The Gula Gula Food Forest Program of West Sumatra

Working with nature for ecosystem restoration in the Singkarak river Basin, Solok District.

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Summary Information

Project Title	The Gula Gula Food Forest Program of West Sumatra Working with nature for Ecosystem Restoration in the Singkarak River Basin, Solok District
Project Location – Country/Region/District	Main site: Lake Singkarak watershed, Solok district, West Sumatra, Indonesia (30 ha with additional 50 ha in 2017) Secondary site: Agam district, West Sumatra (35 ha)
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Summary of Proposed Activities	Ecosystem restoration on degraded agricultural uplands into productive and biodiversity-rich food forests by combining Assisted Natural Regeneration with commercial tree planting.
Summary of Proposed Target Groups	The target groups are poor local Minangkabau communities around Singkarak lake, where increasing vulnerable livelihoods and lack of community-based initiatives hamper ecosystem restoration to restore productive upland tree-based systems.

1 Program Aims & Objectives

Started in 2009, the Gula Gula Food Forest Program in West Sumatra aims to integrate climate change mitigation, poverty alleviation and biodiversity enhancement. We envision that the most significant change can be achieved through ecosystem restoration of degraded areas. How and why this desired change is expected to occur is represented in the Theory of Change (Figure 1).

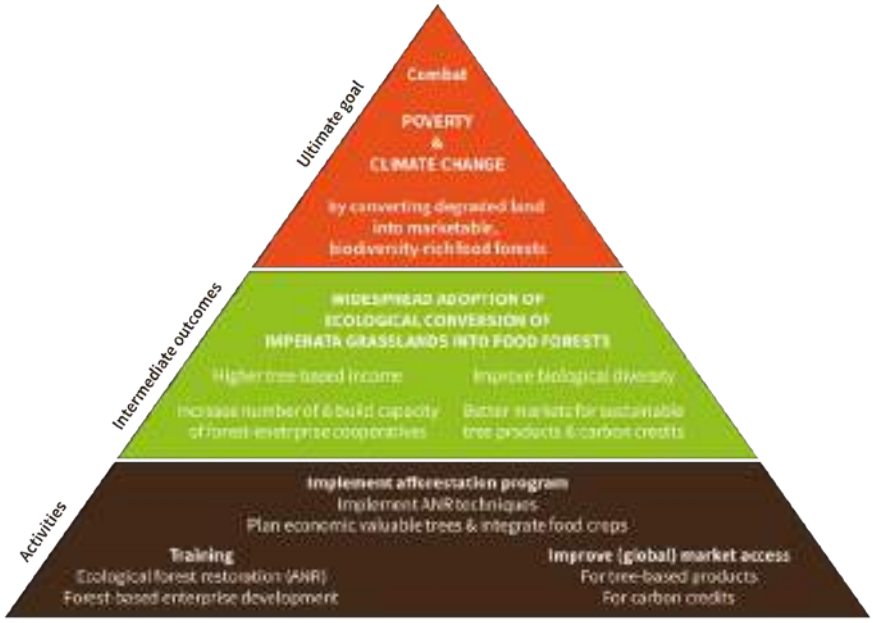
1.1 Ultimate goal and objectives

The ultimate goal is to combat poverty, climate change, and biodiversity losses by converting degraded land into productive, biodiversity-rich food forests.

To achieve the ultimate goal, the objectives of the program are:

- Establish mixed food forests with its associated increase in biodiversity and carbon on degraded land by combining Assisted Natural Regeneration with the planting of economic valuable trees.
- Significantly increase incomes for the local communities from the tree-based product sales.
- Build sustainable business cases that improve incomes through wider (global) market-access for sustainably produced food forest products and carbon credits.
- Empower and increase self-help of communities through ecological forest restoration training and by building community-forest enterprise cooperatives.

Figure 1: The Theory of Change



2 Location of the Gula Gula Food Forest program

2.1 The Singkarak River Basin

The Gula Gula Food Forest is being implemented in the Singkarak river basin, where currently 35ha of degraded agricultural village land is being restored. There is another site of 30 ha in Agam district, West Sumatra. However, we have decided to continue our efforts in the Singkarak Lake Basin (thick blue circle in figure 2). The site in Agam district will continue as a carbon sequestration site, but not further extended.

Figure 2: The Gula Gula Food Forest Sites (blue circles) in Indonesia/West Sumatra province

The Singkarak lake covers 129,000 ha in total. It is a deep depression in the rift valley of the Bukit Barisan mountain range. It takes in water from five streams and rivers from surrounding slopes, while the river basin feeds into important connecting rivers. The lake's natural outflow is via the Ombilin River.

The Singkarak river basin provides important ecosystem service functions.

Hydrological service functions and biodiversity protection are among the most important **environmental** functions. Important **socio-economic** functions consist of income from fishing, domestic water-use, water for irrigated rice production along the shores of the lake and along the connecting rivers. In addition, a 175 MW hydro-electricity power-plant was developed in the 1990s. Situated at the outflow of the lake (Peranginangin et al, 2004), this power-plant adds to the importance of hydrological service functions.

The hydropower plant of Singkarak Lake with its inflow (left)

The main soil types on the slopes are lithosols and Rendzina (Laumonier, 1996). Developed on limestones, these soils are poor in organic matter and have high erosion risks. Forests on these slopes around lake Singkarak have been depleted since the colonial era to provide wood for coal mines. Local communities have since long used these deforested hills for mixed-tree cultivation, including clove trees, fruit trees and government-sponsored pine tree plantations. However, in the 1970s pests and wildfires killed most of the productive trees, while local people claimed that soils dried up after pine trees were planted (Leimona et al, 2015).

Recurrent wildfires have since then turned these hillsides into a grassland/fire climax dominated by *Imperata* grasslands (*Imperata cylindrica* or *alang-alang* in the Indonesian language). Up until today, the uplands remain in a treeless, degraded state, covered with *Imperata* grasslands. About 32% of the area surrounding the lake (18 664 hectare) is considered critical land mostly covered by *Imperata* grassland, while rice paddy (21%), upland crops (17%) and other uses (30%) make up the rest. The satellite image of the lake's current conditions (Figure) show many denuded grass-covered hills around the lake.

Satellite image of lake Singkarak, showing degraded hills surrounding the lake.

3 Socio-Economic Context & the Gula Gula Food Forest

The entire Singkarak watershed hosts over 900,000 people of which around 400,000 live in the *Nagaris* along the shores of the lake. The Singkarak Watershed is situated in the heartland of the matrilineal Minangkabau society.

The *Nagari* is the pre-colonial, political unit for village in Minangkabau society (Von Benda Beckmann, 2001). The *Nagari* boundaries tend to coincide with hydrological sub-catchments. Since the era of decentralization (starting in 2001), the *Nagari* as the political unit has been reinstalled, replacing the administrative "java-based" concept of *desa*.

The Minangkabau culture blends a matrilineal society with Islam, entrepreneurship and a strong tradition of indigenous village government systems, known as *Adat*. The *Adat* regulations stipulate that it is not allowed to sell both the rice and the land from a *sawah giliran*.

3.1 Minangkabau matrilineal culture

In Minangkabau culture, the female family members of a clan (suku) manage and inherit the (irrigated) clan-owned ricefields. A suku consists of the female line of one "mother", so can include a grandmother, mother, sisters, (grand)daughters. These communal ricefields are known as *sawah giliran* or rotational ricefields. Instead of private ownership, access to ricefields can be secured by a female family member of the suku after the females have agreed on who will get the right to cultivate rice during one crop cycle. This right is known as *hak gilir*. In this way, the female who is mostly in need of cultivating rice will usually get a "*hak gilir*". In this way, any female suku member can secure food needs in times of need. Their social and economic power in food production gives women a high social status in the *nagari*. Rice cultivation is important for food security within the family, and provides an important in kind contribution to family wealth.

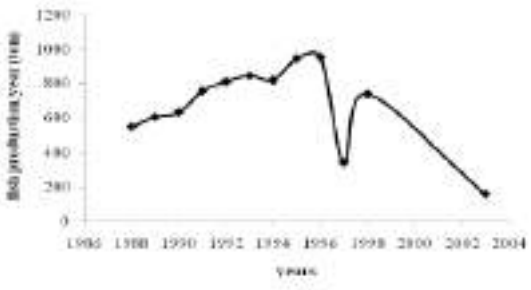


Figure 3: Fish production decline in Lake Singkarak ,1988-2004 (Source: Yuerlita & Perret, 2010)

The main sources of income are from agriculture and fisheries (total 76.5%), indicating that local people depend on the natural ecosystem for their livelihoods. For many, income comes from fishing. However, Figure 3 shows, that fish stocks decreased tremendously between 1996-2003, and has not recovered ever since. Inappropriate fishing techniques and increased sedimentation (causing deaths of fish) are among the main reasons for this decline.

This downward trend is however not limited to fisheries only. Almost every agricultural activity shows this trend, which has further increased the vulnerability of livelihoods, and poverty is widespread. The reliability of the irrigation water for reasons mentioned earlier is significantly reduced. For one, this has negatively impacted on rice

yields. Over the past years, rice yields dropped from an average of 4.2 tons/ha earlier to 3.1 tons/ha nowadays.
In the area where the Gula Gula Food Forest program is situated, the situation is not different. In subdistrict *junjung sirih and* nagari Paninggahan we see a similar pattern. The average monthly income at sub-district level is between 1.3 million to 1.5 million Indonesian Rupiah per month (around € 91 on average, (Tri Martial, 2012). However, in nagari Paninggahan, where the Gula Gula Food Forest (GGFF) Program is implemented, village data show that the situation is even worse; around 1 million rupiah (about € 70) per month. This is almost half the official minimum wage for West Sumatra, set at RP 1,945,000 per month for 2017 (around € 136 per month).

3.2 Improving livelihoods

Through the GGFF, we aim to reverse this trend of downward incomes from agriculture, be it in kind or in cash from selling agricultural produce. In addition to the annual carbon payments to the cooperatives, the livelihoods of individual farmers have started to improve significantly now that various tree products are being harvested.

The distinctive shape of *pinang* trees make it a good tree to serve as a live boundary

Food and income from the rehabilitated slopes mainly comes from planted cloves and various kinds of fruits. P*inang* nuts and mahogany trees are planted along the boundary of the field. Mahogany trees serve as a savings for the (grand) children.

When trees began to bear fruits in 2014, the average income on the restored area increased from zero to an estimated € 900 in the first harvestable year,
and increasing to over € 3,000 for the second year harvest (2015). It must be noted, that this income comes in most cases from less than 0.5 ha per farmer, and prices for cloves were high at the time (almost € 11 per kg dried cloves). The revenue in the first year was generated from about 15 producing trees. Since they planted around 200 trees and production will progressively increase, their income will increase substantially in the (near) future. A future harvest could be on average 40 kg fresh cloves per tree. The dry-weight of cloves is around 33% of fresh weight, so around 13 kg dried cloves per tree. The annual income from clove trees alone could fetch an income for 200 clove trees of

2,640 kg x € 8 = € 21,120 per year per farmer (prices for dried cloves do tend to fluctuate highly between € 6 – € 11). Moreover, their income will also improve in the (near) future as most farmers have begun to apply ANR in other areas as well, and other crops (including fruits) will be harvested in the coming years. As such, their income will be well above the official minimum wage for West Sumatra (set at around € 136/month for 2017). Many farmers are now eager to join the program.

Although clove trees remain dominant, farmers also plant a wide range of other trees, including pinang, melon, cocoa and mangosteen.

Additional income is generated at the cooperative level. Annual carbon payments under the VCM contract are made at the cooperative level, not to individual farmers. The cooperatives invest the annual carbon payments in productive activities. One cooperative invested its carbon revenues in a cattle-fattening program. The sale of the first animal brought substantial new funds into the cooperative, which will be used for further extension of ecosystem rehabilitation. Another cooperative, all women, used the carbon revenues to cultivate ginger in between growing trees as a short-term food and cash crop. Other cooperatives began to convert additional land for rehabilitation. One cooperative recently initiated a savings program. From the earnings of the agroforestry products, members said they put 20,000 rupiah (€ 1.5) into the cooperative's account on a weekly basis during the harvest.

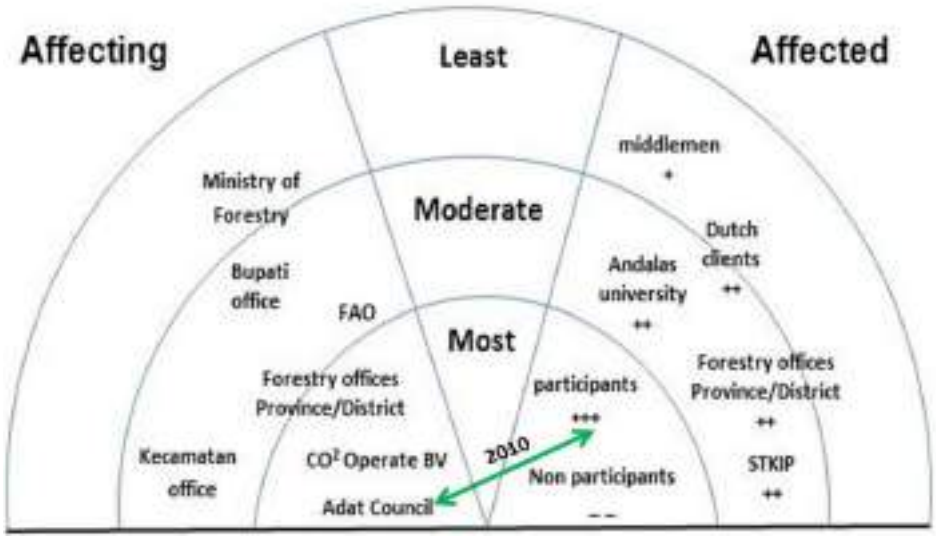
Female participants planted ginger for food and quick income

4 Stakeholders & Target Groups in nagari Paninggahan

Various participatory methods were used before starting the Gula Gula Food Forest program in 2009. A stakeholder analysis was done, using a rainbow diagram. Different stakeholders, potential allies, target groups and detractors can be visualized. It is important to know your

allies and detractors. It shows to what extent a stakeholder is able to affect the program in a positive or negative way, or to what extend a specific stakeholder would be affected by the program (positively or negatively). Figure 4 below shows the result of the stakeholder analysis we conducted among farmer households, farmer groups, government staff and local knowledge centres (College, University).

Figure 4: Rainbow diagram with stakeholders affecting or being affected by ecosystem restoration through the voluntary carbon market initiative.



The diagram showed that village-level institutions, the *Adat* council in particular, are most influential, as they also manage land issues. *It made clear that we were to follow the local structures and* start working through the Village *Adat* council to select the participants for rehabilitation. The community generally trusts that their *nagari* leaders will govern and enforce norms and conventions for the sake of overall prosperity. As a member of the council, the *wali nagari* (village head) would then also be directly involved.

4.1 The Institutional set up

We began a negotiation process called FPIC (or Free, Prior and Informed Consent) to see if the community was interested enough in our program. Through FPIC the proposed intervention was fully explained and negotiated with the community members and local indigenous bodies to give them the right to decide whether they will agree to the project or not. , once they have a full and accurate understanding of the implications of the project on them and their customary land.

4.2 The performance-based carbon contract

The performance-based contract for carbon sequestration was also discussed in detail, including all rights and responsibilities of all parties, including CO^2 Operate BV, the Village *Adat* council and the participating farmers. After consensus was achieved, and farmers agreed to participate, the strong and well-defined customary norms and conventions guided

Land area, contract were all discussed openly with farmers and other stakeholders

the VCM institutional set up. For the success of the program start we judged that it would first be most important to select participants eager enough to make it a success. If benefits are clear, it could then spread to other farming households who might initially be reluctant to join. Collective action was established by organizing interested farmers in farmer groups, where each group would be responsible for a certain land area. Each farmer group would be coordinated by one of the *Adat* village elites, in line with the *Adat* hierarchical system.

4.3 Solving conflicts

Unfortunately, the strong chieftaincy caused group members to be reluctant to speak out their ideas and concerns about the performance of the rehabilitation work. Ultimately, this caused a protest of group members against the strong chieftaincy. They were frustrating rather than supporting the performance-based rehabilitation efforts. A conflicting situation developed, when the handing over of seedling by the village elites to the members of the farmer groups came too late, even though they were already delivered to the *wali nagari* office weeks before by the forestry department. Farmers began to protest openly, who felt ashamed and understood it could limit the performance of the carbon sequestration and hamper carbon payments to them. It resulted not only in the forced resignation of the *Wali Nagari* as project coordinator, but also making him to resign from his position as *Wali Nagari.* The village elite, which included the *Adat* leaders, also had to resign from the activities.

Meeting where unhappy participants requested the Adat leaders to resign from the activities

4.4 Working with democratic organized farmer groups

The farmer-participants requested for a new, transparent and direct agreement between CO^2 Operate BV and the farmer groups only. In 2011, the new W*ali Nagari* and the *Adat Council* agreed that they would be taken out of the contract as direct partners. Instead,

they were given a function in dealing with land distribution only (the green arrow in Figure 4). The new farmer groups were set up based on horizontal social relations. This increased effective participation within and between farmer groups. New participants were chosen independently by the members of each farmer group in an open and transparent way, and by general agreement/vote. Ever since, the carbon sequestration targets and ecosystem restoration have improved considerably. The democratic organization and rules within the cooperatives continue to be the backbone of hard work and success of the program.

5 Land Tenure & Carbon Rights

Decentralization processes from early 2000 onwards paved the way to change the system of governance in West Sumatra from 'village' (*desa*) into the original, pre- colonial governance structure in Minangkabau culture, the *'nagari'*. The *nagari* system recognizes the traditional effectiveness of local communities in managing natural resources, including the land.

5.1 The village and its territory: the Nagari

A *nagari* comprises of the village–territory and the agricultural land. Under *nagari*, land ownership – or more precisely the 'right to use' the land–is governed through the locally defined rules of the *Adat*. The *Adat* Council is the highest governmental body of the *nagari*. Besides ricefields that go along female lines of a *suku* (clan), land of the surrounding hilly landscape in Singkarak is communally managed by both men and female, either at the level of (extended) families or at the *nagari* level (*tanah ulayat nagari*). This is usually land for the benefit of the entire *nagari*, like mosques and schools, but also for specific forest areas which are managed at the *nagari* level (*hutan adat*). However, these are not present in nagari Paninggahan. The hilly dryland agricultural areas belong to the (extended) families and consist of two main types of land ownership under the *Adat* system: 'tribal land' (*Tanah Kaum/Suku*) and 'king land' (*Tanah Rajo*). The former is owned by members of customary groups under the matrilineal system (the female lineage, those with "blood" from one mother). The *Tanah Rajo* is open-access land, which is owned by whoever initially cultivated it; this land can be inherited, but are managed and controlled by the oldest man in the matrilineal lineage, or Datuk. Again, one cannot sell both categories of land. These informal rules are well-defined and enforced. The communities are also well-aware of the formal rules enforced by the state. For instance, state forest land is usually situated beyond the boundaries of a *nagari, and respected as belonging to the government. The Gula Gula Food Forest Program limits its interventions to the well-defined customary, under adat control tanah kaum and tanah rajo (see for instance H. Tegnan, 2015, for more background information; https://www.iss.nl/fileadmin/ASSETS/iss/Research_and_projects/Research_networks/LDPI/CMCP_46-Tegnan.pdf.)*

5.2 Carbon rights and payment schemes

Ownership and benefit sharing mechanisms from selling carbon have been discussed in full detail during the FPIC meetings and with the adjusted contract after the conflict. In the

beginning, the participants requested our support to apply for a formal (cooperative) status for each farmer group. This formal status would enable each farmer group to open a cooperative bank-account. Carbon payments could be made directly into the account of each cooperative. Currently, there are 4 official cooperative farmer groups which remain the basis for further extension (and adopt new members).

There are two different carbon off-setting contracts.

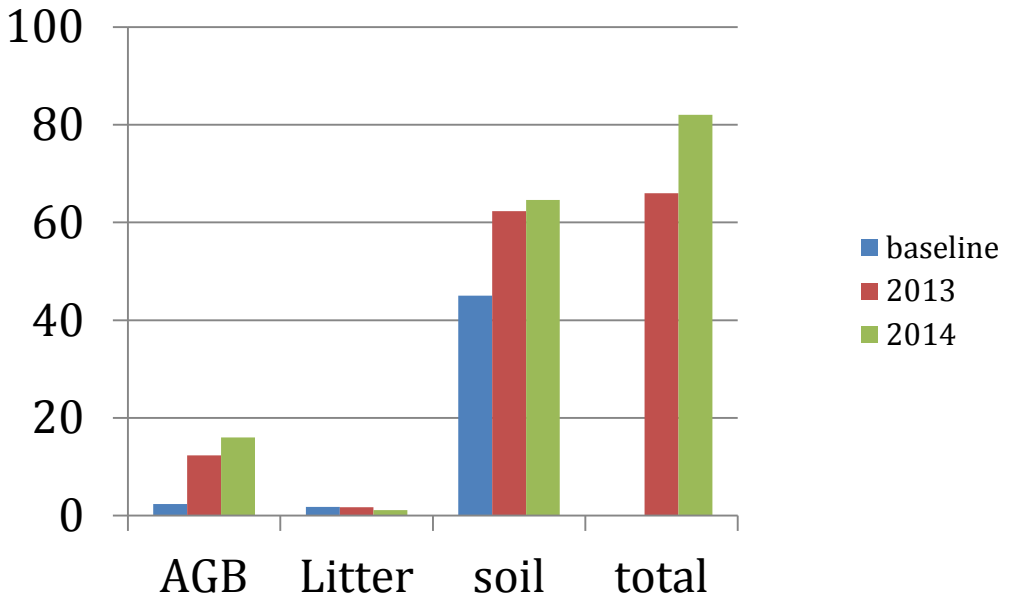
- The first one concerns carbon rights based on project costs. A price per tonne of captured CO_2 is paid that ensures the costs of project development will be covered. These carbon off setting contracts allow to restore a specific new degraded area into a productive food forest, which takes for 5 years to establish, when cloves and other products can be harvested. The 5-year carbon offsetting contract bridges the income gap between planting and harvesting. Under this contract arrangement, CO^2 Operate BV sells the carbon ex ante to a client, based on the carbon assessments that have been made annually over the past 6 years, when the first 60 ha were restored from Imperata grassland into productive food forests. The benefit sharing mechanism is 33% for CO^2 Operate BV and 7% go to the local program managers (RPL). The remaining 60% goes to the farmer cooperatives, and covers annual carbon payments and costs related to managing the village nursery and seedling establishment.
- The second carbon off-setting contract starts after the initial 5 year period of food forest establishment and tree products can be harvested (mainly fruits and cloves). As the trees continue to grow, and carbon being fixed, the aim is to continue selling this additional carbon sequestration each year. This would be possible, as it is a continuation of the carbon trading scheme. As this phase no longer involves the restoration costs as trees are already well established, the (rather low) international carbon credit prices can be used, currently around € 4-5 per tonne of $CO_{2\ eq}$. Discussing this second phase with the farmers, it was suggested that around 70% would go to CO^2 Operate BV and the local NGO RPL, as the farmers reap the full benefits from selling the tree products. Any continuation of carbon payments would be viewed as a bonus, according to the farmers. Therefore, they agreed that the arrangements are reversed after 5 years, and knowing that the price per tonne CO_{2eq} is much lower. The farmers understand that the sale of the "bonus" carbon credits would need official certification for them to be easily sold, hence CO^2 Operate BV and RPL must cover the costs for the official carbon registration/credits and auditing. CO^2 Operate BV and RPL will continue to provide support in the form of technological advice, lobby for the cooperatives at government offices whenever needed and that they will search for new clients. The term *gotong royong*, or reciprocal help, was mentioned by the farmers. Where they received tremendous support in establishing their productive food forest in the beginning, they would now support CO^2 Operate BV and RPL activities that allow everyone to continue working together.

5.3 Carbon sequestration

Over the years, CO^2 Operate BV staff in collaboration with staff and students from the Geography faculty of the teacher's college STKIP in Padang, have monitored and measured carbon sequestration in the field. A combination of the official IPCC methodology and

specific methods for agroforestry systems, developed by the World Agroforestry Centre in Bogor are being used. The program also collaborates with the laboratory of Andalas University, where soil carbon is measured of "randomly" collected soil samples in the food forest area. Analysis of the soil is important, as the decaying *Imperata* grasses add substantial amounts of carbon to the soils (Figure 5). Roughly speaking, over the first 5 year-period of food forest establishment we found a total carbon sequestration of 150 tons of carbon per ha. The time-averaged carbon sequestration during the first 5-year period of food forest establishment is therefore 30 tons CO_2eq/year/ha.

Figure 5: Carbon sequestration in the Gula Gula Food Forest area



CO^2 Operate BV staff and farmers participate in the annual carbon assessment done by students and staff from STKIP Padang.

6 Ecosystem restoration at work

6.1 Assisted Natural Regeneration (ANR) and tree planting

The normal farming practice to open up *Imperata* grasslands is slashing, uprooting and clean-weeding the *Imperata* grasslands in order to plant trees or annual crops. Initially, the Gula Gula Food Forest Program followed this method of reclaiming the land. However, it caused the soil to dry out as the soil is fully exposed to solar radiation. This was aggravated by the drought period caused by El Nino in 2009-2010. The planted trees died under severe solar radiation and lack of rainfall

Working against nature:
The tradition of slashing, uprooting and clean-weeding before tree planting proved to be ineffective for ecosystem restoration

6.2 Collaborating with the Food and Agriculture Organisation

Early 2012, the Food and Agriculture Organisation (FAO) requested us to field-test Assisted Natural Regeneration as a low cost opportunity to restore forests on degraded lands. The big advantage of Assisted Natural Regeneration is that *Imperata* grasslands no longer need to be uprooted and removed, but are simply pressed, using a lodging board. Small, indigenous tree seedlings, which are found in between the *Imperata* grasses, are protected and allowed to grow after pressing the grasses.
This technology has shown a tree growth beyond expectations. Quick gains in carbon stocks were achieved. The growth of the present indigenous species was no longer suppressed. With this knowledge, we began experimenting how to integrate ANR into the VCM activities. The farmers appeared very enthusiastic about the ANR practices, especially in combination with the planting of economic valuable agroforestry trees, as the fast-growing indigenous trees provide favourable micro-climatic conditions for the planted economic valuable trees. In addition, the pressed *Imperata* grasses form a thick isolation blanket, thereby reducing soil temperatures and conserving moisture. Even after a 5-6 weeks dry period we found that the soils below the pressed Imperata remained moist. The decaying *Imperata* provides additional carbon to the soil. The “trapped” moisture and added carbon in the soil most likely explain the rather fast accumulation of soil carbon and fast growth of the trees.

Pressed Imperata grasses provide isolation against evaporation, while decaying imperata adds biomass and carbon to the soil

Pressing Imperata grasslands is a very easy, cost-effective and labour-saving activity compared to the usual practice of slashing, uprooting and often burning of Imperata grasses. When existing trees in between the Imperata grasses are given light and opportunity to grow (picture in the middle), tree cover can be restored in just 6 years (see below).

Combining Assisted Natural Regeneration with the planting of economic valuable trees brings back tree cover in just 5-6 years, and speeds up carbon sequestration

6.3 Monitoring Biodiversity enhancement

As can be seen from the pictures, within 5 years an improved land use develops and a biodiverse food forest establishes which combines the growth of indigenous species with planted agroforestry trees. Besides providing better incomes and a more diverse food pattern for the local community, this forest-like structure begins to provide increasing corridor and habitat functions for a growing number of animals and plants. After 3-4 years we began to see animal tracks in the site and animal-induced tree damage.

Signs of wildlife: tracks of wild boar, damaged trees by deer and monkeys

Farmers see and hear an increasing sound of various types of birds, and found more and more proof of animals using the restored area. In order to find out what animals were visiting the Food Forest, we installed a camera trap. Although we only placed one camera so far, the results have been incredible. A wide variety of birds, monkeys, deer and wild boar are regularly recorded. Birds of prey include eagle and owl (meaning that small animals are also present). More recently, hornbills are sometimes spotted. The farmers judge that the birds divert their flying routes and now use the food forest to rest and find shelter when flying from one patch of forest to another. They are quite excited to see so many different animals using their food forest to hunt, feed, seek shelter or roam around.

The most spectacular animals we think are the Asian leopard, while recently tracks of the Sumatran tiger were spotted. In fact, the farmers sometimes see the tiger close to the site.

Asian Leopard and a 5 toe footprint: proof of a Sumatran Tiger in our Gula Gula site

A variety of bird species are caught on camera, including an owl (middle) and an eagle (right), proof of the presence of small animals that can be hunted.

Deer, wild boar with youngsters, and a kind of squirrel (Tupai), one of the animals hunted by birds of prey.

Some selfies: Various kinds of monkeys have put themselves on camera, including the mitred leaf monkey (right), which is on the IUCN red list.

Another remarkable development is the spread of a plant, called *curcuma zedoaria (left)*. Farmers only know it from the rainforest, but now appears in more and more areas in the food forest. This could point to the fact, that environmental conditions in the food forest resemble a rainforest climate.

We will monitor these developments more systematically from 2017 onwards. Not only will we place a second camera trap, together with the faculty of Biology from STKIP we will set up a research activity to monitor and start to make inventories of the flora and fauna in our site.

6.4 Water storage and improved hydrological conditions

Recently, farmers discovered a well in the site, which has never been there. Apparently it holds water year-round, and could be a sign of improved hydrological functions. We plan to do research into this issue together with STKIP staff and staff from Andalas University.

7 Non-Eligible activities to enhance carbon sequestration

7.1 Training Assisted Natural Regeneration with tree planting

For the success of carbon sequestration, capacity building is a crucial component.

We have developed training modules and training manuals for new participants in the carbon project.

We have developed training manual in Bahasa Indonesia. We make increasingly use of farmer to farmer training, now that more and more farmer experts exist. The course lasts 1 day. A morning session in the “classroom”, explaining Assisted Natural Regeneration whereby farmers from existing cooperatives explain their experiences with ANR. In the afternoon, new members are allowed to practice ANR using a lodging board, while also marking trees. Experienced farmers will guide new members.

7.2 How carbon sequestration and carbon trading works

During the training, in the morning, one session focuses on the complex carbon sequestration issues. This is done with staff from the teacher’s college STKIP. It proved to be an important component for the motivation of the farmers. Once farmers have the basic understanding of the workings of the carbon market, they begin protecting trees already present in the field, as they understand the standing wood has value (the carbon). We had several farmers with some big trees in the field, who refused to cut them and sell to timber traders, who regularly visit the villages.

7.3 Nursery development training

In 2012, the Forestry Department started to support a farmer cooperative with funds and expertise to develop a nursery, to replace costly seedling deliveries for the program. The Gula Gula Food Forest Program has adopted this activity, and all cooperatives now run their own tree nurseries, they grow seedlings from seeds. The nurseries nowadays are fully managed and operated by the farmers. The forestry department however continues to provide advice where needed and most important, where to get the best quality seeds for different agroforestry trees.

The cooperatives develop and manage the nurseries themselves, after initial support from Forestry staff.

7.4 Biodiverse products

Recently, CO^2 Operate BV has begun to import tree-products that originate from the food forests. We have started with *arenga* palm sugar. It is sold directly to customers and in the Business to Business segments. A collaboration has been developed with a cookie factory and a distiller in the Netherlands. Palm sugar cookies and palmsugar rum find their ways into supermarkets in the Netherlands. The rum also attracts clientele from hotels and luxury/hipster bars. For all products sold a specific percentage of the profit is set aside, large enough to allow us to invest in new village nurseries and training costs for farmers. In 2017, we aim to broaden our product range, and will include local production of essential oils from cloves from our Gula Gula Food Forest.

8 Long-Term Sustainability Drivers

8.1 Project Design and sustainability

First of all, the Food Forest provides an income for the farmers through harvesting tree products. It means that the trees are only beneficial to the farmers if trees are not cut down, as their income grows on the trees. Sustainability is therefore embedded in the choice of tree crops.

Secondly, following the latest global climate discussions in general, but carbon tax systems in particular, we anticipate that off-setting and hence income from carbon credits will continue to grow the coming years.

Third, in order to diversify income sources for the farmers, we are also looking at a "worst case" scenario, the collapse of carbon markets. Therefore, we have started to work on requests from the cooperatives to help them with access to foreign markets for their products (see above section on biodiverse products).

Our experiences and market entry points for the *arenga* palm sugar products, we aim to broaden our product range with the processing of clove oil from the Gula Gula Food Forest program. Various market studies point to a fast growing market, for essential oils. With good potential to attract funding for developing processing facilities in the area, we aim to develop a cooperative processing unit for clove essential oil in 2017. Ultimately, the unit will be managed by the NGO RPL together with the farmers in a cooperative way. CO^2Operate BV will remain as preferred buyer.

Finally, another activity that will improve sustainability is a collaboration with a Dutch-Indonesian based travel agent, called Indo-tracks. They will compensate the carbon emissions from their clients in our site. Travelers booking their Indonesian trip through this agency, will also be allowed to plant their carbon sequestration trees themselves in the Gula Gula Food Forest area of Singkarak. A 1-2 day eco-tourism trip for the clients to visit the site is currently being developed. Staff from the local NGO RPL will host these trips in collaboration with the farming community. This kind of ecotourism will be another source of income for the people in Singkarak.

These additional options to earn a better income from clove production and processing in the area provides further incentives for farmers to involve in the ecosystem restoration using our ecological approach, especially when we are able to support them to access the (global) market. The ecological approach, using ANR with tree planting, will become a prerequisite to deliver to the processing unit.

9 Organization & Proposed Governance Structure

9.1 Program Organisational Structure

Over the years, we have built and developed a good collaboration and relationships with various government institutions, local universities, and the farming communities. In order to operate more effectively and get a sound and official representation in the area, we have formalised the collaboration among partners and CO^2 Operate BV staff by setting up a NGO, called Rimbo Pangan Lestari (RPL). Figure 6 below shows the entire governance structure for

our activities in West Sumatra and Java (Jakarta) to continue working on ecosystem restoration. The (governance) structure for the biodiverse product sales is also included (the right side of the graph).

CO^2 Operate BV

CO^2 Operate BV acts as the project coordinator. The legal status is BV (Besloten Vennootschap), or private limited company (Ltd). CO^2 Operate BV is a recognised social enterprise. For more information see (https://www.social-enterprise.nl/wie-doen-het/co2-operate/).
CO^2 Operate BV is the link between carbon off setting clients in the EU and the Gula Gula Food Forest Program. CO^2Operate BV manages the off-setting activities and does all official work related to carbon certification and carbon credit administration. Secondly, with its partners, CO^2 Operate BV brings the biodiverse products from the Food Forests into the market, and re-invests apartof the profits into the Gula Gula Food Forest Program.

NGO Rimbo Pangan Lestari (RPL)

RPL manages the carbon funds and profit-sharing funds from the product sales. RPL staff is also engaged in the daily supervision of the field activities and in direct contact with the farmer cooperatives. Together with CO^2 Operate BV, they are the direct contact for our collaborative partners in West Sumatra, ranging from the farmer cooperatives and the government and non-government institutions, research activities and possibly donors.
RPL organises and conducts farmer training in relation to ANR/carbon market and conducts annual carbon assessments under supervision of staff from STKIP.

STKIP

CO^2 Operate BV has a formal collaboration with STKIP, a signed MoU can be found as an attachment to this document. With STKIP we collaborate on knowledge sharing/joint field research activities. Many students conduct their BSc field research in our site. With Andalas University we have an informal collaboration, mainly in relation to using their laboratory services for soil analyses and other technical research that cannot be done at STKIP. This year (2017), we aim to include some Indonesian students from Andalas University doing their Master research in our site. We believe that capacity building in ecosystem restoration of local young people is crucial for a sustainable future.

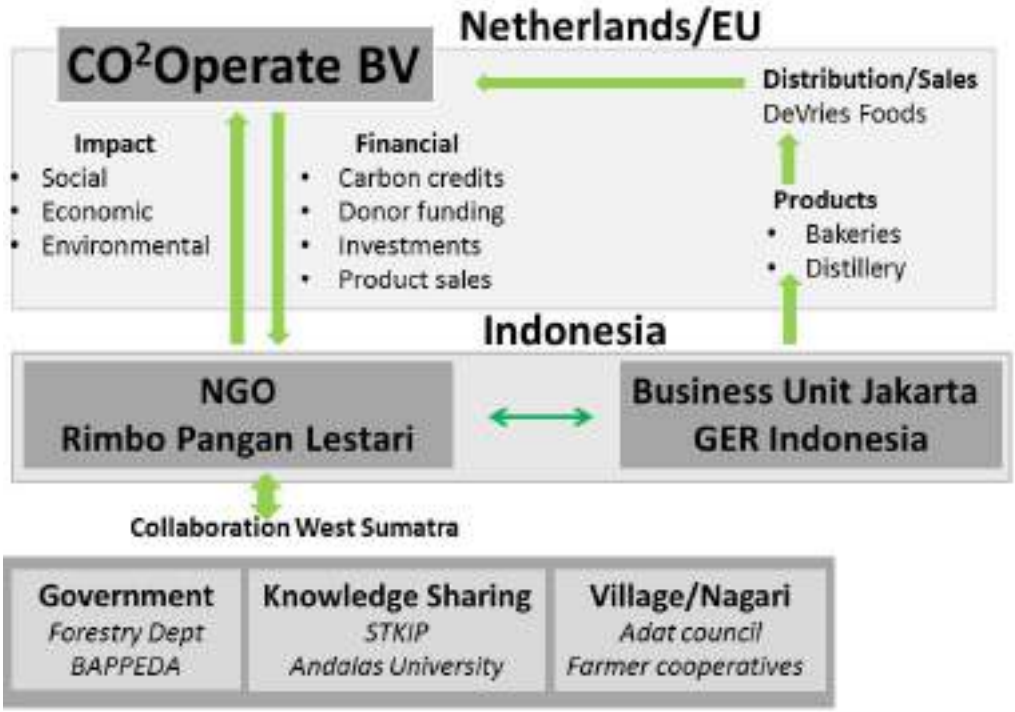
Provincial Forestry Department

The provincial Forestry Department and district office of the Forestry Department in Solok are important partners as a government stakeholder, allowing our work to be rooted in local government priorities. Initially, they supported our work by giving out seedlings, helping us with a “licence to operate”. This has now moved towards training farmers on how to raise their own seedlings in cooperative village nurseries. They can be contacted for many other issues, such as government land issues, joint proposal writing and other issues that could help move forward the Gula Gula Food Forest Program. Recently, our collaboration with FAO has led to begin developing a national program on Assisted Natural Regeneration (ANR) through the Ministry of Environment and Forestry. We were able to get ANR on the political agenda of Forestry. This will strengthen our collaboration and position in Indonesia.

GER Indonesia

For the commercial component in relation to product development/exports we collaborate with a business unit in Jakarta, the social enterprise GER Indonesia (Green Enviro Resources Indonesia).

Figure 6: The governance structure of the Gula Gula Food Forest Program



With all these partners, the main list of activities and responsibilities are listed below.

Table 1: Main activities/responsibilities of the parties in the governance structure

	CO^2 Operate	RPL	Forestry	STKIP	Cooperative	Wali Nagari
Administrative						
PV sale agreements recording	X					
Project financial management	X	X				
Coordinating/reporting monitoring	X	X				
Negotiating sales PV certificates	X				X	
Managing project data	X	X				
Project validation & verification	X	X			X	
TECHNICAL						
Technical support & training producers		X	X	X		
Developing, reviewing agroforestry systems	X	X		X	X	
Participatory Biodiversity assessments		X		X	X	
Evaluating plan vivos	X	X		X	X	X
Monitoring plan vivos	X	X			X	X
SOCIAL		X				
FPIC/workshops communities		X	X	X	X	X
Socio-economic data gathering for impact reporting		X		X		X
Land-tenure issues		X	X		X	X
Development cooperative structures		X			X	X
Selection new members		X			X	X

9.2 Community-Led Design Plan

The program runs already for over 6 years now. At the start of our activities, CO^2 Operate BV used FPIC procedures to ensure agreement, understanding and embeddedness into local practices, culture, community priorities and needs (see section C for details).

During these meetings, the village head (*wali nagari*) and farmers were present to discuss the carbon design plan. Changes to the lay out of the contract have been made by the farmers at the start in 2009, including payment schemes. For instance, farmers suggested that the equal distribution of funds over a 5-year period should change towards a more step-wise approach. Since the highest costs/input of labour are at the beginning, and therefore 50% of the total 5-year carbon payments had to be done in the first year, 20 % in the second, 15% in the third, 10% in the fourth year, and 5% by the end of the contract, when trees start bearing fruits. The reason is very valid, as it will bridge the gap between costs and lack of income during establishment in the beginning without income from the trees.

During these meetings, farmers themselves requested to include a penalty system for those not meeting the quality required, so that they could for instance replace members not doing their job. This was included in the renewed, direct carbon contract between CO^2 Operate BV and the cooperatives after the conflict. The current contract is adjusted to fit everyone's needs and fully accepted by the cooperatives. Seeing their input included has given them a large sense of ownership. This has increased responsibilities to work towards a successful program tremendously.

Another development towards more effective collaboration resulted from one of the group meetings in the early stage of the program. Cooperative members requested our support to apply for a formal (cooperative) status for each farmer group. This would enable each farmer group to open a cooperative bank-account, and carbon payments could be made directly into the account. In 2011, this has been done. The formal status also enables them to apply for development funds from the local government. Recently, together with the *wali nigari,* the farmers were able to attract funds to build a small motorcycle road up the hills, allowing them to carry the harvest from the food forest by motorcycle to the village.

9.3 Participatory monitoring and evaluation

Field staff of CO^2 Operate BV (starting January 2017 staff from RPL) meets every two weeks with the heads and members of each cooperative to discuss progress and possible issues that need to be looked into. CO^2 Operate staff also conducts field checks every month with the farmers. CO^2 Operate BV staff in the Netherlands visits the field at least twice a year. Every year, CO^2 Operate BV staff from the Netherlands conducts a participatory evaluation. Results are discussed with the farmer groups and staff of the local NGO and the *wali nagari.* This is the moment to decide on carbon payments with the cooperative members, based on the monthly reports and carbon assessment over the past year.

A big advantage nowadays is that most of the cooperative members are using whatsapp. CO^2 Operate BV staff in the Netherlands has weekly, and sometimes daily contact with the farmers, the *wali nagari* and sometimes Forestry staff using Whatsapp and Facebook (Messenger). It shows everyone trusts each other and feels free to discuss any issue, even

with the Dutch staff of CO^2 Operate BV.

10 Additionality Analysis

The hilly upland areas under Adat law around lake Singkarak have been left idle since the mid-1970s according to the farmers. Many stories exist of farmers, who explained that their parents were traumatised when pests and diseases killed all their productive trees on the hills starting from the 1970s onwards. Many families got bankrupt, as many families were still waiting for their first harvest. This collective trauma left the slopes unmanaged ever since, allowing *Imperata* grasslands to spread and conquer the hilly uplands on a massive scale. Jeanes (2015) analysed a huge amount of secondary sources on the history of land use in Singkarak. It clearly shows that grasslands begin to appear in official statistics of the lake basin since the 1970s, confirming the farmer stories (Table 2 below). Additionality is therefore very strong in the Gula Gula Food Forest Program. Before the program was implemented, the degraded hills were not targetted for ecosystem restoration efforts or restoration of (perennial) garden areas, not by the communities nor by the (local) government. For one, the government focuses on State Forest Land, and *hutan adat*. REDD+ targets quantified by the Government refer to areas classified as "forest lands". The degraded areas classified as tanah Kaum/Tanah Rajo are not included in the (local) government programs, as they are under full responsibility of the *nagari institutions*.

Table 2: History of Land cover change in the Singkarak-Ombilin basin

Time Line	Data source / Reference		Sub-catchment or Sub-basin / Forested Areas				
			Ombilin Sub-Basin	Lake Basin	Lembang	Sumani	Selo
			Mt. Marapi & Malintang volcanoes Eastern watershed hills	Mt. Marapi, Singgalang & Talang volcanoes Bukit Barisan slopes	Mt. Talang volcano	Mt. Talang volcano Bukit Barisan slopes	Mt. Marapi & Malintang volcanoes Eastern watershed hills
1700's	Marsden (1783)	upland	forest	forest	forest	forest	forest
		lowland	agriculture ?	agriculture?	forest	agriculture ?	agriculture ?
1930's	van Steenis (1935)	upland	forest (upper to mid slopes)	forest (43%) (upper to mid slopes)	forest (25%) (upper slopes) scrubland (mid slopes)	forest (42%) (upper to mid slopes)	forest (15%) (upper to mid slopes)
		lowland	agriculture	agriculture	agriculture	agriculture	agriculture
1950's	Hannibal (1952)	upland	forest (upper to mid slopes)	forest (29%) (upper to mid slopes)	forest (11%) (upper slopes) scrubland (mid slopes)	forest (21%) (upper to mid slopes)	forest (26%) (upper to mid slopes)
		lowland	agriculture grasslands	agriculture ricefields	agriculture ricefields	agriculture ricefields	agriculture ricefields
1970's	BLKT Sumatera Barat (1995) Laumonier et.al. (1986)	upland	forest (upper slopes) grassland / scrubland (mid-slopes)	forest (23 - 34%) (upper slopes) grassland / scrubland (mid-slopes)	forest (5 - 10%) (upper slopes) grassland / scrubland (mid slopes)	forest (24%) (upper slopes) grassland / scrubland (mid-slopes)	forest (16 - 26%) (upper slopes) agriculture (mid-slopes)
		lowland	agriculture tree gardens grassland / scrubland	agriculture (5 - 7%) ricefields (22 - 26%) tree gardens (15 - 17%)	agriculture (5%) ricefields (13%) tree gardens (13%)	agriculture (7 - 9%) ricefields (14%) tree gardens (7 - 10%)	agriculture (12%) ricefields (21 - 27%) tree gardens (9%)
1980's	RePPProt (1988) Peranginangin et.al. (2004)	upland	forest (20%) (upper-mid slopes) agriculture / grassland (mid-slopes)	forest (30 - 32%) (upper slopes) scrubland / agriculture (mid-slopes)	forest (15%) (upper slopes) agriculture (mid-slopes)	forest (23 - 39%) (upper slopes) grassland / scrubland (mid-slopes)	forest (39%) (upper-mid slopes) agriculture (mid-slopes)
		lowland	agriculture (18%) ricefields (13%) tree gardens (10%)	agriculture (12% -21%) ricefields (22 - 19%) tree gardens (6 - 14%)	agriculture (15%) ricefields (46%)	agriculture (9 - 14%) ricefields (16 - 41%) tree gardens (4%)	agriculture tree gardens (46%) grassland (12%)
1990's	Ministry of Forestry (1996) Ministry of Forestry (1999) Helmi (2001) Peranginangin et.al. (2004)	upland	forest (14%) (upper slopes) grassland / scrubland (mid-slopes)	forest (25%) (upper slopes) grassland / scrubland (mid-slopes)	forest (36%) (upper slopes) agriculture (mid slopes)	forest (36%) (upper slopes) grassland / scrubland (mid-slopes)	forest (32%) (upper slopes) agriculture (mid slopes)
		lowland	agriculture (25%) ricefields (11%) tree gardens (13%)	agriculture (15%) ricefields (15%) tree gardens (7%)	agriculture (19%) ricefields (43%)	agriculture (15%) ricefields (41%)	agriculture (12%) ricefields (51%)
2000's	PSDA Sumatera Barat (2004d) Farida et.al. (2005) - ICRAF	upland	forest (18%) (upper slopes) grassland / scrubland (mid-slopes)	forest (21%) (upper slopes) grassland / scrubland (mid-slopes)	forest (4%) (upper slopes) scrubland (mid-slopes)	forest (14%) (upper slopes) grassland / scrubland (mid-slopes)	forest (32%) (upper slopes) agriculture (mid slopes)
		lowland	agriculture (30%) ricefields (10%) tree gardens (29%)	agriculture (18%) ricefields (17%) tree gardens (17%)	agriculture (18%) ricefields (35%) tree gardens (12%)	agriculture (24%) ricefields (24%) tree gardens (18%)	agriculture (27%) ricefields (14%) tree gardens (23%)

Source: Jeanes, 2015

Barriers to implementation have been solved by the Gula Gula Food Forest Program over the past 6 years (see previous sections), and the program is now runnig well, and ready to be scaled-up. The fact that we were able to attract an informal investor last December, who

provided funds for upscaling, in combination with some new off setting clients from 2017 onwards means that in financial terms there are no more barriers.
In the previous 7 years we have been able to overcome various hurdles and barriers, allowing us to fine-tune and organise a well-structured, cost effective collaboration with all parties and stakeholders. The current governance structure (section G) works well in managing the program. The parties involved are also well positioned to cover potential technical and social issues or barriers. The table below shows the various ecological, technical and socio-economic barriers that the project will solve.

Table 3: Summary of barriers

Type of barrier	Description of specific barriers	Overcoming barriers by project activities
Financial/Economic barriers	- No financial resources to develop restoration activities. - No system of community payments for ecosystem restoration. - High economic costs for community to restore degraded Imperata grasslands.	- Carbon payments are secured to develop project, project management and community payments for ecosystem restoration. - Funds secured from FAO to test and implement low-cost, labour saving technique for forest restoration.
Technical barriers	- Community lacks knowledge of low cost, labour saving techniques to restore productive forests on degraded Imperata grasslands. - Project coordinator organisation does not currently have required staff on the ground necessary to efficiently manage and implement the project. - Project coordinator organisation and local staff do not have sufficient knowledge in raising seedlings and manage village nurseries.	- Training is undertaken to teach community members how to use Assisted Natural Regeneration (ANR) as an effective, cheap and labour-saving technique in bringing back tree cover on degraded Imperata grasslands. - Project coordinator organisation has supported locally hired staff to setup the local NGO RPL (Rimbo Pangan Lestari). - Forestry Department extension staff has trained farmers how to raise seedlings from seeds and nursery development.
institutional/political barriers	- Forestry programs focus solely on state forest land, not on village territories under Adat.	- Project activities fill the gap of no forestry programs for reforestation of degraded village land.
Ecological barriers	- Widespread degraded soils in upland areas surrounding villages, causing erosion and floods. - No ecological alternative exists for intensive ploughing and use of pesticides (round-up) by community members.	- Reforestation efforts by the project combine Assisted Natural regeneration with tree planting to reduce erosion and intensive water run-off. - Project will teach community member an ecological sound method to restore (agro)forests on the degraded agricultural area.
Social barriers	- ineffective organisation and mobilisation of local communities and groups to successful restoration of forests on Imperata grasslands. - Low motivation to restore degraded Imperata grasslands	- Project coordinator organisation and the NGO have supported local participants in becoming a performance-based and officially registered cooperative. - Tackling the area with a large enough

	individually because of recurrent wildfires.	group at one time increase motivation and wildfires are absent through community action.
Cultural barriers	- Strong hierarchical Adat council hampers democratic, performance-based cooperative structures needed to achieve carbon targets.	- Under severe pressure of cooperative farmer members Adat council members in cooperatives were forced to resign. Now, cooperatives are based on democratic, horizontal social relations.

11 Notification of Relevant Bodies & Regulations

Under the Indonesian climate plan, the Intended Nationally Determined Contribution (INDC) states that the Indonesian government aims to reduce emissions by 29%, i.e. 835 MTon CO_{2eq} by 2030 compared to the Business as Usual (BaU) scenario. Land rehabilitation and improving the economies of communities living in and around degraded forests and other land-sector domains, such as agriculture, received a prominent position in the national Low Emission Development Strategies (LEDS) in Indonesia. The term 'degraded' has been used in multiple contexts in Indonesian law and policy. It generally denotes land that contains less than 35 MG of carbon per hectare, or land that is legally designated as degraded (Republic of Indonesia, 2015; Gingold et al 2012). Landscape rehabilitation is to be achieved by restoring ecosystem functions and sustainable forest management (including social forestry) in degraded areas through the active participation of the private sector, civil society organizations, local communities and vulnerable groups, especially adat communities and women, both in the planning and implementation stages (INDC 2015).

In West Sumatra, land and forest rehabilitation programs are carried out as part of a community empowerment strategy which includes:

- Regional strategic planning for middle term development (RPJMD)
- Regional Action Plan Policies to reduce Greenhouse Gases (RAD-GRK West Sumatra)
- Provincial Strategy Action Plan (SRAP) Policy for REDD + in West Sumatra
- Provincial Policy Priorities for Forest Plan (PCTR) in West Sumatra

These programs are all geared at land under the control of the provincial and district authorities in West Sumatra and exclude the village *adat* land. Therefore, these programs will not overlap, as the Gula Gula Food Forest Program fills a gap and is therefore complementary to the government programs. In addition, the Gula Gula Food Forest Program has since its start in 2009 collaborated with the Provincial and district offices of the Ministry of Forestry (recently merged into the Ministry of Environment and Forestry). Together with the provincial and district offices of the Forestry Department we discussed that in order to protect current forest areas, village *adat* territory also needed to be targeted to become a bufferzone around (state) forest areas. However, these areas cannot be included in the REDD+ policies of the government of West Sumatra, as they could support activities here, but have no official control over these village areas. They fall under the territory for the *nagari* institutions. The national/local government has little or no control over these areas. The Gula Gula Food Forest Program fills this gap and is therefore seen as an important additional activity within the REDD+ program of West Sumatra.

The concept, principles and procedures for implementing Assisted Natural Regeneration (ANR) and (in our case) combined with tree planting, are fully consistent with the emphasis on trees for carbon enhancement contained in the above-mentioned programs. In fact, the program has been developed in close collaboration with the Forestry Department.

12 Identification of Start-Up Funding

The program runs for more than 6 years now. It is almost entirely funded through carbon offsetting funds from EU-based companies. The payments have covered all project costs, including staff, nursery development and annual carbon payments to farmers. In the past, Farmer Training sessions on applying Assisted Natural Regeneration and the carbon market have been covered with modest funds from the FAO. However, as we make use of farmer to farmer training nowadays, the program can now cover the training costs, which have been significantly reduced (new cooperative members are supported and trained by other members in ”the Gula Gula method” of ecosystem rehabilitation).

Recently, an informal investor (a so-called business angel) and a new off-setting client have secured funding sources for us to scale up our “proof of concept” in ecosystem restoration with over 100 ha in the coming years.

Once we have gone through the process of Plan Vivo certification, we will be able to sell carbon more widely (we have an “intention to buy” letter from an English organisation). We have also received requests from German-based companies, so we do not foresee any problem selling the carbon, hence no lack of funds to finance the program until and after full project registration.