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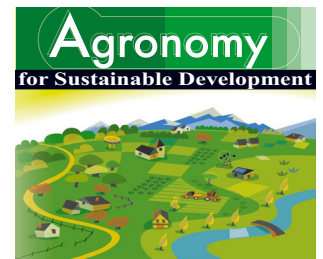
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Research article

False beliefs on the socio-economic drivers of cassava cropping

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Abstract – General belief has it that cassava is (i) a subsistence crop, grown to avoid hunger (ii) by poor farmers, (iii) predominantly as an intercrop, (iv) requiring less labour than other crops and (v) no inputs. These beliefs influence policy, project development and implementation, and if wrong, may have far-reaching consequences for the success and sustainability of interventions. This study examines five beliefs about cassava and discusses consequences for interventions targeting cassava. From 2004 to 2006, 120 detailed farm surveys were carried out with smallholder farmers in 6 sites in central/eastern Uganda and western Kenya, whereby households were categorised in three wealth categories by local key informants. Through structured interviews and field visits, details on the importance of cassava, socio-economic indicators, food security, crop management and labour aspects were obtained. Our results show that cassava does ensure food security, but that the other beliefs are either myths or half truths. Besides supplying 27–41% of starchy staple food consumption, cassava also provided significant income (84 US\$ yr⁻¹), similar to that of maize (90 US\$ yr⁻¹). It is too simplistic to classify cassava as a ‘poor man’s crop’ as in Uganda wealthier households marketed more (+16%), but in Kenya consumed less (–11%) cassava than poorer farmers. Cassava is not predominantly intercropped (30% of acreage in Uganda and 51% in Kenya), farmers do use inputs on cassava (36% of the households hire labour) and total labour requirements (287 mandays ha⁻¹) were higher than for most crops. Contrary to expectations, we conclude that increasing cassava production will not improve food security – unless a disease epidemic is present – but instead will improve the scope for commercialisation of cassava. To ensure that projects designed to enhance cassava production benefit poor and/or labour deficit households, specific provisions are needed, including development of labour saving technologies.

food security / income / input use / labour / wealth classes / weed management

1. INTRODUCTION

Since its introduction in Africa in the 16th century, cassava (*Manihot esculenta* Crantz) has become one of the most important crops on the continent. Production has more than tripled in the last four decades (Hillocks, 2002) and the crop is currently grown on approximately 12 million hectares. As food, feed and industrial markets are promising (FAO, 2004), there is an increasing focus on cassava by governments, research and development institutes in Africa.

Over the centuries, many beliefs have evolved concerning the role of cassava in sub-Saharan Africa. Cassava is said to be a subsistence crop, grown to avoid hunger (Hillocks, 2002; Gatsby, 2004) by resource poor, small farmers (Jameson, 1970; Alves, 2002; FAO, 2004) who plant it preferably as an

intercrop to reduce the risk of crop failure, while maximizing returns to land and labour (Otim-Nape et al., 1997; Leihner, 2002). Further, cassava is thought to require less labour than other crops (Cock, 1985; Berry, 1993) and to be grown without inputs (Leihner, 2002). Such beliefs will influence policy and project development and implementation, and if wrong, may have far-reaching consequences for the success and sustainability of interventions.

Few studies provide solid data to verify these beliefs on the role of cassava. The Collaborative Study of Cassava in Africa (COSCA) reported the most comprehensive information on cassava based cropping systems, but labour use and crop management issues are poorly described and the socio-economic role of cassava has not been investigated. Few other studies are available to confirm findings of the COSCA studies and these are from West and Central Africa (Fresco, 1986; Philips et al., 2006) with none from East Africa.

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The objectives of this study were to investigate to what extent common beliefs about cassava are valid in East Africa and to evaluate consequences for the design and implementation of cassava policies and projects. We carried out a series of detailed farm surveys among smallholder farmers to evaluate the socio-economic role of cassava, crop management and labour use in relation to other crops. The selected study sites are representative for large parts of the cassava area in the mid altitude zone of East Africa as they exhibit a wide range in agro-ecological and socio-economical conditions. With average fresh yields of 10.6 t ha⁻¹ in Kenya and 12.0 t ha⁻¹ in Uganda, cassava yields are just above the African average of 9.9 t ha⁻¹.

2. MATERIALS AND METHODS

2.1. Site selection

This study focused on smallholder farming systems in central and eastern Uganda and western Kenya. Site selection was based on the importance of cassava, the degree of poverty, population density and agro-ecological characteristics (Thornton et al., 2002; Fermont et al., 2008). The farm surveys were carried out in three sites in western Kenya and three sites in Uganda. In Kenya, the sites included Kwang'amor (0°29'N, 34°14'E), Mungatsi (0°27'N; 34°18'E) and Ugunja (0°10'N; 34°18'E) in Teso, Busia and Siaya districts, respectively. In Uganda, the sites included Kisiro (0°67'N; 33°80'E), Kikooba (1°40'N; 32°38'E) and Chelekura (1°14'N; 33°62'E) in Iganga, Nakasongola and Pallisa district, respectively. Altitude in these sites varies between 1100 to 1260 masl, while the topography ranges from gently undulating to undulating. The climate in all sites is sub-humid with a bimodal rainfall distribution. In central Uganda less than 40% of the households falls below the poverty line, while parts of western Kenya have the highest poverty rates (>60%) in East Africa (Thornton et al., 2002). High population pressure in most sites (160–387 persons km⁻²) has resulted in continuous farming systems with limited fallow (Fermont et al., 2008).

2.2. Farm selection and characterization

Households at the six farm survey sites were categorised by local key informants according to their resource endowment into three wealth classes: poorer, medium and wealthier. Criteria used for the categorization were site-specific and included farm size, number of animals, off-farm income and education of children. Within each site twenty households were randomly selected with a minimum representation of three households per wealth category. Structured interviews in combination with a visit to all fields within each farm were used to characterise each household in detail in terms of land use, socio-economic importance of crops, food self-sufficiency, crop management and labour aspects. Household income was calculated from income generated by crop activities, other farm activities (livestock, honey, hiring land), casual

work, permanent income sources (salary or pension), business and remittances or 'money sent home'. Interviews were held with the family member taking most of the decisions on farming activities, but information was cross-checked with other family members. Information was triangulated through multiple questions on sensitive topics, combining interview and field data, confirmation by key informants and subsequent visits. Income data were used to cross check the wealth class of the households, whereby 2 households were reclassified. The farm characterizations were carried out from June to September 2004 in western Kenya and from October 2005 to April 2006 in Uganda.

2.3. Labour use, food self-sufficiency and gross margin analysis

Available labour per farm was calculated from the number of family members in different age categories, assuming that children between 8–12 and 12–16 years contributed 0.15 and 0.45 man years, respectively and an adult person year was comprised of 312 working days (information from resource persons). Available family labour was corrected for labour hired in and hired out. To compare total labour requirements of cassava with other crops, farmers ranked total labour required for one crop cycle of cassava versus total labour required for one crop cycle of selected other sole crops on a same size field. Relative monthly labour requirement was calculated using the average harvest age of cassava as supplied by farmers and a crop cycle of 4, 5.5, 4, 4, 3, 8, 5 and 18 months for maize, millet, sorghum, groundnut, beans, sweet potato, cotton and sugarcane respectively. To evaluate the contribution of cassava to staple food consumption, all households ranked the relative importance of cassava and other starchy staple crops. To quantify food self-sufficiency, households indicated the number of months per year their farm supplied sufficient food.

For each farmer who supplied yield estimates for cassava and maize, partial gross margins for cassava and maize production were calculated. Costs taken into account were labour for ploughing, planting and weeding and purchase of maize seeds and fertilizer. Prices for hired labour were used to mirror the opportunity costs of labour (CIMMYT, 1988) as farmers hired labour for agricultural activities in the study areas. Labour costs did not vary significantly between sites within a country and average values per country were used. The number of weed operations and quantity of fertilizer used were obtained from the farm surveys, whereas constant values were used for ploughing and maize seeds. Harvest and post-harvest labour costs expressed per ton of maize or cassava harvested were measured in Uganda and took into account labour for harvesting, transport, peeling, chipping and drying. Average retail and wholesale market prices during the survey periods were used for maize seeds and fertilizer, cassava chips (250 Uganda Shillings kg⁻¹; Ugsh and 15 Kenya Shillings kg⁻¹; Ksh) and maize (290 Ugsh Kg⁻¹ and 17 Ksh kg⁻¹), respectively (1 US\$ = 1818 Ugsh or 80 Ksh).

Table I. Selected mean characteristics of households in the six study sites in Uganda (U) and Kenya (K) by site and wealth class.

	n	Cropped land (ha)	Hired labour (man days year ⁻¹)	Household income (\$ year ⁻¹)	Farm income (% HH income)	Food self- sufficiency (months year ⁻¹)	Cassava yield (t ha ⁻¹)	Maize yield (t ha ⁻¹)	
Site									
Kisiro	(U)	19	3.9 ± 3.3	438 ± 653	1266 ± 1120	88 ± 15	11.1 ± 2.0	8.3 ± 2.7	1.4 ± 0.4
Kikooba	(U)	21	1.7 ± 1.5	29 ± 53	961 ± 895	50 ± 34	11.7 ± 1.3	11.2 ± 3.5	0.7 ± 0.2
Chelekura	(U)	20	1.7 ± 1.2	482 ± 654	868 ± 855	51 ± 34	10.2 ± 2.5	11.7 ± 3.7	1.0 ± 0.3
Kwang'amor	(K)	20	1.9 ± 1.8	205 ± 351	835 ± 1170	73 ± 26	11.5 ± 1.5	7.7 ± 2.5	1.1 ± 0.6
Mungatsi	(K)	20	1.7 ± 1.3	294 ± 379	1283 ± 1497	55 ± 35	11.5 ± 1.6	6.7 ± 2.3	1.2 ± 0.6
Ugunja	(K)	20	1.0 ± 0.6	70 ± 147	633 ± 703	42 ± 28	11.0 ± 1.4	6.1 ± 1.9	1.0 ± 0.4
<i>P</i>	-	-	<0.01	<0.01	<i>ns</i>	<0.001	<i>ns</i>	<0.001	<0.001
Wealth class									
Wealthier		26	4.0 ± 3.0	670 ± 650	2456 ± 1295	51 ± 34	11.6 ± 1.1	9.9 ± 3.9	1.4 ± 0.7
Medium		39	2.1 ± 1.2	264 ± 425	948 ± 537	70 ± 30	11.5 ± 1.5	9.1 ± 3.1	1.2 ± 0.4
Poorer		55	1.0 ± 0.5	40 ± 84	287 ± 138	56 ± 33	10.7 ± 2.2	7.7 ± 3.4	0.9 ± 0.3
<i>P</i>	-	-	<0.001	<0.001	<0.001	<0.05	<i>ns</i>	<0.05	<0.001
Overall means		120	2.0 ± 2.0	249 ± 457	972 ± 1073	60 ± 33	11.2 ± 1.8	8.6 ± 3.5	1.0 ± 0.5

2.4. Data analysis

Significance of differences between sites and wealth classes for selected socio-economic, food self-sufficiency, crop acreage, crop income and profit parameters were tested using univariate analysis of variance with subsequent Tamhane test for post-hoc comparison or non-parametric Kruskal-Wallis one-way ANOVA where appropriate. One sample t-tests were used to test whether relative total and monthly labour requirements of various sole cropped crops differed significantly from those of sole cropped cassava. Paired t-tests were used to test whether weed management, weeding preference and hired labour differed between cassava and other crops. Chi square tests were used to compare the percentages of households for whom cassava was the most important staple food or for whom cassava generated more income than other crops by wealth class. Chi square tests were also used to compare the percentages of households making profit from cassava and maize. The statistical significance of relations between acreage under cassava and food self-sufficiency and income generated by cassava were assessed by two tailed Pearson correlations. All statistical analyses were carried out using GenStat Discovery for Windows (edition 3) and SPSS for Windows (version 10.0).

3. RESULTS AND DISCUSSION

To examine the validity of common beliefs about cassava, we carried out a total of 120 farm surveys in six sites in western Kenya and central/eastern Uganda among a random selection of households, divided in three wealth classes. Structured

interviews, combined with field visits, were used to characterise households and farm/crop management.

3.1. Description of the farming systems

The amount of cropped land, hired labour, income, food self-sufficiency, natural resource management and crop yields varied strongly between sites and wealth classes (Tab. I). The cropped land ranged from 1.0 to 3.9 ha between sites. Hiring labour for agricultural work was very common in some sites, but limited to a few farmers in others. Cattle, mostly local Zebu (*Bos indicus*) breeds, were more important ($P < 0.01$) in Kikooba and Kwang'amor (7.0 and 4.8 cows per household, respectively) than in the other sites (2.0–2.5 cows per household). Average annual household income ranged from US\$ 633 to US\$ 1,283 between sites and was generated for a large part (42–88%) through farm activities. Wealthier households had more access to land, labour and cattle and earned nearly ten times more income than poorer households ($P < 0.001$). Farms produced at least five to six different types of crops (Tab. II). In all sites, the most important food crops were cassava and maize (*Zea mays* L.), while groundnuts (*Arachis hypogaea* L.), sweet potato (*Ipomoea batatas* L.), finger millet (*Eleusine coracana* L.) and sorghum (*Sorghum bicolor* (L.) Moench) were generally less important, though not in all sites. Cash cropping was restricted to cotton (*Gossypium hirsutum* L.) in one Ugandan site and sugarcane (*Saccharum officinarum* L.) in two Kenyan sites. On average, cassava and maize were planted on 0.58 and 0.55 ha or 34 and 24% of the cropped land, respectively (Tab. II). Cassava yields ranged

Table II. Mean acreage (ha) for selected crop in the six study sites in Uganda (U) and Kenya (K) by site and wealth class.

Site	n	Root and tubers		Cereals			Legumes	Cash crops	
		Cassava	Sweet potato	Maize	Sorghum	Millet	Groundnuts	Cotton	Sugarcane
Kisiro	(U) 19	0.59 ± 0.6	0.19 ± 0.2	1.82 ± 2.7	0.03 ± 0.1	0.05 ± 0.1	0.74 ± 0.56	0.07 ± 0.1	0
Kikooba	(U) 21	0.93 ± 0.8	0.27 ± 0.2	0.18 ± 0.4	0	0.02 ± 0.1	0.12 ± 0.1	0	0
Chelekura	(U) 20	0.56 ± 0.6	0.10 ± 0.1	0.09 ± 0.1	0.08 ± 0.1	0.21 ± 0.2	0.13 ± 0.2	0.21 ± 0.3	0
Kwang'amor	(K) 19	0.71 ± 0.7	0.04 ± 0.1	0.53 ± 0.7	0.04 ± 0.1	0.09 ± 0.1	0.03 ± 0.0	0	0.29 ± 0.7
Mungatsi	(K) 21	0.34 ± 0.2	0.03 ± 0.0	0.36 ± 0.3	0.03 ± 0.0	0.01 ± 0.0	0.02 ± 0.0	0.01 ± 0.0	0.81 ± 0.9
Ugunja	(K) 20	0.32 ± 0.2	0.09 ± 0.1	0.41 ± 0.2	0.14 ± 0.2	0.02 ± 0.1	0.03 ± 0.1	0	0.00 ± 0.0
<i>P</i>	-	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Wealth class									
Wealthier	26	1.14 ± 1.0	0.22 ± 0.2	1.21 ± 2.4	0.10 ± 0.2	0.11 ± 0.2	0.25 ± 0.4	0.03 ± 0.1	0.44 ± 1.0
Medium	39	0.55 ± 0.4	0.12 ± 0.1	0.61 ± 0.7	0.05 ± 0.1	0.07 ± 0.2	0.24 ± 0.4	0.10 ± 0.2	0.21 ± 0.4
Poorer	55	0.33 ± 0.2	0.07 ± 0.1	0.2 ± 0.2	0.03 ± 0.1	0.04 ± 0.1	0.09 ± 0.2	0.03 ± 0.1	0.05 ± 0.2
<i>P</i>		<0.001	<0.001	<0.01	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>	<0.05
Overall means	120	0.58 ± 0.6	0.12 ± 0.2	0.55 ± 1.2	0.06 ± 0.1	0.07 ± 0.1	0.17 ± 0.3	0.05 ± 0.1	0.19 ± 0.5

from 6.6 to 12.7 t ha⁻¹, while maize yields ranged from 0.7 to 1.4 t ha⁻¹ between sites. Cassava yielded significantly ($P < 0.001$) less in Kenya (7.0 t ha⁻¹) than in Uganda (11.3 t ha⁻¹), but maize yields did not vary between countries. Land preparation was either done by hand, or by a combination of oxen and hand ploughing. Manure use was common in four sites (ca. 250–900 kg ha⁻¹), but fertilizer use was limited to the Kenyan sites and generally low (<40 kg ha⁻¹). Wealthier households made up 4 to 16% of the population in all sites, while poorer households constituted between 37 to 64% of the population. We conclude that although cassava and maize were important features in all studied farming systems, farming systems and socio-economic conditions varied considerably between and within the study sites.

3.2. Testing common generalizations

3.2.1. Cassava is a food security crop, not a market crop

The contribution of food crops to the starchy staple food consumption of households varied between sites ($P < 0.01$). Cassava contributed between 27 and 41% of the starchy staple food consumption in the study sites, maize contributed between 14 and 33%, while sweet potato contributed between 11 and 39% (data not shown). Cassava was the most important staple food in 55% of the surveyed households. Due to the mixed nature of the farming systems, East African households depend less on cassava as a staple food than Central African households whose cropping systems are dominated by cassava (Fresco, 1986; Nweke and Enete, 1999). The role of cassava as a staple food has undoubtedly increased over time. In colonial times, cassava was not popular in Uganda and Kenya and cassava planting was forced on farmers by the governments

to prevent famine (McMaster, 1962). However, cassava cultivation has strongly expanded in the last three decades due to increasing land pressure and farmers' perception that cassava improves soil fertility (Fermont et al., 2008). Average food self-sufficiency was high (Tab. I), with only 15% of the surveyed households being food insufficient for more than two months per year. Food self-sufficiency was much higher than in maize dominated farming systems in eastern and southern Africa (Ncube, 2007; Claessens et al., 2008). Food self-sufficiency in our study area was directly related to the absolute acreage under cassava, whereby households with more than 0.6 ha of cassava were always completely self-sufficient in food (Fig. 1a). Average income generated by crops varied strongly between sites (Tab. III). Cassava and maize were marketed in all sites and generated on average 84 and 90 US\$ yr⁻¹, respectively. Groundnut marketing was limited to the Ugandan sites. Sweet potato, millet and sorghum generated small amounts of income only, while income from cash crops was limited to individual sites. Overall, 63% of all households sold cassava, 58% sold maize and 48% sold groundnuts, while all other crops were sold by less than one third of the households. In absolute terms maize, groundnuts, sugarcane and/or cotton generated more income than cassava in most sites (Tab. III), though in 26% of the households cassava generated more income than any other crop. In relative terms, cassava contributed more to crop income than any other crop ($P < 0.05$) as it generated on average 23% of crop income, whereas groundnuts and maize generated 16 and 14%, respectively. Cassava was sold in quantities ranging from a few tins of dried chips on the local market to whole fields sold to traders. On average, households sold 23% of their cassava production. Marketing of cassava was not restricted to households with larger acreages of cassava: households with as little as 0.1 ha of cassava earned some income from cassava (Fig. 1b). Similar trends were found in the COSCA study in Uganda (Nweke

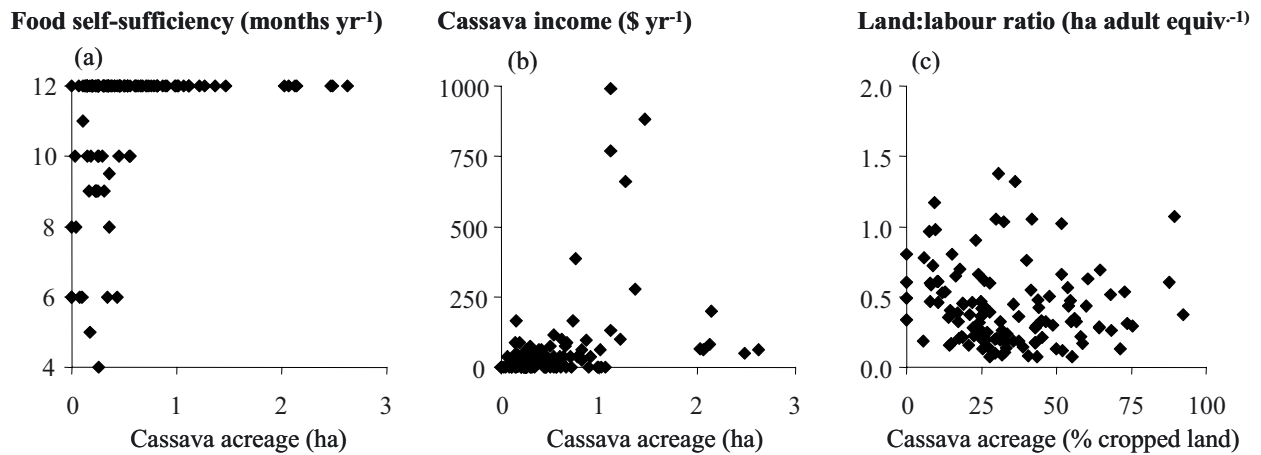


Figure 1. Cassava acreage versus (a) household food self-sufficiency; (b) annual income generated by cassava; and (c) land:labour ratio for the six study sites in Uganda and Kenya. Households that planted more than 0.6 ha of cassava were 100% food self-sufficient (a); even households planting as little as 0.1 ha of cassava generated income from cassava (b); and labour limited households do not plant more cassava than households without labour constraints (c).

Table III. Income (\$ per year) generated by selected crops in the six study sites in Uganda (U) and Kenya (K) by site and country × wealth class.

	n	Root and tubers		Cereals			Legumes	Cash crops	
		Cassava	Sweet potato	Maize	Sorghum	Millet	Groundnuts	Cotton	Sugarcane
Site									
Kisiro	(U) 19	59 ± 226	0	446 ± 586	0	0	485 ± 428	71 ± 139	0
Kikooba	(U) 21	312 ± 527	4 ± 10	20 ± 51	0	0	48 ± 88	0	0
Chelekura	(U) 20	13 ± 25	2 ± 8	4 ± 8	0	25 ± 47	98 ± 180	74 ± 99	0
Kwang'amor	(K) 20	54 ± 46	6 ± 12	46 ± 36	17 ± 24	36 ± 63	5 ± 10	7 ± 22	116 ± 274
Mungatsi	(K) 20	24 ± 25	12 ± 24	39 ± 95	3 ± 7	6 ± 22	4 ± 15	5 ± 24	263 ± 300
Ugunja	(K) 20	27 ± 23	14 ± 19	8 ± 10	12 ± 18	1 ± 5	5 ± 11	0	2 ± 7
<i>P</i>		<0.001	<0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Country x Wealth									
Uganda									
Wealthier	13	439 ± 650	5 ± 12	393 ± 752	0	8 ± 23	338 ± 442	55 ± 138	0
Medium	20	92 ± 214	3 ± 9	154 ± 189	0	17 ± 49	319 ± 385	91 ± 133	0
Poorer	27	18 ± 358	0	34 ± 62	0	2 ± 6	62 ± 98	14 ± 24	0
<i>P</i>		<0.001	<i>ns</i>	<0.05	<i>ns</i>	<i>ns</i>	<0.01	<i>ns</i>	<i>ns</i>
Kenya									
Wealthier	13	37 ± 54	5 ± 8	55 ± 93	17 ± 32	31 ± 77	5 ± 10	0	312 ± 448
Medium	19	37 ± 31	16 ± 27	37 ± 68	12 ± 14	16 ± 31	7 ± 17	11 ± 31	153 ± 176
Poorer	28	33 ± 27	9 ± 15	16 ± 18	7 ± 11	5 ± 13	3 ± 8	2 ± 7	18 ± 44
<i>P</i>		<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>	<0.05
Overall means	120	84 ± 256	6 ± 15	90 ± 280	5 ± 14	12 ± 36	104 ± 251	26 ± 76	63 ± 190

et al., 1999). Nonetheless, cassava is a less important cash crop in eastern Africa than in central and western Africa, where both large and small-scale farmer often derive more cash income from cassava than from any other crop (Fresco, 1986; Philips et al., 2006). Reasons for the larger market share of cassava in central and western Africa include the high urban and industrial demand for cassava products, the introduction of

mechanical graters to reduce post-harvest labour requirements and the introduction of high yielding genotypes in Nigeria and Ghana (Nweke, 2005). Nevertheless, even without these advantages cassava can develop into a cash crop which has better profits than maize in both Uganda and Kenya ($P < 0.001$; Tab. IV). Overall 86% of the households made a profit from cassava compared to 64% for maize ($P < 0.001$).

Table IV. Partial gross margin analysis for cassava and maize for the six study sites in Uganda and Kenya by country.

	Cassava			Maize		
	Total costs (\$ ha ⁻¹)	Revenue (\$ ha ⁻¹)	Gross margin (\$ ha ⁻¹)	Total costs (\$ ha ⁻¹)	Revenue (\$ ha ⁻¹)	Gross margin ¹ (\$ ha ⁻¹)
Uganda	307 ± 59	523 ± 131	216 ± 77	132 ± 17	196 ± 67	64 ± 54***
Kenya	370 ± 91	467 ± 137	97 ± 74	205 ± 54	260 ± 74	55 ± 86
<i>P</i>	<0.001	<0.001	<0.001	<0.001	< 0.001	<0.01

¹ Gross margins for maize followed by an asterisk are significantly different from gross margins for cassava in same row at *** = $P < 0.001$.

Cassava owes its reputation as a food security crop to: (i) its relative good yields under difficult growing conditions; (ii) its in-ground storability that allows farmers to harvest the crop progressively and bridge the food gap between growing seasons; and (iii) its resistance to locust attacks (Nweke, 2005). As cassava contributed roughly one third of the starchy staple food consumption and food security was higher than in maize dominated farming systems, our data confirm for East Africa the general perception that cassava is a food security crop and the notion that where cassava is grown there is no hunger (Hillocks, 2002; Gatsby, 2004). However, we also show that cassava simultaneously is an important income generator as the crop was marketed by 63% of the households and generated a similar income as maize. Thus the lingering idea that cassava is primarily a subsistence crop, as Nweke (2005) noted, is a myth.

3.2.2. Cassava is a poor man's crop

Households from all wealth classes planted, consumed and marketed important amounts of cassava (Tabs. II and III; Figs. 2 and 3). In Uganda, wealthier households planted absolutely larger acreages of cassava (+1.2 ha; $P < 0.001$) and earned absolutely more income from cassava (+421 US\$ yr⁻¹; $P < 0.001$) than poorer households. Also in relative terms, cassava tended to contribute a larger share of crop income for wealthier than for poorer households (+16%). The share of cropped land planted to cassava and the importance of cassava as a food crop did not vary between wealth classes. Considering that in the 1950s Ugandan farmers still regarded cassava to be “food for very low people in their homes” or even “food for prisoners or dogs” (McMaster, 1962), there has been a considerable change in the way Ugandan farmers regard cassava. In Kenya, all wealth classes earned similar absolute amounts of income from all crops, except sugarcane. But while wealthier households tended to plant larger acreages of cassava than poorer households (+0.33 ha), poorer households planted a larger share of cropped land to cassava (+12%; $P < 0.05$) and earned a larger share of crop income from cassava (+19%; $P < 0.05$). Poorer households in Kenya also consumed 11% more cassava ($P < 0.001$) and 10% less maize ($P < 0.05$)

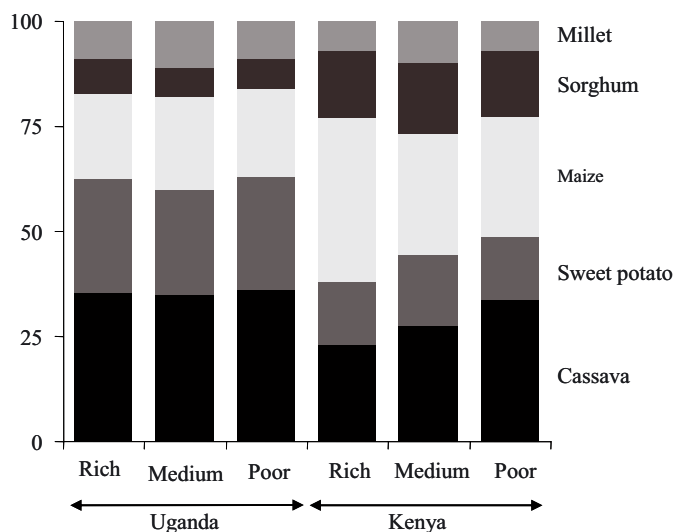
Starchy staple consumption (%)

Figure 2. Contribution of five crops to the starchy staple food consumption of households by country and wealth class for the six study sites in Uganda and Kenya. In Uganda, wealth class did not affect starchy staple food consumption, but in Kenya poorer farmers consumed more cassava and less maize than wealthier farmers.

than wealthier households and cassava was the most important staple food for 67% of the poorer farmers versus 8% of the wealthier farmers ($P < 0.01$). The difference between the two countries is likely due to the presence of an important cash crop (sugarcane) in Kenya, which is preferentially grown and sold by wealthier households (Tabs. II and III, Fig. 3) as it requires inputs and large fields. Within our study area, there was no relation between the general wealth of a site (% poorer households, average income) and the importance of cassava. At a regional level, the average annual income in our study sites (US\$ 633 to US\$ 1,283) is similar to income levels reported for banana-based cropping systems in Uganda (Bagamba, 2007) and maize-based cropping systems in Kenya (De Jager et al., 2001).

Cassava is typically perceived to be grown by resource poor, small farmers (Jameson, 1970; Alves, 2002; FAO, 2004;

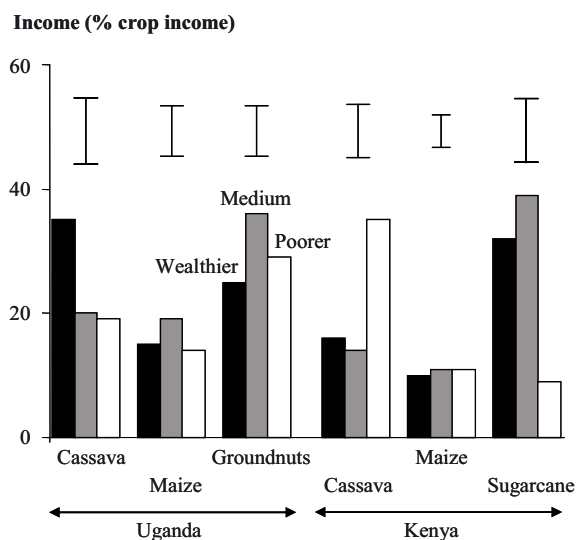


Figure 3. Contribution of selected crops to crop income by country x wealth class for the six study sites in Uganda and Kenya. Lines above bar graphs indicate the Standard Error of the Differences (SED). In Uganda, cassava (but not maize and groundnuts) contributes a larger share to the crop income of wealthier farmers. In Kenya, cassava contributes a larger share to the crop income of poorer farmers, whereas sugarcane contributes a larger share to the crop income of wealthier farmers.

Gatsby, 2004) as it can be produced with family labour and basic inputs only and has low production risks (Nweke, 2005). Food policy analysts often assumed that cassava's per capita consumption will decline with increasing per capita incomes. The COSCA study already showed that this is not true for urban consumers who switch from dried flour forms to more convenient food forms such as gari, when income increases (Nweke, 2005). In our study sites we found little evidence to support the idea that cassava is a poor man's crop. On the contrary, we observed in Uganda that wealthier farmers planted and marketed more cassava than poorer farmers. At regional level there was no indication that cassava is produced in 'poverty pockets'. Nonetheless in the Kenyan sites we observed that poorer farmers consumed more cassava and planted a larger share of their land to cassava. This may have been more the consequence of having an important cash crop (sugarcane) in the farming system that is particular appropriate for wealthier farmers due to its high demand on land and inputs, than the result of a cultural bias. It is thus too simplistic to classify cassava as a poor man's crop. This may be a historical perception from colonial times, when farmers were forced to plant cassava.

3.2.3. Poor farmers intercrop cassava

Cassava intercropping was a more common practice in Kenya than in Uganda, with 51% of the cassava acreage intercropped in Kenya and 30% in Uganda ($P < 0.001$). Maize was the most important intercrop (>50% of the intercropped

acreage) in all but one site, while beans, sorghum and to a lesser extent groundnuts and cotton were locally important intercrops. In Uganda, poorer farmers intercropped a larger proportion of their cassava acreage than wealthier farmers (+29%; $P < 0.05$). A similar trend, though not significant, was observed in Kenya (+14%). Still, poorer households intercropped just 42 and 58% of their cassava acreage in Uganda and Kenya, respectively. Intercropping in our study area was less important than found by previous studies in Africa (Nweke et al., 1999), whereas intercropping systems are also simpler (only one intercrop, no relay cropping) than the complex intercropping systems described in West and Central Africa (Ezeilo, 1979; Fresco, 1986). We can conclude that the perception that poorer farmers intercrop cassava to reduce the risk of crop failure, while maximizing returns to land and labour (Weber et al., 1979; Leihner, 2002) is falsified in the sense that poorer households did not intercrop the majority of their cassava fields. Nonetheless, poorer households did intercrop cassava more than wealthier households.

3.2.4. Cassava is grown without inputs

Manure and chemical fertilizers were primarily applied to sugarcane, cereals and beans and sporadically to groundnuts and tobacco. Chemical fertilizers were never applied to cassava, while only 40% of the households in Chelekura applied manure directly to cassava. This is in line with findings from the COSCA study (Nweke, 1994). Nonetheless, in western Kenya and Chelekura between 45 and 70% of the households applied manure to cassava-maize intercropping systems. Planting material for cassava was obtained from either the own farm (63%) or exchanged with neighbours (37%). Overall, sixty percent of the households planted improved genotypes on 36% of the cassava acreage, but this varied strongly between sites ($P < 0.001$). In East Africa, improved genotypes are/have been distributed through development projects and/or farmer to farmer dissemination in the past 10 years in concentrated efforts to control the cassava mosaic pandemic (Legg et al., 2006). Use of hired labour for crop production varied strongly between sites and crops (Tab. V). Overall, 36% of the households used hired labour for the production of cassava, mainly for weeding (36%), and less so for planting (10%) and harvesting (6%). Average hired labour for cassava amounted to 42 man days per year. This was more than labour hired for sweet potato, sorghum and millet ($P < 0.01$), similar to the labour hired for maize and cotton and less than the labour hired for sugarcane ($P < 0.01$). Hiring labour was strongly influenced by the resource endowment of the households: 60% of the wealthier households hired labour for cassava versus 25% of the poorer households ($P < 0.01$). On average, poorer households hired more labour for cassava than for maize (+17 man days yr^{-1} ; $P < 0.05$). The COSCA study also found that approximately one third of the households hired labour for cassava weeding (Nweke, 1994). We can thus conclude that although input use in cassava is limited to improved genotypes and hiring of labour, the general perception that cassava is

Table V. Hired labour use (man days ha⁻¹) on selected sole planted crops for the six study sites in Uganda (U) and Kenya (K) by site and wealth class^{1,2}.

	Root and tuber crops		Cereals			Legumes	Cash crops	
	Cassava	Sweet potato	Maize	Sorghum	Millet	Groundnuts	Cotton	Sugarcane
Site								
Kisiro	(U) 53 ± 103	1 ± 4 *	158 ± 333	-	53 ± 55	175 ± 206 *	55 ± 69	-
Kikooba	(U) 11 ± 29	0	4 ± 13	-	-	0	-	-
Chelekura	(U) 129 ± 206	0 *	17 ± 41 *	6 ± 22 *	69 ± 98	81 ± 114 *	126 ± 171	-
Kwang'amor	(K) 19 ± 36	0 *	23 ± 47	2 ± 8	4 ± 15 *	5 ± 17	0	295 ± 370
Mungatsi	(K) 37 ± 63	0	36 ± 52	0 *	-	-	-	188 ± 217 **
Ugunja	(K) 6 ± 15	1 ± 3	11 ± 24	10 ± 28	-	-	-	-
<i>P</i>	<0.01	<i>ns</i>	<0.01	<i>ns</i>	<0.01	<0.001	<0.05	<i>ns</i>
Wealth class								
Wealthier	94 ± 127	1 ± 4 ***	137 ± 291	28 ± 39 *	63 ± 93	95 ± 149	138 ± 51	590 ± 221 *
Medium	51 ± 142	0 *	38 ± 75	0 **	57 ± 100	89 ± 173	153 ± 197	122 ± 111 *
Poorer	11 ± 27	0 *	2 ± 10 *	0 *	12 ± 23	11 ± 26	22 ± 28	0
<i>P</i>	<0.001	<i>ns</i>	<0.001	<0.001	<i>ns</i>	<0.05	<0.01	<0.001
Overall means	42 ± 106	0 ± 2 ***	45 ± 153	5 ± 19 ***	37 ± 74 **	57 ± 129	87 ± 138	222 ± 270 **

¹ Analysis based on households that planted the selected crops as a sole crop.

² Numbers within a row followed by asterisks differ significantly from the cassava observation in the same row at * = $P < 0.05$; ** = $P < 0.01$; and *** = $P < 0.001$ (paired T-test).

produced without inputs (Oyetunji et al., 2001; Leihner, 2002) is false.

3.2.5. Cassava requires less labour than other crops

The average total labour requirement for cassava production in our study site was 287 man days ha⁻¹, i.e. 50 days for land preparation (two operations), 23 days for planting, 172 days for weeding and 42 days for harvesting. This makes cassava production in eastern Africa very labour intensive compared with the 76 man days ha⁻¹ used in Nigeria (Nweke, 1996) and the 50–150 man days ha⁻¹ required in Asia, although in Vietnam labour requirements of up to 400 man days ha⁻¹ are reported (Howeler et al., 2001). Most labour (60%) was used on weeding. This was also observed by Nweke and Enete (1999) and Melifonwu et al. (2000). Although the number of weed operations per crop varied strongly between sites for all crops, except sorghum ($P < 0.05$), in all sites cassava was weeded two to three times more than other crops ($P < 0.001$), except sugarcane and cotton (Tab. VI). On average, households gave preference to weeding maize, groundnuts and millet fields over weeding cassava fields ($P < 0.01$), but other crops had a similar weed preference as cassava (Tab. VI). The fact that 36% of the households hired labour for weeding of cassava, may be an indication that although farmers did not give a high preference to weed management of cassava, they still faced a labour constraint for this particular task. The high labour requirements for weed control

may be related to the bimodal rainfall distribution and land preparation by hand resulting in late planting. In addition, the low weeding preference for cassava (Tab. V) and poor soils slow down plant development and increase the need for additional weed operations during the remainder of the growth cycle (Fermont et al., 2009). The high labour requirements for cassava may also explain why households that faced a labour shortage did not increase the share of cassava on their farm (Fig. 2c). Per crop cycle, farmers used more labour per unit area on farm operations for cassava than for cereals, beans and sweet potato ($P < 0.05$), but less labour than for cash crops ($P < 0.001$; Fig. 4a). Taking into account the length of the crop cycle, monthly labour use per unit area for cassava was 1.5 to 4 times less than for all other crops ($P < 0.01$), except for sweet potato (Fig. 4b).

Cassava is typically regarded as a crop with low labour demands as it is much less tightly constrained by seasonality than other crops due to its semi-perennial nature and the ability to tend it during periods of the growing season when more labour is available (Cock, 1985; Fresco, 1986; Berry, 1993). As such it is regarded as specifically suitable for labour-deficit and HIV/AIDS affected households (Nweke, 2005). In contrast to these beliefs, we found that, due to high labour demands for weed control, total labour requirements for cassava were high in comparison with other crops and in comparison with cassava production in other parts of the world. Nonetheless, monthly labour requirements of cassava per unit area were less than for other crops.

Table VI. Weed management for selected sole planted crops for the six study sites in Uganda (U) and Kenya (K) by site^{1,2}.

	Root and tuber crops		Cereals			Legumes	Cash crops	
	Cassava	Sweet potato	Maize	Sorghum	Millet	Groundnuts	Cotton	Sugarcane
# weedings per growth cycle								
Kisiro	(U) 4.3 ± 0.9	1 ± 0 ***	2.7 ± 0.5 ***	-	1 ± 0 **	1 ± 0 ***	4.3 ± 1.0	-
Kikooba	(U) 3.3 ± 1.0	1 ± 0 ***	1.7 ± 0.5 **	-	-	1 ± 0 ***	-	-
Chelekura	(U) 4.5 ± 1.1	1.1 ± 0.3 **	2.4 ± 0.5 **	1.1 ± 0.4 ***	1.7 ± 0.6 ***	2 ± 0.5 ***	4.1 ± 0.6	-
Kwang'amor	(K) 6.0 ± 1.7	1.5 ± 0.6 ***	2.6 ± 0.6 ***	1.1 ± 0.3 *	1.3 ± 0.5 ***	2 ± 0 *	7.3 ± 0.5	6.1 ± 1.5
Mungatsi	(K) 5.2 ± 1.1	1.5 ± 0.8 **	2.7 ± 0.6 ***	1.5 ± 0.6 *	1 ± 0 **	-	-	6.8 ± 1.1 ***
Ugunja	(K) 3.9 ± 1.0	0.8 ± 0.4 ***	1.6 ± 0.6 *	1.4 ± 0.5 ***	-	-	-	-
<i>P</i>	<0.001	<0.001	<0.001	<i>ns</i>	<0.05	<0.001	<0.01	<i>ns</i>
Overall means	4.5 ± 1.4	1.1 ± 0.4 ***	2.4 ± 0.7 ***	1.2 ± 0.4 ***	1.4 ± 0.6 ***	1.4 ± 0.5 ***	4.6 ± 1.3	6.6 ± 1.3 **
Weed ranking ³								
Kisiro	(U) 7.0 ± 2.5	8.9 ± 2.2	4.3 ± 2.3	-	6.6 ± 3.2	4.1 ± 1.2 *	5.7 ± 2.8	-
Kikooba	(U) 7.9 ± 2.5	7.0 ± 2.6	6.4 ± 1.7	-	-	2.7 ± 0.4 ***	-	-
Chelekura	(U) 5.2 ± 2.7	9.5 ± 1.1 ***	6.0 ± 2.6	7.8 ± 2.7	3.6 ± 1.4	6.3 ± 2.8	7.1 ± 2.8	-
Kwang'amor	(K) 8.2 ± 2.2	10 ± 0	4.2 ± 2.3 ***	4.6 ± 1.1 ***	4.5 ± 2.2 *	6.9 ± 3.4	8.6 ± 1.7	8.2 ± 1.8
Mungatsi	(K) 7.4 ± 2.7	8.2 ± 2.1	3.5 ± 1.2 ***	7.3 ± 0.9	8.5 ± 1.9 *	-	-	7.7 ± 2.4
Ugunja	(K) 7.0 ± 2.0	8.6 ± 2.2	3.0 ± 0.4 ***	4.7 ± 2.5	-	-	-	-
<i>P</i>	<0.001	<i>ns</i>	<0.05	<0.05	<0.05	<0.05	<i>ns</i>	<i>ns</i>
Overall means	7.2 ± 2.5	8.2 ± 2.3*	4.4 ± 2.1 ***	5.9 ± 2.4	5.0 ± 2.6 *	4.5 ± 2.4 ***	6.9 ± 2.7	7.9 ± 2.2

¹ Analysis based on households that planted the selected crops as a sole crop.

² Numbers within a row followed by an asterisk differ significantly from the cassava observation in the same row at * = $P < 0.05$; ** = $P < 0.01$; and *** = $P < 0.001$ (paired T-test).

³ Farmers ranked their preference to weed the 3–5 most important sole crops on their farm in case all fields had a similar age and similar weed pressure. Rankings were standardized for the number of crops. A low number indicates a higher preference for weeding.

3.3. Consequences for policies and development interventions

Over half of the rural population in Africa is living in poverty (Ravallion et al., 2007). The World Bank and African governments have recognised the role of agriculture to increase food security and reduce rural poverty (Worldbank, 2008) as each one percent increase in agricultural production in Africa has been shown to reduce poverty by 0.6 percent (IFPRI, 2002). Cassava is well positioned to improve the livelihoods of smallholder farmers in the cassava growing areas of East Africa, as it is consumed and marketed by a large majority of households (Tab. III; Figs. 2 and 3) and it has a good scope for yield improvement through improved agronomic practices (Fermont et al., 2009). Nonetheless, cassava can not be used to specifically reduce food insecurity and poverty amongst the poorest of farmers as has been the objective of several projects, because cassava is not a typical 'poor man's crop'. Its large labour demands for weed control also make the crop less suitable for labour deficit and/or HIV/AIDS affected households than commonly

assumed. Experience from a 'pro-poor' root and tuber program in Ghana showed several other reasons why targeting cassava to the poorest farmers did not result in the anticipated reduction in poverty. These included a lack of land, labour and capital, clashes between labour requirements of cassava and other crops and insufficient capacity to be linked into developing markets (IFAD, 2004). Fermont et al. (2009) further argue that poorer farmers face a larger number of abiotic, biotic and associated management constraints than wealthier farmers and thus increasing cassava production for poorer farmers is more difficult than for wealthier farmers.

Food self-sufficiency in cassava-based farming systems is generally high, even for poorer households (Tab. I). The introduction of technology packages to increase production in these farming systems will thus not significantly enhance food self-sufficiency. It will, however, improve the scope for commercialization of cassava. Nonetheless, in areas where cassava is not yet widely grown or areas affected by the cassava mosaic or brown streak epidemic, food self-sufficiency can be enhanced through the promotion of cassava and/or introduction of resistant genotypes.

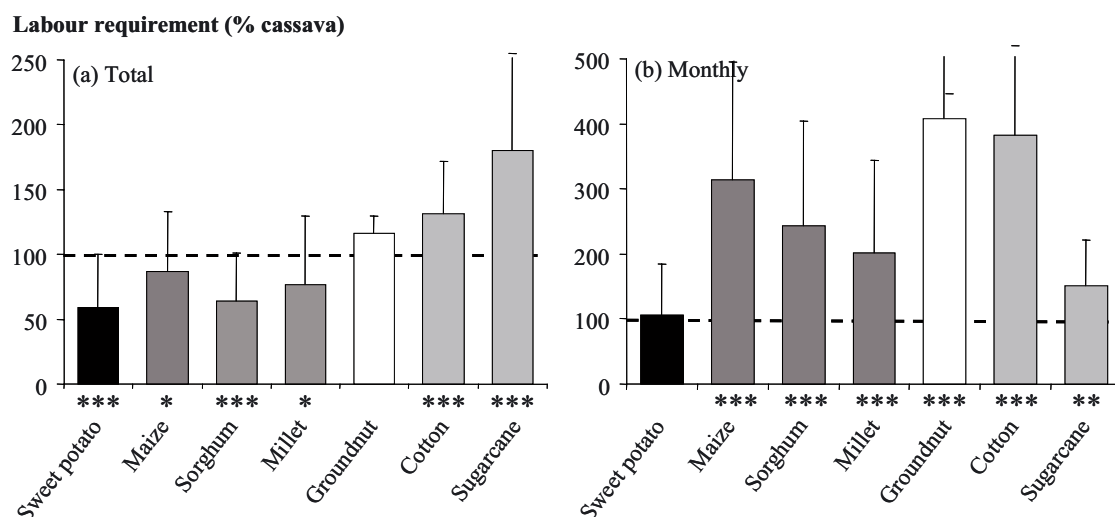


Figure 4. Total (a) and monthly (b) relative labour use of sole planted crops compared to sole planted cassava for the six study sites in Uganda and Kenya. Labour requirements for cassava are 100% in both graphs. Asterisks indicate whether crops have significantly different labour requirements from cassava. The number of households ranking labour for each crop was: cassava (108), maize (66), millet (32), sorghum (26), groundnuts (32), beans (11), sweet potato (67), cotton (26) and sugarcane (18). Total labour requirements for cassava were higher than for most food crops, whereas monthly labour requirements of cassava were lower than for all crops, except sweet potato.

To tap the huge potential of cassava to improve income for the majority of farmers in East Africa, there is a need to develop current and new cassava markets (animal feed, starch, biofuel) to increase opportunities for commercialization. The Ugandan government is dedicated to benchmarking international best practices to learn lessons from other countries that have escaped from poverty. Examples could be Vietnam and Thailand, whose governments are actively promoting cassava starch and ethanol production through the development of an E10 policy (inclusion of 10% ethanol in normal gasoline) and attracting investors (Charoenrath, 2008; Kim et al., 2008). Cassava production prices in Africa are often not competitive with the low world market prices and markets need to be sought within Africa (FAO and IFAD, 2004). On the regional and national markets processed cassava products compete with grain products. Profitability per hectare was greater for cassava than maize using actual wholesale prices (Tab. IV). Experience in Uganda shows that animal feed industries normally offer 70% of the maize price for cassava. Under these conditions, cassava production still is more profitable than maize in Uganda but not in Kenya.

To increase the profitability of cassava production in order to facilitate its development as an industrial crop in East Africa, attention should be given to the development of technology packages to increase crop productivity. Labour deficit and/or HIV/AIDS affected households require specific targeting of labour saving technologies, high yielding genotypes and capacity building. The most important production constraints in East Africa are poor weed management, low soil fertility and a water-deficit during initial growth (Fermont et al., 2009). Removing these limitations by improved weed control, manure and/or fertilizer use and avoiding early drought stress by timely planting in combination with improved genotypes

will increase cassava productivity and profitability. Labour saving technologies should focus on weed management as this currently is very labour intensive. Low-cost options to improve weed control include the use of higher plant densities and introduction of vigorous, early branching genotypes, while other possibilities include fertilizer use to promote early ground cover and herbicides (Fermont et al., 2009). The facts that farmers weed their fields more than recommended and commonly hire labour to produce cassava shows that farmers are willing to use inputs in cassava production (Tabs. V and VI), but most likely lack knowledge on improved production practices as shown by the general restricted use of manure and fertilizer. Current weed management and manure use vary widely between sites, but much less between wealth classes, while land, labour and capital availability varied strongly between sites and wealth classes (Tabs. I, II, V and VI). When developing improved management packages these differences between areas should be taken into account, without losing sight of the variability in resources available to households.

4. CONCLUSION

We conclude that for our study area the five common beliefs on cassava are either myths or half truths: (i) Besides ensuring food security, cassava also generates significant income for the majority of households; (ii) it is too simplistic to classify cassava as a poor man's crop as cassava farmers of all wealth classes plant, consume and market cassava and average farm income was similar to that in non-cassava based farming systems in East Africa; (iii) poorer households do not predominantly intercrop cassava, though they do intercrop cassava more frequently than wealthier farmers; (iv) total labour requirements of cassava are higher than those of other

crops due to frequent weed control, though if expressed on a monthly basis labour requirements of cassava are lower than for other crops; and (v) farmers do use inputs for cassava production in the form of hired labour for weed management and improved genotypes. Perpetuation of these beliefs undermines a deeper understanding of the socio-economic and management aspects of cassava production and thus weakens policy and development efforts to improve cassava production. We conclude that, contrary to expectations, investments in cassava production will not improve food security but instead improve the scope for commercialisation of cassava. Further, such initiatives will not benefit poor and/or labour-deficit households, unless specific provisions are undertaken to ensure this.

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