Hiniduma Biolink Project, Sri Lanka - Reforesting traditional home gardens using the analog forestry concept in wet zones of Sri Lanka

Project Background

Where is the project, and what does it propose to do?

“Hiniduma Biolink Project” is an effort of Conservation Carbon Company (CCC) along with Rainforest Rescue International (RRI) to establish a biodiversity corridor between the two large remnant disturbed rainforest patches in Sri Lanka and to conserve buffer zones around the forest edges.

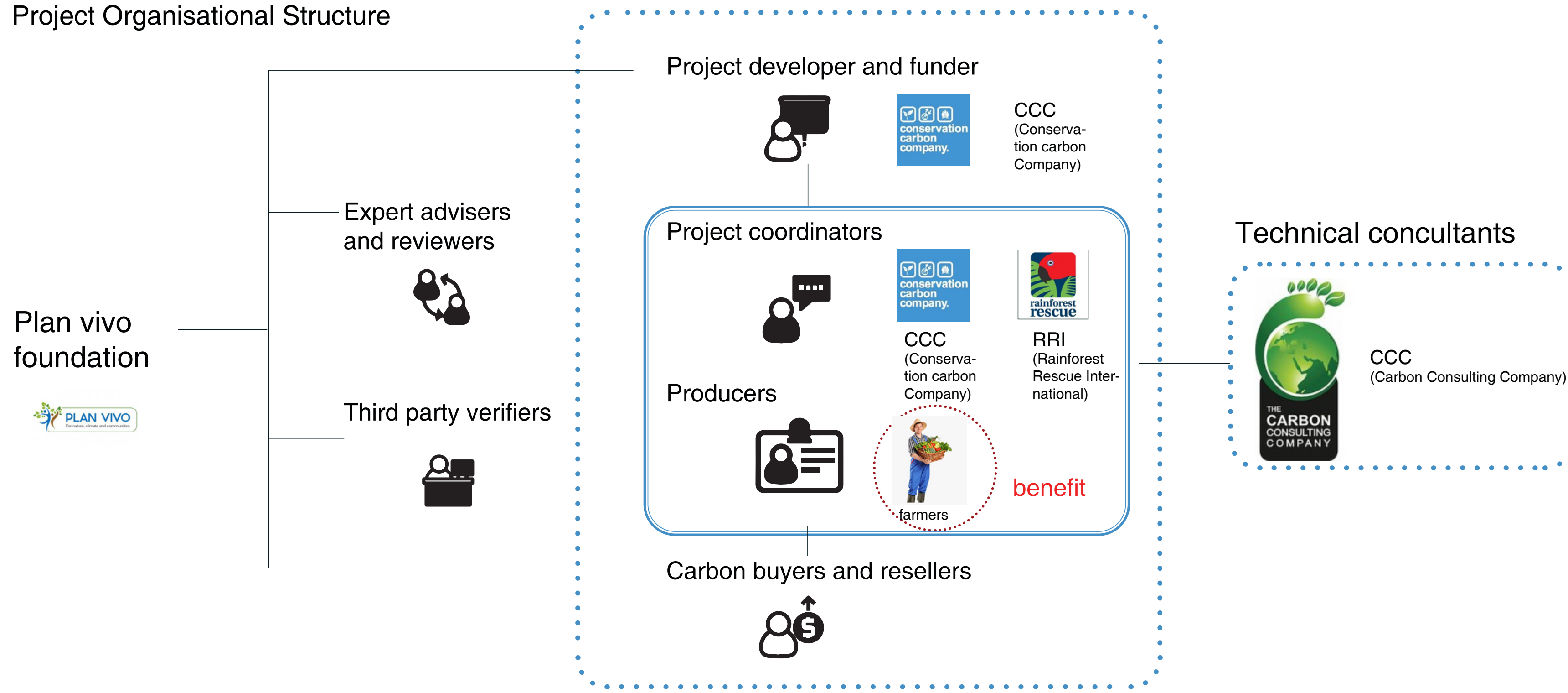
What are the project’s goals?

The project aims to develop a bio-link by setting up few forest corridors to improve biodiversity through flora and fauna movements.

Valuing farmer community involvement to improve the supply of ecosystem services including carbon sequestration is the second objective taking into account the need for activities to be economically viable for communities.

Which organization or individual is responsible for implementing the project?

Who is funding the project or otherwise benefiting from the carbon credits?



Are there additional benefits aside from carbon drawdown (biodiversity, economic development, cultural value, etc?) and for whom?

Biodiversity impacts: -Establishment and protection of wildlife habitat for diverse; -improvement in Microclimate

Water availability impacts: -Reduction of runoff through stem and root effects on soils.

Soil productivity/conservation impacts:

-Reduced soil erosion

Other: - Woodlots will provide a local and sustainable source of firewood, poles and it will reduce pressure on other forest resources.

-Income diversification through non medicines, fruits, shading materials, livestock feeding, etc

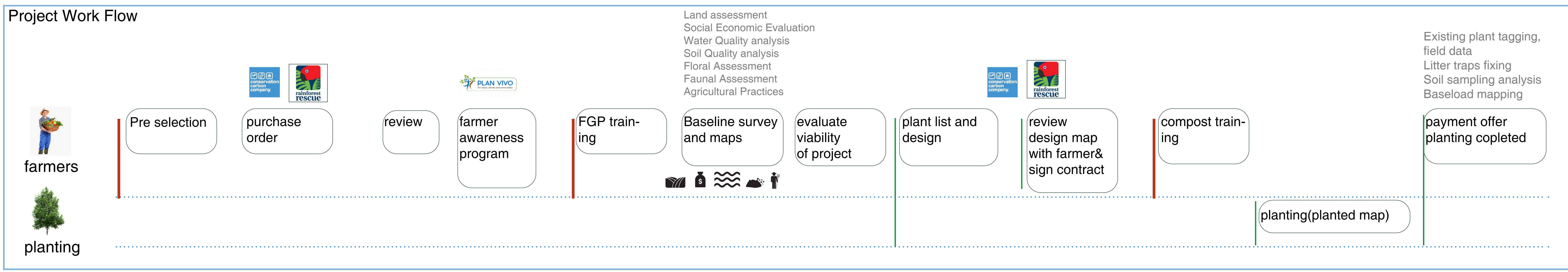
-Provision of potential bee keeping habitat as beehives could be hung in the trees

-Shading for humans and livestock.

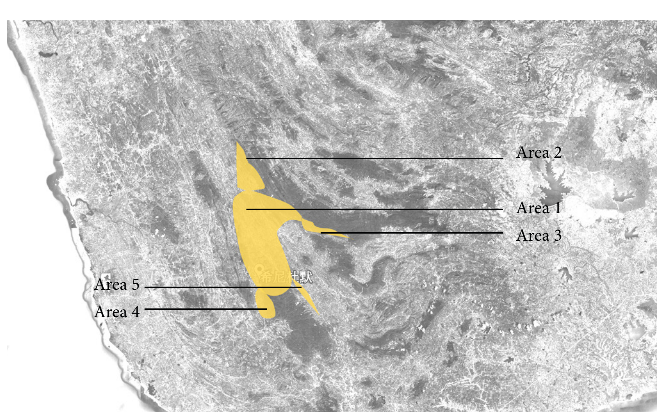
-Pruning material may be used as firewood.

NCS Strategy

Which NCS strategy/strategies are used?



Plan Vivos



The Plan Vivo project activity (PDD Phase 1&2) is located within the polygon named Area 1. The area of this project activity (PDD Phase 1) is 10.88 ha. The yellow polygons in the figure below represent 5 likely corridor candidates of which a total of 2000 ha which is the expanded area of the pilot land areas assumed to be area which will selected based on current knowledge of forest patches, waterways, human population, and land use.

Analog Forestry Concept

Analog Forestry is a system of silviculture, which aims to restore the local biodiversity while providing economic opportunities to small-home-gardens it encourages the use of economically viable crops such as tea, spices, fruit and vegetables, as well as zecologically important species. Where Analog Forestry differs from other systems is in the planting design, which mimics both the structure of a natural forest (i.e. different canopy layers) and the ecological functions of a natural forest (i.e. watershed management).

How much space does the project require?

The total land area of this proposed biodiversity corridor is approximately 2000 ha.

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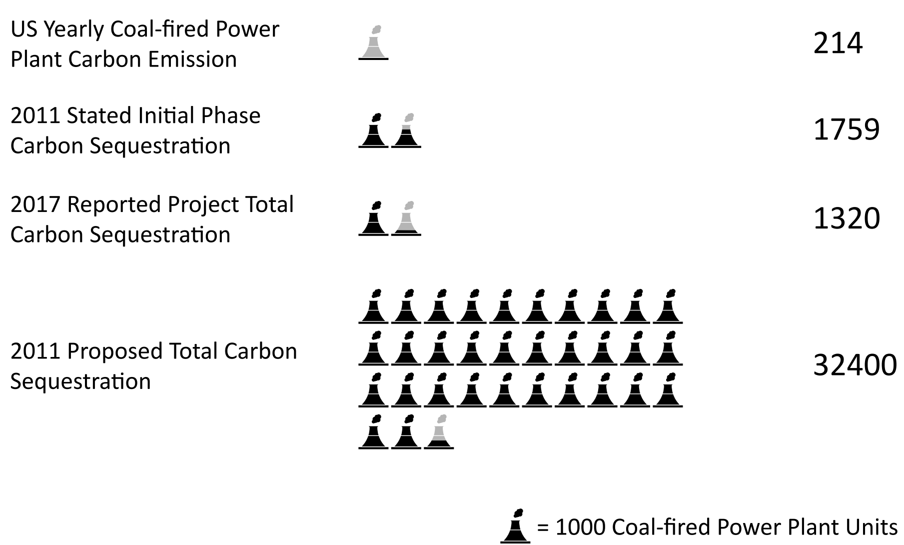
Stated Yearly Carbon Mitigation Estimates

The carbon benefits of the project are assessed using the Plan Vivos project technical specifications. As a multi-phased project, the expected carbon benefit of the second phase with an expanded area of 200 ha land is estimated based on the summaries of the 10.88ha initial pilot phase, which is 1759 ton CO_2, the average carbon benefit of which was 162 ton CO_2 per hectare. The total estimated realizable carbon benefit of the expanded 200 ha, which is expected to be completed by 2015 but has never achieved, is 32,400 ton CO_2. The 2017-2018 annual report, however, states that the survived 8.8 initial phase and phase II has a carbon sequestration of 1320 ton CO_2.

The project technical specification shows that the carbon sequestration of this project is calculated by surveying and measuring the Diameter at Breast Height (DBH) per species to determine species-specific carbon sequestration, which is then calculated with the number of individuals per species. 15% buffer is deducted from the result for resistence.

According to EPA's Emissions and Generation Resource Integrated Database (eGRID), released in 2018 with 2016 data, coal units have an emissions rate of 2,180 pounds (0.99 ton) CO_2 per MWh. In comparison, the stated yearly carbon migitation estimates of the initial stage equals to 1760 coal-fired power plant. That amount is approx. 8 times of a yearly total carbon emission of U.S. coal-fired power plants. If the project completes the stated yearly carbon benefits for the second phase, yearly carbon emissions of approximately 32400 coal-fired power plants (approx. 151 times of U.S. total) will be mitigated.



Implification and Verification

The Report of Carbon Benefits

As the key parameter of the quantification of the ecosystem services of this Plan Vivo project, the carbon sequestration potential of new plants is monitored by CCC and research institutes twice annually according to the given indicators. A monitoring plan is set with a series of phasal goals that must be reached for participating farmers to be verified for payments. The farmers are also encouraged by project coordinators to have their own monitoring plan by farmer organization.

New Plant Data Sheets Template which is used in indicator calculation.

Botanical Name	Tree size	Habitat	Growth Model	Plant Family	Common Name (Sinhala)	Comman Name (English)	Habit	Growth
Adenanthera pavonina	Mediun - large	tropical we zone	D= 0.347e0.173t (R^2 = 0.989)	Fabaceae	Madatiya			
Areca catechu	Small	tropical we zone	D = 0.856e0.148t (R^2 = 0.652)					
Artocarpus altilis	Large	tropical we zone	D= 0.42e0.234x (R^2 = 0.980)	Moraceae	Rata del	bread fruit	Tree	Medium

DBH Measurement in a Monitoring Session
DBH is measured in the annual survey and is the primary data for carbon sequestration estimation in this project.

The Verification of Carbon Benefits

A complete monitoring was conducted by CCC in 2017 after the floods which inundated most of the farmer lands. Another 20% sample that includes 4000 saplings newly planted in 2017 was monitored in 2018. The plant maps on each Plan Vivo land were used for the counting of the saplings initially planted, while the number of dead plants were counted accordingly. The Diameter at Breast Height (DBH) and height of the trees were measured to justify species-specific biomass equations, the results of which were then used to calculated the survival rates for each farmer land, by which the natural regeneration rates were determined which were used in future carbon sequestration estimation.

Species-specific biomass equations were used to calculate future carbon sequestration, which were then compared with recent monitoring activities and has been evaluated and adapted to the developed equations.

CCC is the project coordinator and funder for the Plan Vivo project activity. The project adopts a Payments for Ecosystem Services model: participating farmers will receive staged payments in return for following management plans plan vivos developed with the support of the project. The farmers have complete rights of ownership of any carbon funding received by the use of their lands, as the land tenure of the project area is either solely farmer ownership or provided by Government of Sri Lanka.

Plan Vivo Certificate Registration and Verification Workflow with CCC

A) Land survey; B) Plant sorting and tagging; C) Plant distribution; D) Plant handover to a farmer; E) Planting in a farmer land; F) Signing agreements with new farmers

Is the project working as intended? Were there unintended consequences?

Natural disaster is the major threat to the project. The project area was severely affected by an unexpectedly heavy mansoon in Sri Lanka causing flooding and landslides in May 2017. Some of the participating farmers living close to the Gin Ganga river were affected by the floods. Plants given by this project were also damaged. CCC provided US$ 2,873.67 donations to the victims, and conducted a 100% plant survey to ascertain the survival rate.

The 2017 monitoring results found the total plant survival rate of the project to be 57%. Total issued carbon sequestration were 2767 (after deduction of 15% risk buffer) in 18.8 hectares of the survived project area, and the loss of carbon credits and project area in the 2017 floods were 1447 (tCO_2) and 9.9 hectares respectively.

The 100% Plant Survey Comducted after the 2017 Floods

Monitoring by farmers land:
A) Amarapala's land
B) Wijedasa's land
C) Kumaradasa's land
D) Senevirathne's land
E) During the first monitoring of Piyadasa's land
F) During the first monitoing of Anura Shantha's land

The survival rate should ideally be maintained at a level of ≥ 80% after the third year of planting, as per the project's Technical Specification. Therefore, CCC planted 5,000 new saplings (4,000 in 2017 and 1,000 in 2018) as replacements for dead trees within the Bio-Link Project, with the support of two sponsors. Hence, 34 new farmers have joined the programme and provided 9.6 hectares of lands in order to recover the loss of carbon benefits of the project. Since the growth model for some species of the 5000 plant is absent in the TSS, the carbon credits generated from these plants were removed from the total quantification of the carbon emission reduction, which means that the actual carbon sequestration will possibly be higher than calculated. In addition, fast-growing species with high carbon sequestration were identified and selected by CCC experts. The total estimated delivery of carbon emission reductions is 2,220 (tCO_2), after the deduction of the 15% risk buffer (392 tCO_2). The loss of carbon credits have been reallocated due to planting efforts. Any unallocated carbon will be withheld as a voluntary risk buffer to compensate for any potential future natural disasters or other risks to the project. According to the 2017-2018 annual report of the Hiniduma project conducted by CCC, the recalculated amount of carbon credits of phase I and phase II is 1320 tCO_2.

The re-planting of trees has resulted in slightly higher projected carbon sequestration than the original planted area of the project. The excess amount of carbon credits will be kept as a risk buffer to compensate for potential future natural disasters. The survival rate of the 20% sample of tree monitoring conducted in 2018 was 85%.

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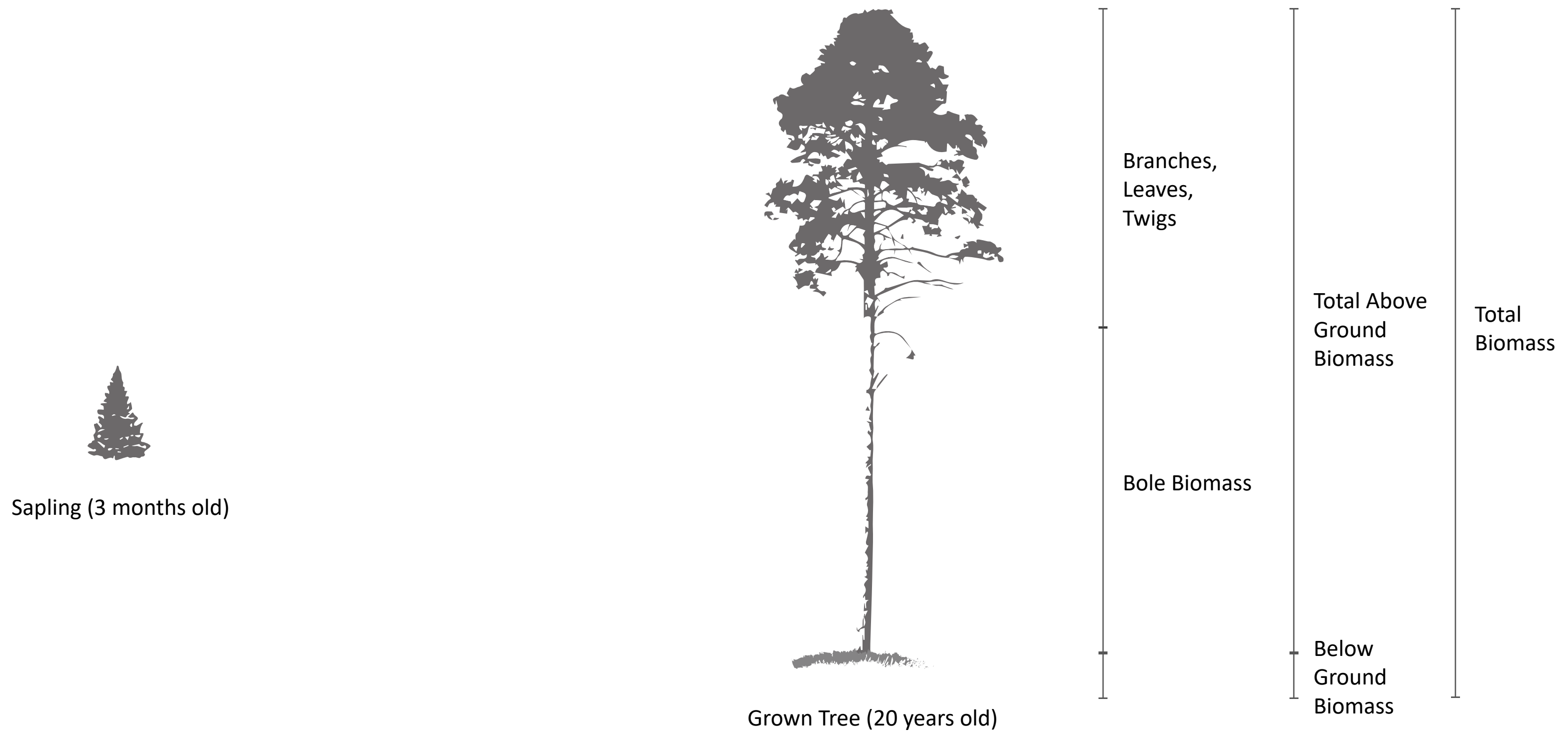
However, the project has achieved major social impacts. To maximize the socio-economic benefit of the project, the reforestation design adopted a participatory approach. Interviewing and consulting was done with farmer households in the project areas to understand the small-scale analog forestry project activity would better respond to their desires for livelihood development by looking at below areas.

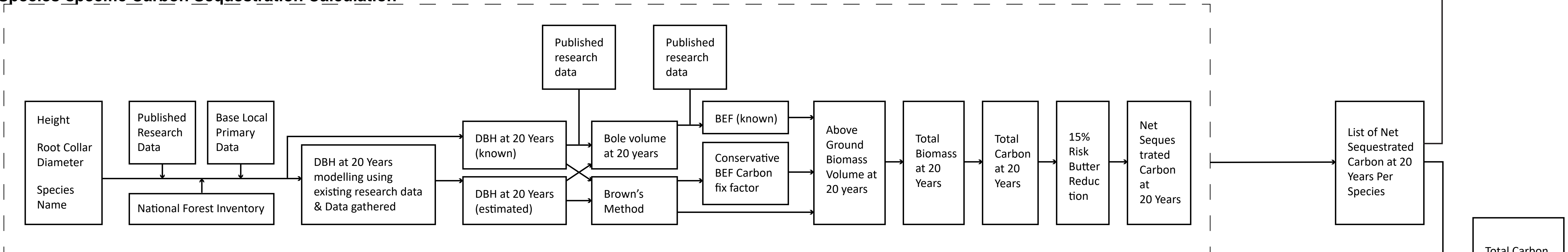
Markets have been contacted and initial discussions have taken place in this regard. Methods of diversification of primary production will be enhanced by introducing a tree cropping regime and processing and bottling of fruit products will be trialed by the community. Benefit of the above actions will be distributed equally among the community using a entrepreneur model.

Plant Survey and Measurement of Total Biomass



List of Carbon Sequestration Results Per Species

Species-specific Carbon Sequestration Calculation



Calculation: $\sum i(Xi \times Yi) \times 75\%$(risk buffer deduction) = 1320 ton C, Xi = the Carbon Sequestration of i, Yi = the Number of i, risk buffer = 15%

The calculating method used in this project is based on the number of growned trees per species and the DBH and the height data per species collected in the plant survey. In this method, survival rate is included as the survey being conducted, and can be used to predict future carbon sequestration. The species-specific method allows for flexibility when local species with little data are used as the case of this project. However, soil respiration is excluded which if considered will cause a shortfall of the result.

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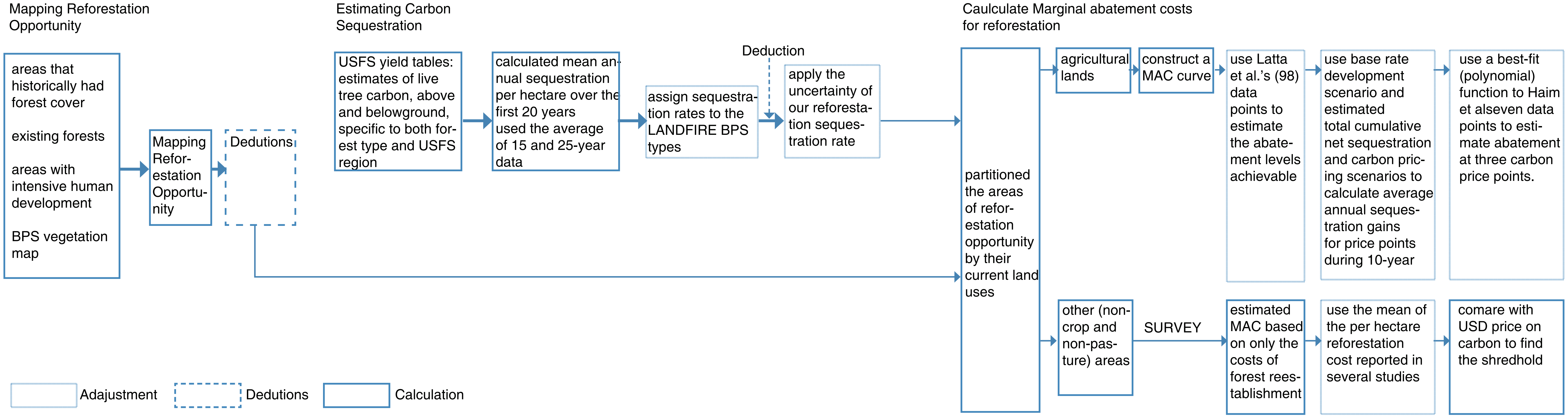
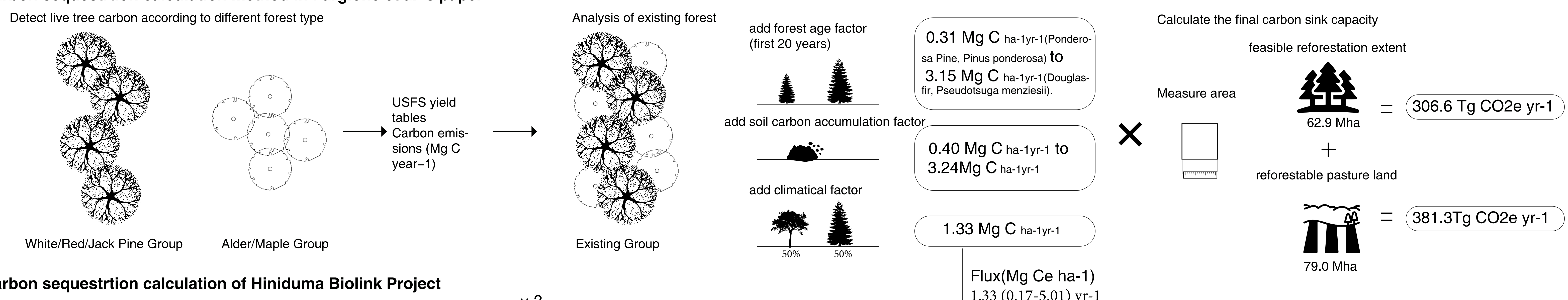
Reforestation proccess in Fargione et al.'s paper

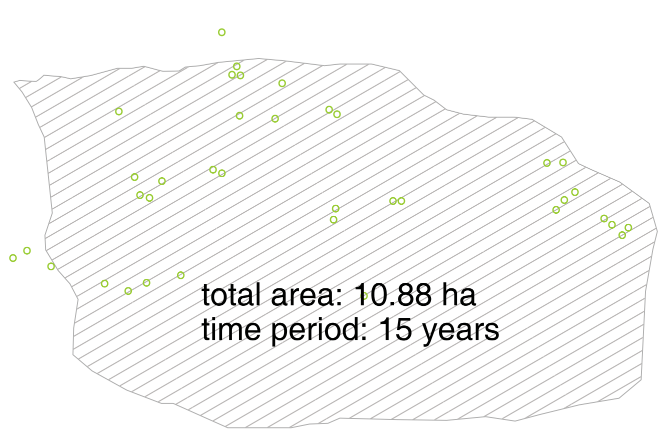


Carbon sequestrtion calculation method in Fargione et al.'s paper



Carbon sequestrtion calculation of Hiniduma Biolink Project

× 3



climatical & tree spicies factor adjustment(according to Table S14. in **Fargione et al.** We compared the carbon sink capacity of deciduous and evergreen forests and obtained this factor)

Calculation: 10.88 Ha × 15yr ×5.01mg c ha-1yr-1 ×3 × 80%(risk factor) = 1308.2 Mg C

The method of Fargione et al. is more generalized and suitable for making cost predictions than measuring single carbon exchange rates for specific tree species in the region and updating carbon sinks by number and year, but deviates from what is actually calculated. In the process of analyzing and trying to apply the Fargione et al. method, we realized that there are various factors that affect the carbon uptake by plants in the actual project, and felt the inf luence of soil, biotype, and climate on the overall carbon environment. However, in terms of the total number of our projects, we are still optimistic that reforestation projects can achieve a certain degree of positive circulation through the accumulation of time and quantity.However, silvicultural projects also require certain adaptive considerations and corresponding policies for various major risk hazards. In reading the project documents we found that the area experienced a major f lood, which had a significant impact on the previous reforestation (for the complexity of the factors we did not consider in detail), which was also the project was once in the doldrums, as re-prone to such climatic disasters in tropical projects, we think the later construction needs to make adaptations to such situations, and timely consolidation of the construction of forest land to reduce the forest land in the storm Losses.

Sustainable Wuji, Hengdong County, Hunan Province, China - Reforesting Waterfront Wetlands using the analog forestry concept in agricultural land

Project Background

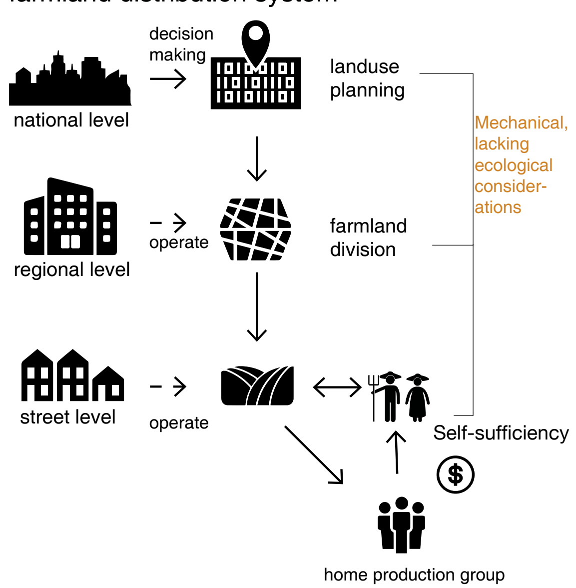
The aim of our project is to re-establish waterfront wetlands along the riverine farming zone in Wu Dong Town to provide f lood protection for the area and to create a better riverine biotope to enhance the sustainability of local development.

Strategy

The project takes into account the combination of local economic and administrative organization structure, in line with the original production habits of the family joint production, to give full play to the dynamics of the family unit, through community education, family labor redistribution in order to make, project construction sustainable, for the overall carbon sink and reduce energy consumption to lay the foundation.

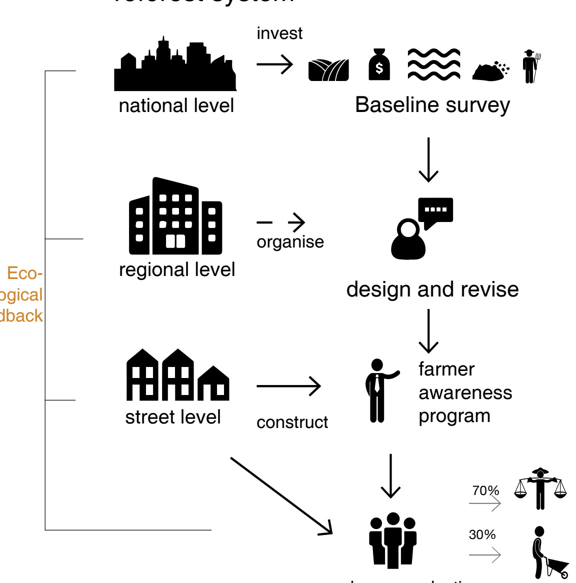
BEFORE

Group Farming Tradition
farmland distribution system



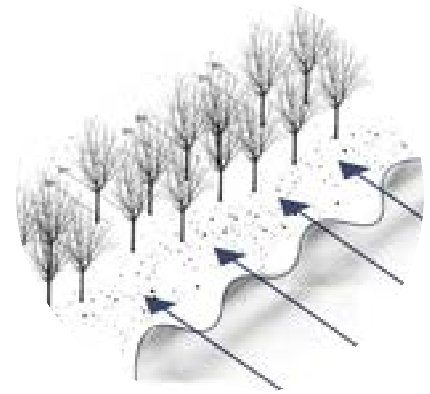
AFTER

New Production Group
reforest system



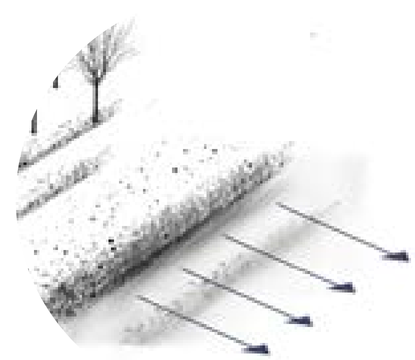
Benefits

Reduce water speed to protect crop



Even in the event of f looding, riparian woodlands can reduce flood flow rates and extend the survival time of rice that can be f looded

Contrust waterbreak



Construction of breakwater terrain in conjunction with reforestation to prevent future sea level rise

Providing Habitat

Lotus provides waterfront habitat for important and precious birds, and the construction of waterfront wetlands can provide habitat for national-level protected animals such as the Chinese sand duck.

Threat 3:
Pollution from argriculture

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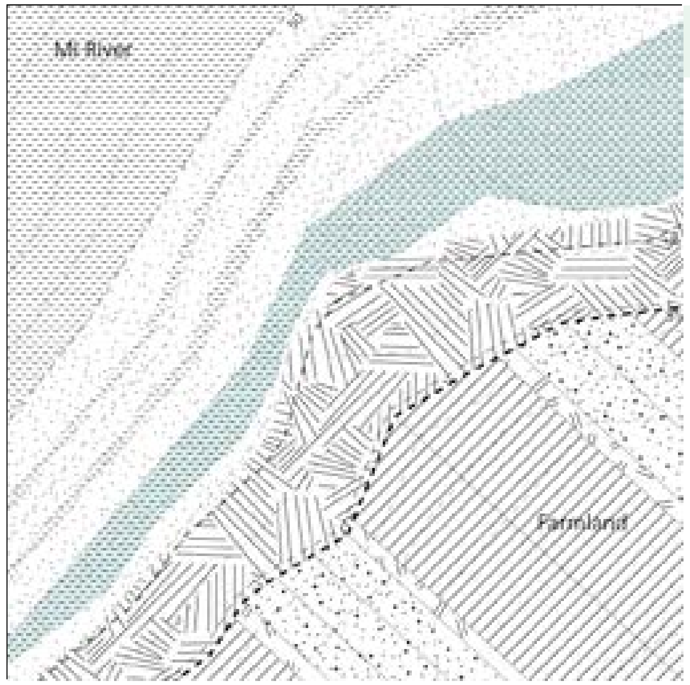
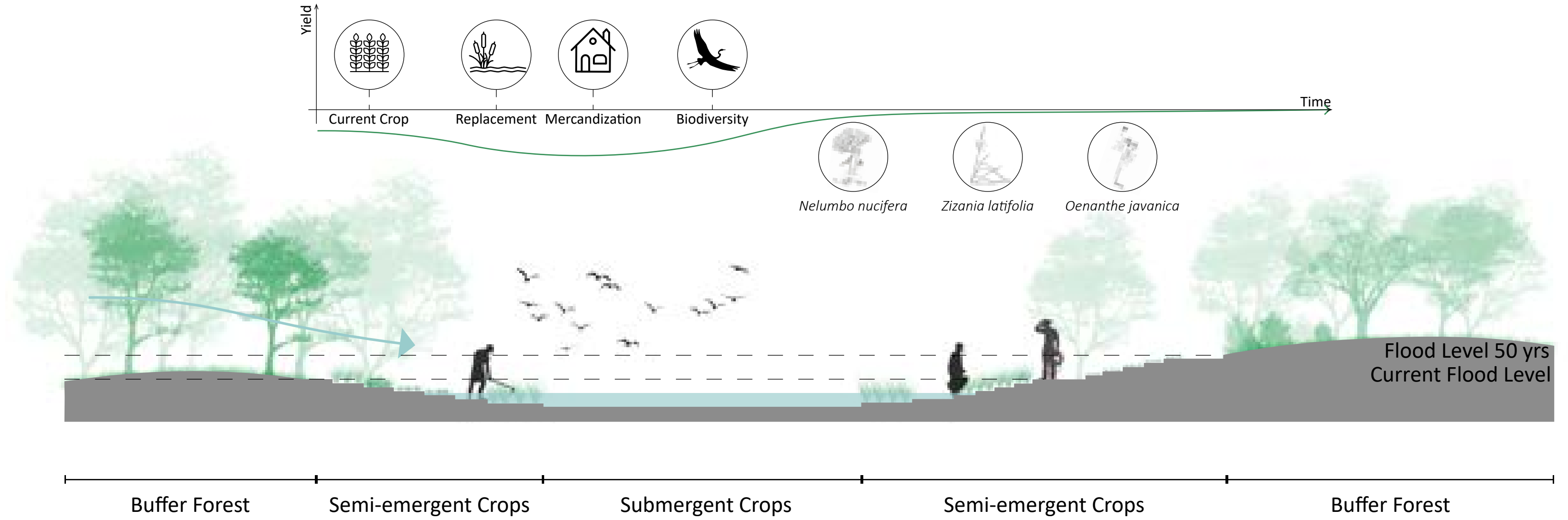


SCENARIO 1

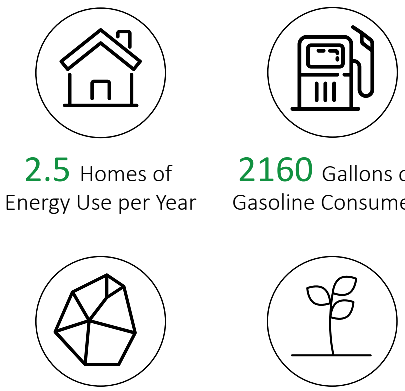
Economical Buffer

Wetland plant species widely planted in this region that creates economic benefits are chosen as a substitue to peasants' income.

5.40 ha wetland ecomonical crops



21.99 Metric Tons of Sequestrated Carbon

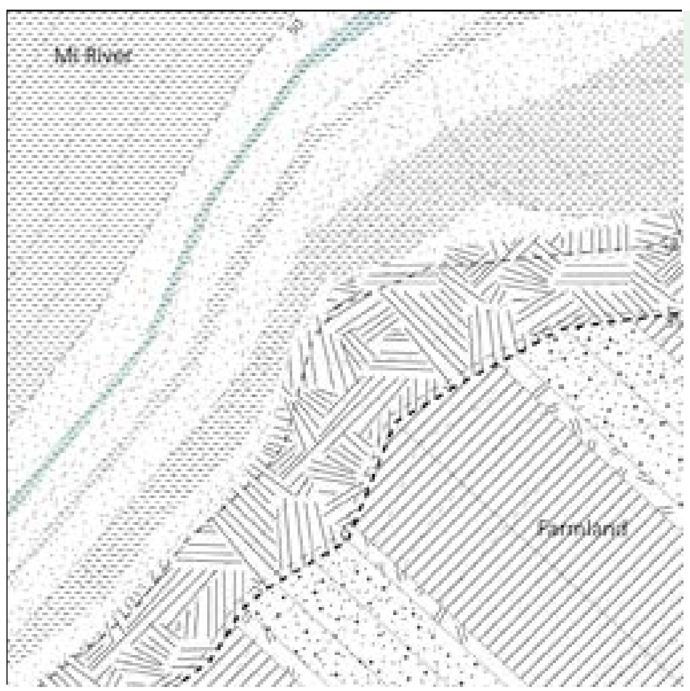


2.5 Homes of Energy Use per Year

2160 Gallons of Gasoline Consumed

10.99 Metric tons of Coal Burned

364 Urban Tree Seedlings for 10 Years

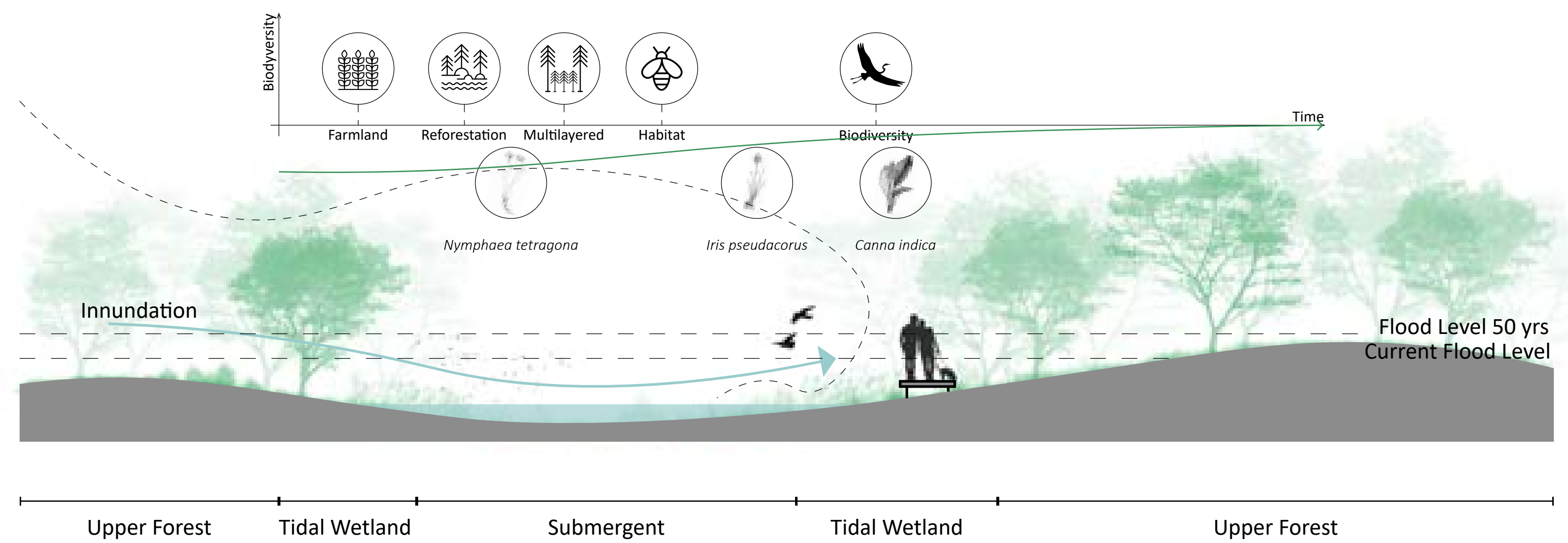


SCENARIO 2

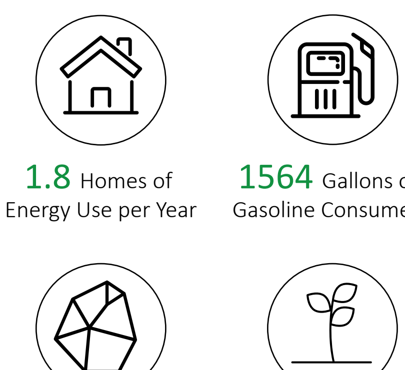
Landsvcape Buffer

Aethetically desirable plant species are chosen to create a walk that appreciates the beauty of preserved *Mergus squamatus* habitat.

3.91 ha restored wetland habitat



15.92 Metric Tons of Sequestrated Carbon

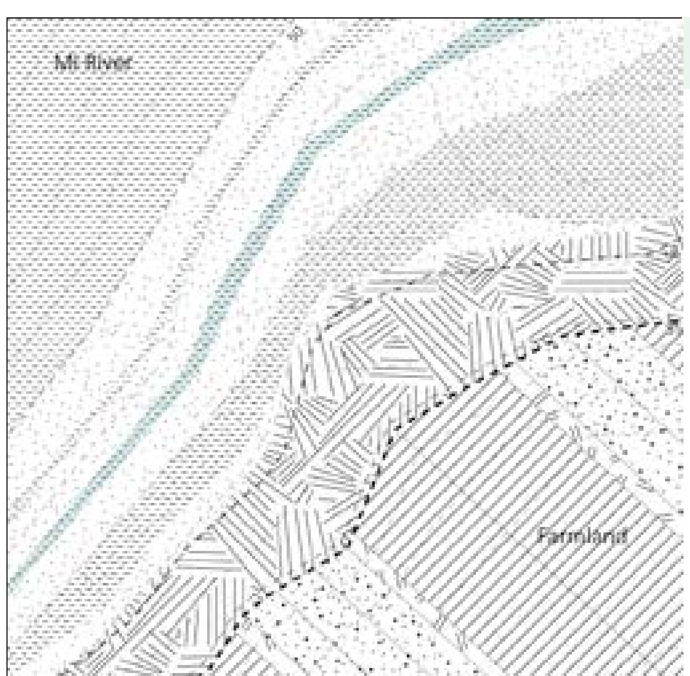


1.8 Homes of Energy Use per Year

1564 Gallons of Gasoline Consumed

7.96 Metric tons of Coal Burned

263 Urban Tree Seedlings for 10 Years

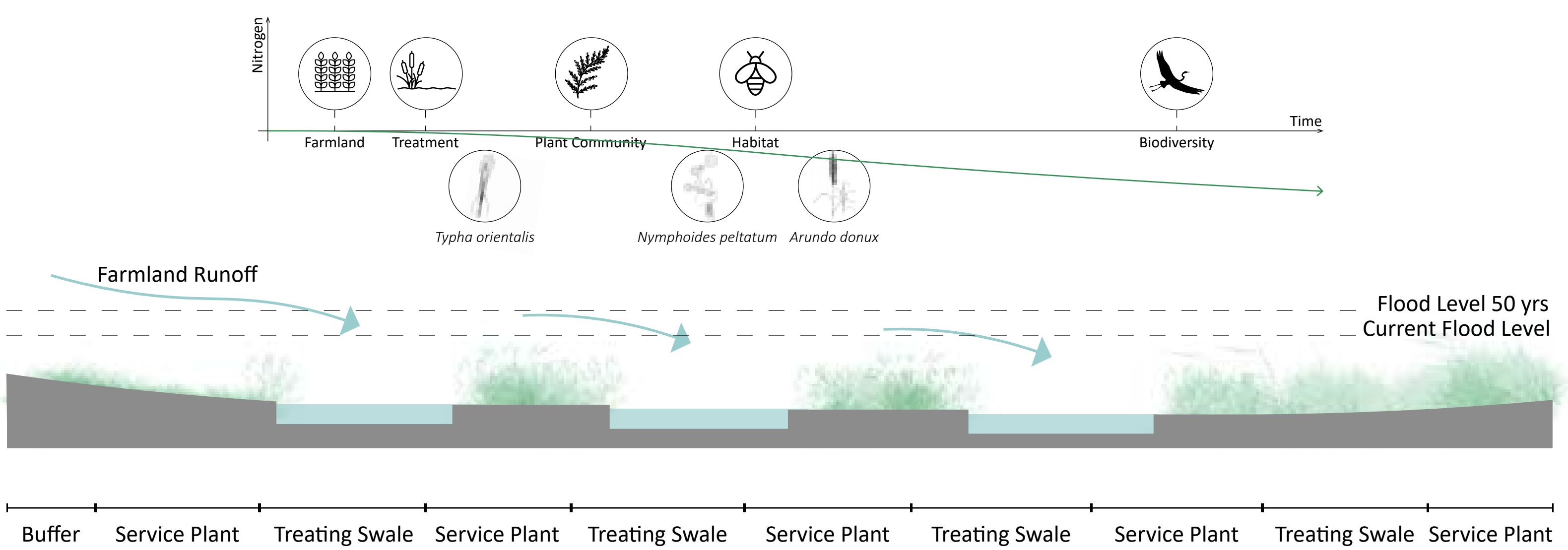


SCENARIO 3

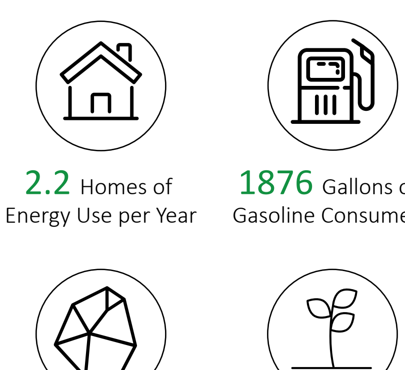
Purification Wetlands

Wetland plants that are efficient in water treatment are applied into water treating steps that decompose agricultural waste from the farmland.

4.69 ha water treatment swales



19.10 Metric Tons of Sequestrated Carbon

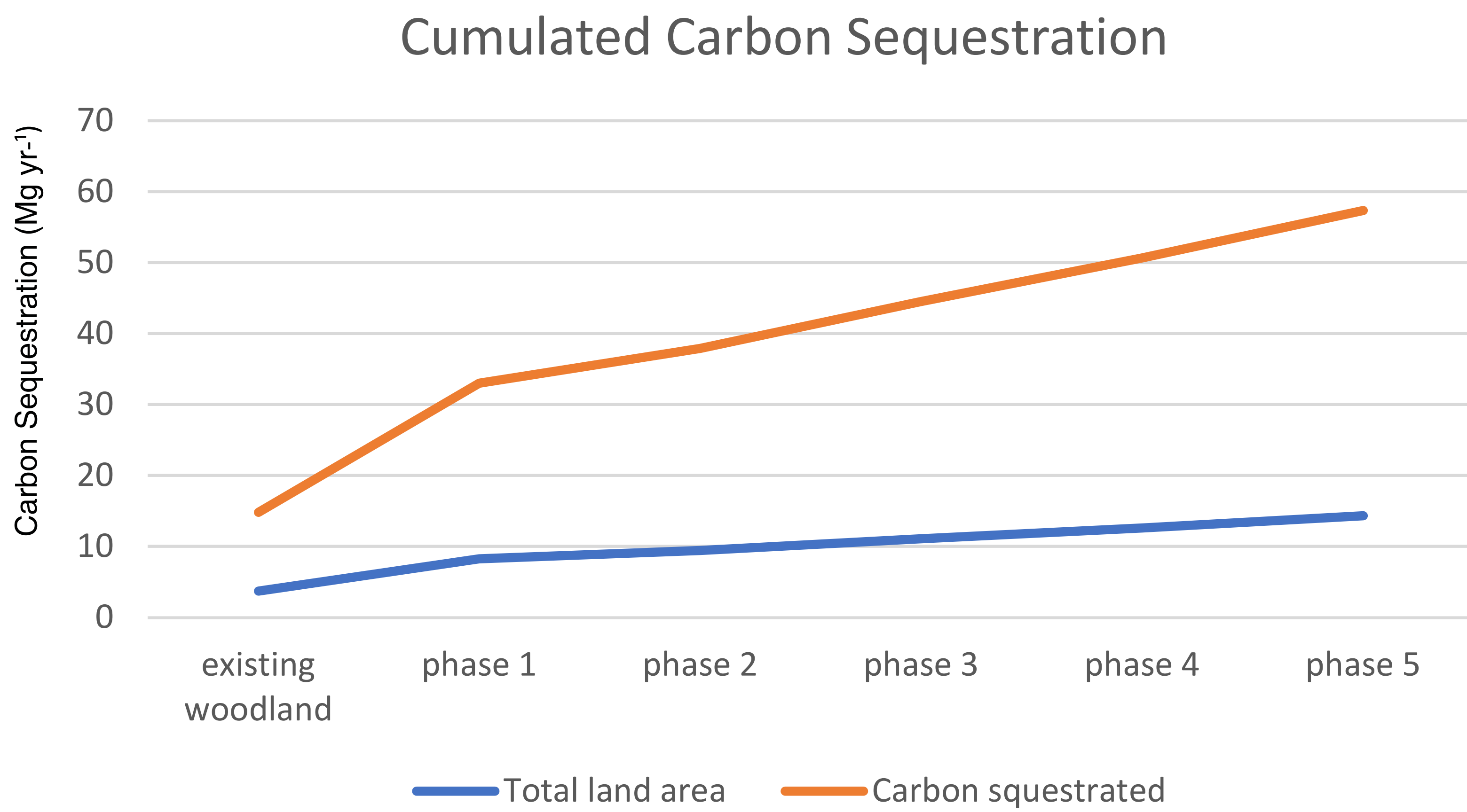


2.2 Homes of Energy Use per Year

1876 Gallons of Gasoline Consumed

9.55 Metric tons of Coal Burned

316 Urban Tree Seedlings for 10 Years



Wetland Restoration: 5.01Mg c ha-1yr-1
Risk Factor: 80%

Existing Woodland
    Area: 3.71 ha
    Carbon Sequestrated:14.8544496 MgC yr-1
Phase 1
    Restoration Area: 4.53 ha
    Total Area: 8.24 ha
    Carbon Sequestrated:33.0275232 MgC yr-1
Phase 2
    Restoration Area: 1.23 ha
    Total Area: 9.47 ha
    Carbon Sequestrated:37.9381248 MgC yr-1

Phase 3
    Restoration Area: 1.64 ha
    Total Area: 11.12 ha
    Carbon Sequestrated:44.5405032 MgC yr-1
Phase 4
    Restoration Area: 1.52 ha
    Total Area: 12.64 ha
    Carbon Sequestrated:50.6458896 MgC yr-1
Phase 5
    Restoration Area: 1.68 ha
    Total Area: 14.31 ha
    Carbon Sequestrated:57.3592896 MgC yr-1

Total Carbon Comparisons
60% Completed
    179,951 pounds of coal
    18,377 gallons of gasoline consumed
    2,700 tree seedings grown for 10 years
    20,827,948 smartphones charged

100% Completed
    231,741 pounds of coal
    23,666 gallons of gasoline consumed
    3478 tree seedings grown for 10 years
    26,822,244 smartphones charged

Other Impacts

Wuji county, composed of 1 community and 10 administrative villages, reports 47 thousand permanent residents by 2019. The land tenure of this area is administrated by production groups which have rights to the use of the lands. The project is designed into 5 phases based on the production group.

The restoration project provides targeted production groups with 10.60 ha new flood-resistent agricultural componants to the existent cropland. Compared to the existent single economic mode of rice planting, which is subject to the increase of extreme weather due to climate change, the proposed multi-composed agricultural land applies wetland economic crops that are adaptive to different levels of inundation in the potential inundation buffer, which significantly eliminates economic risk of extreme weather.

Besides economical benefits, the project also provides a significant habitat for scaly-sided merganser and other migrational birds. The stepped buffer swales create multiple habitats including forest, tidal wetland and lake that provides various habitat to support higher biodiversity. The anolog silviculture strategy increases the vertical complexity of the reforestation area that creates multiple ecological niches.

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