 2030 (Figure 6); labor absorption increased as much as 35.3% under GGP and income per capita is 26.3% higher under GGP

![Intervention Map of South Sumatra GGP](image)

*Figure 5. Intervention Map of South Sumatra GGP*
Formalization of GGP
The Green Growth masterplan was launched on May 9, 2017 by the Governor of South Sumatra. In the mid of 2017, the Governor Regulation No. 21/2017 on Green Growth Masterplan in South Sumatra was also issued. More recently, the GGP has been mainstreamed in the new Medium Term Development Plan and supports the Strategic Environmental Assessment process.

3. Scaling up at site level
Coe et al. [8] pointed out that one of the critical issues in AF scaling up is “the importance of service delivery, market function and the institutional environment to the success of agroforestry adoption over and above the availability of technology options relevant to farmers individual circumstances.” In addressing the AF as a system, increasing productivity in a sustainable manner needs to be integrated with the market function and institutional environment. ICRAF has developed a guideline to establish an integrated business model of agroforestry in the forest-fringed areas [16], with a companion of M&E schemes of the business model [17]. Section 3.1. is heavily drawn from the guidelines. The case study of developing IBAF in Banyu Biru village can be found in [18].

Developing Integrated Business Models for Agroforestry
Two main stages in the integrated business model of AF (IBAF): (I) the commodity production process from the agroforestry-based farming system (AFS); (II) the value chain of commodities produced by AFS. The third stage is the downstream industry, which can be built if the scale of production and market is large enough and sufficient to build a processing plant into finished materials or fulfill export needs which will not be discussed in this study. Stage III is not going to be discussed here. Stage I comprises the AFS improvement through Good Agricultural Practices (GAP), while stage II aims to improve the value chain. Each stage consists of three components: (A) a core business activity component, (B) a business support function, and (C) business enabling factors.

As an illustration, in the coconut IBAF (Figure 6), parts I-A are coconut agroforestry management, with farmers as the actors. In managing their farms, farmers need supporting services (I-B), namely access to agricultural inputs, pest and disease control, and extension services. In this example, the enabling function (I-C) does not exist.

After the coconuts are harvested and transported to be market, stage II begins. If farmers plant coconuts with pineapples in the AFS of stage I, then there are two types of commodities that are produced and will be marketed. These two commodities have different value chains and value chain problems so that in stage II, there will be two value chains to be improved. In this example, we are displaying coconut only. Under II-A, there are two pathways of core business activities. One is farmers
serving round coconuts to small collectors, and then small collectors selling to large collectors. Alternatively, farmers can dry their coconuts after harvest and sell them in the form of copra, which in this example, is sold to large collectors. The required support functions (II-B) are transportation and logistics services. The enabling conditions (II-C) required are post-harvest handling and trade regulations.

The commodity production system of AFS is the core business and needs to be appropriately implemented to create a sustainable, productive system through GAP application. Improvement of the marketing value chain is carried out by transforming the market system through effective supporting functions and enabling factors to create a more efficient and inclusive value chain, thereby benefiting farmers as producers. The integrated approach is expected to catalyze systemic changes sustainably. In each stage and component, the funding aspect is an issue that must be handled carefully. In addition, an absolute requirement for the implementation of IBAF is the formation of an integrated institution consisting of key actors, each of which has clear interests, roles, and responsibilities.

Figure 7. The integrated business model of Agroforestry: framework and component of Agroforestry Framing System and Value Chain of coconut as an illustration

The establishment of the IBAF requires strategic and systematic steps, including data and information collection and analysis. Three principles in developing IBAF: inclusive process with multiple stakeholders, integrative and informed (data and information-based). The steps consist of:
1. Scoping: five livelihood capital assessment, SWOT analysis, identification of dominant land use and identification of key commodity value chains;
2. Identifying potential commodities and suitable AFS scenarios based on scoping results, biophysical land suitability and literature analysis. Guideline in developing AFS scenarios is available (e.g., RECOFTC, ICRAF et al.);[19]
3. Financial feasibility test through profitability analysis of AFS scenarios and comparative analysis between the profitability of AFS using indicators of Net Present Value, Internal Rate of Return, business feasibility ratio and farmer income ratio;
4. Participatory discussion in seeking synergy and agreement between AFS options and commodities with the preferences of farmers, collectors and business actors in the value chain;
5. Establishment of AFS improvement matrix with Good Agricultural Practices (GAP) that is adaptable by farmers, including financing options and actors’ roles;
6. Construction of Value Chain Improvement matrix for each commodity produced from the agreed AFS from Step 4 that includes potential financing options and actors’ roles;

Simultaneously to the six steps above, building partnerships, discussions, engagement, facilitation and negotiations is a continuous process that has been carried out since the beginning. This process aims at determining the most suitable existing or new institution that can accommodate IBAF. In deciding the institutional form of the IBAF, information was collected using the interview method with key informants. Snowball sampling is a method used to determine critical informants to be interviewed. Interviews in data collection for IBAF institutional development aim to:
1. Map the stakeholders involved in commodity production and value chain from the community, village community economic institutions, agricultural/plantation processing industries, financial institutions, market players in the commodity value chain, and all supporting functions from the production process to the marketing of products;
2. Identify partnership, power relations and governance relationships between these elements and their respective roles;
3. Identify the benefits that each element can get from their participation in the business model;
4. Define the responsibilities and roles of each element

4. Discussion and conclusion

GoI’s commitments to promote local people's inclusiveness in managing forests can transform livelihoods and ES through AF

The current policy and government programs have been changing the landscape of land use players by putting local farmers more in the center through multiple. Figure 7 captures the opportunities across the forest and non-forest lands. Further, through rewetting, revegetation and revitalization strategy of peat restoration program throughout Indonesia, participation of local farmers are underlined, as well as AF and paludiculture as modalities of the 3R strategy. In the food system of discussion, AF becomes more visible recently, including in the food estate programs. AF is also a double sword strategy in mitigating climate change and adapting to climate change. The national NDC has recognized integrating CC mitigation and adaptation modalities rather than completely separating them. AF is, therefore, a potential tool to operationalize such integration.

Figure 8. Opportunities of AF scaling up through access to land

Agroforestry practice is a win-win solution between development and environment due to the diverse benefit that can be gained from a unit area, income and subsistence uses to (agro)biodiversity maintenance, soil and water management and carbon sequestration and retention

We are not short of empirical evidence of the multiple and diverse benefits of agroforestry. Globally, AF systems such as cocoa and coffee have been recognized. Major off-takers of cacao have implemented a traceability system of deforestation-free and green cacao from the AF system that increases farmers’ access to the market and incentives. Incentive in the forms of rewards for ES has been piloted, e.g., in
Sumberjaya, Lampung, regarding AF management in the upper watershed. Scaling up beyond piloting is yet to be promoted.

**Scaling up at landscape level: identifying options by contexts in designing partnerships schemes for agroforestry management**

Agroforestry can contribute to green growth at the landscape/jurisdictional level if embedded in sustainable land use planning, forest management, sustainable commodity and restoration programs. A case study from South Sumatra has empirically shown that economic, social and environmental indicators can be improved compared to a business-as-usual scenario. Jurisdictional-based financing from public sectors through EFT and thematic national budget allocation and other mechanisms coupled with green investments are necessary to transform towards sustainable development from the land-based sector. Financing should be linked to KPI that embraces green growth indicators.

**Scaling up at site level: Planting trees and agroforestry management per se are not enough; the supply chain has to be accompanied by improved value chains**

At the plot level, improving the livelihoods of farmers is key to AF scaling up. In addition to increased productivities, the delivery mechanism in terms of market and enabling environment are needed. Integrated business models that sustain high productivity of Agroforestry Farming Systems and at the same time ensure a fair benefit of actors along the value chain should be established under Public-People-Private partnerships. Recent thematic national budget allocation is a breakthrough that can potentially catalyze the AF scaling up.

**References**

[1] Lundgren B O and Raintree J B 1983 Sustained agroforestry Agricultural Research for Development 3 pp 1-27

[2] Young J R 1997 Rethinking the role of the professor in an age of high-tech tools The Chronicle of Higher Education 44 pp 1-10

[3] Patra A K 2013 Agroforestry: Principle and Practices (New Delhi: New India Publishing Agency)

[4] Van Noordwijk M, Coe R, and Sinclair F L 2019 Agroforestry paradigms In: van Noordwijk M, ed. Sustainable development through trees on farms: agroforestry in its fifth decade (Bogor Indonesia World Agroforestry (ICRAF) Southeast Asia Regional Program) pp 1–14

[5] Phalan B T 2018 What Have We Learned from the Land Sparing-sharing Model? Sustainability 10 (doi:10.3390/su100616760)

[6] Matata P Z, Masolwa L W, Ruwuga S and Bagarama F M 2013 Dissemination pathways for scaling-up agroforestry technologies in western Tanzania Journal of Agricultural Extension and Rural Development 5 pp 31-36 (doi:10.5897/JAERD12.099)

[7] Coe R, Sinclair F and Barrios E 2014 Scaling up agroforestry requires research ‘in’ rather than ‘for’ development Curr. Opin. Environ. Sustain. Sustain. Challeng 6 pp 73-77

[8] Buck L, Scherr S, Trujillo L, et al. 2020 Using integrated landscape management to scale agroforestry: examples from Ecuador Sustain Sci 15 pp 1401–1415 (doi.org/10.1007/s11625-020-00839-1)

[9] Tamirat W and Mekides A 2020 Opportunities and challenges of scaling up agroforestry practices in sub-Saharan Africa: A review Agricultural Reviews 4 pp 216-226 (10.18805/Ag.R-154)

[10] Sunderlin W D, Dewi S, Puntodewo A, et al 2008 Why Forests Are Important for Global Poverty Alleviation: A Spatial Explanation Ecology and Society 13

[11] O’Kelly M and Bryan D 1996 Agricultural location theory: von Thunen’s contribution to economic geography Progress in Human Geography 20 pp 457-475 (doi.org/10.1177/030913259602000402)

[12] Costanza R, d’Arge R, and de Groot R 1997 The value of the world’s ecosystem services and natural capital. Nature 387 253–260 (https://doi.org/10.1038/387253a0)

[13] Burkhard B and Maes J (Eds.) 2017 Mapping Ecosystem Services Pensoft Publishers Sofia 374
[14] Bagstad K, Villa F, Batker D, Harrison-Cox J, Voigt B, and Johnson G 2014 From theoretical to actual ecosystem services: Mapping beneficiaries and spatial flows in ecosystem service assessments *Ecology and Society* 19

[15] South Sumatra Province 2017 Towards Sustainable Development in South Sumatra: Masterplan for Renewable Resources- Driven Green Growth 2017-2030

[16] ICRAF World Agroforestry 2020a Panduan Penyusunan Model Bisnis Sosial Berbasis Agroforestri (MBBA) pada Desa di Dalam dan Sekitar Kawasan Hutan Produksi. SEA Regional Programme 46

[17] ICRAF World Agroforestry 2020b Pedoman Pemantauan dan Evaluasi Pelaksanaan dan Capaian Model Bisnis Sosial Berbasis Agroforestri (MBBA) pada Desa di Dalam dan Sekitar Kawasan Hutan Produksi. SEA Regional Programme 21

[18] ICRAF World Agroforestry 2020c Model Bisnis Berbasis Agroforestri (MBBA) untuk desa Banyu Biru SEA Regional Programme 56

[19] RECOFTC ICRAF and AWG-SF 2020 Agroforestry for climate-resilient landscapes (Bangkok RECOFTC) 89