Impact study of Pachamama Raymi in Tanzania, Projects Greening Africa 1 & 2
Final report

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Executive summary

The objective of the study is to evaluate / measure the impact that can be attributed to the actions of Greening Africa (GA), implemented by the NGO Pachamama Raymi (PMR) in the villages of Sarame, Vilima Vitatu (GA 1, 2015-2018), Mwada and Sangaiwe (GA 2, 2017-2020), in the Babati district, Manyara region, Tanzania, two and three years after completing the activities, respectively.

Their impact is measured in light of the Greening Africa objective "to improve the living conditions of extremely poor families, and achieve prosperity through environmental reclamation", and three lines of action that I will address in the study in the following order: a) economic activities alternatives, b) the adoption by the majority of the population of innovations in the management of natural resources, and c) preventive health. The articulation of these axes is aimed at breaking the vicious circle of poverty and degradation of natural resources, key elements of Pachamama Raymi's intervention. Key is also its methodology. It is important to highlight the effectiveness and efficiency of the methodology in its adaptation to the Tanzanian context. A high level of participation has been achieved (GA1 81%, GA2 90%), summoning the commitment of the authorities, the interest and the enthusiasm of the families. These have participated by mobilizing their resources (monetary, labor), achieving an accumulated valued investment in the two areas that represents up to 77% of the total investment of GA 1&2. In this way, the commitment of the families is valued beyond their participation in the contests between families and their organizations, organized by the projects.

Economic alternatives: afforestation is the distinctive feature of Greening Africa. All people interviewed have planted trees, the families have great expectations regarding the future benefit, to make their dreams come true. The economic calculations (paragraph 5.2) indicate that substituting annual crops with perennials that are usually planted by families for timber and fruit means a profit over four times greater or twice greater if it is only fruit trees. Families also obtain significant immediate benefits (in less than 1 year) from milk production and fruit production (papaya), which is consumed and sold.

Promoting attractive economic alternatives for families in order to break the vicious cycle of poverty / resource degradation has been the strategy of Greening Africa. In this sense, the perennials (trees) allow reclamation of natural resources: families value them as they cover the land and prevent it from drying out, produce shade and protect the house (paragraph 5.3.1). I estimate the total area planted with trees at 1,000 hectares (timber, fruit, fodder), which represents ten percent of the total area planted with annual crops and three percent of the total area managed by the four villages. This does not include lands under control of the WMA (Burunge Wildlife Management Area) (paragraph 5.3.2).

Extensive livestock management has not undergone significant changes, except for milk production by some families. The degradation of vast grasslands has not been reversed. Ecological restoration is a long-term goal, achievable if the efforts started by the projects, continues. The effects of climate change in the area limit that possibility. The recently started mining operation in Vilima Vitatu represents a drastic change in that village, affecting the improvements made by the families of this village.

Picture 1
Papaya trees have become popular

All families have improved their home, their latrines, internal order, which undoubtedly leads to better hygiene. Adoption of the improved stove and the vegetable garden were less successful. The diet of the families improved, with the consumption of fruit, produced at home, and to a lesser extent, with the increase in the number of chickens (for meat and eggs). These good practices, together with the extension of the ongoing drinking water service in the area, should lead to a significant improvement in the health of families.
The impact index calculation proposed by PYMWYMIC, which I included in the present report, places Greening Africa as a high impact experience.

The participating families and Greening Africa have largely achieved the goal of improving the living conditions of extremely poor families in the four villages. The foundations to achieve prosperity were established in the six years of presence of Greening Africa.

Introduction

This text summarizes the impact study of two Pachamama Raymi projects in the Manyara region, Tanzania, called Greening Africa 1 and 2 (GA 1&2).

I will briefly describe the background of the projects, explain the terms of reference (objectives and methodology) and briefly comment on the interviews. The impact study itself, presents external factors, that is those factors that were not controlled by Greening Africa and that had a positive or negative impact on the objectives and results as intended by the projects. The analysis of the interviews is then taken up in detail, the basis for approaching the calculations to measure the impact, in four dimensions, 1) the investment of the families versus the investment made by the projects, 2) the benefit / cost ratio of the economic alternatives, 3) innovations in the management of natural resources and 4) preventive health. I will provide the impact analysis using the PYMWYMIC method, which precedes the general conclusions of the study.

Picture 2
Toribio Huillca, executive director of Greening Africa 1&2 and one of the participants

1 Background of the Greening Africa 1 & 2 projects

The NGO Pachamama Raymi (PMR) has a long history in Peru of activities to "*break the vicious circle of environmental degradation and rural poverty by reclaiming natural resources introducing sustainable management. The change of management practices is achieved through peer learning, and motivators to participate and apply the innovations through contests that reward the best implementers.*"
The capabilities of Pachamama Raymi has been recognized by a multitude of projects throughout the Andes of Peru, among others, including close collaboration with municipal governments. Since 2015 PMR implemented projects with the same objective in the Manyara region, Babati district, in northeastern Tanzania, under the name of Greening Africa.

1.1 The geographical areas

The two projects implemented in the Manyara region were:

- Greening Africa 1 (GA1) in the villages of Sarame and Vilima Vitatu.
- Greening Africa 1 (GA1) in the villages of Sangaiwe and Mwada.
-

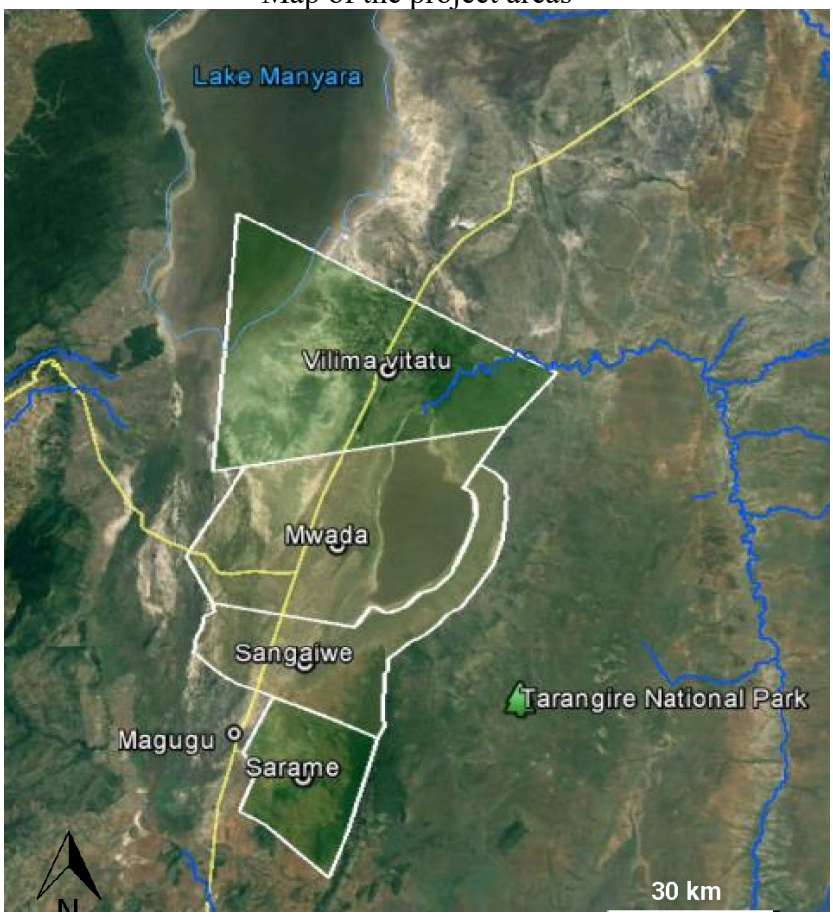
Table 1
Geographical areas of Greening Africa

Greening Africa 1 May 2015-Decembre 2018			Greening Africa 2 May 2017 - December 2020		
Total number of families		**1,141**	**Total number of families**		**1,547**
Sarame	**Sub-Villages**	**Families**	Sangaiwe	**Sub-villages**	**Families**
	Taifa Njema	88		Sangaiwe	225
	Ndorobni	83		Osoley	256
	Kiteto	46		Gembo	123
	Changarawe	60		Neneto	117
	Bulkerre	73		**Total**	**721**
	Total	**350**	Mwada	**Sub-Villages**	**Families**
Vilima Vitatu	**Sub-Villages**	**Families**		Burunge B	177
	Mdori	251		Mbuyuni	227
	Kigongoni	238		Bondeni	179
	Marewa	117		Burunge A	81
	Magomeni	75		Makirinya	162
	Changarawe	53		**Total**	**826**
	Nchemu	57			
	Total	**791**			
Total number of sub-villages in both projects		**20**	**Total number of families in both projects**		**2,688**

Source: PMR, Final-Report Manyara Region, Tanzania, Draft, PMR, January 2021, p. 8

Map 1 shows the location of the four villages, which lie between Tarangire and Lake Manyara National Parks.

Figure 1
Map of the project areas



Source: In the footsteps of an environmental restoration,
evaluation results in Sangaiwe, Mwada, Sarame and VilimaVitatu, PMR, December 2016

In broader terms, the projects are located in an area severely affected by degradation of natural resources, as identified by a United Nations study (see: Annex 1, Tanzania and its areas affected by degradation.)

The four villages are part of the agro-ecological zone "semi-arid lowlands", located between 950 and 1,200 meter above sea level. Annual rainfall in the villages is 500 and 750 mm, which make it the driest area of the Babati district (source: Babati District Council).

42% of the people of the Manyara region are poor, that is, they live on less than USD 2 per person per day. There is no data on poverty at the village level, however, poverty statistics show that it is higher in rural areas. The percentage of poor people is therefore likely to be higher in the project area (the four villages).

The vicious circle of poverty-degradation characterizes the area: poverty drives families to exploit more of their land, whether for rain-fed crops or extensive livestock, both activities are rather sensitive to the weather. Seasonal over-exploitation leads in turn to the depletion of the fertility and productivity of land and pastures, exacerbated by poverty and so on. See: Annex 2 “Degradation and Poverty”.

A fundamental aspect of Greening Africa's strategy is to break this vicious circle.

1.2 Objectives and expected results of the projects

The projects formulated the following objectives:

> GA 1: Improve living conditions of extremely poor families in two villages of the District of Babati in Tanzania achieving adoption by a majority of the population, of innovations in natural resource management, alternative economic activities and preventive health care within four years.
>
> GA 2: Achieve prosperity of the families of the villages of Mwada and Sangaiwe and reclamation of natural resources with a project duration of three years.

In short, the objective of the projects is to improve the living conditions of extremely poor families, and achieve prosperity, with three lines of action:

a) the adoption by the majority of the population of innovations in management of natural resources,
b) alternative economic activities and
c) preventive health measures

Table 2 summarizes the main components, according to the project formulation documents.

Table 2
Projects' main components and activities

1: Innovations in the management of natural resources
Ground cover, natural grass will have improved.
Potential increase in biodiversity due to improvement in natural habitats
2: Alternative economic activities
a) Livestock: Elimination of strong seasonal variation in income for villagers, by producing fodder throughout the year.
Fodder production as a business option.
The results of improving cattle breeds will be evident.
Animal production increased at the end of the four years, as there will be sufficient fodder.
b) Timber:
The introduction of excellent long-term economic options: the production of timber trees.
Each family will have planted at least 1 ha of timber trees.
c) grains
Larger amounts of stored grain.
d) fruits
Each household will have planted at least 15 fruit trees.
The financial capital and fixed assets of families has increased considerably. *Note: as the result of the above mentioned activities*.
3: Preventive health, Improvements in human health, through:
Increase in the quality of food in people's diets, among others, through the consumption of fruits and the production of milk and dairy products The collection of water and construction of shallow wells.
Home improvement

Picture 3
Gliricidia sepium, a great fodder tree, deep roots,
producing even during long draught periods

1.3 The Pachamama Raymi methodology, a central aspect of the Greening Africa projects

A central and key aspect of the GA 1&2 projects in Tanzania is the application of the Pachamama Raymi methodology, fine-tuned over more than three decades by the NGO of the same name. Four fundamental elements of the methodology are:

1) *A clear definition of the objective and targets to be achieved.* For example, about the number of participants which should be sufficient to generate the dynamics to accomplish the widespread adoption of innovations, as well as the precise and demanding determination of what the main innovations should be in order to obtain the greatest impact. The determination of the innovations corresponds to the project team, based on a broad review of the existing alternatives and in the perspective of systemic change. The proposed actions need to complement and reinforce each other and aim to reverse the resource degradation/poverty vicious cycle.

2) *Peer learning*, learning from farmer to farmer, which is done with "farmer experts", who talk and share with the families in their own logic, in their own experience, unlike the training of technical staff who impart mostly abstract knowledge. Such training is reinforced with visits to successful experiences (for example, in the same area of the project or in the Iringa region, at a distance of some 400 km.

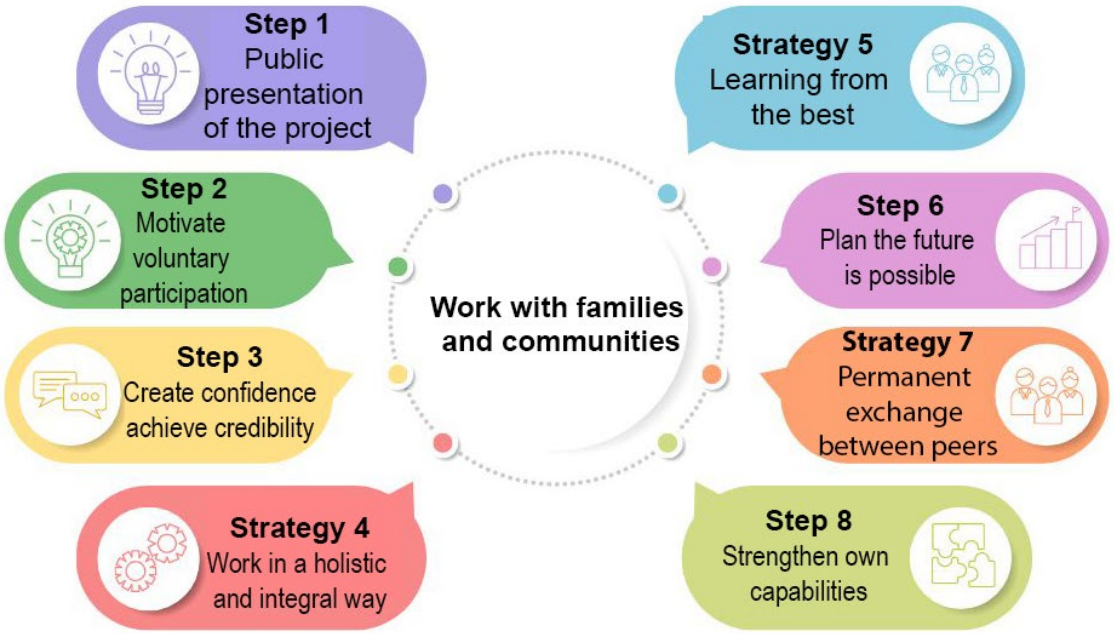
Picture 4
Peer learning, the picture showing a group of farmers
visiting a farmer producing timber trees

3) The *motivation* of families to achieve progress in the adoption of innovations through contests, with appreciable prizes, which proved to be a powerful driver of

family behavior. Six contests were held between families in GA 1 and in GA 2, and between winners (the winners league), contests between their sub-villages, as well as a specific contest about forestation plus a contest for the organization of ceremonies.

4) the *strengthening* of local actors to secure the processes and achieve greater dynamism in territorial development. The support of the organizations of the population and their authorities is important as well as having a favorable environment for the processes promoted. In the case of GA 1&2, the village organization was in charge of organizing the prize award ceremonies of the contests, the organization of the sub-village was in charge of watching over and accompanying the development of the activities (peer learning, and follow-up of the families). Both organizations have participated extensively in the production of seedlings for afforestation (tree nurseries in each village).

Figure 2
Strategy and steps to enhance participation in GA 1&2



Source: "Sustainable environmental reclamation, Towards ecological reclamation and the dreamed future", (2015-2020), 66 pp. Oihana de Gana Romero, June 2022.

For the Pachamama Raymi methodology, its conceptual framework and the logic of the methodological approach, at the heart of the PMR action, see "Poverty, how to accelerate change, experience, results and focus of an innovative methodology from Latin America" [1]

[1] https://pachamamaraymi.org/docs/poverty-how-to-accelerate-change-.pdf

Picture 5
Tree nursery in Sangaiwe

2 Objective and methodology of the impact study

2.1 Objective of the impact study

The objective of the present study is to evaluate / measure the impact of the action developed by Pachamama Raymi in the district of Babati, Manyara region in Tanzania, in the two projects of Greening Africa 1 (GA1) in the villages of Sarame and Vilima Vitatu and GA2, in the villages of Sangaiwe and Mwada.

It is essentially about appreciating the changes caused by the two projects in the lives of families (improved health, increased income, restoration of natural resources) and the prospect that these changes will be sustainable; will last.

The period considers the execution time of the projects from early 2015 to the end of 2020 (six years). The present is carried out three years after completing Greening Africa 1 and two years after completing the activities of Greening Africa 2.

2.2 Methodology of the impact study

I will use two methods:

A. The first is based on the comparison between the situation with and without the project, around the three components mentioned in Table 2.

B. The second is the "PYMWYMIC" proposal based on four parameters and a synthesis index.

A. Method based on the comparison between the situation with and without the project.
In the study I will seek to identify/assess the changes attributable (directly) to the project. It will be necessary to discern the external factors (factors not under the control of the project) favorable or not, that influenced the changes in the period considered. The baselines established by PMR-Greening Africa will serve as a reference for this identification.

The impact to be measured is summarized in the following formula:

X1 the changes or results that have occurred as a result of the project (which are directly attributable to it)	–	X0 the changes or results that would have occurred (anyway), in the absence of the project

The family is the unit of reference. The impacts are measured at the time of the study, including preventive health.

I propose four parameters to evaluate the changes and the perspective of perpetuating them:

Table 3
Parameters to evaluate the changes and data source

Parameters	Data source
A1. GA investment generated in the two project areas (GA1&GA2) The investment generated essentially by the families, and eventually, related investment by third parties (state agencies, municipalities). The score is the ratio of 1 USD invested / 1 USD generated.	Disbursement schedule and financial reports and of PMR- Greening Africa. Data of the contests. percentage of families that applied each innovation. Interviews with families.
A2. Costs/benefit of the promoted alternative economic activities. For each economic activity, the cost of production and the income produced are established. The score is the cumulative average difference per family in the project areas (percent of families that have adopted the alternative).	Data of the contests Interviews with families In-depth interviews with most successful families Field visits
A3. Benefits of innovations in natural resource management With emphasis on 1) plant cover and 2) potential increase in biodiversity. The weighting considers the improved surface in the two project areas and an analysis of the potential impacts in the medium/long term	Data of the contests Cartographic data of PMR Analysis of the bibliographic data Interviews with families Interviews with specialists.
A4. Preventive health Considers the adoption of actions and practices related to family hygiene, diet and home improvement. The weighting takes into account the percentage of families that have adopted/applied the proposals, the investment per household and accumulated, as well as a qualitative assessment of people's health.	Data of the contests Targeted specific investments. Interviews with families.

B. PYMWYMIC impact assessment method[2].

The advantage of applying this method is to use an existing and recognized proposal in the sphere of private investors. The approach is oriented to the impact of all investments of the project.

Its four parameters are measurable with the data available in GA 1&2, plus complementary interviews and field visits.

Table 4 presents the parameters and the source(s) for their measurement.

[2] **Pymwymic** is a group of investors that supports the transition to a sustainable economy to serve the people and the planet. It is based in Amsterdam.

Table 4
The four parameters of the PYMWYMIC method

Parameters	**Measurement sources**
B1. *Impacted lives*: How many lives are positively influenced by the products or services offered by the projects? It is the number of people involved in the activities of PMR in Tanzania.	Data available from PMR records
B2. *Depth of impact*: Do the solutions target the people at the bottom of the pyramid, those who most need help? From 0 to 100%, 100% = most needy population	
B3. *Type of impact*: To what extent are the projects trying to address a systemic change in the reality in which it operates? On a scale from 100% to 200%, based on 1) the type of problem addressed: is it a direct problem or a root cause, that is interconnected with other social and environmental problems? And 2) The approach, single solution / more global (systemic) change The assessment of this parameter will take into account the analysis of parameters A1 and A4	Compilation and analysis of existing bibliography (PMR and others), Interviews with families, interviews with specialists in situ.
B4. *Additional of the company or NGO*: Would the planned change have occurred without PMR? Three closed questions, score 0 for "no", 1 "yes") 1. Would the knowledge/experience have reached the population without PMR? 2. Would families (= market) have looked for impact (changes) without PMR? 3. Would families (= the market) achieve the impact without PMR?	Compilation of existing actions/projects in the area with similar purposes, analysis of their proposals. Interviews with families

The overall (impact) score is the multiplication of the scores for each parameter.

Tools
The two main tools are the review of the available documentation and the interviews in the two project areas.

Review of available documentation:

From PMR: project documents, baselines, evaluations, data of the contests, periodic project reports, methodological documents, reports from other projects.
Other documents: statistical data on the area, projects and studies about the situation in the area, similar areas and problems in Tanzania and East Africa.
See Annex 9, for the documents consulted.

Interviews

With the main actors of the projects:

- families (and their members: female and male)
- local authorities and officials
- The Greening Africa teams: coordinators, expert farmers.

Specifics about the interviews will be provided in the following paragraphs.

2.3 Interviews March-April 2022

I carried out 66 surveys/interviews in total, 31 in the project area of GA 1 and 35 in the area of GA2[3]. This was possible in spite of limitation of the fieldwork (time, distance, availability of people, a single person to organize the visits).

Table 5

Number of families that participated in the projects and number of interviews of families

Project area	Total number of families	Families participating in GA1		Nº of interviews	Project area	Families participating in GA2	Families participating in GA1		Nº of interviews
		Nº	%				Nº	%	
Total GA1	**1,141**	**924**	81%	**31**	**Total GA2**	**1.590**	**1.430**	90%	35
Sarame	**350**	**322**	92%	**15**	**Sangaiwe**	**721**	**634**	88%	12
Taifa Njema	88	78	89%	5	Sangaiwe	225	175	78%	2
Ndoroboni	83	77	93%	3	Osoley	256	251	98%	3
Kiteto	46	46	100%	3	Gembo	123	107	87%	5
Changarawe	60	49	82%	2	Neneto	117	101	86%	2
Bulkeri	73	72	99%	2					
Vilima Vitatu	**791**	**602**	76%	**16**	**Mwada**	**826**	**735**	89%	**23**
Mdori	251	204	81%	3	Burunge B	177	150	85%	4
Kigongoni	238	154	65%	3	Mbuyuni	227	211	93%	5
Maarewa	117	84	72%	3	Bondeni	179	148	83%	4
Magomeni	75	65	87%	2	Burunge A	81	79	98%	4
Changarawe	53	45	85%	2	Makirinya	162	147	91%	6
Nchemu	57	50	88%	3					
Total GA1&2	**2,688**	**2,293**	85%	**66**					

Fuente: Final-Report Manyara Region Tanzania, PMR, January 2021, Survey records, March-April 2022, OdGR, MZP.

[3] The sample is not based on a particular sampling method of the target population. It would have been ideal to establish a list based on categories (families that have participated more, that have participated less, winners of the contests, etc.). This was not possible, Toribio's expertise to organize various interviews has compensated in a certain way, the deficiencies of the sample which was enough to identify trends.

Note on participation: the participation of families in the contests has been 81% of all families in the villages of Sarame and Vilima Vitatu (project area of GA 1) and reached 90% in the villages of Mwada and Sangaiwe (project area of GA 2). Such a level of participation is exceptional. The PMR methodology has worked in a country and continent which was new for the association. The very high percentages of participation is due to several factors, to the suitability of the methodology in this new context, to the expertise of the Greening Africa teams, to the interest and enthusiasm of the families, of course, and also to the involvement of the authorities, who encouraged and even coerced to guarantee the greatest participation of the sub-villages (some authorities mentioned the threat of a fine for those who did not participate!)

Characteristics of the interviewees and their families:
In line with the methodology of Pachamama Raymi, women register their family for the contests. Of the total number of interviewees (66), 40 are women (61%). The men who responded in the interviews, together with their wife or not, did so even if it was the woman who registered the family to participate in the contests.

The average age of the interviewees is 51 years. The women interviewed are younger (48/55). Almost a quarter (24%) are over 60 years old, 6 interviewees are over 70 years old, all men. Only 3 are under 30.

These data may indicate a relatively strong patriarchal matrix.

The family consists of an average of 6 people. In most cases, the family integrates not only children but also grandchildren. A number of children are of school age and most families pay the cost of enrollment in their schools. I have not been able to clearly establish the labor force available in the production unit (adults who work at home, on the farm, temporary contribution from relatives who migrated, for example).

Other interviews, authorities and officials
Presidents of towns and sub-towns, interviews with:
Mwada, all sub-village presidents
Sangaiwe: the president of Gembo and his board, the president of Neneto
Sarame: the village president
Vilima Vitatu: the vice president of the village

Table 6
Interviews with civil servants

Manyara region and the district of Babati:	**The province of Magugu (ward)**
The director of the Forestry Office The director of agriculture The deputy director of the water office	The water project supervisor The director of the Mwada hospital Mwada Health Center

Former members of the GA 1&2 project teams:
Toribio Huillca, executive director, four field facilitators, one workshop with eight facilitators in Magugu.

Picture 6
Preparing to plant timber trees

Family interview data

Land tenure and agricultural production
On average, the families interviewed have four hectares (0.1 hectares, max. 21 hectares). About a third of the families have more than the average; six interviewed families have less than 1 hectare.
More or less half of the interviewees indicate that sunflower (79%) and maize (71%) are their main crops, with yields of 8 and 5 bags (80 kg) respectively. Sesame completes the picture of the main crops (40% indicated to plant sesame). They are followed, to a lesser extent, by planting millet, peanuts, cotton and rice.

Livestock

Cattle:
45% of those interviewed declare having cattle, an average of 14 animals. Of these, a third have dairy cows, on average 2 to 3, with a milk production of 0.5 to 1 liter per day in general. Production is 5 to 15 liters daily with improved animals.

The families declare that they sell their cattle "when they need it". That is, when they have to cover some expense (to pay school enrollment, health, travel). Only a quarter of the interviewees indicate that the they sell three animals per year, on average.

Goats:
The families (47%) have an average of 17 goats. They often keep both cattle and goats or sheep together (in 50% of cases). As for cattle, families sell a goat when they need to.

Table 7
Composition of herds

Herd	**N°**	**%**
Only cattle	7	17%
Cattle + goat and/or sheep	21	50%
Only goats	10	24%
Goat and sheep	4	10%

Sheep, only one in four respondents indicates that they have sheep.

Chickens, 61% of those interviewed have about 10-15 chickens, half of them to sell either chickens or eggs.

Other family activities
41% of those surveyed (27) indicate to have both crops and livestock. It may represent income in combination with the activities, as indicated in the Table 8.

Table 8
Other activities of the families (non-agriculture)

Categories	Nº	%	Kind of activities
Shop and small business	7	26%	Selling some food, beverage, meals
Worker	5	19%	Day laborer, worker in private activities (bus station, mine) and in state run organizations
at home	5	19%	Hairdresser, income can be USD 32 to USD 45 per month and more during the high season Tailoring, income can be USD 45 per month Sale of water, one dollar a day Carpenter
Handicraft	3	11%	Only in Vilima Vitatu handicraft, income can be USD 23 to USD 45 per month.
Retired	3	11%	Retired teacher, from the National Park.
Fishing	2	7%	In Burunge and Manyara Lakes (seasonal)
Other	2		Relative and house rent

Source: Survey records, March-April 2022, OdGR, MZP.

Families and projects GA 1&2

In this chapter I will analyze the responses of the interviewees regarding to their participation in the contests of the GA 1&2 projects. It will show their participation, the cash prizes and their use, as well as the actions that the families implemented, improving their homes, improving their productive activities, in this case livestock and planting trees.

Contests and prizes

Participation in the projects
All the interviewees have participated in contests, at least in one. 52 out of 66 declared having received prizes, for an average of USD 280.

Of the 19 interviewees, 29% indicated that they have participated in all contests, that is, all the contests in which they were allowed to participate, to a maximum of six. [4]

[4] Families that won a prize can compete and win up to three times. After that they can compete in the winner's league or category contests (forestation)

Picture 7
Cash prizes were awarded twice a year

Awards and use

Table 9 shows the priorities for investing the prize money. Half of those interviewed have invested in construction of their house and school fees for their children.

A second priority has been the purchase of animals (cows and goats of a better breed, chickens) and buying food.

Others, to a lesser extent, have dedicated their prizes to the purchase of household appliances and installations, or to improve agricultural production.

Other minority uses: buy land, health expenses and investment in business.

Table 9
Use of the prize money

Use	Answer	Kind of expenses
To build the house	26	Bricks, cement, gravel, corrugated iron sheets, laborers
School fees	25	Shool fees, uniforms
Animal husbandry	19	Purchase of animals: cow, goat, chicken
Food	14	
Appliances	8	Solar panels, TV, cellphone and other devices
Agriculture	7	Inputs, land rent, laborers
Purchase of land	3	Buy land, including to plant trees
Health care	3	To attend some health problem, to send some money to help a relative
Business	2	Small business to fry chips/chicken and banana Capital for the shop

The interviewees freely express their feelings about GA 1&2 did and formulated their own evaluation of the projects' activities. People usually emphasized two aspects: home improvement and tree planting. Chapter 3 will look into the opinions expressed by the interviewees with respect to these two aspects, which are relevant to the impact study.

Picture 8
Improved stove (left) and cow in stable (right)

Impact study

In this chapter, I will address the different elements of the method of the evaluation. In the **first** place, I will compare the "with and without" outcomes of the projects, identifying positive or negative external factors based on the objective of Greening Africa, making a detailed analysis of the interviews, and then, analyze each of the lines of action, a) economic alternatives, b) innovations in the management of natural resources and c) preventive health measures. **Second**, I will apply the PYMWYMIC method to establish the impact index.

3 External factors

In this chapter I will analyze the external factors that could, in a negative or positive way, influence the impact of the Greening Africa projects (combined GA 1&2) in the four

villages of the rural area of the Babati district, in terms of the objective: "*improving the living conditions of extremely poor families, and achieve prosperity*", with the three components of action indicated in Table 2, (1) innovations in the management of natural resources, (2) alternative economic activities and (3) preventive health.

I will review local, national, and international situations that constitute these external factors, based on the interviews carried out, the available information (project documents and available statistical data).

The Covid 19 pandemic

In 2022, a first factor to evaluate is the possible impact of the global COVID 19 pandemic. The Table 10 shows the data for Tanzania, comparing it with two other countries.

Table 10
Data of the COVID 19 pandemic

Country	**Number of cases**	**Deaths per million**
Tanzania	36,174	14
The Netherlands	8,353,626	1,324
Peru	3,675,152	6,475

Source: Cases and deaths from COVID, John Hopkins University, July 2022, Population, in 2020, Internet.

Table 10 shows that COVID 19 has had a much lower incidence in Tanzania than in other countries in the world. It should be noted that Tanzania has not published official figures on the pandemic and that, throughout 2020 and the beginning of 2021, a policy of denial of the disease prevailed.

During the fieldwork, no mention was made of an impact (favorable or unfavorable) of the pandemic.

Socio-economic situation of the country and in the project areas
The socio-economic and political situation in Tanzania does not seem to have affected the results of the projects. The sudden death of President John Magufuli in March 2021 and his replacement by Vice President Samia Suluhu Hassan (until 2025) has not meant any noticeable change in the project areas.

Climate
All those interviewed in March-April 2022 mentioned the lack or delay of the rains which affected their crops. Authorities and families insisted on the intensification and repetition of drought episodes, which is confirmed by the official data. The increase in flooding is another notable change in the country. It is clear that this situation affects agricultural production in the country and in the project areas, given that agriculture mainly includes rainfed crops. In this sense, the weather appears to have had a negative impact on the actions promoted by the projects, such as plantations or maintenance of the family vegetable garden.

Mining in Vilima Vitatu

In the village of Vilima Vitatu, the phosphate mining project (Burunge Industry Project, financed by Burundi, supported by the Tanzanian government) started its operation phase.

In April 2022, the construction of the mining facilities in the sub-village of Nchemu (village of Vilima Vitatu) started. According to the village authorities, some 580 families, 75% of the total number of families of the village, will be affected. The company will proceed to purchase their land (about USD 2,000 per hectare). The purchase operation is piloted by Babati district officials. If the families object, they could go to court (which would be a very expensive option). The families report that the investments they made on their land, such as the afforestation promoted by GA1, will not be taken into account when selling their land. As a reference, 1 hectare of timber trees, planted within the framework of Greening Africa, has a potential income of about USD 22,000, within 4 to 6 years from today. It therefore means a dramatic loss for the families.

The village and district authorities do not propose alternatives for the relocation of the families. Apparently, each family will have to find land, to build a house, to cultivate and to plant trees somewhere else. In general terms, the families lack comprehensive information and support from their authorities. They refer to the possible benefits, either from royalties (about USD 36,000), or from employment generated by the mining operation. The general tone among the affected families, is one of resignation. Families seek individual solutions.

It is likely that mining will mean a drastic change in Vilima Vitatu, all because of the mining exploitation itself and because of related economic activities, shops, accommodation, restaurants.
It should be noted that there are other mining concessions and prospecting in the village and its immediate surroundings.

The Burunge Wildlife Management Area - WMA

The Burunge Wildlife Management Area (see Figure 3) exists since 2003. It was created to support the conservation of wildlife and the environment.

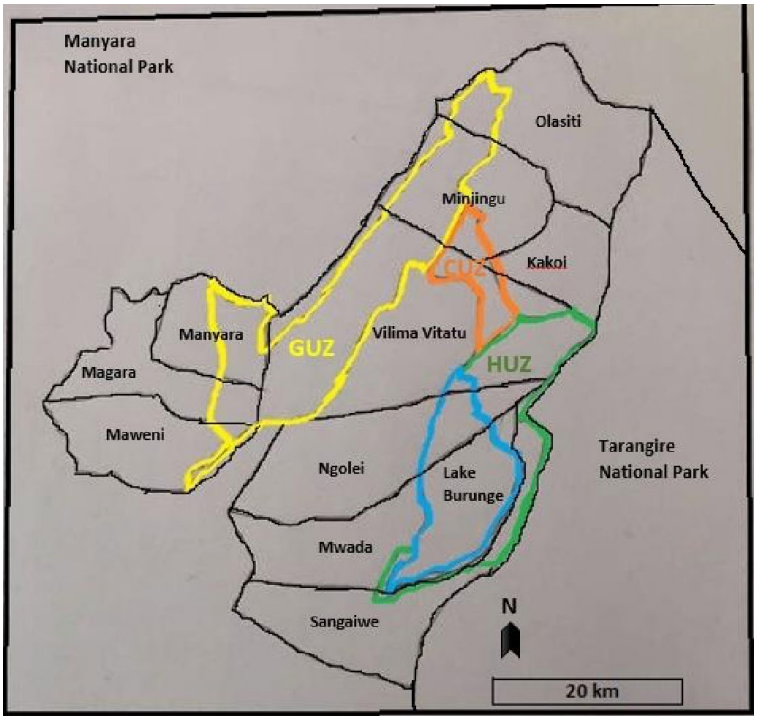
The stated goal of the WMA is to provide economic benefits to local communities and include them in wildlife and habitat conservation projects (Kicheleri et al., 2018)[5]. However, the changes in living conditions of the families of Vilima Vitatu, brought on by the WMA, is not very positive "*At the family level, the loss of food and money has increased due to the destruction of crops and land by wildlife, and the financial gain was better before, without WMA, when the money came directly to the village and not through the WMA. The villages had their own responsibility and control over land areas and could freely access resources. On which the three villages agree*." [6]

[5] The Burunge Wildlife Management Area and its effects on the villages around it- A case study in Babati district, Tanzania, Henni Hernold, Södertörn´s university | School of Natural Sciences, Technology and Environmental Studies, Environment and development in the South | Spring 2017

[6] Ibidem

It is important to mention here that several participating families of Barabaigh herdsmen who lived within the area of the WMA had to relocate. Their extremely modest houses were burned down by the army on at least two occasions between 2017 and 2018, posing extreme difficulties and limiting the livelihoods of the families. This was reported by the project sustainability evaluation carried out in March-April 2022. (Oihane de Gana, op. cit.)

Figure 3
Burunge Wildlife Management Area[7]



Burunge WMA, member villages, tourism investment, and the three use zones. Yellow- GUZ = general use zone, Orange- CUZ = Corridor use zone, Green- HUZ = Hunting use zone (Modified from Moyo, Funk & Pretzsch, 2017). *Note.* This figure is an illustration of the original map, which may result in the scale of the figure not being consistent with reality.

In any case, mining plus the Burunge Wildlife Management Area WMA means, for a GA1 participant interviewed in April 2022, a loss of autonomy and land:

"*Here in Mdori (main sub-village of the village of Vilima Vitatu), we don't have land anymore because we have the wildlife corridor and we can't build [a house] there*" Safari Daff and Fausta Ginana (wife), Marewa, Vilima Vitatu, interview on April 8, 2022[8]

There is no doubt that the achievements of the families, with the support of Greening Africa 1, have been and will be affected by the Wildlife Management Area.

[7] Ibidem
[8] In op.cit., Families in action… p. 58, June 2022,

Picture 9
Shallow well

Piped water from Darakuta

The Darakuta Magugu Minjingu project is promoted by the central government since 2007, according to Aloice Alexander, supervisor of its Magugu project office. It consists of providing drinking water to the towns located south of Babati. The pipeline reached Mwada in 2022. It intends to supply water to the villages of Ngoley, Vilima Vitatu, Minjingu and Mawemairo. The pipeline runs along the highway (paved, from the border with Kenya to the south), In total, the pipeline will serve about 60,000 inhabitants.

Although the main pipeline is installed, the connection to the towns is not entirely guaranteed. As of April 2022, there were 1,500 connections in Magugu, 102 in Mwada, and only 9 in Sangaiwe and 6 in Sarame. In Mwada, the construction of a new regional hospital, which required drinking water, has favored family connections, with connections to the sub-villages.

In April 2022, the authorities and families of Sarame and Sangaiwe had no information on when they would have a connection from the main pipeline.

It should be mentioned, however, that individual connections have a high cost for families, about USD 66 for a basic connection a few meters from the main pipe plus USD 1 per additional meter.
The price of a cubic meter of water is USD 0.25, the average monthly consumption is estimated at about USD 3.90

It is worth mentioning that the projection of the Darakuta drinking water system is to Vilima Vitatu and further north to Minjingu. However, there is also a project coming from Makuyuni (to the north, in the direction of Arusha) or Mayoka (on the western shore of Lake Manyara) to supply Vilima Vitatu and Minjingu, among others. There is no indication as to when the connections will be made.[9]

A pesar de limitaciones e imprecisiones en cuanto al diseño de las conexiones, el servicio de agua potable está llegando poco a poco a los pueblos del ámbito. Es un impacto potencial importante en la zona; las familias podrán contar en el futuro cercano, con el tiempo, con un agua de mejor calidad, y la disminución del tiempo dedicado al recojo del agua.
Coadyuva al logra del objetivo de los proyecto GA 1&2, en el eje de salud preventiva[10].

El hospital regional de Mwada

The installation of a new hospital in the center of the Mwada village may have a positive impact on the health of the inhabitants of the area, and is a positive future element for the objective of the GA1&2 projects, since it improves health services.

For now, a favorable impact of the construction of the hospital already has been the connection of several families from the sub-villages to the new drinking water system.

Table 11 summarizes the impact of external factors on the objective of the GA1 & 2 projects.

Table 11
Summary of external factor son the objective of GA1 & GA2

Positive impact	Negative impact	No noticeable impact
The new regional hospital in the village of Mwada	Burunge Mining Projects and the Wildlife Management Area - WMA	Socio-economic situation of the country and in the area.
Piped water from Darakuta	Climate, extreme weather events	The SARS Covid 19 pandemic

[9] Entrevista al Dr. Rwiza, director of the regional hospital of Mwada "*I heard that this Magugu water is able to go until Vilima Vitatu but I am not sure although we have another project coming from Makuyuni to Vilima Vitatu, Minjingu ,Olasity. Also we have the water coming from Mayoka those projects will connect water to Vilima Vitatu*"

[10] The availability of water of this source and the design of the Darakuta system (capacity of the pipe), is not for irrigation and only for human and animal consumption.

Picture 10
Local business: papaya and eggs

4 Balance and analysis of the interviews

4.1 Home improvement

Home improvement was implemented by all interviewees, by all families that participated in the contests, as required by the contests that were organized by the projects, including the installation of a vegetable garden in the immediate vicinity of the house, however some gardens were abandoned due to extreme draught.

Adoption of installations
The shelves to organize pots and pans, utensils and kitchen supplies, the latrine, the painting and the separation of rooms (implemented in only a few cases) appear to be installations adopted by the families.

Shelves and organization of the house
Shelves and cabinets are needed to keep utensils and food off the ground, which improves hygiene and reduces the chance of infection. All families have installed the shelves and cabinets.

Latrine
Latrines reduce the risk of infections associated with open defecation, especially during the rainy season. In the vast majority of houses, there is a latrine in use, sometimes built before GA. When it has been destroyed or has collapsed, they rebuild it. I did not see a water drum and soap to wash hands after the use of the latrine.
Note: there was a cholera outbreak in the years 2015-2017. Floods and the absence of latrines were identified as causes of the disease. Although I do not have specific data, it is likely that the health services, at this time, have put emphasis on the installation of latrines and basic hygiene measures (washing hands after going to the bathroom) [11].

Plastering and painting of the walls
Walls of the houses were plastered to prevent drafts due to strong winds, between the wood of the walls of traditional houses. This prevents respiratory diseases. In addition, the families have been able to paint images of their future on the walls of their main building. All families painted schemes and drawings although in 2022, they are not always visible, as they were damaged by the rains.

Partial adoption
This is the case of the improved stove and the vegetable garden. Their use at the time of the surveys (1st semester of 2022), 2 or 3 years after their installation by the families show a different picture.

[11] Interview in April 2022 with Dr.Rwiza, assigned at the time to the hospital of Magugu Village: "*When GA came to establish their project we had the issue of cholera, very big from 2015 – 2017. We have such disease. It killed a lot of people in that time. We found the cause was flood and people were not using the latrine and there was the problem of water availability. People were drinking pond water which is dirty*".
Obviously, having access to quality water is another measure to combat the disease.

Improved stove: all the interviewees have built an improved stove. A small majority indicate that it is still in use. The main advantage that they evoke is that it consumes less firewood.
The improved stove is no longer in use with about 41% of the families, for the following reasons:

1) In 40% of the cases, the kitchen, made of sticks and earth, was destroyed by the rains. The stove was not rebuilt when the kitchen was rebuilt, or it is not clear yet if they will do so.

2) They use small fire pits with charcoal, for example, in brick houses that the families built. Some families even use gas.

3) Some find it uncomfortable to cook indoors.

Vegetable garden
All the families have had a vegetable garden "during the contests", except for one interviewee who declared that he never had one.
A minority (10%) continues to work the vegetable garden which was installed because of the contests. 30% indicate that they have a smaller variety of vegetables, that they plant, not necessarily in a specific place, but around their house, and around their farm.
A majority indicates that they no longer have a vegetable garden. The main explanation is "due to lack of water, due to drought".

4.2 Tree plantations

All the interviewed families have planted trees, for timber, fruit or fodder. Most families planted trees for timber and fruit (57%), only 16% planted fruit, timber, and fodder trees.

Table 12
Combined tree planting

Trees	Families	%
For just one use	16	28%
For two uses	33	57%
For three uses	9	16%
Total	**58**	**100%**

Fruit trees
Three out of four interviewed families planted fruit trees. The majority (70%) planted less than 50 fruit trees, usually near their house. There are large plantations, oriented towards commercial production, such as Mr. Ramadani and Ms. Lucia in Sarame, respectively 0.4 and 0.3 hectare.

64% of the families that I interviewed, planted papaya, 42% other fruits, such as guava and passion fruit, 32% mango. The families have declared that they have planted only one type of fruit trees (64%), 26% two types and 10% 3 types of fruit trees. All the interviewees have indicated that they have enjoyed eating fruits, particularly the children. They have even shared with their neighbors, some sold part of their production (see paragraph 5.2.2).

Picture 11
Grafting mango trees

Timber trees
73% of the interviewed families have planted timber trees, an average of 566 plants, equivalent to 0.5 hectare.
Eight families (16%) planted 50 trees or less, around their house.

16 (33%) have planted more than 450 trees, which corresponds to 0.4 hectares, on an area on which annual crops were planted.

On average, 60% of the trees have remained. Losses are due to drought, and insects.

There were also some "accidents", as told by Ms. Margret in Changarawe, in the village of Vilima Vitatu: cows ate the seedlings, or trees were planted on areas that were too salty. In those cases, losses were close to 100% (in Kigongoni, Vilima Vitatu, Gemang'au Meyaba)

Fodder trees
Two thirds of the families that have cattle have planted fodder trees (30 of the interviewed families). In only one case, the family has planted fodder trees without having cattle as a business.
A little more than half of the families that have dairy cows have fodder plantations.

4.3 Livestock improvement

Five of the interviewees indicate that they have inseminated one of their cows to improve the breed of their livestock (cows). They complemented this action by other measures, such as the use of fodder trees and keeping dairy cows in a stable.

4.4 Visions of the future

Table 13 shows the distribution of the 57 answers of the interviewees.
The most prevalent answers about visions of the future: home improvement, new house, build a house to rent, plant more trees and buy or improve livestock.

Table 13
Visions of the future

	Total answers	**57**	**%**
House	Improve, new, rent	18	32%
Improve the production	Plant trees	14	25%
	Livestock	11	19%
	Agriculture	4	7%
Other	Business	3	5%
	Motorcycle	1	2%
	Car	2	4%
	Health	1	2%
	education children	3	5%
	Total	**57**	100%

5 Calculations to measure the impact of the projects

5.1 Family investment / project investment GA 1&2

I think that a significant level of investment on the part of the participating families is a guarantee that they will watch over/take care of that investment; it reinforces the sustainability of the innovations promoted by GA 1&2.

Next, I establish the average amount of the investment by the families, and multiply it by the number of participants.

Then, I compare the total investment by the families with the investment made by the GA 1&2 projects.

Investment by the families

I consider the following investments:

Home improvement

I take into account three of the improvements that families make. Table 14 shows the average estimated investments per family.

Table 14
Average estimated investment per family for home improvement (USD/family)

Investment	USD/family
Construction of latrines and bricks	45.45
stucco and paint	54.55
improved hearth	11.36
Total USD/family	**111.36**

Fuente: interview with Toribio Huillca, April 2022

The surveys (see paragraph 4.1), indicate that all participating families (2,293) invested in improving their houses, so the total investment in home improvement is 111.36 x 2,293 = **USD 255,357**

Tree plantations

Timber trees

Table 15
Costs of planting one hectare of timber trees (USD/ha)

Item	USD/ha
Clearing land	11.36
Dig holes (1,100 per ha)	102.27
Animal dung & transported by tractor	18.18
Prepare and mix the soil, plant the trees	136.36
Guarding the plantation, care of seedlings	27.27
Total investment USD/ha	**295.45**

Source: Interview with Toribio Huillca, April 2022

Note 1: I did not include the cost of irrigating the seedlings recently planted, as the situations are very diverse: in some cases, seedlings were planted and there was sufficient rain after planting, at other times the families had easy access to water, or GA provided support with a water tank.

According to the interviews, 88% of the families have planted timber trees, on average 0.5 hectares, which would be an investment of 0.5 x 709,09 = 354 USD per family.

Table 16
Total investment by the families planting timber trees (USD)

Average investment per family	(USD/fam)	354
Number of participants	(N°)	2,293
Percentage of family that planted timber trees		88%
Number of families that have planted timber trees (N°)		2,015
Total investment	**USD 354 x 2,015 =**	**713,310**

Fruit trees:
Table 17 shows the plantation costs per hectare for fruit trees.

Table 17
Planting costs per hectare for fruit trees (USD/ha)

Item	USD/ha
Cleaning	11.36
Dig holes	29.55
Transport of animal dung	29.55
Prepare and mix	136.36
Plantation	4.55
Total investment USD/ha	**211.36**

Fuente: Entrevista a Toribio Huillca, abril 2022

Picture 12
Grafted mangos fetch a great price on the markets

Surveys indicate that 91% of participating families planted fruit trees, on average 0.179 hectare, which amounts to an investment of 90.9 USD/family.

Table 18
Total investment by the families planting fruit trees (USD)

Average investment per family	(USD)	90.90
Number of participants	(N°)	2,293
Percentage of families that have planted fruit trees		91%
Number of families that have planted fruit trees	(N°)	2085
Total investment	**USD**	**189,498**

Fodder trees
Planting costs in USD per hectare.

Table 19
Planting costs per hectare for fodder trees (USD/ha)

Item	USD/ha
Cleaning	11.36
Prepare and mix	136.36
Plantation	9.09
Total investment USD/ha	**156.82**

Source: Interview with Toribio Huillca, April 2022

Surveys indicate that 30% of the families of the villages planted on average 0.476 hectares of fodder trees, which means, rounding, an investment of USD 178.80

Table 20
Total investment by the families planting fodder trees (USD)

Average investment	(USD/family)	179
Number of participants	(N°)	2,293
Percentage of family that have planted fodder trees		30%
Number of families that planted fodder trees	(N°)	695
Total investment	**USD**	**124,247**

Voluntary contributions in labor in tree nurseries
On average, 60% of the families contributed 18 days of voluntary labor during the projects in the tree nurseries. The contribution for this item is 18 x 1,376 days of work, which amounts to **USD 112,565**.

Table 21
Total estimated investment by 2,293 participating families in the four villages (USD)

Home improvement	255,357
Timber trees	713,310
Fruit trees	189,498
Fodder trees	124,247
Voluntary contributions in labor	112,565
Total in USD	**1,394,977**

In the villages of Sarame, Vilima Vitatu, Mwada and Sangaiwe, the **average investment per participating family is estimated at USD 608 within three years** or **USD 203 per family per year**.

In some cases, families invested cash, for wages or transport of animal dung, for example. Investment in cash is not included in Table 21.

The investment in labor is remarkable, particularly taking into account that, in the case of planting timber trees and also fruit trees, the benefit is in the medium or long term, 10-12 years. Families aimed at investing in their future.

Table 22
Contributions by project financiers
Sological Foundation & Stichting Wees een Kans (USD)

Villages	**USD**
Sarame, Vilima Vitatu (GA1)	815,984
Mwada, Sangaiwe (GA2)	994,143
Total	**1,810,127**

Source: Payment Schedule Greening Africa PMR

Table 21 shows that the total investment in the projects by the financiers was USD 1,820,127.

The participating families invested USD 1,394,977 (see Table 20), which is 77% of the amount invested by the financiers.

The contributions of the financiers as indicated in Table 22 include operational costs and other costs not directly related to investment in the families.

Table 22 shows the net contributions of the financiers that were invested directly in the families.

Table 23
Direct contributions of the financiers in the families (USD)[12]

Villages	**USD**
Sarame & Vilima Vitatu (GA1)	209,561
Sangaiwe & Mwada (GA2)	467,588
Total direct investment	**677,149**

The investment of the families is twice the "direct contributions" the financiers made in the families.

Of course, the calculated investment of the families is a mere approximation. Even so, the enormous investment that the families of the four villages made in their own future, while participation in Greening Africa, is astounding.

As indicated above, the high degree of people's contribution in the activities promoted by Greening Africa 1&2 gives a certain guarantee of sustainability of the innovations that were adopted by the families and of the investment that the project –the financiers– made.

The investment by the families that I calculated in this chapter, is the indisputable and extraordinary result of the methodology used by Greening Africa in the four villages, supported by a highly qualified team.

[12] Direct contributions of the financiers in the families = budget items "Motivators" (budget line 1.05) + study trips and educational material (budget line 1.02). Source: Accountant reports Greening Africa, Audited financial statements at 31/12/2020, Sharex Consultants, 21/03/2021

In the next paragraph (5.2) I will address another aspect that contributes to the sustainability and the benefits that families may obtain from their businesses.

Picture 13
Mango tree plantation in the village of Mwada

5.2 Cost-benefit analysis of the economic alternatives

It became evident from the interviews that I conducted in March-April 2022 that the families identified timber trees as their main economic alternative. People clearly expressed that their participation in the activities of GA 1&2 was motivated by the prospect of planting trees and they mostly planted timber and fruit trees and to a lesser extent, fodder trees.

I will therefore focus in this paragraph on calculating the economic profitability of timber and fruit trees, based on the averages that I estimated in the previous paragraph.

In paragraph 5.2.2 I will look into livestock and dairy production, which a smaller number of families implemented.

5.2.1 Timber trees and comparison with the current production of families

In this sub-paragraph, I will compare:
- The crops that families normally plant.
- Farmers incorporating the alternative of planting timber trees.

For this comparison, I will assume that livestock production will remain the same in both scenarios. I will therefore not take it into account for this calculation.

- **Current situation**, without project, annual crops

The average family owns 4.2 ha. In the case of a simplified average calculation, I take into account the main crops, sunflower, maize and sesame, according to the surveys carried out in March-April 2022 (see paragraph 2.3), even when some families plant other crops but to a lesser extent (rice, cotton, peanuts, etc.).

- **Alternative situation** with project. Table 24 shows that I assumed that trees substitute some of the area with crops.

Table 24
Comparison of situations with and without project (ha)

Crop	Without project (ha)	With project (ha)
Sunflower	1.5	1.2
Maize	1.5	1.2
Sesame	0.8	0.7
Timber trees	0.0	0.5
Fruit trees	0.0	0.2
Around the house, other crops	0.4	0.4
Total area (ha)	**4.2**	**4.2**

Source: Survey records, March-April 2022, OdGR, MZP.

Annex 4 details the production costs, income and benefits for each crop and plantation.

Analysis of the comparison with/without project
All crops mentioned in Table 24 are rainfed and therefore very sensitive to the weather. An important factor of that sensitivity is the depth of the roots of annual crops, if compared to perennials.

In a bad year, the sale of the total harvest barely covers the production costs, if at all, as in the case of maize (see Annex 4, Production costs and income).

Sunflower and sesame have a better perspective, with higher returns.
Table 25 provides details on production costs and profits of the average production of a family.

Table 25
Production costs, income and profits
of families' most common crops (USD)

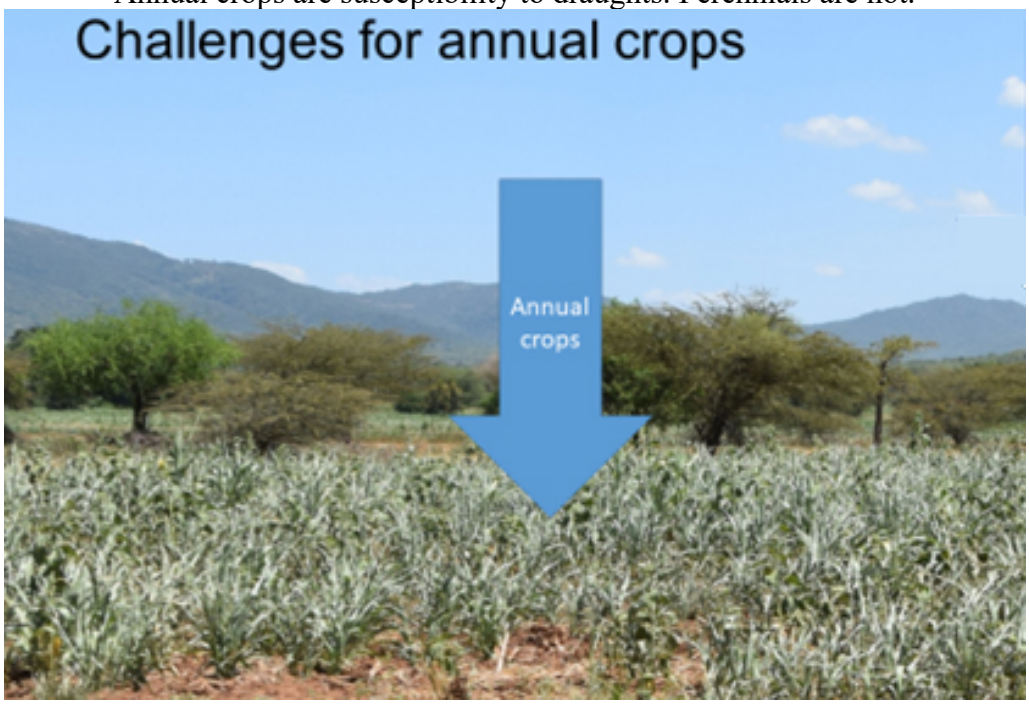
		Without project	With project
Maize	**USD/ha**	**USD / 1.46 ha**	**USD / 1.18 ha**
Production cost	314	460	374
Income per harvest	612	890	724
Average Profit	295	431	350
Sunflower	**USD/ha**	**USD / 1.46 ha**	**USD / 1.18 ha**
Production cost	215	314	255
Income per harvest	413	602	489
Average Profit	196	288	234
Sesame	**USD/ha**	**USD / 0.83 ha**	**USD / 0.68 ha**
Production cost	215	179	145
Income per harvest	835	696	565
Average Profit	620	516	420
Maize+Sunflower+Sesame	**USD/ha**	**USD / 3.75 ha**	**USD / 3.05 ha**
Production cost	744	953	774
Income per harvest	1,861	2,188	1,778
Average Profit	1,112	1,234	1,003

Source: interviews with Toribio Huillca, April 2022

Table 25 (last line, marked cell) shows that, on average, a family can expect a "profit" – earnings– of about USD 1,200 per year for all their crops, that is, if there are no adverse weather events. **That is a big if**.

The estimates included in Table 25 did not take into account the high probability of total or partly failed crops. Another major cost, not included is the loss of fertility of the soil due to crop production.
The estimates of Table 25 therefore give a rather optimistic picture.

Picture 14
Annual crops are susceptibility to draughts. Perennials are not.



Perennials –trees- have a much greater and deeper root system than annual crops. Trees therefor draw from a much larger reservoir of soil water, which explains why trees continue to be green and grow during a draught while annual crops perish, such as the maize crop shown in this picture.

Timber and fruit production as an alternative

For the "alternative", I will consider a very modest substitution: 0.52 ha will be dedicated to plant timber trees and 0.18 ha to mango trees (in total 0.7 ha for trees, or 20% of average cropped area).

- Planting costs
  The cost of planting (year 0) of timber trees is high, about USD 1,718 per hectare. Seedlings (1,100 trees) represent the most important item (57%).
  The planting cost (year 0) of mango trees is less, about 886 USD per hectare as there are less trees per hectare. In this case, the work of preparing the land and the planting itself represent 68% of the total cost, the seedlings for 312 trees represent the balance (32%).

- Estimated production costs of the plantations of timber trees and fruit trees (mango) are indicated in Table 26.

Table 26
Production costs and income of alternatives with timber and fruit trees

Description		**With project**
Timber trees	**USD/ha**	**USD/0.525 ha**
Planting costs, year 0	1,729	908
Pruning, year 3	21	11
Thining 30%, year 6	64	34
Total costs	**1,815**	**953**
Value of trees, year 10	68,725	36,081
Mango trees	**USD/ha**	**USD/0.18 ha**
Planting costs, year 0	883	158
Annual costs, year 1 to 3	274	49
Annual costs, year 4 to 10	317	57
Total costs	**1,474**	**264**
Production, year 4 *	1,275	228
Production, year 5 to 9	3,829	686
Production, year 10	31,910	5,717
Total production (10 years)	**37,014**	**6,632**

* taking into account a 10% loss of fruit trees
Source: interviews with Toribio Huillca, April 2022

Income

- Table 26 provides an estimate of production cost and income for timber and fruit trees. As for timber: the estimate uses the value of a 10-year-old standing tree, so no additional costs for transport etc. is taken into account. The value of one tree is estimated at USD 91 with 756 trees per hectare, taking into consideration that about 30% of trees if the plantation will be thinned some years earlier.

- Mango trees: The trees start producing from the 4th year. The number of fruits per tree increases over time; the 4th year, 20, from the 5th to the 9th, about 60, about 500 from the 10th year.

Table 27
Comparison of the scenarios with and without project over a ten-year period

	Without project	**With project**			
	10 year crops	**Crops**	**Timber**	**Mango**	**Total**
	USD / 3.75 ha	**USD / 3.05 ha**	**USD/0.525 ha**	**USD/0.18 ha**	**USD/3.75 ha**
Production cost	9,530	7,740	953	264	8,957
Income	21,880	17,780	36,081	6,632	60,493
Profit	**12,340**	10,030	35,128	6,368	**51,526**

Note: The estimates included do not take into account the high probability of total or partly failed crops due to weather events. Such losses for timber production are highly unlikely, and are less severe for Mango.
Another major cost for annual crops not included in this calculation, is the loss of fertility of the soil due to crop production.
The difference between profits with project vs without project will therefore be even greater than indicated in Table 27.

The difference between the estimated profit with and "without" project is (51,526 - 12,340) = USD 39,186

Substitution of annual crops with permanent crops provides a sharp increase in "profit", even when substituting only 0.7 ha of crops. This could mean that, in future, people may opt to replace even more annual crops with perennials which would reclaim more land and increase people´s income.

These rather rough calculations already indicate a relevant economic argument to replace annuals with perennials. I will show that the calculus with the Present net value – PNV points in the same direction, allowing us to know the possible profitability of a project or investment in tree planting. This formula uses the values of the cash flows (cash inflows and outflows) discounted to the present date, discounted at a given interest rate. And with their results expressed in terms of units of monetary value.

I then use the following data, already shown in Table 25 and Table 27.

- Initial investment (this is the only investment, there is no other investment during the process).
- Net cash flows, the difference between the expected income and expenditure over the course of the project.
- Opportunity rate, the minimum desired return on investment. I used, 8%, which is the reference rate in Peru.
- Time period or number of economic periods that the project is estimated to last.

Picture 15
Planting timber trees, replacing annual crops.
Maize stalks are still visible in the field

The PNV calculation was applied to the two scenarios of the comparison, without the project (three crops), with the project (three crops, timber and fruit trees). The comparison is expressed in euros.

Table 28
Present net value (PNV) with and without project

	With project 3.05 hectare, maize, sunflower, sesame + 0.7 hectare of timber and mango (USD)	Without project 3.75 hectare, three crops (maize, sunflower, sesame), (USD)
PNV	29,474	7,331

The PNV of the alternative with project (replacing only 0.7 ha (20%) with timber and fruit trees) would mean FOUR times the income of only growing annual crops usually grown by the families. (See Table 28)

Results are also impressive if only mango trees would be planted on the 0.7 ha that replaces part of the annual crops, providing TWICE that income of the situation without project. (See Table 29)

Table 29
Present net value (PNV) with and without project (only mango trees)

	With project 3.05 hectare, maize, sunflower, sesame + 0.7 hectare of timber and mango (USD)	Without project 3.75 hectare, three crops (maize, sunflower, sesame), (USD)
PNV	14,550	7,331

Evidently the difference between the alternatives with and without project would be much greater if weather risks and the loss of soil fertility are taken into account, which both greatly affect the profitability of annual crops.

5.2.2 Other economic activities

As indicate above, the interviewees mostly highlighted timber tree plantations, be they families, authorities or members of GA 1&2 project teams. As paragraph 5.2.1 clearly shows, planting trees is a great way to achieve economic improvement. Besides, the high risk of partly or total loss of annual crops is not an issue when trees are planted to replace such crops.

However, there are other alternatives, which, although they do not have such spectacular results in the medium term, do represent an immediate improvement, with more modest investments.

Livestock production and milk

Half of the interviewed households have a herd of cattle plus goats and/or sheep (see Table 5). All the interviewees say that they sell an animal "*when they need to*", i.e. when they confront an important expense, school fees, purchase of food, travel, illness or some emergency. Livestock is considered as "standing" capital. The interviewees say that they sell about three cattle and about six goats or sheep per year.

Dairy production[13]
Project-driven improvements in milk production included planting fodder trees, keeping cows in stables and very limited artificial insemination.

One-third of the interviewees indicated that they have two to three dairy cows. From what I have been able to verify, is that these animals are mostly kept in a stable and are fed at the trough.

Milk production is 0.5 to 1 litre per cow. An improved breed produces 4 to 15 litres.

Five interviewees indicated that they have had a cow that was inseminated. In total, 26 cows were inseminated (See Annex 4). Insemination costs USD 22 per cow which was paid for by the project. Access to insemination was limited to families that had enough fodder trees.

Picture 16
Artificial insemination to improve the breed of animals
Notice the cow in the stable

[13] The project has not achieved any significant changes in the management of livestock for meat production.

Fodder trees
30% of the respondents indicated that they have planted fodder trees. Most of those with dairy cows planted fodder trees (70%) (mostly Gliricidia sepium), of which the majority (3/4) indicated that they use the fodder, a quarter indicated that the cows do not eat it[14]. Some families planted other fodder such as Maralfalfa grass, a relatively high quality tropical grass.

The way the fodder is used:

- in most cases, families cut the branches, dry the leaves and feed the dry fodder in the stable during the dry season. In this case, fodder is an additional input, as the pastures are losing their appetite and nutritional quality.
- In some cases, the cut branches are fed directly (even in the rainy season), in other cases, the animals are led to the plantation.
- Fodder harvesting can be up to 3 times a year.

The installation costs are high, about 9,000 USD/ha (see Annex 4) due to the high number of trees per hectare (about 1000) and the cost of seedlings. Seedlings were a contribution of the project, so the families only assumed an investment of 870 USD/ha.

The increase in milk production with improved breed and feed can be estimated at 3 - 4 litres per cow per day. Table 30 shows the additional income per cow.

Table 30
Incomes from increased milk production
(0.45 USD/liter, 300 productive days per year)

Increase per cow (litre/day)	Increase per cow (liter/year)	Increased income per cow per year (USD)
3	900 l/year	**403**
4	1,200 l/year	**537**

Families with 2 or 3 dairy cows can expect an income of USD 806 to USD 1,611 per year, which represents respectively, 65% and 130% of the income calculated for the three crops on 3.75 hectare (see paragraph 5.2.1).

Conclusions that can be drawn with regard to the alternatives introduced by GA 1&2: Replacement of annual crops with yearly crops such as timber, fruit and fodder trees is necessary to reclaim degraded soil, and to reduce the risks of failure of annual crops, due to adverse weather events.

Families have implemented the alternatives promoted by GA 1&2 with great enthusiasm, in particular, for tree planting. Despite the high installation cost -high for poor household economies- and an expected medium-term benefit, families have embraced planting timber and fruit trees. The economic calculation indicates that their expectation is justified; the combined planting of timber and fruit trees, according to the average plantings indicated by

[14] Animals need to get used to the taste of Gliricidia sepium.

the surveys, shows a 10-year benefit four times higher than the benefits of the annual crops currently planted by the families. Even planting only fruit trees (mango) means, at the end of the same period, a profit two times higher. The calculation doesn't even take into account the high probability of failure of annual crops due to adverse weather events nor the loss of soil fertility that these crops cause.

Small-scale fruit production, for families who do not own large areas of land, also represents an increase in income from the first year of planting papaya, for example, from 44 to 220 USD. This additional income, which does not require much investment or a lot of work, represents between 20 to 90% of the production of one hectare of maize. There is great scope for increasing these figures with better management of the trees and improved marketing channels, for example to the market in Arusha, a three-hour drive away.

The impact of fodder production on livestock improvement in general is harder to assess. Families sell their animals "when they need them". Livestock is seen as standing capital, a bank that is called upon on an ad hoc basis to cover expenses. This rational is not conducive to more commercial animal production.

Fodder production is therefore mostly oriented towards milk production, although not exclusively. An increase from 0.5-1 litre per cow per day, to 3-5 litres with a slightly improved breed, better feed and stable, means a rather significant income of USD 805 to 1,611, which represents 40-70% of the income of the current crop mix of the interviewees.

Cattle improvement through insemination does not cost very much, USD 22 per cow, but requires logistics (grouping of heats, hiring an inseminator) that can hardly be achieved without project support.

Table 31
Overview of indicators of the Economic Alternatives promoted by Greening Africa

Indicators	**Achievement**
a) Elimination of strong seasonal variation in income for villagers, through year-round fodder production.	Halfway
Elimination of strong seasonal variation in income for villagers, through year-round fodder production.	Halfway
Fodder production as a business option.	No
The results for improving livestock breeds will be evident.	Yes, for dairy cows
Animal production increased at the end of the four years, as fodder will be sufficient.	Difficult to assess, highly dependent on external factors.
b) Timber	
The provision of excellent long-term economic options, i.e. production of timber trees.	Yes
Each family will have planted at least 1 ha of timber trees.	Half a hectare
c) grain	
Increased quantities of stored grain.	No data
d) fruits	
Each household will have planted at least 15 fruit trees.	Yes
Households' financial and fixed capital will have increased considerably.	Difficult to calculate

5.3 Innovations in natural resources management

A key objective of the Pachamama Raymi methodology, implemented in Tanzania through Greening Africa, is to break the vicious cycle of degradation and poverty (see Annex 2: Degradation and poverty). Specifically, the GA 1&2 projects put their emphasis on generating economic alternatives, to reduce pressure on natural resources and reclaim degrading resources. This was discussed in the previous paragraph. The reduction of pressure on natural resources and their reclamation is therefore the consequence of these activities, replacing annual crops with permanent plantations (timber, fruit and fodder trees) and improved livestock management. It is somewhat difficult to measure precisely and quantitatively the impact on ecological recovery two to three years after the end of the activities; recovery/restoration processes take much longer. However, replacing annual crops with perennials (trees) is economically attractive, while also significantly lowering the risk of adverse weather events impacting people's income. It can be expected that this may motivate families to continue replacing annual crops with perennials.

The elements developed below illustrate the progresses and visualise the pathways to ecological recovery in the area.

I will approach the subject on two scales, one, the farm, the family production unit, and the other, the area of the four villages as a whole.

In both cases, tree planting (ground cover) is key, as is changing attitudes, family habits and community dynamics (environmental management).

5.3.1 At the level of the family production unit

There is no doubt that families associate tree planting with environmental improvement. Several testimonies point out as benefits, the shade that protects both humans and animals, the fact that the soil is not dry, that the houses are protected from the sun, etc. Clearly, the interviewees identify a before and an after of the Greening Africa projects.

Martin Baranda, 76 years old, participant and former president of the Makirinya community (Mwada): "*At that time, the environment was not good and we decided to start planting trees... The difference between now and five years ago is the trees, we now have in the village... we have food (fruit trees), shade, improvement of the environment, the land is not dry*".

Petro Ng´adi, 80 years old, Sangaiwe (Sangaiwe): "*There are big changes in the surroundings, in the environment, especially in terms of climate conditions. For example, before there were no trees and now there are. We have trees around the houses, we can sit in their shade.... Cattle, chickens and goats can also shelter under their shade... but before, we could only stay inside the house because of the hot sun*".

Celina Dangalo 63, from Bondeni, Mwada: "*Before, there were no trees, now we have planted trees for fruit, timber, fodder, the environment has improved*".

Stella Mahoyo Chao, 60 years old, also from Bondeni, Mwada: "*...the trees protect the house from the wind, provide shade, protect the environment*".

The benefit of ground cover provided by tree plantations is better moisture retention, prevents aeolian and water erosion.

These are convergent qualitative assessments, complemented by quantitative data in the following point.

5.3.2 In the area of the four villages

At this point, it is important to establish the total area of trees planted in comparison to the total available area in the villages, in order to quantify how much progress has been made in improving ground cover.

Table 32 establishes the area of the four villages as a reference. The area of the wildlife corridor under the Burunge Wildlife Management Area - WMA, which affects three out of four villages, is subtracted from the total area of the villages.

Table 32
Area managed by the villagers of GA 1& 2 (ha)

Village	Total (ha)	WMA (ha)	Managed by villagers (ha)
Mwada	16,552	8,276	8,276
Sangaiwe	9,469	5,546	3,923
Sarame	11,069	0	11,069
Vilima Vitatu	25,129	11,218	13,911
Total	**62,218**	**25,040**	**37,178**

Source: Baseline study, Second Tanzania Project: Sangaiwe and Mwada villages
In the footsteps of environmental degradation, November 2016
Annex 6 Total planted areas in Greening Africa project, June 2020
Own elaboration

Table 32 shows that 37,178 ha is managed by the villagers.

Planted areas

My estimate of the total area planted thanks to GA 1&2 is based on several sources.

The map of the total planted area in the two Greening Africa projects (see Annex 6), shows 303 hectares planted in plots, including timber, fruit and fodder trees. This corresponds to plots with plantations that were geo-referenced. It does not consider trees planted in single rows of trees planted around fields or houses.

I used the averages of areas referenced in the surveys (see paragraphs 4.2). Table 33 shows the calculation of planted areas on this basis. No trees were planted in communal areas.

Table 33
Area planted by participating families
according to the averages resulting from interviews

Trees	Average (ha)	% of 2,293 participating families that planted trees	Total area of trees planted by participating families (ha)
Timber	0.51	88%	1,029
Fruit	0.17	91%	355
Fodder	0.46	30%	316
Total (ha)	**1.14**		**1,700**

Source: Survey registers, March-April 2022, OdGR, MZP

The total area planted according to this estimate is 1,700 ha. However, not all trees survived their first years. According to data from the surveys, between 60% and 67% of the trees survived. The total area of trees is therefore between 1,140 and 1,020 ha.

The production of seedlings in the tree nurseries is another data source to estimate the planted area. (See Annex 7: Seedling production in tree nurseries – four villages). I estimate the total area planted based on the production of seedlings at 1,757 hectares. Considering a survival rate of 60%, would result in a total planted area of 1,055 ha.

The estimates of the total planted area are approximations. Based on the data, I consider the total planted area to be in the order of 1,000 to 1,100 hectares.

The total area managed by the families and their authorities not including the Burunge Wildlife Management Areas (WMA) is 37,178 ha. Of that total area, 3% (1,000 ha) is planted by the participants of the Greening Africa projects[15].

The total cultivated area is approximately 10,900 ha.

Comparing the 1,000 ha planted by the families to the total cultivated area of the villages, which is about 10,900 ha. Approximately 10% of the total cultivated area is now replaced with trees.

There has not been any significant change in the management of pastures and livestock (except for dairy cattle), meaning that there is no significant recovery of grasslands.

Regarding the potential increase in biodiversity due to the improvement in natural habitats, the interviews conducted in March-April nor the literature reviewed, do not provide any data in this respect.

Conclusion about adopted innovations in natural resources management: based on the data presented in paragraph 5.3, the most relevant innovation that was adopted in natural resource management, is the introduction of tree plantations, replacing 10% of annual crops. Other practices to improve soil protection are incipient (livestock management) or absent (protection, and management of common areas).
The families have learned to plant and have a very positive evaluation of the impact of the tree plantations in terms of the environment, as protection of the soil and also their houses. The positive evaluation of replacement of annuals with perennials opens up a good perspective for further planting, relevant for ecological restoration.

[15] The percentage would be higher than 3% if saline areas, where trees cannot grow, were subtracted from the total area of the villages. However, no data is available on this point.

5.4 Preventive health, improving the health of the family

Eradicating poverty also needs to focus on improving people's health. A relevant aspect is preventive health measures. This line of action considers the adoption of a wide range of practices related to the improvement of the family's housing, hygiene and diet. (See Paragraph 4.1).

Table 34 shows the families' access to water (for human consumption), mostly through family or community wells (56%, 70% also taking into account the combined use of well and piped water).

Table 34
Access to (drinking) water

Source	**Nº of interviewees**	**%**
Shallow well	33	51%
Shallow well and piped water	8	12%
Shallow well and river bed	1	2%
Tubed wáter	11	17%
Tubed water and river bed	4	6%
Lake and piped water	1	2%
River bed	1	2%
n/a	6	9%
Total number of surveys	**65**	**100%**

Source: Survey records, March-April 2022, OdGR, MZP.

The piped water project, with water collected in Barakuda, in the district of Babati is progressing in the field, (see Chapter 3). At present 41% of the families have access to the piped system, which, according to the authorities, is potable. However, people also use other sources (shallow wells, boreholes, river bed, lake) whichever is closer to their home. It should be pointed out that access to piped water does not necessarily guarantee good quality; in many cases, the water that reaches the house appears to be insufficiently disinfected, but it is undoubtedly a significant improvement for the families.

Water from shallow wells is unprotected and cannot be considered potable, as is the case of water in riverbeds.

Note: Further analysis of water availability, access, in quality and quantity, is required. The March-April fieldwork did not lend itself to such a purpose. It may be the subject of a specific study.

Picture 17
Prospecting sweet water before constructing the shallow well

c) Dietary improvement

The usual diet of the families is rich in carbohydrates and not particularly balanced. The staple food is ugali (also called sima, sembe, or posho), made from maize flour. It is accompanied by some vegetables and sometimes meat or beans.

"*The idea (of the project) has been that people learn how to raise small animals and grow vegetables so that they can diversify their diet and not have to buy these inputs from the market*". Biyuna Bakari, ex-project coordinator of Sarame Village during three years, interviewed on 19/03/2019.

Improving the diet includes increasing the intake of animal and vegetable proteins, as well as the consumption of fruits.

- *Chicken farming*. 61% of the interviewees have about 10-15 chickens (see: paragraph 2.3). About 50% of the interviewees sell chickens or eggs. The project baseline indicated that 41% of the families had hens. Chicken rearing seems to have improved marginally.
- *Vegetable garden*: the interviewees indicated that they have had a vegetable garden "*during the contests*" but afterwards, they stopped growing vegetables or have decreased the number of species. Only 10% of participating families continue to work the garden in the same way as during the contests. I therefore conclude that vegetable production of the families did not improve. However, the families indicate that they do eat vegetables, but they buy some from the market. (See: paragraph 2.3)

- *Fruit consumption*: the analysis of the interviews shows that families have massively planted fruit trees and consume fruit at home. (See: paragraph 4.2)
  In this sense, the diet of families is improving, as the habit of diversifying foodstuffs has been adopted, incorporating above all low-cost fruit. The high participation of the families in the contests (2,293 participants, which is 85% percent of the total number of families in the four villages), reinforces the diffusion and adoption of this new nutritional habit.

Table 35 summarizes the various innovations promoted by the GA projects, in relation to the main preventable diseases and health problems, as documented in project formulation report of the first Greening Africa project (2014).

Table 35
Preventive health measures and main preventable diseases

Measure/installation	**Health improvement (decreases/eliminates diseases)**
Improved cook stove, which effectively removes smoke from the house.	Bronchopulmonary diseases Anaemia Eye irritation and infection
Increased quantity and better quality water Having and using a latrine or toilet Frequent hand washing Shelves, cupboards to keep utensils and plates clean Keep pets and other animals away from the house and immediate surroundings (install fence) Deworming (human and animal) Prevent reinfection of animals (management of farmyard manure, rotation of paddocks).	Intestinal parasites and diseases. Anaemia
Improved diet (vegetables, fruits, meat, milk). Deworming,	Anaemia, malnutrition
Follow the regular control protocols of the Ministry of Health in the health posts (in each village): Pre and postnatal care provided by Government programmes Developmental control of new-borns Vaccination campaign Family planning programme	Avoid pregnancy complications, and complications at birth Timely detection of developmental problems in children Avoid unwanted pregnancies

Source: Contents of the Project to improve human health, Project Formulation Mission Greening Africa 1, Annex 4, GA1, 3 T1-GA1-Annex-Report-Tanzania.5, December 2014

The practices as a whole aim to improve families' health. However, it is difficult to quantify this improvement. The massive participation of families in GA 1&2 project activities indicates that the practices are widespread in the four villages.

Official health system data

One way to verify and quantify achievements of GA 1&2, from an official and independent source, should be to have records, statistics from the health services. However, it has not been possible to obtain access to this data.

The short interview with the person in charge of the Mwada Health Centre only offered some generalities about the population's health. The motto was that everything was fine.

The interview with Dr. Rwiza, who has worked at Magugu hospital and now takes over the management of the new Mwada hospital, has provided valuable insights into the health situation since 2015, but did not provide statistics from the Ministry of Health and Social Welfare.

Dr. Rwiza makes it very clear that the health of the population has improved over the past five years. He points to the very recent arrival of drinking water from the Darakuta system as a positive point, as well as increased attendance of families, especially women, to health services, including during pregnancy and childbirth. "*that is the big number (of women), they are collaborate with the agency called Farm Access, Farm Access has the project called Mom Care to advice Pregnant mother to visit health centre*". He points out that most of the women (from Magugu and surrounding villages) give birth in the hospital.

He also notes the involvement of Greening Africa: "*In Sarame* (Note: Sarame has no Health Centre, so people use the Magugu health services) *where the GA project took place I can say that during the project families have improved their cooking place by building the stove that is using less fire wood and also the latrines. There were contests on the family level so people improved their latrines. Families planted fruits trees like papayas, mangos but we have the problem of draught*".

Dr. Rwiza points out, however, the permanence of certain diseases, the most common of which are typhoid, diarrhoea, respiratory system infections, pneumonia, urinary tract infection as well as depression, poisoning, food poisoning, hypertension and diabetes. Among children under five years of age, he points to diarrhoea and pneumonia. He also indicates that, although the cholera outbreak has been brought under control, its causes are still latent (inadequate sewage treatment, poor latrines, flooding). He complements the information by indicating that the most important causes of death are traffic accidents, HIV, pneumonia, hypertension, and severe anaemia.

Conclusions on preventive health

The Greening Africa projects have put the emphasis on preventive health, improving the home, hygiene and diet. Except for the production of vegetables in a home garden, and to a lesser extent, the installation and use of an improved cooking place, the level of adoption of the proposed actions is excellent. Their dissemination among the population is ensured by the high participation of families in the contests, and the high rate of implementation of preventive health measures: all the interviewees reported having made improvements in their homes.

There is a converging and consistent set of measures that signify an improvement in preventive health, which is, however, difficult to quantify and attribute to the action of Greening Africa. The extension of the area's recent installation of drinking water service may become a relevant element of the population's health.

Picture 18
Gliricidia sepium, a fodder tree that still needs to make it to all families in the villages wanting to produce milk or meat all year round

6 The PYMWYMIC method

The components needed to calculate the "Impact Index" of the method are:

1. Lives impacted
2. Depth of impact
3. Type of impact
4. Additionality

The distinctive feature of the GA projects is the planting of trees to replace annual crops, both as an economic alternative and as a key measure for environmental restoration. In this sense, the evaluation of components 3 and 4 is based on this feature.

Each component is developed below.

1) **Lives impacted**: How many lives are positively influenced by the products or services offered by the projects?

   This is the number of families that participated in the GA activities in the four villages. This is 2,293 families, multiplied by the average number of family members (6.2) according to the surveys, this is 14,263 inhabitants in the project areas.

2) **Depth of impact**: Does the solution offered by the projects target the people at the bottom of the pyramid, those most in need of help?

   Poverty figures in Tanzania indicate that 42% of the rural population in the Manyara region is poor. In addition, the Human Development Index of the Manyara region is 0.545, which places the region in the "Low human development" category. (See: Annex 8 Human Development Index – Tanzania). Although this figure is above the country average of 0.529, it is in any case close to the lowest indices in the world (around 0.400).
   These elements lead us to consider that the entire population of the four villages is at the bottom of the pyramid, the one most in need of help. The percentage is therefore 100%.

3) **Type of impact**: To what extent does the company (NGO in this case) intend to address systemic change in the industry in which it operates? A scale from 100% to 200%, based on:

   a. *the type of problem addressed*: Throughout this text and in Greening Africa's reference documents, it is shown that the projects' strategy aims to comprehensively address the situation of families in Sarame, Vilima Vitatu, Mwada and Sangaiwe, in economic, social and environmental aspects, identifying problems of family economic situation, and health such as hygiene, household care and family diet.

   b. *The approach*, single solution / more global (systemic) change. The systemic character of the GA projects is developed in Annex 2 Degradation and poverty.

Greening Africa's proposals aim to create a virtuous circle that breaks the vicious circle of poverty and resource degradation.

4) *Company additionality*: Would the intended change have occurred without GA? There are three closed questions, scored 0 for "no", 1 "yes":
   - Would the families (=the market) have achieved the impact -the changes- without PMR, the answer:
   - *Would the knowledge/expertise have been there without the GA projects?*
     There is extensive knowledge about forestry, natural resource management in some areas of Tanzania but not at the level of the four villages. The additionality was achieved with the great majority of the population through the Pachamama Raymi methodology. In the period under consideration (2015-2020), Greening Africa is the only organisation that had the experience in the methodological aspects, together with the expertise in terms of an economic revival and restoration of natural resources.
     The answer is No.
   - *Would the families (=the market) have achieved the impact (changes) without the GA projects?* The families in the area have implemented the activities linked to economic revival and ecological recovery (lines of action 1 and 2) motivated by Greening Africa, particularly in terms of planting timber, fruit and fodder trees, which is the great innovation introduced in the area. Without this motivation, the families would not have been able to "look for the changes" on their own. The answer to the question is "No", the knowledge/expertise would not have been there without the GA projects.

The impact index is calculated as follows:

	Lives impacted #	X	Depth of impact 0-100%	X	Type of impact 100-200%	X	Enterprise Additionality 1 – 3	=	**Impact score**
Greening Africa	14,263	X	100%	X	200%	X	3	=	**85,579**

According to the analysis table proposed by the PYMWYMIC method, Greening Africa is placed in the high impact quadrant. (See: Figure 4).

Figure 4
Impact score of the Greening Africa projects

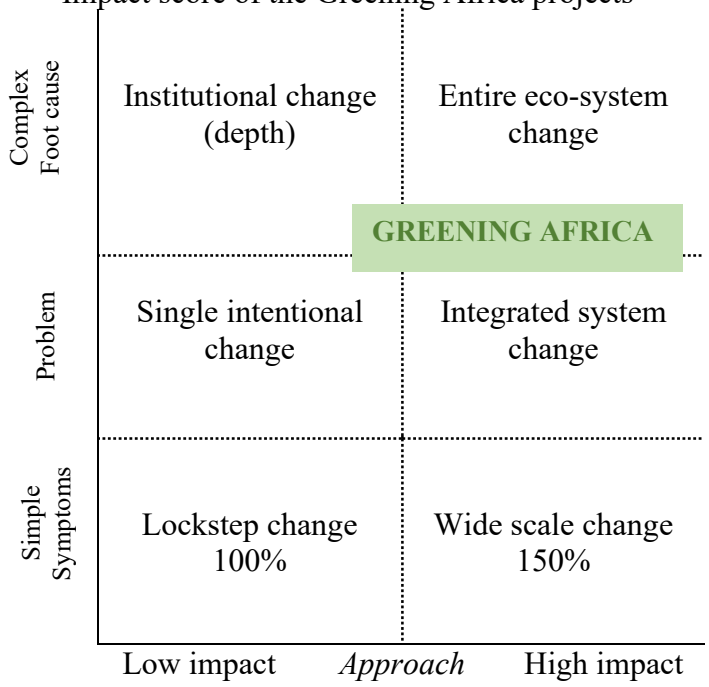


Table 36
Comparison of impact scores between GA 1&2 and present projects in Peru

Project	Lives impacted	Impact score
Accha	1,520	9,120
Independencia	1,815	10,890
Capacmarca	1,600	9,600
Yauyos	1,550	9,300
Echarati	1,500	9,000
Peru (total)	7,985	47,910
Tanzania (GA 1&2)	14,263	85,578

Note: All Pachamama Raymi projects have 100% for "Depth of impact", 200% for "Type of impact" and an "Enterprise Additionality" of 3.

Table 36 shows widely different "Impact scores" for the present projects of Peru and GA 1&2 projects. The score depends to a large degree on the "Lives impacted", even when the methodology in all these projects is the same (Pachamama Raymi), and having the same "Depth of impact", "Type of impact" and the same "Enterprise Additionality".

It therefore appears necessary to make some changes to the formula grading the Impact score and include other relevant factors. Would it be relevant to include the project budget, as related to the number of "lives impacted"? See Table 37, reflecting in this way not just project effectiveness but also project efficiency.

Table 37
Comparison projects with the modified impact score calculations

	1	2	3	4	5	6	3x4x5x6
Project	**Lives impacted**	**Project budget (USD)**	**Live per 1K USD**	**Depth of impact**	**Type of impact**	**Enterprise additionality**	**Impact score**
Accha	1,520	100,000	15	100%	200%	3	91
Independencia	1,815	100,000	18	100%	200%	3	109
Capacmarca	1,600	100,000	16	100%	200%	3	96
Yauyos	1,550	158,169	10	100%	200%	3	59
Echarati	1,500	101,098	15	100%	200%	3	89
Peru	7,985	559,267	14	100%	200%	3	86
GA 1&2	14,263	1,810,127	8	100%	200%	3	47

Note: All Pachamama Raymi projects have 100% for "Depth of impact", 200% for "Type of impact" and an "Enterprise Additionality" of 3.

The "modified impact score" should probably be called "impact & efficiency score". Table 37 shows a lower score for the projects in Tanzania, indicating that they were somewhat less efficient than those in Peru. Also, within Peru there are interesting differences: Yauyos gets the lowest score. This project is being implemented in an area with a very large mining operation (Sierra Metals), impacting the price of inputs. Prize money is also considerably higher for Yauyos, as prizes in the social and economic reality of this area need to be higher.

Calculating this modified impact score, somewhat changes the idea of the impact score, as it would not just look at impact. Just have a way to grade projects on their impact only, may be the whole point of this variable. The designers of the impact score may favour other means to differentiate projects, more closely related to measuring or predicting the project impact.

Not reflected in the "impact scores", modified or not, is the time required to achieve the desired impact, even when time is rather central to achieving an impact in the lives of families. Time and budget are related, as a project needing ten years will most likely cost more than one that requires only four.

The "the number of lives impacted", as a factor in the original impact score calculation would mean that the larger the project, the greater the impact. However, what is of interest is the impact on the lives of families. A higher impact score should also mean a more relevant impact on the families. Instead of number of families, I therefore propose to use the percentage of lives impacted (number of families impacted as related to the total population of the project area), eliminating the problem that the impact score would be highly dependent on the size of the project.

These considerations are reflected in the Impact score calculator of Table 38.

Table 38
Comparison of projects using impact scores reflecting project duration and percentage of lives impacted

Project	1	2	3	4	5	1x2x3x4x5
	Project duration (1/years)	Lives impacted (%)	Depth of impact (%)	Type of impact (%)	Enterprise Additionality (1-3)	Impact score
GA	1/4	85	100%	200%	3	128
PMR (targets)	1/3	60	100%	200%	3	120
PMR (normal)	1/3.5	80	100%	200%	3	137
LAMP (max)	1/10	20	100%	200%	3	12

Notes:

- Column 2 is the percentage of the population that was impacted as related to the total population.
- "PMR targets". These targets are: (1) Over 60% of the population is greatly impacted; (2) within three years
- "PMR normal". Is what PMR projects in Perú normally achieve: 80% greatly impacted, within 3.5 years.

Included in Table 38 is the Swedish LAMP project, which was also implemented in Manyara, near GA 1&2 (see Annex 3). The LAMP project promoted very similar innovations to be adopted as Greening Africa: measures to reclaim degraded natural resources. I do not have data on the investment of that part of the LAMP project, but do have relevant information about two central issues: necessary project duration and percentage of lives impacted. Both are taken from the project design report of GA1, which includes testimony of Dr. Per Hillbur, who worked in the LAMP project and later performed several studies and evaluations post project. Rather than what was actually achieved by LAMP, I use the numbers Dr. Per Hillbur mentioned, the numbers that he would have wished for: within 10 years, achieve that 20% of the population adopts the innovations needed to reverse degradation. I take "Depth of impact", "Type of impact" and Enterprise additionality as being the same as for the Pachamama Raymi projects.

Sustainability

Not included in any of the alternative calculations of the impact score, is the sustainability of the impact. In the end, sustainability is a key. Without it, no investment is worth doing. The issue of sustainability may simply be take up as a factor between 1 and 0. Multiplying the impact score as reflected in Table 38, with 1 would mean: everything the project meant to achieve, proved to be –or is expected to be- sustainable. If 0 applies: nothing is sustainable and the Impact Score is 0.

Conclusion regarding the PYMWYMIC method

The rating of each of the four components of the method clearly places Greening Africa in the "high impact" category of possible impact scores, in part due to the many lives impacted, which is related to project size. The impact scores for different sizes of projects, but are

otherwise very similar, differ greatly. In other words, the impact score does not provide relevant scores on projects.

It therefore appears that the original impact score calculation, requires some modifications to provide relevant information on project performance. It appears that the percentages of lives impacted (instead of the number of lives impacted) would need to be included. Project duration also is a relevant item to grade project impact.
Sustainability of project achievements is yet another issue not included in the impact score, while it is a requirement of any project.

General conclusions

The study presented in this text seeks to identify the impact of the Greening Africa projects in Sarame - Vilima Vitatu and Mwada - Sangaiwe, two and three years after the completion of the activities respectively. The aim is to assess the changes that families are determined to take on, out of conviction and interest. In summary:

1) The massive participation of the families in the Greening Africa projects stands out. It is characterised by the high percentage of participants in the contests: 81% in GA1, 90% in GA2. It also manifests itself by the great enthusiasm of the families to boast about their achievements and talk about their dreams for the future during the interviews. The families express their support and interest in the innovations introduced by Greening Africa and ask for the continuation of the projects. Importantly, the families have mobilised a significant investment of time, energy and money in the improvement of their houses, in the alternatives proposed by the projects, the value of which represents 77% of the total budget of Greening Africa in the areas. The investment is even more remarkable, given that the benefit of a relevant part of their investment (tree planting) starts paying out in 4 to 10 years.
2) In this respect, plantations of timber and fruit trees have a very encouraging medium-term economic result, with the prospect of a profit four times higher than the current production of the families (maize, sunflower, sesame). Dairy production, with the combination of genetic improvement, fodder production and stabling, also represents a significant improvement in income, although for a smaller number of families.
3) Innovations in management of natural resources derive from the economic alternatives implemented, namely afforestation: plantations allow for greater soil cover, maintain humidity, produce shade, protect the house and largely avoid damage by draughts. It is unanimously appreciated in the interviews as an improvement of the environment. On the scale of the territory, the improvement already achieved replacing an estimated 10% of annual crops.
4) As for preventive health, families have implemented and value a set of actions and practices to improve their habitat. The actions are aimed at improving hygiene and the family diet, particularly with the incorporation of home-grown fruit.
5) The prospect and hope of improving the quality of life and increasing income is limited by the scarcity of water. Although the connection to the drinking water service is underway, with an undoubtedly positive impact on health and the workload of families to obtain daily water, agricultural production in the area will continue to depend on rainfall. The effects of climate change may mean further uncertainty in this regard.
6) Mining in Vilima Vitatu means a major change in this village, not only because of the trauma of the loss of land and houses, but also because of the change of economic direction, which will probably revolve around mining activity (employment in the mine, related services). The achievements of the families, made with the support of Greening Africa, may be largely lost. However, families that can hold on to their land or obtain it elsewhere, will benefit from the knowledge, knowhow and experience obtained during the projects.

7) It appears that the PYMWYMIC method requires further adaptions to provide a measuring tool for impact and project efficiency. It maybe that several tools are required to grade a project on impact on people's life, efficiency, effectiveness, cost and sustainability.

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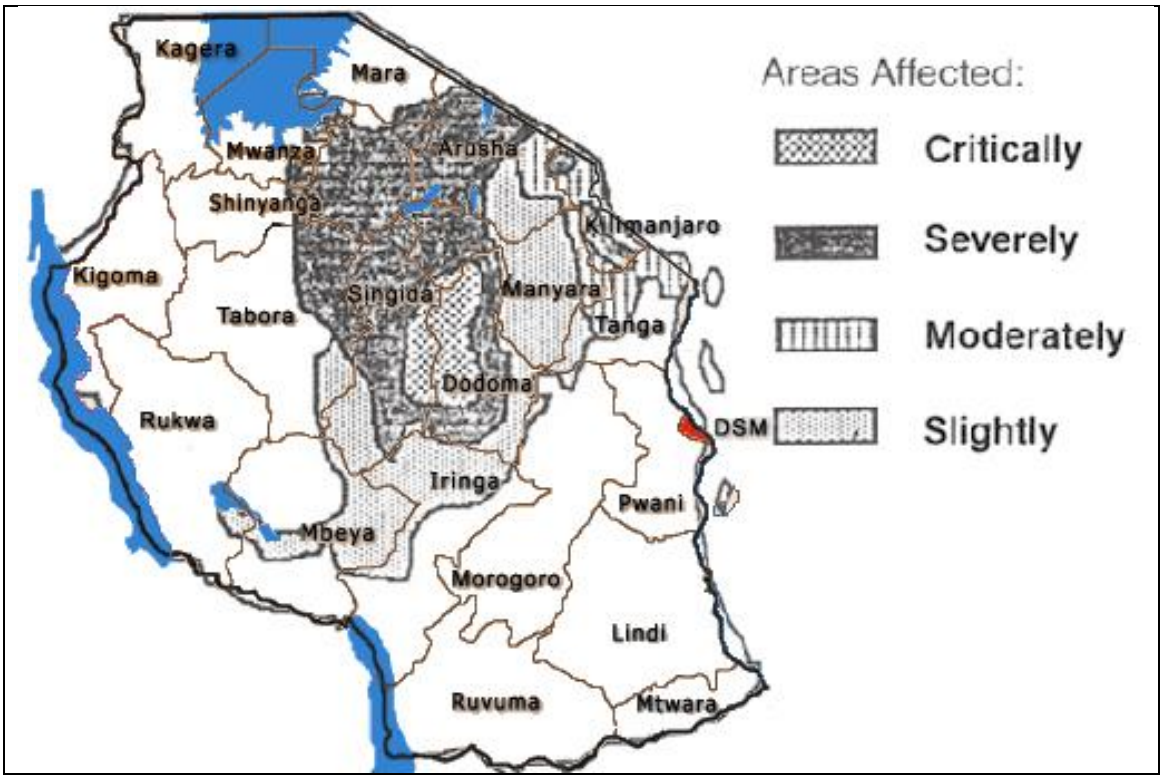
Annexes

Annex 1

Map of degraded areas of Tanzania

Source: www.unsystem.org/scn/archives/tanzania/ch09.htm#bm14-The%20environment%20and%20food%20security



UN study on the environment and food security

In Tanzania, the scale of deforestation is alarming. It is estimated to be advancing at an annual rate of 300,000 to 400,000 ha and the rate is rapidly accelerating [URT, 1991]. Much of the deforestation is due to clearing for unsustainable crop production, overgrazing and fuel wood. Wood is by far the most important source of energy in Tanzania and is estimated to contribute more than 90 percent of the total national energy supply. Tanzania is estimated to consume annually about 27 million m^3 of solid wood of which about 22 million cubic meters are consumed by households and the remainder by agriculture, rural industries (including brick factories) and the service sector. However, the estimated sustainable annual yield of wood-fuel from natural forests and public woodlands is 18 million m^3 which means there is already a deficit of 9 million m^3. As a result, degradation is taking place rapidly. The UN has estimated that the degraded area is between 33 percent and 45 percent of the total land area of Tanzania.

This massive environmental degradation is detrimental to the country's future development; the land resource base is dwindling, while the growing population needs more food, fuel and other basic commodities.

Annex 2

Degradation and Poverty[16]

Introduction

Our interest in soil degradation originates from the fact that it is closely related to rural poverty, food insecurity and famine. More degradation means less plant production, and consequently -in a rural economy- poverty and hunger. Reclamation of degraded areas can reduce poverty and often has the potential to make rural communities prosper.
In this paper I will argue that common measures to counter soil erosion do not address its causes and have no impact on reclaiming this vital resource or on rural poverty. By contrast, changing management practices is an effective measure to reclaim degraded soils, and as a result, eliminate rural poverty and erosion.

Soil degradation and poverty

It is all very well known: soil degradation and rural poverty are linked and occur worldwide. Ecological collapse generates millions of eco-refugees and destabilizes entire regions. International, governmental and Non-Governmental organizations distribute handouts, including food, trying to stem the tide. Small and large projects fight against soil erosion.

[16] In: La sierra es el epicentro del colapso ecológico de Perú, su recuperación es "El Reto" Asociación civil Pachamama Raymi-Aprender de los mejores, and all, 230 pages, 2021

Sarame village, Babati District, Tanzania

Degradation, a physical phenomenon?

"Degradation" and "erosion" are often taken as synonyms. Erosion is easy to spot: soil was transported downhill, leaving behind very clear signs of what happened (see picture on the left). Clearly, erosion is a physical process: soil is on the move.

How can erosion be stopped? The answer seems obvious.

Block that movement of soil and only let the water go downhill (see picture on the right).

Another obvious option would be to allow the water to infiltrate by constructing infiltration ditches (see picture below), or by building terraces or a combination of all such physical control measures.

Erosion usually affects entire landscapes. Building erosion control measures on that scale requires enormous investments. These structures also require regular maintenance. In spite of the severe problems caused by soil erosion, such investments are often hardly justified because these eroded lands are infertile and unproductive.

The population that depends for their livelihood on these unproductive resources is invariably poor. They cannot be expected to invest in, or maintain erosion control structures on any relevant scale. That is why governments and charitable organizations often build such structures for them.

It seems hopeless so people abandon eroded landscapes

Should we just assist people to move to a better place?

A broader view

Erosion is not just a physical phenomenon. It is part of a much broader process in which people ultimately abandon their villages. We all need to understand that broader process to come up with another perspective on erosion.

What started the process that resulted in erosion? Population pressure forced an increasingly more intensive exploitation of the land. Fallow periods are shortened resulting in unproductive and sterile land, in crop failures and erosion. Grass of lush pastures is not allowed enough time to regrow after grazing. There is no longer enough grass production to incorporate organic matter into the soil. The soil therefore loses its organic matter and becomes hard and little rainwater will infiltrate into it. This means that less water will be available for the grass to grow. Wonderful rangelands deteriorate.

Degradation of the main resources of rural areas –crop- and rangelands– is directly related to their overexploitation. The process of degradation can be described in ecological terms, using the concept of succession, which is a basic ecological phenomenon. Plant succession is the process of the development of vegetation where different plant communities successively occupy an area. I distinguish progressive and regressive succession.

Progressive succession is the process of the development of vegetation in which different plant communities of a higher ecological order successively populate an area. The last step in this sequence is the climax vegetation. This is the highest level of development of the plant community: the energy system (ecosystem) is at its highest point of productivity. The soil develops in parallel with its vegetative cover, culminating in a “climax soil” or mature soil. Erosion is virtually nonexistent in this soil and runoff is negligible, and the soil is stable.

Regression –regressive succession– uses the same "ladder" as progressive succession, but in the opposite direction: the community of plants is being replaced by one of a lower ecological order. Productivity of the vegetation drops. The process culminates when productivity is (close to) zero. Causes of regression can be free grazing, excessive

burning, plowing, cutting of trees and some other management practices. Erosion is the last step of the regression process.

In grasslands, regression is characterized by the succession of plant species that are less palatable to livestock. That is, regression not only reduces the amount of fodder but also its quality. Under these conditions, livestock production drops and will approach zero as regression advances.

Regression shows up in soil development and is characterized by passing successively through the following stages:
- Loss of organic matter;
- Deterioration of soil structure and compaction;
- Accelerated erosion.

Erosion is the last step in the process of soil degradation and it ends when the rock is reached from which the soil was formed, thousands of years ago when progressive succession began. Obviously, erosion will simply continue when the “rock” is not solid but granular.

The loss of organic matter implies that soil fertility will drop. Increased soil exposure means that the difference between day and night temperatures increases. The loss of structure and compaction imply that infiltration capacity is reduced, which means that the moisture in the soil will decrease. In general, the microclimate in and above the soil becomes increasingly hostile to the development of plants. Less water infiltrates in the compacted soil so springs will dry up and the base flow of rivers will reduce, often to zero.


Laminar erosion. Raindrops mobilize unprotected soil.

The most common type of erosion is "laminar erosion" also known as sheet erosion. This type of erosion is caused by rain, which almost homogeneously mobilizes and transports the soil towards gullies and rivers. There are no cuts or other clear signs that warn about its occurrence. This type of erosion often goes unnoticed. Over-exploitation of the land can accelerate erosion and the topsoil –the fertile soil– will disappear within just a few years after erosion starts. The land will become infertile and unproductive.

With worsening erosion, "laminar erosion" advances into furrow erosion. That is, the eroding water forms furrows as the erosion concentrates. The furrows deepen and can become gullies.

A gully in Sarame (Manyara Region, Tanzania), a landmark of serious resource degradation.

Sheet erosion is everywhere when gully erosion is present in the landscape. Much of the rainwater disappears through such gullies instead of infiltrating to be taken up by plants or replenish fresh groundwater.

Erosion not only causes damage where it occurs. Sedimentation affects areas downstream of the eroded areas: rivers and lakes fill up with sediments.

Rivers overflow as less rainwater infiltrates into the soil and more rainwater quickly reaches the river as surface runoff. As a result, flooding becomes more frequent and flood peaks get higher, affecting agricultural land in the valleys. Inundated cropland and pastures are not only damaged by flooding but also by sediments. Sediments can cause excessive wear on turbines of hydro electrical plants.

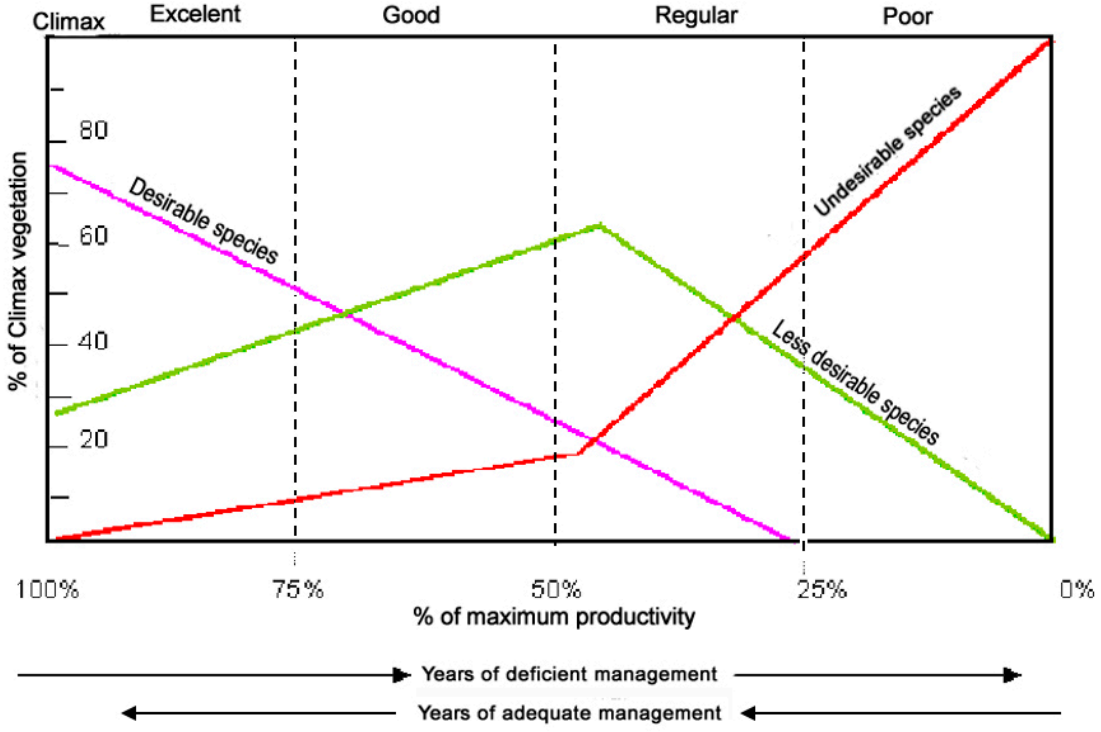
Plant production in relation to degradation

Plant production and degradation are closely linked. Annex 2, Figure 1 shows this relation for graze lands (as an example). It illustrates that productivity declines due to deficient management. Productivity can be close to zero after years of poor management (bottom right hand of Annex 2, Figure 1).

After years of deficient management, there are no plant species left that animals can feed on…

After years of deficient management, we'll find species that are too woody, too thorny or venomous.

Annex 2, Figure 1
Condition of Pasture and Productivity



Annex 2, Figure 1 illustrates the composition of rangelands as a function of management practices. After years of deficient management, there are no plant species left, that animals can feed on. There are only “undesirable species”. Under such conditions, one animal needs many hectares and will spend all its energy to find something to eat.

Severely degraded grassland, Araucanía, Chile after years of deficient management (right side of Annex 2, Figure 1).

Below, is a picture taken from the same piece of land as seen in the previous picture, taken at a vertical angle.

Severely degraded grassland, Araucanía, Chile (2)

Soil is exposed and the few plants that are present, are not edible for livestock.

This severely degraded grassland produces very little organic matter, implying that this soil will only lose organic matter.

The soil lost its structure and is compacted. People living off such degraded resources are extremely poor.

Productivity and quality of management are linked as shown in Annex 2, Figure 1. It also shows that it is possible to boost productivity in severely degraded areas, simply by changing management practices. Importantly, the essence of *changing management is not about making investments*; it is about day-to-day decisions, such as where the animals should graze today, or which crop should come after peas. Such decisions depend on the farmer's knowledge and expertise, and on what (s)he knows and understands of degradation and reclamation.

The same soil and climate as the pastures of the previous picture.
Lush grassland and high productivity is possible by changing grassland management.
(Left side of Annex 2, Figure 1)

Projects and reclamation of resources

Some projects try to reclaim degraded resources by building terraces, infiltration ditches and building dams in gullies. These structures effectively stop erosion and surface runoff.

Surface runoff and sedimentation in the river plain and lakes would be stopped if an entire degraded river basin were to be treated with such structures. Terraces, infiltration ditches, and other erosion control structures are effective tools in fighting one symptom of the last step of the degradation process: erosion. However, such structures do not stop the degradation process; they cannot stop and much less reverse the ecological process of regression; structures cannot recover the potential productivity of the land.

It is sometimes argued that erosion control structures can achieve that water infiltrates in the soil and that this will help plant growth, which in turn will improve the soil, and thus result in soil reclamation. This would imply that flat areas cannot be affected by soil degradation. Unfortunately, that is not the case. Plant communities on flat areas will go through the very same regression as plant communities on slopes if exposed to deficient management**:** soil will lose organic matter and its structure, become more compact and lose its fertility and most of its infiltration capacity. The only symptom of degradation that will be different in nature is soil erosion: on slopes, soil will be transported downhill, while on flat areas, all forms of erosion are absent, except splash erosion.

The degradation process for flat and sloping areas will follow the same route shown in Annex 2, Figure 1: toward zero productivity. The soil does not become more fertile nor does it become more productive by constructing infiltration ditches or flat terraces. There is no point in fighting symptoms of degradation –such as erosion– when its cause (deficient management) is not addressed. There is no need to construct terraces, infiltration ditches, etc. when deficient management is replaced by adequate management, as adequate management will result in soil reclamation.

Reclamation of degraded soils –on slopes or flat areas– will take place if adequate management replaces deficient management. Reclamation of degraded soils means that:

- Soil will recover its structure and become less compact and more permeable for rainwater, so
- More rainwater will infiltrate and less water will be lost as surface runoff.
- The content of organic matter and soil fertility will increase.
- Soil cover will improve and the quality of fodder and animal production will increase.
- Soil erosion will diminish and finally disappear.

Management practices of thousands of farmers

Changing management practices of many extremely poor farmers requires adoption of a number of innovations, by a majority, if it is to impact erosion of large areas such as watersheds. Conventional training methodologies such as Training of Trainers, Training & Visit are not capable of such a feat within normal project duration (4 to 10 years).

Changing management practices from deficient to adequate by a majority of the population is possible with the Pachamama Raymi methodology; the results become evident within the first project years.

Changing management practices do not just make poor people less poor; it can make them prosperous, as productivity will go from almost zero to many times the present levels (see the x-axis of Annex 2, Figure 1). Incomes can be multiplied accordingly and increase 10 times and more as productivity was almost zero.

Extremely poor people living off severely degraded resources have great potential, which can be unleashed simply by changing their management practices! That is what

Pachamama Raymi does in entire districts and many villages in Peru and also in Africa and Nepal.

Annex 3

The Swedish LAMP project[17]

We found that important projects, particularly the Swedish LAMP project ([18]) and Farm Africa ([19]) had done much over the past decades in the Manyara Region, studying what to do to reclaim natural resources, planting millions of trees and constructing countless hectares of terraces.

However, effective reclamation of natural resources needs more. It requires that the people change their habitual management practices of their farm- and rangelands that caused the degradation in the first place. It soon became clear to us that the mentioned projects (LAMP, Farm Africa) had not been very successful at this essential aspect. They did train the farmers but only few changed some aspects of how they manage their resources. Evaluations of the LAMP project reported the "low adoption" rates. Several important efforts were undertaken to improve adoption, without producing the desired results.

The usual answer to "low adoption rates" is to extend project duration. We thus find that many projects lasted 10 years or even longer, often without achieving their goal.

The issue of "adoption rates" is a major obstacle to achieve efficient and effective poverty eradication in rural development and natural resource reclamation necessary to improve the rural economy significantly and lastingly.

Projects as LAMP tried to increase adoption as much as possible within the possibilities of conventional training methodologies. Dr. Per Hillbur studied the issue of adoption in the context of the LAMP project in great detail ([20]) in an attempt to find how to improve it. We were so lucky to meet him during his short visit to Babati. When asked what he considered "good adoption" to be, he answered: "*10% to 20% of the population adopt the innovation in about 10 years"*.

Such a percentage may be "good" within the context of what is possible with conventional training methodologies. We believe it is still low when compared to what is necessary, as the "tipping point" is at around 30% of the total population. The "tipping point" is the point from which adoption will continue as a speedy and natural process of diffusion. Therefore, the tipping point is what is needed for a training program to achieve sustainable results.

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17 From the project formulation mission, December 2014

18 LAMP (stands for **LA**nd **M**anagement and Environment **P**rogramme), a multi-million afforestation program between 1982 and 2009. From 1992 it was broader than forestation and aimed at increasing productivity through community-based management of natural resources, such as soil, wildlife management and forestry. See: www.sida.se/globalassets/global/countries-and-regions/africa/tanzania/sweden-tanzania-cooperation.pdf
And: www.bistandsdebatten.se/wp-content/uploads/2012/09/0312-Three-Decades-of-Swedish-Support-to-the-Tanzanian-Forest-Sector-Evaluation-of-the-period-1969-2002.pdf

19 Farm Africa (**F**ood and **A**gricultural **R**esearch **M**anagement), is a British NGO that works in five East African countries. See also: www.farmafrica.org. It has been working in Tanzania since 1990, working with smallholders, pastoralists and forest communities, helping them become self-sufficient.

20 Per Hillbur, Head of Department, Associate Professor Human Geography, Senior Lecturer Environmental Science, Malmö University, Sweden.

Adoption should still be higher, because some reduction of the rate of adoption can be expected after project retreat. To compensate for that, we aim at 50% (30 + 20), at least.

The methodology Pachamama Raymi specializes in achieving high adoption rates under the most trying conditions in Latin America. We are confident that we will also achieve adoption rates over 50% in Tanzania. Instead of extending the project to last a decade or more, we use potent motivators that have shown to achieve the 50% adoption, or more, within three to four years. The methodology we use is capable of making adoption an intentional and controlled process.

A major hurdle is taken to overcome rural poverty and reclaim natural resources in sub-Saharan Africa if we really do succeed in generating high adoption rates in Tanzania. The next hurdle would be to introduce the methodology Pachamama Raymi to more projects. By the way, better adoption rates are not the only major difference between conventional methodologies and Pachamama Raymi. Determining which innovations should be introduced is another difference (see the paragraph 3 “Projects, project contents and adoption”).

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Annex 4

Production costs and incomes

Crops and plantations - Cost, incomes, and profit per acre

Description	Unit	Quantity	Unit Cost	Total (Euro/acre)
Maize				
Production costs				**117.42**
Seeds	kg	15	0.41	6.09
Cleaning the land	Daily wage	2	4.06	8.13
Ploughing	acre	1	16.25	16.25
Sowing	Daily wage	1	10.16	10.16
Weeding	Daily wage	1	10.16	10.16
Fumigation	whole	3	10.16	30.47
Insecticide	whole	3	3.25	9.75
Security of the field	month	1.5	12.19	18.28
Harvest	Daily wage	1	8.13	8.13
Incomes for harvest +	bag	20	16.25	325.05
Incomes for harvest -	bag	8	16.25	65.01
Average incomes	bag	14	16.25	227.53
Profit +				**207.62**
Profit -				**12.60**
Average profit				**110.11**

Description	Unit	Quantity	Unit Cost	Total (Euro/acre)
Sunflower				
Production cost				**80.25**
Seeds	kg	2	0.51	1.02
Cleaning the land	Daily wage	1	10.16	10.16
Ploughing	acre	1	16.25	16.25

Sowing	Daily wage	1	10.16	10.16
Weeding	Daily wage	1	10.16	10.16
Fumigation	whole	3	4.06	-
Insecticide	whole	3	3.25	-
Security of the field	month	1.5	16.25	24.38
Harvest	Daily wage	1	8.13	8.13
Transport of bags	bag	4	1.22	5.42
Incomes for harvest -	bag	4	40.63	180.81
Incomes for harvest +	bag	4	28.44	126.57
Average incomes	bag	4	34.54	153.69
Profit +				**100.56**
Profit -				**46.32**
Average profit				**73.44**

Description	Unit	Quantity	Unit Cost	Total (Euro/acre)
Sesame				
Production cost				**80.25**
Seeds	kg	2	0.51	1.02
Cleaning the land	Daily wage	1	10.16	10.16
Ploughing	acre	1	16.25	16.25
Sowing	Daily wage	1	10.16	10.16
Weeding	Daily wage	1	10.16	10.16
Security of the field	month	1.5	16.25	24.38
Harvest	Daily wage	1	8.13	8.13
Incomes for harvest -	bag	3	121.89	365.68
Incomes for harvest +	bag	2	121.89	255.97
Average incomes	bag	2	121.89	310.97
Profit +				**285.43**
Profit -				**175.73**
Average profit				**230.58**

3 crops 1 acre				
Average production cost				**277.92**
Average incomes				**692.04**
Average profit				**414.13**

Description	Unit	Quantity	Unit Cost	Total (Euro/acre)
Timber trees				
Plantation costs, year 0				**643.59**
Seedlings	Seedling	450	0.81	365.68
Cleaning the land	Daily wage	1	10.16	10.16
Digging holes	Hole	450	0.20	91.42
Transport of fertilizer	Round	1	16.25	16.25
Preparing and mixing the soil	month	1	121.89	121.89
Planting	Daily wage	1	4.06	4.06
Watering, tank GA	Round	3	3.25	9.75
Security of the field	month	2	16.25	24.38
Prune 3nd year	Daily wage	1	8.13	8.13
Prune the plantation 30% 6th year	Daily wage	2	12.19	24.38
Sale in the field	Tree	315	81.26	25,597.44

Description	Unit	Quantity	Unit Cost	Total (Euro/acre)
Fruit trees Mango				
Plantation costs, year 0				**328.70**
Seedlings	Seedling	130	0.81	105.64
Cleaning the land	Daily wage	1	10.16	10.16
Digging holes	Hole	130	0.20	26.41
Fertilizers, buckets	Daily wage	7	4.06	26.41
Preparing and mixing the soil	month	1	121.89	121.89
Planting	Daily wage	1	4.06	4.06
Watering, tank GA	round	3	3.25	9.75
Security in the field	Month	2	16.25	24.38

Yearly costs				**81.26**
Prune after 6 months, then each 2/3 years	Daily wage	1	8.13	8.13
Fungicide	whole	1	30.47	30.47
Insecticides, phytohormones	whole	1	16.25	16.25
Fertilizer, 1 bucket by tree	Daily wage	7	4.06	26.41
Harvest costs, since 4th year				
Harvest costs	Whole	1	16.25	16.25
Total amount full production per year				**97.51**

Description	Unit	Quantity	Unit Cost	Total (Euro/acre)
Fodder trees				
Production cost				**3,372**
Seedling	Seedling	5,000	1	3,047
Cleaning the land	Daily wage	1	10	10
Preparing and mixing the soil	month	1	122	122
Planting	Daily wage	2	4	8
Watering, tank GA	Round	1	20	20
Annual cost				**103**
Fungicides	whole	1	30	30
Harvest	Daily wage	18	4	73

Other costs

Description	Unit	Quantity	Unit Cost	Total (Euro/acre)
Nursery work	Daily wage	18	4.06	73.14

Description	Unit	Quantity	Unit Cost	Total (Euro/acre)
Insemination - 26 cows				

Total costs				**528**
hormones	whole	1	6.09	6.09
Tank	Tank	1	28.44	28.44
Semen	whole	1	6.09	6.09
Inseminator	Month	1	487.57	487.57
Cost by cow				20.32

Description	Unit	Quantity	Unit Cost	Total (Euro/acre)
House improvement				
Total cost				**99.55**
Latrines building and bricks	whole	1	40.63	40.63
Rendering and painting	Daily wage	24	2.03	48.76
Improved cooking place	Whole	1	10.16	10.16

Annex 5

Net Present Value

YEARS	0	1	2	3	4	5	6	7	8	9	10
Timber trees											
INITIAL INVESTMENT	-644	0	0	0	0	0	0	0	0	0	0
INCOMES	0	0	0	0	0	0	0	0	0	0	25,597
EXPENDITURE	0	0	0	8	0	0	24	0	0	0	0
	-644	0	0	-8	0	0	-24	0	0	0	25,597
FRUIT TREES											
INITIAL INVESTMENT	-328	0	0	0	0	0	0	0	0	0	0
INCOMES	0	0	0	475	1,426	1,426	1,426	1,426	1,426	1,426	11,885
EXPENDITURE	-102	102	102	118	118	118	118	118	118	118	118
	-430	-102	-102	358	1,308	1,308	1,308	1,308	1,308	1,308	11,767
MAIZE											
INITIAL INVESTMENT	0	0	0	0	0	0	0	0	0	0	0
INCOMES	0	647	647	647	647	647	647	647	647	647	647
EXPENDITURE	-334	334	334	334	334	334	334	334	334	334	334
	-334	313	313	313	313	313	313	313	313	313	313
SUNFLOWER											
INITIAL INVESTMENT	0	0	0	0	0	0	0	0	0	0	0
INCOMES	0	437	437	437	437	437	437	437	437	437	437
EXPENDITURE	-228	228	228	228	228	228	228	228	228	228	228
	-228	209	209	209	209	209	209	209	209	209	209
SESAME											
INITIAL INVESTMENT	0	0	0	0	0	0	0	0	0	0	0
INCOMES	0	505	505	505	505	505	505	505	505	505	505
EXPENDITURE	-130	130	130	130	130	130	130	130	130	130	130
	-130	375	375	375	375	375	375	375	375	375	375
TOTAL											
INITIAL INVESTMENT	-1,766	0	0	0	0	0	0	0	0	0	0
INCOMES	0	1,590	1,590	2,065	3,016	3,016	3,016	3,016	3,016	3,016	39,072
EXPENDITURE	0	794	794	819	811	811	835	811	811	811	811
	-1,766	795	795	1,246	2,205	2,205	2,181	2,205	2,205	2,205	38,261
NPV	26,442										

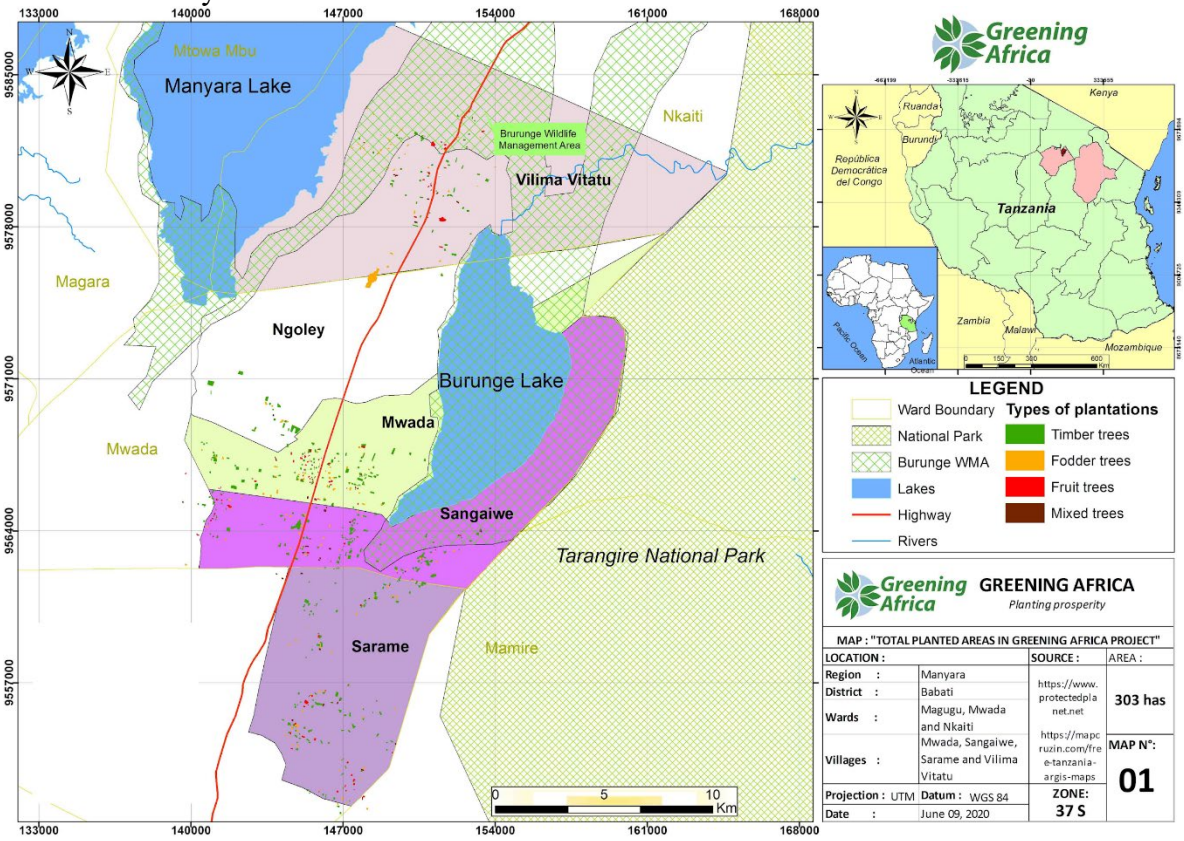
USUAL PRODUCTION

YEARS	-	1	2	3	4	5	6	7	8	9	10
MAIZE											
INITIAL INVESTMENT	-	-	-	-	-	-	-	-	-	-	-
INCOMES	-	796	796	796	796	796	796	796	796	796	796
EXPENDITURE	-411	411	411	411	411	411	411	411	411	411	411
	-411	385	385	385	385	385	385	385	385	385	385
SUNFLOWER											
INITIAL INVESTMENT	-	-	-	-	-	-	-	-	-	-	-
INCOMES	-	538	538	538	538	538	538	538	538	538	538
EXPENDITURE	-281	281	281	281	281	281	281	281	281	281	281
	-281	257	257	257	257	257	257	257	257	257	257
SESAME											
INITIAL INVESTMENT	-	-	-	-	-	-	-	-	-	-	-
INCOMES	-	622	622	622	622	622	622	622	622	622	622
EXPENDITURE	-160	160	160	160	160	160	160	160	160	160	160
	-160	461	461	461	461	461	461	461	461	461	461
TOTAL											
INITIAL INVESTMENT	-852	-	-	-	-	-	-	-	-	-	-
INCOMES	-	1,956	1,956	1,956	1,956	1,956	1,956	1,956	1,956	1,956	1,956
EXPENDITURE	-	852	852	852	852	852	852	852	852	852	852
	-852	1,104	1,104	1,104	1,104	1,104	1,104	1,104	1,104	1,104	1,104
NPV	6,553										

Annex 6

Total planted areas in Greening Africa project

Pachamama Raymi June 2020



Annex 7

Production of seedlings in tree nurseries and area planted

		Timber trees				Fruit trees		Fodder trees	
Planting season	Village	produced	Distributed	Balance	Planted (ha)	produced	Distributed	Distributed	Planted (ha)
2017	Sarame	75,895	38,985	36,910	35	15,523	2,463	25,910	3
	Vilima Vitatu	67,506	19,450	48,056	17	26,183	4,846	48,633	5
	Vilima Vitatu							20kg seed	4
2018/19	Sarame	145,702							
	Vilima Vitatu	167,645							
	Sarame +VV					21,334*	21,334		15
Total 2 years	Sarame	221,597	38,985	36,910	35	15,523	2,463	25,910	3
	Vilima Vitatu	235,151	19,450	48,056	17	26,183	4,846	48,633	9
	Sarame +VV	-	-	-	-	-	21,334	-	15
	Total GA1	456,748	58,435	84,966	52	63, 040	28,643	74,543	27
* only the number of seedlings distributed is available, so production is minimally equal to that number									
2017/2018	Mwada	89,812							
	Sangaiwe	63,905							
2018/2019	Mwada	307,600							
	Sangaiwe	125,450							
2019/2020	Mwada	271,447				31,316	26,116		8
	Sangaiwe	236,228				8,011	3,928		3
2019	Mwada								4
	Sangaiwe								2
Total 3 years	Mwada	668,859	-	-	-	31,316	26,116	-	12
	Sangaiwe	425,583	-	-	-	8,011	3,928	-	5
	Total GA2	1,094,442	-	-	-	39,327	30,044	-	17
	Total GA 1&2	1,551,190	58,435	84,966	52	102,367	58,687	74,543	44

Area planted (potential as per the number of seedlings produced)

	Timber	Fruit	Fodder	Total (ha)
Seedlings per ha	1,112	321		
Ha	1,395	319	44*	**1.757**

* Directly expressed in hectares

Annex 8

Human development index

Regions of Tanzania by Human Development Index year 2018

Rank	Regions	HDI (2018)
	Medium human development	
1	Mjini Magharibi	0.690
2	Dar es Salaam	0.631
3	Kilimanjaro	0.613
4	Unguja South	0.612
5	Pemba South	0.577
6	Unguja North	0.560
7	Iringa & Njombe	0.554
	Low human development	
8	Tanga	0.547
9	**Arusha & Manyara**	**0.545**
10	Pemba North	0.543
11	Ruvuma	0.533
-	 **Tanzania (average)**	**0.529**
12	Morogoro	0.525
12	Singida	0.525
14	Mbeya	0.523
15	Mara	0.522
16	Pwani	0.506
17	Geita & Mwanza	0.505
18	Kagera	0.501
19	Kigoma	0.499
20	Lindi	0.490
20	Shinyanga & Simiyu	0.490
22	Mtwara	0.488
23	Dodoma	0.479
24	Katavi & Rukwa	0.467
25	Tabora	0.464

Annex 9

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• **PYMWYMIC IMPACT REPORT 2018,** Period: 1st January to 31st December, 2018	2018

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