DOI: 10.5716/cifor-icraf/BR.46178

#ClimateSmartAgriculture

Brief

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Promoting Climate-Smart Agriculture (CSA) through Strengthening the Capacity of Smallholder Farmers

Lessons from Kapuas Hulu District, West Kalimantan

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Executive summary

Kapuas Hulu District in West Kalimantan has abundant natural resource potential but faces growing sustainability challenges in the context of climate change, particularly for key plantation commodities such as cacao, rubber, coffee, and oil palm, which are generally cultivated in monoculture systems. These systems are highly vulnerable to market price fluctuations, pest and disease outbreaks, and climate variability. The promotion of climate-smart agriculture (CSA) through agroforestry is seen as a way to strengthen the economic and environmental resilience of smallholder farmers in responding to climate change impacts.

To build smallholders' capacity to apply CSA practices, the *Enhancing the Climate-Smart Agriculture Technologies and Practices of Smallholder Commodity Farmers* (ECSAP) program implements a range of activities aimed at driving behavioural change using the ADKAR approach (Awareness, Desire, Knowledge, Ability, and Reinforcement). The program has supported the emergence of 24 Independent Extension Agents and Model Farmers who provide farmer-to-farmer extension to promote the adoption of CSA practices for the main plantation commodities in Kapuas Hulu.

This brief also presents a set of recommendations for relevant stakeholders at local and national levels to support smallholder capacity building and to encourage the wider and more sustained implementation of CSA.

Background

Kapuas Hulu District, as a strategic landscape in West Kalimantan, holds abundant natural resource potential. However, it now faces growing challenges in sustainable management, including in the agriculture and plantation sectors. The district's leading plantation commodities—cacao, rubber, coffee, and oil palm—are generally cultivated in traditional monoculture systems. The homogeneous production that characterises monoculture makes these systems vulnerable to changes in market prices, pest and disease outbreaks, and climate change. Low crop diversity in monoculture systems also results in suboptimal yields per unit of land for smallholder farmers (Khasanah et al., 2020).

The challenges faced by smallholder farmers in Kapuas Hulu District prompted the Center for International Forestry Research – World Agroforestry (CIFOR-ICRAF), through the ECSAP program[1], to support them in adopting climate-smart agriculture (CSA)[2] practices for key plantation commodities in three implementation clusters (Figure 1). The program aims to strengthen the economic resilience of smallholder farmers in the face of increasingly complex climate risks by building the roles of Independent Extension Agents and Model Farmers. This is achieved by enhancing their technical knowledge, skills, and capacities in implementing CSA, so that they in turn can train other smallholder farmers through farmer-to-farmer extension methods (Martini et al., 2023).

Following the issuance of Presidential Instruction (Inpres) No. 3 of 2025 on the Utilization of Agricultural Extension Workers in the Framework of Accelerating Food Self-Sufficiency[3], the roles of existing field agricultural extension workers have been reorganised and are now coordinated by the national-level government, with a strong focus on the food crop sector to achieve national food self-sufficiency. This policy has reduced the scope for field extension workers to support the development of plantation commodities at the subnational level. At the same time, it has opened new opportunities for Independent Extension Agents and Model Farmers to provide farmer-to-farmer extension that promotes the adoption of CSA, particularly through agroforestry systems for key plantation commodities in Kapuas Hulu.

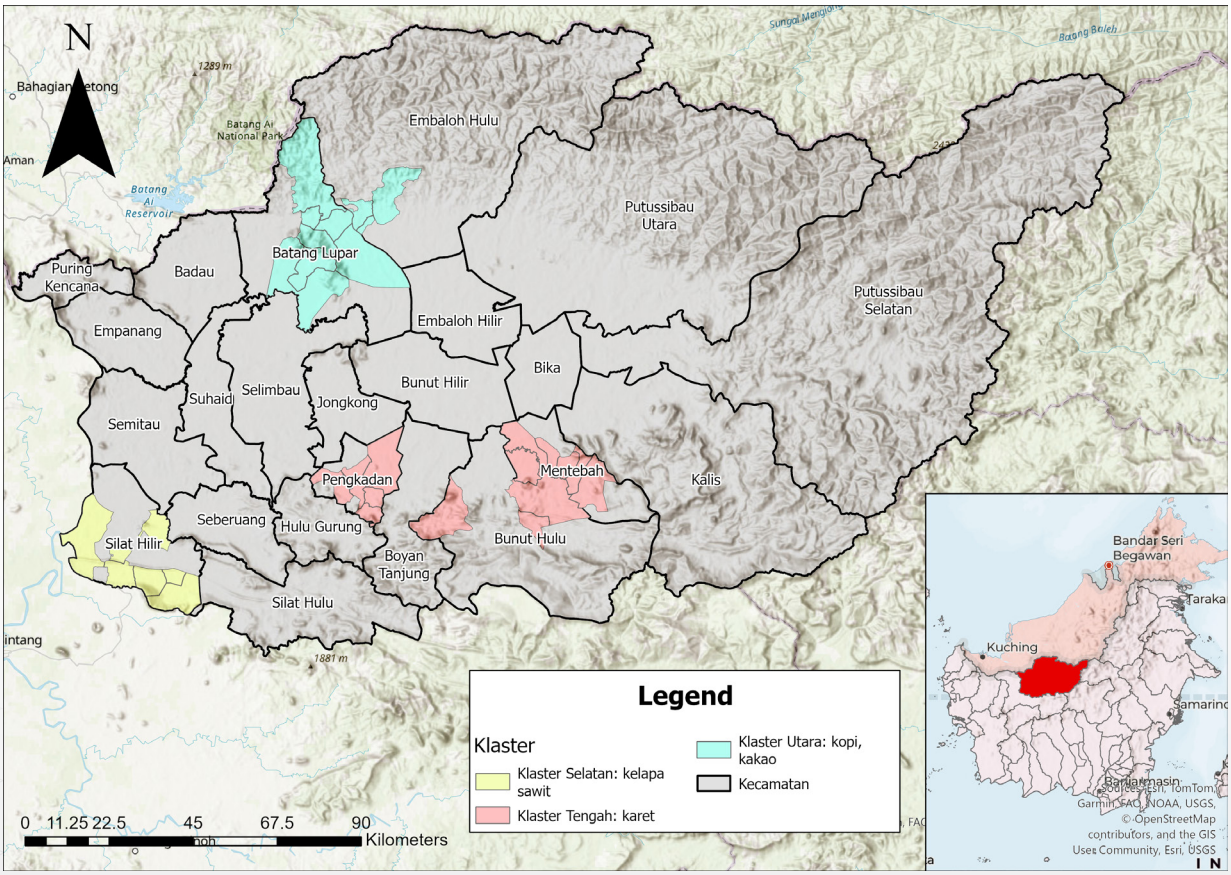


Figure 1. Map of ECSAP program activity areas in Kapuas Hulu District, West Kalimantan

1 The Enhancing the Climate-Smart Agriculture Technologies and Practices of Smallholder Commodity Farmers (ECSAP) program is part of the Greening Agricultural Smallholder Supply Chains (GRASS) project (Greening Agricultural Smallholder Supply Chains (GRASS) | GIZ), which is funded by GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit). More information on the GRASS project: https://www.giz.de/en/projects/greening-agricultural-smallholder-supply-chains-grass

2 Climate-smart agriculture (CSA) is an approach developed by FAO to transform agricultural systems to become more environmentally sustainable and climate-resilient. More information: https://www.fao.org/climate-smart-agriculture/en/

3 Presidential Instruction (Inpres) No. 3 of 2025 instructs the implementation of the utilisation of agricultural extension workers to achieve sustainable food self-sufficiency, with a focus on food crops.

1 Characteristics and challenges of agriculture in Kapuas Hulu District

Within its scope of work, the ECSAP program identified agricultural characteristics and challenges across three cluster areas where the GRASS[4] project is implemented, representing conditions in Kapuas Hulu and its leading commodities: the central, northern, and southern clusters. The diagnosis of agricultural problems in these three clusters forms the basis for developing CSA practices that are tailored to agricultural conditions in Kapuas Hulu.

Central cluster: rubber as an underperforming and less competitive commodity

This cluster covers several villages in the subdistricts of Bunut Hulu, Mentebah, and Pengkadan, where rubber is the main commodity. However, rubber is no longer viewed as the primary source of livelihood for smallholder farmers. In addition to monoculture rubber, farmers traditionally combine rubber with various other crops such as coffee, *tengkawang* (illipe), *petai* (stink bean), langsat, durian, *jengkol*, and others.

Latex production is low because most rubber trees are old and poorly managed, and latex prices are relatively low. Rubber must compete with other livelihood options such as oil palm, kratom, and gold mining, which offer higher short-term economic returns and easier land management. Beyond tree age, low latex yields are also linked to poor-quality planting material, limited farmer skills in applying good agricultural practices, suboptimal tapping techniques, and post-harvest handling that does not meet market standards. Rubber farmers commonly rely on wet latex processing, which fetches lower prices than dry rubber, further reducing incentives to invest in rubber.

Other factors that weaken rubber's competitiveness include low and unreliable availability of fertiliser, widespread fertiliser adulteration, high prices for fertiliser, high labour costs for maintenance and tapping, and pest and disease problems such as white root fungus.

Even so, many farmers retain their rubber gardens as a long-term livelihood "fortress" (Neilson, 2025), which means rubber still has potential to be further developed[5].

Photo: Muhammad Azizy/ CIFOR-ICRAF Program Indonesia

Northern cluster: coffee and cacao not yet developed sustainably

This cluster includes several villages in the subdistricts of Embaloh Hulu and Batang Lupar. The area lies relatively close to the forest, and shifting cultivation is the dominant land-use practice. In this cluster, the main commodities developed are coffee and cacao in agroforestry systems, planted under rubber stands or under shade trees such as petai. Rubber and kratom are also important livelihood sources.

Coffee and cacao cultivation in this cluster is relatively new and has not yet been optimised sustainably. Most coffee trees—mainly liberica and robusta—are not harvested for commercial sale but used for household consumption. Cacao tree density per unit of land is also low, and cacao beans are processed without fermentation.

Coffee and cacao cultivation face multiple challenges in adopting good agricultural practices. Farmers have limited access to high-quality seedlings and limited knowledge of coffee and cacao agroforestry management; fertiliser use is suboptimal; pest and disease control is not yet integrated; and harvest techniques for cacao and coffee are not fully appropriate. Post-harvest handling is also not optimal, especially for cacao, where the absence of fermentation reduces the potential for higher value addition.

4 https://www.giz.de/sites/default/files/media/pkb-document/2025-07/giz2024-en-ecological-assessment.pdf

5 This phenomenon is commonly found in Indonesia. Neilson (2025) defines it as fortress farming, a livelihood strategy in which farms or agricultural plots are not only a source of income, but also serve as a "fortress" that protects the survival of farming households, especially amid economic and environmental uncertainty.

Southern cluster: ageing, uncertified monoculture oil palm

This cluster covers several villages in the Silat Hilir subdistrict. Smallholder farmers in this area have cultivated oil palm in monoculture and relied on it as their main livelihood for around 20 years. Smallholder oil palm plantations are typically established on former rubber gardens that had become less economically viable. The conversion from rubber to oil palm has been driven both by oil palm's higher economic returns and by its easier management and more secure market access.

However, smallholder oil palm cultivation faces many challenges. Many plantations are entering the replanting phase, and replanting costs are high. In addition, most smallholder oil palm farmers are not organised into strong farmer groups, which limits their access to the government's smallholder oil palm replanting scheme (Peremajaan Sawit Rakyat, PSR)[6] and to sustainable oil palm certification[7].

At the farm level, cultivation problems include limited availability of quality seedlings, high prices for quality seedlings and fertiliser, widespread circulation of fake planting material, labour shortages, and disease and pest pressures such as *Ganoderma* infection and attacks by rats and rhinoceros beetles. High transport costs for harvested fresh fruit bunches (FFB) are compounded by theft incidents, which further reduce net economic benefits. FFB prices are strongly influenced by market dynamics, increasing the vulnerability of smallholder farmers who depend on oil palm yields from monoculture systems.

2 Potential for implementing climate-smart agriculture

Climate-smart agriculture (CSA) is an approach that transforms agricultural systems to become more environmentally sustainable and climate-resilient. It rests on three interlinked pillars:

1. **Productivity** – efforts to increase agricultural productivity and income on the same area of land, for example, through crop diversification and agroforestry;
2. **Adaptation** – strengthening farmers' capacity to adjust and build resilience to the impacts of climate change; and

Photo: Riky M Hilmansyah/ CIFOR-ICRAF Program Indonesia

3. **Mitigation** – reducing greenhouse gas emissions from the agriculture sector, where possible.

Through these three pillars, CSA practices can empower farmers and enhance their resilience to climate impacts and market price volatility. From an economic perspective, CSA can strengthen household livelihood security by diversifying crops and income sources.

Agroforestry[8] —integrating trees with agricultural crops and/or livestock on the same plot of land—is one form of CSA practice. As a single integrated system, agroforestry can improve household livelihood resilience while at the same time contributing to both climate change adaptation and mitigation.

From a social perspective, agroforestry can increase women's participation and create opportunities to access programmes and services. At the same time, agroforestry practices can improve ecosystem health through a range of environmental services, such as storing carbon, maintaining water availability and soil fertility, conserving biodiversity, and reducing pest and disease attacks.

6 The Smallholder Oil Palm Replanting Program (Peremajaan Sawit Rakyat, PSR) is a government financing initiative that helps smallholders to replant their oil palm plantations so that they become more sustainable and higher quality, and to reduce the risk of illegal land clearing.

7 To achieve environmental objectives and increase value added for farmers, oil palm commodity certification is applied, both voluntary schemes such as RSPO and mandatory schemes such as ISPO, which is regulated by Presidential Regulation No. 44/2020.

8 The concept of agroforestry was first introduced in the 1970s by ICRAF. It has been widely practised, including in Indonesia, under various local names such as talun (West Java), tembawang (West Kalimantan), repong (Lampung), wanatani or kebun campur (mixed gardens, more generally), and others. Its definition has continued to evolve, not only at plot level but also at landscape and policy levels (van Noordwijk (ed.), 2019).

In the context of developing key commodities in Kapuas Hulu, agroforestry systems can help address the challenges faced by smallholder farmers. The approach is flexible enough for rubber, coffee, cacao, and even oil palm to be integrated with other suitable crops on the same plot of land. Planting patterns and spacing can be arranged optimally to match local agroclimatic and socio-economic conditions, while applying good agricultural practices for each commodity.

However, the adoption of agroforestry as a CSA approach still faces several challenges, particularly limited farmer understanding of how to implement it in practice. Knowledge gaps extend beyond CSA and agroforestry concepts to good agricultural practices (GAP) and post-harvest management, which means that the benefits obtained so far are not yet optimal. In addition, the limited availability and reach of public extension services are a challenge in itself. This makes the involvement of Independent Extension Agents and Model Farmers a key success factor for the implementation of CSA and agroforestry.

Approach to promoting CSA

Promoting the adoption of CSA requires a long-term, continuous process because it involves changes in the behaviour of smallholder farmers. To understand how such behavioural change happens, the ECSAP program uses the ADKAR framework (Hiatt, 2006): Awareness, Desire, Knowledge, Ability, and Reinforcement. The activities implemented under ECSAP reflect each stage of ADKAR, as shown in Figure 2.

In the initial stages of behavioural change, the process of building **Awareness, Desire,** and **Knowledge** is supported through several tools, including the development of curricula and training materials on CSA and agroforestry in both conventional and digital formats. In addition, Training of Trainers (ToT) is conducted for Independent Extension Agents and Model Farmers, who are expected to train other smallholder farmers.

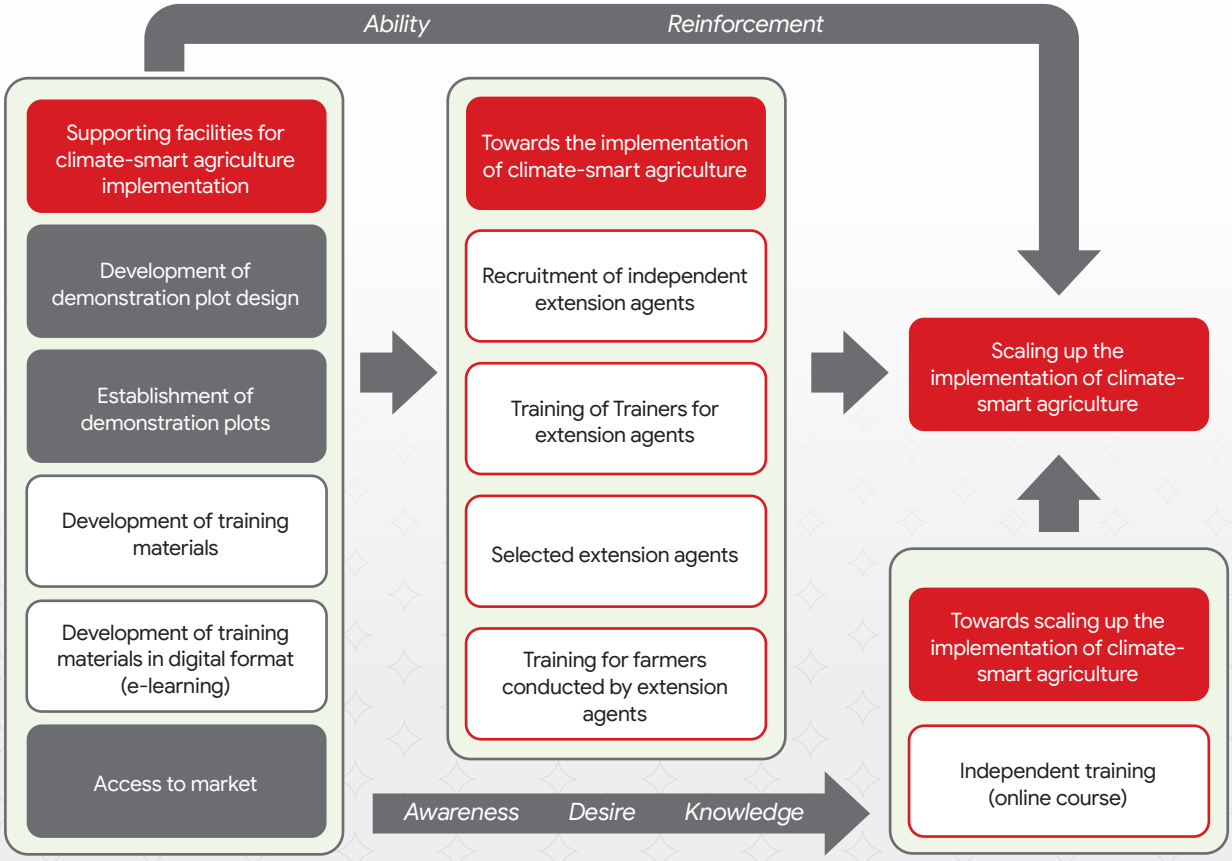


Figure 2. Flowchart of the approach used to implement CSA practices in Kapuas Hulu District, West Kalimantan

To ensure that farmers who already have Awareness, Desire, and Knowledge also develop the Ability to implement CSA practices, agroforestry demonstration plots, and nurseries are established. These provide farmers with direct, hands-on learning spaces and improve their access to high-quality planting material. Facilitating better market access and improved prices for farm products is also a key component of **Reinforcement**, helping to ensure that farmers who have adopted CSA practices do not revert to unsustainable practices.

Towards the adoption of CSA and agroforestry

1 Awareness of CSA

Building awareness of the importance of CSA is the first step towards its adoption. At this stage, farmers need to understand that climate change is already having concrete impacts on agriculture: planting seasons are becoming less predictable, yields are declining, and the risk of crop failure is increasing. Farmers also need to recognise that changes in farming practices are necessary and that adopting CSA is essential for sustaining production and reducing the impacts of climate change.

Awareness and understanding of CSA are strengthened through information campaigns, community dialogues, and extension activities at district and subdistrict levels, including workshops and focus group discussions (FGDs). These involve a range of stakeholders, including Model Farmers, Independent Extension Agents, and field agricultural extension workers. These activities also help develop a shared understanding of smallholder livelihood systems, including farming systems, land productivity, market access, and current cultivation practices for the main commodities—cacao, coffee, rubber, and oil palm. In addition, they explore how smallholder farmers perceive CSA and agroforestry systems for these four key commodities in Kapuas Hulu.

Photo: CIFOR-ICRAF Program Indonesia

2 Desire to adopt CSA

Once farmers understand the importance of CSA, it is crucial to build their desire to support and participate in change. This desire may arise when farmers see why applying CSA on their own land matters—not only to reduce the impacts of climate change, but also to increase productivity and income.

To increase farmers' interest in adopting CSA, the program develops agroforestry demonstration plots as concrete examples and learning sites where farmers can visit and see the benefits of CSA and agroforestry directly.

This approach is implemented in three stages:

1. Involving Independent Extension Agents and Model Farmers in designing the demonstration plots;
2. Establishing demonstration plots on farmers' land in locations that are easy to access; and
3. Mobilising smallholder farmers to visit the plots, learn from them, and discuss experiences with farmers who have successfully adopted the practices through farmer-to-farmer extension.

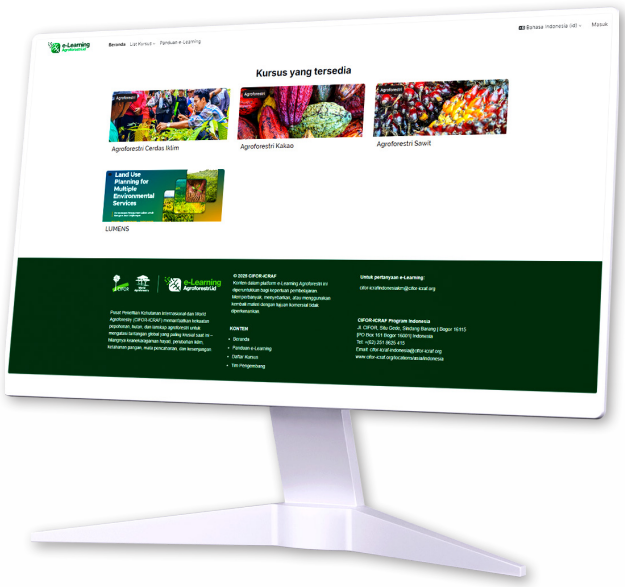
3 Knowledge of CSA

ToT is conducted to strengthen knowledge of CSA practices that are appropriate to the Kapuas Hulu context and how to apply them on farmers' fields. The ToT is based on a curriculum and training materials on CSA and agroforestry for Independent Extension Agents and Model Farmers, developed in both conventional[9] and electronic[10] formats. The curriculum and materials comprise six modules:

1. CSA and agroforestry;
2. Cacao agroforestry;
3. Coffee agroforestry;
4. Rubber agroforestry;
5. Oil palm agroforestry; and
6. Extension strategies to accelerate the adoption of CSA and agroforestry.

9 Training manuals, training materials and collections of posters can be found in the publications section of this webpage: https://www.cifor-icraf.org/project/ECSAP/

10 The electronic training materials (e-learning) are available on several platforms, including Atingi (https://online.atingi.org/course/view.php?id=5445) and the CIFOR-ICRAF E-Learning platform (https://e-learning.agroforestri.id/course/view.php?id=20).



ToT was delivered to 100 Independent Extension Agents and Model Farmers, from whom 24 trainers were selected. These trainers are responsible for disseminating knowledge through training and direct extension to 1,200 smallholder farmers across the three clusters in Kapuas Hulu. Knowledge dissemination is also supported through electronic training materials (e-learning), which are designed to reach younger farmers who understand, are interested in and are willing to learn more about CSA and agroforestry.

4 Ability to implement CSA

Knowledge alone is not enough to change behaviour. If smallholder farmers lack access to inputs, practical skills and other forms of support, their ability to implement CSA and agroforestry will remain constrained.

At this stage, direct field facilitation and the provision of agricultural inputs and tools that support the practices learned are critical. Efforts to strengthen farmers' ability to implement CSA and agroforestry are carried out through several approaches:

Photo: Riyandoko/ CIFOR-ICRAF Program Indonesia

1. Initiating the establishment of nurseries and mother trees garden (as source of scions and buds) to help farmers access quality planting material;
2. Training in vegetative propagation as a way to improve the genetic quality of trees and support the replanting of main and companion species in agroforestry plots;
3. Training in the production of organic fertiliser as a climate-smart and environmentally friendly input; and
4. Providing regular, hands-on support to smallholder farmers in applying CSA and agroforestry, to ensure that the practices introduced during training are actually implemented.

5 Reinforcement to sustain CSA adoption

Once smallholder farmers have the ability to implement CSA and agroforestry, they need reinforcement so that these practices are not abandoned over time. Reinforcement can take the form of improved access to markets for more sustainable products, social recognition, and ongoing technical support.

To help sustain CSA adoption, several activities are implemented, including:

1. Advanced training and regular mentoring for Independent Extension Agents and Model Farmers, so that their knowledge and skills on CSA and agroforestry are continuously updated.
2. Facilitating market access for rubber, coffee and cacao, complemented by post-harvest processing training to improve product quality and value addition.
3. Supporting sustainable oil palm certification to meet global, deforestation-free market standards and to increase the competitiveness of smallholder oil palm products[11].

Way Forward

In the face of growing challenges in the agriculture and plantation sectors under climate change, programme initiatives related to CSA and agroforestry need to be mainstreamed through policy at both local and national levels. This policy brief proposes several recommendations for different stakeholders to support capacity building for smallholder farmers in adopting CSA (Table 1).

11 Through the GRASS and SASCI+ projects, GIZ facilitates various commodity market access partnerships, such as rubber (Continental) and cacao (Kalara Borneo), supports the development of local coffee value-added products by farmers, and facilitates ISPO and RSPO certification for oil palm. https://www.giz.de/sites/default/files/media/pkb-document/2025-07/grass-roots-newsletter-5th-edition-indonesian.pdf

Table 1. Recommendations and stakeholder roles in implementing CSA at different levels

Scope	Recommendation	Stakeholders
Local	Strengthen the capacity of local extension workers on CSA and agroforestry	• District Agriculture and Food Office • NGOs/CSOs/development partners
	Improve market access and access to innovative finance for smallholder farmers	NGOs/CSOs/development partners
	Integrate CSA and agroforestry curricula and materials (both conventional and electronic) into extension workplans and training modules for field agricultural extension workers (PPL)	• Field agricultural extension workers (PPL) • Subdistrict Agricultural Extension Centres (Balai Penyuluhan Pertanian)
	Formally recognise Independent Extension Agents and Model Farmers as community-based extension providers through local decrees or recommendation letters	Local government, particularly the District Agriculture and Food Office
	Develop new agroforestry demonstration plots as sustainable farmer learning sites at the village level, financed through village funds for food security	• Village governments • Local government, particularly the District Agriculture and Food Office and the Community and Village Empowerment Service (Dinas Pemberdayaan Masyarakat dan Desa, DPMP)
	Allocate agricultural inputs and machinery to support CSA and agroforestry adoption at farm level	Local government, particularly the District Agriculture and Food Office
National	Mainstream CSA and agroforestry materials (both conventional and electronic) into human resource development for the extension system	• Agricultural Extension and Human Resources Development Agency, Ministry of Agriculture • Agricultural Training Centres (Balai Besar Pelatihan Pertanian, BBPP) • State agricultural polytechnics in Indonesia
	Promote case studies of good practices and lessons from field-level experiences with CSA and agroforestry	• Ministry of Agriculture • Agricultural Extension and Human Resources Development Agency, Ministry of Agriculture • Agricultural Training Centres (BBPP) • State agricultural polytechnics in Indonesia
General	Disseminate CSA and agroforestry curricula and training materials (both conventional and electronic) to the wider public through diverse information channels	All relevant stakeholders

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diimplementasikan oleh: giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

bekerjasama dengan: KEMENTERIAN PERTANIAN REPUBLIK INDONESIA

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