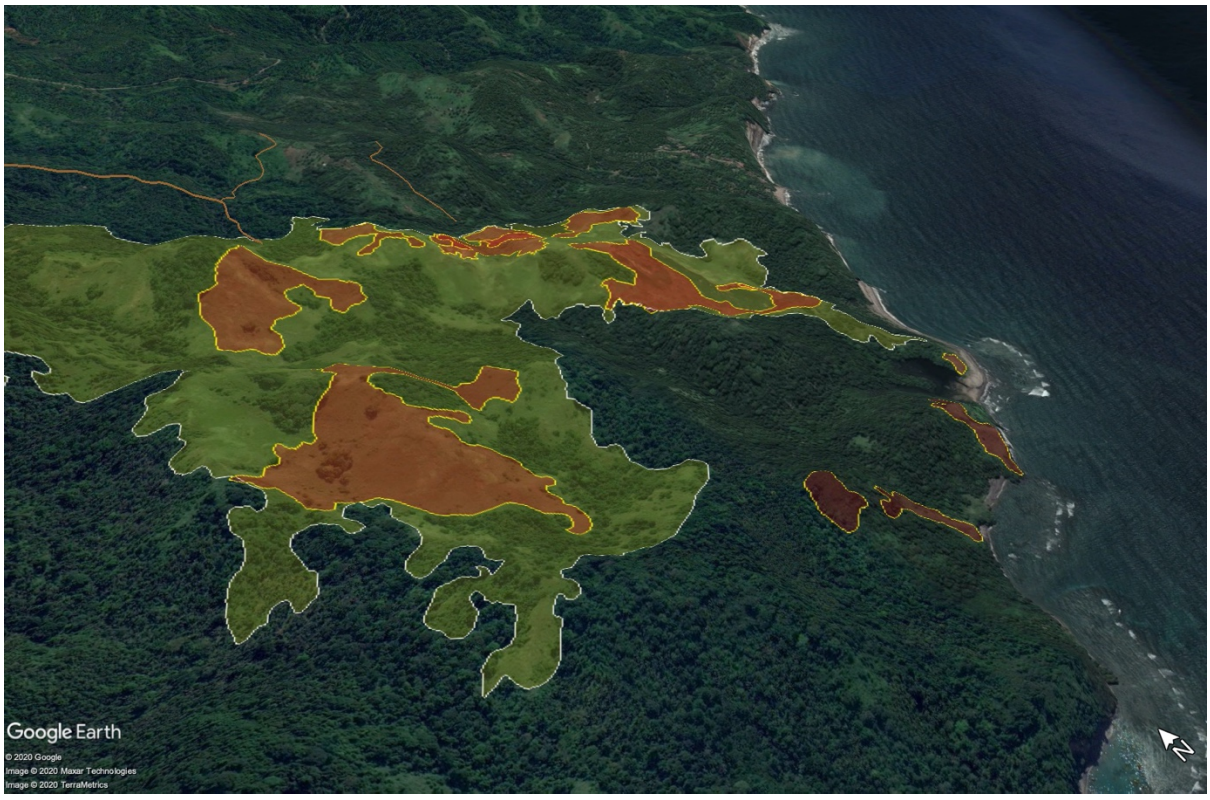
MASARANG
FOUNDATION

Temboan Beach Master Plan

Masarang Foundation, a non profit environmental NGO registered under the laws of Indonesia, has acquired large tracts of land along the Temboan Beach in the Minahasa district of North Sulawesi, Indonesia. The area has experienced long term non-sustainable land management followed by recurring fires and as a result there are now vast areas of *Imperata cylindrica* grass, also known as Pogon Grass. These grasslands are prone to more frequent fires in the future, thereby every time expanding the grassland area when more trees on the edges die. The picture beneath shows the extent of the grasslands and very poor quality shrubs most in need of rehabilitation. The brown areas show the last occurring burned areas before Masarang acquired the area. The image was taken from the south to show that it is predominantly the south facing slopes that repeatedly burn. This is related to the southern dry winds that occur especially during the months of July till September. These were the areas that did burn in 2018.



Masarang intends to make this acquired area into a permanent conservation zone, a process that is actively supported by the local government. To achieve this legal status a procedure is needed through the regional land agency to change the status of agricultural land to conservation area and with a HGU (the right for Masarang to manage the land in any way that contributes to the zonation designation). This process will run parallel with the finalization of the land ownership certificate to join all the different pieces of land already legally purchased from many individual owners into one large and secure property in name of the Masarang Foundation. Local government has promised to speed up the process of the status change, supporting the approaches of the Masarang Foundation of working with the environment and local people. Masarang is the first NGO, at least in North Sulawesi, to acquire private lands legally and then make them into a permanent conservation area. The map below shows the target final outline of the Temboan reforestation project.

The following chapters below describe the background, basic philosophy, zonation and plans for activities in the Temboan reforestation and conservation project in more detail.

Background

1. Temboan Beach in North East Sulawesi comprises some three kilometers of coast that is a nesting ground for all the five regionally occurring sea turtle species including the critically endangered leatherback turtles
2. The turtles are under continuous pressure from hunters/poachers (eggs as well as turtle meat that is sold in the highland bushmeat trade)
3. Wastewater from agriculture and sediments from erosion of the denuded hills behind the beach has destroyed some of the reefs and would destroy more coral reefs and the underwater nature of Temboan beach such as the sea grasses that get covered by algae and then support fewer turtles and manatees
4. In addition, mining companies have cast their eye on the magnetite embedded in the beach sands and under the corals in front of the Temboan coast
5. The coastal area is also interesting for farmers because there are a number of small rivers that always flow with water. The use of agricultural pesticides and artificial fertilizers would damage the nearby coral reefs and seagrass beds even more
6. There are some beautiful and still intact coral reefs in front of some of the beaches (as well as some areas damaged by bomb fishing in the past) and project developers are always on the outlook for such potential touristic locations. If tourism development is done without great care it will lead to further degradation of the corals and seagrasses
7. Masarang has already acquired several hundred hectares of land along the three kilometers of coastline and will develop this area into a large integrated conservation project
8. There is some 50 hectares of existing mixed forest with local fruit trees and wild figs in the area that can be used to release animals from the Tasikoki Wildlife Rescue and Education Center once the protection can be fully guaranteed
9. The area also has many sugar palms and coconuts and even some nipa palm stands that all have economical value and could at least initially be used sustainably until they have been replaced by a biodiverse forest supporting wildlife

Objectives

1. Safeguard the precious Temboan Beach and its coral reefs (including the hinterland)
2. Develop structural initiatives to protect the endangered leatherback and other sea turtle species through patrols and socialization programs and educational programs
3. Protect the beaches from aberration by sea level rise through a package of practical measures such as speeding up coral growth with low voltage Biorock systems and providing strategically placed physical structures to enhance sand deposition (project in cooperation with the local ITM University and Dutch Delft Technical University)
4. Engage the local community by offering small-scale and zero-waste employment opportunities such as small-scale agroforestry, work in reforestation, providing palm juice to a mini sugar factory, construction and operation of an eco-lodge and as our forest rangers
5. Plant a new biodiverse food forest (named Benni's forest after our Masarang Ambassador in Germany, Benni Over) on the more than 100 hectares of grasslands to stop fires and erosion to protect the corals, to produce food for animals at site and in Tasikoki, to create a new habitat for wildlife releases and support local jobs
6. Make the project self-sufficient from the ecolodge income, the tapping of palm trees, production of surplus fruit, provision of volunteer opportunities and production of non-timber forest products such as rattan, resins, aromatic oils, coconut fibers and potentially carbon credits
7. Set up an educational program and unit to demonstrate the use and value of biochar, promising local plant species, environmentally friendly zero waste production systems and agroforestry-based reforestation
8. Involve local students and potentially foreign students in research on the coral reefs and seagrass areas and see how the reforestation reduces the sediment load in the water coming into the present coral and seagrass area and how this impacts the quality of those two important ecosystems
9. Demonstrate the value of this approach for carbon sequestration on top of the People/Planet/Profit benefits

Planning

1. Phase 1: Acquire the land based on thorough analysis of our land expertise lawyer Mr. Indra Socheh. Mr Indra is responsible for verifying the land rights and zoning plans, conducting physical measurements of the land plots, and leading negotiations with the owners until the land documents are issued in name of Masarang. Maximum size of target area is some 350 hectares that stretch mostly along the coast over some three kilometers and include a hinterland area of more than 100 hectares of fire prone grasslands. Once all the acquisitions have been done to join them in one certificate with conservation status under the Masarang Foundation. We will try to smoothen the boundaries to follow rivers and watershed boundaries by exchanging pieces of land with neighbors
2. Phase 2 : Yayasan Masarang Indonesia (the Masarang Foundation) will set up basic protection measures (rangers, equipment such as cameras, microphones, drones) to protect the beach and the hinterland. Educate the local Temboan village to avoid illegal logging and poaching. In this phase we will also try to set up a mini factory for palm sugar production on the north east boundary of the property (see map) and a tree nursery next to the local wetland area. We will construct simple roads to patrol and

access the area with one gate only to easily protect the area. At this moment we are in the process of making the plans for the beach recovery and the new ecolodge (starting with simple facilities first to house staff and volunteers). Harry Kaunang has been appointed project manager and has set up the first part of the team to work here. With the reforestation work, we will start the monitoring program with students on the changes in the environment as a result of the reforestation efforts (coral reefs, seagrasses, river flows, biodiversity, impact on rainfall, etc.). In addition are looking for investors to construct an integrated processing facility for sugar palm and coconut products to deal with products at our own Masarang Temboan land and from land owned by the surrounding local people. In this phase we will also develop the internal road access system, create swales and small dams as well as a number of lakes to reduce sediment run off with the small excavator of the Masarang Foundation

3. Phase 3 : Physical construction activities of ecolodge and beach protection. Continued reforestation of the remaining degraded lands and planting of a clear final boundary comprising sugar palms and thorny Salak palms. Commercial production of palm sugar and non-timber forest products from existing sugar palms in the area as well as from the sugar palms of the local people from Temboan village. Temboan village is the main producer of the illegal alcoholic drink named Cap Tikus and processing the palm juice they use to distill the social problems causing alcoholic drink into sugar would help both the people and the environment. In 2020 it is hoped to have the first releases of Tasikoki animals when possible. Continued research studies will take place too (erosion, sediment load, carbon balance, climate, biodiversity, etc.).

Land use planning

We will follow a recipe approach for the area with dedicated zones. The categories for the recipes and the activities for each zone are described here in more detail. Basically, we will have:

1. A buffer zone to protect the area against fires and encroachment as well as a wildlife fence that provides income from sugar palms. The fence part on the border of the property will consist of extremely dense and thorny Salak (snake fruit) palms. Underneath the trees in the buffer zone we can still plant some coffee or cacao;
2. The zone along the various small water streams will be planted with long-lived fruit trees, bamboos and tuber crops of shade tolerant plants like Colocasia. This is to prevent sediment from reaching the small streams and getting flushed out to the beach and sea;
3. The next type of planting zone comprises the steepest slopes. Here we will plant sugar palms, fig trees, climbing rattans, medicinal plants and long-lived trees that provide fruit, resins, or other non-timber forest products. This is a permanent vegetation type that can be utilized for additional income without ever cutting the trees, whilst the dense deep roots of sugar palms and dense more superficial roots of the fig trees and bamboos (the latter only in zones with less fire risk) will prevent land slides and erosion;
4. The special zone of more than 100 hectares of grasslands will be replanted first with a mix of soil improving leguminose trees and trees that can compete with the grass roots and can shade out the grass underneath. This zone will together with the buffer zone have the highest priority to start planting. The trees will be used to produce mulch and fodder for some of the wildlife locally and animals presently at the

Masarang Tasikoki Wildlife Rescue and Education Center. In the future these trees will also provide food for animals to be reintroduced there later;

5. Wetland and mangrove zone. In this zone we will plant additional trees as needed and this zone will be utilized to tap the Nipah palms

1. Buffer zone

The area around the Temboan land will continue to represent fire risks from the slash and burn agriculture and accidental fires in the grasslands outside our area. Therefore, and for monitoring purposes with drones and satellites, we will plant a buffer zone of sugar palms and Salak palms along the complete periphery on land. The sugar palms will be planted in 8 rows with 7 meters triangular spacing between them along the border. The Salak palms will be planted very densely exactly on the border with the neighboring lands. This will create a zone with virtually no burnable material. It will also be a zone that in the future will be visited on a daily basis to do tapping of the sugar palms and picking of coffee and cacao by local people who benefit from these jobs. At the same time all woody material like dead leaves and branches that might pose a fire risk will be removed.

The sugar palms will also yield many other products like the fibers, leaves, valuable wood, fruits, honey and other products for local use. By having an intensive management of this outer zone, we will be able to both protect the inner area against fires through both the physical protection of the sugar palms and the continuous presence of workers that will detect any trails of poachers or outside people compromising the fence. The additional benefit is that this zone will yield income that can support the long-term financing of the area protection.

2. Protected zones along streams

Along the streams we will plant bamboos mixed with legume trees and various local fruit trees to support wildlife. The aim is to reduce the sediment load of the water. Smaller gullies will also be closed at regular distances with micro dams to improve the infiltration of water and reduce run-off water to build up a higher soil water level which will make the area less prone to fires. We will also construct several slightly bigger dams to create permanent ponds. These ponds will be important in case of fires to fill firefighting water bags. These ponds can also be used for some aquaculture to produce fish. Around the ponds for fish production we will also mix in sugar palms with their very dense root system, but not do so elsewhere so as to create quiet zones for wildlife along the rest of the streams. In between the stream side reforestation we will plant the shade tolerant *Colocasia esculenta* as shown here on the right planted between sugar palms. The leaves as well as the starch from the big tubers can be used as fish food. The bamboos will be regularly harvested to prevent the buildup of dead material and to be used in the tapping of the sugar palms growing in the buffer zone.

3. Steep slopes

The steep slopes are causing most of the erosion, especially when they are only covered by grasslands. Here we will plant sugar palms, fig trees, climbing rattans, medicinal plants and long-lived trees that provide fruit, resins, or other non-timber forest products. The dense deep roots of sugar palms and dense more superficial roots of the fig trees and bamboos (only in zones with little fire risk) will prevent landslides and erosion. In between we will grow a legume cover crop to reduce surface run off and to help build up the organic matter underneath to improve infiltration of water and reduce the surface run off. The seedlings that will be planted here need to be bigger size than in the flat areas and the planting holes need to have a copious amount of well fertilized soil (biochar inoculated with compost) to get them going very fast. We will also try to make swales wherever the slopes are not too steep and can probably apply some coconut-fiber mats in some of the gullies to reduce erosion as well, made from the abundant coconut peels that we have laying around of the 3.000 existing coconut trees in the acquired area.

The reforestation on these steep slopes will become a permanent vegetation type that can be utilized for additional income without ever cutting the trees, whilst providing constant protection and supporting wildlife. There will be minimal maintenance and therefore disturbance in these forests. The initial cost of this type of reforestation is more than double that of planting more undulating and flat land.

4. Grasslands

Beneath is a panorama picture of the hinterland which is dominated by the alang-alang grasslands (*Imperata cylindrica*), in English known as Pogon grass. This grass produces abundant amounts of dry straw that is very inflammable. Once they become the dominating vegetation fires will come back regularly and kill off any seedlings that might have sprouted in between the fiercely competitive grass. The grass has deep rhizomes (root structures with reserves) that are not affected by the fire and is therefore able to immediately sprout again after a fire. When seeds want to germinate in between the dense grass clumps the exudates from the grass roots also negatively impact their sprouting. Once there is a fire in these grasslands it is extremely hard to stop. So once again the focus in the reforestation recipe is on preventing fire.

We have more than one hundred hectares of the above grasslands in our area. They are all connected with each other. One of the first approaches we will follow is making fire breaks by weeding wide strip of the grass, thereby dividing the area into smaller parcels that can contain the fires if they would occur. The grass that we harvest will be used for the shade

roofs in the nursery and later also for the additional facilities needed for staff and guests. The dead grass material we will convert into biochar. The open strips will be planted by a cover crop like Sunn Hemp which is already widely used in Indonesia. These legumes yield food for livestock and seeds that can be used to make biofuel. They can also yield material that can be made into biochar while adding nitrogen to the soil and shading out the Pogon grass.

The first practical step will be to roll down the grass in the larger patches so as to crush the stems near their appearance from the soil. This does not kill the grass but deprives most of it from light and prevents new shoots from coming through, thus weakening the grass over time. With repeated crushing the grass will eventually lose out in competition with the trees we will plant there. And as mentioned the Sunn Hemp will also help suppress the grass from growing back. The trees will later provide shade that will further prevent the grass from growing back.

Half of the initially planted tree species will be leguminous trees that have nitrogen fixing bacteria in their root nodules since the soils under the yellow grass have been depleted much by the rains and loss of organic matter. These trees will be planted with a density of 1.111 trees per hectare (3 x 3 meters) to quickly shade out the dangerous grass.

For all the aforementioned steps it will be highly beneficial if we can make use of a mini excavator with different attachments. It would be ideal for all above mentioned actions and much more, including road construction. The mini excavator comes with extra wide track and does not cause soil compaction and is easy to operate and very low in maintenance and operational costs.

Once the leguminous trees are planted, we will plant at 9 x 9 meter spacing many more different local tree species and high producing fruit tree species underneath, amongst which many local fig species.

On the flat areas and undulating areas, we will make swales (using the mini excavator with small bulldozer blade attachment) to reduce run off and erosion and speed up growth of the trees planted on these small ridges. In the small gullies we will make micro dams where we will use local organic material on the uphill side of these dams to strengthen the small dams and to add filtration capability to retain nutrients. Chipped woody material would be best for this purpose, which can also be produced with an additional attachment to the mini skidder.

The forest that will grow on these grasslands will be known as Benni's forest, named after Benni Over, an important supporter of the orangutans and their habitat, who is doing most of the fund raising for the reforestation program here, to show that there are alternatives to converting orangutan habitat to oil palm and other uses by utilizing degraded lands and improving them. Within Benni's forest specific plots can be assigned to parties that would like to compensate their carbon emissions through tree planting. Since we start from almost zero carbon content in and above the soil, it will be relatively easy to measure the true performance of carbon sequestration in this area. The appendix about Benni's forest provides more details.

5. Wetlands and mangroves

Within the area close to the beach we have several wetlands and a three-hectare lake. In principle we will keep these in their natural state where they are still intact. For some of them

we will plant local water plants to reduce the sediment brought by run off from the nearby open land (some grasslands, some coconuts). Around the wetlands we will plant many fig species.

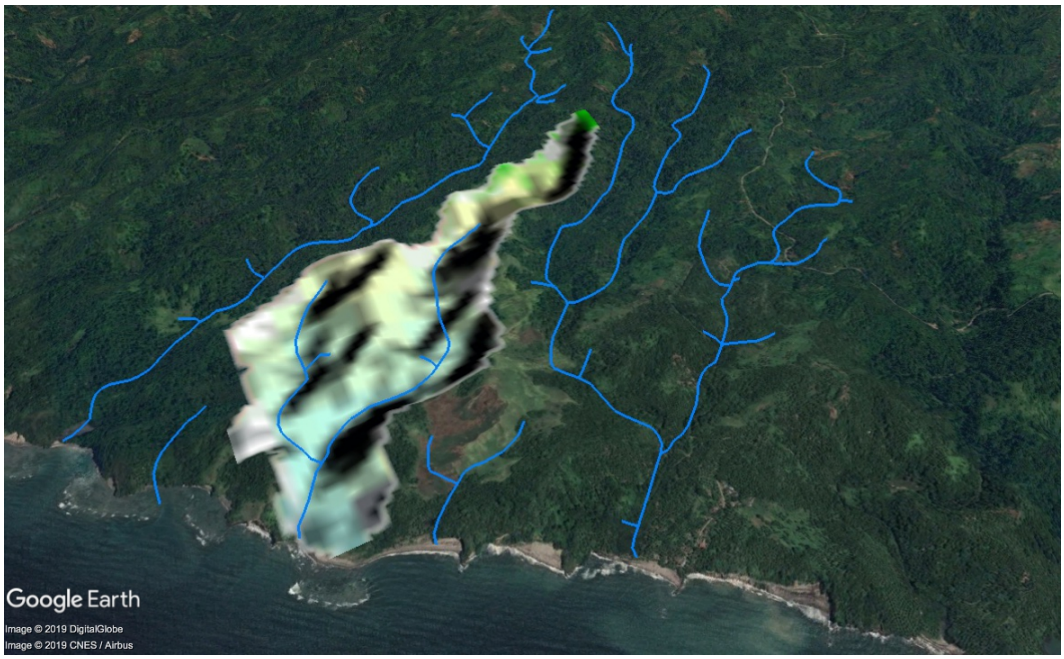
We have some small patches of mangroves. These will be left to regenerate naturally. We will use some of the mangrove fruits for local income only. So, the only treatment for these coastal wetland areas is their protection and monitoring.

Besides the above mentioned ecotypes we also have almost one hectare of nipa palms, palms that grow in brackish water as shown in the picture on the left. These can be used for their leaves as roofing material or the flower stems can be tapped to make a refreshing drink or processed, very much like we do with the Arenga palm juice, into valuable sugar or ethanol. Again, this natural vegetation does not need any additional treatment beyond controlled use and the construction of simple access paths for tapping purposes, made from old tires.

Research

There is one complete watershed located within the Temboan Project, as can be seen on the picture below, which will be part of a long term study plan to monitor changes in hydrology and water quality as the reforestation program progresses. We will also do research on the condition of the coral reefs and sea grasses near the outlet of the river from the watershed.

In addition we will conduct a Biorock coral restoration scheme where dynamite fishing in the past has damaged some of the reefs. We will monitor how the coral will grow and how biodiversity is impacted in a positive way by the Biorock restoration scheme.



Education

During the whole project there will be much focus on education. This will not only involve school groups but also local farmers in conducting good forms of agroforestry. In addition we will work with volunteers from around the world that can participate in the reforestation work and patrolling and management of the new turtle hatchery we will built on the Temboan beach. We will also involve students that are receiving fellowships from Masarang in the planting of trees as part of their environmental education.

Project Organization

The project will be supervised by our specially assigned project manager named Max Harry Kaunang (seen in the picture above), but for his friends known as Erik Kaunang. Erik is a professional forester that has worked with the Ministry of Forestry for many years as an extension officer providing training in reforestation, setting up nurseries, plant propagation and conservation. He first learned and studied with Willie Smits in East Kalimantan more than 20 years ago. He is the recipient of several awards for his work, including Indonesia's highest environmental award Kalpataru from the president of Indonesia for his work in reforestation, working with local communities, and protecting valuable forests and springs. He was responsible for most of the reforestation done at the Masarang Mountain and at the Pulisan reforestation project of the Masarang Foundation. Erik was also a lurah, or village head, in the Tomohon government, meaning he knows everything about the rules and regulations for land acquisition, land use planning, permits, etc. and has a valuable network to support the Temboan needs.

Initially we will start in Temboan with setting up the nursery and starting up plant production for reforestation. The team working with Erik will consist of one local supervisor and four workers. They will manage the nursery, do the detailed mapping of the terrain, patrol the area, plant trees, produce biochar, produce compost, supervise coconut collecting, and assist with the turtle hatchery. All of these people will be hired from the local community in Temboan and in nearby Rumbia village. In addition there will be two full time staff for turtle protection and nest relocations, that outside the nesting season will help planting vegetables and collect fruit from the existing forest to support Tasikoki and the local activities.

Later, as facilities and activities develop (ecolodge, mini factory, antenna for communication and internet camera) more staff will be added, but for the first phase these 8 people will suffice.

Ecotourism

Responsible ecotourism will be promoted in the Temboan Project but the 2020 pandemic has made it necessary to postpone this program for now. Once the lodge is built, we hope that the income from ecotouristm can contribute to the operational budget of maintaining the conservation area and running educational programs. The lodge will be an example of locally adapted environmentally friendly construction with its own sustainable electricity and water supply. It may contain a small number of high-end facilities for special visitors as well as a more dormitory style facility. The lodge will mostly make use of locally grown vegetables, fruit and fish.

We hope to provide additional income to local people from handicraft made from local materials, guiding visitors, diving and from fishing trips. We plan to build a mini sugar factory that can run on waste biomass from the area and process the sugary juice from the sugar palms into syrup so it can be transported to Tomohon to be processed into Masarang Palm Sugar.

Some Pictures

Here are some pictures that provide some insight in the location and its assets as well as how the land was acquired.

A team of the local government, the owner of the land to be sold to Masarang and the Masarang land measurement staff checking the boundaries of the land to be sold. On the right walking through some of the existing sugar palm stands that are part of the land already bought.

The leatherback turtle nesting beach at Temboan. The light green hill in the middle may be the location of the ecolodge, overlooking the beach and the coral reefs in front. On the left is a sweet water lake of 3 hectares that is frequented by many different kinds of birds.

This is the sweet water lake that has some nipa palms on its banks. The lake has a good fish population.

View from the proposed location for he ecolodge overlooking coral reefs that protect the turtle nesting sites.

On the left some of the mangrove vegetation inside the area. There are many crabs living here and some of the fruits of these trees can be made into special snacks.

Above: there is no beach access to the beach belonging to the Temboan Project. Huge cliffs mark the boundaries and make that the beach is very easy to protect to guarantee the seat turtles safe nesting grounds.

On the left: the magnetite mixed in the beach sands that was the target for businessman to try to get access to the turtle beaches to mine it both on the beach and in the sea, which would have led to irreparable damage for both the beach and the coral reefs there. Masarang was just in time to prevent the company executing their illegal plans and destroy these valuable turtle nesting grounds.

Beneath are some pictures of the alang-alang grasslands. The first picture shows the grass sprouting after a fire four weeks before hat burned off all above ground parts. The second picture shows the condition of the grass just two weeks after the fire. The third picture on the right shows the huge extent of the grasslands in need of reforestation.

Some pictures of some of the better spots inside the Temboan Project area. Top left is a spring. Above a clump of local bamboo. On the left a clump of palms in the valley close to the lake.

Coral restoration

Background

Coral reefs are the world's most biodiverse underwater ecosystems that support a huge variety of species of incredibly diverse life forms, especially in our area which is located within the coral triangle, the area of the world with the highest coral biodiversity. Many new discoveries are made from the organisms inhabiting those systems that are important for humans for instance in the field of medicine. Coral reefs also help protect people and beaches in case of tsunamis and protect beaches against abrasion by breaking the wave energy. Furthermore, coral reefs are important breeding grounds for many economically important fish species that support the fishing communities and fishing industry. They also can bring in important income from tourism.

Coral reefs are also under threat because of a range of factors, the most important one being climate change. Especially during so-called El Nino events the rise in sea temperature surface water can lead to the coral building polyps expelling their symbiotic algae that produce the energy from sunlight that the polyps need. This leads to the ever more frequent and serious bleaching events that kill off, or seriously degrade, vast areas of coral reefs. Coral reefs also can get damaged by illegal fishing techniques with trawler nets, underwater bombs or use of poisons. Tourism can also seriously damage the slow growing corals with too many people stepping on them and boats anchoring at random to corals. One other important factor is the run off of polluted water from the land. High sediment loads with high concentrations of nutrients and poisonous products used in agriculture can lead to algae blooms covering the corals and choking them. The polluted water, which also brings plastic waste that can cover and choke corals and enter into the underwater organisms as well as being eaten by sea turtles and sea birds, even has led to the expansion of vast dead zones near river mouths.

In Masarang's Temboan area we see many of the above mentioned problems. We still have areas with pristine corals but also have areas with severe damage. We will attempt to protect the remaining corals and reestablish coral reefs in areas with loss of coral. Here we describe the methodology for the direct coral restoration part of the project. This will involve a technology called BioRock which we will explain in the following parts of this description.

Phase 1

In this phase we will study the underwater topography in front of the 3 kilometers beach front of Masarang's Temboan area. Then we will look at flows of water and how they impact the turtle nesting grounds through losses and expansion of the sand deposits, which can be temporal because of seasonal winds and direction of water flows. We will also in this phase make an inventory of the condition of the corals in front of our property and produce detailed maps of their distribution and types. This work will mostly be done by students and volunteers.

In this phase we will also start acquiring the equipment needed for the BioRock coral restoration methodology. This includes the solar panels, the batteries and the power cables that will bring the low voltage electricity to the iron cathodes and anodes in the water. We will build a small shed for the batteries and monitoring equipment and the regulators. We will also buy diving equipment for the inventory, underwater photography equipment and a small

boat to do the sonar mapping and taking students, researchers and volunteers to the various areas for the inventory and mapping exercise.

We will also start looking for cheap metal, some of it from torn down concrete constructions, that we can use to build the structures that can be covered by mineral deposits that resemble the coral material. These structures need to be welded/bound together before being transported (sometimes by the boat) to the places where they will be strategically placed for maximum impact on beach protection. We will transport the materials to our Temboan location and make a welding shed there. We will buy a small welding set to do the work with local welders. The structures will use various designs to optimize them for coral fish.

This first phase will take some 3 months to execute and during this phase we will also have a socialization program for the local people to understand what the project is about and how it will help their local fishery and local economy through additional jobs from visitors.

Phase 2

This phase will comprise the actual placement of the welded structures and the grafting of small pieces of various coral species on them. A monitoring program will be started up with students and volunteers to regularly record the growth of the new corals.

The diving and underwater photography equipment will be frequently used for the monitoring and checking on the underwater infrastructure.

Coordination of the program will be under the lodge manager of Temboan, where the equipment will be placed in front of the lodge facilities. This will make maintenance of the installation easier and also is better for the security of the equipment and operational management.

Budget

This project is supported by Tom Nuytens from a surfboard company from Pasuruan in East Java that will also make use of some of the wood we will plant in the initial reforestation to suppress the pogon grasslands.

No.	Item description	Cost
1.	Diving equipment, underwater photography, sonar sea floor mapping	
2.	Solar panels, cables, batteries, connectors, regulators	
3.	Small boat with outboard motor, swim vests, anchor, glass bottom	
4.	Welding equipment and safety equipment for welders	
5.	Acquisition and transport of iron material to construct the structures	
6.	Socialization program, operational costs, overhead, unforeseen	
	Total: 22.500 Euro	

Appendix 1: **Benni's Forest**

Benni's Forest is named after Benni Over, an inspiring young German man who loves orangutans. Benni suffers from an incurable genetic disease called Duchenne Muscular Dystrophy. Despite his handicap, he and his family flew 15.000 kilometers to visit us in Indonesia in his wheelchair. Even though not being able to move more than his face muscles and some of his fingers he also travelled all the way over poor roads and rivers to the heart of Borneo. Here he met orangutans, with eye to eye contact, in the Sintang Orangutan Center (SOC).

Now Benni is motivating school children and the general public in Germany to care for our environment and protect forests, the homes of the orangutans and many other species, that are threatened especially by their conversion of their habitat to palm oil plantations.

One of the alternative solutions that Benni is supporting is the planting of Benni's forest to demonstrate that we can make valuable new forests on degraded lands. This helps people as well as nature and reduces the pressure upon the remaining intact forests.

Benni's forest will be planted in one of the most degraded habitats in Indonesia, vast pogon grasslands, that are very fire-prone and that cannot protect soil from erosion and loss of nutrients as forests do. The several hundred acre area is in the Temboan region of North Sulawesi. This land has been recently purchased by the Masarang Foundation, which also supports the work of the Sintang Orangutan Centre. The aim of the purchase is to continue the mission of the Foundation which is a environmental restoration model that provides solutions for people and nature. The Sintang Orangutan Center and the Masarang Foundation will convert these grasslands to a species rich biodiverse forest that will store carbon as well as improve the water quality in the area, which will benefit a priceless sea turtle nesting site beach just downstream from this reforestation area. We hope for your support!

The first phase of the project will be planting more than 100.000 trees in the open grasslands to become Benni's forest. For this special project we will run a tree adoption program. Over time the program and its monitoring will become more sophisticated, but initially we will establish one dedicated tree planting fund (Benni's Forest) where all the tree adoption funds will be transferred too. All reforestation costs will then be paid from this fund and the areas of actual reforestation will be reported upon. In addition to articles on all our associated websites, the reforestation will be presented in three monthly drone images that will be uploaded to Google Earth for general viewing.

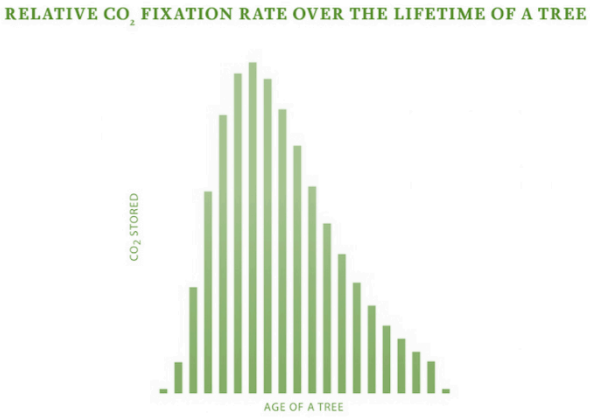
During the execution of the project we will do research in cooperation with local universities and NGO's that will look at the recovery of the water quality outflow from the reforestation area, the increase in biomass and total CO_2 sequestration effects of the reforestation as well as the recovery of biodiversity (focusing on birds and mammal species initially).

The project will be coordinated and supervised by Masarang's Harry Kaunang, a multi-decorated forester and conservationist with a long track record of successful reforestation projects. Harry is an ex-student of Dr. Willie Smits, the founder of the foundation and SOC, who will also personally supervise the project.

Note: The utilization of the funds will be independently audited as part of the yearly audit for the Masarang Foundation and reported under its own heading, namely 'Benni's Forest'.

Temboan and carbon sequestration

I was asked to explain more about our approach to carbon sequestration for our Temboan project supporters. This is not an easy subject to explain because the actual amount of CO_2 trees can sequester is extremely variable with growing season, which is related to altitude, temperature, climate seasons while soil type, tree species choice, forest management and many more factors also influence the amounts. Then there is the annual amount of CO_2 that young trees absorb which is lower than that of mature trees. Then towards the end of life of the trees that amount decreases again as shown in the picture to the right. So not easy to give a single simple number of how much carbon one tree absorbs and sequesters but let me try to explain what we are doing that makes our Temboan project in Benni's forest so special in terms of carbon sequestration. And I will have to start with explaining what exactly we are measuring as carbon sequestration and CO_2 effects, so bear with me while I try to keep this simple.



CO_2 versus C: What do we measure?

Normally people speak of carbon dioxide sequestration as a generally accepted standard comparison. We can calculate the amount of CO2 sequestered from the biomass of a tree, which comprises stem, branches, twigs, leaves and roots. About half of this weight is made up of pure carbon or C. Every molecule of carbon dioxide contains one C atom and two O or oxygen atoms. The atomic weight of a C molecule is 12 while that of O is 16. This means that compared to the number 12 of C for each CO_2 molecule we have to add two times 16 for the two O atoms which is 12 + 16 + 16 = 44. So every carbon atom represents 44/12 times CO_2 in weight. This is 3.67 times more.

So let's look at an example if a tree weighs 100 kilograms (in the form of oven dry weight) then 50% of this weight or 50 kilograms comprises pure carbon. This amount we now multiply with 3.67 to get the number for CO_2 this tree utilized to make its biomass through photosynthesis, which in this example is 183 kilograms. Now we look at how old this 100 kg tree is and divide the 183 by the tree age which gives us a number for the amount of CO_2

sequestered by this tree each year at this particular moment in time. I guess one starts to see the complexity of doing this individual tree based calculations. Therefore we will use the actual increase in total C in the Temboan project area as a result of our activities as basis for our CO_2 sequestration number per area unit and individual tree.

Why is Temboan so special?

First of all the project area is located in the tropics where the growing season is 365 days each year and the temperature is always good for optimal growth. This is why our tree planting can result in several times higher biomass increase compared to other regions. Next we are planting a biodiverse forest which can achieve a much faster and higher biomass than a monoculture reforestation scheme. Also we have vast areas with severely degraded lands where there is no vegetation besides some short grass and virtually no organic material in the soil which as a result of that absence easily erodes and experiences frequent landslides. This means we have an excellent baseline condition from where we can prove by a variety of techniques how much carbon has really been sequestered and how other factors like biodiversity, rainfall, etc. have improved as well.

How do we measure and monitor the results?

We are using a combination of satellite monitoring, drone images, a live video link and scientific measurements on the ground to provide our supporters with timely and accurate information. From permanent inventory field plots we can get data that we can extrapolate to the surrounding areas with the same reforestation recipes so we do not need to measure each individual tree in all of the area.

Besides the biomass measurements we will also record the effects of our biodiverse reforestation on wildlife, hydrology, recovery of the downstream corals, job opportunities for local people, local climate, costs, etc. We look at as many triple P factors as possible and use the Sustainable Development Goals as guidelines in the assessment.

But there is much more…

- In the Temboan project we build a integrated mini factory that can process the palm juice of local people. Then they do no longer need to cut trees for fuel wood to process the juice and we expect like we have seen in Tomohon that the land of the local people will grow more trees than before. This is an effect known as positive leakage.

- We will also produce biochar, which is a kind of charcoal that can last hundreds if not thousands of years in the soil. It is made from fallen branches and thinning wood of the reforestation. This biochar mixed with compost greatly increases carbon in the soil and also the microbial life in the soil. These bacteria, fungi and other soil organisms also add much biomass to the soil. At the same time the biochar makes the soil more productive thereby increasing the amount of C that can be sequestered in the living biomass of the new forest.

- We also will not use any fossil fuel based artificial fertilizer or pesticides and will share our organic alternatives with the local people around our area. This again reduces the emissions.

- In addition we will produce food from trees for people and livestock that will reduce the need for agricultural land thereby reducing the carbon footprint further.

- We are also creating a more fire resistant forest and through local climate change and job opportunities for local people expect fires to become less frequent around our area, thereby again contributing to fewer emissions and more carbon sequestration.

- By utilizing part of the biomass in wooden houses, furniture and other items, as well as a fossil fuel replacement, we also sequester carbon and reduce emissions.

- From sugar palms, nipa palms and coconuts we can produce biofuels that do not reduce the biomass of the reforestation while replacing fossil fuels

We will still look at other effects, but this short overview may make it clear that it is not easy to give a onetime number for how much carbon your dollar or euro is sequestering. So in our scheme we will invite an independent third party to do the evaluation that we will report to our supporters on their independent evaluation of the additional biomass we generated and other estimated carbon effects. Still we need something to start with. Here are some of the more generally accepted numbers from various sources:

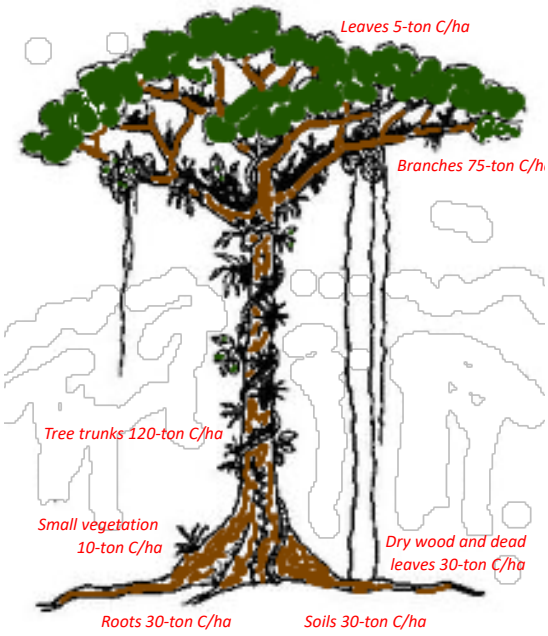
A tree can absorb as much as 48 pounds of carbon dioxide per year and can sequester 1 ton of carbon dioxide by the time it reaches 40 years old.
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=2ahUKEwiLqsWDzPDiAhUDbawKHZeWD9sQFjABegQIFRAE&url=https%3A%2F%2Fprojects.ncsu.edu%2Fproject%2Ftreesofstrength%2Ftreefact.htm&usg=AOvVaw1OrmgfksA6PokxOll0RWgZ

On average, one acre of new forest can sequester about 2.5 tons of carbon annually.
Young trees absorb CO2 at a rate of 13 pounds per tree each year. Trees reach their most productive stage of carbon storage at about 10 years at which point they are estimated to absorb 48 pounds of CO2 per year.
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=10&cad=rja&uact=8&ved=2ahUKEwiLqsWDzPDiAhUDbawKHZeWD9sQFjAJegQIFhAg&url=http%3A%2F%2Furbanforestrynetwork.org%2Fbenefits%2Fair%2520quality.htm&usg=AOvVaw3WrHmpXHS8c77VDz6hfQ48

The average tropical tree sequesters a minimum of 50 lbs or 22.6 kg of carbon each year. The size and growth rate of each individual tree coupled with its specific density of biomass determines how much CO2 is pulled from the atmosphere and stored.
http://www.communitycarbontrees.org/climate-change-solutions#Tropical-Rainforest-Trees-for-CO2-Sequestration

Initially we will plant 1.100 trees per hectare at a cost of 2.2 Euro per tree which includes everything from the maintenance for three years after which the forest can be left to its own till the monitoring, management and security of the area. We will assume a period of 45 years in which the maximum biomass in a stable equilibrium will be achieved. But not all trees will survive till 45 years since some individuals will outcompete others. The number of mature trees per hectare in the stable condition that we aim for in Temboan is for now assumed to be 300. With the number of 22 kilograms per tree per year on average for carbon sequestration this means a total sequestration of 300 * 45 * 22 kg = 297 tons of C per hectare which is what a "normal rainforest" should have and which is very realistic for the growing conditions and expected end situation in the Temboan project area (see typical example of carbon storage in a tropical forest to the right). This number is however an underestimate in view of the other positive factors that contribute to the carbon issues as described above. If we now calculate back to the amount of carbon per initially planted tree we get 297 tons divided by 45 years and 1.100 trees which is 6 kg C per tree per year and a total of 270 kg C per tree over the 45 years.

How carbon is stored in a tropical forest



With a initial cost of 2.420 Euro per hectare we achieve a minimum of 297 tons of C sequestration. This represents 297 * 3.67 tons of CO_2 equivalents or 1.089 tons. This means that the cost to generate 1 ton of CO_2 compensation is 2.22 Euro per ton. The price of CO_2 in compensation schemes has been set at 20 Euro per ton in many countries which is almost ten times more! However this value is created over a period of 45 years. We have to still decide how we can translate this biomass in carbon credits and to which party these carbon credits can be accredited. In principle these credits should go to Masarang to be used in a transparent way for the goals of the foundation.

How will sponsors to the Temboan project benefits from their contributions?

The principles of the financing of the project and reporting on outputs that can be related to individual contributions of sponsors towards the project are as follows:

- All contributions from donors towards the Temboan tree planting scheme will go to a single Temboan reforestation fund. This fund will be used to:
  - Produce, plant and maintain the trees
  - Construct all necessary infrastructure
  - Do all the management, monitoring and reporting
  - Pay for external CO_2 audits and reporting
- Donors will have areas of Temboan reforestation land assigned to their contributions that match the density of 1.100 trees per hectare in the initial planting. So if a donor contributes 1.000 Euro we will assign the following area of land to them:
  - 1.000 Euro divided by 2.2 Euro per tree represents 455 trees
  - 455 trees divided by 1.100 trees per hectare represents then 0.41 hectares

- This specific area will be shown on the online map of the Temboan project and sponsors can access a 3 monthly overview of their area in the form of drone images and updates on activities and any pictures and/or measurements that may have been done during that period
- In case we remove the initial trees that were used to restore microclimate the sponsors do not pay separately for the replacement trees that will form the eventual forest condition

- For transparency, monitoring and reporting purposes we will take the following steps:

  - We will construct an online counter that shows the number of trees planted at any moment in time which is based upon the monthly input of actual field activity data by the Masarang team
  - We will keep track of the carbon amounts. This will initially be very basic because the costs for this are high and must be paid for from the total incoming funds for tree planting. Once all infrastructure is in place the planting costs take relatively up less of the incoming funds and the tracking and R&D can be expanded and improved with the available funds
  - Carbon accounting will be based on the average carbon per hectare generated in the total project area. So sponsors will not be given different values depending upon which species is planted but they contribute to the total pool of trees planted and can say they supported X amount of CO_2 sequestration as a result of the number of trees they sponsored at regular time intervals
  - Once we have the live Internet connection up to directly observe a large part of the area we will provide sponsors with access to this connection. Of course sponsors will have the right to visit the area themselves and refer to their contribution for their PR or CSR programs