Ariadne’s Thread
Navigating crop choices in Tanzania’s Lake Zone and their implications for cotton

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Catalyst for SME and Farmer Development

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The Cotton and Textile Development Programme (CTDP) is a project initiated by the Tanzania Gatsby Trust (TGT), and is funded by the Gatsby Charitable Foundation and the Department for International Development (DFID). The Programme is implemented in cooperation with the Tanzania Cotton Board, and with a number of other partner institutions. These include the Competitive African Cotton Initiative, Ukiriguru Research Institute and the Conservation Agriculture Regional Programme.

The overall objective of the Programme is to improve the cotton value chain, allowing cotton farmers and other actors in the chain to improve their productivity, production, incomes and livelihoods. In the past number of years, the Programme has worked on the assumption that cotton was, is and for the coming years will be an important crop both for farmers and the industry. Cotton is seen as an important cash crop as it allows farmers to generate cash revenue, and adds considerably to regional incomes from the economic multiplier effect of farmers’ earnings and through the benefits of jobs created in the cotton industry in the production regions and the country as a whole.

However, anecdotal evidence and available statistics show that cotton as a crop is not always as successful as expected. Unofficial data from FAO suggest that since 2008, the total production of cotton in Tanzania has stagnated or even declined in some years.

One important reason for this is the choice farmers have to make each year on how to apply their resources for the next planting season. This determines the amount of money and other resources that farmers invest in cotton (acreage to plant and amount to invest in inputs including their labour). It also determines at the aggregate level the production of cotton in the country and thus the success of the sub-sector in national economic development, exports and growth.

Whether farmer choose to grow cotton is affected by a range of variables. These include the opportunities presented by alternative income sources from competing crops or non-agricultural activities, the relative terms of trade between cotton and other crops, especially food crops that need to be purchased, alongside potential expenditure savings from food crop production. Additional variables are the relative risks associated with the various crops in terms of environmental conditions, market developments, and other threats. And non-economic reasons for crop choices may also apply, such as the cultural attachment many farmers express towards a certain crop.

Information on driving forces of crop choice will clearly be helpful to the Programme to address factors that could lead to reduced interest in cotton and its associated reduction of total production, or to support farmers in increasing the area under and productivity in cotton, to achieve Programme goals and objectives and those of the farmers.

This study has sought to investigate and analyse the range of options available to farmers in the Lake Zone of North-Western Tanzania as alternative income sources, and to develop baseline data for these alternative crops. It attempts to understand the driving forces of crop choice.

The study has collected data on these issues in two main ways - through a large-scale survey of farmers in the Lake Zone of North-Western Tanzania (a total of 1534 respondents were interviewed and included in the database), and secondly through a substantial number of semi-structured Focus Group Discussions (50 FGDs). This was supplemented by a number of interviews with cotton sector actors, through observations on farms and in markets places, and from secondary data sources.

This report presents data and analysis in some detail, to allow the reader to obtain an intimate knowledge of the data, and an understanding of how the aggregate data have been arrived at. The purpose of the report is to achieve a thorough understanding of the realities that cotton farmers and producers of alternative crops face.

The structure of this report is as follows: After a discussion on the methodology, we present a brief background on respondent households, incomes and food security situation. This is followed by chapters on the four most important crops cited by respondents in the study: cotton, maize, rice and cassava. Another chapter features smaller crops that are being grown in the region, and which together compete with cotton in terms of acres planted and resources invested. Following this, we synthesise the findings in a cross-crop comparative analyses chapter. The report finished with a conclusions chapter, summarising the main findings.

Methodology

The Royal Tropical Institute (KIT) in Amsterdam was commissioned to carry out the CTDP Alternative Crop Study. KIT was responsible for designing the research methodology in consultation with TGT, and carrying out the fieldwork. Two teams of 10 local researchers collected
the data in September and October 2014, each led by a local consultant, and trained and overseen by KIT. KIT was also responsible for the analysis of the data and development of this report.

The research aims to give information on a representative selection of (cotton) farmers in the Western Cotton Growing Area (WCGA), to understand the choice farmers make for cotton or another crop in their farming system, and be able to extrapolate the findings to the wider cotton economy. A number of considerations were taken along:

- The study was to generate a baseline dataset that would allow future assessment of the cotton production sector. Subsequent surveys in years to come should allow for a comparative study over time (panel data) of those farmers who focus some of their efforts on cotton production.

- The study should include non-monetary as well as monetary considerations by farmers that steer their crop choice, such as the availability of seeds, other inputs, and the reliability of the market.

- The CTDP aims to reach 500,000 farmers producing cotton in the WCGA. This was to have implications for the sample size as well as the demographic composition of the survey population.

The research design employed mixed methods – a large scale survey, focus group discussions and key informant interviews.

Survey

The total number of households to be surveyed was set at 1500, which meant a mean number of 25 households selected per village (1500 surveys / 60 villages = 25 households per village). Households were selected on a random basis, usually from village level lists of households. In practice, 1534 surveys were collected.

<table>
<thead>
<tr>
<th>Region</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>311</td>
<td>20.42</td>
</tr>
<tr>
<td>Mara</td>
<td>210</td>
<td>13.79</td>
</tr>
<tr>
<td>Mwanza</td>
<td>312</td>
<td>20.49</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>225</td>
<td>14.77</td>
</tr>
<tr>
<td>Simiyu</td>
<td>385</td>
<td>25.28</td>
</tr>
<tr>
<td>Tabora</td>
<td>80</td>
<td>5.25</td>
</tr>
<tr>
<td>Total</td>
<td>1,523</td>
<td>100</td>
</tr>
</tbody>
</table>

Figure 1 Districts studied and respondents surveyed

<table>
<thead>
<tr>
<th>District</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bariadi</td>
<td>85</td>
<td>5.58</td>
</tr>
<tr>
<td>Bukombe</td>
<td>91</td>
<td>5.98</td>
</tr>
<tr>
<td>Bunda</td>
<td>75</td>
<td>4.92</td>
</tr>
<tr>
<td>Busega</td>
<td>79</td>
<td>5.19</td>
</tr>
<tr>
<td>Bulama</td>
<td>65</td>
<td>4.27</td>
</tr>
<tr>
<td>Chato</td>
<td>79</td>
<td>5.19</td>
</tr>
<tr>
<td>Geita</td>
<td>69</td>
<td>4.53</td>
</tr>
<tr>
<td>Igunga</td>
<td>80</td>
<td>5.25</td>
</tr>
<tr>
<td>Itilima</td>
<td>74</td>
<td>4.86</td>
</tr>
<tr>
<td>Kahama</td>
<td>74</td>
<td>4.86</td>
</tr>
<tr>
<td>Kishapu</td>
<td>76</td>
<td>4.99</td>
</tr>
<tr>
<td>Kwimba</td>
<td>78</td>
<td>5.12</td>
</tr>
<tr>
<td>Magu</td>
<td>72</td>
<td>4.73</td>
</tr>
<tr>
<td>Maswa</td>
<td>66</td>
<td>4.33</td>
</tr>
<tr>
<td>Mbongwe</td>
<td>72</td>
<td>4.73</td>
</tr>
<tr>
<td>Meatu</td>
<td>81</td>
<td>5.32</td>
</tr>
<tr>
<td>Misungwe</td>
<td>83</td>
<td>5.45</td>
</tr>
<tr>
<td>Sengerema</td>
<td>79</td>
<td>5.19</td>
</tr>
<tr>
<td>Serengeti</td>
<td>70</td>
<td>4.6</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>75</td>
<td>4.92</td>
</tr>
<tr>
<td>Total</td>
<td>1,523</td>
<td>100</td>
</tr>
</tbody>
</table>

Timing of the research

The data presented here was collected in September and October 2014. Respondents were asked to recall their most recent complete cropping season. For cotton, for example, this is mid-2014. This is important to note as certain crops can be grown twice in a year, and seasons differ in how successful farmers are due to rain, pests etc.

Measuring the difference between crops

The researchers were asked to conduct an analysis of the financial returns to farmers from cotton compared to the returns for popular alternative Lake Zone crops. Thus the research analyses the differences in costs and benefits between crops per acre, not between plots.
Research area and sampling

The process of respondent sampling was multi-stage. In the first instance, the Western Cotton Growing Area (WCGA) was identified and the regions listed, as this is the intervention area of the CTDP. These regions appear as the default level for which aggregate data are presented in this report.

The Tabora region is particularly large and extends south beyond the immediate Lake Zone that defines the WSGA. As far as Tabora and Shinyanga are concerned, we included the most northern districts only. Conditions in the southern parts of Tabora and Shinyanga are quite different but these are not included in this study. This means that data presented for Tabora and Shinyanga should not be viewed as representative of the entire region, but their northernmost districts only.

Districts were selected from each of the regions in the study. This was done with a view of selecting areas where cotton traditionally has been grown in the past, and where it still features prominently today. The selected districts include those where there is and has been CTDP interventions. The following map shows the location and names of the districts selected.

A random sample was made of villages in the selected districts. The following maps show the location of those villages. In all, sixty villages were selected, with a relatively even spread across the Lake Zone region.

From the villages, farmer households were randomly selected using household lists from the villages.

Representativeness

The study took place in the WCGA with the explicit aim to capture the decision making behaviour of cotton farmers with regard to cotton or alternative crops. With districts being selected where farmers grow cotton traditionally, it should be assumed that cotton growers have been oversampled. It is therefore best to think of the study area as being representative of farmers in cotton growing areas in the WCGA.

The KIT research team was asked to accommodate requirements from a parallel study in the research design.
This led to certain compromises, one of which was to ask respondents only about their most important and second most important crops. The consequence was that we do not have yield data for those who grew various crops as their third, fourth or fifth most important crop. This means it is possible that figures may over-estimate variables such as yield, based on the hypothesis that farmers who grow a crop as their most important or second most important give it more attention and investment than crops which a farmer considers less important. On the other hand, collecting data on most important and second most important crops did have the benefit of including some data on minor crops that was not intended in the original design.

The data is thus representative of farmers and their most important or second most important crops in the cotton growing districts of the WCGA, North-Western Tanzania.

**Hired and household labour days**

In both the survey and the focus groups respondents were asked for the number of person labour days spent per cropping activity. (For example, 3 persons doing an activity for 2 days is 6 person labour days). A labour day is that which a farmer considers to be a ‘normal’ working day in the field, and is not linked to a specific number of hours.

Activities asked about in the surveys were: Land preparation (clearing, uprooting, ploughing, ridging etc.); planting; fertilizer application; weeding; spraying and top dressing; and harvesting (stooking, shelling, winnowing, transport to storage).

As mentioned above, it would be preferable if the various activities were split out more distinctly, but this grouping was necessitated by a standardised set of questions for ‘most important’ and ‘second most important’ crops. It is thus possible that days for some activities have been underestimated in the reporting of the survey data. For labour days, it is the survey data which is reported, not the focus group data – however the survey data was cross-checked with the focus group data to eliminate clear outliers. For example, the focus group data records 2-3 days for cotton thinning which was not captured in the survey data. It is also possible that uprooting of cotton shrubs, which should occur at the end of the cotton harvest, is not included as this was grouped with land preparation, which occurs at the start of a season.

**Hired and household labour costs**

The research presents costs and benefits in the broadest sense: when discussing costs of labour, we include both hired and household labour. The research team feel that only the inclusion of household labour, calculated against as reasonable a shadow price can give the whole picture of why farmers choose certain crops over others. Indeed, the labour efforts involved were described in the focus group discussions as one of the factors influencing the desirability to grow a crop or not.

To calculate the cost of household labour (as an opportunity cost) the research team needed a proxy rate that would be consistent for comparison across all the crop choices, and in line with regional and district variances found in hired labour costs.

The KIT research team made the decision to use the mean hired labour rate as the shadow household labour price\(^1\). Pricing household labour may be contentious for some but, in the researcher’s view, necessary to illuminate the full costs and resources invested in crop production. For those not interested in costing household labour, we also report other costs disaggregated, and also present household labour in terms of days invested. Using the mean hired labour rates gives the higher end of the household labour cost range (between not costing and this rate). There were a number of considerations here:

- Convenience, consistency and comparability across all crops. Farmers have different proportions of hired and household labour on their farms, so a consistent rate allows comparison regardless of other variables (such as differences in proportions of hired/household labour costs with increasing land sizes). Thus the rate used can also be regarded as the replacement cost.
- The World Bank reports that in 2011 the average poverty line in developing countries was US$2 per day, and that this is “another common measurement of deep deprivation”\(^2\). US$2 is 3470 TZS, above the average rates used by us, which was found to be 3355 TZS in this study. Therefore applying the hired labour rate for household labour as an opportunity cost is reasonable in the view that the rate is close to the World Bank poverty line.
- It is important to note that whatever rate is chosen, this will affect all of the crops in the study.

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1 KIT consulted with Wageningen university, who agreed this was a reasonable approach and rate.

more or less equally and will not change the findings in terms of comparability across crops.

The same applies for benefits. We value the production of a crop using a shadow price for the particular produce (the price mentioned by the farmer as his/ her sales price for the crop he/ she sold). For cotton, the farmer sells virtually all of the crop. For the other crops, there is a certain percentage that is consumed by the household as these crops are both cash and food crops. The value of the part that is consumed is calculated using the market price obtained by the same farmer.

**Tables and graphs presented in this report**

When not indicated otherwise, all tables and graphs refer to the data collected in the survey. Where tables are generated from FGD data, this is indicated beneath the table.

**Regression analysis**

A multivariate regression is presented for each of the analyzed crops (Table 105). The regression reports the effects of an additional acre grown of a given crop; an additional crop being grown by a farmer (many grow a number of crops); an additional day of labour; an additional TZS spent on manure, pesticides and seed; and controls for regional variances which account, for example, for the effects differences in climate and soils. By running the model we filter the effects of the variables on each other. For example, we know that both the total acres and the number of crops influence the yields, but the total acres also influence the number of crops. In this model, we have the additional effect of each variable, once all other cross-effects are already taken into account.

**Focus groups**

The CTDP – Alternative Crop research team also included qualitative data collection. 60 Focus group discussions were organised, one in each of the same villages where the surveys were conducted. The focus group data complements and validates respondent’s answers in the survey. In particular, labour inputs, costs and prices of inputs and crops were obtained through the FGDs and used to triangulate the survey data.

For the focus groups, an adapted version of the PADev methodology was used that KIT has previously developed with partners (www.padev.nl). This was done for a number of purposes:

- It provided information on the ranges of yields, costs of inputs and labour costs, and prices for various crops experienced within the respective villages. This was used later in the survey to develop a dataset that could replace missing values, and to assess at where the respective cut-off points would have to be to exclude outliers that were clearly mistakes on the part of the enumerator.
- It provided valuable information of a non-monetary kind on the reasons for choosing particular crops, and on drivers of change that can’t be captured in a quantitative survey. These non-monetary reasons for the selection of crops feature also in this report.
- It allowed a check on the context: in certain areas, other programmes may also be active that target agriculture in ways that either positively or negatively influence the CTDP activities. Knowledge of these programmes is useful for a better understanding of the anomalies in the survey.

The FGDs tools utilised were geared towards collecting information on the following issues:

- Project recall. This is a tool that allows for a list of other interventions to be made, with information on the implementing agency and the usefulness of the project or programme from the perspective of the beneficiaries (men/women, rich/ poor).
- Crop choice. This tools elucidates the main crops grown in the village, and their rank from 1-4. It also includes farmers own reasons and motivations for growing each of the crops mentioned. Furthermore it gathers data on the percentage of farmers in the village that produce each main crop in the village now, and 5 years ago.
- Changes Cotton. A tool that elicits changes in certain aspects of cotton farming between now and 5 years ago, and reasons and effects of these changes.
- Changes other crops. As above, but asking about crops other than cotton.
- Challenges. This tool asks systematically for a description of challenges that people experience in the production of cotton, and is the reverse image of the choice for other crops: a balanced picture of positive and negative issues surrounding the various crops is developed in this way. It also has participants rank their challenges.
Farm budget. This tool is used to find and describe the costs and benefits for a given crop. It collects modal values for inputs and labour days and prices for each farming activity for a given crop. It also collects data on yields and prices obtained for crops on the other, and calculates common levels of revenue and profit experienced in each village. For each district in the study, we aimed to have at least one farm budget for cotton, and one for another main crop, or a crop that was important locally. Apart from maize, a large number of crops were discussed but not all of them in sufficient number to allow for use in establishing ranges in the statistical analysis of the survey.
Background

In this section, we discuss the key variables of households that we met in the survey and FGDs.

In the tables below we present the Mean and confidence levels (Lower and Upper Confidence Intervals (LCI and UCI)) of the absolute frequency and percentages. These provide an indication of the distributions of the respective variables.

Household sizes are relatively large in the area studied - an average of 8 persons per household. Dependency ratios are important for the household labour availability: these are around 50% for the whole of the population. Confidence intervals show a reasonably homogeneous population in this respect.

Table 2 Household size and makeup

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of household members</td>
<td>8.07</td>
<td>7.85</td>
<td>8.29</td>
</tr>
<tr>
<td>Male adults over 60</td>
<td>0.17</td>
<td>0.14</td>
<td>0.21</td>
</tr>
<tr>
<td>Female adults over 60</td>
<td>0.2</td>
<td>0.17</td>
<td>0.23</td>
</tr>
<tr>
<td>Male adults 18-59</td>
<td>2.07</td>
<td>1.99</td>
<td>2.15</td>
</tr>
<tr>
<td>Female adults 18-59</td>
<td>1.99</td>
<td>1.91</td>
<td>2.06</td>
</tr>
<tr>
<td>Male children 0-17</td>
<td>1.94</td>
<td>1.86</td>
<td>2.02</td>
</tr>
<tr>
<td>Female children 0-17</td>
<td>1.96</td>
<td>1.88</td>
<td>2.04</td>
</tr>
</tbody>
</table>

The following table shows all income sources as reported by respondents. In the study area, an overwhelming 95 percent of the population surveyed has at least some income from agriculture. This should not be a surprise considering the purpose of the study and the sampling procedure.

Household income and resources

Table 3 Household income sources

<table>
<thead>
<tr>
<th>Income source</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent employment (non-farm)</td>
<td>2%</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>Temporary employment (non-farm)</td>
<td>5%</td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td>Permanent farm labour</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>Temporary farm labour</td>
<td>6%</td>
<td>5%</td>
<td>7%</td>
</tr>
<tr>
<td>Remittances/ money gifts</td>
<td>9%</td>
<td>8%</td>
<td>11%</td>
</tr>
<tr>
<td>Sale of land/ leasing land</td>
<td>2%</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Own business / self employed</td>
<td>23%</td>
<td>21%</td>
<td>25%</td>
</tr>
<tr>
<td>Sale of crops</td>
<td>95%</td>
<td>94%</td>
<td>96%</td>
</tr>
<tr>
<td>Sale of livestock/ livestock products (e.g. milk)</td>
<td>19%</td>
<td>17%</td>
<td>21%</td>
</tr>
<tr>
<td>Government transfers</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Temporary (farm) labour makes up a very small percentage of income sources, with a slightly larger percentage of farmers indicating that they receive remittances. Sale of livestock provides an income to about 20 percent of farmers, while almost a quarter also has an income from (small) businesses.

As to the biggest income source, the following table presents the data. Again, for most people, selling of crops provides the highest income of all sources. 117 people indicated that their main income came from a business.

Table 4 Household biggest income source

<table>
<thead>
<tr>
<th>Income source</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale of crops</td>
<td>1,293</td>
<td>84.79</td>
</tr>
<tr>
<td>Own business / self-employed</td>
<td>117</td>
<td>7.67</td>
</tr>
<tr>
<td>Sale of livestock/ livestock products (e.g. milk)</td>
<td>39</td>
<td>2.56</td>
</tr>
<tr>
<td>Permanent employment (non-farm)</td>
<td>22</td>
<td>1.44</td>
</tr>
<tr>
<td>Temporary employment (non-farm)</td>
<td>21</td>
<td>1.38</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
<td>0.85</td>
</tr>
<tr>
<td>Temporary farm labour</td>
<td>9</td>
<td>0.59</td>
</tr>
<tr>
<td>Remittances/ money gifts</td>
<td>6</td>
<td>0.39</td>
</tr>
<tr>
<td>Government transfers</td>
<td>4</td>
<td>0.26</td>
</tr>
<tr>
<td>Permanent farm labour (hired to do farm)</td>
<td>1</td>
<td>0.07</td>
</tr>
<tr>
<td>Total</td>
<td>1,525</td>
<td>100</td>
</tr>
</tbody>
</table>

The second most important source of income shows a broader distribution across the various types of income sources. It shows that there is a limited range in the types of income sources: apart from agriculture (both income from crop or livestock sales and income from labour), a limited number of people relying on own small businesses, and income from remittances and government transfers, there are not many other sources of income.
Table 5 Household second biggest income source

<table>
<thead>
<tr>
<th>Income source</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale of crops</td>
<td>305</td>
<td>31.06</td>
</tr>
<tr>
<td>Own business / self-employed</td>
<td>240</td>
<td>24.44</td>
</tr>
<tr>
<td>Sale of livestock/ livestock products</td>
<td>204</td>
<td>20.77</td>
</tr>
<tr>
<td>Temporary farm labour</td>
<td>53</td>
<td>5.4</td>
</tr>
<tr>
<td>Remittances/ money gifts</td>
<td>52</td>
<td>5.3</td>
</tr>
<tr>
<td>Other</td>
<td>51</td>
<td>5.19</td>
</tr>
<tr>
<td>Temporary employment (non-farm)</td>
<td>47</td>
<td>4.79</td>
</tr>
<tr>
<td>Permanent employment (non-farm)</td>
<td>12</td>
<td>1.22</td>
</tr>
<tr>
<td>Sale of land/ leasing land</td>
<td>11</td>
<td>1.12</td>
</tr>
<tr>
<td>Government transfers</td>
<td>6</td>
<td>0.61</td>
</tr>
<tr>
<td>Permanent farm labour</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>982</td>
<td>100</td>
</tr>
</tbody>
</table>

Most households stated they had an annual income of between half and one million TZS (between around $265 and $530). The pattern is quite consistent across regions, with Geita, Mwanza and Simiyu having the higher peaks in that range.

Table 6 Household income brackets per region (TZS)

<table>
<thead>
<tr>
<th>Income bracket</th>
<th>Geita</th>
<th>Mara</th>
<th>Mwanza</th>
<th>Shinyanga</th>
<th>Simiyu</th>
<th>Tabora</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 500k</td>
<td>71</td>
<td>59</td>
<td>74</td>
<td>37</td>
<td>25</td>
<td>7</td>
<td>273</td>
</tr>
<tr>
<td>500k - 1m</td>
<td>122</td>
<td>68</td>
<td>119</td>
<td>91</td>
<td>103</td>
<td>20</td>
<td>523</td>
</tr>
<tr>
<td>1m - 2m</td>
<td>75</td>
<td>48</td>
<td>74</td>
<td>70</td>
<td>84</td>
<td>25</td>
<td>376</td>
</tr>
<tr>
<td>2m – 4m</td>
<td>32</td>
<td>26</td>
<td>32</td>
<td>22</td>
<td>98</td>
<td>22</td>
<td>232</td>
</tr>
<tr>
<td>4m – 8m</td>
<td>8</td>
<td>7</td>
<td>9</td>
<td>4</td>
<td>46</td>
<td>6</td>
<td>80</td>
</tr>
<tr>
<td>8m – 16m</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>17</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>16m – 32m</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>311</td>
<td>210</td>
<td>310</td>
<td>225</td>
<td>378</td>
<td>80</td>
<td>1514</td>
</tr>
</tbody>
</table>

As the scale on the x-axis is not linear, this must be interpreted with care, but what it does show is the unequal distribution of income, and the lower incomes in Mara, Mwanza and Geita study areas for interviewees.

Food security

An important issue is the food security situation of households. The survey asked respondents the number of months of the year their household had either 3, 2, or 1 meal(s) per day.

Table 7 Food security – number of months household has 3, 2, 1 meals per day

<table>
<thead>
<tr>
<th>Region</th>
<th>3 meals</th>
<th>2 meals</th>
<th>1 meal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>4.12</td>
<td>7.86</td>
<td>0.03</td>
</tr>
<tr>
<td>Mara</td>
<td>4.35</td>
<td>7.36</td>
<td>0.42</td>
</tr>
<tr>
<td>Mwanza</td>
<td>5.51</td>
<td>6.34</td>
<td>0.19</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>7.08</td>
<td>4.92</td>
<td>0.04</td>
</tr>
<tr>
<td>Simiyu</td>
<td>6.94</td>
<td>5.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Tabora</td>
<td>8.93</td>
<td>2.85</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Respondents from Geita (4.1) and Mara (4.4) had the lowest number of months with 3 meals per day, suggesting they are the least food secure. Tabora had the highest level of food security with almost 9 months of 3 meals per day, and this is in line with income bracket distribution of the population in Tabora.

Of course, there may be a preference for two meals per day, or farmers have no lunch as they are working on the field away from the farm. However, assuming this is not related to unknown factors that differ per district, the differences are what count, and whether these findings show correlations with other indicators of wellbeing, such as income, ownership of assets etc.
Land

For the distribution of land holdings, Mara, Mwanza and Geita regions, again in that order, show the lowest land ownership figures. Again, Tabora has the highest land resources figures per household. This also correlates with the density of the population in the various regions.

Though correlation does not always reflect causation, the income and food situation could be related to - if not caused by - the smaller land holding that is associated with higher density of population. We therefore considered land owned, leased and subsequently cultivated, averages across regions.

Table 8 Land owned per region (acres)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>10.51</td>
<td>0.65</td>
<td>9.24</td>
<td>11.78</td>
</tr>
<tr>
<td>Mara</td>
<td>7.83</td>
<td>0.53</td>
<td>6.78</td>
<td>8.87</td>
</tr>
<tr>
<td>Mwanza</td>
<td>7.85</td>
<td>0.46</td>
<td>6.94</td>
<td>8.76</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>13.01</td>
<td>0.91</td>
<td>11.22</td>
<td>14.79</td>
</tr>
<tr>
<td>Simiyu</td>
<td>10.76</td>
<td>0.61</td>
<td>9.56</td>
<td>11.96</td>
</tr>
<tr>
<td>Tabora</td>
<td>13.67</td>
<td>1.31</td>
<td>11.09</td>
<td>16.25</td>
</tr>
</tbody>
</table>

An almost similar pattern is seen with land borrowed and leased from neighbours. Again the Mara and Mwanza regions show relatively low acreage leased and borrowed.

Table 9 Land borrowed/leased per region (acres)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>1.14</td>
<td>0.14</td>
<td>0.87</td>
<td>1.41</td>
</tr>
<tr>
<td>Mara</td>
<td>0.99</td>
<td>0.13</td>
<td>0.73</td>
<td>1.25</td>
</tr>
<tr>
<td>Mwanza</td>
<td>0.80</td>
<td>0.09</td>
<td>0.62</td>
<td>0.99</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>0.92</td>
<td>0.17</td>
<td>0.60</td>
<td>1.25</td>
</tr>
<tr>
<td>Simiyu</td>
<td>1.67</td>
<td>0.15</td>
<td>1.38</td>
<td>1.96</td>
</tr>
<tr>
<td>Tabora</td>
<td>1.08</td>
<td>0.28</td>
<td>0.53</td>
<td>1.62</td>
</tr>
</tbody>
</table>

The result reflects the same pattern: Mara and Mwanza have the smaller land holdings, and this may well be related to higher density of population, in turn causing smaller incomes and thus lower food security.

Table 10 Land cultivated per region

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>8.25</td>
<td>0.40</td>
<td>7.46</td>
<td>9.04</td>
</tr>
<tr>
<td>Mara</td>
<td>5.52</td>
<td>0.24</td>
<td>5.05</td>
<td>6.00</td>
</tr>
<tr>
<td>Mwanza</td>
<td>6.46</td>
<td>0.26</td>
<td>5.94</td>
<td>6.97</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>9.39</td>
<td>0.43</td>
<td>8.55</td>
<td>10.24</td>
</tr>
<tr>
<td>Simiyu</td>
<td>8.47</td>
<td>0.38</td>
<td>7.73</td>
<td>9.21</td>
</tr>
<tr>
<td>Tabora</td>
<td>11.89</td>
<td>1.00</td>
<td>9.93</td>
<td>13.86</td>
</tr>
</tbody>
</table>

Indeed, the total area cultivated per household across regions is the lowest in the Mara and Mwanza areas, followed by Geita. Tabora again has the largest average acreage of the regions studied. Of course, type of crop and intensity of cropping also partly determines income and wellbeing, and we now turn to these issues.

Crops

An aggregate view of cropping patterns for the study area shows that maize, as in many other areas of eastern Africa, is the most popular crop. 93 percent of the surveyed population grew maize last season. In this study cotton was the second most frequently grown crop, which is not unexpected in view of the selection of study area. Rice and cassava are third and fourth. These are the four main crops we will be discussing in later chapters. In saying this, groundnuts and sweet potato are also increasingly popular. Green grams and beans are followed by sorghum and sunflower. Most of the above crops are reasonably drought resistant, and according to farmers in the FGDs, maize is often a short cycle variety. We will come back to this issue in later chapters with analysis on how these crops may compete with cotton.
Table 11 Crops grown and sold last season

<table>
<thead>
<tr>
<th>Crop</th>
<th>Grown last season</th>
<th>Sold last season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>93%</td>
<td>21%</td>
</tr>
<tr>
<td>Cotton</td>
<td>71%</td>
<td>69%</td>
</tr>
<tr>
<td>Rice</td>
<td>39%</td>
<td>18%</td>
</tr>
<tr>
<td>Cassava</td>
<td>33%</td>
<td>9%</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>28%</td>
<td>9%</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>28%</td>
<td>2%</td>
</tr>
<tr>
<td>Green grams</td>
<td>21%</td>
<td>15%</td>
</tr>
<tr>
<td>Beans</td>
<td>13%</td>
<td>2%</td>
</tr>
<tr>
<td>Sorghum</td>
<td>11%</td>
<td>1%</td>
</tr>
<tr>
<td>Sunflower</td>
<td>10%</td>
<td>7%</td>
</tr>
<tr>
<td>Tomato</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Millet</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>Potato</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td>Spinach</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Cabbages</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Chickpea</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Cowpea</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Lentils</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Onions</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Pigeon peas</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Pulses</td>
<td>1%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Note: Many other crops were asked about, only crops where at least 1% are growing have been reported.

Horticultural crops also appear: these seem to be either cultivated using water harvesting or in the lower lying areas, or close to the lake by people who have leased or borrowed land there for cash crop production. These crops have become popular in villages near urban centres where demand has been growing.

Table 12 Crops grown per district

<table>
<thead>
<tr>
<th>District</th>
<th>Cotton</th>
<th>Maize</th>
<th>Cassava</th>
<th>Rice</th>
<th>Groundnuts</th>
<th>Green grams</th>
<th>Sweet potato</th>
<th>Sorghum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bariadi</td>
<td>89%</td>
<td>100%</td>
<td>0%</td>
<td>40%</td>
<td>11%</td>
<td>27%</td>
<td>40%</td>
<td>4%</td>
</tr>
<tr>
<td>Bukombe</td>
<td>66%</td>
<td>95%</td>
<td>64%</td>
<td>35%</td>
<td>63%</td>
<td>0%</td>
<td>13%</td>
<td>2%</td>
</tr>
<tr>
<td>Bunda</td>
<td>85%</td>
<td>91%</td>
<td>35%</td>
<td>25%</td>
<td>1%</td>
<td>0%</td>
<td>11%</td>
<td>16%</td>
</tr>
<tr>
<td>Busega</td>
<td>92%</td>
<td>99%</td>
<td>35%</td>
<td>14%</td>
<td>14%</td>
<td>13%</td>
<td>38%</td>
<td>10%</td>
</tr>
<tr>
<td>Butiama</td>
<td>75%</td>
<td>78%</td>
<td>66%</td>
<td>18%</td>
<td>2%</td>
<td>0%</td>
<td>28%</td>
<td>14%</td>
</tr>
<tr>
<td>Chato</td>
<td>78%</td>
<td>96%</td>
<td>51%</td>
<td>23%</td>
<td>11%</td>
<td>0%</td>
<td>20%</td>
<td>4%</td>
</tr>
<tr>
<td>Geita</td>
<td>64%</td>
<td>96%</td>
<td>65%</td>
<td>26%</td>
<td>23%</td>
<td>0%</td>
<td>14%</td>
<td>0%</td>
</tr>
<tr>
<td>Igunga</td>
<td>78%</td>
<td>95%</td>
<td>0%</td>
<td>26%</td>
<td>18%</td>
<td>56%</td>
<td>41%</td>
<td>8%</td>
</tr>
<tr>
<td>Itilima</td>
<td>84%</td>
<td>97%</td>
<td>0%</td>
<td>23%</td>
<td>23%</td>
<td>12%</td>
<td>51%</td>
<td>3%</td>
</tr>
<tr>
<td>Kahama</td>
<td>27%</td>
<td>99%</td>
<td>55%</td>
<td>78%</td>
<td>65%</td>
<td>3%</td>
<td>12%</td>
<td>0%</td>
</tr>
<tr>
<td>Kishapu</td>
<td>80%</td>
<td>93%</td>
<td>0%</td>
<td>39%</td>
<td>39%</td>
<td>53%</td>
<td>38%</td>
<td>26%</td>
</tr>
<tr>
<td>Kwilimba</td>
<td>72%</td>
<td>88%</td>
<td>36%</td>
<td>83%</td>
<td>21%</td>
<td>41%</td>
<td>23%</td>
<td>40%</td>
</tr>
<tr>
<td>Magu</td>
<td>74%</td>
<td>90%</td>
<td>29%</td>
<td>50%</td>
<td>8%</td>
<td>18%</td>
<td>17%</td>
<td>0%</td>
</tr>
<tr>
<td>Maswa</td>
<td>88%</td>
<td>100%</td>
<td>0%</td>
<td>41%</td>
<td>65%</td>
<td>23%</td>
<td>71%</td>
<td>5%</td>
</tr>
<tr>
<td>Mtongwe</td>
<td>71%</td>
<td>94%</td>
<td>50%</td>
<td>54%</td>
<td>74%</td>
<td>1%</td>
<td>17%</td>
<td>0%</td>
</tr>
<tr>
<td>Meatu</td>
<td>98%</td>
<td>86%</td>
<td>0%</td>
<td>4%</td>
<td>26%</td>
<td>59%</td>
<td>44%</td>
<td>26%</td>
</tr>
<tr>
<td>Misungwi</td>
<td>47%</td>
<td>99%</td>
<td>31%</td>
<td>88%</td>
<td>39%</td>
<td>71%</td>
<td>31%</td>
<td>22%</td>
</tr>
<tr>
<td>Sengerema</td>
<td>15%</td>
<td>91%</td>
<td>71%</td>
<td>42%</td>
<td>9%</td>
<td>1%</td>
<td>6%</td>
<td>0%</td>
</tr>
<tr>
<td>Serengeti</td>
<td>70%</td>
<td>83%</td>
<td>67%</td>
<td>3%</td>
<td>1%</td>
<td>0%</td>
<td>6%</td>
<td>23%</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>71%</td>
<td>89%</td>
<td>1%</td>
<td>55%</td>
<td>40%</td>
<td>36%</td>
<td>41%</td>
<td>25%</td>
</tr>
</tbody>
</table>

Most common crops only included
Farmers were asked about their most important and second most important crops. The following table presents the results.

Table 13 Most important crop

<table>
<thead>
<tr>
<th></th>
<th>Geita</th>
<th>Mara</th>
<th>Mwanza</th>
<th>Shinyanga</th>
<th>Simiyu</th>
<th>Tabora</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>42%</td>
<td>53%</td>
<td>28%</td>
<td>37%</td>
<td>64%</td>
<td>53%</td>
<td>46%</td>
</tr>
<tr>
<td>Maize</td>
<td>41%</td>
<td>20%</td>
<td>35%</td>
<td>23%</td>
<td>30%</td>
<td>8%</td>
<td>32%</td>
</tr>
<tr>
<td>Rice</td>
<td>5%</td>
<td>4%</td>
<td>24%</td>
<td>23%</td>
<td>1%</td>
<td>4%</td>
<td>10%</td>
</tr>
<tr>
<td>Cassava</td>
<td>6%</td>
<td>15%</td>
<td>10%</td>
<td>0%</td>
<td>0%</td>
<td>6%</td>
<td>4%</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>2%</td>
<td>0%</td>
<td>3%</td>
<td>2%</td>
<td>0%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>Sorghum</td>
<td>0%</td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Sunflower</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Millet</td>
<td>0%</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Other1</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>2%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Green grams</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Beans</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Not surprisingly, the four main crops appear again on top, though now cotton (46%) leads maize (32%), rice (10%) and cassava (6%). Across regions, small differences appear, with Simiyu leading in terms of cotton as a dominant crop in the farming systems of the region. Rice is popular in Mwanza and Shinyanga, with flood water from either lake or river. Cassava is popular in the Mara area and Mwanza. The spatial distribution of these crops is an intricate combination of factors obviously, the main theme of this report. Perhaps surprisingly given the hype sunflower does not appear frequently as one of the most important crops.

The second most important crop is presented in the next table. The same four crops also take up second place in most people’s farming system. With cotton first as a most important crop, maize now appears second most important, in view of the need for food security based on home consumption of home grown food.

Table 14 Second most important crop

<table>
<thead>
<tr>
<th></th>
<th>Geita</th>
<th>Mara</th>
<th>Mwanza</th>
<th>Shinyanga</th>
<th>Simiyu</th>
<th>Tabora</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>37%</td>
<td>38%</td>
<td>41%</td>
<td>41%</td>
<td>51%</td>
<td>52%</td>
<td>43%</td>
</tr>
<tr>
<td>Cotton</td>
<td>21%</td>
<td>17%</td>
<td>13%</td>
<td>17%</td>
<td>22%</td>
<td>24%</td>
<td>18%</td>
</tr>
<tr>
<td>Rice</td>
<td>11%</td>
<td>7%</td>
<td>24%</td>
<td>18%</td>
<td>5%</td>
<td>8%</td>
<td>12%</td>
</tr>
<tr>
<td>Cassava</td>
<td>14%</td>
<td>24%</td>
<td>12%</td>
<td>3%</td>
<td>2%</td>
<td>0%</td>
<td>10%</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>12%</td>
<td>0%</td>
<td>2%</td>
<td>8%</td>
<td>2%</td>
<td>0%</td>
<td>4%</td>
</tr>
<tr>
<td>Green grams</td>
<td>0%</td>
<td>0%</td>
<td>2%</td>
<td>5%</td>
<td>4%</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>Sorghum</td>
<td>0%</td>
<td>6%</td>
<td>2%</td>
<td>3%</td>
<td>2%</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>Sunflower</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>6%</td>
<td>8%</td>
<td>2%</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>0%</td>
<td>1%</td>
<td>1%</td>
<td>2%</td>
<td>2%</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td>Beans</td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>Millet</td>
<td>0%</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Chickpea</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Lentils</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

A summary table shows the relative positions of these four crops. Presented below is the percentage of farmers growing each crop, and the percentage for which it is the number 1 and 2 crops.

Table 15 Summary of respondents growing 4 main crops and their importance

<table>
<thead>
<tr>
<th></th>
<th>Grown</th>
<th>#1 important</th>
<th>#2 important</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>71%</td>
<td>46%</td>
<td>18%</td>
<td>7%</td>
</tr>
<tr>
<td>Maize</td>
<td>93%</td>
<td>32%</td>
<td>43%</td>
<td>18%</td>
</tr>
<tr>
<td>Rice</td>
<td>39%</td>
<td>10%</td>
<td>12%</td>
<td>17%</td>
</tr>
<tr>
<td>Cassava</td>
<td>33%</td>
<td>6%</td>
<td>10%</td>
<td>17%</td>
</tr>
</tbody>
</table>

In the analysis we also assessed what the second crop was when one of the four main crops was said to be the most important. If maize was said to be the most important crop then cotton was most frequently mentioned with it. When cotton is the most important crop, maize is clearly the dominant number two: food security considerations make this imperative.

In a number of instances, there wasn’t a large difference between these first and second position. Other crops however can take the place of cotton as a cash crop, including food crops.
Table 16 Crop combinations - If maize is the most important crop, what is the second most important crop

<table>
<thead>
<tr>
<th>Crop</th>
<th>Freq</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>207</td>
<td>43.31</td>
</tr>
<tr>
<td>Rice</td>
<td>91</td>
<td>19.04</td>
</tr>
<tr>
<td>Cassava</td>
<td>57</td>
<td>11.92</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>40</td>
<td>8.37</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>17</td>
<td>3.56</td>
</tr>
<tr>
<td>Sorghum</td>
<td>14</td>
<td>2.93</td>
</tr>
<tr>
<td>Green grams</td>
<td>13</td>
<td>2.72</td>
</tr>
<tr>
<td>Beans</td>
<td>11</td>
<td>2.3</td>
</tr>
<tr>
<td>Sunflower</td>
<td>8</td>
<td>1.67</td>
</tr>
<tr>
<td>Chickpea</td>
<td>4</td>
<td>0.84</td>
</tr>
<tr>
<td>Lentils</td>
<td>4</td>
<td>0.84</td>
</tr>
<tr>
<td>Millet</td>
<td>4</td>
<td>0.84</td>
</tr>
</tbody>
</table>

The same applies for rice, which thus shows the pattern for cash cropping. Rice is indeed often mentioned as a preferred cash crop, with the additional bonus that it can be eaten while people wait for better prices.

Table 17 Crop combinations - If cotton is the main crop, what is the second most important crop

<table>
<thead>
<tr>
<th>Crop</th>
<th>Freq</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>463</td>
<td>66.33</td>
</tr>
<tr>
<td>Rice</td>
<td>79</td>
<td>11.32</td>
</tr>
<tr>
<td>Cassava</td>
<td>67</td>
<td>9.6</td>
</tr>
<tr>
<td>Sunflower</td>
<td>25</td>
<td>3.58</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>16</td>
<td>2.29</td>
</tr>
<tr>
<td>Green grams</td>
<td>14</td>
<td>2.01</td>
</tr>
<tr>
<td>Sorghum</td>
<td>14</td>
<td>2.01</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>7</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 18 Crop combinations - If rice is the main crop, what is the second most important crop

<table>
<thead>
<tr>
<th>Crop</th>
<th>Freq</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>94</td>
<td>61.04</td>
</tr>
<tr>
<td>Cotton</td>
<td>27</td>
<td>17.53</td>
</tr>
<tr>
<td>Cassava</td>
<td>13</td>
<td>8.44</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>11</td>
<td>7.14</td>
</tr>
<tr>
<td>Sorghum</td>
<td>4</td>
<td>2.6</td>
</tr>
<tr>
<td>Green grams</td>
<td>3</td>
<td>1.95</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>2</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Table 19 Crop combinations - If cassava is the main crop, what is the second most important crop

<table>
<thead>
<tr>
<th>Crop</th>
<th>Freq</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>49</td>
<td>55.68</td>
</tr>
<tr>
<td>Cotton</td>
<td>21</td>
<td>23.86</td>
</tr>
<tr>
<td>Rice</td>
<td>11</td>
<td>12.5</td>
</tr>
</tbody>
</table>
The following tables provide further information on the crop combinations employed by farmers when they grow each of the 4 main crops – cotton, maize, rice and cassava. In general, the ranking order of other crops grown with the main 4 crops follows Table 11: maize, cotton, rice, cassava, groundnuts, sweet potato and green grams. This data, along with that of the most important and second most important crop combinations, suggests that farmers are not employing much of a different cropping system with regards to cotton (or indeed any of the other main crops).
Table 22 Crop combinations - percent of respondents growing crops when maize is grown

<table>
<thead>
<tr>
<th>If maize is grown...</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>71%</td>
<td>69%</td>
<td>73%</td>
</tr>
<tr>
<td>Rice</td>
<td>39%</td>
<td>36%</td>
<td>41%</td>
</tr>
<tr>
<td>Cassava</td>
<td>32%</td>
<td>30%</td>
<td>35%</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>29%</td>
<td>26%</td>
<td>31%</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>29%</td>
<td>26%</td>
<td>31%</td>
</tr>
<tr>
<td>Green grams</td>
<td>22%</td>
<td>20%</td>
<td>24%</td>
</tr>
<tr>
<td>Beans</td>
<td>13%</td>
<td>12%</td>
<td>15%</td>
</tr>
<tr>
<td>Sorghum</td>
<td>11%</td>
<td>9%</td>
<td>13%</td>
</tr>
<tr>
<td>Sunflower</td>
<td>10%</td>
<td>9%</td>
<td>12%</td>
</tr>
<tr>
<td>Tomato</td>
<td>5%</td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td>Millet</td>
<td>4%</td>
<td>3%</td>
<td>5%</td>
</tr>
<tr>
<td>Potato</td>
<td>3%</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Spinach</td>
<td>2%</td>
<td>1%</td>
<td>3%</td>
</tr>
</tbody>
</table>

N=1426; Reporting cut off at 2%

Table 23 Crop combinations - percent of respondents growing crops when rice is grown

<table>
<thead>
<tr>
<th>If rice is grown...</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>maize</td>
<td>93%</td>
<td>91%</td>
<td>95%</td>
</tr>
<tr>
<td>cotton</td>
<td>63%</td>
<td>59%</td>
<td>67%</td>
</tr>
<tr>
<td>cassava</td>
<td>35%</td>
<td>31%</td>
<td>38%</td>
</tr>
<tr>
<td>groundnuts</td>
<td>34%</td>
<td>30%</td>
<td>38%</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>27%</td>
<td>23%</td>
<td>31%</td>
</tr>
<tr>
<td>Green grams</td>
<td>23%</td>
<td>20%</td>
<td>27%</td>
</tr>
<tr>
<td>beans</td>
<td>14%</td>
<td>11%</td>
<td>16%</td>
</tr>
<tr>
<td>sorghum</td>
<td>12%</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>sunflower</td>
<td>9%</td>
<td>7%</td>
<td>11%</td>
</tr>
<tr>
<td>tomato</td>
<td>5%</td>
<td>3%</td>
<td>7%</td>
</tr>
<tr>
<td>Spinach</td>
<td>4%</td>
<td>3%</td>
<td>6%</td>
</tr>
<tr>
<td>chickpea</td>
<td>2%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>lentils</td>
<td>2%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>millet</td>
<td>2%</td>
<td>1%</td>
<td>4%</td>
</tr>
<tr>
<td>potato</td>
<td>2%</td>
<td>1%</td>
<td>4%</td>
</tr>
</tbody>
</table>

N=591; Reporting cut off at 2%

Table 24 Crop combinations - percent of respondents growing crops when cassava is grown

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>91%</td>
<td>88%</td>
<td>93%</td>
</tr>
<tr>
<td>Cotton</td>
<td>64%</td>
<td>59%</td>
<td>68%</td>
</tr>
<tr>
<td>Rice</td>
<td>40%</td>
<td>36%</td>
<td>45%</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>28%</td>
<td>25%</td>
<td>32%</td>
</tr>
<tr>
<td>Beans</td>
<td>22%</td>
<td>19%</td>
<td>26%</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>21%</td>
<td>17%</td>
<td>24%</td>
</tr>
<tr>
<td>Sorghum</td>
<td>9%</td>
<td>7%</td>
<td>12%</td>
</tr>
<tr>
<td>Green grams</td>
<td>7%</td>
<td>5%</td>
<td>9%</td>
</tr>
<tr>
<td>Tomato</td>
<td>5%</td>
<td>3%</td>
<td>7%</td>
</tr>
<tr>
<td>Millet</td>
<td>4%</td>
<td>3%</td>
<td>6%</td>
</tr>
<tr>
<td>Spinach</td>
<td>4%</td>
<td>2%</td>
<td>6%</td>
</tr>
<tr>
<td>Chickpea</td>
<td>2%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>Lentils</td>
<td>2%</td>
<td>1%</td>
<td>4%</td>
</tr>
<tr>
<td>Millet</td>
<td>2%</td>
<td>1%</td>
<td>4%</td>
</tr>
</tbody>
</table>

N=506; Reporting cut off at 2%
Households nearly always grow more than one crop. In fact, farmers most often grow 2, 3, 4 or 5 crops, and there is quite a normal distribution around a mean of 3.7 crops grown per household.

### Table 26 Number of crops grown per household

<table>
<thead>
<tr>
<th>Number of crops grown</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>9</td>
<td>0.59</td>
</tr>
<tr>
<td>1</td>
<td>36</td>
<td>2.35</td>
</tr>
<tr>
<td>2</td>
<td>282</td>
<td>18.38</td>
</tr>
<tr>
<td>3</td>
<td>430</td>
<td>28.03</td>
</tr>
<tr>
<td>4</td>
<td>372</td>
<td>24.25</td>
</tr>
<tr>
<td>5</td>
<td>228</td>
<td>14.86</td>
</tr>
<tr>
<td>6</td>
<td>113</td>
<td>7.37</td>
</tr>
<tr>
<td>7</td>
<td>42</td>
<td>2.74</td>
</tr>
<tr>
<td>8</td>
<td>17</td>
<td>1.11</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>0.13</td>
</tr>
<tr>
<td>Total</td>
<td>1,531</td>
<td>100</td>
</tr>
</tbody>
</table>

### Labour costs

The following section discusses a very important ingredient in the analysis of economic logic behind crop choice later in this report: the cost of labour. We calculated the mean cost of labour both for the regions and the district. Those means differ more than expected, between 4000 and 2500 TZS.

### Table 27 Cost of labour per region

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>2559</td>
<td>49</td>
<td>2462</td>
<td>2655</td>
</tr>
<tr>
<td>Mara</td>
<td>3253</td>
<td>86</td>
<td>3085</td>
<td>3422</td>
</tr>
<tr>
<td>Mwanza</td>
<td>3343</td>
<td>75</td>
<td>3196</td>
<td>3490</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>4250</td>
<td>107</td>
<td>4040</td>
<td>4460</td>
</tr>
<tr>
<td>Simiyu</td>
<td>3399</td>
<td>61</td>
<td>3279</td>
<td>3520</td>
</tr>
<tr>
<td>Tabora</td>
<td>4081</td>
<td>142</td>
<td>3803</td>
<td>4359</td>
</tr>
<tr>
<td>All areas</td>
<td>3355</td>
<td>34</td>
<td>3288</td>
<td>3423</td>
</tr>
</tbody>
</table>

The standard errors are quite low in this table. The number of observations per region is relatively high.

However, the figures for the district level are more illuminating, certainly when plotted on the map. The table gives the detail, but the map (see below) gives the insight.

First of all the standard errors go up in the district level table, and we think that any step further down the spatial scale (to village level) will reduce the number of observations and increase the standard error to levels too high to allow their use in any procedure to replace missing values or calculate shadow prices.
We used the data at district level to calculate shadow prices later on in this report, which we used to value household labour when cost-benefit analyses per crop are made. A few remarks can be made on this. One is that it may well be that these prices are relatively high as they use the price of labour at a time when it is most in demand: during weeding and harvesting. Other activities, with lower peaks in labour needs, may be done using household labour, at the time when demand for labour and thus costs are lower too. This would underestimate the profit.

However, this probably applies to all crops to a certain degree, with the exception of cassava which is probably less critical in timing of labour application for weeding and certainly harvesting. So we expect this issue not to change the relative labour costs for the four main crops, and since we are primarily interested in comparing crops rather than calculating absolute levels, we will see no change in relative positions of these crops along the continuum of profit and loss.

The following figure presents the cost of labour per day, in TZS. per district. The value classes are quintiles. It appears that the central area indeed has the highest labour costs per day, while the westernmost and lake-bound areas have lower labour costs. The reasons for this are unclear; they may be related to competing labour opportunities such as in the gold mining industry, though the locations of the mines is more to the west of the high-cost area. But the consequences are clear: higher costs of production, both in terms of hired labour as well as for the shadow price of household labour.

**Figure 5 Hired Labour costs**
Cotton

Background

Cotton is still a major crop which occupies a large area and share of farm land. Farmers growing cotton last season as their most important or second most important crop had on average 3.6 acres under it. Not surprisingly, cotton cultivation is most extensive in Tabora due to land availability, least extensive in Mara and Mwanza.

Figure 6 Cotton, percent of farmers growing per district

Table 29 Cotton mean acres for those growing as most important or second most important crop (per region)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>3.02</td>
<td>0.24</td>
<td>2.55</td>
<td>3.48</td>
</tr>
<tr>
<td>Mara</td>
<td>2.60</td>
<td>0.17</td>
<td>2.27</td>
<td>2.92</td>
</tr>
<tr>
<td>Mwanza</td>
<td>2.79</td>
<td>0.16</td>
<td>2.48</td>
<td>3.10</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>4.17</td>
<td>0.28</td>
<td>3.61</td>
<td>4.72</td>
</tr>
<tr>
<td>Simiyu</td>
<td>4.19</td>
<td>0.27</td>
<td>3.65</td>
<td>4.73</td>
</tr>
<tr>
<td>Tabora</td>
<td>6.34</td>
<td>0.59</td>
<td>5.19</td>
<td>7.49</td>
</tr>
<tr>
<td>Total</td>
<td>3.66</td>
<td>0.12</td>
<td>3.42</td>
<td>3.90</td>
</tr>
</tbody>
</table>

Note this should not be read as the mean of cotton in the regions overall, as only farmers who are growing cotton as their most important or second most of crop were reporting. This likely skews the mean higher.

The share of farmers’ land dedicated to cotton varies little between regions, with between 40% and 47% of land under the crop. Those shares are actually slightly above the ideal of 33%, which is what a farming system with full crop rotation would look like.

Table 30 Share of land under cotton for those growing as most important or second most important crop per region

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>39%</td>
<td>0.01</td>
<td>0.36</td>
<td>0.41</td>
</tr>
<tr>
<td>Mara</td>
<td>47%</td>
<td>0.02</td>
<td>0.43</td>
<td>0.50</td>
</tr>
<tr>
<td>Mwanza</td>
<td>41%</td>
<td>0.02</td>
<td>0.38</td>
<td>0.44</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>42%</td>
<td>0.02</td>
<td>0.38</td>
<td>0.45</td>
</tr>
<tr>
<td>Simiyu</td>
<td>47%</td>
<td>0.01</td>
<td>0.45</td>
<td>0.49</td>
</tr>
<tr>
<td>Tabora</td>
<td>46%</td>
<td>0.02</td>
<td>0.41</td>
<td>0.50</td>
</tr>
<tr>
<td>Total</td>
<td>44%</td>
<td>0.01</td>
<td>0.42</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Changes in land under cotton compared with 5 years ago

Percentage estimates of changes in land under cotton were made with participants in the focus groups by asking them whether or not they were growing each of the main crops 5 years ago and today.

Table 31 Farmer reported changes in farmers growing various crops, 5 years ago and today

<table>
<thead>
<tr>
<th>Crop</th>
<th>Mean % of farmers growing 5 years ago</th>
<th>Mean % of farmers growing now</th>
<th>Change in percentage points</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>90</td>
<td>53</td>
<td>-37</td>
<td>50</td>
</tr>
<tr>
<td>Cowpea</td>
<td>100</td>
<td>80</td>
<td>-20</td>
<td>1</td>
</tr>
<tr>
<td>Beans</td>
<td>100</td>
<td>100</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Millet</td>
<td>25</td>
<td>25</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Sorghum</td>
<td>40</td>
<td>42</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Cassava</td>
<td>86</td>
<td>89</td>
<td>3</td>
<td>29</td>
</tr>
<tr>
<td>Maize</td>
<td>93</td>
<td>98</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>Rice</td>
<td>67</td>
<td>72</td>
<td>5</td>
<td>33</td>
</tr>
<tr>
<td>Onions</td>
<td>50</td>
<td>60</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>80</td>
<td>91</td>
<td>11</td>
<td>28</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>65</td>
<td>88</td>
<td>23</td>
<td>13</td>
</tr>
<tr>
<td>Sunflower</td>
<td>46</td>
<td>69</td>
<td>23</td>
<td>7</td>
</tr>
<tr>
<td>Chickpea</td>
<td>55</td>
<td>80</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Green Grams</td>
<td>35</td>
<td>95</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>10</td>
<td>100</td>
<td>90</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: focus group discussions

According to farmers across 60 focus group discussions, cotton has declined most dramatically in terms of the
percent of farmers growing the crop, and is actually the only crop said to have experienced such a decline. Crops increasing in popularity are typically food cash crops. Tomatoes are as yet a minor crop, but in some few areas they feature as growing rapidly in popularity. The production of sunflower is promoted by development programmes and private enterprises. But for other crops it is mostly farmers identification of opportunities. After some experimentation and learning from each other and the market, they may convert part of their farm to these cash crops.

The other main crops in the area, maize, rice and cassava, have seen little change in the numbers of farmers growing them, and were already well established in many areas.

**Crop replacement**

In the focus group discussions, farmers clearly suggested that several crops are replacing and competing with cotton for acreage, and almost all of these crops can be deemed to be alternative cash crop options (even if they are also used for home consumption). It is also clear that crop replacement doesn’t necessarily mean swapping cotton for another crop. Crop displacement (i.e. changes in proportions grown of the same crops) also occurs, where farmers may reduce the land under cotton in favour of another crop option believed to be more profitable or otherwise desirable.

Participants in the focus groups were asked: ‘if a crop had declined, what is it being replaced with?’ Participant groups listed many different crops and not one particular crop as replacing cotton, depending on the local circumstances. Crops frequently mentioned by different focus groups (mentioned by at least 3 groups) included: cassava, sunflower, green grams, maize, sorghum, sweet potatoes and groundnuts. Also it should be noted that several groups excluded rice as a crop replacing cotton, which was an early hypothesis.

**Maize:** As we’ve seen, virtually everyone grows maize. It is interesting that a high number (50% or more) of participant groups said that maize production land is increasing and displacing cotton. This is particularly the case in areas that receive sufficient rainfall (non-arid). This may be related to the introduction of short cycle maize, but this needs further study.

**Rice:** While some participant groups did say rice is replacing cotton, many more said that either the land is being increased for rice (and not displacing other crops) or that farmers were giving it more attention in production, but not necessarily displacing cotton. Some explicitly said rice did not replace cotton.

**Sweet potato:** Many of the participant groups who said they grow sweet potato also say that it is replacing cotton. It’s a relatively newly introduced crop in the southernmost areas.

**Cassava:** A large number of participant groups said that cassava is being expanded, displacing cotton (about 33% of groups citing). Anecdotal evidence shows that this is both because of food security reasons, and because there is a ready market for cassava.

**Green grams:** It was perhaps surprising to hear green grams mentioned, but as a newly introduced crop it is said to be partially competing with cotton. It is intercropped with maize and sunflower, and even cotton.

**Sorghum:** The picture for sorghum is mixed and unclear as it is not one of the major crops. Some groups say there is little change, some communities say it is declining and in others say it is partially replacing cotton. One feature of sorghum though is its drought resistance making it suitable to the semi-arid regions where cotton is also found.

**Sunflower:** Sunflower is a newly introduced crop and in Simiyu (semi-arid) is said to be replacing cotton. One group each in Geita and Tabora agreed that it plays a role replacing cotton.

**Groundnuts:** In Geita and Shinyanga groundnuts were quite frequently mentioned as displacing cotton.

**Reasons given by farmers for growing Cotton**

The most frequently mentioned and highest ranked reason for growing cotton was that farmers earn cash crop income from it. Despite declining land under cotton, some farmers still mention that it is the main (or even the only) cash crop in their area from which they can receive a sizeable income at a single time. This lump sum amount of cash is the major motivator, as it may cover school fees, transport costs, ‘bride fees’, other social celebrations and all sorts of miscellaneous spending that households make through the year. It is also said to be quite reliable in marketing terms – there is an assurance that what is produced can be sold, and that farmers will get a reasonable lump sum payment.

Drought resistance was the second most frequently mentioned reason for growing cotton. Cotton is said to resist drought or poor and sporadic rainfall better than most other crops. Interestingly, this drought resistant feature was mentioned in all regions.
However, it is also clear that interwoven with these reasons is a historical and cultural attachment. Cotton has been their cash crop for generations. Cotton is said to be 'part of their heritage' and their way of life as it was 'inherited'. It is embedded in their culture and identity, even for groups who mentioned its low profitability. Several groups mentioned that growing cotton in one's village gave them a sense of pride, and that there was an associated prestige. Several participant groups also mentioned that they stick with cotton in ‘hope’ that it will again become profitable.

Participants in the southern areas also mentioned that their land and soil is well suited to cotton.

Table 32 Farmer reasons for growing cotton

<table>
<thead>
<tr>
<th>Reason cotton</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Crop income</td>
<td>554</td>
</tr>
<tr>
<td>Drought resistant</td>
<td>200</td>
</tr>
<tr>
<td>Culture</td>
<td>149</td>
</tr>
<tr>
<td>Land availability and suitability</td>
<td>71</td>
</tr>
<tr>
<td>Climate and weather</td>
<td>41</td>
</tr>
<tr>
<td>Payment slow</td>
<td>28</td>
</tr>
<tr>
<td>Price low</td>
<td>28</td>
</tr>
<tr>
<td>Cost of production high</td>
<td>26</td>
</tr>
<tr>
<td>Hope</td>
<td>23</td>
</tr>
<tr>
<td>Soil</td>
<td>18</td>
</tr>
</tbody>
</table>

Source: Focus group data from 50 focus groups. The table is intended to be illustrative of respondents perceptions. Respondents ranked their reasons for growing cotton. The first ranked reason was given a score of 10, second ranked a score of 9 and so on. Usually 4 or less reasons were given per focus group. These rank scores were added from all focus groups.

Knowledge and experience

The historic and cultural dimension referred to above is reflected in the time people have planted cotton. The average number of years respondents have been growing cotton is 17 years. Some farmers have grown the crop all their lives.

Table 33 Mean years growing cotton per region

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>15.68</td>
<td>0.77</td>
<td>14.16</td>
<td>17.20</td>
</tr>
<tr>
<td>Mara</td>
<td>14.06</td>
<td>0.90</td>
<td>12.31</td>
<td>15.82</td>
</tr>
<tr>
<td>Mwanza</td>
<td>15.92</td>
<td>0.94</td>
<td>14.08</td>
<td>17.76</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>19.32</td>
<td>1.26</td>
<td>16.84</td>
<td>21.80</td>
</tr>
<tr>
<td>Simiyu</td>
<td>17.19</td>
<td>0.63</td>
<td>15.94</td>
<td>18.43</td>
</tr>
<tr>
<td>Tabora</td>
<td>20.05</td>
<td>1.51</td>
<td>17.10</td>
<td>23.01</td>
</tr>
</tbody>
</table>

One would assume that with time, farmers would have a thorough knowledge of the crop. However, anecdotal evidence shows that there are recent changes to the crop:

new diseases have started to appear, and farmers don’t always feel they know enough about the crop. The following table presents farmer perceptions of their knowledge was adequate. Around 46% feel their knowledge of cotton is less than adequate, although a similar percentage hold the same views of their knowledge with regards to other crops too.

Table 34 Self-perceptions of cotton knowledge

<table>
<thead>
<tr>
<th></th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>85</td>
<td>8.74</td>
</tr>
<tr>
<td>Not sufficient</td>
<td>358</td>
<td>36.83</td>
</tr>
<tr>
<td>Adequate</td>
<td>327</td>
<td>33.64</td>
</tr>
<tr>
<td>Good</td>
<td>181</td>
<td>18.62</td>
</tr>
<tr>
<td>Very good</td>
<td>21</td>
<td>2.16</td>
</tr>
<tr>
<td>Total</td>
<td>972</td>
<td>100</td>
</tr>
</tbody>
</table>

Production costs of cotton per acre

Land leasing

Apart from land in ownership, quite a number – about 30% of respondents - lease or borrow land in order to increase their area for production. It is unknown what percentage of farmers lease specifically for cotton. Leasing land costs in the range of 30,000 – 100,000 per acre (there is good consistency in the FGD data). The average cost is about 55,000 per season per acre.

Land preparation – clearing and ploughing

Land clearing is most often done with household labour. The prices of hired labour were varied. The costs per day seem to have been slightly higher in the FGDs than what was found in the survey. A minority used hired labour to clear land. The cost also depends on what needs to be cleared: virgin land or land earlier cultivated.

Ploughing includes harrowing and discing. Often ploughing was described as being done with animals but most often this was manual labour. The mean days spent on land preparation was 10.
Table 35 Cotton land clearing and ploughing labour days (per acre)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hired labour days</td>
<td>782</td>
<td>2.11</td>
<td>1.81</td>
<td>2.41</td>
</tr>
<tr>
<td>Household labour days</td>
<td>885</td>
<td>8</td>
<td>7.42</td>
<td>8.58</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>10.11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Seeds purchase**

Virtually all farmers buy cotton seed every season, as they must from the ginners. In the focus group discussions, farmers frequently said they had to use about twice the recommended amount of seeds (at least when they used delinted improved seed obtained through the ginners) because of the low germination rates in recent seasons.

Table 36 Cotton seed cost

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed cost (inc. 0)</td>
<td>957</td>
<td>8593</td>
<td>8142</td>
<td>9043</td>
</tr>
<tr>
<td>Of those who purchased last season</td>
<td>918</td>
<td>8958</td>
<td>8503</td>
<td>9412</td>
</tr>
<tr>
<td>Percent who purchased last season</td>
<td>96%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These figures again tally with the data provided by the TCDP, and are above those commonly mentioned in the FGDs.

**Planting**

Planting days typically ranged between 2-7 days per acre in the focus group discussions. In the survey data the mean days spent on planting was 6. Sometimes this was not recorded separately as the last ploughing pass (or discing) was used to also plant the seeds, and therefore the ploughing was sometimes higher in price because of this.

Table 37 Cotton planting labour days (per acre)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hired labour days</td>
<td>756</td>
<td>1.15</td>
<td>0.95</td>
<td>1.34</td>
</tr>
<tr>
<td>Household labour days</td>
<td>913</td>
<td>4.98</td>
<td>4.68</td>
<td>5.28</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>6.13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fertilizer**

Only 1% of farmers (10 cases) have used fertilizer for cotton at an average price for those who did use it of TZ shs. 35000. It is insignificant in the overall calculations. Manure is used by more cotton farmers (28%) although amounts used are very difficult to calculate and most farmers reported not paying for the manure they used.

**Thinning**

This activity was not captured in the survey data but was in the focus group budgets. Those who actually thinned paid in the range of 9000-27000 TZS per acre, and an average cost of 17000 TZ shs per acre. Thinning would take between 2-4 days, or 3 days on average.

**Weeding**

Weeding is done repeatedly for cotton – up to four times per season, making the mean labour days for weeding cotton (21.5) higher than for either rice or maize, and only slightly lower than for cassava (22.5).

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hired labour days</td>
<td>813</td>
<td>6.73</td>
<td>6.07</td>
<td>7.38</td>
</tr>
<tr>
<td>Household labour days</td>
<td>846</td>
<td>14.79</td>
<td>13.84</td>
<td>15.74</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>21.52</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pesticides purchasing**

The cost of buying pesticides ranges depending on how many bottles are used per application, and how many applications. Earlier CTDP estimates seem to have been on the lower side. Most farmers (78%) said used pesticides because otherwise pests/diseases are too big of a problem. The number of sprayings ranges between 3-6 times per season. Usually, each time 2-3 bottles are used per spraying per acre. Bottles of pesticides are subsidized by government according to farmers: one 160ml bottles costs between 2000 – 2500. This means that per spraying the price is at least 4000-5000. We find that the cost of buying pesticides per acre is between 8000-30000 TZS. The survey data gives a mean of nearly 12000 TZS for those using pesticides. This amount is slightly lower than the amounts mentioned in the FGDs, but within the range given.

Fertiliser was hardly used in the area, and so no costing could be made. This undoubtedly also influences the yields negatively in the study area.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pesticides cost (inc. 0)</td>
<td>948</td>
<td>8947</td>
<td>8306</td>
<td>9588</td>
</tr>
<tr>
<td>Of those who purchased last season</td>
<td>718</td>
<td>11813</td>
<td>11061</td>
<td>12545</td>
</tr>
<tr>
<td>Percent who purchased last season</td>
<td>96%</td>
<td>78%</td>
<td>75%</td>
<td>81%</td>
</tr>
</tbody>
</table>

**Pesticide application**

The application of pesticides generally takes 1 day per acre, per application. As mentioned above, the number of applications ranges from between 3-6 times. The mean
labour days from the survey is 1.7, however this is a little low because some 22% reported not applying pesticides.

We also set the labour needs against the same type of data presented in the literature. In various studies, we found our findings to be within the ranges presented in those studies. However, studies with lower number of labour days are also available, though in some cases we found that not all types and categories of labour in cotton seemed to have been taken along in the calculation.

Table 39 Cotton - pesticides application labour days (per acre)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hired labour days</td>
<td>726</td>
<td>0.22</td>
<td>0.14</td>
<td>0.29</td>
</tr>
<tr>
<td>Household labour days</td>
<td>843</td>
<td>1.45</td>
<td>1.28</td>
<td>1.61</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1.67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Harvesting

Each cotton harvesting phase commonly takes between 5-10 person days and some farmers harvest up to three times per season. The total number of days of labour can amount to 15-45 person days. Remember too that farmers plant differing amounts of seed per acre so yields and hence harvest days will differ with higher yields taking more labour days per harvest. The survey data gave a mean of 22 days per harvest.

Table 40 Cotton - harvesting labour days (per acre)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hired labour days</td>
<td>825</td>
<td>7.01</td>
<td>6.29</td>
<td>7.72</td>
</tr>
<tr>
<td>Household labour days</td>
<td>819</td>
<td>15.26</td>
<td>14.19</td>
<td>16.34</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>22.27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Uprooting and burning

Cotton must be uprooted after harvest to prevent diseases building up in the soil. In the focus group discussions, most farmers said it took between 3-5 days work per acre to uproot trees after harvesting. This would mean a range of 10000–17000 TZS. This was not included as a separate activity in the survey data, so it is uncertain if this labour day cost was indeed included under land preparation.

Total labour days

The total mean labour days (hired + household) for cotton were found to be 62.5 days. This seems relatively high, even though the data are consistent across the districts, and are corroborated by the data collected through the FGDs in the various villages. In those FGDs, we systematically asked for the range of labour days for the respective activities, and we found the findings in the survey consistent with the range obtained through the FGDs.

Yields

Mean yields as reported by farmers were around the 300kg mark, with a low standard error. As the mean can be influenced by outliers, we took a logical cut-off point by cross checking the low, common and high estimations reported in the FGDs, and secondly used a histogram to cross check whether that range was reflected in the survey findings. We ultimately determined the high and low cut-off points by choosing a gap where the tail breaks and the histogram, as cross checked with the reported ranges in the focus group discussions. Typically this meant excluding a low number of observations (around 10 or so) which can be deemed as obvious outliers with questionable reliability.

---


### Table 42 Cotton - mean yields per region (kg/acre)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>268.66</td>
<td>12.84</td>
<td>243.46</td>
<td>293.85</td>
</tr>
<tr>
<td>Mara</td>
<td>350.77</td>
<td>17.70</td>
<td>316.03</td>
<td>385.52</td>
</tr>
<tr>
<td>Mwanza</td>
<td>323.85</td>
<td>17.29</td>
<td>289.92</td>
<td>357.78</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>231.14</td>
<td>15.71</td>
<td>200.30</td>
<td>261.98</td>
</tr>
<tr>
<td>Simiyu</td>
<td>316.87</td>
<td>10.26</td>
<td>296.74</td>
<td>337.01</td>
</tr>
<tr>
<td>Tabora</td>
<td>243.11</td>
<td>17.70</td>
<td>208.36</td>
<td>277.86</td>
</tr>
<tr>
<td>All areas</td>
<td>299.41</td>
<td>6.10</td>
<td>287.43</td>
<td>311.39</td>
</tr>
</tbody>
</table>

### Table 43 Cotton mean yields per district (kg/acre)

<table>
<thead>
<tr>
<th>District</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>95% Conf. Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bariadi</td>
<td>348.37</td>
<td>21.44</td>
<td>306.28 - 390.45</td>
</tr>
<tr>
<td>Bukombe</td>
<td>237.41</td>
<td>17.72</td>
<td>202.62 - 272.20</td>
</tr>
<tr>
<td>Bunda</td>
<td>378.93</td>
<td>31.07</td>
<td>317.95 - 439.90</td>
</tr>
<tr>
<td>Busega</td>
<td>360.24</td>
<td>23.82</td>
<td>313.48 - 406.99</td>
</tr>
<tr>
<td>Bulama</td>
<td>307.27</td>
<td>34.99</td>
<td>238.59 - 375.96</td>
</tr>
<tr>
<td>Chato</td>
<td>335.02</td>
<td>5.26</td>
<td>284.07 - 385.97</td>
</tr>
<tr>
<td>Geita</td>
<td>263.73</td>
<td>17.70</td>
<td>208.36 - 339.69</td>
</tr>
<tr>
<td>Igunga</td>
<td>243.11</td>
<td>17.70</td>
<td>208.36 - 277.86</td>
</tr>
<tr>
<td>Itilima</td>
<td>348.64</td>
<td>27.52</td>
<td>294.63 - 402.64</td>
</tr>
<tr>
<td>Kahama</td>
<td>270.95</td>
<td>45.03</td>
<td>182.57 - 359.33</td>
</tr>
<tr>
<td>Kishapu</td>
<td>241.29</td>
<td>23.99</td>
<td>194.21 - 288.38</td>
</tr>
<tr>
<td>Kwimba</td>
<td>340.87</td>
<td>24.37</td>
<td>293.05 - 388.70</td>
</tr>
<tr>
<td>Magu</td>
<td>322.39</td>
<td>31.72</td>
<td>260.12 - 384.65</td>
</tr>
<tr>
<td>Maswa</td>
<td>280.68</td>
<td>16.94</td>
<td>237.62 - 323.75</td>
</tr>
<tr>
<td>Mbongwe</td>
<td>215.86</td>
<td>15.27</td>
<td>185.87 - 245.84</td>
</tr>
<tr>
<td>Meatu</td>
<td>249.73</td>
<td>16.94</td>
<td>216.47 - 282.98</td>
</tr>
<tr>
<td>Misungwi</td>
<td>259.55</td>
<td>47.22</td>
<td>166.87 - 352.24</td>
</tr>
<tr>
<td>Sengerema</td>
<td>386.11</td>
<td>48.18</td>
<td>291.53 - 480.69</td>
</tr>
<tr>
<td>Serengeti</td>
<td>350.01</td>
<td>26.37</td>
<td>298.24 - 401.78</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>202.48</td>
<td>22.30</td>
<td>158.70 - 246.25</td>
</tr>
<tr>
<td>All areas</td>
<td>299.41</td>
<td>6.10</td>
<td>287.43 - 311.39</td>
</tr>
</tbody>
</table>

Spatially, there are some differences in cotton yields as can be expected. The following maps illustrate those differences. Yields are highest in the northern part of the study area. This may partly reflect rainfall patterns. Cotton, though it is a drought resistant crop, does perform better when rainfall is higher. The regional distribution of yields presented in the graph above and plotted on the map, show that the higher yields are achieved in the areas in the northern part of the study area, which in some years receives slightly higher levels of rainfall. Cotton is rarely produced under irrigation in Tanzania (we find that rice is often preferred under such conditions), so the yield gradient may follow the rainfall gradient. However, rainfall is not so different across the districts studied, so other factors may equally play a role. This would need additional data and analysis.
Prices

Prices obtained by farmers were quite consistent across the study area. Despite the fact that prices were set by the government (TCB) prior to harvest at 750 TZS, when farmers sold they did not always obtain the established price. We could speculate also that some farmers gave the set 2014-15 price of 750 TZS/kg (just harvested) and others the 2013-2014 price of 700 TZS.

Table 44 Mean price of cotton per region

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>[95% Conf. Interval]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>725.90</td>
<td>0.38</td>
<td>725.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>726.64</td>
</tr>
<tr>
<td>Mara</td>
<td>741.58</td>
<td>0.13</td>
<td>741.32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>741.84</td>
</tr>
<tr>
<td>Mwanza</td>
<td>731.55</td>
<td>0.63</td>
<td>730.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>732.79</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>728.43</td>
<td>0.28</td>
<td>727.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>728.98</td>
</tr>
<tr>
<td>Simiyu</td>
<td>747.12</td>
<td>0.54</td>
<td>746.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>748.17</td>
</tr>
<tr>
<td>Tabora</td>
<td>745.00</td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

Revenue

Cotton revenue is calculated from the data by first checking if all respondents gave a value for the common price or whether this is missing. If the price was missing for an observation in rare cases, the district average was used for that observation. For each farmer the price * total production was used, and then divided by the total acres under cotton to give the revenue per acre for cotton. From this we find a mean revenue for all areas of 220824 TZS per acre.

This histogram below shows the fraction of farmers generating a specific revenue. The graph shows a typical form often associated with total factor productivity, income, and revenues. The distribution is skewed in the way most income graphs are.

Table 10 Cotton mean revenue (per acre)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>[95% Conf. Interval]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>195671</td>
<td>9527</td>
<td>176972</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>214371</td>
</tr>
<tr>
<td>Mara</td>
<td>258687</td>
<td>12969</td>
<td>233231</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>284144</td>
</tr>
<tr>
<td>Mwanza</td>
<td>238131</td>
<td>12680</td>
<td>213241</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>283020</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>168223</td>
<td>11466</td>
<td>145717</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>190728</td>
</tr>
<tr>
<td>Simiyu</td>
<td>235795</td>
<td>7558</td>
<td>220960</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>250629</td>
</tr>
<tr>
<td>Tabora</td>
<td>180628</td>
<td>13090</td>
<td>154934</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>206322</td>
</tr>
<tr>
<td>All areas</td>
<td>220824</td>
<td>4503</td>
<td>211985</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>229663</td>
</tr>
</tbody>
</table>
Profitability

The following table presents the means of all costs and revenues to provide a simplified representation of the profitability of cotton. Profitability is also given as a breakdown a) excluding all labour, b) excluding only household labour, and c) including all costs (inputs such as seed, pesticides, fertilizer etc., hired labour and household labour).

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planting fertilizer</td>
<td>409</td>
<td>108</td>
<td>710</td>
</tr>
<tr>
<td>Top dressing</td>
<td>385</td>
<td>156</td>
<td>614</td>
</tr>
<tr>
<td>Manure</td>
<td>1337</td>
<td>942</td>
<td>1733</td>
</tr>
<tr>
<td>Pesticides</td>
<td>8947</td>
<td>8306</td>
<td>9588</td>
</tr>
<tr>
<td>Fungicides</td>
<td>27</td>
<td>7</td>
<td>61</td>
</tr>
<tr>
<td>Herbicides</td>
<td>308</td>
<td>169</td>
<td>448</td>
</tr>
<tr>
<td>Seed</td>
<td>8593</td>
<td>8142</td>
<td>9043</td>
</tr>
<tr>
<td>Hired labour - land prep</td>
<td>6154</td>
<td>5312</td>
<td>6995</td>
</tr>
<tr>
<td>Hired labour - planting</td>
<td>3607</td>
<td>2982</td>
<td>4231</td>
</tr>
<tr>
<td>Hired labour - fert. app</td>
<td>117</td>
<td>23</td>
<td>211</td>
</tr>
<tr>
<td>Hired labour - weeding</td>
<td>22369</td>
<td>1984</td>
<td>2489</td>
</tr>
<tr>
<td>Hired labour - spraying</td>
<td>789</td>
<td>482</td>
<td>1096</td>
</tr>
<tr>
<td>Hired labour - harvesting</td>
<td>24326</td>
<td>2128</td>
<td>2736</td>
</tr>
<tr>
<td>Household labour - land prep</td>
<td>26368</td>
<td>2434</td>
<td>2839</td>
</tr>
<tr>
<td>Household labour - planting</td>
<td>16937</td>
<td>1580</td>
<td>1806</td>
</tr>
<tr>
<td>Household labour - fert. app</td>
<td>2740</td>
<td>2028</td>
<td>3453</td>
</tr>
<tr>
<td>Household labour - weeding</td>
<td>49497</td>
<td>4608</td>
<td>5290</td>
</tr>
<tr>
<td>Household labour - spraying</td>
<td>5095</td>
<td>4376</td>
<td>5814</td>
</tr>
<tr>
<td>Household labour - harvesting</td>
<td>51267</td>
<td>4732</td>
<td>5521</td>
</tr>
</tbody>
</table>

| Costs inputs (fertilizer, pesticides, seed etc.) | 20006 |
| Costs hired labour                              | 57361 |
| Costs household labour (opportunity cost)       | 15190 |
| Total costs - all                               | 22927 |

| Total revenue                                  | 22100 |

| Profit - excl. all labour                      | 20099 |
| Profit - excl. household labour                | 14363 |
| Profit - all costs                             | -8272 |

In the subsequent histograms, we provide a step by step impression of what happens when certain categories of costs are deducted from the revenues above, which obviously have a downward effect on the net profit. For various reasons, certain farmers may end up having a negative net profit, for example if they had costs, but because of diseases in their crop, or very bad prices obtained, had very low revenues. The revenues and costs are always cited per acre.
Deducting costs of inputs from the revenues achieved by individual farmers, the net profit of all farmers goes down, and a few farmers now find themselves having little profit.

The following graph shows farmer’s results when both inputs and the costs of hired labour are deducted. The first thing that strikes is that so many farmers are now close to the zero net profit mark. The tail has almost completely disappeared. When household labour is included at the mean hired labour rate, a sizeable percent of the farmers now have a negative net profit.

Household labour is often neglected by farmers (and government and development agencies) in the calculation of profits: most farmers in the world even do not calculate their own labour costs and if they would, they would often make a loss. The problem is aggravated here because so much of the labour is household labour, and so much of the costs of production consists of labour costs. For example, rather than buying herbicides, farmers rely on household labour for weeding. The result is a distribution of revenues around the zero when shadow prices in the district are used to put a price to that labour.

However, it is right that an effort is made to price household labour in order to highlight the full costs of production. To some extent farmers do this themselves subconsciously – in the focus group discussions many participants lamented to the high labour days of cotton compared with other crops such as maize, and discussed how this was a factor in them determining whether to grow cotton or not. What farmers were effectively saying was that they could get good results from other crops by working less hard under the sun, and that they too value their leisure.

Cotton regression

The regression (Table 105) shows that there is no significant correlation between the amount of land under which cotton crop is cultivated and the yield. There is also no significant correlation between the number of crops a farmer grows and his/ her yield. However, there are highly significant effects on the yield of cotton when either adding labour, or investments in manure, pesticides and seed. For each additional labour day, yield of cotton increases by 0.98kg per acre (which at an average price of 737.9 TZS,
the value of that additional day would be 723.14 TZS). For every 1000 TZS spent on manure yields for cotton increase by 4kgs. This means that with an investment of 1000 TZS, there would be an increase in revenue of $4 \times 737.8 = 2951$ TZS. Likewise, for every 1000 TZS spent on pesticides for cotton the increase is 3kgs (an added turnover of 2213 TZS), and for every 1000 TZS increase in spending on seed the cotton yield increases 4kgs (again an added turnover of 2951 TZS).

Figure 15 Cotton regression, effect of variables on cotton yields

Challenges of growing cotton

The FGDs also provided an understanding of farmers’ perspectives on the challenges in cotton production. We discuss the most important challenges below. The FGDs find that certain problematic issues influence the production of cotton negatively. Participants described the main
challenges they face when growing cotton. Farmers then ranked these challenges.

For the analysis rankings were turned into scores, with the first ranked challenge given a score of 10, second ranked a score of 9 and so on. Usually 5 or fewer challenges were given per focus group. These rank scores were added from all focus groups.

In reality it was interesting to find how many of these challenges were linked and not isolated (for example prices were too low because costs were too high), making the scoring somewhat superficial. Nevertheless it is presented here as indicative of farmer’s responses.

Table 46 Challenges in cotton production, FGDs

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prices</td>
<td>512</td>
</tr>
<tr>
<td>Pesticides quality and timing</td>
<td>335</td>
</tr>
<tr>
<td>Weighing machine</td>
<td>313</td>
</tr>
<tr>
<td>Seed quality and timing</td>
<td>285</td>
</tr>
<tr>
<td>Inputs cost</td>
<td>202</td>
</tr>
<tr>
<td>Diseases</td>
<td>56</td>
</tr>
<tr>
<td>knowledge &amp; practice</td>
<td>51</td>
</tr>
<tr>
<td>Climate</td>
<td>40</td>
</tr>
<tr>
<td>Wild animals</td>
<td>29</td>
</tr>
<tr>
<td>Pesticide sprayers</td>
<td>24</td>
</tr>
<tr>
<td>Governance</td>
<td>21</td>
</tr>
<tr>
<td>Capital</td>
<td>20</td>
</tr>
<tr>
<td>Subsidies lack</td>
<td>20</td>
</tr>
<tr>
<td>Storage</td>
<td>15</td>
</tr>
<tr>
<td>Traders/agents</td>
<td>13</td>
</tr>
</tbody>
</table>

Source: Focus group discussions

Prices

Up to and including the 1980s, farmers were told of the prices at the start of the season, before they committed to growing cotton. This is no longer the case and they don’t know the recommended price until after they have committed to planting. While this is the same for other crops (as the free market determines the price), for cotton this is difficult for farmers to reconcile because a) previously farmers were told, and not anymore, so this is a change b) cotton is only marginally profitable in their view, and only if the price is sufficiently high. Prices in recent years are thus putting off farmers from investing more (land, inputs, labour) in cotton. The fact that farmers are so sensitive to the price of cotton due to its marginal profitability leads them to sometimes say that they are being ‘cheated’ when they are encouraged to grow cotton by various actors at the start of the season because prices will be ‘good’.

A number of focus groups mentioned that the price of cotton seems to fluctuate unevenly with no specific trend (that farmers understand). Whether farmer’s perception of such a fluctuation is greater than for other crops is unclear, as farmers didn’t mention other crop price fluctuations.

Farmers say that the price - even at 750 TZS/kg - does not reflect the costs incurred in production. Farmers recall that in 2011 the price was 1100 TZS/kg, and are troubled by the instability of prices that are being recommended, without a clear understanding of why they are set at such a price. Farmers think that they are arbitrary, or if low, that someone else (the government) is taking their profit. A number of groups suggested rather hopefully that a good price would be 2000 TZS/kg, or nearly three times the current fixed price.

In nearly all cases, the challenge of low prices is linked by farmers to high costs of production - so the challenges are obviously intertwined and perceived in this way by farmers.

Pesticides quality and timing

Timeliness is a problem with pesticides, according to farmers. They are required from January onwards, but only reach farmers between February and March. This affects the crop in the early stages of growth and reduced the yield.

Pesticide effectiveness is repeatedly mentioned as well. Pesticides which have been brought to farmers recently are perceived to be not effective. Farmers mention that previous types and brands of pesticides (Theodung, Caleti, Musso and Summit were mentioned) were oily and did not require dilution with other fluids. They are said to stick to the plants better. Recent pesticides (Phenoum, Lamdus and Abametrin were the names given) require dilution. Possibly this leads to sub-optimal practices by farmers. Previously with earlier generation of pesticides, cotton required about three applications of pesticides per season. But now with less effective pesticides a farmer may apply pesticides up to six times.

The obvious effect of poor performing pesticides is that farmers are paying more for a greater number of applications. Alternatively farmers are increasingly inflicted with diseases that reduce cotton yields and eating into profits. Apparently, the disease that recently has started to affect the crops (provisionally called ‘Premature Defoliation Syndrome’ (PDS)), is a severe handicap to
farmers. The disease affects the leaves and the formation of the boll, and farmers did not know what to do about it.

A lack of training in disease treatment and how pesticides should be applied was mentioned in the challenges, and is a possible contributor to poor pesticide performance. This may include sprayers, which not many farmers have. Borrowing the sprayers often delays the application, affecting the crops.

While these costs of seed and pesticides might not seem to be the major costs, they are lump sum costs which farmers don’t associate with other crops. Because farmers are cash poor, these lump sum costs put more stress on households than for example hired farm labour does. If they are unable to purchase the correct amount of inputs this constrains them from achieving better outputs. (High costs of various inputs is possibly one of the reasons that fertilizer use is so low).

Financing these inputs is an issue therefore. Farmers reflected on earlier times when all inputs could be bought on credit and paid back after harvesting and marketing their crop. The long season for cotton is another factor, with farmers recouping the money invested later than for many competing crops. Lack of loans at reasonable rates is an often heard complaint.

Weighing machine

The under reporting of cotton bag weights was cited as a major challenge, and surprisingly highly ranked. Farmers believe scales to often be wildly out in their measurements. There is some scepticism of digital weighing machines also, because farmers do not understand how these work, and say they would like to be trained in this. Some also believe that the buying company themselves do not properly know how to use it. Farmers frequently said that when measuring with ruler callipers in the past that one bag might weight 120kg, whereas digital scales indicate only 80kgs. These reports are obviously very difficult to verify but it was mentioned by farmers in most focus group sessions. On the other hand, some farmers admit stones and sand are sometimes added to a bag. As there is no grading system, there is no way to prevent this practice by the buyer.

Seeds quality and timing

As with other inputs (particularly pesticides), farmers complain that seeds are not distributed to farmers in a timely manner, and that the quantities of seed provided are insufficient. Lack of timeliness in seed provision is a frequent complaint: planting time for many areas is from October to November but seed may reach them around December. This results in poor crop timing and subsequently poorer harvests. This is particularly frustrating for farmers because timing of seed supply is not a challenge they have to deal with for other crops whereby they can recycle their own seed, or buy from agro-dealers or other farmers.

Another frequent complaint with seed is low germination rates. Some farmers say they have responded to this by planting more than the recommended amount, increasing costs but helping them to achieve their desired germinating seed count. In some cases, farmers said they were previously supplied with fuzzy seeds, while in recent years they are supplied with delinted seeds. These delinted seeds are reported to germinate poorly after planting. Some farmers speculate that this poor germination is because of climatic conditions and delinted seed needing higher rainfall. Others blame the seed supplier - Quton is often mentioned -. Others feel they may need training in the use of this seed. There is confusion among farmers why fuzzy seeds and delinted seeds have different prices, particularly because experiences with Quton delinted seed appears to be resulting in unsatisfactory germination compared with farmer expectations.

Farmers perceive that cotton production needs investments in inputs that other crops do not need. Seed is one such example, but a definite need to buy and apply pesticides, and high labour costs are other examples. This can be contrasted with maize where only 14% of farmers bought clean seed last season, and pesticides are virtually unused. Farmers believe the cost of inputs to be rising year on year, while prices of harvested cotton are not sufficiently reflecting these increases.

Soil quality deterioration

Almost all FGDs complained about the reduced soil fertility, which was generally perceived to be caused by the continuous cultivation of the same crop for years. Reduced areas of land available to farmers caused reduced crop rotations. Fertiliser is too expensive for most farmers, and manure is not always available. When any fertility management is done, it is the application of manure. Only twice was conservation farming mentioned, as introduced in cooperation with the CTDP programme.

Yields

For all the reasons mentioned above, yields have declined in the past years. The range is still wide, but generally
yields between 250kg/acre and 350kg/acre were reported with 299 kg/acre being the mean. Declining soil fertility, diseases and lack of good pesticides, lack of input supply and timing, lack of quality seeds, and a changing climate are among the many reasons perceived to be reducing yields. In certain areas quite unique problems also appeared. Wildlife frequently destroys the crop in certain areas and the government was seen to act reluctantly.

**Training and knowledge**

About one quarter of the focus groups directly mentioned a lack of knowledge to apply to their cotton growing practices. Typically a lack of extension officers were mentioned, to continue to remind farmers about good practices. Farmers admit that some (many?) do not always adhere to good practices (such as clearing the farm after harvesting), and need reminders and support. A few groups say that rice, maize and cassava are crops that they are used to. But dealing with new cotton seeds and pesticides are something that they are not all comfortable with, and they see no training or support packages.

**Marketing**

According to farmers, there have been a number of shifts in cotton marketing over the years. The scenario that farmers describe is as follows. After the cotton market was liberalised, instead of the one buyer (Nyanza), a large number of buyers flooded the market, (some FGDs mention 12 companies) trying to vie for the attention of the farmers. However, some of these companies didn’t honour their commitments and went out of business. Now, a reduced number of buyers is present.

Contrary to commonly assumed, farmers thought the situation previous to the establishment of the free market was not all bad. Prices were set, farmers contracted, and a certain risk reduction arrangement between trader and producer seemed to have been part of the set-up. After liberalisation, farmers often had to find buyers themselves, and often had to sell their crop immediately after harvest, fetching low prices. When established relationships existed between farmers and buyers, both parties realised that long term benefits implied a truthful negotiation of prices with both parties coming out well. High prices would act as incentives for farmers, low prices would act as incentives for traders: together, farmers and traders had arranged a win-win agreement. With the coming of new players in the field, this arrangement often broke down.

A certain positive feedback process started in some areas, because with the post-liberalisation arrangement, cotton declined as a crop, and traders bypassed certain areas if they expected insufficient production for reliable procurement. They feared not making enough profit for the costs involved (buyers scout the area and try to assess the production and potential for buying later in the season). At the same time, this seems to push them to areas where there still was sufficient production, so that demand and prices increased in those areas, and farmers reacted by increasing their production of cotton. The farmers in the FGDs in those areas state that cotton as a crop has improved. Some companies even offer a minimum price (400 TZ shs per kg) and top up later when the official price is announced, to allow farmers to earn money quickly after harvest. Farmers in the areas where cotton is in decline, and where hardly any traders come along, bring their cotton to other villages, incurring higher transport costs.

**Group Organisation and Cooperatives**

In the focus group discussions, positive changes in ‘group organisation and cooperatives’ were cited a little more frequently than negative changes. The most common responses were that there are now more groups than 5 years ago.

This is a positive change because farmers can receive training together and access a supply of chemicals on credit and/or subsidized inputs. S&C, OLAM and ALLIANCE are all examples of this. Many spoke of how the formation of groups had meant they were now engaged in a contract farming arrangement.

However, a large set of focus group participants said that although many groups have been formed in the last 5 years, many of these groups quickly became inactive. Often contract farming arrangements with buying companies were said not to have worked due to ‘weak’ contracts, which some elaborated as meaning that the terms and conditions of the contract were violated by either the farmers, companies or both. This is one reason given for a large number of groups to have become inactive. Another reason given for becoming inactive a lack of capacity and then little or no follow-up from the supporting institution. (Technoserve was mentioned as a trainer just once).
Maize

Background

Changes in land under maize compared with 5 years ago

Percentage estimates of changes in land under maize were made with participants in the focus groups by asking them whether or not they were growing each of the main crops 5 years ago and today. This found that 93% of participants were growing maize 5 years ago, and 98% today.

![Map showing percentage of farmers growing maize per district](image)

Figure 16 Maize, percent of farmers growing per district

On average, those farmers growing maize as a most important or second most important crop have 3.29 acres of land under maize, which is 46% of their total land.

Table 47 Maize mean acres for those growing as most important or second most important crop (per region)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>3.36</td>
<td>0.17</td>
<td>3.03</td>
<td>3.69</td>
</tr>
<tr>
<td>Mara</td>
<td>2.43</td>
<td>0.14</td>
<td>2.16</td>
<td>2.70</td>
</tr>
<tr>
<td>Mwanza</td>
<td>2.53</td>
<td>0.11</td>
<td>2.31</td>
<td>2.74</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>3.42</td>
<td>0.21</td>
<td>3.01</td>
<td>3.83</td>
</tr>
<tr>
<td>Simiyu</td>
<td>3.24</td>
<td>0.16</td>
<td>2.93</td>
<td>3.55</td>
</tr>
<tr>
<td>Tabora</td>
<td>6.73</td>
<td>0.66</td>
<td>5.44</td>
<td>8.02</td>
</tr>
<tr>
<td>All areas</td>
<td>3.29</td>
<td>0.09</td>
<td>3.13</td>
<td>3.46</td>
</tr>
</tbody>
</table>

n=1129. Note this should not be read as the mean of maize in the regions overall, as only farmers who are growing maize as their most important or second most important crop were reporting. Farmers growing maize but who regard it as a less important crop were not asked to respond. This likely skews the mean higher

Table 48 Share of land under maize for those growing as most important or second most important crop per region

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>48%</td>
<td>1%</td>
<td>45%</td>
<td>50%</td>
</tr>
<tr>
<td>Mara</td>
<td>51%</td>
<td>2%</td>
<td>47%</td>
<td>55%</td>
</tr>
<tr>
<td>Mwanza</td>
<td>45%</td>
<td>1%</td>
<td>43%</td>
<td>48%</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>40%</td>
<td>1%</td>
<td>37%</td>
<td>43%</td>
</tr>
<tr>
<td>Simiyu</td>
<td>45%</td>
<td>1%</td>
<td>43%</td>
<td>47%</td>
</tr>
<tr>
<td>Tabora</td>
<td>50%</td>
<td>2%</td>
<td>46%</td>
<td>55%</td>
</tr>
<tr>
<td>All areas</td>
<td>46%</td>
<td>1%</td>
<td>45%</td>
<td>47%</td>
</tr>
</tbody>
</table>

Reasons given by farmers for growing Maize

The most common reason farmers grow maize is, unsurprisingly for food consumption. It is a staple food and the ground into flour as the main ingredient in ugali and makande (maize and beans stew). However, close behind is the reason of cash crop income. There is said to be a good market with traders coming from all around the country, and decent prices. Several participant groups described how maize used to be more a food crop, but now with an expanding market is also a reliable cash crop option. Clearly not all households rely on maize as a cash crop, but many do, and certainly it is seen as a supplementary cash crop. Farmers see maize as a flexible option for both consumption and cash. On average 81% of maize produced is consumed within the household, with about 14% marketed.

Maize was frequently mentioned as being cheap to cultivate in terms of inputs required. Several groups said that they don’t use pesticides or fertilizers for maize reducing costs (although surely production levels also). Moreover, maize also requires relatively low labour inputs. Farmers are weeding maize less frequently (often once, sometimes twice) than cotton and in general maize was
described as 'less laborious'. Prior to harvesting, maize requires little attention.

Another important advantage of maize is that many farmers are able to grow 2 seasons of maize, utilizing also the short rains and the characteristic of maize being a relatively short season crop (3-5 months, short growing seasons especially when improved varieties are used.). The 2 seasons obviously gives farmers the opportunity to double their maize output on the same plot of land in a single year, compared with cotton which only has a single season per year.

A less frequent but still often mentioned reason is that maize prices can rise in the market and are not fixed. While obviously market prices can go down also, this seems to be a remark meant to be contrasted with cotton’s fixed prices. Farmers can hold maize for at least several months and sell if need be at higher prices outside of peak harvest time. Marketing of maize is said to be easy, and maize can even be sold to Congo or Rwanda at present.

Other less frequently mentioned reasons were that prices for maize are quite reasonable, many land and soil types are suitable to its cultivation, that it can be intercropped, and that improved seed varieties that are drought resistant are now more widely available.

Table 49 Farmer reasons for growing maize

<table>
<thead>
<tr>
<th>Reasons for growing maize</th>
<th>Rank score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food consumption</td>
<td>493</td>
</tr>
<tr>
<td>Cash crop income</td>
<td>400</td>
</tr>
<tr>
<td>Cost of production low</td>
<td>248</td>
</tr>
<tr>
<td>Season short</td>
<td>142</td>
</tr>
<tr>
<td>Market</td>
<td>58</td>
</tr>
<tr>
<td>Land availability and suitability</td>
<td>58</td>
</tr>
<tr>
<td>Seed</td>
<td>48</td>
</tr>
<tr>
<td>Intercropping</td>
<td>34</td>
</tr>
<tr>
<td>Price good</td>
<td>32</td>
</tr>
<tr>
<td>Culture</td>
<td>26</td>
</tr>
<tr>
<td>Soil</td>
<td>21</td>
</tr>
<tr>
<td>Livestock feed</td>
<td>21</td>
</tr>
<tr>
<td>Climate and weather</td>
<td>16</td>
</tr>
<tr>
<td>Yield high</td>
<td>10</td>
</tr>
</tbody>
</table>

Source: Focus group data from 50 focus groups. The table is intended to be illustrative of respondent’s perceptions. Respondents ranked their reasons for growing maize. The first ranked reason was given a score of 10, second ranked a score of 9 and so on. Usually 4 or less reasons were given per focus group. These rank scores were added from all focus groups.

Crop replacement

As described above, virtually all farmers are growing maize. It is interesting to see from the focus group discussions that a high number of participant groups (50% or more) said that land under maize production land is increasing and displacing cotton. Put another way, the proportion of maize relative to the proportion of cotton grown is increasing. This is particularly the case for areas that receive sufficient rainfall (non-arid).

Knowledge and experience

Maize is well established, with 17 years being the average number of years respondents have been growing maize. Farmer perceptions of their maize knowledge is not so high, with around 44% believing that their knowledge is less than adequate. In saying this, farmers gave very similar responses about their knowledge of the other main crops also, which suggests more of a systemic lack of farming knowledge.

Table 50 Mean years growing maize per region

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>16.55</td>
<td>0.73</td>
<td>15.11</td>
<td>17.98</td>
</tr>
<tr>
<td>Mara</td>
<td>12.52</td>
<td>0.95</td>
<td>10.65</td>
<td>14.39</td>
</tr>
<tr>
<td>Mwanza</td>
<td>17.92</td>
<td>0.86</td>
<td>16.23</td>
<td>19.60</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>18.88</td>
<td>1.00</td>
<td>16.91</td>
<td>20.85</td>
</tr>
<tr>
<td>Simiyu</td>
<td>17.76</td>
<td>0.63</td>
<td>16.52</td>
<td>19.00</td>
</tr>
<tr>
<td>Tabora</td>
<td>17.76</td>
<td>1.43</td>
<td>14.95</td>
<td>20.56</td>
</tr>
<tr>
<td>All areas</td>
<td>17.13</td>
<td>0.35</td>
<td>16.44</td>
<td>17.83</td>
</tr>
</tbody>
</table>

Table 51 Self-perceptions of maize knowledge

<table>
<thead>
<tr>
<th>Perception</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>98</td>
<td>8.65</td>
</tr>
<tr>
<td>Not sufficient</td>
<td>406</td>
<td>35.83</td>
</tr>
<tr>
<td>Adequate</td>
<td>437</td>
<td>38.57</td>
</tr>
<tr>
<td>Good</td>
<td>167</td>
<td>14.74</td>
</tr>
<tr>
<td>Very good</td>
<td>25</td>
<td>2.21</td>
</tr>
<tr>
<td>Total</td>
<td>1,133</td>
<td>100</td>
</tr>
</tbody>
</table>

Consumption and marketing

As mentioned above, the majority of maize produced is consumed at household level. The mean percentage consumed at home is 81% and the mean sold 13% (the difference can be put down to post harvest losses, giving away, bartering or other). 68% of respondents reported selling no maize that they produced, while 32% did sell maize.
### Marketing

<table>
<thead>
<tr>
<th>Crop</th>
<th>Consumed %</th>
<th>Sold %</th>
<th>Average price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>81.20</td>
<td>13.52</td>
<td>388.60</td>
</tr>
</tbody>
</table>

#### Production costs per acre

**Land leasing**

Quite a number of respondents (31%) say they leased or borrowed land last season, but the study did not collect specific data on what crop(s) this land is leased for. According to the focus group budget data, when maize farmers lease land, it costs on average 50000 TZS per acre per season, and ranges between 30000 and 100000 TZS.

**Land clearing and ploughing**

The survey data shows that land clearing and ploughing takes nearly 10 days per acre of maize. Predominantly household labour is used over hired labour. The range of labour days can be up to 60 days in rare cases. In reality, the number of labour days spent depends on many variables such as whether animal traction was used, whether than land is virgin or recently cultivated.

**Seed cost**

A relatively high number of farmers reported buying maize seed last season (52%). The mean amount spend on seed of all maize farmers was 7668 TZS. If we include only those who bought seed, the mean is 14682.

#### Table 52 Maize land clearing and ploughing labour days (per acre)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hired labour days</td>
<td>951</td>
<td>1.70</td>
<td>1.46</td>
<td>1.93</td>
</tr>
<tr>
<td>Household labour days</td>
<td>1052</td>
<td>8.14</td>
<td>7.61</td>
<td>8.67</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>9.84</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Table 53 Maize seed cost

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed cost (inc. 0)</td>
<td>112</td>
<td>7668</td>
<td>7021</td>
<td>8314</td>
</tr>
<tr>
<td>Of those who purchased last season</td>
<td>587</td>
<td>1468</td>
<td>1375</td>
<td>1560</td>
</tr>
<tr>
<td>Percent who purchased last season</td>
<td>52%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Planting

Planting takes an average of 5.5 days, but in reality this figure may be misleading as respondents may plant at the same time as final discing, or conversely count the final land preparation with the planting days.

#### Table 54 Maize planting labour days (per acre)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hired labour days</td>
<td>928</td>
<td>0.67</td>
<td>0.56</td>
<td>0.78</td>
</tr>
<tr>
<td>Household labour days</td>
<td>1080</td>
<td>4.87</td>
<td>4.6</td>
<td>5.14</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>5.54</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Fertilizer purchase

Very few farmers used fertilizer last season (2%). A much higher number of farmers reporting using manure for their maize (31.8%), however we know very little about the practices and quantities of manure use from this study. Mean fertilizer application thus amounts to only 0.8 labour days.

#### Table 55 Maize- Cost of fertilizer

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer cost (inc. 0)</td>
<td>112</td>
<td>510</td>
<td>228</td>
<td>793</td>
</tr>
<tr>
<td>Of those who purchased last season</td>
<td>19</td>
<td>3028</td>
<td>1938</td>
<td>4118</td>
</tr>
<tr>
<td>Percent who purchased last season</td>
<td>2%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Weeding

Weeding takes a considerable number of days (16.5) but in reality farmers say they are only weeding maize once or twice per season, and maize weeding days is lower than for the other main crops.
Table 56 Maize weeding labour days (per acre)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hired labour days</td>
<td>966</td>
<td>4.02</td>
<td>3.6</td>
<td>4.44</td>
</tr>
<tr>
<td>Household labour days</td>
<td>1037</td>
<td>12.43</td>
<td>11.72</td>
<td>13.15</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>16.45</td>
<td></td>
</tr>
</tbody>
</table>

Pesticides purchase

Relatively few maize farmers use pesticides (7%) and pests and diseases are generally said to not be a big problem for maize. Mean pesticide application thus amounts to only 0.14 labour days.

Table 57 Maize - Cost of pesticides

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pesticides cost (inc. 0)</td>
<td>1128</td>
<td>312</td>
<td>207</td>
<td>417</td>
</tr>
<tr>
<td>Of those who purchased last season</td>
<td>76</td>
<td>463</td>
<td>342</td>
<td>5844</td>
</tr>
<tr>
<td>Percent who purchased last season</td>
<td>1132</td>
<td>7%</td>
<td>5%</td>
<td>8%</td>
</tr>
</tbody>
</table>

Other chemical inputs

Other chemical inputs (fungicides, herbicides) were reported in less than 1% of cases, so will not be discussed further here.

Harvesting

Table 58 Maize harvesting days (per acre)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hired labour days</td>
<td>982</td>
<td>3.07</td>
<td>2.71</td>
<td>3.44</td>
</tr>
<tr>
<td>Household labour days</td>
<td>1038</td>
<td>9.08</td>
<td>8.56</td>
<td>9.6</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>12.15</td>
<td></td>
</tr>
</tbody>
</table>

The mean harvesting labour days for maize is 12, which is easily the lowest of the main crops. In saying this, it is possible that some respondents didn’t include threshing in this labour days estimation (even though threshing was bracketed as an activity to include in harvesting days).

Yields

The mean yield as reported by farmers was 462 kg per acre. Standard error was low. As the mean can be influenced by outliers, we took a logical cut-off point by cross checking the low, common and high estimations reported in the FGDs, and secondly used a histogram to cross check whether that range was reflected in the survey findings. We ultimately determined the high and low cut-off points by choosing a gap where the tail breaks in the histogram, as cross checked with the reported ranges in the focus group discussions. Typically this meant excluding a low number of observations (around 10 or so) which can be deemed as obvious outliers with questionable reliability.

Maize yields were highest in Simiyu (602 kg/acre) and lowest in Shinyanga (325 kg/acre).

Table 59 Maize yields per region (kg per acre)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>427.51</td>
<td>21.41</td>
<td>385.49</td>
<td>469.53</td>
</tr>
<tr>
<td>Mara</td>
<td>421.22</td>
<td>32.60</td>
<td>357.24</td>
<td>485.19</td>
</tr>
<tr>
<td>Mwanza</td>
<td>408.80</td>
<td>22.80</td>
<td>364.06</td>
<td>453.54</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>324.95</td>
<td>19.87</td>
<td>285.96</td>
<td>363.95</td>
</tr>
<tr>
<td>Simiyu</td>
<td>601.78</td>
<td>20.30</td>
<td>561.96</td>
<td>641.61</td>
</tr>
<tr>
<td>Tabora</td>
<td>428.50</td>
<td>31.23</td>
<td>367.21</td>
<td>489.79</td>
</tr>
<tr>
<td>All areas</td>
<td>461.78</td>
<td>10.33</td>
<td>441.51</td>
<td>482.04</td>
</tr>
</tbody>
</table>

Figure 17 Maize yields per region (kg per acre)
### Prices

Maize prices are free to float on the open market and varied across regions and districts. Respondents were asked what the most common price was that they sold most of their maize last season. From this data, the mean price reported for all areas was 398 TZS /kg, with the highest prices reported in Mara (536 TZS /kg) and the lowest in Tabora (260 TZS /kg).

### Revenue

Maize revenue is calculated from the data by 1) first checking if all respondents gave a value for the common price or whether this is missing. If the price was missing for an observation in rare cases, the district average was used for that observation. For each farmer the price * total production was used, and then divided by the total acres under maize to give the revenue per acre for maize. From this we find a mean revenue for all areas of 174000 TZS per acre.
Figure 20 Maize revenue per acre (TZS)

<table>
<thead>
<tr>
<th>Area</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>UCI</th>
<th>LCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>158202</td>
<td>8546</td>
<td>141432</td>
<td>174973</td>
</tr>
<tr>
<td>Mara</td>
<td>214266</td>
<td>14898</td>
<td>185052</td>
<td>243501</td>
</tr>
<tr>
<td>Mwanza</td>
<td>176694</td>
<td>10132</td>
<td>156811</td>
<td>196576</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>111928</td>
<td>7080</td>
<td>98035</td>
<td>125821</td>
</tr>
<tr>
<td>Simiyu</td>
<td>206486</td>
<td>6985</td>
<td>192779</td>
<td>220193</td>
</tr>
<tr>
<td>Tabora</td>
<td>111808</td>
<td>8261</td>
<td>95596</td>
<td>128019</td>
</tr>
<tr>
<td>All areas</td>
<td>173661</td>
<td>4043</td>
<td>165727</td>
<td>181595</td>
</tr>
</tbody>
</table>

Figure 5 shows that in terms of revenues, maize seems to have a distribution of benefits that reflects TFP curves: no losses are incurred obviously as no costs are yet deducted.

Figure 21 Maize mean revenues, per acre, fraction of farmers

Profitability

The following table presents the means of all costs and revenues to present a simplified representation of the profitability of maize. Profitability is also given as a breakdown a) excluding all labour, b) excluding only household labour, and c) including all costs (inputs such as seed, pesticides, fertilizer etc., hired labour and household labour).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planting fertilizer</td>
<td>510</td>
<td>228</td>
<td>793</td>
</tr>
<tr>
<td>Top dressing</td>
<td>646</td>
<td>321</td>
<td>972</td>
</tr>
<tr>
<td>Manure</td>
<td>1758</td>
<td>1312</td>
<td>2204</td>
</tr>
<tr>
<td>Pesticides</td>
<td>312</td>
<td>207</td>
<td>417</td>
</tr>
<tr>
<td>Fungicides</td>
<td>4</td>
<td>-4</td>
<td>12</td>
</tr>
<tr>
<td>Herbicides</td>
<td>90</td>
<td>-18</td>
<td>198</td>
</tr>
<tr>
<td>Seed</td>
<td>7668</td>
<td>7021</td>
<td>8314</td>
</tr>
<tr>
<td>Hired labour - land preparation</td>
<td>4956</td>
<td>4236</td>
<td>5675</td>
</tr>
<tr>
<td>Hired labour - planting</td>
<td>2076</td>
<td>1687</td>
<td>2465</td>
</tr>
<tr>
<td>Hired labour - fertilizer application</td>
<td>226</td>
<td>76</td>
<td>376</td>
</tr>
<tr>
<td>Hired labour - weeding</td>
<td>12623</td>
<td>11185</td>
<td>14060</td>
</tr>
<tr>
<td>Hired labour - spraying</td>
<td>92</td>
<td>14</td>
<td>171</td>
</tr>
<tr>
<td>Hired labour - harvesting</td>
<td>10396</td>
<td>9036</td>
<td>11757</td>
</tr>
<tr>
<td>Household labour - land preparation</td>
<td>25880</td>
<td>24194</td>
<td>27567</td>
</tr>
<tr>
<td>Household labour - planting</td>
<td>16301</td>
<td>15292</td>
<td>17311</td>
</tr>
<tr>
<td>Household labour - fertilizer application</td>
<td>2499</td>
<td>1883</td>
<td>3115</td>
</tr>
<tr>
<td>Household labour - weeding</td>
<td>40950</td>
<td>38330</td>
<td>43570</td>
</tr>
<tr>
<td>Household labour - spraying</td>
<td>356</td>
<td>192</td>
<td>521</td>
</tr>
<tr>
<td>Household labour - harvesting</td>
<td>29674</td>
<td>27787</td>
<td>31561</td>
</tr>
</tbody>
</table>

While the above table presents the means, it is informative to consider the following histograms regarding the profitability of maize in different scenarios. This shows that on average, maize is marginally profitable for virtually all farmers if household labour is excluded as a cost. However, if household labour as an opportunity cost is included then maize has nearly zero profitability on average - nearly half of all respondents would experience a negative profit.
Figure 22 Maize mean revenues minus input costs, per acre, fraction of farmers

Figure 23 Maize mean revenues minus input costs and hired labour costs, per acre, fraction of farmers

Figure 24 Maize mean revenues minus input costs and hired and household labour costs, per acre, fraction of farmers

Maize regression

The regression (Table 105) shows that there is no significant correlation (at the 5% level) between the amount of land under which maize is cultivated and the yield (although negative as expected and significant at the 10% level). There is also no significant correlation between the number of crops a farmer grows and his/her maize yield. However, there are highly significant effects on the yield of maize when adding labour, or investments in manure, and seed. Investments in pesticides does not influence yields with a statistically significant difference, and are seldom used in maize production. For maize each additional day of labour sees a 2.34 kg increase (2.34 * 388.6 TZS = 909.32 TZS).

Figure 25 Maize regression, effect of variables on maize yields
Effect of an additional acre cultivated on maize yield (kg/acre) Not significant at 5% level

Effect of an additional crop grown by the household on maize yield (kg/acre) Not significant

Effect of an additional day of labour on maize yield (kg/acre) *** significant

Effect of an additional TZS spent on manure on maize yield (kg/acre) *** significant

Effect of an additional TZS spent on pesticides on maize yield (kg/acre) Not significant

Effect of an additional TZS spent on seed on maize yield (kg/acre) *** significant
Rice

Background

Changes in land under rice compared with 5 years ago

Percentage estimates of changes in land under rice were made with participants in the focus groups by asking them whether or not they were growing each of the main crops 5 years ago and today. 33 of the 60 focus groups said that rice was grown in their area, and reported similar percentages of farmers growing rice today (67%) as 5 years ago (72%).

Figure 26 Rice, percent of farmers growing per district

On average, those farmers growing rice as a most important or second most important crop have 2.92 acres of land under rice, which is 37% of their total land.

Table 63 Rice mean acres for those growing as most important or second most important crop (per region)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Err.</th>
<th>[95% Conf. Interval]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>3.03</td>
<td>0.38</td>
<td>2.29</td>
</tr>
<tr>
<td>Mara</td>
<td>2.43</td>
<td>0.65</td>
<td>1.14</td>
</tr>
<tr>
<td>Mwanza</td>
<td>2.86</td>
<td>0.22</td>
<td>2.41</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>3.59</td>
<td>0.37</td>
<td>2.86</td>
</tr>
<tr>
<td>Simiyu</td>
<td>1.56</td>
<td>0.31</td>
<td>0.96</td>
</tr>
<tr>
<td>Tabora</td>
<td>1.22</td>
<td>0.22</td>
<td>0.79</td>
</tr>
<tr>
<td>All areas</td>
<td>2.92</td>
<td>0.16</td>
<td>2.61</td>
</tr>
</tbody>
</table>

Note this should not be read as the mean of rice in the regions overall, as only farmers who are growing rice as their most important or second most crop were reporting. Farmers growing rice but who regard it as a less important crop were not asked to respond. This likely skews the mean towards the higher scores.

Table 64 Share of land under rice for those growing as most important or second most important crop per region

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>28%</td>
<td>2%</td>
<td>24%</td>
<td>31%</td>
</tr>
<tr>
<td>Mara</td>
<td>33%</td>
<td>5%</td>
<td>22%</td>
<td>43%</td>
</tr>
<tr>
<td>Mwanza</td>
<td>39%</td>
<td>1%</td>
<td>36%</td>
<td>42%</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>41%</td>
<td>2%</td>
<td>37%</td>
<td>45%</td>
</tr>
<tr>
<td>Simiyu</td>
<td>33%</td>
<td>5%</td>
<td>24%</td>
<td>41%</td>
</tr>
<tr>
<td>Tabora</td>
<td>46%</td>
<td>11%</td>
<td>24%</td>
<td>68%</td>
</tr>
<tr>
<td>All areas</td>
<td>37%</td>
<td>1%</td>
<td>35%</td>
<td>39%</td>
</tr>
</tbody>
</table>

Reasons given by farmers for growing Rice

Rice’s qualities as a food commodity and cash crop were equally cited as being the most important reasons for its being grown. Many groups cited rice as being the second or third food crop after maize (or maize and cassava) in the household. As a food crop it contributes to food security, but it is also regarded as 'respectable' crop in that it is desirable for community celebrations also. In general the market for rice is said to be very good - there is high demand and good prices.

Furthermore, rice stores well and easily for more than one year without needing chemicals for storage. Farmers say they can hold the crop and decide later if they wish to sell more or keep for household consumption, or hold rice and wait for an ideal market price or when they have a need for cash.

The other major reason for growing rice is the relatively low costs involved in production. In general it is said that the inputs and labour is lower than cotton and the yields better. Part of the reason for low production costs is the low prevalence of diseases. Land suitability and availability is another factor with farmers saying that in some areas rice valleys are increasingly being expanded.
Crop replacement

While a few participant groups did say rice is replacing cotton, many more emphasized that either cultivatable land is being increased for rice (and not displacing other crops), or that farmers are now giving it more attention in production. In many areas rice does not seem to be displacing cotton and some respondents explicitly stated this.

Knowledge and experience

Rice is well established in Mwanza and Shinyanga especially, with around 16 years being the average number of years respondents have been growing cotton in these areas (these areas had the most respondents growing rice). In studied villages in other areas, rice has been introduced relatively recently. Farmer perceptions of their rice knowledge is not so high, with around 50% believing that their knowledge is less than adequate. In saying this, farmers gave very similar responses about their knowledge of the other main crops also, which suggests more of a systemic lack of farming knowledge.

Consumption and marketing

39% of respondents reported growing rice last season. Of those growing rice, 45% reporting selling some of their crop last season (18% of the total survey sample).

For those growing rice as their most important or second most important crop, 74% of respondents reported marketing rice, which is much higher than either cassava or maize. The mean percentage share of rice marketed by all rice farmers is 34% (including those who marketed none). However the mean percentage marketed of those who sold at least some rice was 53%.

This shows that rice is both a cash crop and a crop for household consumption and food security.

Production costs per acre

Land leasing

Quite a number of respondents (31%) say they leased or borrowed land last season, but the study did not collect specific data on what crop(s) this land is leased for. According to the focus group budget data, when rice farmers lease land, it costs on average 50000 TZS per acre per season, and ranges between 30000 and 100000 TZS.
Land preparation

The survey data shows that land preparation takes about 13 days per acre of rice. Predominantly household labour is used over hired labour, as is the case with other crops. The range of labour days can be up to 60 days in rare cases. In reality, the number of labour days spent depends on many variables such as whether animal traction was used, whether land is virgin or recently cultivated with rice.

<table>
<thead>
<tr>
<th>Table 68 Rice land clearing and ploughing labour days (per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Hired labour days</td>
</tr>
<tr>
<td>Household labour days</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Seed cost

A relatively low number of farmers reported buying rice seed last season (20%). The mean spend on seed of all rice farmers was 2369 TZS. If we include only those who bought seed, the mean is 12096 TZS.

<table>
<thead>
<tr>
<th>Table 69 Rice seed cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Seed cost (inc. 0)</td>
</tr>
<tr>
<td>Of those who purchased last season</td>
</tr>
<tr>
<td>Percent who purchased last season</td>
</tr>
</tbody>
</table>

Planting

Planting rice takes an average of 14 labour days per acre. This is more than double the time taken to plant cotton and maize and nearly double that of cassava. The reason is that rice needs to be transplanted from a seed bed, which is fairly labour intensive.

<table>
<thead>
<tr>
<th>Table 70 Rice planting labour days (per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Hired labour days</td>
</tr>
<tr>
<td>Household labour days</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Fertilizer purchase

Very few farmers (3%) reported using fertilizer last season. Only marginally more farmers reported using manure (7%).

<table>
<thead>
<tr>
<th>Table 71 Rice- Cost of fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Fertilizer cost (inc. 0)</td>
</tr>
<tr>
<td>Of those who purchased last season</td>
</tr>
<tr>
<td>Percent who purchased last season</td>
</tr>
</tbody>
</table>

Weeding

Weeding takes a considerable number of days (18.5) but this is less than for cotton and cassava, although more than for maize.

<table>
<thead>
<tr>
<th>Table 72 Rice weeding labour days (per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Hired labour days</td>
</tr>
<tr>
<td>Household labour days</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Pesticides purchase

Relatively few farmers use pesticides (7%) compared with cotton and this amounts to very low mean labour days on spraying.

<table>
<thead>
<tr>
<th>Table 73 Rice - Cost of pesticides</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Pesticides cost (incl. 0)</td>
</tr>
<tr>
<td>Of those who purchased last season</td>
</tr>
<tr>
<td>Percent who purchased last season</td>
</tr>
</tbody>
</table>
Other chemical inputs

Other chemical inputs (fungicides, herbicides) were very rarely reported (less than 1% of cases).

Harvesting

The mean labour days for harvesting rice is 18, which is less than cotton (22) and cassava (24) but more than for maize (12). This is also the activity with the most reported hired labour days on average.

Table 74 Rice harvesting days (per acre)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hired labour days</td>
<td>311</td>
<td>5.31</td>
<td>4.16</td>
<td>6.45</td>
</tr>
<tr>
<td>Household labour days</td>
<td>297</td>
<td>12.78</td>
<td>11.06</td>
<td>14.5</td>
</tr>
<tr>
<td>Total</td>
<td>18.09</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Yields

The mean yield as reported by farmers was 594 kg per acre. As the mean can be strongly influenced by outliers, we took a logical cut-off point by cross checking the low, common and high estimations reported in the FGDs, and secondly used a histogram to cross check whether that range was reflected in the survey findings. We ultimately determined the high and low cut-off points by choosing a gap where the tail breaks in the histogram, as cross checked with the reported ranges in the focus group discussions. Typically this meant excluding a low number of observations which can be deemed as obvious outliers with questionable reliability.

Rice yields were 502 kg/acre in Mwanza and 522 kg/acre in Shinyanga – the regions with the most observations. Simiyu, Tabora and Mara all recorded less than 30 observations of farmers growing rice as the most important or second most important crop, and as a result have a higher standard error.

Table 75 Rice yields per region (kg per acre)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>681.74</td>
<td>66.22</td>
<td>551.30</td>
<td>812.18</td>
</tr>
<tr>
<td>Mara</td>
<td>875.80</td>
<td>117.35</td>
<td>644.65</td>
<td>1106.95</td>
</tr>
<tr>
<td>Mwanza</td>
<td>501.87</td>
<td>39.71</td>
<td>423.66</td>
<td>580.09</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>522.77</td>
<td>44.16</td>
<td>435.79</td>
<td>609.76</td>
</tr>
<tr>
<td>Simiyu</td>
<td>781.53</td>
<td>88.80</td>
<td>606.62</td>
<td>956.44</td>
</tr>
<tr>
<td>Tabora</td>
<td>1092.50</td>
<td>474.72</td>
<td>157.43</td>
<td>2027.57</td>
</tr>
<tr>
<td>All areas</td>
<td>594.29</td>
<td>27.21</td>
<td>540.69</td>
<td>647.89</td>
</tr>
</tbody>
</table>

Table 76 Rice yields per district (kg per acre)

<table>
<thead>
<tr>
<th>District</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bariadi</td>
<td>706.22</td>
<td>113.68</td>
<td>482.30</td>
<td>930.13</td>
</tr>
<tr>
<td>Bukombe</td>
<td>518.76</td>
<td>191.03</td>
<td>142.48</td>
<td>896.05</td>
</tr>
<tr>
<td>Bunda</td>
<td>923.18</td>
<td>160.62</td>
<td>606.80</td>
<td>1239.56</td>
</tr>
<tr>
<td>Busega</td>
<td>125.00</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Bullama</td>
<td>668.24</td>
<td>137.66</td>
<td>397.09</td>
<td>939.39</td>
</tr>
<tr>
<td>Chato</td>
<td>896.33</td>
<td>170.03</td>
<td>561.42</td>
<td>1231.24</td>
</tr>
<tr>
<td>Geita</td>
<td>751.82</td>
<td>114.01</td>
<td>527.25</td>
<td>976.38</td>
</tr>
<tr>
<td>Igunga</td>
<td>1092.50</td>
<td>474.72</td>
<td>157.43</td>
<td>2027.57</td>
</tr>
<tr>
<td>Itilima</td>
<td>1041.00</td>
<td>105.23</td>
<td>833.73</td>
<td>1248.27</td>
</tr>
<tr>
<td>Kahama</td>
<td>331.24</td>
<td>37.50</td>
<td>236.35</td>
<td>405.95</td>
</tr>
<tr>
<td>Kishapu</td>
<td>737.88</td>
<td>144.79</td>
<td>452.68</td>
<td>1023.07</td>
</tr>
<tr>
<td>Kwimba</td>
<td>321.15</td>
<td>43.05</td>
<td>236.35</td>
<td>405.95</td>
</tr>
<tr>
<td>Magu</td>
<td>576.41</td>
<td>142.05</td>
<td>296.61</td>
<td>856.21</td>
</tr>
<tr>
<td>Maswa</td>
<td>874.46</td>
<td>225.32</td>
<td>430.64</td>
<td>1318.29</td>
</tr>
<tr>
<td>Mbongwe</td>
<td>823.69</td>
<td>89.12</td>
<td>448.15</td>
<td>799.23</td>
</tr>
<tr>
<td>Misungwi</td>
<td>451.68</td>
<td>50.53</td>
<td>352.15</td>
<td>551.21</td>
</tr>
<tr>
<td>Sengerema</td>
<td>832.24</td>
<td>106.79</td>
<td>621.89</td>
<td>1042.59</td>
</tr>
<tr>
<td>Serengti</td>
<td>1600.00</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>709.97</td>
<td>64.36</td>
<td>583.19</td>
<td>836.74</td>
</tr>
<tr>
<td>All areas</td>
<td>594.29</td>
<td>27.21</td>
<td>540.69</td>
<td>647.89</td>
</tr>
</tbody>
</table>
Prices

Rice prices are free to float on the open market and varied across regions and districts. Respondents were asked what the most common price was that they sold most of their cassava last season. From this data, the mean price reported for all areas was 683 TZS/kg. The highest prices reported in Mara (878 TZS/kg) and the lowest in Geita (518 TZS/kg).

Revenue

Rice revenue is calculated from the data by 1) first checking if all respondents gave a value for the common price or whether this is missing. If the price was missing for an observation in rare cases, the relevant district average was used for that observation. For each farmer the price * total production was used, and then divided by the total acres under rice to give the revenue per acre for rice. From this we find a mean revenue for all areas of 343606 TZS per acre.
Profitability

The following table presents the means of all costs and revenues to provide a simplified representation of the profitability of rice in a single season. Profitability is also given as a breakdown a) excluding all labour, b) excluding only household labour, and c) including all costs (inputs such as seed, pesticides, fertilizer etc., hired labour and household labour).

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Costs inputs (fertilizer, pesticides, seed etc.)</strong></td>
<td>4698</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Costs hired labour</strong></td>
<td>51443</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Costs household labour (opportunity cost)</strong></td>
<td>168586</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total costs - all</strong></td>
<td>224726</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total revenue</strong></td>
<td>343606</td>
<td>311000</td>
<td>376000</td>
</tr>
<tr>
<td><strong>Profit - excl. all labour</strong></td>
<td>338908</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Profit - excl. household labour</strong></td>
<td>287465</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Profit - all costs</strong></td>
<td>118880</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

While the above table presents the means, it is informative to consider the following histograms regarding the profitability of cassava in different scenarios. This shows that rice has good profitability for all farmers if household labour is excluded as a cost. In fact, there is a very large range in the profitability of rice and some farmers are doing very well from the crop. However, if household labour as an opportunity cost is included then rice has a lower profitability with quite some respondents experiencing a negative profit. Nevertheless, some farmers will still do very well from the crop. Rice is the most profitable crops of the four the study looked at in detail (cotton, maize, cassava and rice).
Rice regression

For rice, none of the correlations are significant at the 5% level (although the effect of an additional acre of rice on yield is negative and significant at the 10% level). This is partly due to the number of observations available for all the variables. With additional observations it might be assumed that there would be a weak positive effect of additional labour and seed investments on yield, which would follow the pattern of cotton and maize. See Table 105 for full regression table.
Figure 34 Rice regression, effect of variables on rice yield

- Effect of an additional acre cultivated on rice yield (kg/acre): Not significant at the 5% level
- Effect of an additional crop grown by the household on rice yield (kg/acre): Not significant
- Effect of an additional day of labour on rice yield (kg/acre): Not significant
- Effect of an additional TZS spent on manure on rice yield (kg/acre): Not significant
- Effect of an additional TZS spent on pesticides on rice yield (kg/acre): Not significant
- Effect of an additional TZS spent on seed on rice yield (kg/acre): Not significant
Cassava

Background

Changes in land under cassava compared with 5 years ago

Percentage estimates of changes in land under cassava were made with participants in the focus groups by asking them whether or not they were growing each of the main crops 5 years ago and today. 29 of the 60 focus groups said that cassava was grown in their area, and they reported a similar percentage of farmers growing cassava today (86%) as 5 years ago (83%).

Table 80 Cassava mean acres for those growing as most important or second most important crop (per region)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>3.56</td>
<td>0.36</td>
<td>2.85</td>
<td>4.27</td>
</tr>
<tr>
<td>Mara</td>
<td>2.09</td>
<td>0.13</td>
<td>1.83</td>
<td>2.35</td>
</tr>
<tr>
<td>Mwanza</td>
<td>2.16</td>
<td>0.31</td>
<td>1.55</td>
<td>2.76</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>1.71</td>
<td>0.38</td>
<td>0.97</td>
<td>2.45</td>
</tr>
<tr>
<td>Simiyu</td>
<td>3.07</td>
<td>0.89</td>
<td>1.31</td>
<td>4.83</td>
</tr>
<tr>
<td>All areas</td>
<td>2.53</td>
<td>0.15</td>
<td>2.24</td>
<td>2.83</td>
</tr>
</tbody>
</table>

Note this should not be read as the mean of cassava in the regions overall, as only farmers who are growing cassava as their most important or second most of crop were reporting. Farmers growing cassava but who regard it as a less important crop were not asked to respond. This likely skews the mean higher.

Table 81 Share of land under cassava for those growing as most important or second most important crop per region

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>48%</td>
<td>3%</td>
<td>42%</td>
<td>54%</td>
</tr>
<tr>
<td>Mara</td>
<td>45%</td>
<td>2%</td>
<td>41%</td>
<td>50%</td>
</tr>
<tr>
<td>Mwanza</td>
<td>45%</td>
<td>3%</td>
<td>40%</td>
<td>51%</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>32%</td>
<td>5%</td>
<td>23%</td>
<td>41%</td>
</tr>
<tr>
<td>Simiyu</td>
<td>33%</td>
<td>5%</td>
<td>23%</td>
<td>44%</td>
</tr>
<tr>
<td>All areas</td>
<td>45%</td>
<td>1%</td>
<td>42%</td>
<td>48%</td>
</tr>
</tbody>
</table>

Reasons given by farmers for growing Cassava

There are four main reasons why cassava is grown – food consumption, drought resistance, cash crop income and ease of storage.

It is an ingredient in Ugali and often cassava flour (udaga) is mixed with maize flour. It is a staple of many households, along with maize, and hence it contributes greatly to household food security. Cassava plays an important role in food security because it can left in the field for 2 years or more without rotting or being infected by disease.

Cassava was also very frequently mentioned as a good drought resistant crop option for farmers, and was said to do well in times of high rains too. Due to the wide usage of cassava, there is a ready market for it both inside and beyond the village. Hence it is mentioned also as a cash crop, despite its long cycle (1-1.5 years).

Respondents noted that it is easy to store cassava - after one year or so it is mature, but it can be left in the field after maturing to grow even larger for more than 2 years without any effort. Alternatively it can be stored in its milled dry form (udaga). In both ways cassava is resistant to disease. It is a good ‘insurance’ crop for both food security and the ability to sell it if money is needed.
Table 82 Farmer reasons for growing cassava

<table>
<thead>
<tr>
<th>Reasons for growing cassava</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food consumption</td>
<td>232</td>
</tr>
<tr>
<td>Drought resistant</td>
<td>219</td>
</tr>
<tr>
<td>Cash Crop income</td>
<td>188</td>
</tr>
<tr>
<td>Storage</td>
<td>173</td>
</tr>
<tr>
<td>Processing</td>
<td>72</td>
</tr>
<tr>
<td>Cost of production low</td>
<td>38</td>
</tr>
<tr>
<td>Culture</td>
<td>34</td>
</tr>
<tr>
<td>Soil</td>
<td>32</td>
</tr>
<tr>
<td>Climate and weather</td>
<td>30</td>
</tr>
<tr>
<td>Season long</td>
<td>16</td>
</tr>
<tr>
<td>Firewood source</td>
<td>15</td>
</tr>
</tbody>
</table>

Source: Focus group data from 29 focus groups mentioning cassava. The table is intended to be illustrative of respondents’ perceptions. Respondents ranked their reasons for growing cassava. The first ranked reason was given a score of 10, second ranked a score of 9 and so on. Usually 4 or less reasons were given per focus group. These rank scores were added from all focus groups.

Crop replacement

A number of focus groups (for which participants were growing cassava) said that gradually cassava cultivation is being expanded, displacing cotton (about 33% of groups citing). This is statistically unreliable as a firm number, however it does indicate that cassava does compete with cotton, and a farmer may choose to replace cotton on a farm with cassava or reduce the proportion of land under cotton in favour of cassava.

Knowledge and experience

Cassava is well established in Geita, Mara and Mwanza. Farmer perceptions of their cassava knowledge is not so high, with around 41% believing that their knowledge is less than adequate. In saying this, farmers gave very similar responses about their knowledge of the other main crops also, which suggests more of a systemic lack of farming knowledge.

Table 83 Mean years growing cassava per region

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>16.27</td>
<td>2.23</td>
<td>11.87</td>
<td>20.66</td>
</tr>
<tr>
<td>Mara</td>
<td>21.55</td>
<td>1.30</td>
<td>18.98</td>
<td>24.11</td>
</tr>
<tr>
<td>Mwanza</td>
<td>16.75</td>
<td>1.77</td>
<td>13.25</td>
<td>20.25</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>16.33</td>
<td>6.30</td>
<td>3.92</td>
<td>28.75</td>
</tr>
<tr>
<td>Simiyu</td>
<td>11.60</td>
<td>3.11</td>
<td>5.48</td>
<td>17.72</td>
</tr>
</tbody>
</table>

Consumption and marketing

33% of respondents reported growing cassava last season. Of those growing cassava, 26% reporting selling some of their crop last season (9% of the total survey sample).

For those growing cassava as their most important or second most important crop, 55% of respondents reported marketing cassava. The mean percentage of cassava marketed by all cassava farmers is 33% (including those who marketed none). However the mean percentage marketed of those who sold at least some cassava was 60%.

This shows that cassava is largely a crop for household consumption and food security, but that it is still marketed by many in the research area and doubles as a cash crop for those growing cassava seriously.

Production costs per acre

Land leasing

Quite a number of respondents (31%) say they leased or borrowed land last season, but the study did not collect specific data on what crop(s) this land is leased for. According to the focus group budget data, when cassava farmers lease land, it costs on average 50000 TZS per acre per season, and ranges between 30000 and 100000 TZS.
Land clearing and ploughing

The survey data shows that land clearing and ploughing takes about 14 days per acre of cassava. Predominantly household labour is used over hired labour, as is the case with other crops. The range of labour days can be up to 60 days in rare cases. In reality, the number of labour days spent depends on many variables such as whether animal traction was used, whether land is virgin or recently cultivated.

| Table 85 Cassava land clearing and ploughing labour days |
|---------------------------------------------|----------|------|------|
| N   | Mean | LCI  | UCI  |
| Hired labour days | 180 | 1.99 | 1.35 | 2.62 |
| Household labour days | 207 | 12.26 | 10.73 | 13.80 |
| Total | 14.25 |  |  |

Seed cost

A relatively low number of farmers reported buying cassava seed last season (8%). The mean spend on seed of all cassava farmers was 1211 TZS. If we include only those who bought seed, the mean is 14664.

<table>
<thead>
<tr>
<th>Table 86 Cassava seed cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>Seed cost (incl. 0)</td>
</tr>
<tr>
<td>Of those who purchased last season</td>
</tr>
<tr>
<td>Percent who purchased last season</td>
</tr>
</tbody>
</table>

Planting

Planting takes an average of 7.5 days and is mostly done by household labour.

| Table 87 Cassava planting labour days (per acre) |
|---------------------------------------------|----------|------|------|
| N   | Mean | LCI  | UCI  |
| Hired labour days | 172 | 0.84 | 0.4 | 1.28 |
| Household labour days | 218 | 6.78 | 5.93 | 7.64 |
| Total | 7.62 |  |  |

Fertilizer purchase

There was not one single case of a farmer growing cassava using chemical fertilizer. Only 16% of cassava farmers reported using manure, and the quantities used were unable to be accurately determined.

Weeding

Weeding takes a considerable number of days (22.5), which is the most labour days of any of the main crops studied and slightly higher than cotton weeding days (21.5).

| Table 88 Cassava weeding labour days (per acre) |
|----------------|----------|------|------|
| N   | Mean | LCI  | UCI  |
| Hired labour days | 182 | 4.36 | 3.15 | 5.56 |
| Household labour days | 201 | 18.15 | 15.96 | 20.34 |
| Total | 22.51 |  |  |

Pesticides and other chemical inputs

Other chemical inputs (pesticides, fungicides, herbicides) were reported in less than 1% of all cases.

Harvesting

The mean labour days for harvesting cassava is 24, which is the highest of the main crops in the study, and slightly higher than cotton (22). This is probably due to the fact that cassava is harvested by hand by separating the stem from the plant and then pulling out the roots of the ground. The stem then needs to be looked after so that it can be re-used to propagate cassava.

| Table 89 Cassava harvesting days (per acre) |
|----------------|----------|------|------|
| N   | Mean | LCI  | UCI  |
| Hired labour days | 167 | 4.08 | 2.36 | 5.8 |
| Household labour days | 173 | 20.25 | 17.4 | 23.11 |
| Total | 24.33 |  |  |

Yields

The mean yield as reported by farmers was 566kg per acre. As the mean can be influenced by outliers, we took a logical cut-off point by cross checking the low, common and high estimations reported in the FGDs, and secondly used a histogram to cross check whether that range was reflected in the survey findings. We ultimately determined the high and low cut-off points by choosing a gap where the tail breaks and the histogram, as cross checked with the reported ranges in the focus group discussions. Typically this meant excluding a low number of observations (around 10 or so) which can be deemed as obvious outliers with questionable reliability.
The highest (reliable) cassava yields were in Mwanza (602 kg/acre) and lowest in Mara (515 kg/acre).

Table 90 Cassava yields per region (kg per acre)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>564.57</td>
<td>61.79</td>
<td>442.38</td>
<td>686.75</td>
</tr>
<tr>
<td>Mara</td>
<td>515.37</td>
<td>70.74</td>
<td>375.48</td>
<td>655.25</td>
</tr>
<tr>
<td>Mwanza</td>
<td>601.98</td>
<td>57.62</td>
<td>488.05</td>
<td>715.92</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>593.33</td>
<td>303.39</td>
<td>-6.64</td>
<td>1193.30</td>
</tr>
<tr>
<td>Simiyu</td>
<td>626.06</td>
<td>150.73</td>
<td>327.98</td>
<td>924.14</td>
</tr>
<tr>
<td>All areas</td>
<td>566.39</td>
<td>34.66</td>
<td>497.87</td>
<td>634.91</td>
</tr>
</tbody>
</table>

Figure 36 Cassava yields per region (kg per acre)

Table 91 Cassava yields per district (kg per acre)

<table>
<thead>
<tr>
<th>District</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bukombe</td>
<td>556.79</td>
<td>116.37</td>
<td>326.65</td>
<td>786.92</td>
</tr>
<tr>
<td>Bunda</td>
<td>355.17</td>
<td>114.86</td>
<td>128.03</td>
<td>582.31</td>
</tr>
<tr>
<td>Busega</td>
<td>626.06</td>
<td>150.73</td>
<td>327.98</td>
<td>924.14</td>
</tr>
<tr>
<td>Butiama</td>
<td>528.22</td>
<td>88.28</td>
<td>353.63</td>
<td>702.81</td>
</tr>
<tr>
<td>Chato</td>
<td>660.00</td>
<td>173.24</td>
<td>317.42</td>
<td>1002.59</td>
</tr>
<tr>
<td>Geita</td>
<td>562.18</td>
<td>88.71</td>
<td>386.76</td>
<td>737.60</td>
</tr>
<tr>
<td>Kahama</td>
<td>593.33</td>
<td>303.39</td>
<td>-6.64</td>
<td>1193.30</td>
</tr>
<tr>
<td>Kwimba</td>
<td>341.67</td>
<td>8.33</td>
<td>325.19</td>
<td>358.15</td>
</tr>
<tr>
<td>Magu</td>
<td>608.75</td>
<td>172.05</td>
<td>268.51</td>
<td>948.99</td>
</tr>
<tr>
<td>Mbongwe</td>
<td>311.25</td>
<td>48.75</td>
<td>214.84</td>
<td>407.66</td>
</tr>
<tr>
<td>Misungwi</td>
<td>576.46</td>
<td>149.94</td>
<td>279.94</td>
<td>872.98</td>
</tr>
<tr>
<td>Sengerema</td>
<td>629.93</td>
<td>69.15</td>
<td>493.18</td>
<td>766.68</td>
</tr>
<tr>
<td>Serengeti</td>
<td>720.31</td>
<td>216.57</td>
<td>292.04</td>
<td>1148.59</td>
</tr>
<tr>
<td>All areas</td>
<td>566.39</td>
<td>34.66</td>
<td>497.87</td>
<td>634.91</td>
</tr>
</tbody>
</table>

Figure 37 Cassava yield per district (kg/acres)

Price

Cassava prices are free to float on the open market and varied across regions and districts. Respondents were asked what the most common price was that they sold most of their cassava last season. From this data, the mean price reported for all areas was 537 TZS /kg, but there was a big range. The highest prices reported in Mara (856 TZS /kg) and the lowest in Geita (323 TZS /kg)
Table 92 Mean price of cassava per region (TZS per kg)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>323.26</td>
<td>1.72</td>
<td>319.88</td>
<td>326.64</td>
</tr>
<tr>
<td>Mara</td>
<td>856.01</td>
<td>9.50</td>
<td>837.37</td>
<td>874.65</td>
</tr>
<tr>
<td>Mwanza</td>
<td>561.53</td>
<td>7.66</td>
<td>546.49</td>
<td>576.56</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>207.50</td>
<td>0.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Simiyu</td>
<td>555.00</td>
<td>0.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>All areas</td>
<td>536.59</td>
<td>8.18</td>
<td>520.54</td>
<td>552.64</td>
</tr>
</tbody>
</table>

Figure 38 Cassava - Average price per district (TZS/kg)

Legend

Average price Cassava:
- 0 - 333
- 333 - 470
- 470 - 555
- 555 - 725
- 725 - 1030

Figure 39 Cassava mean revenues, per acre, fraction of farmers

Profitability

The following table presents the means of all costs and revenues to provide a simplified representation of the profitability of cassava in a single season. Profitability is also given as a breakdown a) excluding all labour, b) excluding only household labour, and c) including all costs (inputs such as seed, pesticides, fertilizer etc., hired labour and household labour).

Revenue

Cassava revenue is calculated from the data by 1) first checking if all respondents gave a value for the common price or whether this is missing. If the price was missing for an observation in rare cases, the district average was used for that observation. For each farmer the price * total production was used, and then divided by the total acres under cassava to give the revenue per acre for cassava. From this we find a mean revenue for all areas of 300008 TZS per acre.

Table 93 Cassava revenue per acre (TZS)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geita</td>
<td>189922</td>
<td>25470</td>
<td>139525</td>
<td>240319</td>
</tr>
<tr>
<td>Mara</td>
<td>359465</td>
<td>39974</td>
<td>280369</td>
<td>438561</td>
</tr>
<tr>
<td>Mwanza</td>
<td>354145</td>
<td>36583</td>
<td>281760</td>
<td>426531</td>
</tr>
<tr>
<td>Shinyanga</td>
<td>132867</td>
<td>77584</td>
<td>-20646</td>
<td>286379</td>
</tr>
<tr>
<td>Simiyu</td>
<td>374561</td>
<td>87476</td>
<td>201475</td>
<td>547647</td>
</tr>
<tr>
<td>All areas</td>
<td>300008</td>
<td>19755</td>
<td>260928</td>
<td>339088</td>
</tr>
</tbody>
</table>
Table 94 Cassava profitability per acre

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planting fertilizer</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Top dressing</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Manure</td>
<td>631.16</td>
<td>61.87</td>
<td>1200.45</td>
</tr>
<tr>
<td>Pesticides</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fungicides</td>
<td>108.7</td>
<td>-105.48</td>
<td>322.87</td>
</tr>
<tr>
<td>Herbicides</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Seed</td>
<td>1211.35</td>
<td>459.12</td>
<td>1963.58</td>
</tr>
<tr>
<td>Hired labour - land preparation</td>
<td>5385.62</td>
<td>3425.05</td>
<td>7346.19</td>
</tr>
<tr>
<td>Hired labour - planting</td>
<td>2524.17</td>
<td>1250.77</td>
<td>3797.57</td>
</tr>
<tr>
<td>Hired labour - fertilizer application</td>
<td>4.91</td>
<td>-4.78</td>
<td>14.59</td>
</tr>
<tr>
<td>Hired labour - weeding</td>
<td>11442.14</td>
<td>8179.55</td>
<td>14704.74</td>
</tr>
<tr>
<td>Hired labour - spraying</td>
<td>12.05</td>
<td>-11.74</td>
<td>35.84</td>
</tr>
<tr>
<td>Hired labour - harvesting</td>
<td>12465.37</td>
<td>6845.61</td>
<td>18085.13</td>
</tr>
<tr>
<td>Household labour - land preparation</td>
<td>38302.71</td>
<td>31692.79</td>
<td>44912.63</td>
</tr>
<tr>
<td>Household labour - planting</td>
<td>20254.89</td>
<td>17265.07</td>
<td>23244.7</td>
</tr>
<tr>
<td>Household labour - fertilizer application</td>
<td>1019.06</td>
<td>196.66</td>
<td>1841.45</td>
</tr>
<tr>
<td>Household labour - weeding</td>
<td>56412.17</td>
<td>47543.69</td>
<td>65280.65</td>
</tr>
<tr>
<td>Household labour - spraying</td>
<td>215.41</td>
<td>-67.94</td>
<td>498.76</td>
</tr>
<tr>
<td>Household labour - harvesting</td>
<td>60186.3</td>
<td>50054.06</td>
<td>70318.54</td>
</tr>
</tbody>
</table>

Costs inputs (fertilizer, pesticides, seed etc.) 1951
Costs hired labour 31834
Costs household labour (opportunity cost) 176391
Total costs - all 210176

Total revenue 300008        260,928         339,088
Profit - excl. all labour 298056
Profit - excl. household labour 266222
Profit - all costs 89832

While the above table presents the means, it is informative to consider the following histograms regarding the profitability of cassava in different scenarios. This shows that cassava is profitable for virtually all farmers if household labour is excluded as a cost. In fact, there is a very large range in the profitability of cassava among farmers and some farmers are doing rather well from the crop. However, if household labour as an opportunity cost is included then cassava has quite a low profitability on average – and maybe 40% of all respondents would experience a negative profit. Nevertheless, some farmers will still do very well from the crop.
Cassava regression

The regression (Table 105) shows that there are no significant correlations between the regressed variables and cassava yield. The effects of additional acres under cassava and number of crops grown in relation to yield are again negative but not significant, consistent with other crops studied. For pesticides, manure and seed, these are all not significant and there are very few cassava farmers investing in these at all. There appears to be a weak positive effect from additional labour, but again this is not significant.

Figure 43 Cassava regression, effect of variables on cassava yield
**Other crops and activities**

Despite the fact that this report focuses on the four main crops, a considerable amount of information was collected in the course of the study on smaller crops. Here we briefly summarise this information for each. Some of these crops seem to be doing well against cotton. The information is derived from the FGDs within the villages where at least 3 participant groups mentioned the crop.

**Sweet potato**

Sweet potatoes were most frequently mentioned as a good option for household food consumption. Several groups made mention of it as a perfect food given that it doesn't require other ingredients such as when making a stew or soup. It's a good alternative to maize and children in particular prefer it because it is a little sweet. Commonly it is stored dried, as michembe.

Sweet potato as a cash crop is secondary to it being a crop for household food consumption. It is mainly sold when there is an obvious surplus or if the household is in urgent need of money. Prices are said to be good compared with other crops and prices rise with time from the harvest season. The cost of production is also said to be very low compared with cotton, and requires less family labour and no chemical inputs. For example farmers only need one weeding season and as a short season crop it is ready to harvest in only 2.5-3 months.

Recent changes in the crop include the appearance of pests that affect the tubers in the ground. This has caused the crop to be no longer fit for storage in the ground as is the case with cassava. Instead, farmers now harvest and dry the roots and store them in bags and cans. The reason given for this development is that the soil is being exhausted, and this reduces the resistance of the crop to these diseases.

**Table 95 Farmer reasons for growing sweet potato**

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food consumption</td>
<td>200</td>
</tr>
<tr>
<td>Cash Crop income</td>
<td>105</td>
</tr>
<tr>
<td>Cost of production low</td>
<td>52</td>
</tr>
<tr>
<td>Storage</td>
<td>39</td>
</tr>
<tr>
<td>Land availability and suitability</td>
<td>38</td>
</tr>
<tr>
<td>Season short</td>
<td>17</td>
</tr>
<tr>
<td>Processing</td>
<td>16</td>
</tr>
</tbody>
</table>

Source: Focus group data. The table is intended to be illustrative of respondent’s reasons. Respondents ranked their reasons with the first ranked reason given a score of 10, second ranked a score of 9 and so on. Usually 4 or less reasons were given per focus group. These rank scores were added from all focus groups.

**Green grams**

Green grams are said to have a lower cost of production than cotton. While not the major crop in most household production systems, it nonetheless is described as a good
crop for household consumption, while at the same time being one of the crops contributing to additional household income given the increased demand for this crop. While before it was something of a local crop, there is a good market now both inside and outside the village and is said to fetch a good price: it is a seller’s market. It is flexible for intercropping with either maize, cotton or sunflower. It is also a short season crop – harvested within 2-3 months, and two harvests are possible per year. The crop is reasonably drought resistant. Though there have been extension efforts, there doesn’t seem to be anything but local varieties of this crop available in the market as seed.

Table 96 Farmer reasons for growing green grams

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of production low</td>
<td>58</td>
</tr>
<tr>
<td>Cash Crop income</td>
<td>58</td>
</tr>
<tr>
<td>Food consumption</td>
<td>54</td>
</tr>
<tr>
<td>Intercropping</td>
<td>53</td>
</tr>
<tr>
<td>Land availability and suitability</td>
<td>39</td>
</tr>
<tr>
<td>Season short</td>
<td>25</td>
</tr>
</tbody>
</table>

Sorghum

The main reason farmers grow sorghum is that it is highly resistant to drought or unfavourable rain conditions. It is said to persist for 1-2 months without much rain, which will only reduce the yield by a quarter. Many farmers say that they are unsure what rains will come the following season, so sorghum is a good option. In this way it is a kind of insurance crop, for as one group explained, when all other crops fail, sorghum is at least left. Sorghum is an important crop for household food security, similar to maize, but for less endowed areas.

Sorghum is also one ingredient in the staple food, ugali, where sorghum flour can be mixed with cassava flour (udaga). Some people mentioned that it is a ‘lower class’ food, but others emphasized its qualities as a healthy and nutritious food.

As a supplementary cash crop, there is a good market as it is an ingredient in the local brew called Nyere, which is sold in local bars. If the household doesn’t need the sorghum they grow for household consumption (i.e. because other crops yielded well), then most of the sorghum will be sold, for which there is a good market due to its use in brewing beer.

It seems that the growth in popularity of sorghum is at least partially caused by the promotion of this crop by government extension agencies. The Shinyanga District Council is promoting the crop actively, and many groups mentioned the support they were given in terms of new seeds and knowledge on this crop. The lake zone is still an unknown area for sorghum, and for that reason is not yet being visited a lot by traders, but with time this may change. One indication that conditions for this crop are changing is that it is less often stored in traditional storage bins, and increasingly in bags, for ease of handling. Improved varieties have been introduced and are now being grown, such as the Macia variety (SDS 3220) around 2000, a white seed particularly suited for food purposes but also good for beer brewing.

Table 97 Farmer reasons for growing sorghum

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought resistant</td>
<td>91</td>
</tr>
<tr>
<td>Food consumption</td>
<td>78</td>
</tr>
<tr>
<td>Cash Crop income</td>
<td>47</td>
</tr>
<tr>
<td>Season long</td>
<td>20</td>
</tr>
<tr>
<td>Market</td>
<td>18</td>
</tr>
<tr>
<td>Cost of production low</td>
<td>17</td>
</tr>
<tr>
<td>Season short</td>
<td>17</td>
</tr>
<tr>
<td>Land availability and suitability</td>
<td>7</td>
</tr>
</tbody>
</table>

Sunflowers

Sunflower is one of the hyped ‘new’ crops in Tanzania but its role in displacing cotton seems to be overstated and is mostly limited to Simiyu. Farmers in these areas say they
prefer it as a crop for cooking oil as it is a healthy choice: it is cholesterol free. As well as being consumed at home, it has a good market across East Africa. There is said to be a reliable market with traders looking to buy throughout the year. For those in Simiyu, it was described as a good alternative to cotton, given its higher profitability (price and yields). Furthermore, the cost of labour and inputs is low - certainly lower than cotton. There is just a single weeding done in a season, no fertilizer is applied and no chemical inputs. The result is a slow increase in the area under sunflower.

### Table 98 Farmer reasons for growing sunflowers

<table>
<thead>
<tr>
<th>Reasons sunflowers</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil consumption</td>
<td>75</td>
</tr>
<tr>
<td>Cash Crop income</td>
<td>73</td>
</tr>
<tr>
<td>Cost of production low</td>
<td>43</td>
</tr>
<tr>
<td>Season short</td>
<td>16</td>
</tr>
<tr>
<td>Pest traps</td>
<td>7</td>
</tr>
<tr>
<td>Livestock feed</td>
<td>7</td>
</tr>
<tr>
<td>Storage</td>
<td>6</td>
</tr>
</tbody>
</table>

### Groundnuts

Groundnuts are used first and foremost for household food consumption. They can be used as an additive to dishes or eaten raw or roasted. They are also said to have a high value in the market, and this rises after the harvest season due to good demand. This market is increasingly far away: with the opening up of the Rwanda market, people have also shifted to the red introduced varieties, rather than producing only the white local varieties. Traders are said to now come from all over east Africa to buy the crop in this area.

Groundnuts also require little in the way of inputs, with no fertilizer applied and only a single weeding season, meaning that its cost of production is lower than cotton.

Even though this crop is mentioned as potentially competing with cotton, we did have reports of it being affected by changing climatic conditions, affecting the yields. Other challenges were the susceptibility for diseases: wilting and fungi were said to increasingly be problematic in groundnuts, but little pesticides were still used. Apparently, interventions have made people aware that storage is important in groundnuts.

### Table 99 Farmer reasons for growing groundnuts

<table>
<thead>
<tr>
<th>Reason</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Crop income</td>
<td>57</td>
</tr>
<tr>
<td>Food consumption</td>
<td>50</td>
</tr>
<tr>
<td>Cost of production low</td>
<td>41</td>
</tr>
<tr>
<td>Land availability and suitability</td>
<td>24</td>
</tr>
<tr>
<td>Oil consumption</td>
<td>20</td>
</tr>
</tbody>
</table>

### Tomatoes

Tomatoes
Finally, tomatoes are being increasingly grown. This crop is not being promoted, but farmers have identified its usefulness, have acquired knowledge from neighbours and are producing this crop for a few urban markets. In areas close to Mwanza (and close to irrigation or the lake) it is said to be displacing cotton as it requires little land and fetches good prices. In a few villages, it is said to provide 50% of household income, from being unknown as a crop choice only three years ago.

Summary of other crops

In all, a number of crops are being promoted or are increasingly popular as they combine favourable characteristics such as increased marketability, high revenue and/or low costs, and improved resistance to drought or unfavourable climatic conditions. Other common attributes are that they have shorter seasons and most require less labour than cotton. Furthermore, they double as food (or oil) crops so also act as a risk mitigation strategy for those farmers who are only moderately food secure.

Farmers have found a way around problems they encountered, such as is the case with sweet potato being affected by diseases. New varieties introduced such as for groundnuts and sorghum have accelerated this process. None of these crops on their own have had a large impact on cotton, however cumulatively they have taken away share from cotton.

Other business activities

As presented in Table 3, of the 1534 respondents, 347 (23%) reported having their own business or being self-employed. While not being central to this study, it was examined whether crop yields of those who had their own businesses differed from the overall mean. This analysis found that for cotton and maize (the only two crops with sufficient observations), farmers had on average somewhat higher yields. While this is interesting, a few factors need to be taken into consideration. Those with other businesses did report being in higher income categories, but it is unclear whether the source of their relatively greater wealth is in fact other business activities or is derived from the profit of selling their crops. Likewise, it is unclear whether other business activities are providing the additional capital to make extra investments in agriculture, or vice versa – good farming practices and resulting profits have enabled some farmers to diversify outside of agriculture, so that farmers with better practices and thus higher yields could have diversified to other non-farm activities rather than vice versa. Furthermore, farmers involved in business activities are more likely to be those who are more business-minded and professional in their farming practices also helping them to achieve somewhat better results on average. Most likely this is a two way relationship.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Err.</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton (other businesses)</td>
<td>321</td>
<td>14</td>
<td>294</td>
<td>349</td>
</tr>
<tr>
<td>Cotton (all areas)</td>
<td>299</td>
<td>6</td>
<td>287</td>
<td>311</td>
</tr>
<tr>
<td>Maize (other businesses)</td>
<td>526</td>
<td>24</td>
<td>480</td>
<td>573</td>
</tr>
<tr>
<td>Maize (all areas)</td>
<td>462</td>
<td>10</td>
<td>442</td>
<td>482</td>
</tr>
</tbody>
</table>

The question on other business activities was asked by the other research group involved (see methodology), which reported 153 respondents having their own business (less than half the figures cited above), 41 of which were reported as ‘agriculture’. 
Cross crop synthesis

The cross crop synthesis chapter brings together the findings of the preceding chapters. Here we discuss costs (labour and inputs), profit models and displacement models for cotton.

Labour costs

The following figure shows the relative weights of the various types of labour, in days. We have included both hired and household labour. Labour costs have been treated consistently across crops so that the findings are comparable. Differences between crops in terms of labour costs will not significantly change when different labour costs per day of labour are being used.

These costs are made in the course of the season rather than at one point in time, and for that reason may be underestimated by farmers when discussing costs for specific activities when demand for labour is high in the area. Only when each activity is being discussed one by one do we obtain an idea of the importance of labour in the cost structure of cropping. If farmers would keep records, this would become more clear to them, though people are reasonably unaware of the high labour costs of certain activities for certain crops.

Table 100 Labour days hired and household for cotton, maize, rice and cassava

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cotton</th>
<th>Maize</th>
<th>Cassava</th>
<th>Rice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Preparation (hired)</td>
<td>2.11</td>
<td>1.7</td>
<td>1.99</td>
<td>1.9</td>
</tr>
<tr>
<td>Land Preparation (household)</td>
<td>8</td>
<td>8.14</td>
<td>12.26</td>
<td>10.78</td>
</tr>
<tr>
<td>Planting (hired)</td>
<td>1.15</td>
<td>0.67</td>
<td>0.84</td>
<td>3.83</td>
</tr>
<tr>
<td>Planting (household)</td>
<td>4.98</td>
<td>4.87</td>
<td>6.78</td>
<td>9.89</td>
</tr>
<tr>
<td>Fertilizer application (hired)</td>
<td>0.04</td>
<td>0.06</td>
<td>0</td>
<td>0.04</td>
</tr>
<tr>
<td>Fertilizer application (household)</td>
<td>0.78</td>
<td>0.74</td>
<td>0.33</td>
<td>0.07</td>
</tr>
<tr>
<td>Weeding (hired)</td>
<td>6.73</td>
<td>4.02</td>
<td>4.36</td>
<td>4.4</td>
</tr>
<tr>
<td>Weeding (household)</td>
<td>14.79</td>
<td>12.43</td>
<td>18.15</td>
<td>14.03</td>
</tr>
<tr>
<td>Spraying (hired)</td>
<td>0.22</td>
<td>0.03</td>
<td>0</td>
<td>0.02</td>
</tr>
<tr>
<td>Spraying (household)</td>
<td>1.45</td>
<td>0.11</td>
<td>0.07</td>
<td>0.04</td>
</tr>
<tr>
<td>Harvesting (hired)</td>
<td>7.01</td>
<td>3.07</td>
<td>4.08</td>
<td>5.31</td>
</tr>
<tr>
<td>Harvesting (household)</td>
<td>15.26</td>
<td>9.08</td>
<td>20.25</td>
<td>12.78</td>
</tr>
<tr>
<td>Total labour days</td>
<td>62.52</td>
<td>44.92</td>
<td>69.11</td>
<td>63.09</td>
</tr>
</tbody>
</table>

On the other hand, as discussed above, these figures for labour days per crop per acre are often on the higher end of the range found in the literature, possibly caused by higher than expected labour needs due to higher incidence of pests and pesticide application, more frequent harvesting rounds, and higher labour needs related to reseeding in this area due to the seeds provided (see below for the details). And of course there may be season-specific reasons why labour needs are higher than expected initially.

Table 101 Labour days total for cotton, maize, rice and cassava

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cotton</th>
<th>Maize</th>
<th>Cassava</th>
<th>Rice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Preparation</td>
<td>10.11</td>
<td>9.84</td>
<td>14.25</td>
<td>12.68</td>
</tr>
<tr>
<td>Planting</td>
<td>6.13</td>
<td>5.54</td>
<td>7.62</td>
<td>13.72</td>
</tr>
<tr>
<td>Fertilizer application</td>
<td>0.82</td>
<td>0.8</td>
<td>0.33</td>
<td>0.11</td>
</tr>
<tr>
<td>Weeding</td>
<td>21.52</td>
<td>16.45</td>
<td>22.51</td>
<td>18.43</td>
</tr>
<tr>
<td>Spraying</td>
<td>1.67</td>
<td>0.14</td>
<td>0.07</td>
<td>0.06</td>
</tr>
<tr>
<td>Harvesting</td>
<td>22.27</td>
<td>12.15</td>
<td>24.33</td>
<td>18.09</td>
</tr>
<tr>
<td>Total labour days</td>
<td>62.52</td>
<td>44.92</td>
<td>69.11</td>
<td>63.09</td>
</tr>
</tbody>
</table>

Household labour dominates every type of activity: this is not a fully commercial system at all. In relative terms, land preparation, weeding and harvesting for cotton is characterized by higher degrees of monetization than we find for these activities in other crops.

For cotton, we indicated that certain types of activities may be underrepresented as the survey may not have captured these (for example thinning of cotton and uprooting). Labour requirements for cassava came out higher than expected, relative to the other main crops. Significantly, cassava is an annual crop (quite often in this area even more than an annual cycle), and so the investments a made over the course of a year or more. Weeding may not be done often, but having cassava in the field for a year or more requires several weeding moments which add up.
Also harvesting is an acknowledged time consuming activity in cassava.

Overall labour costs for cassava are not substantially higher than those for cotton, partly because the labour costs per day in the areas that cassava is mostly grown are lower (see the profitability model, below).

**Input costs**

Inputs are bought at a single time, and it can be difficult for farmers to find the money at once. Input costs for cotton are substantially higher for cotton than for the other main crops, in particular cassava. This is due to the imperative of buying seed and pesticides each season for cotton. Therefore, as discussed earlier, farmers do complain about the high costs of inputs.

**Figure 51 Input costs in TZS, per input, four main crops**

![Input costs chart](chart.png)

However, without claiming a judgment on farmers’ perception of input costs, the total amount of money involved is relatively small even in the case of cotton, which is reflected in the profitability model graph below (income and expenditure per crop). Seed costs are the biggest worry of the farmer, and in the case of cotton the costs of pesticides is considerable too. This is often reflected in the statements made by respondents in the FGDs. Manure also appears here: as fertilisers are prohibitively expensive or not available, some farmers have turned to manure and even spend a little money on this, however small.

**Yields and prices**

The following table presents the average price (TZS per kg), average yield (Kg per acre) subsequent average revenues per acre for the four main crops. While comparing prices and yields across different crops is like comparing the proverbial ‘apples and pears’, what is clear is that rice and cassava generate much higher revenues that cotton does – only maize has a lower revenue per acre per growing season than cotton.

**Table 102 Mean prices, yields and revenue per acre for cotton, maize, cassava and rice**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Avg. Price TZS/kg</th>
<th>Avg. Yields kg/acre</th>
<th>Avg. Revenue/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>737.9</td>
<td>299.4</td>
<td>220,927</td>
</tr>
<tr>
<td>Maize</td>
<td>388.6</td>
<td>461.7</td>
<td>179,417</td>
</tr>
<tr>
<td>Cassava</td>
<td>617.4</td>
<td>566.4</td>
<td>349,695</td>
</tr>
<tr>
<td>Rice</td>
<td>722.5</td>
<td>594.3</td>
<td>429,382</td>
</tr>
</tbody>
</table>

**Profitability model**

Integrating the costs and revenues in one multi-crop productivity model gives us the following figure which shows the revenue (including the SD around the mean) minus the total costs, including the shadow cost of household labour.

It shows that the costs of inputs, hired labour and household labour are relatively high in cotton. When adding the relatively low revenues, the mean net profit for cotton can be regarded as negative by a small amount.

The (shadow) cost of household labour makes up a substantial part of the total costs, and absorbs much of the profit of all crops. This issue is therefore critical to the profitability of the various crops, and we will briefly discuss this issue of shadow pricing again later (see below). However, though the importance of household labour costs in these calculations makes the analysis of the level of profit for each crop sensitive to the shadow price used, in relative terms, this does not make much difference for our understanding of these crops relative to one another.

While on average, farmers do not make a net profit with cotton, and do make a profit with maize, rice and cassava, not all farmers are the same. As should be clear from the histograms in the cotton chapter and later when the other crops are discussed, some farmers will still make a handsome profit with cotton after all costs are deducted. Conversely some farmers already make a loss before household labour is deducted.
Table 103 Cost, revenue, profit model for 4 main crops (TZS)

<table>
<thead>
<tr>
<th></th>
<th>Cotton</th>
<th>Maize</th>
<th>Rice</th>
<th>Cassava</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purchased - Planting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fertilizer</td>
<td>409</td>
<td>510</td>
<td>1111</td>
<td>0</td>
</tr>
<tr>
<td><strong>Purchased - Top dressing</strong></td>
<td>385</td>
<td>646</td>
<td>1045</td>
<td>0</td>
</tr>
<tr>
<td><strong>Purchased - Manure</strong></td>
<td>1337</td>
<td>1758</td>
<td>35</td>
<td>631</td>
</tr>
<tr>
<td><strong>Purchased - Pesticides</strong></td>
<td>8947</td>
<td>312</td>
<td>78</td>
<td>0</td>
</tr>
<tr>
<td><strong>Purchased - Fungicides</strong></td>
<td>27</td>
<td>4</td>
<td>0</td>
<td>109</td>
</tr>
<tr>
<td><strong>Purchased - Herbicides</strong></td>
<td>308</td>
<td>90</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td><strong>Purchased - Seed</strong></td>
<td>8593</td>
<td>7668</td>
<td>2369</td>
<td>1211</td>
</tr>
<tr>
<td><strong>Hired labour - land preparation</strong></td>
<td>6154</td>
<td>4956</td>
<td>6358</td>
<td>5386</td>
</tr>
<tr>
<td><strong>Hired labour - planting</strong></td>
<td>3607</td>
<td>2076</td>
<td>13007</td>
<td>2524</td>
</tr>
<tr>
<td><strong>Hired labour - fertilizer application</strong></td>
<td>117</td>
<td>226</td>
<td>165</td>
<td>5</td>
</tr>
<tr>
<td><strong>Hired labour - weeding</strong></td>
<td>22369</td>
<td>12623</td>
<td>13815</td>
<td>11442</td>
</tr>
<tr>
<td><strong>Hired labour - spraying</strong></td>
<td>789</td>
<td>92</td>
<td>66</td>
<td>12</td>
</tr>
<tr>
<td><strong>Hired labour - harvesting</strong></td>
<td>24326</td>
<td>10396</td>
<td>18032</td>
<td>12465</td>
</tr>
<tr>
<td><strong>Household labour - land preparation</strong></td>
<td>26366</td>
<td>25880</td>
<td>37992</td>
<td>38303</td>
</tr>
<tr>
<td><strong>HH labour - planting</strong></td>
<td>16937</td>
<td>16301</td>
<td>34830</td>
<td>20255</td>
</tr>
<tr>
<td><strong>HH labour - fertilizer application</strong></td>
<td>2740</td>
<td>2499</td>
<td>240</td>
<td>1019</td>
</tr>
<tr>
<td><strong>HH labour - weeding</strong></td>
<td>49497</td>
<td>40950</td>
<td>49602</td>
<td>56412</td>
</tr>
<tr>
<td><strong>HH labour - spraying</strong></td>
<td>5095</td>
<td>356</td>
<td>174</td>
<td>215</td>
</tr>
<tr>
<td><strong>HH labour - harvesting</strong></td>
<td>51267</td>
<td>29674</td>
<td>45748</td>
<td>60186</td>
</tr>
<tr>
<td><strong>Costs inputs (fertilizer, pesticides, seed etc.)</strong></td>
<td>20006</td>
<td>10989</td>
<td>4698</td>
<td>1951</td>
</tr>
<tr>
<td><strong>Costs hired labour</strong></td>
<td>57361</td>
<td>30369</td>
<td>51443</td>
<td>31834</td>
</tr>
<tr>
<td><strong>Costs household labour (opportunity cost)</strong></td>
<td>151905</td>
<td>115661</td>
<td>168586</td>
<td>176391</td>
</tr>
<tr>
<td><strong>Total costs - all</strong></td>
<td>229272</td>
<td>157018</td>
<td>224726</td>
<td>210176</td>
</tr>
<tr>
<td><strong>Total revenue</strong></td>
<td>221000</td>
<td>174000</td>
<td>344000</td>
<td>300000</td>
</tr>
<tr>
<td><strong>Profit - excl. all labour</strong></td>
<td>200944</td>
<td>16301</td>
<td>339302</td>
<td>296049</td>
</tr>
<tr>
<td><strong>Profit - excl. household labour</strong></td>
<td>143633</td>
<td>132642</td>
<td>287860</td>
<td>266215</td>
</tr>
<tr>
<td><strong>Profit - all costs</strong></td>
<td>-8272</td>
<td>16982</td>
<td>119274</td>
<td>89824</td>
</tr>
</tbody>
</table>

The above data are used to generate the graphs below. Profit for cotton is a small negative profit. As indicated, these are averages.

The above presents the situation on one end of the range: when household labour is costed at market rates. However, at the other end of the range, if we wish to assume household labour is not calculated as a cost at all, the following figure is derived.

Figure 53 Profitability per acre of the four main crops, in TZS, no household labour

Now it appears that cotton is doing slightly better than maize, but not as well as cassava or rice (cassava and rice are almost twice as profitable as cotton in that case).

The following figure shows the percentage of farmers that is making a loss when inputs, hired labour and household labour are being deducted from their revenues.

Figure 54 Share of farmers with negative net profits are various levels of cost calculation, per crop, in percent
**Return to labour**

One interesting issue of course is the return to labour. We have calculated this using the full number of days used for the crop (both hired and household) versus the profit, and obtained the following results (table below). The same pattern arises, with rice and cassava being the better options in terms of labour productivity.

<table>
<thead>
<tr>
<th></th>
<th>Cotton</th>
<th>Maize</th>
<th>Rice</th>
<th>Cassava</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>221000</td>
<td>174000</td>
<td>344000</td>
<td>300000</td>
</tr>
<tr>
<td>Costs inputs</td>
<td>20006</td>
<td>10989</td>
<td>4698</td>
<td>1951</td>
</tr>
<tr>
<td>Days</td>
<td>62.52</td>
<td>44.92</td>
<td>69.11</td>
<td>63.09</td>
</tr>
<tr>
<td>Return to labour</td>
<td>3215</td>
<td>3629</td>
<td>4910</td>
<td>4724</td>
</tr>
</tbody>
</table>

**Marginal return to labour**

Another interesting finding with relation to labour is the marginal return to labour in the production model for cotton and other crops. In the regression below, we find that the MRL is around a kg of product for cotton, cassava and rice (and thus in TZS depends on the value of that product) and is about 2.4 kg for maize. The result is a MRL for cotton, maize, cassava and rice of 723, 909, 617 and 665 TZS per day. These are fairly low levels of marginal returns to labour, a similar amount of money spent on seeds and pesticides (at least for maize and cotton for which we have significant figures) would yield better results (between 3 to 7 times more).

**Regression model**

The regression (Table 105) shows that there is no significant correlation between the amount of land under which a crop is cultivated and the yield (although maize and rice is negative and significant at the 10% level, and cassava and rice are negative and not significant). There is also no significant correlation between the number of crops a farmer grows and his yield for cotton, maize, rice and cassava. However, there are highly significant effects on the yield of cotton when either adding labour, or investments in manure, pesticides and seed. Most of these highly significant effects also apply to maize, except pesticides which are seldom used in maize production. For rice and cassava, the effects are not significant mainly because the sample sizes become too small after 0 values for all regressed variables are removed.

For each additional labour day, yield of cotton increases by 0.98 kg (which at an average price per kg of 737.9 TZS = 723.14 TZS). For maize the increase is a 2.34 kg increase (2.34 * 388.6 = 909.32 ). For every 1000 TZS spent on manure yields for cotton increase 4kgs. Likewise, for every 1000 TZS spent on pesticides and seed for cotton the increase is 3kgs, and for every 1000 TZS increase in spending on pesticides and seed for maize the yield increases by 5 and 7 KGs.

It may be noted that the researchers choose not use the marginal effect of an additional day of labour as a shadow labour rate for several reasons: The coefficient is not significant for all crops; This value is so far below the average hired labour rate than no farmers would seriously entertain this as a value of their labour.
Table 105 Regression of variable effects on yield of cotton, maize, cassava and rice (kg per acre)

<table>
<thead>
<tr>
<th>Effect of additional acre grown of crop</th>
<th>Yield Cotton</th>
<th>Yield Maize</th>
<th>Yield Cassava</th>
<th>Yield Rice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effect of additional acre grown</td>
<td>-1.906</td>
<td>-8.028</td>
<td>-16.987</td>
<td>-22.685</td>
</tr>
<tr>
<td>(1.854)</td>
<td>(4.236)*</td>
<td>(20.082)</td>
<td>(13.543)*</td>
<td></td>
</tr>
<tr>
<td>Effect of additional crop grown</td>
<td>-3.730</td>
<td>-2.870</td>
<td>-32.444</td>
<td>4.949</td>
</tr>
<tr>
<td>(5.096)</td>
<td>(8.376)</td>
<td>(33.452)</td>
<td>(18.440)</td>
<td></td>
</tr>
<tr>
<td>Effect of additional day of labour</td>
<td>0.982</td>
<td>2.348</td>
<td>0.999</td>
<td>0.921</td>
</tr>
<tr>
<td>(0.222)***</td>
<td>(0.457)***</td>
<td>(1.331)</td>
<td>(0.854)</td>
<td></td>
</tr>
<tr>
<td>Effect of additional TZS spent in manure</td>
<td>0.004</td>
<td>0.004</td>
<td>-0.006</td>
<td>-0.005</td>
</tr>
<tr>
<td>(0.001)***</td>
<td>(0.002)**</td>
<td>(0.015)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect of additional TZS spent in pesticides</td>
<td>0.003</td>
<td>0.005</td>
<td></td>
<td>(0.051)</td>
</tr>
<tr>
<td>(0.001)***</td>
<td>(0.006)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect of additional TZS spent in seed</td>
<td>0.003</td>
<td>0.007</td>
<td>0.019</td>
<td>(0.005)</td>
</tr>
<tr>
<td>(0.001)***</td>
<td>(0.001)***</td>
<td>(0.009)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mara</td>
<td>68.751</td>
<td>-12.854</td>
<td>-266.134</td>
<td>177.528</td>
</tr>
<tr>
<td>(25.501)***</td>
<td>(47.943)</td>
<td>(121.566)**</td>
<td>(154.307)</td>
<td></td>
</tr>
<tr>
<td>Mwanza</td>
<td>73.470</td>
<td>-24.727</td>
<td>-75.559</td>
<td>-74.513</td>
</tr>
<tr>
<td>(22.960)***</td>
<td>(34.652)</td>
<td>(112.017)</td>
<td>(87.629)</td>
<td></td>
</tr>
<tr>
<td>Shinyanga</td>
<td>14.873</td>
<td>-76.224</td>
<td>-317.688</td>
<td>-36.536</td>
</tr>
<tr>
<td>(22.572)</td>
<td>(34.585)**</td>
<td>(283.029)</td>
<td>(91.953)</td>
<td></td>
</tr>
<tr>
<td>Simiyu</td>
<td>82.867</td>
<td>103.497</td>
<td>283.502</td>
<td>154.957</td>
</tr>
<tr>
<td>(20.168)***</td>
<td>(35.369)**</td>
<td>(235.357)</td>
<td>(288.694)</td>
<td></td>
</tr>
<tr>
<td>Tabora</td>
<td>32.815</td>
<td>75.445</td>
<td>338.574</td>
<td>338.574</td>
</tr>
<tr>
<td>(27.725)</td>
<td>(46.427)</td>
<td></td>
<td>(225.628)</td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>148.495</td>
<td>312.018</td>
<td>702.648</td>
<td>525.401</td>
</tr>
<tr>
<td>(29.420)***</td>
<td>(45.761)***</td>
<td>(161.759)***</td>
<td>(131.213)***</td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>0.19</td>
<td>0.17</td>
<td>0.15</td>
<td>0.13</td>
</tr>
<tr>
<td>N</td>
<td>523</td>
<td>682</td>
<td>85</td>
<td>169</td>
</tr>
</tbody>
</table>

Relevant coefficients in bold. Standard error in parentheses.

Example: effect of pesticides on cotton: Each additional TZS spent yields an increase of 0.003kg of cotton. Per 1000 TZS this equals 3kg. When applying pesticides, 1 application of 2 bottles is between 4000 and 5000 TZS. Therefore 1 additional application of pesticides worth 5000 TZS yields an additional 15 kg of cotton (5000/1000) * 3kg. This means 15kg * 735 average cotton price = 11025 TZS additional revenue per pesticide application; and 11025 – 5000 = 6025 TZS additional profit. With average yields, that is the same effect as increasing the price by 6025 TZS / 300kg = 20 TZS, or 2.7%. i.e. (20/735)=2.7%

The regression analysis shows us the relative weights farmers could give to their crops, given their resource availability and relative costs and benefits. In that sense, this is a model that helps explain overall impact of crop choices for certain types of farmers, or the effect of adding particular resources to a certain crop they are cultivating presently.
Conclusions

In this chapter we conclude by summarizing the most salient findings.

- From the combined sources of data, we deduct that there are many crops competing with and replacing cotton, not just one alternative cash crop. Green grams, groundnuts, sunflower, sweet potato, tomatoes, and sorghum were all mentioned, in addition to the main crops: maize (as a short cycle crop), rice and cassava.

- The studied crops have different growing seasons and often more than one season per year. We have described the profitability of the crop per acre per season rather than the farm per year. Crops like maize and rice often have more than one season in the year, while cotton and cassava generally have one season only. This affects the productivity of land. Most costs are not dependent on the time it takes to grow the crop.

- Cotton is usually not stored but is sold more or less immediately. There are several reasons for this: Prices are fixed so are unlikely to fluctuate. Also, it is a cash crop that provides the farmer with a lump sum, needed for large expenditures such as school fees, or paying off debts. Another reason is that it spoils with time, taking up moisture and sand in the place it is stored. Furthermore, it is a fire risk to have cotton in the homestead.

- Usually crops fetch their lowest price immediately after harvesting. For cotton this is not the case with prices fixed, but for other crops it usually is. For rice, waiting is an option. Farmers mentioned they liked rice because it can be stored for a year without much loss of quality, can be sold when needed and when prices are high, and can meanwhile be eaten for subsistence. Cassava can be stored in the ground: one simply leaves it until it is needed, and can be sold. Maize is the only crop that can’t be stored for long periods without loss of quality, but most maize is consumed anyway, and not sold.

- Cotton and maize are a solid, but not exceptional, food/cash crop combination. However, other cash crops may replace, or displace cotton partly as they have the advantage over cotton of being both cash and food crops, which is important in the many areas where food security is not assured. This appears to be important as a risk strategy.

- Cotton is disadvantaged by the high costs of seed and pesticides in particular. Other crops incur less of these costs. However, the complaints that farmers voice about the high costs of inputs is put into perspective by our findings: farmers are often cash poor and cannot pay for these easily even if there are many bigger labour costs.

- The value of household labour put into the cropping system is not calculated by farmers. This is hardly ever done by smallholders, and farmers do not keep note of the hours worked on the crop. However, when these costs are quantified, at whatever level of shadow pricing, most profits would either evaporate (cotton, maize) or be reduced (cassava, rice). Nevertheless we hear in focus group discussions that households do value their labour by expressing a preference for crops that need less labour and attention.

- Seed and pesticides must be bought every year for cotton, whereas seed for maize only needs to be refreshed once every three or four seasons. This is a disadvantage for cotton not only in terms of cost. Cotton farmers complain seriously about the lack of timeliness of seed and pesticides supply, which negatively affects yields when not on time. The same does not seem to apply for maize seeds, as this is available in most agro-vet shops. The implication of this is that the way the input supply markets are organized is influencing the success rates of the crop.

- There is a relationship between labour availability and financial resources for inputs. Increasing pesticide use increase labours costs to apply it. The 3-6 applications of pesticides for cotton increases labour days for those farmers using pesticides.

- The use of fertilizer and above all herbicides (both minimally used in the studied area) would, on the other hand, save labour as weeding would be minimized. However, both fertilizer and herbicides are expensive and not accessible to farmers at this time.

- The quality of cotton seeds is believed to have declined. Seed germination of cotton is said to be an issue in recent years, a situation well known at CTDP and TCB. This may be a temporary situation, though it may remain for a long time in the memories of the farmers.
• The change to water based pesticides also made them less effective according to farmers (but more environmentally friendly). Farmers seem not to be well trained in mixing pesticide concentrates and pesticide application, and they realize this.

• Apart from the economic crop choice considerations, cotton is a decent cash crop choice for farmers in semi-arid and drought conditions. However, other drought resistant crops have been introduced, or improved varieties of other crops, so there are more options available in recent years. This is being mentioned by farmers: their range of options has increased and groundnuts, sunflower, sweet potato, green grams, maize, cassava, sorghum seem to find a growing popularity.

• The low profitability of cotton in the area of study is related to low yields, but particularly to low prices. Cotton yields are relatively closer to worldwide averages than the other main crops. Cotton prices however seem to be low in the studied area, and as far as farmers are concerned, erratic. We didn’t calculate a detailed terms of trade between cotton and a package of consumer goods (or maize) in this area, but this terms of trade, as far as we can establish, is below the generally accepted ideal of 1 : 2 (for cotton : maize). The impact of that depends on the fact whether a farmer household has a net surplus or net deficit in maize production.

• Many farmers continue to grow cotton and there is a special cultural attachment to the crop. So while some farmers leave cotton, many more continue but look to diversify into other cash crops which have the advantage of being cash/consumption crops (maize, rice, cassava, groundnuts, sunflower, sweet potato, green grams, and sorghum). These crops are a good option for farmers with moderate food security concerns, and who are cash poor and frequently avoid buying inputs (fertilizer, pesticides) or even seed.

• Considerations of market availability are important: in some areas, close to infrastructure and major towns, alternative crops may become interesting regardless of institutional investments in cotton. When conditions are low risk (high demand for a certain crop, water available, good returns), this shift may take place quickly. This applies to main crops (cassava for instance) but also to relatively new or minor crops (sunflower, green grams, sweet potato, tomatoes).

• A number of variables show the same distribution across regions: size of the fields, revenues, income and food security all show relatively low scores in Mara, Mwanza and Geita, and higher scores in Shinyanga and above all Tabora. Population density may be a determinant of this distribution. This may systematically affect cotton, as farmers stated that when the land becomes scarce, cotton will decrease in extend due the fact that rotations become increasingly important and problematic. The theory of Change in that situation would be as follows: greater population pressure → smaller farms → lower soil fertility and lower yields → lower incomes → more rotation of higher value and shorter cycle crops → smaller share of land under cotton.

• A regression analysis was done to study the effects of important variables in individual crops, in relation to each other. For individual farmers, each situation is particular, but this models shows the effect of a number of important variables on yields for the population as a whole, and helps understanding crop choice in the population. The regression analysis on all crops shows that there is no significant correlation between the amount of land under which a crop is cultivated and the yield (although maize and rice is negative and significant at the 10% level, and cassava and rive are negative and not significant). There is also no significant correlation between the number of crops a farmer grows and his yield for cotton, maize, rice and cassava. However, there are highly significant effects on the yield of cotton when either adding labour, or investments in manure, pesticides and seed. Most of these highly significant effects also apply to maize, except pesticides which are seldom used in maize production. For rice and cassava, the effects are not significant mainly because the sample sizes become too small after 0 values for all regressed variables are removed.