Targeting cassava processing research for development investments to upgrade cassava value chains in Tanzania

Bachwenkizi, B\textsuperscript{1}; Rusike, J\textsuperscript{1}; Abass, A\textsuperscript{1}; Mlingi, N\textsuperscript{1}; Towo, E\textsuperscript{2}; Meghji, W\textsuperscript{2}; Malimi, K\textsuperscript{2}

1. International Institute of Tropical Agriculture (IITA), Carolyn House, 26 Dingwall Road, Croydon CRE 3EE, UK

2. Tanzania Food and Nutrition Centre, P.O Box 977, Dar es Salaam, Tanzania

Abstract:
There is empirical evidence that traditional cassava processing is labor intensive, high cost and supplies low quality products. This is a binding constraint on adoption of improved varieties and crop management practices and large-scale impact of cassava research investments. This paper uses econometric analysis with survey data collected in the coastal areas of Tanzania in 2011 to develop a typology of actors of cassava processing and marketing sub sector, identify factors affecting profitability and areas for prioritizing cassava research for development investments. The study finds that the actors of cassava processing and marketing sub sector vary with the scale of operation from hand-manual methods, through buying and selling, to partially mechanized to fully mechanized. Research investments need to target simple general purpose processing and drying technology and linking to markets for traditional processors; time saving processing technology to enable traders traders to have consistent supply of good quality of products to the consumers and reliable market for traders; drying technologies, reliable market, infrastructure, water supply and availability of fresh cassava for partially mechanized processors

Keywords: Cassava, quantile regression, traditional processors, partially mechanized processors, fully mechanized processors.
Introduction

Cassava production and supply in Tanzania is dominated by small scale producers and processors. These are characterized by hand-processing low technology, lack of economies of scale, high product losses, poor quality of products, informal trade and low competitiveness to supply end-markets that requires timely supply of adequate volume of consistent quality of raw materials. These characteristics have contributed to poor performance of cassava supply system in Tanzania (Kapinga et al., 1996).

There is growing evidence that in order to improve the performance of the supply system to meet rapidly growing demand for food by urban household and raw materials for production of livestock and industrial products, mechanized cassava processing is needed. Mechanized cassava processing is important. This is because it adds value to cassava farm produces; increases labour efficiency; and improves performance (Hahn, 1989). This is because mechanized processing enhances the shelf life of the products, reduce transportation costs, improve market opportunities and upgrade nutrition. The government of Tanzania is placing emphasis on agriculture policy interventions that targeting blending of cassava flour with maize.

There is a debate in the literature of whether introducing small scale, medium scale and large scale cassava processing technology is appropriate to improve the performance of the supply system. Oyebanji et al. (2003) reported that, the vast majority of cassava roots are processed at the village level by a variety of small-scale methods into many different product that cater for local customs and preferences. Consequently, large scale assembly that is able to process roots quickly is not feasible. Medium and large scale processing plants are forced to operate seasonally and at low capacity.

Similarly, a study by Westby (2008) of cassava utilization, storage and small scale cassava processing revealed that producing gari on a large scale have not always been successful because of problems of raw material supply and producing a product that is competitive with that produced at small enterprise level.

In contrast, IFAD and FAO (2004) indicated that large scale would have the capacity for large tonnage processing with wider market opportunities. A number of studies have analyzed cassava processing technologies (see, among others, Kambewa, 2010; FAO, 2005; COSCA, 1996; Hahn, 1989; Mlingi, 1995) few studies have explicitly investigated whether the introduction of small scale, medium scale, and large scale cassava processing can improve the performance of supply system in Tanzania.

This paper addresses whether introduction of mechanized cassava processing can add value at a cost that is less than benefit or at a benefit that is less than cost. The objectives of this paper are to develop the typology of cassava processing and marketing business, to identify factors affecting the profitability and to identify areas for prioritizing cassava research for development investments.
The next section discusses the conceptual framework, hypothesis and data collection methods. This is followed by descriptive analysis of data, estimation of the results and discussion. The final section summarizes the study finding and presents the conclusion.

**Conceptual framework**

The conceptual framework used in this study for analyzing the targeting of cassava processing research for development investments to upgrade cassava value chain in Tanzania draws from the literature on agribusiness and value chain development in developing countries (UNIDO, 2011; Ponte, 2011; Haggblade, 2010). The literature conceptualizes value chain as the full range of activities required to bring a product or service from conception, through the different phases of production. This involves a combination of physical transformation and the input of various producer services, delivery to final consumers and final disposal after use (Kaplinsky and Morris, 2001).

Haggblade (2010) has developed a framework for analyzing cassava value chains in sub-Saharan Africa countries. This framework conceptualizes that the value chain are organized into 5 channels (Figure 1). Channel 1 consists of subsistence production and consumption; channel 2 consists of marketed fresh cassava for human consumption; channel 3 deals with processed cassava for human consumption (chips); channel 4 consists of livestock feed; and channel 5 is for industrial uses (flour, starch, sweeteners and ethanol). Several studies of cassava value chain in Tanzania have found that three channels dominate the system: subsistence production and consumption; sale of cassava as a fresh product in local and long distance markets; and sale of cassava as a dried product in local and long distance markets. (Mlingi et al., 1995; Kapenga et al., 1996; Mkamilo and Jeremiah, 2005; Kilimo trust, 2007; Mpagalile et al., 2008; and Mnenwa, 2009).

The literature argues that value chain can be upgraded through product upgrading, process upgrading, functional upgrading and inter-sectoral upgrading (Ponte, 2011). Product upgrading involves moving into more sophisticated products with increased unit value or that match more exacting product standards. Process upgrading is achieving a better transformation of inputs into outputs through reorganization of productive activities, or from improving standards in quality management, environmental impact and the social conditions of production. Functional upgrading consists of acquiring new functions that increase the skill content of activities and improve profitability. By contrast inter-sectoral upgrading is applying competences acquired in one function of a chain and using them in a different sector. The upgrading improves the efficiency of the value chain in 5 ways: quality of the product; consistency of supply; reliability; volume of supply; and price cost competitiveness versus improved substitutes, for example wheat or maize flour. Ponte (2011) argues that past upgrading of cassava value chains in Zambia have focused on new products, processing systems and market development at local scale. However the key processing activities were storage for raw fresh cassava roots; and peeling, chipping, soaking, fermenting, drying, milling into flour, granulated roasted cassava, livestock feed and industrial starches.

Studies show that in Tanzania the development of cassava value chain is lagging behind that of Zambia. Processors use mostly manual methods. These are characterized by low technology,
poor quality of products and lack of capacity to consistently supply produces in large volume. Mkamilo and Jeremiah (2005) argue that improved cassava processing techniques and utilization in the country such as use of motorized graters, mechanical press and mills have significant opportunities to upgrade the value chain. But the opportunities and constraints for wide spread adoption at a large scale have not been assessed.

Figure 1: Zambia Cassava value chain

Source: Haggblade (2010)
Hypothesis and empirical approach

The study tests three hypothesis that flow from the conceptual framework.

1. The first hypothesis is that subsistence farmers producing cassava for household consumption and cassava processors can exploit the opportunities of upgrading the economies of scale if they shift to long distance trade to partially mechanize.

2. The second hypothesis is that profitability increase by shifting the channels of the cassava value chain from subsistence production and consumption, through trading to partially mechanized processing.

3. The third hypothesis is that the binding constraints for traditional processors are time consuming, drying problem, lack of market and lack of processing technology; for traders are time consuming and lack of market; and for partially mechanized processors are drying problem, lack of market lack of processing technology, transportation problem, lack of water and availability of fresh cassava;

Methods

The first hypothesis is tested by quantile regression. The regress was specified using logarithm of output as the dependent variable. We transform it to logarithm because of making the relationship between variables more linear. The explanatory variables were age of the respondents, years of school, years of experience, distance from the processing plant to local shopping center, dummy traditional processors, and dummy partially mechanized processors.

The second hypothesis is tested by a quantile regression. The dependent variable was specified using logarithm of gross margin. We also transform it to logarithm so as to make the relationship between variables more linear. The explanatory variables were age of the respondents, years of school, years of experience, distance from the processing plant to local shopping center, and dummy traditional processors; dummy partially mechanized processors.

The third hypothesis is tested by tallying the frequency of responses of the sample households and processors to question asking them their perception of major cassava processing constraints.

Data

The study uses both primary and secondary data. Primary data were collected by a survey of farm households and cassava processors in Coast Region and Masasi district. Data were collected from the respondents using a pre-tested questionnaire. A random sampling approach was employed in selection of cassava processors and farm household respondents. Thirty four cassava processing enterprises and ninety one household respondents were selected. A total of 125 respondents were randomly selected and interviewed. However, due to data constraints (i.e., missing information), only data from 117 respondents are used in the analysis. Thirty one are cassava processors and eighty six are farm households.

The data were collected from March to April 2011. The survey collected data on organizational characteristics, participation in cassava processing development projects, employment of labour,
revenue and operation schedule, enterprise assets, cassava processing constraints and recommendations.

Results and Discussion

Characteristics of actors in the processing and marketing sub-sectors

The survey data were used to construct a typology of actors in the processing and marketing sub-sectors. The typology was based on the type of processing technology, the average yield of 7.5MT/ha, 0.5ha/household and 30% of their produced cassava is processed and sold. The typology consists of 3 types of actors (Figure 2). The first group consists of traditional processors. These are mostly households growing cassava primarily for their own consumption and processing marketable surpluses into dried cassava. They use manual methods. They use sun drying to produce products such as makopa and dried chips. Most of them operate at below 1.13 ton per annum. The second group is composed of traders. This group buys dried cassava from farmers, bulk, store, transport and then sells to retailers or consumers mostly in urban markets. They also operate at below 1.13 ton per year, this is because they buy cassava at the rural market where farmers produces cassava mainly for household consumption. The third group consists of partially mechanized units. These processors use some components of the package such as chippers, graters and pressers, graters, pressers and milling machines. In some cases partially mechanized processors access machinery services on hire basis as they do not own machines per year. The annual output of partially mechanized processors ranges from 1.13 to 11 ton. The results show that most of them operate at below 1.13. This is because they use cassava produced from their own farms with the average ha of 0.5. Two of the processors in this group processed more than 30MT/year. This is due to the fact that in addition to their own produced cassava, they bought cassava from other farmers for processing.
Opportunities to upgrade cassava value chain

This section tests the hypothesis that subsistence farmers producing cassava for household consumption and cassava processors can exploit the opportunities of upgrading the economies of scale if they shift to long distance trade to partially mechanize. To test this hypothesis a quantile regression was estimated. The results are reported in figure 3&4. The results in figure 3 indicate that the level of output is negatively low at lower quantile and positively high at the higher quantile as our priori expectations. The quantile regression results (Figure 4) indicate that the effect of traditional technology has low impact at lower quantile of logarithm of output. This may be due to the fact that traditional methods involve a combination of activities and number of steps which are performed manually to generate a wide range of product intermediate. This results into producing low volume and poor quality of products. However the results show that the effect of partially mechanized technology is high on lower and higher quantiles of logarithm of output. This suggests that partially mechanized technology is the key driver in shifting the scale of economies from traditional processors through trading to superior partially mechanized.
Figure 3: Quantile of the output level
Figure 5: Quantile of the profitability of cassava processors
poor quality of products which fails to attract higher income urban consumers and lack of processing technology. Similarly, traders reported time consuming as they rely in supplies of poor products produced by traditional processors and lack of market. Finally, partially mechanized processors reported drying problem during rain seasons, lack of market to sell their products, lack of processing technology, transportation problem from the farm to the processing plant and to the market, lack of water and availability of fresh cassava.

Table 1: Cassava processing constraints

<table>
<thead>
<tr>
<th>Constraints</th>
<th>Traditional processors n= 69</th>
<th>Traders n=13</th>
<th>Partial mechanized n=30</th>
<th>Total n=112</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time consuming</td>
<td>39.1</td>
<td>76.9</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>Drying problem</td>
<td>29</td>
<td>0</td>
<td>33.3</td>
<td>26.8</td>
</tr>
<tr>
<td>Lack of market</td>
<td>17.4</td>
<td>23.1</td>
<td>20</td>
<td>18.8</td>
</tr>
<tr>
<td>Lack of processing technologies</td>
<td>14.5</td>
<td>0</td>
<td>3.3</td>
<td>9.8</td>
</tr>
<tr>
<td>Transportation problem</td>
<td>0</td>
<td>0</td>
<td>16.7</td>
<td>4.5</td>
</tr>
<tr>
<td>Lack of water</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>5.4</td>
</tr>
<tr>
<td>Availability of fresh cassava</td>
<td>0</td>
<td>0</td>
<td>6.7</td>
<td>1.8</td>
</tr>
</tbody>
</table>

**Conclusions and recommendations**

Based on the analysis the study recommends that interventions to resolve the constraints and enable/permit households and processors to exploit the upgrading opportunities are targeted at introducing time and labor saving processing and drying technologies, and linking to market for traditional processors; time saving processing technologies to enable traders to have consistent supply of good quality of products to the consumers and reliable market for traders; drying technologies, reliable market, infrastructure, water supply and availability of fresh cassava for partially mechanized processors.
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