INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
sustainable solutions for ending hunger and poverty
Supported by the CGIAR

USSP Background Paper 04

Analysis of relative profitability of key Ugandan agricultural enterprises by agricultural production zone

David Kraybill & Michael Kidoido

Department of Agricultural, Environmental, and Development Economics
Ohio State University
Columbus, Ohio, USA

Uganda Strategy Support Program (USSP)
Background Paper no. USSP 04

November 2009

IFPRI-KAMPALA

Plot 15, East Naguru Road
P.O. Box 28565
Kampala, Uganda
Tel: +256-414-285-060/064
Fax: +256-414-285079
E-mail: ifpri-uganda@cgiar.org

IFPRI HEADQUARTERS

International Food Policy Research Institute
2033 K Street, NW
Washington, DC 20006-1002
USA
Tel: +1-202-862-5600
Skype: IFPRIhomeoffice
Fax: +1-202-467-4439
E-mail: ifpri@cgiar.org
www.ifpri.org

UGANDA STRATEGY SUPPORT PROGRAM (USSP)
BACKGROUND PAPERS

ABOUT USSP

The Uganda Strategy Support Program is an initiative to strengthen evidence-based policymaking in Uganda in the areas of rural and agricultural development. Facilitated by the International Food Policy Research Institute (IFPRI), USSP works closely with the government of Uganda, represented by the secretariat for the Plan for the Modernisation of Agriculture (PMA), and other development partners to provide information relevant for the design and implementation of Uganda's agricultural and rural development strategies. For more information, see www.ifpri.org/themes/ussp/ussp.htm or www.pma.go.ug.

ABOUT THESE BACKGROUND PAPERS

The Uganda Strategy Support Program (USSP) Background Papers contain preliminary material and research results from IFPRI and/or its partners in Uganda. The papers have not been subject to a formal peer review. They are circulated in order to stimulate discussion and critical comment. The opinions are those of the authors and do not necessarily reflect those of their home institutions or supporting organizations.

Analysis of relative profitability of key Ugandan agricultural enterprises by agricultural production zone

David Kraybill & Michael Kidoido

Department of Agricultural, Environmental, and Development Economics
Ohio State University
Columbus, Ohio, USA

David Kraybill is a Professor in the Department of Agricultural, Environmental, and Development Economics at Ohio State University, Columbus, OH, USA. Michael Kidoido is a PhD candidate in the same department.

Copyright © 2009 International Food Policy Research Institute. All rights reserved. Sections of this material may be reproduced for personal and not-for-profit use without the express written permission of but with acknowledgment to IFPRI. To reproduce the material contained herein for profit or commercial use requires express written permission. To obtain permission, contact the Communications Division at ifpri-copyright@cgiar.org.

TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... **VII**
Background vii
Methodology vii
Findings and Conclusions vii
Study recommendations viii

INTRODUCTION **1**
Overview of Uganda's Agricultural Sector 1
Uganda's Resource Base and Production Systems 2
Uganda's agricultural production zones 2

METHODOLOGY FOR COMPUTING ENTERPRISE GROSS MARGINS **5**
Farm gate prices 6
Enterprise output/yield levels 6
Per unit variable costs of production 7

RESULTS AND DISCUSSION **8**
National enterprise gross margins 8

CROP-SPECIFIC ENTERPRISE BUDGETS **9**
Banana enterprise budgets 9
Bean enterprise budgets 10
Cassava enterprise budgets 11
Cocoa enterprise budgets 12
Coffee enterprise budgets 12
Cotton enterprise budgets 13
Field pea enterprise budgets 14
Finger millet enterprise budgets 15
Groundnut enterprise budgets 15
Irish potato enterprise budgets 16
Maize enterprise budgets 17
Passion fruit enterprise budgets 17
Pigeonpea enterprise budgets 18
Rice enterprise budgets 19
Simsim enterprise budgets 20
Sorghum enterprise budgets 20
Soyabean enterprise budgets 21
Sunflower enterprise budgets 22
Sweet potato enterprise budgets 22
Tea (out-grower scheme) enterprise budgets 23
Tobacco enterprise budgets 24
Beekeeping (apiary) enterprise budgets 24
Dairy enterprise budgets 25
Goat (for meat) enterprise budgets 26

ANALYSIS OF ENTERPRISE PROFITABILITY BY AGRICULTURAL PRODUCTION ZONES **26**
Enterprise profitability in the North-eastern Drylands (Zone 1) 27
Enterprise profitability in the North-eastern Savannah Grasslands (Zone 2) 28
Enterprise profitability in North-western Savannah Grasslands (Zone 3) 29
Enterprise profitability in Para-savannahs (Zone 4) 30
Enterprise profitability in Kyoga Plains (Zone 5) 31
Enterprise profitability in Lake Victoria Crescent (Zone 6) 32
Enterprise profitability in Western Savannah Grasslands (Zone 7) 33
Enterprise profitability in Pastoral Rangelands (Zone 8) 35
Enterprise profitability in South-western Farmlands (Zone 9) 36
Enterprise profitability in Highland Ranges (Zone 10) 37
Summary of profitable enterprises by agricultural production zone 38

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS **39**

APPENDIX: THE USE OF THE UNHS FOR GROSS MARGINS ANALYSIS **41**
Crop production modules 41
Livestock production modules 41

BIBLIOGRAPHY **42**

LIST OF TABLES

Table 1: Distribution of agricultural production zones 3
Table 2: National farm gate prices for enterprise products by season (UShs/kilogram) 6
Table 3: Summary of agricultural wages by seed type (UShs/day) 7
Table 4: National crop enterprise gross margins (UShs/hectare) 9
Table 5: National livestock gross margins (UShs/livestock unit) 9
Table 6: Banana enterprise budget under low input use/subsistence (UShs/hectare) 10
Table 7: Banana enterprise budget under high input use/recommended (UShs/hectare) 10
Table 8: Bean enterprise budget under low input use/subsistence (UShs/hectare) 11
Table 9: Bean enterprise budget under high input use/recommended (UShs/hectare) 11
Table 10: Cassava enterprise budget under low input use/subsistence (UShs/hectare) 11
Table 11: Cassava enterprise budget under high input use/recommended (UShs/hectare) 12
Table 12: Cocoa enterprise budget under low input use/subsistence (UShs/hectare) 12
Table 13: Cocoa enterprise budget under high input use/recommended (UShs/hectare) 12
Table 14: Coffee enterprise budget under low input use/subsistence (UShs/hectare) 13
Table 15: Coffee enterprise budget under high input use/recommended (UShs/hectare) 13
Table 16: Cotton enterprise budget under low input use/subsistence (UShs/hectare) 14
Table 17: Cotton enterprise budget under high input use/recommended (UShs/hectare) 14
Table 18: Field pea enterprise budget under low input use/subsistence (UShs/hectare) 14
Table 19: Field pea enterprise budget under high input use/recommended (UShs/hectare) 15
Table 20: Finger millet enterprise budget under low input use/subsistence (UShs/hectare) 15
Table 21: Finger millet enterprise budget under high input use/recommended (UShs/hectare) 15
Table 22: Groundnut enterprise budget under low input use/subsistence (UShs/hectare) 16
Table 23: Groundnut enterprise budget under high input use/recommended (UShs/hectare) 16
Table 24: Irish potato enterprise budget under low input use/subsistence (UShs/hectare) 16
Table 25: Irish potato enterprise budget under high input use/recommended (UShs/hectare) 17
Table 26: Maize enterprise budget under low input use/subsistence (UShs/hectare) 17
Table 27: Maize enterprise budget under high input use/recommended (UShs/hectare) 17
Table 28: Passion fruit enterprise budget under low input use/subsistence (UShs/hectare) 18
Table 29: Passion fruit enterprise budget under high input use/recommended (UShs/hectare) 18
Table 30: Pigeonpea enterprise budget under low input use/subsistence (UShs /hectare) 18
Table 31: Pigeonpea enterprise budget under high input use/recommended (UShs/hectare) 19
Table 32: Rice enterprise budget under low input use/subsistence (UShs/hectare) 19
Table 33: Rice enterprise budget under high input use/recommended (UShs/hectare) 19
Table 34: Simsim enterprise budget under low input use/subsistence (UShs/hectare) 20
Table 35: Simsim enterprise budget under high input use/recommended (UShs/hectare) 20
Table 36: Sorghum enterprise budget under low input use/subsistence (UShs/hectare) 21
Table 37: Sorghum enterprise budget under high input use/recommended (UShs/hectare) 21
Table 38: Soyabean enterprise budget under low input use/subsistence (UShs/hectare) 21
Table 39: Soyabean enterprise budget under high input use/recommended (UShs/hectare) 21
Table 40: Sunflower enterprise budget under low input use/subsistence (UShs/hectare) 22
Table 41: Sunflower enterprise budget under high input use/recommended (UShs/hectare) 22
Table 42: Sweet potato enterprise budget under low input use/subsistence (UShs/hectare) 23
Table 43: Sweet potato enterprise budget under high input use/recommended (UShs/hectare) 23
Table 44: Tea enterprise budget under low input use/subsistence UShs/hectare) 23
Table 45: Tea enterprise budget under high input use/recommended (UShs/hectare) 23
Table 46: Tobacco enterprise budget under low input use/subsistence (UShs/hectare) 24
Table 47: Tobacco enterprise budget under high input use/recommended (UShs/hectare) 24
Table 48: Beekeeping enterprise under low input use/traditional production (UShs/beehive) 25
Table 49: Beekeeping enterprise budget under high input use/recommended (UShs/beehive) 25
Table 50: Dairy enterprise budget under low-input use/subsistence (UShs/dairy cow) 25
Table 51: Dairy enterprise budget under high-input use/recommended (UShs/dairy cow) 26
Table 52: Goat enterprise budget under low input use/subsistence (UShs/goat) 26
Table 53: Goat enterprise budget under high input use/recommended (UShs/goat) 26
Table 54: Crop enterprise gross margins for North-eastern Drylands (Zone 1) (UShs per hectare) 27
Table 55: Livestock enterprise gross margins for North-eastern Drylands (Zone 1) (UShs per livestock unit) 28
Table 56: Crop enterprise gross margins for North-eastern Savannah Grasslands (Zone 2) (UShs per hectare) 28

Table 57: Livestock enterprises gross margins for North-eastern Savannah Grasslands (Zone 2) (UShs per livestock unit) 29
Table 58: Crop enterprise gross margins for North-western Savannah Grasslands (Zone 3) (UShs per hectare) 30
Table 59: Livestock enterprises gross margins for North-western Savannah Grasslands (Zone 3) (UShs per livestock unit) 30
Table 60: Crop enterprise gross margins for Para-savannahs (Zone 4) (UShs per hectare)....31
Table 61: Livestock enterprises gross margins for Para-savannahs (Zone 4) (UShs per livestock unit) 31
Table 62: Crop enterprise gross margins for Kyoga Plains (Zone 5) (UShs per hectare)....32
Table 63: Livestock enterprises gross margins for Kyoga Plains (Zone 5) (UShs per livestock unit) 32
Table 64: Crop enterprise gross margins for Lake Victoria Crescent (Zone 6) (UShs per hectare)....33
Table 65: Livestock enterprises gross margins for Lake Victoria Crescent (Zone 6) (UShs per livestock unit) 33
Table 66: Crop enterprise gross margins for Western Savannah Grasslands (Zone 7) (UShs per hectare) 34
Table 67: Livestock enterprises gross margins for Western Savannah Grasslands (Zone 7) (UShs per livestock unit) 34
Table 68: Crop enterprise gross margins for Pastoral Rangelands (Zone 8) (UShs per hectare)....35
Table 69: Livestock enterprises gross margins for Pastoral Rangelands (Zone 8) (UShs per livestock unit) 35
Table 70: Crop enterprise gross margins for South-western Farmlands (Zone 9) (UShs per hectare)....36
Table 71: Livestock enterprises gross margins for South-western Farmlands (Zone 9) (UShs per livestock unit) 37
Table 72: Crop enterprise gross margins for Highland Ranges (Zone 10) (UShs per hectare) 38
Table 73: Livestock enterprises gross margins for Highland Ranges (Zone 10) (UShs per livestock unit)....38
Table 74: Most profitable enterprises by agricultural production zone....39

LIST OF FIGURES

Figure 1: Map of Uganda's agricultural production zones....3

Executive Summary

Background

Uganda's economy remains heavily reliant on the agricultural sector. The agricultural sector contributes about 90 percent of total export earnings, generates about 23.7 percent of total Gross Domestic Product (GDP), and directly or indirectly provides a livelihood to almost 90 percent of the population. However, most of the agricultural production is by small-scale subsistence farmers who engage in non-market production and work under a myriad of production and post-production constraints. The Plan for the Modernisation of Agriculture (PMA) was therefore designed as a strategic framework for eradicating poverty through the implementation of multi-sectoral interventions to tackle the constraints that ordinary farmers face. Specifically, PMA is aimed at increasing income, quality of life, household food security, providing gainful employment, and providing sustainable use and management of resources.

In support of PMA priority interventions, the Government of Uganda (GoU) is implementing the Prosperity for All development framework that embraces rural enterprise and promotes industry by building on the Plan for Zonal Agricultural Production, Agro-processing and Marketing. By applying zoning and enterprise selection criteria, PMA hopes to provide information and guidance to local governments and individual farmers on agricultural investments. The Kampala office of the International Food Policy Research Institute (IFPRI), as a principal partner under its Uganda Strategy Support Programme, is assisting the PMA Secretariat in building capacity to select enterprises based on their relative profitability at the agricultural production zone level. The current analysis is in line with this broad objective and is aimed at 1) providing information on the relative profitability of PMA priority enterprises at the agricultural production zone level, and 2) assessing the use of the Uganda National Household Survey (UNHS) for developing partial budgets for PMA priority enterprises.

Methodology

The study utilized the farm household data available in the 2005/06 Uganda National Household Survey (UNHS) to generate enterprise budgets for PMA priority enterprises. Enterprise budgets were the basis for computing enterprise-specific gross margins at both national and zone levels. Budgets for the following enterprises were prepared: banana, beekeeping, coffee, cotton, dairy farming, goats, groundnut, maize, rice, sorghum, sunflower, tobacco, tea, cocoa, bean, cassava, Irish potato, sweet potato, simsim, finger millet, soyabean, field pea, and pigeonpea. Gross margins were computed as gross revenue less operating (variable) costs of production per standard unit (hectare for crop production and animal unit for livestock). Computation of gross margins requires three types of information: farm gate prices (calculated as season district median per kilogram farm gate prices), enterprise output/yield levels and per unit variable costs of production. For crop enterprises, variable costs of production include cost of family labour or hired labour, cost of material inputs such as seeds, fertilizers and other chemicals, and cost of mechanization or draft power. The cost of family labour was calculated based on average district wage rates for hired labour. Partial budgets for each enterprise were also prepared along with the gross margins. Two types of enterprise budgets were prepared: 1) budgets based on the median revenue and median variable costs (to represent low-input use technology), and 2) budgets based on the 75th percentile revenue and variable costs (to represent high-input technology).

Findings and Conclusions

The following findings emerged from the study:

- Labour demands, especially for family labour, constitute a significant proportion of total variable costs of production for most crop enterprises in Uganda.

- For traditional cash crops, cost of material inputs such as fertilizers and other chemicals constitute a significant proportion of total variable costs besides labour cost.
- At the national level, cocoa, banana, tobacco and tea are the most profitable crops during the first season, whereas banana, cocoa, passion fruit, tobacco, and rice are the most profitable crops during the second season.
- For crop enterprises such as cotton, field pea, millet, Irish potato, pigeonpea, simsim, sorghum, soybean, and sweet potato that are considered to have few alternative high-yielding varieties, the difference in gross margins generated with low-input technology and high-input technology is found to be insignificant.
- Local goat enterprise is profitable in many zones and its profitability is largely attributed to low input use.
- With respect to the use of the Uganda National Household Survey (UNHS) for generating enterprise budgets, the study notes that the UNHS in its current form is not well structured for computation of enterprise gross margins. Sections 4, 5, 6, 7 of the UNHS crop module are not linked by seed type and production method. Consequently, crop output could not be associated with a particular seed type or cropping pattern (monocrop or intercrop). Furthermore, for some of the crop enterprises, there are few high-yielding varieties. Crops of this category include cotton, field pea, millet, Irish potato, pigeonpea, simsim, sorghum, soybean, and sweet potato. For these crops, there is little difference in gross margins between the low-input technology and the high-input technology.
- For the livestock module of the UNHS, sections 10 and 11 are not linked by animal enterprise type. Livestock expenditure and production levels could not be linked to specific livestock enterprises. Therefore, variable costs associated with specific livestock enterprises could not be computed for farms that produced more than one type of livestock.

Study recommendations

- Labour-saving technologies, including row planting of crops normally broadcasted and use of draft animals, should be made significant components of the PMA technology packages. Other labour-saving technologies including use of herbicides, practicing minimum tillage, and intercropping leguminous cover crops to suppress weeds should also be encouraged. In addition, farmers should be encouraged to join farmer groups or labour rotation groups where member farmers develop alternative ways to ensure mutual labour availability among group members.
- PMA should ensure that yield-enhancing inputs, particularly improved varieties, are accessible to farmers to enable them improve gross margins through better yields.
- Local goat production should be promoted in most agricultural production zones.
- The following enterprises are recommended for the various agricultural production zones:
    - *North-eastern Drylands – Zone 1*: Maize and sorghum for crop production and local goats for livestock production;
    - *North-eastern Savannah Grasslands – Zone 2*: Field pea, cassava, and simsim for crop production and local goats for livestock production;
    - *North-western Savannah Grasslands – Zone 3*: Coffee, tobacco, cassava, banana, sweet potato, and maize for crop production and beekeeping and goat for livestock production;

- *Para-savannahs – Zone 4*: Maize, cassava, and sweet potato for crop production and goat for livestock production;
- *Kyoga Plains – Zone 5*: Rice, sweet potato, maize, cassava, and banana for crop production;
- *Lake Victoria Crescent – Zone 6*: Rice, cassava, banana, sweet potato, and finger millet for crop production;
- *Western Savannah Grasslands – Zone 7*: Passion fruit, tobacco, maize, banana, and coffee for crop production and local goat for livestock production;
- *Pastoral Rangelands – Zone 8*: Banana, sweet potato, Irish potato, finger millet, and maize for crop production;
- *South-western Farmlands – Zone 9*: Banana, rice, groundnut, maize, coffee, and Irish potato for crop production and dairy for livestock production;
- *Highland Ranges – Zone 10*: Coffee, cocoa, Irish potato, banana, and bean for crop production and improved goat breeds for livestock production.

- For the UNHS to be more useful in generating enterprise partial budgets, the following changes should be effected. Sections 4, 5, 6, and 7 of the crop module should be reported at the plot level. Also, formal names of crop varieties should be used in the survey so that errors in assigning crops to local versus improved varieties can be avoided. This will allow a more consistent identification of crop varieties.
- For the livestock module of UNHS, sections 10 and 11 should be linked by livestock type. In this way, livestock enterprises costs and production values can be computed accurately for farms that produce more than one type of animal.

Introduction

Overview of Uganda's Agricultural Sector

Uganda's economy is heavily dependent on agriculture. Over 90 percent of Uganda's export earnings and close to 23.7 percent of the total Gross Domestic Product (GDP) are generated from the agricultural sector. Similarly, the agricultural sector is the major source of livelihood for about 90 percent of the population, providing direct employment to more than 80 percent of the country's population (MFPED, 2009). Most of the country's agricultural production, however, is undertaken by small-scale subsistence farmers that are engaged in non-market agricultural production, utilising on average less than 2 hectares of land. Most farmers are relatively poor, scattered and use rudimentary technology. Many farmers lack access to productivity enhancing inputs, suffer from heavy produce loss due to pests and diseases, lack knowledge and specialized skills, have low capital and no access to credit, face poorly functioning produce markets and lack efficient storage technology. Consequently, agricultural productivity across the country remains low, leading to low overall aggregate agricultural production.

The Plan for the Modernisation of Agriculture (PMA) was designed as a strategic framework for eradicating poverty through the pursuance of multi-sectoral interventions to tackle a wide range of multi-faceted constraints that farmers face. The PMA is part of the Government of Uganda's strategy of poverty eradication as contained in the Poverty Eradication Action Plan. The main objectives of the PMA are:

- To increase incomes and improve the quality of life of poor subsistence farmers through increased productivity and increased marketing of farm production;
- To improve household food security through the market rather than emphasizing self sufficiency;
- To provide gainful employment through agro-processing factories and services, and;
- To promote sustainable use and management of natural resources by developing improved land use and land management policy and by promoting environmentally friendly technologies.

The PMA identified the agricultural sector as an important avenue for improving the livelihoods of the population given the sector's invaluable contribution to the country's economy. The multi-sectoral interventions of PMA are meant to increase the productivity of factors of production in agriculture, ensure food security, create gainful employment, increase incomes, and improve the quality of life of those engaged in agriculture. To accomplish this, PMA advocates a shift from subsistence to commercial agriculture. Therefore, in support of the PMA priority interventions, the Government of Uganda is implementing the Prosperity for All development framework that includes rural enterprise and rural industry promotion, building on the Plan for Zonal Agricultural Production, Agro-processing, and Marketing. The zonal plan aims at increasing household incomes through sustainable and profitable zonally-prioritized agricultural production for exports. The plan advocates for an integrated approach to link all key related priorities including; increased production and productivity, value addition and quality assurance, sustainable access to markets, poverty eradication at individual and household levels, export promotion for increasing national income and national economic growth.

The PMA aims to use agricultural zoning and enterprise selection criteria in guiding agricultural investment by local governments and individual farmers to improve household incomes and reduce rural poverty. In order to achieve this, the PMA Secretariat seeks to develop its capabilities to make recommendations regarding choice of crop and livestock enterprises in particular regions of the country based on agro-ecological suitability and profitability. Ten agricultural production zones were identified for this purpose. The ten

agricultural zones were identified by the Ministry of Agriculture, Animal Industries and Fisheries (MAAIF) in collaboration with the Ministry of Finance, Planning and Economic Development (MFPED). The Kampala office of the International Food Policy Research Institute (IFPRI), under the Uganda Strategy Support Programme, is supporting the efforts of the PMA Secretariat, as a principal partner of these ministries, in developing tools to enable the selection of priority zonal agricultural enterprises.

As part of its efforts in this regard, the PMA Secretariat, with technical support from IFPRI, in late 2008 and early 2009 conducted a small crop budget survey with smallholder farmers categorized into three farmer types – traditional, low-input users, and high-input users – in several agricultural zones of the country. Agricultural enterprise budgets and gross margin analyses are now being prepared by analysts at the PMA Secretariat and IFPRI-Kampala using the information gathered in this survey. However, the relatively small scope and size of the crop budget survey has raised concerns that only limited information for enterprise selection will be derived from these analyses. IFPRI-Kampala and the PMA Secretariat desired that a parallel crop budget analysis be carried out using data from the 2005/06 Uganda National Household Survey (UNHS). They recognized that the UNHS gathered information from a large sample of farming households and that this information would complement gross margins calculated from the crop budget survey and allow the quality of the analytical results from the crop budget survey to be validated. The objectives of this study are therefore 1) to develop agricultural zonal enterprise production budgets for the purpose of generating zonal enterprise gross margins and to use them to rank zonal enterprises by profitability; and 2) to assess the suitability of the Uganda National Household Survey (UNHS) for developing PMA priority enterprise partial budgets.

Uganda's Resource Base and Production Systems

Uganda is located on the equator and has temperatures ranging from 15 to 30 degrees centigrade. Most parts of the country are located between 1,000 and 2,500 meters above sea level. The largest part of Uganda enjoys a fairly reliable rainfall pattern that varies from 750 mm per annum in parts of the Karamoja pastoral areas in the Northeast Uganda to 1,500 mm per annum in the high-rainfall areas on the shores of Lake Victoria, around the highlands of Mt. Elgon in the East, and in the Southwest Highlands.

Areas close to the equator, around the Lake Victoria Crescent and some regions in the highlands, enjoy two distinct rainy seasons whereas the rest of the country receives a single long rainy season. The country is 241,000 square kilometers in size. About 75 percent of this land is available for cultivation, pasture, or both. The remaining 25 percent constitutes lakes, swamps and forestry zones. Of the land that is available for farming, about 5 million hectares are cultivatable (i.e., less than 30 percent of the total arable land). Land is increasingly becoming a constraint on agricultural production in some parts of the country, especially in the southern and eastern regions of the country, due to rapid increasing population. On average, landholding is 2.2 hectares per household. Customary, freehold and mailo are common and legally recognized forms of land tenure in the country.

Uganda's agricultural production zones

According to the PMA and MFPED (2004), an "a*gricultural production zone"* is an area with similar socio-economic characteristics and where ecological conditions, farming systems and practices are fairly homogeneous. It is assumed that a unique agricultural production zone has common crops and livestock types. Zones may cut across districts. The following factors were considered important for the zoning exercise:

- Agro-ecological characteristics: rainfall, land forms (topology), soil types, water bodies, vegetation cover, and temperature regimes;
- Cropping and livestock systems;

- Socio-economic factors: attitudes, resource endowments, demographic patterns, literacy levels;
- Geo-politics: the nature of civil strife or political boundaries;
- Infrastructure: transport, communication, production facilities, processing facilities, and marketing facilities;
- Land: tenure, availability, land holdings; and
- On-going agriculture-based programmes/projects/initiatives.

The exercise of dividing the country into agricultural production zones identified ten (10) zones. Figure 1 is a map showing the location of the various agricultural production zones, while Table 1 presents a description of them.

Figure 1: Map of Uganda's agricultural production zones

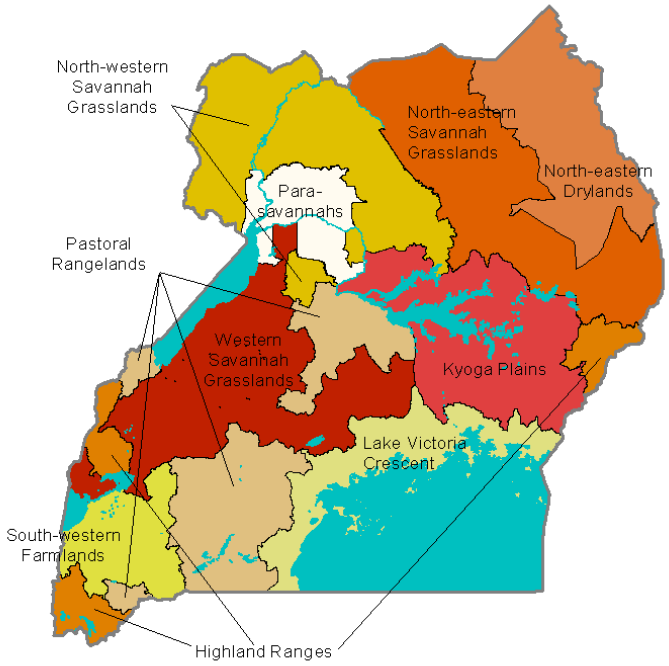


Table 1: Distribution of agricultural production zones

Zone	Name of Zone	Districts	Characteristics of the zone	Enterprises
1	North-eastern Drylands	Moroto northern Kotido eastern Kitgum	• Average rainfall - 745 mm • One rainy season: April –September • Soils are moderate to poor • Largely subsistence farming and pastoral activities	• Gum Arabica • Simsim • Beekeeping • Goats/skin • Beef cattle/hides • Ostriches • Sunflower
2	North-eastern Savannah Grasslands	Pader Kitgum eastern Lira Katakwi northern Sironko northern Kapchorwa Nakapiripirit southern Kotido	• Average rainfall - 1,197 mm • One rainy season: April-October • Soils are moderate to poor • Predominantly subsistence with a few emerging commercial farms	• Beekeeping • Beef cattle/hides • Goats/skins • Simsim • Cassava • Pulses • Sunflower

Zone	Name of Zone	Districts	Characteristics of the zone	Enterprises
3	North-western Savannah Grasslands	Adjumani western Nebbi Arua Moyo Yumbe northern Gulu northern Apac western Lira	• Average rainfall - 1,340 mm • One rainy season: April -November • Soils are good to moderate • Out growers schemes exists • Possibility of block farming • Cross-border trade advantage	• Spices • Tobacco • Beekeeping • Cotton • Pulses • Simsim • Robusta coffee
4	Para-savannahs	eastern Nebbi southwestern Gulu western Masindi	• Average rainfall - 1,259 mm • One rainy season: March -November • Soils are good to moderate • Largely park land with potential for livestock farming • Possibility of block farming • Cross-border trade advantage	• Spices • Fisheries • Cassava • Beekeeping • Beef/hides • Goats/skins • Cotton
5	Kyoga Plains	Kayunga Kamuli Iganga northern Bugiri Tororo northern Busia southern Mbale Pallisa Kumi Soroti Kaberamaido southern Lira southern Apac	• Rainfall - 1,215 mm • Two rainy seasons • Main season: March –May • Secondary season: August –November • Soils are poor to moderate • Small-scale subsistence with some pastoralism • Possibility of commercial farming	• Fisheries • Beekeeping • Maize • Pulses • Beef cattle • Cassava • Goats
6I	Lake Victoria Crescent	Kampala Mukono Wakiso eastern Mpigi eastern Masaka eastern Rakai Kalangala Jinja Mayuge southern Bugiri southern Busia	• Rainfall - 1,200 to 1,450 mm • Two rainy season • Main season: March-May • Secondary season: October -December • Soils are good to moderate • Small medium and large-scale intensive farming • Availability of skilled labour • Good infrastructure • Numerous resources • High availability of immigrant labour	• Robusta coffee • Fisheries • Spices • Floriculture • Horticulture • Vanilla • Cocoa • Dairy cattle
7I	Western Savannah Grasslands	Hoima Kiboga southern Luwero Mubende Kibaale Kyenjojo Kabarole Kamwenge southern Kasese	• Rainfall - 1,270 mm • Two rainy seasons • Main season: August-November • Secondary season: March-May • Soils are moderate to good • Out-grower system exists • Moderately developed infrastructure	• Robusta coffee • Tea • Beekeeping • Maize • Banana (brewing) • Bean • Beef cattle/hides
8	Pastoral Rangeland	eastern Masindi Nakasongola northern Luwero central Kiboga southern Mubende western Mpigi western Masaka western Rakai Ssembabule eastern Mbarara southern Ntungamo northern Bundibugyo	• Rainfall – 915 to 1,021 mm • Two rainy seasons • Main season: March-May • Secondary season: January- February • Soils are moderate to poor • Communal grazing • Absentee landlords • Moderate to poorly developed infrastructure • Agro-pastoral practices	• Beef cattle • Dairy cattle • Goats • Spices • Beekeeping • Citrus • Pineapple
9	South-western Farmlands	western Mbarara Bushenyi northern Ntungamo Rukungiri northern Kanungu	• Rainfall- 1,120 to 1,223 mm • Two rainy seasons • Main season: August –November • Secondary: March-May • Land shortage • Relatively well endowed and organized • Fairly well developed infrastructure	• Robusta coffee • Tea • Dairy/hides • Banana (dessert) • Vanilla • Tobacco

Zone	Name of Zone	Districts	Characteristics of the zone	Enterprises
10	Highland Ranges	northern Mbale southern Sironko southern Kapchorwa southern Kanungu Kabale Kisoro northern Kasese southern Bundibugyo	• Rainfall - 1,400 mm • Two Rainy seasons • Main season: September -December (for Kabale, Kisoro and Kasese region) • One long rainy seasons from March to October (first peak in April and second peak in August) for northern Mbale, Sironko, Southern Kapchorwa • Soils are mostly young volcanic soils that are rich in nutrients • Mountainous • Land shortage • Fairly developed entrepreneurial skills	• Arabica coffee • Passion fruit • Vanilla • Dairy/hides • Spices • Maize • Irish potato

Methodology for Computing Enterprise Gross Margins

This study prepared agricultural enterprise budgets and conducted gross margin analyses using farm household data available in the 2005/06 Uganda National Household Survey (UNHS). Enterprise budgets were developed for the following PMA priority enterprises: banana, beekeeping, coffee, cotton, dairy, goats, groundnut, maize, rice, sorghum, sunflower, and tobacco. Budgets were also prepared for tea, cocoa, bean, cassava, Irish potato, sweet potato, simsim, finger millet, soyabean, field pea, and pigeonpea. Given the computational difficulties encountered in computing gross margins for intercrops and mixed enterprises, especially in terms of being able to allocate total costs and total yields to the individual enterprises, we worked only with data from pure-stand crop enterprises and from households with single livestock enterprises. Enterprise budgets were the basis for computing enterprise-specific gross margins both at national and zonal levels. Gross margins were defined as gross revenue, less operating (variable costs) of production. Gross margins were computed based on the following equation:

$$GM = P_y Y - \sum_i P_i X_i$$

where GM[1] is gross margin in Uganda shillings per hectare for a given crop enterprise or a unit of livestock during a given production period; P_y is the farm gate price of a given crop product or livestock product; Y is the quantity of crop output per hectare or unit of livestock for a given season; P_i is the price of the i^{th} variable input used to produce a given crop product or livestock product for a given production period; and X_i is the quantity of the i^{th} variable input per hectare or per unit of livestock used in production. For national gross margins, we adopted the season definition of the UNHS, according to which the first season is defined as January through June and the second season is defined as July through December. At the agricultural production zone level, however, growing seasons for some zones do not fit neatly into this scheme.

The computation of enterprise gross margins requires three types of information: farm gate prices, crop or livestock output levels, and variables costs per unit of production. By long-

[1] Gross margins were computed based on median gross revenues and median variable costs of production. We chose to use the median because of the several advantages it posses such as being unaffected by extreme values, being unaffected by skewness of distributions, and being able to be efficiently applied to a wide range of data types, including categorical data. Nonetheless, the following disadvantages of the median could potentially impact results; it is likely to differ across samples from the same population and it is less utilized compared with the mean or other measures of central tendency. Overall, the advantages of using the median outweigh the disadvantages especially where the median can be computed with relative ease.

standing convention gross margin exclude fixed costs[2]. Fixed costs are those costs that are unrelated to the size of the farm.

Farm gate prices

Prices were calculated as season district median farm gate prices per kilogram for each product. Table 2 reveals a high variation in prices between the first and second season. In the first season, finger millet, soyabean, and tobacco farm gate prices were higher than for the second season. This difference is ultimately reflected in the computed values of gross margin, where the gross margins of first-season crops were greater than those of the second season. On the other hand, the second season farm gate prices for cocoa, field pea, groundnut, pigeonpea, and rice were higher than for the first season. In most cases, farm gate prices tend to rise when the crops are off-season and therefore scarce and fall when there is a bumper harvest.

Table 2: National farm gate prices for enterprise products by season (UShs/kilogram)

	First Season			Second Season		
Product	**Median Price (UShs)**	**Sample Size**	**Standard Deviation**	**Median Price (UShs)**	**Sample Size**	**Standard Deviation**
Crops						
Banana	195	798	82	142	912	65
Bean	457	519	113	467	634	236
Cassava	308	1,073	343	335	839	244
Cocoa	1,000	16	112	1,500	16	235
Coffee	544	237	413	445	304	1,185
Cotton	350	17	414	344	259	422
Field Pea	460	9	162	709	29	350
Finger millet	430	215	161	375	386	433
Groundnut	413	383	261	862	347	745
Irish potato	193	113	97	187	137	85
Maize	219	1,052	92	281	1,213	97
Passion fruit	507	10	281	650	7	1,115
Pigeonpea	460	9	127	600	8	151
Rice	786	168	213	912	109	583
Simsim	732	35	360	633	208	241
Sorghum	263	416	152	250	380	142
Soyabean	600	18	309	437	26	190
Sunflower	240	20	104	250	35	143
Sweet potato	142	1,928	96	151	1,626	129
Tea (leaf)	160	10	42	Data not collected		
Tobacco (leaf)	1,320	54	3,967	500	27	1,331
Animals						
Beekeeping (honey per litre)	4,000	24	4,498	Data not collected		
Dairy (milk per litre)	400	107	124	Data not collected		

Enterprise output/yield levels

Crop yields were calculated on a per-hectare basis for each of the two growing seasons. For livestock enterprises, where production is not necessarily tied to the cycle of rains, total yield was considered as the sum of all items produced by the animal in a production period (six

[2] The gross margin is not the same as profit (net margin/net income) since the computation of the gross margin excludes overhead costs, such as interest and depreciation on assets. Fixed costs do not vary with the size of the enterprise. Consequently, the use of profit for farm planning is not recommended since fixed cost elements do not vary in proportion to the size of the enterprise (Upton, 1987).

months for this study). For instance, dairy output was calculated as the total quantity of butter and milk produced over six months period. For the beekeeping enterprise, output was considered as the total quantity of honey produced per beehive in a six month period. For animals, output was equated to the market weight of a mature animal. The output estimates were then valued using production period farm gate prices to be able to generate total revenue for each product. Given the structure of the UNHS, most crop enterprises were assessed based on the two calendar-year seasons, whereas livestock enterprises were based on a six-month production period.

Per unit variable costs of production

Variable costs include the costs of family labour, cost of hired labour, and costs of material inputs (such as seeds, fertilizers, other chemicals, and mechanized and draft power) associated with the production of a hectare of a particular crop, a unit of livestock, or a stream of livestock products. In the UNHS, the amount of family labour allocated to an enterprise is reported as the total effective work-days allocated to a specific agronomic task during a production period. Expenditures on other inputs including hired labour, seed, fertilizer, chemicals, and animal draft power or machinery are reported as the actual monetary values spent on each input. Livestock expenditure values were reported as the actual values spent on a particular item over a period of six months.

Family labour cost in crop production was calculated as the total value of man-days that the household allocated to the production of a hectare of an enterprise. Total household man-days were calculated as the sum of all labour hours that household members allocated to an enterprise. Man-day equivalences of woman-days and child-days were estimated based on weights suggested by Upton (1987). Accordingly, one woman-day was considered to be equivalent to 0.67 of a man-day whereas a child-day was equated to 0.33 of a man-day. Total effective man-days were then monetized using season median district wage rate imputed from the equivalent amount money paid for hired labour. According to a number of sources, the shadow family labour wage rate has often been considered to be lower than the hired labour wage rate since few alternative employment opportunities exist for most rural households who constitute the bulk of farmers in Uganda (Picazo-Tadeo and Reig-Martinez, 2005; de Janvry, Fafchamps, and Sadoulet, 1991; Gittinger, 1984). We set family labour man-days at 0.67 of the cost of an equivalent number of hired man-days. Table 3 presents a summary of the average agricultural wage rates by crop type and cropping season.

Table 3: Summary of agricultural wages by seed type (UShs/day)

	First Season Wages			Second Season Wages		
Seed type	Median	Sample Size	Standard Deviation	Median	Sample Size	Standard Deviation
Improved Varieties	1,571	13,897	261	1,938	13,766	406
Local Varieties	1,417	13,897	261	1,429	13,766	279

Generally, agricultural wage rates are found to be higher for those tasks associated with production of improved varieties than for agronomic activities associated with the production of local varieties. It is presumed that higher wage rates for improved varieties could be a result of the fact that higher levels of skill are required to carry out agricultural practices recommended for improved varieties, and that such skills are scarce. Hence, workers hired to work on improved crops receive a wage premium.

Overall, national average wage rates range from UShs 1,400 for tasks associated with local varieties to UShs 1,900 for those associated with improved varieties.

In the sections that follow, we first present the national level gross margins for the various enterprises and then gross margins at the agricultural production zone level.

Results and Discussion

National enterprise gross margins

In this section, results of the aggregated gross margin analyses for the major crop and animal enterprises across the country are reported. National gross margins reflect relative enterprise profitability; however, these gross margins can be misleading and should be interpreted with caution since production conditions, such as wage rates, input costs, output prices, and yield vary by agricultural production zone. Table 4 presents national aggregated enterprise gross margins by season and by seed type. We present results by season since seasonal variations in output prices, wage rate, and yield are common and have large impacts on the overall relative profitability of enterprises. Thereafter, enterprise budgets are presented. Two types of enterprise budgets are presented: 1) budgets based on average costs of production across the country to represent enterprise production with low-input technology, and 2) budgets based on costs and output levels of the 75th percentile of farmers to represent enterprise production with high-input technology. The second type of budget is based on the assumption that the 75th percentile farmer is a relatively more commercialized farmer who is able to carry out recommended production practices. The gross margins of 75th percentile farmers are computed as 75th percentile of enterprise-specific revenue minus the 75th percentile enterprise-specific variable costs of production.

Overall, during the first season (January-June) cocoa and banana generate more than UShs 500,000 per hectare in gross margins. Tobacco, cassava, and tea follow with gross margins between UShs 300,000 and UShs 400,000 per hectare. This is consistent with the historical agricultural production literature where these crops feature among the high income-generating crops of the country. Field pea, Irish potato, and sunflower follow in the ranking, generating between UShs 200,000 and UShs 300,000 per hectare in gross margins. Coffee, cotton, maize, rice, and sweet potato are relatively less competitive, generating gross margins between UShs 100,000 to UShs 200,000 per hectare. Among enterprises with improved crop varieties, bean, maize, tobacco, groundnut, and rice outperform the respective local varieties, generating higher gross margins.

During the second season (July-December), the ranking of enterprises based on relative profitability (gross margins) follows a pattern nearly similar to the one of the first season. Banana, cocoa, passion fruit, and tobacco generate gross margins in excess of UShs 500,000 per hectare. These are followed by rice, generating about UShs 420,000 per hectare, cassava (UShs 320,000 per hectare), bean, coffee, maize, and sweet potato (generating between UShs 200,000 and 300,000 per hectare), and then by Irish potato, pigeonpea, and simsim (generating between UShs 100,000 and UShs 200,000 per hectare). The rest of the crop enterprises generate less than UShs 100,000 per hectare in the second season. Improved varieties of banana, bean, cassava, coffee, groundnut, rice, simsim, and sunflower generate significantly higher gross margins than local varieties in the second season.

Table 4: National crop enterprise gross margins (UShs/hectare)

	Local Type				Improved Type			
	First Season		Second Season		First Season		Second Season	
Crop	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins
Banana	784	509,929	893	547,361	14	520,370	19	3,276,440
Bean	500	129,637	619	208,496	19	141,981	22	274,625
Cassava	975	343,441	733	321,471	98	280,594	106	607,625
Cocoa	16	775,576	16	1,345,535				
Coffee	229	192,287	287	231,061	8	128,686	17	301,864
Cotton	17	100,252	158	4,716			101	-69,109
Field pea	9	265,098	29	44,814				
Finger millet	215	12,530	386	74,696				
Groundnut	353	-104,350	321	40,554	30	259,438	26	114,363
Irish potato	113	285,842	123	157,401			14	-158,294
Maize	856	100,352	805	291,991	196	205,122	208	255,859
Passion fruit	10	73,196	7	1,031,436				
Pigeonpea	9	-25,764	8	123,417				
Rice	143	177,370	93	426,430	25	221,341	16	1,620,946
Simsim	35	44,700	195	108,491			13	260,378
Sorghum	416	-24,468	366	53,834			14	13,891
Soyabean	18	-60,142	26	17,988				
Sunflower	13	258,376	28	-3,515	7	23,764	7	480,188
Sweet potato	1,928	191,647	1,626	238,323				
Tea	10	369,697						
Tobacco	43	428,866	16	4,086,382	11	605,871		

Table 5: National livestock gross margins (UShs/livestock unit)

	Local Breeds		Improved Breeds	
Livestock Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins
Beekeeping	24	5,438		
Dairy	80	59,436	27	172,724
Goat	4,828	20,000	245	40,000

Crop-specific enterprise budgets

Banana enterprise budgets

Banana are grown for both household food security and household cash needs. Banana is mostly marketed from the farm, sold to middle-men or traders who then transport them to cities or major urban centers. Small amounts of banana are exported to neighboring countries or air freighted to Europe and other overseas markets. The most widely-produced banana are the cooking type, especially *Mpologoma, Kisansa, Nakitembe, Kibuzi, Mbwazirume, Enyeru, Musakala* and *Nfuuka* (USAID-Agricultural Productivity Enhancement Program, 2008; Bagamba, 2007). Major areas of commercial banana production in Uganda include Mbarara, Bushenyi, Ntungamo, Masaka, Rakai, and Bugisu. In terms of agricultural production zones, banana is extensively produced in Zones 4, 7, 8, 9, and 10. When produced with low-input technology, banana generally generates relatively low gross margins (Table 6). In contrast, the production of banana with high-input technology improves gross margins by about three-fold for improved varieties and by about two-fold for local varieties. Shifting banana production from local varieties to improved varieties improves gross margins by about five-fold in the second season with high input use. This improvement in gross margins is a result of improved varieties generating higher yields compared to local varieties.

In the second season, with low input use, local varieties generate about UShs 500,000 per hectare whereas improved varieties generate up to UShs 3 million per hectare. The relative profitability of banana is affected by the high cost of family labour which constitutes nearly 100 percent of the variable costs under low-input production and almost 50 percent of the variable costs under high-input production.

Table 6: Banana enterprise budget under low input use/subsistence (UShs/hectare)

	First Season		Second Season	
	Local Type (N=784)	**Improved Type (N=14)**	**Local Type (N=893)**	**Improved Type (N=19)**
Value of output (UShs/ha)	668,657	1,243,463	669,162	3,644,133
Family labour (UShs)[3]	158,728	723,093	121,801	367,693
Hired labour (UShs)	0	0	0	0
Total input costs (UShs)	0	0	0	0
Draft power/mechanization	0	0	0	0
Total Costs	158,728	723,093	121,801	367,693
Gross Margins	509,929	520,370	547,361	3,276,440

Table 7: Banana enterprise budget under high input use/recommended (UShs/hectare)

	First Season		Second Season	
	Local Type (N=784)	**Improved Type (N=14)**	**Local Type (N=893)**	**Improved Type (N=19)**
Value of output (UShs/ha)	2,135,969	2,854,595	2,278,542	10,400,000
Family labour (UShs)	159,827	695,610	189,561	367,693
Hired labour (UShs)	118,683	577,980	125,970	535,496
Total input costs (UShs)	64,875	606,522	61,750	298,870
Draft power/mechanization	0	0	0	0
Total Costs	343,385	1,880,112	377,281	1,202,059
Gross Margins	1,792,584	974,483	1,901,261	9,197,941

Bean enterprise budgets

High levels of production of bean are found in Kabale and Kisoro districts in south western Uganda; Arua, Nebbi, Lira, and Apac districts in northern Uganda; Masindi, Hoima, Kibaale, Bushenyi, Kamwenge, Kasese and Fort Portal districts in western Uganda; and Mbale, Sironko, and Kapchorwa districts in eastern Uganda. The most common bean varieties released by the National Agricultural Research Institutes include K131, K132, and K20 (Ministry of Tourism Trade and Industry, 2008). Gross margins by seed type and input use are presented in Tables 8 and 9. The analysis reveals that during the second season, the difference in gross margins between local bean varieties and improved ones is insignificant. Nonetheless, improved bean varieties generate about one third or more in gross margins compared with local varieties. This pattern of relative profitability is consistent even for the case of bean production under high-input technology.

[3] Labour costs are categorized into family and hired labour since different valuation procedures were used for these two types of labour.

Table 8: Bean enterprise budget under low input use/subsistence (UShs/hectare)

	First Season		Second Season	
	Local Type (N=500)	Improved Type (N=19)	Local Type (N=619)	Improved Type (N=22)
Value of output (UShs/ha)	313,698	262,502	372,540	538,022
Family labour (UShs)	164,301	105,371	134,404	159,657
Hired labour (UShs)	0	0	0	7,410
Total input costs (UShs)	19,760	15,149	29,640	96,330
Draft power/mechanization	0	0	0	0
Total Costs	184,061	120,520	164,044	263,397
Gross Margins	129,637	141,982	208,496	274,625

Table 9: Bean enterprise budget under high input use/recommended (UShs/hectare)

	First season		Second Season	
	Local Type (N=500)	Improved Type (N=19)	Local Type (N=619)	Improved Type (N=22)
Value of output (UShs/ha)	973,914	652,698	1,041,073	1,193,371
Family labour (UShs)	174,549	105,371	185,030	201,132
Hired labour (UShs)	111,150	108,680	135,850	202,128
Total input costs (UShs)	49,400	87,177	49,400	82,333
Draft power/mechanization	0	0	0	0
Total Costs	335,099	301,228	370,280	485,593
Gross Margins	638,815	351,470	670,793	707,778

Cassava enterprise budgets

Cassava produces more starch per hectare under dry conditions than any other crop in Uganda (National Agricultural Research Organization, 1994). The crop generates over 60 percent of the basic food requirements for the north, eastern and west Nile regions of the country (NARO, 1994). Production of the crop has gained prominence because 1) it has high yielding capabilities, 2) it is easy to cultivate and thus requires relatively little labour, and 3) it can be stored in the ground for up to three years. Many local varieties are available to farmers across the country. Also, the National Agricultural Research Organization has released a number of mosaic resistant varieties under the *NASE* series (NARO, 1994). The gross margin analysis below reveals that improved cassava varieties generate up to twice the gross margins generated by local varieties. Cassava production using high-input technology generates gross margins up to five times the gross margins generated using low input technology.

Table 10: Cassava enterprise budget under low input use/subsistence (UShs/hectare)

	First Season		Second Season	
	Local Type (N=975)	Improved Type (N=98)	Local Type (N=733)	Improved Type (N=106)
Value of output (UShs/ha)	586,272	610,990	459,235	1,020,477
Family labour (UShs)	242,831	330,396	137,764	410,874
Hired labour (UShs)	0	0	0	0
Total input costs (UShs)	0	0	0	1,650
Draft power/mechanization	0	0	0	0
Total Costs	242,831	330,396	137,764	412,524
Gross Margins	343,441	280,594	321,471	607,953

Table 11: Cassava enterprise budget under high input use/recommended (UShs/hectare)

	First Season		Second Season	
	Local Type (N=975)	Improved Type (N=98)	Local Type (N=733)	Improved Type (N=106)
Value of output (UShs/ha)	1,895,347	3,172,524	1,490,233	3,526,349
Family labour (UShs)	205,231	307,824	164,543	407,166
Hired labour (UShs)	115,644	130,471	96,330	138,320
Total input costs (UShs)	40,466	39,520	29,640	30,828
Draft power/mechanization	81,510	106,210	57,428	75,335
Total Costs	442,851	584,025	347,941	651,649
Gross Margins	1,452,496	2,588,499	1,142,293	2,874,701

Cocoa enterprise budgets

Cocoa production is slowly returning to Uganda's agricultural sector with a significant contribution to income for farmers involved in its production. Cocoa is gaining prominence mainly in Bundibugyo, Jinja, Hoima, Kamwenge, Kibaale, Kiboga, Luwero, Masindi, Mayuge, Mubende, Mukono, and Wakiso. Bundibugyo district, which is located in Zone 10, is currently the leading producer of cocoa in Uganda. Gross margin analysis indicates that cocoa production is quite profitable, generating high gross margins under both low-input and high-input technologies. Cocoa production does not have any reported improved varieties. However, even with low-input technology, the available varieties of cocoa generate a good return. Labour cost (particularly family labour) contributes a significant proportion to cocoa enterprise total variable costs.

Table 12: Cocoa enterprise budget under low input use/subsistence (UShs/hectare)

	First Season	Second Season
	Local Type (N= 16)	Local Type (N=16)
Value of output (UShs/ha)	963,071	1,696,722
Family labour (UShs)	187,494	351,187
Hired labour (UShs)	0	0
Total input costs (UShs)	0	0
Draft power/mechanization	0	0
Total Costs	187,494	351,187
Gross Margins	775,577	1,345,535

Table 13: Cocoa enterprise budget under high input use/recommended (UShs/hectare)

	First Season	Second Season
	Local Type (N= 16)	Local Type (N=16)
Value of output (UShs/ha)	3,228,299	3,598,138
Family labour (UShs)	476,834	120,151
Hired labour (UShs)	644,396	515,772
Total input costs (UShs)	148,200	131,184
Draft power/mechanization	0	0
Total Costs	1,269,429	767,107
Gross Margins	1,958,870	2,831,031

Coffee enterprise budgets

Coffee has long been the leading export commodity of Uganda. Arabica and Robusta coffee are the two most common types grown in Uganda. Arabica coffee has better yield and is commonly found in the high altitude areas of the eastern, western, and southern regions of the country in agricultural production Zone 10 (USAID-APEP, 2008). Robusta coffee, on the other hand, is a native Ugandan coffee type grown in almost all parts of Uganda. Robusta

coffee is grown in Zones 6, 7, and 9. For both coffee types, a number of varieties are found. Robusta coffee can be produced as clonal coffee, a fast maturing and better yielding type (USAID-APEP, 2008). Most coffee on the local market is Clonal Robusta and other Robusta coffee varieties. Production of coffee under low-input technology generates around UShs 200,000 per hectare. Production of improved coffee with low-input technology generates about UShs 300,000 per hectare. The use of high-input technology for local and improved varieties improves gross margins by four-fold or more. However, farmers must be able to bear substantial material input costs if they are to use high input-technology.

Table 14: Coffee enterprise budget under low input use/subsistence (UShs/hectare)

	First Season		Second Season	
	Local Type (N=229)	**Improved Type (N=8)**	**Local Type (N=287)**	**Improved Type (N=17)**
Value of output (UShs/ha)	304,820	261,859	343,876	545,616
Family labour (UShs)	112,533	86,712	112,815	228,932
Hired labour (UShs)	0	14,203	0	0
Total input costs (UShs)	0	32,258	0	14,820
Draft power/mechanization	0	0	0	0
Total Costs	112,533	133,173	112,814	243,752
Gross Margins	192,287	128,686	231,061	301,864

Table 15: Coffee enterprise budget under high input use/recommended (UShs/hectare)

	First Season		Second Season	
	Local Type (N=229)	**Improved Type (N=8)**	**Local Type (N=287)**	**Improved Type (N=17)**
Value of output (UShs/ha)	1,034,838	540,198	1,719,379	2,749,050
Family labour (UShs)	112,875	190,151	179,501	336,220
Hired labour (UShs)	98,800	45,274	90,566	247,000
Total input costs (UShs)	62,985	123,500	61,750	185,448
Draft power/mechanization	0	0	0	0
Total Costs	274,660	358,925	331,817	768,667
Gross Margins	760,178	181,273	1,387,562	1,980,383

Cotton enterprise budgets

Over 50 percent of Uganda's cotton is produced north and east of the River Nile. Cotton production in Uganda has been constrained by a number of factors including limited access to land, unreliable cotton markets, inadequate extension services, lack of access to credit and inputs, and lack of basic cotton information. Cotton production competes with sunflower and simsim production for resources since the crops are all mostly produced in the same season and in same agricultural production zones. Cotton is mostly intercropped with bean. Two types of cotton varieties are known to be grown in Uganda, *Pedigree Alba* (PBA) and *Serena Type Uganda* (SATU). PBA is the most common (PMA, 2009; CDO, 2008). Some cotton is grown organically with little use of inorganic fertilizers and chemicals while other cotton is grown in the traditional way with relatively high levels of input use. According to Tables 16 and 17, the local type of cotton is more profitable than the improved types.

Table 16: Cotton enterprise budget under low input use/subsistence (UShs/hectare)

	First Season	Second Season	
	Local Type (N=17)	Local Type (N=158)	Improved Type (N=101)
Value of output (UShs/ha)	208,406	172,900	165,896
Family labour (UShs)	94,569	138,544	195,485
Hired labour (UShs)	0	0	0
Total input costs (UShs)	13,585	29,640	39,520
Draft power/mechanization	0	0	0
Total Costs	108,154	168,184	235,005
Gross Margins	100,252	4,716	-69,111

Table 17: Cotton enterprise budget under high input use/recommended (UShs/hectare)

	First Season	Second Season	
	Local Type (N=17)	Local Type (N=158)	Improved Type (N=101)
Value of output (UShs/ha)	987,436	397,238	518,700
Family labour (UShs)	120,151	145,779	245,058
Hired labour (UShs)	24,700	78,546	58,202
Total input costs (UShs)	18,937	19,760	24,700
Draft power/mechanization	0	0	0
Total Costs	163,788	244,085	327,959
Gross Margins	823,648	153,153	190,741

Field pea enterprise budgets

Field pea is grown mainly in the eastern and northern regions of the country and is produced largely for the local market. The largest gross margins from field pea are generated with the local varieties and in the first season. Relative profitability of field pea under low-input and high-input technologies is not significantly different (Tables 18 and 19). On average, local field pea varieties generate about UShs 250,000 per hectare with or without high-input technology. Increasing input use in field pea production does not significantly increase gross margins. The similarity in returns is indication that the absence of improved varieties is a limiting factor in field pea production.

Table 18: Field pea enterprise budget under low input use/subsistence (UShs/hectare)

	First Season	Second Season
	Local Type (N=9)	Local Type (N=29)
Value of output (UShs/ha)	395,200	111,150
Family labour (UShs)	100,462	56,456
Hired labour (UShs)	0	0
Total input costs (UShs)	29,640	9,880
Draft power/mechanization	0	0
Total Costs	130,102	66,336
Gross Margins	265,098	44,814

Table 19: Field pea enterprise budget under high input use/recommended (UShs/hectare)

	First Season	Second Season
	Local Type (N=9)	Local Type (N=29)
Value of output (UShs/ha)	427,246	173,554
Family labour (UShs)	71,948	98,262
Hired labour (UShs)	77,805	61,750
Total input costs (UShs)	37,544	14,203
Draft power/mechanization		
Total Costs	187,297	174,214
Gross Margins	239,949	-660

Finger millet enterprise budgets

Finger millet is found predominantly in eastern and western regions of Uganda. The crop is produced for food security and household social needs, such as brewing. Our analysis indicates that production of finger millet is barely profitable. Gross margins generated with low-input technology are estimated at UShs 12,500 per hectare for the local varieties and at UShs 74,500 per hectare for improved varieties. However, production of the crop is more profitable under high-input technology, generating up to three times the gross margins generated under low-input technology. The cost of family labour is a major component of the total variable costs and it significantly affects the overall profitability of the enterprise.

Table 20: Finger millet enterprise budget under low input use/subsistence (UShs/hectare)

	First Season	Second Season
	Local Type (N=215)	Local Type (N=386)
Value of output (UShs/ha)	187,596	264,678
Family labour (UShs)	175,066	172,692
Hired labour (UShs)	0	0
Total input costs (UShs)	0	17,290
Draft power/mechanization	0	0
Total Costs	175,066	189,982
Gross Margins	12,530	74,696

Table 21: Finger millet enterprise budget under high input use/recommended (UShs/hectare)

	First Season	Second Season
	Local Type (N=215)	Local Type (N=386)
Value of output (UShs/ha)	409,299	606,263
Family labour (UShs)	147,237	210,624
Hired labour (UShs)	61,750	74,100
Total input costs (UShs)	39,520	27,200
Draft power/mechanization	74,100	76,570
Total Costs	322,607	388,494
Gross Margins	86,692	217,769

Groundnut enterprise budgets

Although groundnut is grown in most parts of Uganda, the eastern region is the largest producer of the crop. Relative profitability analysis reveals that the crop is profitable only with use of improved varieties, high-input technology or a combination of the two. The use of high-input technology on improved groundnut varieties improves gross margins by about two-fold, as indicated in Tables 22 and 23.

Table 22: Groundnut enterprise budget under low input use/subsistence (UShs/hectare)

	First Season		Second Season	
	Local Type (N=353)	Improved Type (N=30)	Local Type (N=321)	Improved Type (N=26)
Value of output (UShs/ha)	81,562	212,572	182,083	199,637
Family labour (UShs)	150,344	302,626	102,008	40,320
Hired labour (UShs)	35,568	37,050	0	17,167
Total input costs (UShs)	0	132,335	39,520	27,788
Draft power/mechanization	0	0	0	0
Total Costs	185,912	472,011	141,528	85,274
Gross Margins	-104,350	-259,439	40,555	114,363

Table 23: Groundnut enterprise budget under high input use/recommended (UShs/hectare)

	First Season		Second Season	
	Local Type (N=353)	Improved Type (N=30)	Local Type (N=321)	Improved Type (N=26)
Value of output (UShs/ha)	210,932	924,405	497,952	490,778
Family labour (UShs)	143,655	307,216	145,863	132,423
Hired labour (UShs)	82,333	209,950	98,800	55,575
Total input costs (UShs)	59,280	61,750	69,160	94,354
Draft power/mechanization	58,045	58,045	27,788	27,788
Total Costs	343,313	636,961	341,610	310,140
Gross Margins	-132,381	287,444	156,342	180,638

Irish potato enterprise budgets

Irish potato are largely produced in the highland regions of Uganda, i.e., Kigezi highland districts of Kabale and Kisoro in the southwest and Mbale and Kapchorwa districts on the slopes of Mt. Elgon in eastern Uganda. Also, small-scale potato production takes place in Nebbi district, a mid-altitude region found in the north-western part of Uganda. Farmers growing Irish potato in Uganda have access to a wide range of varieties, both local and improved. The most common improved varieties are *Nakpot* which is the most recent release from the research stations, *Victoria* which is the most marketable variety, and *Rutuku* which is a major food crop in Kabale district (Government of Uganda, 2001). Production of local varieties of Irish potato under low-input technology generates relatively larger gross margin than production of improved Irish potato varieties under low-input technology. However, production of improved varieties under high-input technology generates a much higher gross margin than producing local varieties under high-input technology. Material input costs constitute a significant portion of the variable costs of production for the improved varieties in low-input technology and high-input technology production.

Table 24: Irish potato enterprise budget under low input use/subsistence (UShs/hectare)

	First Season	Second Season	
	Local Type (N=113)	Local Type (N=123)	Improved Type (N=14)
Value of output (UShs/ha)	477,535	356,386	1,037,743
Family labour (UShs)	176,873	198,985	320,834
Hired labour (UShs)	0	0	139,143
Total input costs (UShs)	14,820	0	736,060
Draft power/mechanization	0	0	0
Total Costs	191,693	198,985	1,196,037
Gross Margins	285,842	157,401	-158,294

Table 25: Irish potato enterprise budget under high input use/recommended (UShs/hectare)

	First Season	Second Season	
	Local Type (N=113)	Local Type (N=123)	Improved Type (N=14)
Value of output (UShs/ha)	1,595,778	976,222	2,955,896
Family labour (UShs)	179,922	238,703	409,983
Hired labour (UShs)	243,913	197,600	489,060
Total input costs (UShs)	148,200	247,000	469,300
Draft power/mechanization	0	0	0
Total Costs	572,034	683,303	1,368,343
Gross Margins	1,023,744	292,919	1,587,553

Maize enterprise budgets

Maize is among the most important crops for food security and is produced in most parts of the country. A number of maize varieties exist and are relatively accessible to farmers across the country. Maize varieties are broadly categorized into open pollinated varieties and the hybrids. A large proportion of Ugandan farmers (about 94 percent) use local varieties (MAAIF, 2009; UBOS, 2006). An exception is the eastern part of the country, where much higher percentages of farmers use improved varieties. With low-input technology, local maize varieties generate on average UShs 200,000 per hectare in gross margins whereas improved varieties generate an average of UShs 230,000 per hectare. Maize production is more profitable with high-input technology than with low-input technology and with improved varieties than with local varieties. Under high-input technology, gross margins are about four times higher than those generated under low-input technology.

Table 26: Maize enterprise budget under low input use/subsistence (UShs/hectare)

	First Season		Second Season	
	Local Type (N=856)	Improved Type (N=196)	Local Type (N=805)	Improved Type (N=208)
Value of output (UShs/ha)	225,132	467,970	452,974	434,654
Family labour (UShs)	121,569	169,996	149,867	149,155
Hired labour (UShs)	0	0	11,115	29,640
Total input costs (UShs)	3,211	92,852	0	0
Draft power/mechanization	0	0	0	0
Total Costs	124,780	262,848	160,982	178,795
Gross Margins	100,352	205,122	291,992	255,859

Table 27: Maize enterprise budget under high input use/recommended (UShs/hectare)

	First Season		Second Season	
	Local Type (N=856)	Improved Type (N=196)	Local Type (N=805)	Improved Type (N=208)
Value of output (UShs/ha)	494,102	1,775,331	1,355,782	1,260,075
Family labour (UShs)	123,162	167,794	192,145	161,009
Hired labour (UShs)	49,400	123,500	86,203	0
Total input costs (UShs)	17,583	61,750	24,700	51,870
Draft power/mechanization	50,635	158,080	74,100	0
Total Costs	240,780	511,124	377,148	212,879
Gross Margins	253,322	1,264,207	978,634	1,047,197

Passion fruit enterprise budgets

Passion fruit production in Uganda is limited to a few regions, mainly the eastern and western highlands. The crop is among the key high-value crops exported to Europe.

Passiflora edulis sims is the most commonly found passion fruit species. Gross margin analysis indicates that passion fruit production is relatively profitable. Passion fruit generates up to UShs 5 million per hectare if produced under high-input technology. Under the high-input technology, the costs of material inputs are a substantial share of total costs.

Table 28: Passion fruit enterprise budget under low input use/subsistence (UShs/hectare)

	First Season	Second Season
	Local Type (N=10)	Local Type (N=7)
Value of output (UShs/ha)	340,016	1,296,750
Family labour (UShs)	266,820	265,314
Hired labour (UShs)	0	0
Total input costs (UShs)	0	0
Draft power/mechanization	0	0
Total Costs	266,820	265,314
Gross Margins	73,196	1,031,436

Table 29: Passion fruit enterprise budget under high input use/recommended (UShs/hectare)

	First Season	Second Season
	Local Type (N=10)	Local Type (N=7)
Value of output (UShs/ha)	6,621,672	1,852,500
Family labour (UShs)	205,836	309,268
Hired labour (UShs)	518,700	230,533
Total input costs (UShs)	246,533	230,533
Draft power/mechanization	0	0
Total Costs	971,069	770,334
Gross Margins	5,650,603	1,082,166

Pigeonpea enterprise budgets

Pigeonpea are commonly produced in the eastern and northern parts of the country and are produced for the local market. Gross margin analysis indicates that the production of the crop is profitable only with improved varieties. However, the use of high-input technology does not increase gross margin significantly. The use of improved varieties under both low-input and high-input technologies generates an average gross margin of UShs 130,000 per hectare.

Table 30: Pigeonpea enterprise budget under low input use/subsistence (UShs /hectare)

	First Season	Second Season
	Local Type (N=9)	Local Type (N=8)
Value of output (UShs/ha)	90,878	158,308
Family labour (UShs)	101,822	24,041
Hired labour (UShs)	0	0
Total input costs (UShs)	14,820	10,850
Draft power/mechanization	0	0
Total Costs	116,642	34,891
Gross Margins	-25,764	123,417

Table 31: Pigeonpea enterprise budget under high input use/recommended (UShs/hectare)

	First Season	Second Season
	Local Type (N=9)	Local Type (N=8)
Value of output (UShs/ha)	136,591	248,537
Family labour (UShs)	73,232	26,845
Hired labour (UShs)	35,815	59,280
Total input costs (UShs)	14,820	17,784
Draft power/mechanization	0	0
Total Costs	123,867	103,909
Gross Margins	12,724	144,628

Rice enterprise budgets

The traditional rice growing areas in Uganda are the districts of Pallisa, Kamuli, Iganga, Tororo, Butaleja and Kumi in the eastern region, and the districts of Lira, Gulu, Amuru and Kitgum in the northern region. Rice has traditionally been a cash crop but, of recent, many households have also regarded it as a food crop raised for household consumption. In eastern Uganda, 70 percent of the rice produced is lowland rice and 30 percent is upland. On the other hand, 75 percent of the rice produced in northern Uganda is upland rice and 25 percent is lowland. Recently, other areas besides the eastern and northern regions have started growing upland rice as a result of government efforts to promote upland rice production in the country (PMA, 2009). Upland rice is now grown in Zones 2, 3, 6, 8, 9 and 10. According to the gross margin analysis, improved rice varieties in the second season generate almost three times the gross margins that are achieved with local rice varieties. In general, the use of high-input technology greatly improves the gross margins of both local rice varieties and improved rice varieties.

Table 32: Rice enterprise budget under low input use/subsistence (UShs/hectare)

	First Season		Second Season	
	Local Type (N=143)	Improved type (N=25)	Local Type (N=93)	Improved Type (N=16)
Value of output (UShs/ha)	536,562	413,725	799,943	2,022,189
Family labour (UShs)	256,275	170,154	208,517	245,016
Hired labour (UShs)	16,467	0	41,496	37,667
Total input costs (UShs)	86,450	22,230	123,500	118,560
Draft power/mechanization	0	0	0	0
Total Costs	359,191	192,384	373,513	401,243
Gross Margins	177,371	221,341	426,430	1,620,946

Table 33: Rice enterprise budget under high input use/recommended (UShs/hectare)

	First Season		Second Season	
	Local Type (N=143)	Improved Type (N=25)	Local Type (N=93)	Improved Type (N=16)
Value of output (UShs/ha)	1,310,287	515,925	1,473,108	3,276,159
Family labour (UShs)	254,112	170,154	244,126	324,784
Hired labour (UShs)	91,884	49,400	98,800	114,855
Total input costs (UShs)	30,628	58,663	49,400	29,228
Draft power/mechanization	121,853	121,853	135,850	135,850
Total Costs	498,477	400,069	528,176	604,718
Gross Margins	811,810	115,856	944,932	2,671,442

Simsim enterprise budgets

The production of simsim, or sesame, is concentrated mostly in the regions of Lango, Teso, Acholi, and West Nile. These regions represent Zones 1, 2, and 3 of the agricultural production zones of the country. Only two simsim varieties are known to be grown in Uganda, *Sesim I* and *Sesim II*. *Sesim II* is the most recently released variety which yields more than *Sesim I* (a local variety grown by many farmers) (USAID-APEP, 2008). Improved varieties generate more than two-fold of the gross margins achieved with local varieties in the second season. However, there is no significant difference in the gross margins achieved with low-input technology vis-à-vis high-input technology. The similarity of gross margins between local and improved varieties is most likely a result of the general lack of access to alternative high-yielding varieties.

Table 34: Simsim enterprise budget under low input use/subsistence (UShs/hectare)

	First Season	Second Season	
	Local Type (N=35)	Local Type (N=195)	Improved Type (N=13)
Value of output (UShs/ha)	201,790	210,839	327,687
Family labour (UShs)	132,723	67,494	52,488
Hired labour (UShs)	0	0	0
Total input costs (UShs)	24,700	34,850	14,820
Draft power/mechanization	0	0	0
Total Costs	157,423	102,344	67,308
Gross Margins	44,367	108,495	260,379

Table 35: Simsim enterprise budget under high input use/recommended (UShs/hectare)

	First Season	Second Season	
	Local Type (N=35)	Local Type (N=195)	Improved Type (N=13)
Value of output (UShs/ha)	520,531	359,412	442,762
Family labour (UShs)	99,592	79,980	52,488
Hired labour (UShs)	51,870	92,796	22,230
Total input costs (UShs)	19,760	17,290	11,897
Draft power/mechanization	39,726	61,750	61,750
Total Costs	210,948	251,816	148,365
Gross Margins	309,583	107,596	294,397

Sorghum enterprise budgets

Sorghum is mostly a staple food crop but it is also an important raw material for the beer industry in Uganda. The traditional sorghum growing areas include mainly the drier areas of Karamoja, Teso, and the highlands of Kabale. Like many other crops that are traditionally recognized as food crops, sorghum production is constrained by lack of alternative high-yielding varieties. Sorghum production is mostly profitable under high-input technology. Relative profitability analysis of sorghum indicates that production of local sorghum varieties under high-input technology generate up to UShs 150,000 per hectare. The gross margin is relatively low, an indication of relative unprofitability of the crop.

Table 36: Sorghum enterprise budget under low input use/subsistence (UShs/hectare)

	First Season	Second Season	
	Local Type (N=416)	Local Type (N=366)	Improved Type (N=14)
Value of output (UShs/ha)	156,336	141,978	100,631
Family labour (UShs)	156,339	78,262	59,570
Hired labour (UShs)	0		4,940
Total input costs (UShs)	24,465	9,880	
Draft power/mechanization	0		22,230
Total Costs	180,804	88,142	86,740
Gross Margins	-24,468	53,835	13,892

Table 37: Sorghum enterprise budget under high input use/recommended (UShs/hectare)

	First Season	Second Season	
	Local Type (N=416)	Local Type (N=366)	Improved Type (N=14)
Value of output (UShs/ha)	483,127	344,712	208,329
Family labour (UShs)	150,231	100,540	192,282
Hired labour (UShs)	98,800	74,100	55,987
Total input costs (UShs)	24,601	13,405	9,880
Draft power/mechanization	59,743	62,746	62,746
Total Costs	333,375	250,791	320,895
Gross Margins	149,752	93,921	-112,566

Soyabean enterprise budgets

The production of soyabean is profitable only under the use of high-input technology. Under high-input technology, soyabean generates about UShs 150,000 per hectare. This value of gross margins is about 4 times that generated under low-input technology.

Table 38: Soyabean enterprise budget under low input use/subsistence (UShs/hectare)

	First Season	Second Season
	Local Type (N=18)	Local Type (N=26)
Value of output (UShs/ha)	96,771	175,457
Family labour (UShs)	113,070	125,113
Hired labour (UShs)	1,853	0
Total input costs (UShs)	41,990	32,357
Draft power/mechanization	0	
Total Costs	156,913	157,470
Gross Margins	-60,142	17,986

Table 39: Soyabean enterprise budget under high input use/recommended (UShs/hectare)

	First Season	Second Season
	Local Type (N=18)	Local Type (N=26)
Value of output (UShs/ha)	296,400	293,312
Family labour (UShs)	104,148	124,614
Hired labour (UShs)	31,934	49,400
Total input costs (UShs)	24,124	24,083
Draft power/mechanization	0	0
Total Costs	160,205	198,097
Gross Margins	136,195	95,216

Sunflower enterprise budgets

Traditional sunflower growing areas have included the Teso and the agro-ecological zones in northern Uganda, i.e., Zones 1 and 2. Most recently, there has been an aggressive promotion of sunflower production in central Uganda (i.e., Zones 6 and 7). Not so many varieties of sunflower are known to be grown in Uganda. Indeed, *sunfola* is the most common type (PMA and MAAIF, 2009). Relative profitability analysis reveals that the differences in gross margin across season and seed type for sunflower are inconsistent. However, production under high-input technology increases gross margins by about two times relative to low-input technology. Input costs are a significant component of total variable costs and affect relative profitability of sunflower production under low-input and high-input technology. The cost of mechanization is also prominent, mainly due to the fact that sunflower production is common in areas where draft power use is wide-spread.

Table 40: Sunflower enterprise budget under low input use/subsistence (UShs/hectare)

	First Season		Second Season	
	Local Type (N=13)	Improved Type (N=7)	Local Type (N=28)	Improved Type (N=7)
Value of output (Shs/ha)	492,265	341,198	101,426	888,136
Family labour (UShs)	109,895	169,543	48,872	147,363
Hired labour (UShs)	27,664	16,055	6,175	209,950
Total input costs (UShs)	96,330	115,781	49,894	34,580
Draft power/mechanization	0	16,055	0	16,055
Total Costs	233,889	317,434	104,941	407,948
Gross Margins	258,376	23,764	-3,515	480,188

Table 41: Sunflower enterprise budget under high input use/recommended (UShs/hectare)

	First Season		Second Season	
	Local Type (N=13)	Improved Type (N=7)	Local Type (N=28)	Improved Type (N=7)
Value of output (UShs/ha)	1,075,754	1,156,650	234,655	5,291,620
Family labour (UShs)	130,793	192,548	88,395	139,952
Hired labour (UShs)	93,057	23,466	60,640	205,990
Total input costs (UShs)	36,803	22,724	4,940	32,110
Draft power/mechanization	49,894	49,894	49,894	49,894
Total Costs	310,547	288,631	203,869	427,946
Gross Margins	765,207	868,019	30,786	4,863,674

Sweet potato enterprise budgets

Although sweet potato production is wide-spread, the crop is most important in the Lake Victoria Crescent region. Several improved varieties have been developed, including Kawogo, Dimbuka, Rangira, Entebbe Road, and Nangumi (Abidin et al., 2005). Under low-input technology, sweet potato production generates up to UShs 210,000 per hectare in gross margins. The use of high-input technology improves gross margins by an average of three-fold in both growing seasons.

Table 42: Sweet potato enterprise budget under low input use/subsistence (UShs/hectare)

	First Season	Second Season
	Local Type (N=1,928)	Local Type (N=1,626)
Value of output (UShs/ha)	432,260	411,301
Family labour (UShs)	240,613	172,978
Hired labour (UShs)	0	0
Total input costs (UShs)	0	0
Draft power/mechanization	0	0
Total Costs	240,613	172,978
Gross Margins	191,647	238,323

Table 43: Sweet potato enterprise budget under high input use/recommended (UShs/hectare)

	First Season	Second Season
	Local Type (N=1,928)	Local Type (N=1,626)
Value of output (UShs/ha)	1,175,199	988,155
Family labour (UShs)	236,344	228,813
Hired labour (UShs)	115,267	111,150
Total input costs (UShs)	44,460	43,843
Draft power/mechanization	81,510	57,428
Total Costs	477,581	441,233
Gross Margins	697,618	546,922

Tea (out-grower scheme) enterprise budgets

Tea is among Uganda's key cash crops and is found mostly in central and western regions of Uganda. The crop is grown at small-scale level (through several out-grower schemes) and large scale-level (through tea plantations). Like many other traditional cash crops, relative profitability of tea enterprise is affected by high costs of hired labour and material inputs (Tables 44 and 45).

Table 44: Tea enterprise budget under low input use/subsistence UShs/hectare)

	First Season	Second Season
	Local Type (N=10)	Local Type (N=10)
Value of output (UShs/ha)	470,102	203,987
Family labour (UShs)	8,285	48,526
Hired labour (UShs)	59,280	92,449
Total input costs (UShs)	32,840	50,635
Draft power/mechanization	0	0
Total Costs	100,405	191,609
Gross Margins	369,697	12,378

Table 45: Tea enterprise budget under high input use/recommended (UShs/hectare)

	First Season	Second Season
	Local Type(N=10)	Local Type (N=10)
Value of output (UShs/ha)	1,511,640	1,137,611
Family labour (UShs)	16,583	112,864
Hired labour (UShs)	59,280	105,857
Total input costs (UShs)	52,929	68,172
Draft power/mechanization	0	0
Total Costs	128,792	286,893
Gross Margins	1,382,848	850,718

Tobacco enterprise budgets

The study finds no clear difference in gross margins generated under tobacco local varieties and improved varieties. Reasons for the similarity in gross margins might include our inability with the UNHS data to differentiate tobacco by seed type. Nonetheless, tobacco production is among the most profitable crop enterprises in Uganda, generating higher gross margins than other PMA priority crops. Using low-input technology, tobacco generates up to UShs 4 million per hectare. Meanwhile, under the high-input technology, tobacco generates more that UShs 6 million per hectare.

Table 46: Tobacco enterprise budget under low input use/subsistence (UShs/hectare)

	First Season		Second Season	
	Local Type (N=43)	Improved Type (N=11)	Local Type (N=16)	Improved Type (N=4)
Value of output (UShs/ha)	903,361	1,434,942	4,267,154	1,133,918
Family labour (UShs)	181,059	260,303	147,427	153,419
Hired labour (UShs)	31,616	148,200	0	42,472
Total input costs (UShs)	261,820	420,568	33,345	194,814
Draft power/mechanization	0	0	0	0
Total Costs	474,495	829,071	180,772	390,704
Gross Margins	428,866	605,871	4,086,382	743,214

Table 47: Tobacco enterprise budget under high input use/recommended (UShs/hectare)

	First Season		Second Season	
	Local Type (N=43)	Improved Type (N=11)	Local Type (N=16)	Improved Type (N=4)
Value of output (UShs/ha)	1,956,739	7,149,625	5,636,564	1,650,336
Family labour (UShs)	167,559	254,603	150,912	156,840
Hired labour (UShs)	172,900	177,957	54,340	60,244
Total input costs (UShs)	247,000	366,511	151,905	153,341
Draft power/mechanization				
Total Costs	587,459	799,071	357,157	370,425
Gross Margins	1,369,280	6,350,554	5,279,407	1,279,911

Beekeeping (apiary) enterprise budgets

In the past, beekeeping or apiary production in Uganda was largely considered traditional and seasonal, mainly because it relied on seasonal bee swarming and rudimentary harvest methods. Honey production in Uganda relies mainly on the *Apis mellifera* bee species (PMA, 2008). Traditional apiary production involves the use of simple hives constructed from bamboo trees. These beehives are relatively simple and non-durable. Of recent, in an effort to diversify the export base of the country, the beekeeping sub-sector has experienced relative commercialization. Honey production using the improved traditional beehive technology (the top-bar hive), has become common in Uganda (PMA, 2008). Relative profitability analysis reveals that use of such beehives improves gross margins from UShs 5,500 per beehive up to UShs 15,400 per beehive (Table 48 and 49).

Table 48: Beekeeping enterprise under low input use/traditional production (UShs/beehive)

	Apiary (N=24)
Value of a beehive	5,438
Animal herding	0
Feeding	0
Veterinary services	0
Other costs	0
Total Costs	0
Gross Margins/hive	5,438

Table 49: Beekeeping enterprise budget under high input use/recommended (UShs/beehive)

	Apiary (N=24)
Value of beehive	17,125
Animal herding	0
Feeding	0
Veterinary services	0
Other costs	1,750
Total Costs	1,750
Gross Margins/hive	15,375

Dairy enterprise budgets

Most of Uganda's milk production is by small-scale farmers who own over 90 percent of the national cattle herd (FAO, 2008). Households keep mostly indigenous cattle and use low-input technology. Under low-input technology, improved cattle breeds give an estimated three times more in gross margins compared to local dairy breeds. Profitability analysis shows that a local breed dairy cow generates an average of USh 60,000 in six months whereas the improved breed cow generates about three times more (USh 170,000). However, it is noteworthy that for local breeds, the use of high-input technology does not significantly improve gross margins. Improved dairy breeds have the potential of doubling gross margins if high-input technology is used. The analysis finds that whereas veterinary costs constitute a significant proportion of the total variable costs of production for the local breeds, feeding and animal herding costs are the most significant costs for the improved breeds.

Table 50: Dairy enterprise budget under low-input use/subsistence (UShs/dairy cow)

	Local Breed (N=80)	Improved Breeds (N=27)
Value of animal (per unit of animal)	64,833	213,500
Animal herding	1,412	17,777
Feeding	237	16,037
Veterinary services	2,625	6,962
Other costs	1,123	0
Total Costs	5,397	40,776
Gross Margins	59,436	172,724

Table 51: Dairy enterprise budget under high-input use/recommended (UShs/dairy cow)

	Local Breed (N=80)	Improved Breeds (N=27)
Value of animal (per unit of animal)	127,000	576,000
Animal herding	33,333	135,000
Feeding	5,000	48,000
Veterinary services	10,000	40,000
Other costs	4,000	4,000
Total Costs	52,333	227,000
Gross Margins	74,667	349,000

Goat (for meat) enterprise budgets

Goats make a great economic contribution to the subsistence sub-sector of Uganda's agriculture. Three major local goat breeds are found: 1) the Small East African, which gives about 20-30 kilograms of mature goat weight, is common in the drier areas of Buganda i.e., Buruli, Bulemezi and Bugerere, 2) the Mubende goat, which is relatively heavier, gives between 30-35 kilograms of mature goat weight and is common in Mubende district, and 3) the Kigezi goat which gives about 25-30 kilograms of mature weight and is common to the districts of Kabale, Kisoro and Rukungiri (Ocaido et al., 2009). Recently, there has been an effort by the government to promote production of a South African improved goat breed ("Boer goat"). The breed gives an average of 25-30 kilograms of mature goat weight and achieves market weight much earlier than local breeds. Relative profitability analysis indicates that production of goats under low-input technology is more profitable compared with production under high-input technology. Gross margins with subsistence methods (i.e., where the animals are left to roam wildly or tethered) are twice as high as gross margins with high-input technology.

Table 52: Goat enterprise budget under low input use/subsistence (UShs/goat)

	Local Breed (N=4,828)	Improved Breeds (N=245)
Value of animal (per unit of animal)	20,000	40,000
Animal herding	0	0
Feeding	0	0
Veterinary services	0	0
Other costs	0	0
Total Costs	0	0
Gross Margins	20,000	40,000

Table 53: Goat enterprise budget under high input use/recommended (UShs/goat)

	Local Breeds (N=4,828)	Improved Breeds (N=245)
Value of animal (per unit of animal)	25,000	70,000
Animal herding	9,000	32,400
Feeding	1,333	4,000
Veterinary services	2,000	5,000
Other costs	1,000	3,000
Total Costs	13,333	44,400
Gross Margins	11,667	25,600

Analysis of enterprise profitability by Agricultural Production Zones

Gross margin analysis is considered most useful when applied to assessing and comparing relative profitability of agricultural enterprises that face similar input and output conditions. In

the following section, we present results of enterprise relative profitability analysis at the agricultural production zone level. Tables 54-73 present enterprise gross margins computed by season and agricultural production zone.

Enterprise profitability in the North-eastern Drylands (Zone 1)

The North-eastern Drylands (Zone 1) is characterized by flat land and moderate to poor rated soils. The zone is dominated by pastoral activities and therefore very little crop production exists. Low crop production of the zone is also attributed to the semi-aridness of the region. Crop production is mostly with few drought resistant crops. Crop production is undertaken mainly in one long rainy season which begins in April and ends in September. Tables 54 and 55 present a summary of the enterprise gross margins for Zone 1. The study finds maize and sorghum to be common. However, maize and sorghum generate low positive gross margins for the first season and negative gross margins for the second season. With respect to the livestock sector, besides beef production (which was not analyzed in this study), the local goat enterprise was the most common livestock enterprise. Despite the presence of a large number of cattle in the zone, little diary production exists. Also, beekeeping is not common. These findings are consistent with characteristics of areas that are predominantly pastoral. Since very few alternative crop enterprises are available in Zone 1 and, given that PMA's additional objective is to ensure food security, we recommend that maize and sorghum enterprises be promoted alongside local goat production.

Table 54: Crop enterprise gross margins for North-eastern Drylands (Zone 1) (UShs per hectare)

	Local Type				Improved Type			
	Secondary Season		Major Season (Apr-Sept)		Secondary Season		Major Season (Apr-Sept)	
Crop Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins
Banana								
Bean								
Cassava								
Cocoa								
Coffee								
Cotton								
Field pea								
Finger millet								
Groundnut								
Irish potato								
Maize	5	5,208	10	33,078				
Passion fruit								
Pigeonpea								
Rice								
Simsim								
Sorghum	29	-18,213	35	3,736				
Soyabean								
Sunflower								
Sweet potato								
Tea								
Tobacco								

Table 55: Livestock enterprise gross margins for North-eastern Drylands (Zone 1) (UShs per livestock unit)

	Local Breed		Improved Breeds	
Livestock Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins
Beekeeping				
Dairy				
Goat	102	15,000		

Enterprise profitability in the North-eastern Savannah Grasslands (Zone 2)

The North-eastern Savannah Grasslands (Zone 2) is characterized by moderate to poorly rated soils and has extensive wetlands that give it the potential for irrigated agriculture. The zone has characteristics similar to Zone 1, especially in terms of agricultural production. Tables 56 and 57 present enterprise gross margin analysis for various agricultural enterprises found in Zone 2. Bean, cassava, finger millet, groundnut, maize, pigeonpea, simsim, sorghum, sweet potato, and goat enterprises are the most common enterprises. Agricultural production is mostly done in one major season, i.e., between April and October. Profitability analysis reveals that during the major growing season, field pea generates the highest gross margins (up to UShs 150,000 per hectare). Maize, on the other hand, achieves negative gross margins. Although the use of improved crop varieties is uncommon, groundnut improved varieties generate higher gross margins compared with the local varieties for both growing seasons. On the livestock side, goat production is found to be relatively competitive and generates about UShs 20,000 per mature goat. This analysis, therefore, recommends field pea, cassava, simsim and goat enterprises as most profitable enterprises in Zone 2.

Table 56: Crop enterprise gross margins for North-eastern Savannah Grasslands (Zone 2) (UShs per hectare)

	Local Type				Improved Type			
	Secondary Season		Major Season (Apr-Oct)		Secondary Season		Major Season (Apr-Oct)	
Crop Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins
Banana								
Bean	16	-91,533	11	24,114				
Cassava	18	-847	9	43,626				
Cocoa								
Coffee								
Cotton							7	-34,522
Field pea			10	168,215				
Finger millet	18	-14,520						
Groundnut	24	9,042			6	459,070	9	72,373
Irish potato								
Maize	22	5,498	16	-9,462	8	26,128		
Passion fruit								
Pigeonpea	6	7,544						
Rice								
Simsim	10	-7,378	17	39,339			5	36,706
Sorghum	34	-48,020	31	24,052				
Soyabean								
Sunflower								
Sweet potato	54	13,578	22	36,238				
Tea								
Tobacco								

Table 57: Livestock enterprises gross margins for North-eastern Savannah Grasslands (Zone 2) (UShs per livestock unit)

	Local Breed		Improved Breeds	
Livestock Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins
Beekeeping				
Dairy				
Goat	153	20,000		

Enterprise profitability in North-western Savannah Grasslands (Zone 3)

The North-western Savannah Grasslands (Zone 3) is relatively more suitable for crop production than Zones 1 and 2. Zone 3 is endowed with high rainfall and has good to moderate rated soils. Most of the agricultural production in the zone occurs in a single rainy season that begins in April and ends in mid November. Farmers in Zone 3 also enjoy the advantages of cross-border trade with Democratic Republic of Congo (DRC) and southern Sudan. Tables 58 and 59 present a summary of the relative profitability of enterprises in Zone 3. Most of the PMA priority crops are found. However, maize, tobacco, sorghum, groundnut, cotton, bean, cassava, sweet potato, simsim, finger millet, and field pea are found to be the most common enterprises. Considering production with local varieties during the main growing season, coffee and cassava are more profitable generating up to UShs 400,000 per hectare in gross margins. Sweet potato, banana, and maize follow in order of relative profitability, generating between UShs 100,000 and UShs 200,000 per hectare. During the secondary season, tobacco generates the highest gross margins estimated at about UShs 516,150 per hectare. Crop production with improved varieties is more profitable for groundnut and sunflower generating higher gross margins that the local varieties. Besides crop production, goat and beekeeping enterprises are common. Relative profitability analysis indicates that an improved goat generates about UShs 27,000 per animal while a local goat of mature weight generates up to UShs 20,000 per animal. Honey production with improved beehives generates about UShs 12,285 per beehive. Overall, coffee, tobacco, cassava, banana, sweet potato, and maize, in that order of relative profitability, are recommended for Zone 3. Given that goat and beekeeping production require less per unit resources use, medium-scale production of goat and beekeeping is highly recommended for the zone.

Table 58: Crop enterprise gross margins for North-western Savannah Grasslands (Zone 3) (UShs per hectare)

	Local Type				Improved Type			
	Secondary Season		Major Season (Apr-Nov)		Secondary Season		Major Season (Apr-Nov)	
Crop Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins
Banana	13	87,330	16	194,209				
Bean	88	46,430	92	4,924			6	-145,154
Cassava	225	336,874	162	486,787	5	853,807		
Cocoa								
Coffee	7	487,929	10	539,266				
Cotton			30	44,332			21	7,410
Field pea	5	-53,619	19	510				
Finger millet	21	41,576	38	22,357				
Groundnut	41	-44,351	76	-21,273	5	-241,564	6	138,088
Irish potato	5	-31,106	7	-385,836				
Maize	178	30,266	107	96,483	18	182,757	23	115,804
Passion fruit								
Pigeonpea	5	-79,311						
Rice	16	65,659	14	52,305				
Simsim	14	104,800	134	54,904			8	75,850
Sorghum	82	-6,314	100	10,259			7	-60,244
Soyabean	5	256						
Sunflower	9	261,535	25	11,029	5	109,425	5	583,818
Sweet potato	181	113,673	178	189,180	5	130,178		
Tea								
Tobacco	35	516,159			11	830,834		

Table 59: Livestock enterprises gross margins for North-western Savannah Grasslands (Zone 3) (UShs per livestock unit)

	Local Breed		Improved Breeds	
Livestock Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins
Beekeeping	8	12,285		
Dairy				
Goat	616	20,000	10	27,000

Enterprise profitability in Para-savannahs (Zone 4)

The Para-savannahs (Zone 4) experiences one long rainy season, which lasts for about 8 months. Despite the soils being rated good to moderate, little agricultural production is found in this zone, due to the zone being mostly parkland. Nonetheless, the area has potential for livestock production and has the additional advantage of the cross-border trade with DR Congo. Tables 60 and 61 present gross margins generated by various enterprises in Zone 4. Maize, cassava, sweet potato, and goats are the most common enterprises in the zone. During the major growing season, maize and sweet potato generate more than UShs 200,000 per hectare. In the secondary season, cassava generates better gross margins estimated at UShs 300,000 per hectare. The local goat enterprise generates about UShs 25,000 per local goat in six months. Therefore, this study recommends maize, sweet potato, and goat as the most profitable enterprises for Zone 4.

Table 60: Crop enterprise gross margins for Para-savannahs (Zone 4) (UShs per hectare)

	Local Type				Improved Type			
	Secondary Season		Major Season (Mar-Nov)		Secondary Season		Major Season (Mar-Nov)	
Crop Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins
Banana								
Bean								
Cassava	9	322,002	10	152,252	5	5,742		
Cocoa								
Coffee								
Cotton							5	160,797
Field pea								
Finger millet								
Groundnut								
Irish potato								
Maize	7	88,903	7	244,545				
Passion fruit								
Pigeonpea								
Rice								
Simsim			5	-8,313				
Sorghum								
Soyabean								
Sunflower								
Sweet potato	10	7,761	10	229,354				
Tea								
Tobacco								

Table 61: Livestock enterprises gross margins for Para-savannahs (Zone 4) (UShs per livestock unit)

	Local Breed		Improved Breeds	
Livestock Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins
Beekeeping				
Dairy				
Goat	30	25,000		

Enterprise profitability in Kyoga Plains (Zone 5)

The Kyoga Plains (Zone 5) has soils that are rated poor to moderate and receives enough rainfall to undertake agricultural production. The zone has two rainy seasons, the first and major growing season occurs between March and May, while the secondary growing season occurs between August and November. Most PMA priority enterprises are common in the zone. Tables 62 and 63 present gross margins for key enterprises in the zone. Maize, coffee, groundnut, sorghum, cotton, rice, banana, sweet potato, and finger millet are the most widely grown crops. On the livestock side, dairy, beekeeping, and goat enterprises are common. During the first growing season (major season), rice and sweet potato are more profitable. The ordering of enterprises in terms of relative profitability in the second growing season is quite similar to the first growing season. Rice is ranked the most profitable enterprise (UShs 560,000 per hectare), followed by sweet potato (UShs 220,000), maize (UShs 200,000), cassava (UShs 160,000), and banana (UShs 140,000). For the livestock sector, the local dairy breed enterprise generates about UShs 47,000 per local dairy cow. Local dairy is followed by the improved goat enterprise generating up to UShs 25,000 per weight improved goat and then the local goat enterprise which generates about UShs 20,000 per local goat. Beekeeping generates about UShs 8,700 per hive in a six months period.

Table 62: Crop enterprise gross margins for Kyoga Plains (Zone 5) (UShs per hectare)

	Local Type				Improved Type			
	Major Season (Mar-May)		Second Season (Aug-Nov)		Major Season (Mar-May)		Second Season (Aug-Nov)	
Crop Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins
Banana	72	52,721	86	138,845				
Bean	37	-38,137	47	27,273				
Cassava	281	43,291	206	159,181	47	145,885	56	262,037
Cocoa								
Coffee	40	49,837	47	47,986				
Cotton	9	-33,598	78	-36,063	5	186,849	48	-29,386
Field pea			5	1,358				
Finger millet	111	-51,610	43	6,830				
Groundnut	97	-180,793	56	24,265	16	-272,547	8	-82,897
Irish potato								
Maize	352	24,276	341	199,682	85	128,372	85	309,328
Passion fruit								
Pigeonpea			5	52,862				
Rice	103	102,950	46	563,977	14	-8,472	8	1,883,760
Simsim	9	20,778	37	37,594				
Sorghum	97	-27,439	75	-14,744				
Soyabean	5	6,161	11	-49,918				
Sunflower								
Sweet potato	603	97,545	471	217,476	11	439,587		
Tea								
Tobacco								

Table 63: Livestock enterprises gross margins for Kyoga Plains (Zone 5) (UShs per livestock unit)

	Local Breed		Improved Breeds	
Livestock Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins
Beekeeping	6	8700		
Dairy	19	47,000		
Goat	1,218	20,000	50	25,000

Enterprise profitability in Lake Victoria Crescent (Zone 6)

The Lake Victoria Crescent (Zone 6) is among the most agriculturally productive zones of Uganda. The zone receives two rainy seasons in a year, the first one begins in March and ends in May whereas the second season begins in August and ends in November. Soils are rated moderate to good and thus render the zone highly productive. The zone is well endowed with resources and has better access to infrastructure than other zones. Produce markets are well developed and as a result farmers receive better farm gate prices. Farmers in this zone have good access to skilled labour force which gives them the potential for high value crop production. Generally, Zone 6 has strong potential for commercialized agricultural production. Tables 64 and 65 present relative profitability analysis for key enterprises in Zone 6. During the first growing season, maize, coffee, banana, bean, rice, cassava and sweet potato are relatively more profitable. However, rice, cassava, banana and coffee are the most profitable, generating more than UShs 250,000 per hectare in gross margins. These enterprises are then followed by sweet potato and finger millet, which generate up to UShs 130,000 per hectare. Improved varieties of maize and banana generate significantly better gross margins than their respective local varieties. During the second season, banana and cassava generate the highest gross margins, estimated at UShs 300,000 per hectare. These are followed by rice and maize, which generate between UShs 200,000 and UShs 300,000 per hectare.

On the livestock side, goat and dairy enterprises are also prominently found in the zone. It is noteworthy that in Zone 6 improved animal breed enterprises are more profitable than the local breed enterprises. For instance, an improved dairy cow generates up to UShs 468,000 compared with about UShs 66,000 generated by a local dairy breed. Similarly, an improved goat breed generates more than triple the gross margins generated by local goat breed. The difference in gross margins as highlighted in this analysis is most likely to result of the price premium that improved goat breeds generate and also the extra value of output (milk and butter) that the improved dairy breeds generate. Beekeeping is absent in Zone 6. Overall, banana, cassava, rice, and maize are the recommended crop enterprises whereas improved goat and improved dairy enterprises are the recommended livestock enterprises for Zone 6.

Table 64: Crop enterprise gross margins for Lake Victoria Crescent (Zone 6) (UShs per hectare)

	Local Type				Improved Type			
	Major Season (Mar-May)		Second Season (Aug-Nov)		Major Season (Mar-May)		Second Season (Aug-Nov)	
Crop Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins
Banana	113	386,096	151	309,575	5	857,374	9	3,746,408
Bean	38	84,216	54	179,462				
Cassava	135	524,480	115	311,220	29	335,963	28	652,312
Cocoa								
Coffee	40	278,587	53	143,340			6	355,794
Cotton								
Field pea								
Finger millet	8	132,370						
Groundnut	17	-129,996	25	37,050				
Irish potato			8	14,413				
Maize	69	60,080	86	260,069	27	159,328	33	120,867
Passion fruit								
Pigeonpea								
Rice	10	560,685	8	292,977	6	11,475		
Simsim								
Sorghum	19	-53,189	9	67,870				
Soyabean			5	59,280				
Sunflower								
Sweet potato	295	135,918	272	165,730	5	-138,110		
Tea								
Tobacco								

Table 65: Livestock enterprises gross margins for Lake Victoria Crescent (Zone 6) (UShs per livestock unit)

	Local Breed		Improved Breeds	
Livestock Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins
Beekeeping				
Dairy	12	66,000	6	468,000
Goat	508	24,725	24	41,666

Enterprise profitability in Western Savannah Grasslands (Zone 7)

The Western Savannah Grasslands (Zone 7) receive two rainy seasons. Whereas the first season starts in March and ends in May, the second and major rainy season begins in August and ends in November. Zone 7 is endowed with vast amounts of free land that is underutilized. The majority of farmers are small-scale though many are progressing towards medium-scale farming. Tables 66 and 67 present gross margins for key enterprises in Zone 7. The study finds that maize, coffee, groundnut, sorghum, banana, bean, cassava, Irish

potato, sweet potato, and finger millet are the most widespread enterprises. During the major growing season (i.e., August-November), tobacco generates the highest gross margins, estimated at about UShs 4 million per hectare. This is followed by banana and maize, which generate between UShs 200,000 and UShs 400,000 per hectare. Also coffee, sorghum, bean, Irish potato, and sweet potato are relatively competitive, generating between UShs 100,000 and UShs 200,000 per hectare in gross margins. During the less important first season, passion fruit is the most profitable enterprise in the zone. Passion fruit generates up to UShs 1 million per hectare in gross margin and is followed by banana, cassava, rice and bean, which generate between UShs 200,000 and UShs 400,000 per hectare. Zone 7 has very little use of improved crop varieties.

On the livestock side, despite the absence of improved dairy breeds and beekeeping, production of improved goats is common and is found to be competitive. A single mature improved goat generates up to UShs 60,000 in six months. Overall, passion fruit, tobacco, maize, banana and coffee, in that order of profitability, are the most promising crop enterprises, whereas local dairy and improved goats are the most profitable among the livestock enterprises.

Table 66: Crop enterprise gross margins for Western Savannah Grasslands (Zone 7) (UShs per hectare)

	Local Type				Improved Type			
	First Season (Mar-May)		Second (major) Season (Aug-Nov)		First Season (Mar-May)		Second (major) Season (Aug-Nov)	
Crop Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins
Banana	172	350,429	241	289,249				
Bean	57	252,486	93	122,183				
Cassava	177	337,192	130	77,775				
Cocoa								
Coffee	44	99,906	57	195,678				
Cotton	5	120,245	19	-49,919				
Field pea								
Finger millet	16	-77,590	52	92,824				
Groundnut	36	-205,410	50	-24,837				
Irish potato	41	46,606	52	120,042				
Maize	105	121,445	122	313,752	14	-803	18	42,955
Passion fruit	5	1,299,328						
Pigeonpea								
Rice	5	219,802	8	26,790				
Simsim								
Sorghum	24	69,672	33	158,903				
Soyabean								
Sunflower								
Sweet potato	293	186,120	253	161,618				
Tea								
Tobacco	7	15,510	9	4,228,955				

Table 67: Livestock enterprises gross margins for Western Savannah Grasslands (Zone 7) (UShs per livestock unit)

	Local Breed		Improved Breeds	
Livestock Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins
Beekeeping				
Dairy	13	72,000		
Goat	566	20,000	30	63,750

Enterprise profitability in Pastoral Rangelands (Zone 8)

Pastoral Rangelands (Zone 8) receives two rainy seasons; the first season starts in March and ends in May, whereas the second season begins in September and ends in December. Soils are moderate to poor. General infrastructure and marketing systems are rated poor to moderate. Tables 68 and 69 present gross margins for key crop and livestock enterprises in Zone 8. During the major growing season, banana and sweet potato are the most profitable crop enterprises, generating about UShs 353,000 and UShs 215,000 per hectare, respectively. They are followed by Irish potato (UShs 174,916 per hectare), finger millet (UShs 125,010 per hectare), and maize (UShs 100,114 per hectare). The enterprise profitability ranking for second season is similar to the first season. The banana enterprise emerges as the most profitable enterprise, generating more than UShs 300,000 per hectare in gross margins. Maize, bean, and Irish potato, in that order of relative profitability, follow and generate between UShs 100,000 and UShs 200,000 per hectare. On the livestock side, dairy and goat enterprises are common but relatively unprofitable. Among the livestock enterprises, the local dairy enterprise is the most profitable. A local dairy cow generates up to UShs 60,000 in a six months period. Overall, the production of banana, sweet potato, Irish potato, finger millet and maize and local dairy are recommended for the zone.

Table 68: Crop enterprise gross margins for Pastoral Rangelands (Zone 8) (UShs per hectare)

	Local Type				Improved Type			
	Major Season (Mar-May)		Second Season (Sep-Dec)		Major Season (Mar-May)		Second Season (Sep-Dec)	
Crop Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins
Banana	155	353,504	155	306,213				
Bean	66	81,108	67	136,404				
Cassava	39	59,522	30	68,686				
Cocoa								
Coffee	33	57,800	44	54,291				
Cotton								
Field pea								
Finger millet	10	125,010	50	-26,583				
Groundnut	35	-77,666	19	-57,872				
Irish potato	15	174,916	19	127,623				
Maize	56	100,114	61	181,872	6	288,456	13	541,710
Passion fruit								
Pigeonpea								
Rice								
Simsim								
Sorghum	7	92,566	10	90,582				
Soyabean								
Sunflower								
Sweet potato	111	214,562	96	80,947				
Tea								
Tobacco								

Table 69: Livestock enterprises gross margins for Pastoral Rangelands (Zone 8) (UShs per livestock unit)

	Local Breed		Improved Breeds	
Livestock Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins
Beekeeping				
Dairy	8	60,000		
Goat	8	25,000		

Enterprise profitability in South-western Farmlands (Zone 9)

The South-western Farmlands (Zone 9) has two rainy seasons and experiences a highly variable rainfall pattern with rainfall varying between 800 mm in the Kasese rift valley and 1,500 mm in the Rwenzori mountain highlands. The first rainy season starts in March and ends in May, whereas the second one begins in August and ends in November. In some parts of the zone, farmers face severe land shortages thus limiting the expansion of crop and livestock production. However, farmers in this zone enjoy fairly developed infrastructure and marketing systems. Tables 70 and 71 present the relative profitability of major crop and livestock enterprises in Zone 9. During the second growing season, the major season, maize, coffee, groundnut, sorghum, cotton, banana, rice, bean, cassava, sweet potato, Irish potato, and finger millet are widely grown. However, banana, rice, and groundnut generate the highest gross margins, estimated between UShs 400,000 and UShs 600,000 per hectare. These are followed by maize, which generates up to UShs 284,706 per hectare, coffee (UShs 157,037 per hectare), and Irish potato (UShs 105,000 per hectare). During the first growing season (March-May), the pattern of relative profitability is similar to the second season. In the first growing season, banana (UShs 541,000 per hectare) is the most profitable enterprise, followed by Irish potato (UShs 197,447 per hectare), cassava (UShs 182,025 per hectare), and maize (UShs 173,646 per hectare). Use of improved crop varieties in Zone 9 is low. On the livestock side, improved animal breed enterprises are common. The widespread existence of improved animal enterprises is probably a result of land scarcity which limits farmers to intensive animal production. Dairy production is relatively profitable. Local dairy animals generate about UShs 96,000 per animal, a higher value that in other zones. Beekeeping is present but is not as competitive as in other agricultural production zones. A single beehive generates about UShs 3,500 in six months.

Table 70: Crop enterprise gross margins for South-western Farmlands (Zone 9) (UShs per hectare)

	Local Type				Improved Type			
	First Season (Mar-May)		Second (major) Season (Aug-Nov)		First Season (Mar-May)		Second (major) Season (Aug-Nov)	
Crop Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins
Banana	182	541,047	152	604,711				
Bean	116	26,770	85	72,674				
Cassava	57	182,025	34	-19,142				
Cocoa								
Coffee	40	50,289	43	157,037				
Cotton			12	-29,062				
Field pea								
Finger millet	15	13,272	179	36,109				
Groundnut	86	-149,442	67	455,577				
Irish potato	14	197,447	17	105,711				
Maize	22	173,646	18	284,706				
Passion fruit								
Pigeonpea								
Rice			10	428,253				
Simsim								
Sorghum	45	-54,751	38	-36,794				
Soyabean								
Sunflower								
Sweet potato	240	9,161	183	75,444				
Tea								
Tobacco								

Table 71: Livestock enterprises gross margins for South-western Farmlands (Zone 9) (UShs per livestock unit)

	Local Breed		Improved Breeds	
Livestock Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins
Beekeeping	7	3,500		
Dairy	9	96,250	5	180,000
Goat	9	30,000	49	40,000

Enterprise profitability in Highland Ranges (Zone 10)

The Highland Range (Zone 10) is as competitive as Zones 6 and 7, particularly in crop production. Zone 10 receives a higher amount of rainfall than all other agricultural production zones. In some areas of the zone, rainfall is received almost throughout the year (March to October). Rainfall occurs with two peaks, one in April and the other one in August. In other parts of the zone, two rainy seasons are experienced, the first one beginning in March and ending in October, whereas the second one begins in September and ends in December. Soils are fertile and mostly volcanic soils. Zone 10 is commonly known for producing high value crops. However, farmers in Zone 10 are constrained by poor infrastructure due to the nature of terrain. In Tables 72 and 73, we present gross margins of various enterprises in Zone 10. During the first growing season, maize, coffee, groundnut, sorghum, banana, cocoa, bean, cassava, Irish potato, sweet potato, and finger millet are widely produced. Cocoa, banana and Irish are found to be the most profitable crop enterprises during the first season. Cocoa, banana and Irish potato generate more than UShs 400,000 per hectare in gross margins. Specifically, Irish potato generates UShs 867,283 per hectare, cocoa UShs 822,000 per hectare and banana generates UShs 404,494 per hectare. During the second season, coffee is found to be the most profitable, generating about UShs 1,305,278 per hectare. Coffee is followed by cocoa (UShs 373,309 per hectare), banana (UShs 345,306 per hectare), sorghum (UShs 281,040 per hectare), and bean (UShs 226,030 per hectare). In comparison with many other agricultural production zones, Zone 10 has a relatively high percentage of farmers using improved varieties and improved animal breeds. Improved variety use, especially with maize, cotton, bean, and cassava generates significantly better gross margins than the respective local varieties. On the livestock side, a number of livestock farmers have improved dairy cows and goats. However, improved dairy animals are less profitable than in other zones. In conclusion, coffee, cocoa, Irish potato, banana and bean are the most profitable crop enterprises whereas as improved goat enterprise is the most profitable animal enterprise.

Table 72: Crop enterprise gross margins for Highland Ranges (Zone 10) (UShs per hectare)

	Local Type				Improved Type			
	Major Season (Mar-Oct)		Second Season (Sep-Dec)		Major Season (Mar-Oct)		Second Season (Sep-Dec)	
Crop Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins	Sample Size	Gross Margins
Banana	77	404,494	92	345,819				
Bean	80	88,336	167	226,030	6	679,071	14	71,854
Cassava	34	74,817	37	54,643			8	1,473,371
Cocoa	15	822,775	16	373,306				
Coffee	25	82,930	33	1,350,278				
Cotton			12	25,883			14	80,406
Field pea								
Finger millet	21	-71,626	17	469,637				
Groundnut	14	-105,562	22	48,544				
Irish potato	36	867,524	20	-124,819	5	5,867,932	9	-598,846
Maize	40	60,794	37	91,508	37	465,443	32	365,277
Passion fruit								
Pigeonpea								
Rice	6	-53,328	7	133,004				
Simsim								
Sorghum	79	-50,716	32	281,040				
Soyabean			5	-77,697				
Sunflower								
Sweet potato	141	96,283	141	68,440				
Tea								
Tobacco								

Table 73: Livestock enterprises gross margins for Highland Ranges (Zone 10) (UShs per livestock unit)

	Local Breed		Improved Breeds	
Livestock Enterprise	Sample Size	Gross Margins	Sample Size	Gross Margins
Beekeeping				
Dairy	21	48,000	8	36,000
Goat	506	20,000	36	142,100

Summary of profitable enterprises by agricultural production zone

Table 74 is a summary of the most profitable enterprises by agricultural zone. Among crop enterprises, banana and maize are the two most universally profitable enterprises, each appearing on the list of profitable enterprises in seven zones. The third most universally profitable crop in the country is sweet potato, while cassava is the fourth. Among animal enterprises, the most universally profitable enterprise, by far, is production of local goats. It should be noted, however, that insufficient production detail was available in the UNHS data to consider poultry and aquaculture, which may also be profitable in some zones. Summarized across regions, in the first growing season of the annual production calendar, cocoa, banana, tobacco and tea are the most profitable crops; in the second season, the most profitable crops are banana, cocoa, passion fruit, tobacco and rice.

Table 74: Most profitable enterprises by agricultural production zone

Enterprise	Zone*										No. of zones
	1	2	3	4	5	6	7	8	9	10	
Crops											
Banana			X		X	X	X	X	X	X	7
Bean										X	1
Cassava		X	X		X	X					4
Cocoa							X			X	2
Coffee			X						X	X	3
Field pea		X									1
Finger millet						X		X			2
Groundnut									X		1
Irish potato								X	X	X	3
Maize	X		X	X	X		X	X	X		7
Passion fruit							X				1
Rice					X	X			X		3
Simsim		X									1
Sorghum	X										1
Sweet potato			X	X	X	X		X			5
Tobacco			X				X				2
Animal											
Beekeeping			X		X						2
Dairy					X	X	X	X	X		5
Goats	X	X	X	X		X	X			X	7

*Zones
1 - North-eastern Drylands
2 - North-eastern Savannah Grasslands
3 - North-western Savannah Grasslands
4 - Para-savannahs
5 - Kyoga Plains
6 - Lake Victoria Crescent
7 - Western Savannah Grasslands
8 - Pastoral Rangelands
9 - South-western Farmlands
10 - Highland Ranges

Summary of findings, conclusions and recommendations

This study was intended to assess the relative profitability of PMA priority enterprises across agricultural production zones. Our approach was to develop agricultural production zone based enterprise budgets and use them to generate enterprise specific gross margins. The study found that labour (family and hired) in crop production is a high proportion of total costs (around 70 percent). The study recommends that government policy interventions aimed at promotion of commercialized crop production should endeavor to integrate labour-saving interventions in technology packages. A number of labour-saving interventions, most of which are suitable for the sub-Saharan Africa region, are recommended, especially row planting of crops that have traditionally been broadcasted and draft power. Other labour-saving technologies including use of herbicides, minimum tillage, and intercropping of leguminous cover crops to suppress weeds are also available. In addition, farmers should be encouraged to join farmer groups or labour-rotation groups where group members develop alternative methods to ensure mutual labour availability throughout the growing seasons.

For some of the crop enterprises, there are few high-yielding varieties. Crops in this category include cotton, field pea, millet, Irish potato, pigeonpea, simsim, sorghum, soybean, and sweet potato. For these crops, there is little difference in gross margins between the low- and high-input technologies. Attention by agricultural policymakers should be given to these crops to identify the ones for which high-yielding varieties could most readily be developed.

Besides crop production, the local goat enterprise is highly competitive across a wide range of agricultural production zones. The local goat enterprise is so profitable because of its low

input use. It also requires less land for production, relatively inexpensive feeds, and goats are resistant to a number of livestock diseases.

Based on the relative profitability analysis, this study recommends that the following enterprises be promoted in the following agricultural production zones:

- *North-eastern Drylands – Zone 1*:
  - Crop sector – maize and sorghum;
  - Livestock sector – local goat enterprise.
- *North-eastern Savannah Grasslands – Zone 2*:
  - Crop sector – field pea, cassava, and simsim;
  - Livestock – goat enterprise.
- *North-western Savannah Grasslands – Zone 3*:
  - Crop sector – coffee, tobacco, cassava, banana, sweet potato, and maize;
  - Livestock sector – beekeeping and goat enterprise.
- *Para-savannahs – Zone 4*:
  - Crop sector – maize and sweet potato;
  - Livestock sector – goat enterprise.
- *Kyoga Plains – Zone 5*:
  - Crop sector – rice, sweet potato, maize, cassava, and banana.
- *Lake Victoria Crescent – Zone 6*:
  - Crop sector – rice, cassava, banana, sweet potato, and finger millet.
- *Western Savannah Grasslands – Zone 7*:
  - Crop sector – passion fruit, tobacco, maize, banana, and coffee;
  - Livestock sector – local goat enterprise.
- *Pastoral Rangelands – Zone 8*:
  - Crop sector – banana, sweet potato, Irish potato, finger millet, and maize.
- *South-western Farmlands – Zone 9*:
  - Crop sector – banana, rice, groundnut, maize, coffee, and Irish potato;
  - Livestock sector – dairy enterprise.
- *Highland Ranges – Zone 10*:
  - Crop sector – coffee, cocoa, Irish potato, banana, and bean;
  - Livestock sector – improved goat enterprise.

Appendix: The use of the UNHS for gross margins analysis

Although the research team was able to extract some information from the UNHS data set for the purpose of preparing enterprise budgets, a number of issues related to the structure of the UNHS data set limited the level to which most of the observations would be used. In this section we present those limitations and emphasize various ways of improving the UNHS data collection instrument to facilitate better use of the UNHS for enterprise gross margin analysis. Recommendations are presented by enterprise module (see UNHS questionnaire)

Crop production modules

In the UNHS, total crop output (section 7) is collected and recorded as total crop output. Crop output is not disaggregated by seed type and production method (i.e., intercrop or monocrop). The data in its current form does not allow us to link acreage (section 4), input use (sections 6 and 7), and yield (section 7) with seed types and production methods. Since most crops are produced in a variety of ways and using a variety of seed types, it is important that output be disaggregated by crop type. One way of dealing with this problem is to structure the UNHS data collection instrument such that plot level reporting is maintained all throughout sections 4, 5, 6 and 7. In this way, aspects of production associated with a particular crop would be tracked.

The current differentiation of seed type (improved versus local varieties) does not portray the reality faced by most rural farmers. In most cases, a range of improved varieties are introduced to farmers over a long period of time and with time, some of the improved varieties become local varieties. The Uganda Bureau of Statistics, in planning each UNHS, should work with MAAIF and the National Agricultural Research Institutions to identify the formal names of the existing improved varieties by agricultural production zone. A question that elicits for the exact name of the improved variety should be added to section 4 of the crop module and codes should be associated with each crop variety. The names should be provided to enumerators during training and data collection.

For most crops including maize, bean, cassava and sweet potato, harvest occurs over a lengthy period of time, as long as the product is needed for household consumption or sale. The research team found it challenging to convert output values reported as harvested in one state (green or dry) to another state. The UNHS data does not provide a solid basis for computing the equivalence of crop harvested in one state to a standard state, such as the marketed state. We recommend that future UNHS data collection efforts incorporate conversion factors.

Livestock production modules

Section 11 of the livestock module reports total livestock expenditures for the household. However, expenditures are not linked to section 10 which provides information related to the characteristics of livestock types. The livestock module provides insufficient information for extracting expenditures by livestock type. We recommend that livestock data be collected by enterprise type and that sections 11 and 10 be linked by enterprise type.

Bibliography

Abidin, P.E., Van Eeuwijk, F.A., Stam, P., Sturik, P.C., Molasetti, M., Mwanga, R.O.M., Odongo, B.,Hermann, M., and Carey, E.E. 2005. *Adaptability and suitability of sweet potato varieties for low-input systems in Uganda*. Plant Breeding. 124 (5):491-497.

Bagamba, Fredrick. 2007. Market access and agricultural production: the case of banana production in Uganda. Ph.D. Thesis. Wageningen University.

Cotton Development Organization (CDO). 2008. *The cotton sub-sector at a glance*. CDO. Kampala, Uganda.

de Janvry, Alain, Fafchamps, M., and Sadoulet, E. 1991. *Peasant household behavior with missing markets: some paradoxes explained*. The Economic Journal. 101 (409): 1400-1417.

Food and Agriculture Organization (FAO). 2006. *The state of food insecurity in the world, 2006*. Rome, Italy.

Gittinger, Price. J. 1984. Economic analysis of agricultural projects. 2nd ed. John Hopkins University Press. Baltimore, Maryland, USA.

Government of Uganda (GoU). 2001. *Uganda's Irish potato sector*. Prepared for the Government of Uganda's conference on competiveness of selected strategic exports. Government of Uganda. Kampala, Uganda.

Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). 2000. Plan for the Modernisation of agriculture: eradicating poverty in Uganda. MAAIF. Entebbe, Uganda.

Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) and Ministry of Finance, Planning and Economic Development (MFPED). 2004. *Increasing incomes through exports: a plan for zonal agricultural production, agro-processing and marketing*. Entebbe, Uganda.

Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). 2009. PMA maize market research study in Uganda: Improving food security and farm income using maize enterprise: the case of Busoga region. May, 2009. MAAIF. Entebbe, Uganda.

Ministry of Finance, Planning and Economic Development (MFPED). 2009. *Background to the budget 2009/10.* MFPED. Kampala, Uganda.

Ministry of Tourism, Trade and Industry (MTTI). 2008. *Dry beans: product profile no.12.* MTTI. Kampala, Uganda.

National Agricultural Research Organization (NARO). 1994. *Cassava production and utilization manual.* NARO. Entebbe, Uganda.

Ocaido, M, Muwazi, R.T., and Opuda-Asibo, J. 2009. Financial analysis of livestock production systems around Lake Mburo national park in South-western Uganda. *Livestock Research for Rural Development*. 21(70).

Picazo-Tadeo, A.J. and Reig-Martinez, E. 2005. Calculating shadow wages for family labour in agriculture: an analysis for Spanish citrus fruit farms. Cashiers d'economie et sociologie rurales. 75(2005).

Plan for the Modernisation of Agriculture (PMA) and Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). 2009. *Analysis of sunflower value chain in central Uganda.* February, 2009. PMA-MAAIF. Kampala, Uganda.

Plan for the Modernisation of Agriculture (PMA). 2009. A market research study on rice value chain in the Acholi and Lango sub-regions of Northern Uganda. May, 2009. PMA. Kampala, Uganda.

Plan for the Modernisation of Agriculture (PMA). 2009. *Uganda cotton sub-sector in the Lango and Acholi sub-region.* June, 2009. PMA. Kampala, Uganda.

Plan for the Modernisation of Agriculture (PMA). 2008. *Market research study on the beekeeping value chain in West Nile region.* December, 2008. PMA. Kampala, Uganda.

Uganda Bureau of Statistics (UBOS). 2006. Statistical Abstract 2006. Kampala, Uganda.

Upton, Martin. 1987. African farm management. Cambridge University Press. Cambridge, Great Britain.

USAID-Agricultural Productivity Enhancement Programme (APEP). 2008. *Practitioners' quick reference guide: East African highland bananas.* USAID-APEP. Kampala, Uganda.

USAID-Agricultural Productivity Enhancement Programme (APEP). 2008. *Practitioners' quick reference guide: sesame.* USAID-APEP. Kampala, Uganda.

USAID-Agricultural Productivity Enhancement Programme (APEP). 2008. *Practitioners' quick reference guide: Arabica coffee.* USAID-APEP. Kampala, Uganda.