Forest Gardens in Tabora, Tanzania

SUMMARY

In 2019, Green Earth Appeal began funding Forest Garden Projects in the Mabama area of Tabora, Tanzania. This funding has supported more than half of the total project cost helping 487 farming families – comprising 3,696 people - to improve their lives through planting trees in sustainable farming systems. The project began in May 2019 and, as of March 2020, the farmer participants have planted nearly 1 million trees on 700 acres of land.

PROJECT CONTEXT AND OBJECTIVES

The Tabora area is known for growing high-value tobacco. However, to cure tobacco it must be 'smoked'. Thousands of acres of trees have been cut in the last few decades to 'smoke' tobacco and make room for additional farmland for growing tobacco. In addition to tobacco, corn is grown as a staple crop. However, the cutting of trees and monocropping of tobacco and corn have left the soil depleted of nutrients. The environmental impacts of growing monocrops of tobacco and corn in Tabora cannot be separated from that of modern agriculture in general. The most detrimental impacts from agriculture occur due to land-use change, poor farming practices, loss of soil fertility and tree cover, and runoff from fertilisers and insecticides. Many farmers in our Tabora projects have chosen to develop their forest gardens on farmland that they had abandoned due to soil infertility. This is particularly interesting because it gives us an opportunity to see enormous changes in soil fertility as the Forest Garden develops. In just under a year, farmers in Mabama are beginning to restore this land by planting live fencing/ green walls around their fields and alley cropping with nitrogen-fixing species.

The impact that agroforestry systems can achieve are as follows:

- Ecosystem synergies that allow the entire intercropping system to produce higher yields protects the fragile ecosystem with semi-arid and complex soil conditions in Kigoma, which cannot support typical monoculture palm oil plantation.
- Large quantities of biomass for mulching and moisture retention.
- Increased farmer incomes and food security
- Adaptation to climate change and resilience to rainfall variability, including drought and flooding: reducing the effects of climate-induced hydro-meteorological events by transforming dryland into a sponge that can absorb and channel rainwater into the ground during heavy rain events and release green water during months of drought.
- CO_2 sequestration-intensive farmland
- Improved soil fertility through intensive pruning, mulching, use of manure and the introduction of nitrogen-fixing (leguminous) cover crops.
- Adopted organic practices - no pesticides or chemical fertilizers.

PROJECT BENEFICIARIES

In May 2019, following a three-month mobilization and registration period, farmers in the Mabama Forest Garden Projects began training in Forest Garden Design and Nursery Development. They are currently completing their first year of the four-year program. The figures below provide information on the number and demographic breakdown of total project beneficiaries and the numbers that we have supported through our partnership.

	Project Total	Total Supported by Green Earth Appeal
Number of Farmers **Female 33%** **Male 66%**	487	292
Families Beneficiaries	3,696	2,218

TREE PLANTING ACTIVITIES

Our projects are planned and implemented following a seasonal calendar (See Season Planting and Harvesting Work Plan). In Tanzania, the rainy season occurs between late November to January. Often there is a dry month in February, and the rain continues into March and April. However, this second rain is highly variable. This year, the rains have continued and allowed for excellent continued tree growth.

In preparation for a successful outplanting season, technicians spend months training farmers in groups on the following modules:

- Forest Garden Design
- Composting
- Nursery Development
- Perma Gardening and
- Outplanting techniques

November and December 2019 saw Mabama farmers plant nearly 1 million trees. Throughout the year they held 144 training sessions on 5 Forest Garden Development modules.

	Project Total	Total Supported by Green Earth Appeal
Number of Trees Planted	910,071	546,042
Number of Training Conducted	144	86
Number of Acres Planted	700	420

See the table below, highlighting the tree species and vegetables outplanted. The accompanying Season Planting and Harvest Work plan provides visual details on the function of each tree species with the system and the planting and harvesting times for tree and vegetable crops.

Trees	Vegetables
Leucaena leucocephala – animal fodder, live fence *Moringa olifera - food, intercropping* *Acacia polyacantha - live fence* *Gliricidia sepium - animal fodder, live fence* *Grevillea robusta (Grevillea, Silky Oak) - timber* *Pasiflora edulis (Passion Fruit) - fruit* *Carica papaya (Papaya) -fruit* *Mango - fruit* *Avocado- fruit*	*Kale Okra* *Carrot* *Onion* *Tomatoes* *Pumpkin* *Cassava* *Beans* *Watermelon*

AGROFORESTRY SYSTEM DESIGN AND COMPONENTS

Our Forest Garden Approach is an adaptable methodology. Although they have recommended species and approaches that farmers learn during training, ultimately the farmer designs their own Forest Garden. During Forest Garden Design training, the technicians utilise a participatory process to engage with farmers to further adapt the design to align with farmer's recommendations. This results in a design, crop selection, and placement that all farmers are committed to implementing because they have ownership over the design process. The basic building blocks of all forest gardens are outlined below.

Living Fence/Green Wall

Green Walls consist of three rows of agroforestry trees that surround the entire perimeter of the field. The purpose of the green wall is to protect the field from animals, wind and water erosion, stabilise soils, fix nitrogen in soils, provide organic matter for composting and provide additional food crops and animal fodder. The two outer rows consist of a mixture of agroforestry trees indicated in the Planting and Harvesting Plan. Additional seedlings are grown in later years for transplanting to fill in missing spaces of those that may not survive. The inner third layer of the green wall consists of a row of timber trees that support the structure of the outer layers and provide a long-term investment and may be sold for poles in 30 plus years.

Alley Cropping

Alley cropping segments the field with nitrogen-fixing and food crop trees. Alley cropping improves the soils, provides organic material for composting and mulching, captures and infiltrates rainfall and also provides animal fodder and food.

Fruit Trees

Fast-growing, quick producing fruit trees including *Papaya and Passion Fruit* were planted throughout the field. These trees will provide a valuable food source and income within the first three years. In addition, slower-growing fruit trees, including *Avocado and Mango* were planted in the field and will produce after the third year.

Staple Crops

In the alleys between trees, farmers have the choice of growing staple crops or expanding vegetable permaculture. Either way, these alleys provide a secure food source and income. Farmers plant a variety of crops in these alleys including: *Beans, Cassava, Maize, Sweet Potato, and other*. Some alleys may be split with various staple crops. In addition, some farmers may choose to plant horticulture crops in a portion of the alleys including tomatoes, watermelons and pumpkin.

Market Garden

The market garden provides a space for continuous horticulture production, including once the trees are fully grown. Crops grown in this area are for home consumption and/or sale including: *Okra, Carrots, Onion, Kale, Sunflower, Tomato, Watermelon, and Pumpkin.* Market gardens produce during different seasons: including wet and dry season crops. Some of these crops will also be grown in the staples alleys during the first 3

years of production, and some staple crops could be grown in this area post 5 years.

Composting and Mulching: Farmers develop one open-pit compost pile within the first year and a second later in the project. The compost includes a mixture of available organic matter, manure (if available) and is continuously turned and kept at optimal moisture to ensure aerobic decomposition. Farmers are trained on compost development and can additionally harvest leaves, from trees in the green wall and alleys, to mix into the compost to add organic matter. In addition, these leaves make excellent mulching material for fruit trees.

Aggregation and Processing: With increased production of fruits and vegetables, there is an opportunity to aggregate the production of these smallholder farmers for processing or sale to a higher market.

Value-added products: High protein animal feed can be made from species in the green wall. In addition, flowering trees will provide an ideal environment for beekeeping. These food and income-generating activities can be introduced later in the project.

Biodegradable seedling sacs: With the expansion of agroforestry systems and the desire to have all elements of the value chain sustainable, a commitment has been made to use biodegradable tree seedlings sacs which were used in all projects in 2019. However, in Tanzania, they were unavailable and importing across the border from Kenya proved to be infeasible. For 2020 a supplier has been found in Tanzania, and they will now be using 100% biodegradable tree sacs.

Papaya Trees 2 months after out planting - These trees will produce fruit by September 2020

Trees planted in Live Fence after only 2 months of growth

MONITORING AND EVALUATION

Monthly farmer visits are conducted by technicians to observe progress and provide one-on-one mentoring and technical support. Technicians also record the amount of training conducted, and trees planted and report this information through an online Monthly Reporting Form integrated with SalesForce. Randomly selected samples of this data and the data collected below are backchecked by the Regional Coordinator, Country Director and Programs Director annually.

To track the impact of the projects, our tree planting partners have a robust GIS-based mobile Monitoring and Evaluation system, TaroWorks, integrated with SalesForce. Through this system, they register farmers at the beginning of the program and conduct two annual surveys:

Registration: This records the farmers name, GPS point of the field, photo of farmer and land, land size, baseline tree count and crops species. It also records gender and family demographics.

Annual Technical Data Form TDF: This annual survey is conducted for every forest garden and tracks the physicalities and production (size, marketable products, # of trees on-site, and household data. This annual survey is conducted in September, several months following tree planting, to observe and record actual trees in the field, providing survival rate information. Therefore, there is currently only the 2019 baseline TDF data for Mabama (see table below).

Annual Sample Survey: For this annual survey, ArcGIS is used to determine a selection size that will result in a 95% confidence level and randomly select farmers in each country to do this more in-depth survey which includes 75 questions in four areas:

- General demographics: family size, age, education levels, gender
- Food and security access: (USAID Household Access to Food Survey)
- Household dietary diversity (FAO survey) Questions regarding different types of foods eaten in the last 24 hours and directly correlated to food groups.
- Household resilience reflecting increase in income

The timing of these surveys is critical. They are taken during periods of highest stress in the year (before harvest) and measure important aspects of the realities of our participants' day-to-day lives. For the communities in Tabora, this is between January and February. There is currently baseline data on food security and dietary diversity for Mabama. This data was taken prior to their first vegetable harvest. As you can see in the chart below, the food insecurity is quite high and dietary diversity very low. The numbers for food insecurity and dietary diversity in the chart are 'index scores'.

Project	Category	Period			
		2019	2020	2021	Goal
Tanzania: Mabama	**Food Crops**	1	-	-	4
	Marketable Products	1	-	-	8
	Trees per Acre	10	-	-	2,500
	Species per Acre	2	-	-	20
	Food Insecurity	-	8.51	-	4.26
	Dietary Diversity	-	5.17	-	8.58

Household Food Insecurity Access Score: Our journey is to build more prosperous and resilient farming communities, one of the major impacts they aim for is increased food security for participating farmers and their households. By improving people's access to food, their work is eliminating hunger for thousands of families. The way in which this impact is measured is via the Sample Survey's Household Food Insecurity Access Scale (HFIAS). This tool was developed by the United States Agency for International Development (USAID) and is a global standard for measurement of household food insecurity.

Each of the questions in the survey is asked with a recall period of four weeks (30 days). The respondent is first asked an occurrence question – that is, whether the condition in the question happened at all in the past four weeks. These are very difficult questions to ask and to hear the results for. A sample of some of the questions are listed below.

- Did you or any household member have to eat a limited variety of foods due to a lack of resources?
- Did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?
- Did you or any household member have to eat fewer meals in a day because there was not enough food?
- Was there ever no food to eat of any kind in your household because of a lack of resources to get food?
- Did you or any household member go a whole day and night without eating anything because there was not enough food?

Results of Mabama's baseline HFIAS can be seen below. Experience with thousands of similar farmers across Africa gives us confidence that Mabama farmers food security will greatly increase in 2020.

Mabama Project HFIAS Results

Household Food Insecurity Access Score	2020	2021	Target
Average (out of 27)	8.51	-	4.26

Household Food Insecurity Access Category	2020	2021
Food Secure	6.41%	-
Mildly Food Insecure	7.69%	-
Moderately Food Insecure	51.28%	-
Severely Food Insecure	34.62%	-

Household Dietary Diversity Score (HDDS): A second metric used to measure the food security of households also relates to the nutritional qualities of meals is dietary diversity. Dietary diversity is defined as the number of different foods or food groups eaten over a reference time period.

Based on research conducted by the Food and Agriculture Organization (FAO), when combined with access, the diversity of a diet can provide an adequate measure of food security.

Our tree planting partners' Household Dietary Diversity Score (HDDS) survey is adapted from USAID's Household Dietary Diversity Score. Many of their sampling and analysis procedures were kept from the USAID survey, but they adapted the questions to include local foods commonly eaten in the areas where programs are implemented.

To better reflect a quality diet, the number of different food groups consumed is calculated, rather than the number of different foods consumed. This is a more meaningful indicator than knowing that households consume four different foods, which might all be cereals. The following set of 12 food groups is used to calculate the HDDS:

a. Cereals
b. Root and tubers
c. Vegetables
d. Fruits
e. Meat, poultry, offal (organs)
f. Eggs
g. Fish and seafood
h. Pulses/legumes/nuts
i. Milk and milk products
j. Oil/fats
k. Sugar/honey
l. Miscellaneous

Data for the HDDS indicator is collected by asking the respondent a series of yes or no questions regarding the food they have consumed using the previous 24 hours as a reference period (24-hour recall). Longer reference periods result in less accurate information due to imperfect recall. Results of Mabama's HDDS baseline survey can be seen below. Experience with thousands of similar farmers across Africa gives us confidence that Mabama farmers dietary diversity will greatly increase in 2020.

Mabama - HDDS Results

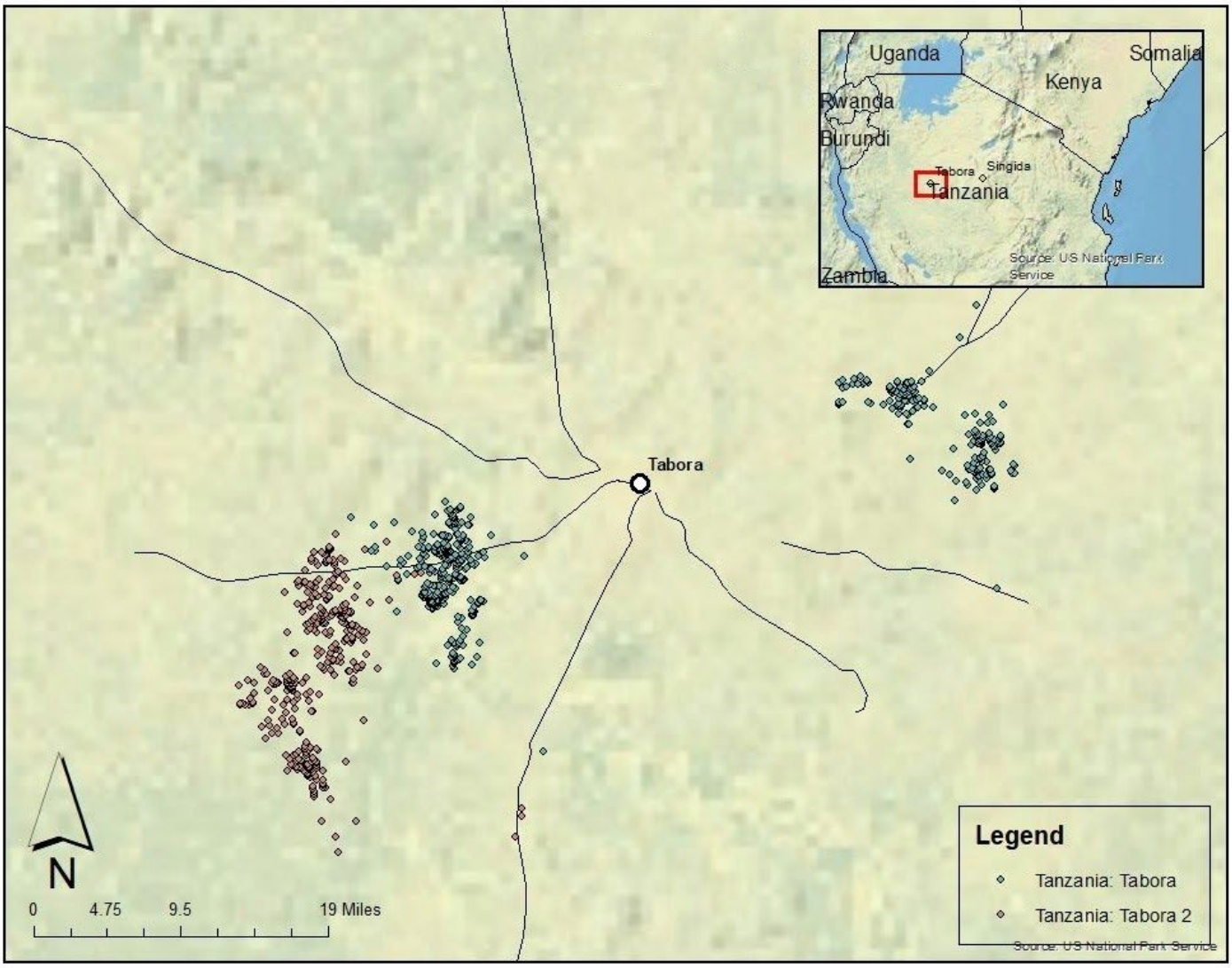
Household Dietary Diversity Score	2020	2021	Target
Average (out of 12)	5.17	-	8.58

Household Dietary Diversity Category	2020	2021
High Dietary Diversity	6.41%	-
Moderate Dietary Diversity	57.69%	-
Low Dietary Diversity	35.90%	-

Data Shared:

We strive to provide the most robust data so we can fully understand the impact of our support on both the environment and people. We also encourage Adopt Project supporters to visit their projects in Africa. As well as numerical data, we provide photos and special interest stories. Although we collect GPS points, we do not share this information publicly as we strongly feel that this is a privacy issue as well as a land tenure issue. Making public the GPS coordinates of thousands of acres of contiguous land could leave farmers prey to the 'land grab' problem that is plaguing African countries.

MAP OF TABORA PROJECTS IN TANZANIA



Mabama: Season Planting and Harvesting Workplan

Nursery Establishment	Function in the System							Jan		Feb		March		April		May		June		July		Aug		Sept		Oct		Nov		Dec	
Transplanting Direct seeding H = Harvesting Time	Live Fence	Animal Fodder	Alley Crop	Fixes Nitrogen in soil	Food	Fruit Trees	Perma-Garden																								
AGROFORESTRY TREES																															
Leucaena leucocephala	X	X	X	X																											
Moringa olifera*2			X		X																										
Acacia polyacantha	X																														
Gliricidia sepium	X	X		X																											
TIMBER TREES																															
Grevillea robusta	X																														
FRUIT TREES																															
Passion Fruit*5					X	X								H	H	H	H	H	H												
Papaya*5					X	X										H	H	H	H	H	H	H	H	H	H						
Mango *1,4					X	X		H																				H	H	H	H
Avocado *1,4					X	X														H	H	H	H	H	H						
Staple CROPS																															
Beans			X	X	X			H	H	H	H					H	H	H	H												
Cassava*3			X		X			H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Maize			X		X											H	H	H	H	H	H										
Sweet Potato			X		X							H	H	H	H	H	H														
MARKET GARDEN																															
Okra					X		X									H	H	H	H	H	H	H	H								
Carrots					X		X									H	H	H	H	H	H	H	H								
Onion					X		X									H	H	H	H	H	H										
Kale					X		X									H	H	H	H	H	H	H	H	H	H	H	H				
Sunflower				X	X		X	H	H									H	H												
Tomato				X	X		X									H	H	H	H	H	H										
Watermelon				X	X		X									H	H	H	H	H	H	H	H								
Pumpkin				X	X		X	H	H	H	H	H	H													H	H	H	H	H	H

*1 Harvest year-round (peak times indicated)

*2 Harvest year-round

*3 Year-round because of multiple varieties

*4 These fruits are grafted in the nursery in August and take 3 years to mature

*5 Produce Fruit in the first year

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Mabama Forest Garden Project

Details for Each Project Type	Mabama Totals Impact	Total Impact of Co-Funding from Other Source	Total Impact from Green Earth Appeal Funding
Number of Farming Families	487	195	**292**
Trees Planted/Farming Family	1,869	1,869	**1,869**
Number of Trees to be planted	910,071	364,028	**546,043**