Cultivation of improved banana varieties, in combination with mulching, trenches and organic compost in Uganda

Source: FAO Strategic Objective 5 – Resilience, in FAO

Keywords: Bananas, mulching, trenches, organic composting, improved varieties, Uganda, climate change, disaster risk reduction, dry spells

Country of first practice: Uganda

ID and publishing year: 8947 and 2017

Sustainable Development Goals: No poverty, climate action, and life on land

Summary

This technology describes a combination of good practices for soil and water conservation to enhance the resilience of banana plantations to increasing dry spells in the central cattle corridor of Uganda, as part of the Global Climate Change Alliance (GCCA) project on Agriculture Adaptation to Climate Change in Uganda. The combination of good practices include:

- mulching, a low cost practice that consists in covering the soil with locally available degradable plant materials to reduce water runoff and evapotranspiration as well as to improve soil quality;
- digging contour trenches for harvesting water during the rainy season while preserving soil quality;
- preparation and application of organic compost to improve soil fertility at low costs; and
- the introduction of high-yielding, resistant banana varieties.

This technology briefly introduces the concepts of mulching, trenches, organic compost and the introduction of high-yielding banana varieties and presents a cost-benefit analysis of the combination of the four good practices compared to usual practices.

Description

1. Step by step application of the technology

1.1 Banana cultivation

Bananas are among the major cultural food crops grown mainly in the southern, western and central Uganda and are becoming a major cash crop, mainly cultivated by smallholders.

Banana cultivation is done through propagation of suckers, and they generally flower between 8 to 16 months after sucker planting, and the first harvest matures three to four months later (farmers must therefore wait 11 to 20 months from planting suckers until the first harvest of banana fruit).

Bananas should preferably be planted at the beginning of the rainy season so that plants establish well before the onset of dry weather conditions. Banana can be spaced at 4.5 m x 3 m.
Bananas grow best under conditions in which relative humidity is greater than 60 percent and with an average annual rainfall of 1 500 to 2 500 mm, but due to the increasing dry spells and delays in rainy seasons in Uganda, the use of resistant varieties along with water conservation practices, such as application of mulch and dig of trenches along the plantation is helping to reduce the negative impacts on banana yields and rural livelihoods.

1.2 Mulching
Mulch is defined as any material applied to the soil surface as cover. Mulching is a low cost practice that consists in covering the soil with locally available degradable plant materials to help the soil-crop system to reduce water runoff and evapotranspiration, as well as for the mineralization of organic matter, while counteracting the nutrient loss.

1.2.1 Socio economic benefits of mulching
Mulching allow to:
- conserve soil moisture, and therefore reduce effects of rainfall variabilities and droughts;
- improve soil fertility and health;
- reduce direct raindrop impact and reduce soil erosion, for instance in case of intense rainfall;
- reduce runoff and helps water seep into the soil;
- slow water evaporation;
- prevent weeds from emerging;
- improve organic matter content and soil nutrient status;
- provide a beneficial environment for soil organisms, such as worms and millipedes, that are important for biological tillage; and
- regulate the temperature during warmer and colder seasons.

1.2.2 Costs
Usually, organic matters for mulching are available on the farm as they mostly consist in crop residues. Mulching therefore only involves some labor to cut and bring the crop residues on the soil, but in most cases no additional costs to buy the mulch itself.

1.2.3 Side effects
Organic mulches decompose over time, improving soil structure and quality, and returning nutrients to the soil. Increased amounts of organic matter will improve soil tilth and drainage, increase soil moisture retention, reduce soil compaction and attract earthworms. Because organic mulches decompose, they need to be replaced. Depending on the type of mulch used, replacement intervals vary from one to four years.

1.2.4 Major barriers
Organic mulching requires access to some crop residues, compost, grass, animal manure or leaves.

1.2.5 General recommendations
- The general recommendation is to have a mulching depth of 2 to 4 inches (5 to 10 cm).
- Mulch should be kept at a minimum of
20 cm away from the trunk of the plant. This space will allow for air circulation around the base of the plant and help avoid potential disease problems that can arise from excessive moisture against the trunk.

1.2.6 Synergies with other good practices
- Cover crops.
- Minimum tillage.
- Improved varieties.
- Organic fertilizers.

1.3 Trenches
Trenches are dug along the contours of the plantation, with the aim of harvesting water during the rainy season and by keeping it around the agricultural land, infiltration and soil moisture are enhanced. In addition, trenches slow down rainwater runoff and as a consequence soil moisture is improved and soil quality is preserved. This technique is particularly useful in areas where rainfall is sparse, and their applicability fits all kinds of soils and rain conditions.

1.3.1 Socio economic benefits of trenches
Trenches allow to:
- harvest water;
- prevents soil degradation and erosion, hence, preserving soil quality; and
- enhance surface water infiltration.

1.3.2 Costs
This technique only involves labor (depending on the soil conditions) to dig the trenches along the contours of the plantation, which could be the most expensive input, in addition to the cost of basic construction materials for digging the trenches.

1.3.3 Side effects
No side effects were identified regarding the use the trenches.

1.3.4 Major barriers
- It requires work from farmers to dig and maintain the trenches.
- Less land might be available for cultivation.

1.3.5 General recommendations
- Sediments should be removed from the trenches and reapplied to the field.

1.3.6 Synergies with other good practices
- Mulching.
- Cover crops.
- Minimum tillage.
- Improved varieties.
- Organic fertilizers.
- Agroforestry.

1.4 Organic composting
Compost is decomposed organic matter, such as crop residues and/or animal manure. Composting contributes to soil fertility and soil structure in the long term due to the increase of organic matter content of the soil.

Adding compost to sandy soils increases the water retention capacity. This means that water remains longer in the soil and thus remains available to plants for a longer time in periods of drought.

Compost is an organic fertilizer that can be made on the farm at very low cost, since most of its ingredients (natural materials of either plant or animal origin, including livestock manure, green manures, crop residues, household waste and woodland litter) can be easily found around the farm, being the farmer’s labor the most important input.

1.4.1 Socio economic benefits of organic composting
Continued use of organic fertilizers results in increased soil organic matter,
reduced erosion, better water infiltration and aeration, higher soil biological activity as the materials decompose in soil, and increased yields after the year of application. Crops with fertilizer application perform better (better yields) than the plots with inorganic fertilizers.

During production of compost manure, large amounts of vegetation such as crop remains, garden weeds, kitchen and household waste, hedge cuttings, and garbage are put to good use. Benefits include:

- when properly made, compost is immediately available as plant food;
- compost does not cause excessive weed growth;
- good crop yields can be obtained without the need for extra chemical inputs;
- all farmers regardless of their financial abilities, can make and use compost;
- compost manure can be used in all soils with low fertility;
- compost manure is especially good in areas that receive low rainfall. In such areas, artificial fertilizers cannot be used effectively because of limited moisture. In addition, compost will maintain soil moisture, which artificial fertilizers do not do;
- compost manure is also useful in sandy soils which have poor water holding capacity.

1.4.2 Costs

Compost is made by farmers or bought. They are usually available on or near the farm at very little or no cost other than labor costs of handling, transportation, or opportunity costs of land used for their production.

Estimating the cost of the technology can be difficult because most of the necessary resources are found within the farm. Labor for constructing compost pits is the most expensive input. Depending on the size, it can be estimated to be equivalent to one person working for a day. Collecting organic material and then applying the compost constitute the additional costs.

1.4.3 Side effects

No side effects were identified regarding the use organic fertilizers.

1.4.4 Major barriers

It requires work from farmers to create their own compost, prior to its application to the field. Organic composting limitations:

- Composting is labor intensive and requires a lot of organic materials. Some have to be gotten outside the farm;
- The outputs of using compost are not immediate, results appear only after some seasons.

1.4.5 General recommendations

- If the quantity of organic fertilizer is limited, it may be banded along furrows or spot applied, but the seed needs to be placed away from the fertilizer.
- The outputs of using compost are not immediate, results appear only after some seasons and it requires some labor. Farmers see immediate results with inorganic fertilizers, but these have adverse impacts at the difference of organic ones. The challenge is to teach farmers to be patient and consistently use compost for six years without switching if they don’t see immediate results.
1.4.6 Synergies with other good practices
• Improved varieties.
• Mulching.
• Minimum tillage.
• Cover crops.

1.5 Improved varieties
1.5.1 Synergies with other good practices
• Mulching.
• Trenches.
• Organic composting.
• Intercropping.

2. Benefits
All farmers but one said they would replicate the good practice in the coming seasons since it resulted in higher yields and positive impact on income and food security. One farmer said replication would depend on income levels. 85 percent of farmers found that the good practice brought higher banana yields, and about 70 percent of farmers said that their income has increased due to the good practice. On a 1 to 5 scale, farmers assigned a 4.4 score to the performance of this good practice in the face of dry spell.

One farmer noticed an increase in pests after the introduction of the good practice. All farmers stated that their knowledge of resilient practices has increased, and most of them recommended to conduct additional trainings on banana plantation management.

2.1 Cost-benefit analysis
Cost-benefit analyses were conducted based on quantitative data collected during the monitoring period in the 2016 dry season (Jun-Aug). Data collected from good practice plots were compared with data collected from control plots within the same farms, or from neighboring farms where the good practice had not been implemented yet.

The CBA calculates the cumulative net benefits obtained from 1 hectare of banana over a period of 11 years, as well as the benefit-cost ratio (BCR), which is the ratio between total discounted benefits and total discounted costs over the appraisal period. A 10 percent discount rate is applied to express the future value of costs and benefits in present terms.

Figure 2 provides an overview of the outcome of the CBA. In particular, it shows that:

• In farms affected by dry spell, the cumulative net benefits over 11 years from 1 hectare of banana where mulching, trenches, organic composting and high-yielding varieties were implemented are almost 10 times higher in farms that adopt the good practice package, as compared to non-adopters. The good practice requires additional labour and some farmers hired agricultural workers to help with plantation management activities. On the other hand, the overwhelming increase in yields due to the crops’ enhanced resistance to dry spells more than compensated the additional input cost.
• The benefit cost ratio (BCR) of the good practice is 2.16, as compared to 1.16 for the existing local practice.
• The low-cost, high-returns features of this good practice package make it very suitable for this agro-ecological zone of Uganda.

2.2 Added benefits
Added benefits under non-hazard conditions could not be analysed since all farms were affected by dry spell.

2.3 Avoided losses
In farms affected by dry spells, the good practice package brought net benefits about
10 times higher than that of the existing local practice. This was largely due to enhanced drought resilience.

Figure 2: Cumulative Net Benefits and Benefit Cost Ratios of Good Practice and Local Practice (USD per acre per year) 2016 Dry Season (Jun-Aug)

2.4 Co-benefits
According to farmers interviewed, soil quality has improved considerably since the implementation of the good practice.

3. Validation of the practice
3.1 Geographical area of practice validation
Sixteen farms in Kiboga (5), Mubende (2) and Sembabule (9) districts in the central cattle corridor of Uganda.

3.2 Context of implementation
3.2.1 Environmental and climatic (period/season) context
During the 2016 dry season, comprehending the months of June, July and August, the performance of this good practice package was monitored in 16 farms in Kiboga (5), Mubende (2) and Sembabule (9) districts.

All the farms were affected by dry spell during the monitoring period. In particular, rainfall was between 50 to 100 percent below normal in August, and land surface temperatures were 3 to 7 °C above average, causing a reduction in water availability. The results of the qualitative and quantitative analyses conducted based on field demonstration data are summarized hereafter.

3.2.2 Economic (Livelihood strategy) and Social (target group) context
Banana producers of the central cattle corridor of Uganda.

4. Necessary basic conditions for a successful implementation
• Bananas should preferably be planted at the beginning of the rainy season so that plants establish well before the onset of dry weather conditions.
• Banana can be spaced at 4.5 m x 3 m.
• Constrains (limiting factors) for the implementation of the technology
• The implementation of the good practice implies high capital and running costs.
• The good practice requires additional labor and capital costs (i.e. purchase of improved varieties of banana suckers and materials for digging trenches).
• Time: farmers will have to wait almost two years to have the first harvest of bananas.

5. Further reading

6. Agro-ecological zones
• Tropics, warm