Introduction of early maturing cassava varieties in Bolivia, a cost benefit analysis

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Country of first practice
Bolivia (Plurinational State of)

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Life on land

Summary
This technology describes the introduction of early maturing purple cassava varieties in the Bolivian eco-region of the Beni river watershed. In this area, farmers are used to cultivate white cassava, which has a growing cycle of more than 90 days. Given the long growing period, traditional white cassava often cannot be harvested before the start of the flooding season, leading to significant production losses.

Early maturing cassava can be harvested before local cassava varieties, thereby reducing the vulnerability of farmers to floods. Furthermore, early maturing purple cassava is considered more valuable than white cassava because it is an ingredient commonly used in local dishes; therefore, it can be sold at higher prices in local markets.

In 2015, the performance of this disaster risk reduction (DRR) good practice was monitored in six farms in Rurrenabaque’s communities of Puerto Yumani (5) and Bajo Colorado (1).

This technology briefly introduces the concept of early maturing cassava and presents a cost-benefit analysis of the practice compared to normal practices for cassava production.

Description

1. Description (step by step) of the application of the technology/practice

This technology describes the introduction of early maturing purple cassava varieties in the Bolivian eco-region of the Beni river watershed. In this area, farmers are used to cultivating white cassava, which has a growing cycle of more than 90 days. Given the long growing period, traditional white cassava often cannot be harvested before the start of the flooding season, leading to significant production losses.

Early maturing cassava (Manihot esculenta Crantz) can be harvested before local cassava varieties, thereby reducing the vulnerability of farmers to floods. Furthermore, early maturing purple cassava is considered more valuable than white cassava because it is an ingredient commonly used in local dishes; therefore, it can be sold at higher prices in local markets.

Growing early maturing purple cassava is considered a disaster risk reduction (DRR) practice because it addresses harvest losses due to floods. In 2015, the performance of this DRR good practice was monitored in six farms in Rurrenabaque’s communities.
of Puerto Yumani (5) and Bajo Colorado (1). This technology briefly introduces the concept of early maturing cassava and presents a cost-benefit analysis of the practice compared to normal practices for cassava production.

1.1 Early maturing cassava varieties

Cassava (Manihot esculenta Crantz) thanks to its efficient use of water and soil nutrients, and tolerance to drought and sporadic pest attacks, can produce reasonable yields, using few if any inputs, in areas with poor soils and unpredictable rainfall. Despite its tolerance to drought, increased intensity and frequency of droughts and floods seriously affects cassava cultivation. As cassava is almost exclusively a rainfed crop, in areas with only one rainy season per year, farmers usually plant white cassava as soon as the rains start so the plants have adequate soil moisture during the most critical part of their growth cycle, for instance any delay on the planting could lead to drastic yield reductions. Stakes should be planted at a shallow depth of 5 to 10 cm, in heavy and wet soils. In light-textured and dry soils stakes should be planted slightly deeper to avoid surface heat and lack of moisture.

In Bolivia, planting of white cassava in April and May, for example at the beginning of the dry season, coincides with the high possibility of drought occurrences, making planting and growing difficult. On the other hand, the thickening of the roots which takes more than three months then coincides with the flood season, causing the rotting of the root. In the case of the purple early maturing variety, farmers plant as soon as the dry season starts, in order to be harvested right before the rainy season starts, so the roots do not rot.

With the aim of reducing the risk of loss of production due to drought and flood, as well as to guarantee the production of this basic crop, it is recommended to cultivate an early maturing cassava variety (purple cassava Manihot esculenta Crantz), which is not as vulnerable as the white cassava to low soil moisture, hence can be planted during the dry season, during the months of April to July and in some cases August (taking advantage of the cold fronts that come up from the Patagonia usually in July and August), and can be harvested after 90 days (during the months of July to October, depending on the months the purple cassava was planted), at which point the cassava reaches a thickness suitable for the household consumption, and up to 120 days, to allow the thickening of the roots, when the cassava is to be commercialized.

![Figure 1. Early maturing cassava production](image)

The Purple Cassava variety (Manihot esculenta Crantz) has a soft texture and brown periderm colour, the bark is purple and the pulp is white with some purple spots, its leaves are purple and its roots are short and conical in shape. At early stages of its maturing process (90 days) it becomes suitable for consumption. This variety renders good yields; 18 to 25 tonne per ha, making it an effective alternative to guarantee food
security for the populations living at the river banks of Bolivia’s lowlands.

1.1.1 Socio-economic benefits of early maturing cassava varieties
- Early maturing cassava variety (*Manihot esculenta Crantz*) helped in reducing the negative impact caused by unexpected floods.
- Early maturing cassava varieties brought an increase in production due to higher yields, allowing to commercialize part of the production while guaranteeing food security during the flood season.
- Early maturing purple cassava is considered more valuable than white cassava because it is an ingredient commonly used in local dishes; therefore, it can be sold at higher prices in local markets.
- This variety of cassava can be processed into chivé, a typical, highly nutritive beverage which can be stored for longer periods, as cassava after two or three days of harvest is not any longer fresh, becoming woody.

1.1.2 Prices
Farmers do not use fertilizers nor pesticides for the production of cassava (both white and purple) in the analysed communities.

The prices mentioned in this practice refer to the time of writing.

1.1.3 Side effects
No side effects were identified.

1.1.4 Major barriers
No barriers were identified.

1.1.5 General recommendations
- Although cassava can withstand periods of drought, it is very sensitive to soil water deficit. Water stress at any time in the early period reduces significantly the growth of roots and shoots, and impairs subsequent development of the storage roots.

Table 1. Planting, maturing and harvest of early maturing cassava (*Manihot esculenta Crantz*)

<table>
<thead>
<tr>
<th>Month</th>
<th>Planting, maturing and harvest of Early Maturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td></td>
</tr>
<tr>
<td>February</td>
<td></td>
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<tr>
<td>March</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td><img src="image1" alt="Planting" />, <img src="image2" alt="Maturing" />, <img src="image3" alt="Harvest" /></td>
</tr>
<tr>
<td>May</td>
<td><img src="image1" alt="Planting" />, <img src="image2" alt="Maturing" /></td>
</tr>
<tr>
<td>June</td>
<td><img src="image1" alt="Planting" />, <img src="image2" alt="Maturing" />, <img src="image3" alt="Harvest" /></td>
</tr>
<tr>
<td>July</td>
<td><img src="image1" alt="Planting" />, <img src="image2" alt="Maturing" /></td>
</tr>
<tr>
<td>August</td>
<td><img src="image1" alt="Planting" />, <img src="image2" alt="Maturing" /></td>
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<tr>
<td>September</td>
<td><img src="image1" alt="Planting" />, <img src="image2" alt="Maturing" /></td>
</tr>
<tr>
<td>October</td>
<td><img src="image1" alt="Planting" />, <img src="image2" alt="Maturing" /></td>
</tr>
<tr>
<td>November</td>
<td><img src="image1" alt="Planting" /></td>
</tr>
<tr>
<td>December</td>
<td><img src="image1" alt="Planting" /></td>
</tr>
</tbody>
</table>

Source: FAO 2017
Cassavas grow better in well-drained soil, for which digging trenches along the plantation could contribute to this aim.

Cassava growers should be encouraged to adopt minimum tillage and, ideally, zero tillage, especially on well-aggregated, friable soils with adequate levels of organic matter. Even if this conservation tillage produces lower yields, it offers farmers economic advantages: reduced spending on the fuel and equipment needed for conventional tillage, and the opportunity to produce cassava more intensively and sustainably, without the need for high levels of external inputs.

Reduced or zero tillage will also be important as an alternative to conventional tillage in cassava-growing areas affected by climate change. Where rainfall is reduced, this practice will help to conserve soil moisture; where rainfall increases, it will help reduce soil erosion and improve soil structure, allowing better internal drainage.

Along with reduced or zero tillage, it is recommended to maintain a protective organic cover on the soil, using crop residues and mulches, in order to protect the surface, reduce runoff and erosion, and suppress weeds.

Mulch cover also serves as an insulating layer that reduces diurnal temperature variations and water evaporation. It increases the soil organic matter content and provides a favorable environment for soil micro-organisms and below-ground fauna. By creating better physical soil conditions - reduced soil temperatures, higher levels of moisture, increased water infiltration capacity and lower evaporation - mulching favors higher yields.

It is encouraged to cultivate a wider range of plant species in associations, sequences and rotations with cassava that may include trees, shrubs and pastures. Mixed cropping diversifies production, which helps farmers to reduce their economic risk, respond to changes in market demand and adapt to external shocks, including climate change. Rotating or associating nutrient-demanding crops with soil-enriching legumes, and shallow-rooting crops with deep-rooting ones, maintains soil fertility and crop productivity and interrupts the transmission of crop-specific pests and diseases.

### 1.1.6 Synergies with other good practices

- Agroforestry Coffee cultivation in combination with mulching, trenches and organic composting in Uganda.
- Banana cultivation with mulching, digging of trenches for water retention, organic composting and improved varieties, Uganda.
- Mulching in Organic Agriculture.

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Table 2: Early and maturing cassava prices per kg

<table>
<thead>
<tr>
<th></th>
<th>Max (Bs/kg)</th>
<th>Min (Bs/kg)</th>
<th>AVG (Bs/kg)</th>
<th>AVG (USD/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early maturing cassava (purple cassava) - Bs/kg</td>
<td>20</td>
<td>40</td>
<td>30</td>
<td>4.34</td>
</tr>
<tr>
<td>Traditional cassava (white cassava) - Bs/kg</td>
<td></td>
<td></td>
<td>10</td>
<td>1.45</td>
</tr>
</tbody>
</table>

Source: FAO 2017
2. Benefits

2.1 Cost-benefit analysis

Cost-Benefit Analyses were conducted based on quantitative data collected during the monitoring period (July-October) in 2015. Data collected from plots where the early maturing purple cassava was grown were compared with data collected from control plots within the same farms, or from neighbouring farms where the good practice had not been implemented yet and where the commonly grown white cassava was cultivated.

The CBA calculates the cumulative net benefits obtained from 1 hectare of cassava 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.

2.1.1 An overview of the outcome of the CBA (Figure 2)

- Cumulative net benefits in farms where a mix of early maturing purple cassava and traditional white cassava was planted are about 188 percent higher than the benefits of farms where only traditional white cassava was planted. The good practice and the local practice were monitored under non-hazard conditions; therefore, the differences are largely attributable to the higher yields obtained from early maturing varieties, combined with higher prices driven by the high demand of purple cassava in local markets.
- The BCR of the good practice is 32, as compared to 11.8 for the usual practice. Such high BCR values for both white and purple cassava are due to the low costs of inputs (e.g. no fertilizer nor pesticides are used, and no external workers are hired for cassava cultivation in the monitored farms). The large difference between the BCR of purple and white cassava is mainly due to differences in yields and prices.

2.2 Added benefits

Under non-hazard conditions, the data reveals that the DRR good practice (cultivating early maturing purple cassava) brings benefits almost three times higher than the local practice. This makes it a “no-regret” DRR measure.

2.3 Avoided losses

The hazard scenario could not be analysed yet, as no farms were affected by hazards during the monitored period.

2.4 Co-benefits

Early harvesting reduces the cassava growing period, thereby requiring a lower amount of inputs. Additional research is needed to analyse the impact of these co-benefits on the environment.

Figure 2. Benefit and Benefit Cost Ratios of DRR Good Practice (cultivating early maturing purple cassava) and Existing Local Practice (local white cassava)

Source: FAO 2017
3. Validation of the practice

3.1 Geographical area of practice validation
In 2015, the performance of early maturing purple cassava was monitored in six farms in Rurrenabaque’s communities of Puerto Yumani (5) and Bajo Colorado (1).

3.2 Context of implementation
3.2.1 Environmental and climatic (period/season) context
The Mamore and Beni rivers watersheds are located in the lowlands of the southwestern Amazon Basin. Abundant rainfall characterizes this eco-region, with an average comprised between 1 300 mm and 2 000 mm per year.

During the rainy season between December and May, the rivers usually flood covering a large part of the surrounding land. Contrary to expectations, however, no floods occurred in the area during the monitoring period. Therefore, the performance of the good practice (growing early maturing purple cassava instead of white cassava) was assessed under non-hazard conditions only.

3.2.2 Economic (livelihood strategy) and Social (target group) context
Farmers of the Mamore and Beni rivers watersheds lowlands of Bolivia’s southwestern amazon basin.

4. Minimum requirements for the successful implementation of the practice
Following indications should be observed for good yields of purple cassava:

• Stakes should be planted at a shallow depth, of 5 to 10 cm, in heavy and wet soils, but slightly deeper in light-textured and dry soils to avoid surface heat and lack of moisture.
• Planting of purple cassava at the beginning of the dry season, from April to July and not later than August.
• The cassava should be grown under direct sunlight and no shades, as it is highly sensitive to shade.
• Ensure proper draining.

4.1 Constrains (limiting factors) for the implementation of the technology
The difference in the price of seeds for the early maturing cassava (USD 4.34 kg) and the traditional white cassava (USD 1.45 kg), may affect the initial introduction of the early maturing cassava, when farmers are still not aware of the benefits of growing the early maturing cassava variety.

5. Further reading
• FAO. (2016) Save and Grow: Cassava. URL

6. Agro-ecological zones
• Tropics, warm

7. Objectives fulfilled by the project
7.1 Resource use efficiency
This technology, through inefficient use of water and soil nutrients, and tolerance to drought and sporadic pest attacks, can produce reasonable yields, using few inputs, in areas with poor soils and unpredictable rainfall.

7.2 Pro-poor technology
This technology reduces the vulnerability of farmers to floods, therefore increasing yields and providing more food security.