Supporting Agroforestry

The December 26, 2004 tsunami destroyed Indonesia, and more specifically, Aceh’s primary sources of livelihood – agriculture. However, it is also necessary to acknowledge the physical and ecological degradation of the land and its resources due to poor agricultural practices even prior to the destruction from the tsunami, including a long history of slash-and-burn, illegal logging of timber, monoculture plantations, and shifting cultivation. Along with the devastating loss of habitats and lowland forests from the tsunami, it is now critical to implement and adopt more sustainable and community-oriented methods in the management of their natural resources.

Individuals and communities have the opportunity to re-establish lost forest systems by making small efforts such as planting fruit trees alongside their gardens. To create more substantial forested areas, shelterbelts can be planted adjacent to farmlands, and coastal reforestation projects that support local industries, resources, and coastal biodiversity. These projects can be implemented within the local communities or with the aid of facilitators such as NGOs and government agencies.

The Garden, The Farm, and Coastal Reforestation represent the 3 different community agroforestry plans which demonstrate the different scales in which the local community can manage and directly benefit from reforestation. Each plan looks at how both the private landowner and communities can practice sustainable agroforestry practices as a means to regreen, increase biodiversity, minimize and mitigate further soil degradation, and promote social and economic recovery. These plans also provide useful planting techniques that can be applied to the lowland areas of the Aceh Province.

These reforestation strategies can be applied simultaneously or independently, depending on the needs of its respective community. And each suggestion can be evaluated and adopted based on specific site conditions, community needs, and resource availability.

for more information please visit http://courses.washington.edu/larescue
Community-oriented reforestation and environmentally sensitive agricultural practices can occur at 3 different scales and/or land uses.

**THE FARM**
Establish agroforest shelterbelts alongside farmlands to supplement and replace agricultural activities, provide windbreaks, and discourage the necessity of shifting cultivation. Shelterbelts help to reduce wind speed, prevent wind erosion, provide areas of shelter and shade.

**THE GARDEN**
Incorporate fruit tree stands adjacent to private and community garden spaces to add vegetative complexity to the site and provide additional resources to complement garden activities and crop production.

**COASTAL REFORESTATION**
In order to re-establish vegetation and habitat, to Aceh’s devastated shoreline, a program will focus on the maintenance of protected swaths of coastal forest adjacent to development and establish community-based forest management practices.

1. fruit tree stands
2. agroforest shelterbelts
3. coastal reforestation

See [http://courses.washington.edu/larescue/jenn/design.htm](http://courses.washington.edu/larescue/jenn/design.htm) for more in-depth information and resources.

for more information please visit [http://courses.washington.edu/larescue](http://courses.washington.edu/larescue)
Fruit Tree Stands

Goals
Incorporate fruit tree stands adjacent to private garden spaces to add vegetative complexity to the site and provide additional resources to complement garden activities and crop production.

Planting Fruit Trees
Fruit tree stands may be planted in a variety of forms that depend on the relationship between the garden and its immediate context. Planting in dense clusters establishes a distinct canopy and has the potential to support biodiversity in the understory.

Placing trees adjacent to a private garden may provide shade and vegetative buffers between neighboring properties, communities, or other garden spaces.

Plant stands of fruit trees on the windward side of the farm to create a windbreak in order to protect the adjacent farmland.

Fruit Trees
- coconut — banana — mango
Rice Paddy in Depression
- rice
Slope Control + Intercropping
- lemon grass — maize

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The Garden

Techniques

SOIL
Short Term: A simple and low cost technique to soil desalinalization at the garden scale is labor-oriented tillage of clean, coarse materials into the soil in order to promote saline drainage. Fast growing legumes should be planted to provide organic matter, fix soil nitrate level, and provide a cheap and easy source of protein to the community.

Long Term: Intercropping and crop rotation should be implemented to maintain soil nutrients. Green mulch helps to build healthier soil and control invasives while enhancing garden productivity.

WATER
Short Term: Supply of irrigation water might not be sufficient before any clean water well or storage plant is restored / established. Rain barrels or other collection devices can be used to collect irrigation water if there is a lack of clean water available.

Long Term: Effective mulching techniques should be considered to maintain long-term soil moisture. On slopes, more drought tolerant species should be planted uphill and more water-dependent species such as rice should be planted in depressions, valleys, or foothills.

Planting List

Plant low maintenance fruit trees that can be cultivated in low and medium elevations. The following list of fruit trees can be customized according to the demands of the land and its respective communities.

<table>
<thead>
<tr>
<th>Tree Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mango</td>
<td>Mangifera indica</td>
</tr>
<tr>
<td>Soursop</td>
<td>Annona Muricata</td>
</tr>
<tr>
<td>Starfruit</td>
<td>Averrhoa Carambola</td>
</tr>
<tr>
<td>Jambu Air</td>
<td>Sizygium Aquem Merr &amp; L.M. Perry</td>
</tr>
</tbody>
</table>

Economic Benefits

To produce a larger variety of non-timber products (e.g. fruits) that can be harvested throughout the year for self-consumption or sale in the local markets.

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Agroforest Shelterbelts

Goals
Establish agroforest shelterbelts alongside farmlands to supplement and replace agricultural activities, provide windbreak, and discourage the necessity of shifting cultivation. Field Shelterbelts reduce wind speed and prevent wind erosion, provide sheltered areas, and provide shade. The practice also provides more diverse agricultural products to improve local economy.

How to create a shelterbelt?

Height and Density : Dense shelterbelts that include tall standing trees of large, evenly dispersed canopies.

Row Design + Spacing : Plant 2-4 rows of taller tree species near the center of the shelterbelt to achieve an effective windbreak. Shelterbelts do not necessarily have to take up large portions of land, but biodiversity increases with the width of the shelterbelt. It is suggested that rows should be spaced at 2 to 4 meters apart. Low growing intercrops can be planted between rows to retain moisture.

Species Composition : Species selection determines the success of shelterbelts. It is important to choose native tree species of appropriate hardiness, foliage, uniform canopy, and good branch retention for taller species that occupy the center (windbreak) of the shelterbelt. Smaller trees and shrub species should be planted on the outer edges of a belt.

Intercropping : Intercropping techniques can be implemented between tree rows to encourage agroforestry practices within a shelterbelt while supplementing agricultural revenue.

Typical Phases of Growth of a agroforest shelterbelt:

- **Phase I** : quick changes and growth of shrubs and intercrops.
- **Phase II** : trees begin to develop and shade out non-woody species. Shade tolerant species can be established.
- **Phase III** : trees mature and forest canopy develops. Shelterbelt form establishes.
- **Phase IV** : forest canopy can reach up to 35 meters.

for more information please visit http://courses.washington.edu/larescue
The Farm

Techniques

SOIL

Short Term: At the farm scale, machines like a mechanical roller/tiller should be considered to mix coarse materials into the soil to improve drainage (site and salt content specific).

Long Term: Intercropped shelterbelts should be planted along windward periphery to slow runoff, check soil erosion and invasives, and to promote soil nutrients through intercropping and green mulching. When land is left fallow, controlled and productive species should be introduced to replenish soil nutrients as well as substitute and discourage traditional slash-and-burn practices.

WATER

Short Term: The size and shape of the farm, the slope, and the orientation of planting beds should all be considered to collect runoff and minimize surface evaporation (open water surface under tree canopy). On slopes, more drought tolerant species should be planted uphill, and more water demanding species like rice should be planted in depressions, valleys, or foothills.

Long Term: Matching plant selection to site conditions reduces the need of long-term irrigation. Microtopography such as depressions or trenches helps to trap irrigation or drinking water. Maximize vegetation coverage to promote extensive and consistent infiltration rate and groundwater recharge.

Planting List

The following tree species function successfully within a shelterbelt and/or common coastal and lowland species that will contribute to the reestablishment of lowland forest systems.

<table>
<thead>
<tr>
<th>Trees</th>
<th>Intercrops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubber Tree - <em>Ficus elastica</em></td>
<td>Phase I and II:</td>
</tr>
<tr>
<td>Sumatran Pine - <em>Pinus merkusii</em></td>
<td>+ Sweet potato, Soybean</td>
</tr>
<tr>
<td>Coconut tree - <em>Cocos nucifera</em></td>
<td>+ Cinnamon, Rice, and</td>
</tr>
<tr>
<td>Acacia - <em>Acacia mangium</em></td>
<td>+ Leguminous crops (e.g. Groundnuts)</td>
</tr>
<tr>
<td>Durian - <em>Durio zibethinus</em></td>
<td>Phase III +:</td>
</tr>
</tbody>
</table>

Other intercrops that have a varying degrees of shade tolerance (less shade tolerant in the beginning phases of the shelterbelt, and intercrops with higher shade tolerance as the canopy develops) will provide a sustainable environment to retain moisture and prevent invasive growth along the understory.

Economic Benefits

On top of basic crops from farms, shelterbelts would provide non-timber products such as fabrics, fruits, annual crops and firewood to maximize overall revenue for local communities year-round and improve the standard of living.

for more information please visit http://courses.washington.edu/larescue
Coastal Reforestation

phase I [0-2 years] : Rebuilding Coastal Communities
phase II [2-5 years] : Establishing Young Coastal Forests
phase III [5-8 years] : Harvesting Young Coastal Forests
phase IV [8+ years] : Coastal Forests Matured

Goals
Use large-scale planning strategies to identify and reclaim coastal community land in order to establish and preserve coastal forests, mitigate coastal erosion and re-establish coastal habitat in order to sustain aquaculture.

In order to re-establish vegetation and habitat to Aceh’s devastated shoreline, a program will focus on the maintenance of protected swaths of coastlines as agroforests adjacent to coastal development in order to improve forest management and community economy.

Short-Term Program :
+ Delineate reforestation areas adjacent to coastal development and communities
+ Tree Propagation
+ Building of coastal infrastructure
+ Establish community ownership of coastal forests

Long-Term Program :
+ Coastal forests to function as a landscape buffer and productive agroforest.
+ Establish and preserve sustainable coastal ecosystems.
+ Integrate forestry management practices in coordination with other coastal industries and sources of livelihood.

Creating Biodiversity
The coastal forest as a landscape buffer between:

Sea + Shore : Mitigate further coastal erosion and reduce impacts upon the coastline from future storms and winds.

Coastal Developments : To diffuse the impact of development along the coastline with reforestation.

Habitats : Promote vegetative density planting of a variety of coastal tree species to encourage diversity in coastal habitat and plant species.

+ Establish herbaceous, shrub, and fast-growing tree species in initial development to create biomass.
+ Interplant with slower growing tree species that will help in long-term stabilization of the land.

Creating Biodiversity

Coastal Economy + Biodiversity

Coastal Development

shoreline protection through reforestation

coastal development buffered by forests

forest as a windbreak

+ Establish herbaceous, shrub, and fast-growing tree species in initial development to create biomass.
+ Interplant with slower growing tree species that will help in long-term stabilization of the land.
Community agroforestry

Coastal Reforestation

Techniques

SOIL

Short Term: For large-scale coastal reforestation, wash soil with chemicals and mix with coarse materials. It is ideal to mitigate the soil through the cultivation of salt tolerant annuals and then gradually shift to fruit trees or other complex plant communities as soil quality improves. Green mulch or other groundcovers can be planted to protect fragile transitional spaces from weed invasion.

Long Term: Agroforestry and intercropping promote biodiversity and a healthy ecosystem. Here, healthy soil can be established as various macro and micro flora and fauna flourish, especially in a no-tillage, forested environment.

WATER

Maximize vegetation coverage to promote extensive and consistent infiltration rate and groundwater recharge. Select appropriate plants to specific site conditions which will also reduce the need of irrigation in the long run.

Planting List

Coconut tree - Cocos nucifera
Casuarina - Casuarina equisetifolia
Sea Almond Tree - Combretaceae Terminalia catappa

Other coastal species in the Aceh province:
Casuarinaceae Casuarina equisetifolia [tree]
Euphorbiaceae Glochidion sp.
Goodeniaceae Scaevola sericea [shrub]
Guttiferae Calophyllum inophyllum [tree]
Lecythidaceae Barringtonia asiatica [tree]
Leguminosae - Papilionoideae [tree]
Sagu Palm - Palmae Metroxylon sagu
Nipah palm - Nypa fruticans [grows well in mangrove forests]
Pandanaceae Pandanus sp. [palm tree]

Economic Benefits

Major economic benefits would come from non-timber products of coconut, rubber, palm fabrics and various fruit trees. Selective harvesting of the timber would be recommended, giving communities the option to replace initial species with market-demand crops. Instead of selling raw materials for timber products, communities should also consider processing and crafting their resources into products to increase economic gains.

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