Establishing demonstration sites and training of farm supervisors

A mission within the project:

Stonemeal, a better life for farmers and mine workers in Ethiopia.

Addis Abbeba, Rema, Holeta and Arsi Negele, Ethiopia

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META

Rockin Soils

Table of contents

About the Author

The expert on this mission is Mr. Rubén Borge Robles. Rubén has worked over ten years in studying and simplifying appropriate technology to create healthy local food and energy production systems and regenerate exhausted soils. He works with local communities in Europe, Africa and South America.

He gives farming families better access to information and skills to regenerate their farms, soils and communities. He combines techniques to increase the retention of water and nutrients and grow healthy plants. All the techniques are easily accessible to any producer in any country. His trainings include specific examples regarding the elaboration and use of compost, bio-fertilizers, and mineral additives based on local rock dust. He also coaches farming families to record and share their experiences within their own communities and build up local knowledge centers.

Summary of the results and recommendations

Ethiopian farming lands are decreasing in fertility, due to erosion and unbalanced fertilizer strategies; while farmers have limited access to information how to direct local resources as fertilizer inputs. Chemical fertilizer technologies are not affordable and/or not available to the average farmer and their environmental and socio-economic effects on the long term are questionable. The integration of local rock dust in the composting process of farm site offers an affordable powerful instrument to poor farmers to increase soil fertility, improve harvest quality and move one step further towards food security.

The primary goal of this mission is to train farmers and local extension workers in producing local rock dust enriched fertilizer. The training shows how to process locally available vegetable wastes and rock dust from mining wastes to produce high value organic fertilizers. The second goal is to train the trainers in developing demonstration fields where the produced rock dust fertilizer products can be tested in teff, wheat and sorghum systems, and be optimized during 4 cropping seasons.

A total of 60 participants from which (15 women, 25 farmers, 15 extension officers and 5 vocational school managers) in the locations Rema, Holeta and Solulta and Arsi Negele, participated actively in the training and workshops. With these skills each trained group will produce their own rock dust based fertilizer this season and test them on their demonstration plots, as well as train surrounding farmer communities, students.

Waste materials from farms and households are abundant and available at little or no cost. Especially women in rural areas are familiar with fermentation processes since they brew beer and honey-wine. These types of skills will facilitate the dissemination of these technologies, as they are also based on fermentation (production of bio-fertilizer liquid spray e.g.).

Chapter 1. Introduction and preparation of the mission

Background

80 million inhabitants make Ethiopia the second most populated country in Africa. With 83 percent of Ethiopians living in rural areas, agriculture is the main source of income in Ethiopia; both in terms of exports, employment and Gross Domestic Product (46% of GDP).

Despite the growth of agricultural production the last years, food security remains fragile. Reasons are the rain-fall dependent nature of agriculture, low fertility of farming soils, primarily being caused by a non-circular nutrient flows (cow dung being dried and sold at markets as fuel, crop residues being burned or fed to cows).

Methodology

The main objective of this mission is to establish five pilot projects to product, apply rock dust enriched bio-fertilizer in demonstration plots and monitor the results for 4 seasons. Based upon the preliminary results, a dissemination strategy will be developed. To achieve these objectives the following methodology is used:

Demonstration plots were selected on a basis of availability of infrastructure, capacity and motivation of local host organizations to initiate this project. The selected areas were: Rema, Holeta, Solulta, Ziway and Arsi Negele. Each host organization selected participants based on their background and capacity to test and disseminate the technology within their communities in later phases. The participants consisted basically of:

- Model farmers,
- Extension workers of NGO's,
- Local agricultural extension officers,
- Vocational schools directors.

Location	Host organization
Rema	Getaw Mekonnen mixed farm
Holetta and Solulta	Holeta Agricultural research center
Arsi Negele	ANCEDA, Vocational Training Centers
Ziway	SEDA and RCWDO

Table1. Host organizations and training locations

Participants who joined the training, where also selected by the local organizations as future demonstration plot managers. Also additional participants were invited based upon their potential to adopt and disseminate the technology. After this mission trainers and farmers are expected to implement the techniques in demonstration plots, monitor the developments and communicate actively the results obtained for a period of at least 3 seasons. MetaMeta signed a contract with each of the trained organization in which the mutual responsibility (including finances) for the project are outlined.

During the monitoring period, field visits will be organized to the experimental plots to disseminate the best practices to interested farmers and small and medium local businesses.

Mission Objectives

The primary goal of the mission was to train local NGO's, governmental extension workers and model farmers in producing fertilizer from local resources to restore the soil fertility and improve the nutrient supply to and of their crops. The training showed how to process locally available vegetable waste and mineral waste from mining wastes (rock dust) to produce the following high value organic fertilizers:

- Bocashi compost to improve soil conditions within one- to two years.
- Liquid bio fertilizer to feed the plants and increase production from the first season.
- Mineral solutions to raise the quality of the final product while protecting crop from insects and diseases.

A secondary objective of this mission is to gain general information about other agronomic (soil, water, climate and plant) and socio-economic factors that limit the plant production. The information gained is reported under de chapter 3: assessment of the composting situation of the area)

Chapter 2. Activities of the mission

Contents of the training

The intensive 5-day training on bio-based fertilizers combined theoretical and practical sessions. It aimed to show participants the mechanisms of nutrients cycles and how to influence them in order to restore the natural fertility of exhausted soils. The group discussions focused on soil fertility and preventive plant health techniques.

The practical sessions included specific examples regarding the elaboration and use of fertilizers and mineral additives based on natural local inputs that are easily accessible to all farmers. All measures pointed towards improving soil conditions like structure, texture, nutrient availability aeration, moisture retention and drainage. It was central in the training that a fertile soil system will support healthy and good crop production and will become the basis for sustainable incomes.

To build fertile soils farmers need to manage the water, minerals, air and the living organisms in and on the soil. The training gave basic techniques to manage these elements. Participants learned how to increase water retention, drainage, nourish the plants and work with the soil microorganisms. The different techniques will increase the crop production on their farms in the short term while improving the soil fertility on the long term. Participants acquired basic practical experience easy to transmit within their communities. Annex 1 outlines the programs as provided at the training sites. The specific description for each site is provided below.

Training site I. Rema. March, 13- 16

The training was held at Getaw's farm. The farm of 185 ha is a convex-shaped parcel situated at the top of a plateau. The farm is exposed to wind and sun and lacks from structures like trees or bushes to protect it from wind. The soil has been put into production five years ago and is still relatively new. The farms lays in an area sensitive to erosion (wind and water).

The land is leased from the government and can be used for farming activities as long as

certain -no specified- conservation measures[1] are taken. So far the agricultural practices are conventional and include the use of a disc plow to invert the land and the use of herbicide, UREA and DAP as fertilizers. Crop rests are partially burnt, especially those derived from sorghum, to facilitate the plowing. Plowing is done between March and April, just before the rain season. Plowing incorporates crop rests in the soil allowing decomposition, but leaving bare ground exposed to erosive elements: sun, wind and water. The topography of the farm makes water retention challenging. The farmers pay attention to plough along the contour lines in order to prevent erosion. Currently the farm produces sorghum, teff, soya and local legumes. Besides the crops the farm also feeds more than 20 cows. Most of the crop rests are used to feed the animals. The manure from the animals is spread to the land during the pasture during the day and accumulates in the beds where the animals are kept at night. The oxes are kept apart from the cows in a barn. The limiting factor for the animal production is the water. Not all straw is consumed by the animals. Some is burnt (especially from sorghum) and some is taken to the village to feed the animals for the households.

Regarding the maintenance of trees, dispersed trees - around and within the farm - are daily been chopped with no apparent plan and wood is constantly transported to the village to be used mostly for construction (housing) and to fuel the kitchens. Acacia trees have the ability to re-grow after been chopped, but young trees are chopped before becoming adults. A few trees remain untouched and reach their natural size. The reason to leave these trees untouched follows no apparent logic.

The farm manager is aware of the high costs of the chemical fertilizers and herbicides. He sees opportunities in the reuse of crop rests to produce compost since the crop rests are abundant and removed from the land. In this way he regards the project to produce low cost rock dust bio-fertilizer and compost as a good opportunity.

As the farm did not have the proper installation to allocate the bio-digester and the compost, a part of the barn was taken to accommodate both compost and bio-fertilizer. In the long term, more space will be created by extending the barn.

The soil is a *vertisoil* type composed mainly by expansive clay. The root system of the planned crops (teff, sorghum, and wheat) is mainly superficial and does not require deep plowing.

Basalt stone is common in the area though no nearby quarry site was identified that could supply rock dust. The basalt we found is highly weathered and its applicability as fertilizer is questionable. Taking these factors in consideration, we carried out the experiment using the crushed basalt rocks from Solulta's Quarry. This type of basalt is fine grained. The abundance of local basalt and the lack of local rock dust is an opportunity to bring a crusher to the area. If the demand is seasonal or not big enough, this device can be (a mobile unit) transported to meet demand almost at farm level. This will also avoid high transportation costs, due to the sometimes poor road quality.

Training site II, Holeta and Solulta March, 19-21

The theoretical part of this training site was at the head office of the woreda's in Holeta. The workshops were held at Getechu´s farm, situated next to the demonstration plots of the offices. Participants included model farmers and staff from Holeta FTC, staff of Oromiya Special Zone Department, but also staff of Solulta FTC participated in the training.

Straw from teff is much finer than straw from wheat. The mix of both materials when possible

[1] The observed common conservation measures are building terraces, ridging along contours and gully control works. Re-forestation and changes in land use are less common. These observations counts for all sites visited.

facilitates the gradual decomposition of the cellulose. Also due to the traditional way of separating the grain from the husk, a lot of husk is left with the straw. Since husk is rich in silica than the straw, this increases the content of Silica in the compost. This is a desired effect, especially when growing grasses, since silica provides structural strength to the plants.

Plowing is mainly done by using oxen. Tractors are not common in this area. The ox-plow does vertical plowing and does not invert the land. This practice does not incorporates the organic material, leaving it at the surface where is still can have beneficial functions as mulch and source of nutrients.

Close to the demonstration plots there are at least two quarries (one public, and one private) where pyroxene basalt is crushed, mainly to supply raw materials for road construction. During the process of crushing, and sieving basalt a cloud of dust is created that precipitates clay size sediments next to the installation, and often accumulate under the machines or following the direction of the dominant winds. At those places, still mixed with other stones of diverse sizes, rock dust can be easily collected. 2 hands full of basalt rock dust is approximately 1 kg.

All participants to the trainings have experience with different composting techniques. The most common technique is the anaerobic fermentation in a pit. This technique is widely disseminated by extension officers and by NGO's. This form of composting is however seldom used by the farmers, because of the high labor input it requires and secondly, because farmers report that they become sick after using that compost. Health risks related to composting processes are mainly associated with intoxication after inhalation of H_2S gas formed during the rotting process. Also the interest is there of Oromiya Special Zone Department to integrate the Bocashi Composting technique in their composting outreach program. MetaMeta will develop this program further and involve Rockin Soils in this.

Training site III, Arsi Negele March, 26-28

The city and district of Arsi Negele is 200 km south of Addis Ababa and so far away from the basalt platforms of the north, which having their southern border at Addis. The rock minerals are found in local quarries of which a total of 3 quarries were identified during the visit. The local available scoria is too soft for building roads. For this purpose a kind of hard volcanic rocks are brought and crushed at places near the road.

All participants to the trainings have experience with different composting techniques. The most common technique is the anaerobic fermentation in a pit. Although this formula is well known and widely accepted, again farmers do not practice this technique because the high labor intensity and the bad smell.

Anceda´s bio gas installation in Arsi Negele treats human and animal manure and produce biogas and a by-side product used as fertilizer. The production of fertilizer is well known and the cultural burdens to reuse human excreta in the food production chain seem not to play a role in this experience. The final product is solid dry grain that can be spread in the fields. The strong presence of Anceda in the field and their previous experience (technical as well as project management) with biogas plant could be the key to achieve results in the pilot and disseminate them fast in the region.

Several experiences in similar projects around Africa show an increasing demand for the process of bio-digestion. But the raise in the demand of gas is not as high as the demand for fertilizer. This would probably explain the high motivation and interest of the participants in this site.

Chapter 3. Results and findings of the mission

Results Achieved

General awareness:

- Know and recognizing the origin, function, elements and factors of a natural soil.
- Identifying the elements of a healthy soil
- Understanding the soil food web and nutrient retention (symbiosis relations, antagonisms and dependences)
- Gain awareness of the soil factors that affect plant nutrition.
- Finding local supplies and suppliers for the materials (rock dust, manure, etc.).
- Understanding of the relation insect/ fungal disease/plant

Specific skills:

- Know how to make Bocashi copost with rock dust
- Understand the effects of temperature in Bocashi and the need to control it daily.
- Know how to test the quality of good compost
- Use of Bocashi for seeding and transplanting operations
- Seed treatment with rock dust
- Know how to diagnose presence of coffee diseases.
- Know how to make bio-fertilizer with rock dust
- Self-sufficiency in mounting a bio-digester
- Preparation of ash solution and understanding the application and doses.
- Understanding soil management systems to increase nutrient and water retention and water recharge.

Other results

- Setting up the demonstration fields
- Demonstration fields have been marked and the procedures have been discussed with the farm manager (only in Rema).

About the products

Bocashi means fermented compost. It is produced through aerobic fermentation of diverse vegetable rests, forest earth and soil microorganisms in presence of minerals from rock dust. Bocashi is known for its capacity to regenerate exhausted soils. I adapted the receipt to integrate teff wastes and other farm waste. Making compost means sometimes conducting repetitive tasks. This allows building routines and making time for reflection: while making the products, participants were talking among them, discussing about the best way to proceed.

Bio fertilizer is a product that results from the anaerobic fermentation of fresh cow manure and minerals of the rock dust. During this process bacterium enzymes attack minerals from rock dust making them bio-available for the crops. Bio-digesters at the three sites showed bacterial activity within 24 hours. We analyzed the most common causes for failure in the process of producing bio-fertilizers.

Ash solution is a preparation that dissolves ash in water and makes minerals from the ash, available to plants. The composition of the ash depends on the original material used. Ash from wood is rich in K and Si. In Ethiopia it is common to use cow dung in the kitchen as fuel. The chemical composition of cow dung ashes vary from cow to cow and depend on the fodder and time of the year (it is related to the different development stages of the grasses along the season). The same account for the trees being used as source of wood for the fireplaces.

Soil management techniques facilitate the retention of nutrients and maintenance of the optimal soil moisture. After perceiving concerns from the organizations on water, soil moisture and erosion management, we decided to address this issue and discuss some strategies that increase moisture and nutrient retention in the soil.

Assessment of the composting situation in the area

Compostable materials from farms and households are abundant and available at little or no cost. Furthermore, many of these materials are currently not used, but disposed at different places where they can pollute air and water and lose its function as soil improver. This is often an environmental problem. Turning these wastes into soil food is an easy way to solve environmental problems (polluting water and air) and create valuable products for communities

Hereunder, I list some of the materials with good potential to be used for cost effective - low investment- soil fertility restoring programs in the rural areas of Ethiopia.

- Wood dust from sawmills (with no chemicals)
- Rock dust from quarries (like Holeta and crushing of locally available basalt rock dust.)
- Ashes from kitchens and fireplaces
- Charcoal dust form charcoal production places and /or kitchens
- Organic waste from the kitchen (only the vegetal fraction)
- Animal bones to recover phosphorus
- Crop rests such as teff, wheat, sorghum
- Cow dung, dried as well as fresh
- Milk or whey

- Coffee rests
- Bran / husk from wheat and teff
- Sugarcane rests
- Chopped weed from farms, roads, or gardens
- Rain water

Opportunities for farm nutrient recovery

Based on the local conditions different strategies might be adopted to increase the organic matter content of the soil. These conditions can be physical like the soil type, farm size, location, the access to machinery, the presence of cattle, chicken or other domestic animals, but also social, like the possibility to enroll in a farm cooperative, availability of labor, etc. Each condition will demand a different strategy and generate specific opportunities.

As an example: vegetable rests can be composted or used directly to mulch the soil. It is advised to use vegetable or porous biodegradable materials to mulch the soil, because it allows gas exchange between the root zone and the atmosphere.

Where vegetable rests are used for animal feed, there would be more manure to produce composts. And where animal compost is used as fuel, there would be more ashes to fertilize green manures.

Potential of local rocks to make fertilizer

It is possible for most of the pilots to access volcanic rock dust from quarries, especially for Holeta and Solulta, places where there are different quarries locates that crush basalt rocks.

Rema is a remote area. There is no basalt quarry located in the near surroundings, although basalt is a common rock there. Fortunately there is regular transport from the farm to Addis Ababa, and the route goes through Solulta where there is at least one quarry of basalt.

Another possibility for the farms in Rema is the crushing of the local available basalt. It might be meaningful to do some research around Rema to identify the types of basalt with higher mineral diversity.

For Arsi Negele, farmers will need to find their way to get volcanic rock dust. The rocks crushed at the 3 local quarries must be analyzed. Tuff is also locally available. This rock can easily be smashed by the farmers themselves. Proper identification (mapping) and analysis of these resources might be of good help to stimulate farmers. In the mission of November 2013 a small zeolite quarry, tested at Utrecht University, was identified in a place nearby.

Volcanic rocks, especially basalt, are generally good agro-minerals and very abundant in Ethiopia. This rock can be applied to compost, bio-fertilizer or directly spread around in the field at (1 to 2 ton per hectare per yea eq. to 100-200 gr/ m^2/year). Local rock dust is rich in macro, micro and trace elements. This makes rock dust a valuable nutrient resource for smallholder farmer soils, which were not fertilized during last decades.

Chapter 4 Conclusions

Participants at all workshops were positive, motivated, eager to learn and ready for implementation. The participative design of the training created space for interaction and reflection.

Bocashi, bio-fertilizers and the ash solution trainings were such designed to allow easy local fertilizer development to farmers in the most remote areas of developing countries. Still, finding the materials and ingredients requires time and finding suppliers can be challenging. However once the suppliers are identified, making these preparations is simple, cost effective and rewarding. In our case, we adapted locally available jerry cans to brew bio-fertilizer. We also adapted the formulas of Bocashi to produce food for soil and plants by reusing waste available at the farms. These techniques are easy to reproduce even in the most remote areas we operated.

Manage clay

All visited areas had clay soils (vertisoil type). Clay soil is good at retaining water, but is bad in draining it. During the rainy season there is big chance of having anaerobic conditions in the soil during the flowering period. Lack of air is an important stress factor that can limit plant production, especially when this stress happens at critical vegetative periods, like flowering. The continued use of organic soil amendments through the years like Bocashi would improve soil structure and end up in a better development of the crop roots that will ensure their natural supply for nutrients and water. This would be difficult to measure though the impact in other indirect parameters such as sickness and harvest can be important.

Composting is not new

Many farmers and trainers reported to be familiar with composting techniques, most of them are used to produce compost in a pit system. Pits are more labor intensive technologies because they require digging of a pit and extracting the compost form the pit is tedious work. Moreover, these systems lack ventilation and create anaerobic conditions. Under these conditions, fermentation of the compost often forms substances like *putrefacine* and *cadaverine,* both toxins for plants and animals and farmers too. During the field visit farmers reported to have almost abandoned the production of the compost in a pit because of the labor intensity and also because of the intense bad smell coming from the pit that, as the literary said: made them feel sick.

Women are key

Knowledge about brewing beer and honey-wine, as well as making other types of compost gives farmers a good basis to make a good Bocashi. Especially women in rural areas have the knowledge and skills to produce beer and bread, as also experienced during the workshops. They know the care needed for the fermentation processes and are capable to adopt this knowledge fast and effectively. They will play a key role in a further dissemination strategy.

Organisation

Preparing and applying organic fertilizer demands planning skills for two reasons. Firstly, each fertilizer has to be applied at the right crop phase and secondly, it takes one month to make the fertilizers. A crop calendar in hands of the farmers is a powerful tool that can help farmers to apply fertilizer at the right moment. The crop calendar can be a poster to remind farmers about making, and applying these new projects. It is agreed that at each site a crop calendar will be developed.

Nutrient & moisture retention

After the training most farmers agreed that land cover is key to retain nutrients and moisture. Green manures are commonly known, but they are not applied. Participants' reason for not growing green manures is lack of water. However, even a short rain season can allow the growth of a green manure to increase biomass and hence water holding capacity. We need to discuss in following phases the progress that has been done in introducing green manures in arid areas.

There is still a lot to win on improving water retention by regenerating land cover. Now, farmers are in a vicious spiral with dry soils discouraging farmers not to growth green manure, so further decreasing soils organic content, creating soils with even lower water holding capacity; and so on.

Chapter 5. General Recommendations

The recommendations are now in general and will in a further stage be prioritized per location. These are the general recommendations for all sites:

- Waste is food. After learning this logic farmers will develop ways to reuse all possible forms of waste around their homes/ farm.

- Become a researcher in your farm. Learn the techniques untill you master them, adapt them to your needs and create your own formulas.

- If possible, use basalt rock dust. Local rocks we used at the training will work wonders and is free of charge. Use rock dust in the compost, Bio-fertilizer, on seeds or on the bare ground. You can use up to 2 tons/ha without problems.

- Increase mulching and organic matter application at the farm. Think about beans to get food and fix nitrogen, if possible during the *soft raining season.*

- Instead of using herbicide to avoid competences, increase the plant density because shadow kills weed seedlings. If some weeds still grow, chop them to increase mulch and therefore, litter.

- Use variety of green manures, if possible indigenous legumes such as *(i.e. Crotolaria ochlroleuca G. (sunhemp), Mimosa invisa L.(Colla), Cassia obtusifolia L.(Sicklepod) Sesbania. Other common legumes are Sesbania Rostrata.*

- Superimpose bio-fertiliser or rock dust as fertilizer to increase land cover, infiltration, de-compaction, mulch, water retention and nutrient storage and control other weeds. Green manures increase organic matter, fix the nutrients, enables life and grows on site, avoiding need for transport and labor on fertilization.

- Plant trees to create shadow and wind. Suggestions are *Calliandra calothyrsus,* Acacia Mearnsii (wind can damage directly but also increase evaporation and erosion).

- In the long term, poly-cultures with animals and the use of animals like chicken to pasture the green manures, will disinfects the crops from larvae and insects, as well as fertilize the soil too, while also generating extra income.

- Combine always compost (bocashi) with biofertilizer. Bio-fertilizer will nourish the plant and act on the short term. Compost nourishes the soil and create the long term solution. Relying on bio-fertilizer alone is a labor intensive method that makes plant dependent of the farmer.

- Never use chemical fertilizers/ pesticides of any kind as they also kill what makes soils fertile.

- Share your experience with your fellow farmers/ female farmers. This will create value for all.

- Find and buy the proper barrels to make the bio fertilizer.

- Make a list of supplies and suppliers.

- Facilitate the supply of seed for green manures: Consult the nearest seed bank for the availability of forages. For consultancy on species, visit for example http://www.tropicalforages.info

- Support other initiatives like Oromiya Special Zone Department to integrate the Bocashi Composting technique in their composting outreach program. MetaMeta will will develop this program further and involve Rockin Soils in this.

- Encourage the local entrepreneurs to purchase a mobile unit stone crusher to get fine stuff to supply the increasing demand to be expected in the coming year. Transport of one or two machines will be more effective than transport of basalt material.

Chapter 6. Work plan for follow-up

Action plan/ Follow up

Phase 1. Producing their own inputs

During the training samples of all preparations were made at each site. To execute the demonstration, more products will be needed and this means that the farmers will have to collet ingredients themselves and produce the taught bio fertilizer products. Technical assistance during this phase is recommended. Next visit in June will pay attention to this issue.

Phase 2. Applying the products during growing season

Although the first training gave information over application doses, timing and other details, hand outs handed to the course participants give also information about the application. The visit in June will make more emphasis in application of the product and data collection during the growing and harvest season.

Phase 3. Evaluating results of the first season

After the first season, the data need to be analyzed and used to prepare the strategy and the action-plan for the second season. Communication with the people in the field is crucial to get the right data and context.

Annexes

1. Event Program
2. Participants
3. Comparative of bio-digesters

Annex 1. Event Program

At each site the following 3-day program is followed	
Consultant:	Rubén Borge (Rockin Soils)
Day 0	
	Preparation materials and visit the training site and the farm with the demonstration plots
Day 1	
Session 1. Theory	Introduction Regenerative Farming. Evolution of the soil. Soil biology. Feeding the soil.
Session 2 Practice	Bocashi compost elaboration. Uses of Bocashi.
Day2	
Session 3 Theory	Bio-re-mineralization and bio-fertilizers. Doses, applications and experiences.
Session 4 Practice	Bio-fertilizer Brewing.
Day3	
Session 5 Theory	Trophobiosis. Control of plagues and diseases.
Session 6 Practice	Elaboration of ash solutions
Session 7 Practice	Introduction to land management for water and nutrient retention. Wrap up

Annex 2. Participants

List of participants yet to be added. (input from Tegenu)

Figure 1: course participants in Rema

Figure 2: Preparing ash solution in Holeta

Annex 3. Analysis of the Bio-digester prototypes

The Prototype1 was installed at the three experimental sites. Due to difficulties that may arise to get the blue barrels chemical free, a second prototype is being tested in Addis Ababa. The table below gives a description of both digesters establishing their main differences.

	Description	**Advantages**	**Disadvantages**
Prototype 1	160 up to 200l blue barrel with black lid.	Cheap 450 birr (the barrel) available in Addis (Mercato)	Many of these barrels have been used to import chemicals. We observed paints, industrial ingredients and even pharmaceutical ingredients (antibiotics) These types of barrels are often reused to transport other chemicals. Often also reused to store water for domestic and often animal consumption. Availability only around Addis, in rural areas there is not enough supply of this device.
Prototype 2	25l Edible oil plastic jerry can	Easy to get even in remote areas. Cheap. 25-50 birr. Different sizes from 20 up to 40 liters capacity. Cheap 3 USD good sealing	Small opening valve system need to be mounted on the lid with risk of damage of lid losing air

Figure 3 Prototype 1

Figure 4: Prototype 2