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Full Length Research Paper

Can markets deliver the dual objectives of income generation and sustainability of natural resources in Uganda?

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In this study, we set out to determine whether strategies used to link farmers to markets resulted in household level livelihood and NRM impacts measured by the participation in the market and the value of sales from the markets. Farmer to market linkages have improved livelihoods in developing countries due to policy, institutional and implementation strategies, however, equal emphasis has not been placed on investments in Natural Resource Management (NRM). Areas with high market access have often been cited as the highest in soil nutrient depletion, while input markets and labour required for land management are scarce at community level. We established a higher human capacity through formal education and technical skills built through extension and training services provided by the institutional affiliation which enabled support to specific enterprise production. We also observed increased commercialization through increased number of crops sold to the market through more than one marketing channel, including food and cash crops which compete with one another. Investment in NRM was low despite increased income.

Key words: Linking farmers to markets, natural resource re-investment, sample selection model, impacts, rural livelihoods.

INTRODUCTION

Much of sub-Saharan Africa faces the inter-related challenges of rural poverty and environmental degradation. The increasing interests in market orientation and special programs to support this, example, African Growth and Opportunity Act (AGOA), New Partnership for African Development (NEPAD) offer new opportunities for smallholder farmers in developing countries to alleviate poverty by increasing their income opportunities. However, this transition to market orientation is constrained by a range of bio-physical, economic and social factors at the household, and community level (Kaaria and Ashby, 2001).

Farmer to market (F2M) linkages plays a critical role in poverty alleviation in poor economies (Dorward et al., 2003; Sanginga et al., 2004; Canz, 2005). Smallholders can benefit directly from poverty alleviation through productivity gains, which result in higher incomes, and commercialization. They can also benefit from regional spill over benefits such as the agricultural contribution to growth, and the generation of economic opportunity in the non farm sector (Govereh et al., 1999; Warning and Key, 2002; Dorward et al., 2003; Govereh and Jayne, 2003). As a result, many African countries shifted their agricultural and rural development focus towards fiscal and economic reforms geared to the market driven approach to production in the 1980's. These policy interventions have produced mixed results.

Positive evidence that markets have an impact on rural poverty in Africa is widely published (Zeller et al., 1998;

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Warning and Key, 2002; Afri-sefa, 2007: 436; Kaaria et al., 2008). In a study in Uganda and Malawi, Kaaria et al. (2008) found that households benefited significantly from linkages to markets through increased household incomes, social and human capital and changes in intra-household decision making. In Senegal, Warning and Key (2002: 262) reported that the social impacts of market linkages included the use of social collateral which played a critical role in the inclusion of the rural poor when used as a substitute for physical collateral.

However, there is evidence that farmer - market linkages do not always benefit the marginalized. Porter and Howard–Phillips (1997) and Warning and Key (2002) reported a skewed distribution of income due to power imbalances at the household level. Women were excluded from market linkages because of the dependence on seed which they obtained from their husbands and the income benefits often accrued to the husband. Kaaria et al. (2008) showed that the income of male respondents and gains in human capital, were significantly higher than female group members. At the community level, market oriented production has created a privileged group of farmers with access to new technologies, who used this to capture new economic opportunities (DFID, 2005). They also increased their access to market opportunities, which increased competition by other producers, driving other local producers out of production (Dorward and Poole, 2003). Other types of market production, such as, contract marketing have been criticized because 'farmers become a little more than industrial workers in their own farms' and severe deskilling occurs because the farmer's decision making is taken from their hands and stipulated in contracts (González and Nigh, 2005).

Market linkages in Uganda

The Government of Uganda (GoU) has provided an environment that is conducive for the improvement of market linkages for small scale producers in Uganda. The Poverty Eradication Action Plan (PEAP; MFPED, 2001) was instituted by the GoU to improve production and trade through policy adjustment, institutional reform and decentralized planning. Under this program the Plan for Modernization of Agriculture (PMA; MAAIF and MFPED, 2001) was aimed at transforming smallholder farmers from subsistence to commercial production through the National Agricultural Advisory Services (NAADS), the advisory arm of the PMA.

The policy environment provided by GoU has created an institutional setting that facilitates smallholder market linkages at various levels. The private and Non Governmental Organization (NGO) sectors have used a variety of strategies at different scales to engage communities in increasing market access and participation in market chains (Pali, 2008). In general, these approaches facilitate a relationship between producers, service providers, and input-output markets. In these linkages, technologies and production support activities are linked to market demand and viewed within the context of the whole market chain, through effective business development services (BDS) (Shepherd, 2007). Predictably, a recent assessment by the Ministry of Finance Planning and Economic Development (MFPED, 2007) showed that the policy and institutional interventions resulted in a decline in the income poverty, described as the proportion of households whose expenditure per adult equivalent fell below the poverty line; from 69% in 1992 to 31% in 2006. However, the current poverty level is significantly above the ten percent target that the GoU aims to achieve by 2017.

Varied quantitative impacts of F2M linkages in Uganda have been reported, depending on the strategies employed and services provided (Tulip and Ton, 2002; Benin et al., 2007; Bolwig and Odeke, 2007; Gibbon and Bolwig, 2007). For instance, Bahiigwa et al. (2005) found that the majority of the households with declining poverty are involved in export cash crop production of cotton, maize, beans and legumes. An impact study conducted on the NAADS program found that their program helped farmer groups to avoid large declines in farm income that affected most Ugandan farmers between 2000 and 2004, by encouraging diversification into profitable new farming enterprises, such as, groundnuts, maize and rice (Benin et al., 2007). The organic sector in Uganda, largely undertaken by the private sector, has played a significant role in increasing linkages to export markets. This sector, which applies out-growers schemes, has registered substantial increases in numbers of certified farmers from 200 farmers in 1994 to 108,050 in 2007 (Walaga, 2008). However, economic impacts from the organic export markets have been mixed and highly crop specific. Crop incomes of approximately US $ 2,375 and US $ 1,125 for certified organic and conventional pineapples respectively, were reported while for coffee farmers, incomes of US $ 375 and US $ 187.5 for certified organic and conventional farmers respectively, were reported. No significant differences were found for cocoa producers (Gibbon and Bolwig, 2007: 21).

Various studies assessing farmer to market linkages have reported low use of inputs and poor adoption of sustainable land management practices. On the contrary, others for example, Govereh et al. (1999), Delve and Roothaert (2004), Abdoulaye and Sanders (2006), found that linkages to markets have been associated with increased technological use; while institutional affiliation was reported to improve NRM re-investments (Pender et al., 2004; Walaga et al., 1999). The NRM re-investment levels especially fertilizer investments resulted from market policy reform (Jayne et al., 2003; Kelly et al., 2003) and increased economies of scale in fertilizer trade brought about by the critical mass of commercial farming in the locality (Waithaka et al., 2007). Although these

levels of re-investment differed by country (Kelly et al., 2003; Waithaka et al., 2007; Kaaria et al., 2008). For example, Kaaria et al. (2008) found that households in Malawi invested their incomes in NRM, but in Uganda for women and poor farmers re-investment in NRM was not among their first priorities. An assessment of NRM impacts within NAADS in Uganda, which is linking smallholder farmers to markets, found that the program registered more success in promoting the adoption of yield enhancing technologies than improved soil fertility management. Other studies in the export organic sector in Uganda show that NRM re-investment is low (Bolwig and Odeke, 2007: 13; Gibbon and Bolwig, 2007: 14).

In Uganda, the institutional framework has been effective in facilitating access to markets and economic impacts -albeit- mixed, of smallholder farmers; therefore, with increased linkages to markets, investment in NRM is expected, to enhance productivity. However, several studies in Uganda report a decline in NRM, while limited studies report on the impacts of market linkages on livelihoods and whether they result in NRM reinvestment.

Objectives of this study

We quantify the impact of F2M linkages on smallholder livelihoods in Uganda, with a focus on the production side of the market chain. We explore whether the strategies used to link farmers to markets are resulting in household level livelihood and NRM impacts measured by the participation in the market and the value of sales from the markets. We explore three contrasting sectors: (i) cotton as a cash crop, (ii) dual food and cash crops (rice) and (iii) pineapple as a high value certified organic export crop, to ascertain the strategies that can be used to ensure improved institutional F2M linkages.

The main objective of this study is to analyze the determinants of the extent of participation in the market within institutional F2M linkages. We explore the following research questions:

(i) How does service provision, such as, extension, market information and farmer organization processes, affect the value of sales?
(ii) Does increased income lead to re-investment in NRM and which integrated soil fertility management (ISFM) technologies are being invested in?
(iii) What is the relationship between value of sales from the market with household, socioeconomic, production and marketing variables?

CONCEPTUAL FRAMEWORK

The production to consumption framework (Figure 1; Kaaria and Ashby, 2001) ensures backward and forward relationships between community assets (natural, physical, social, human, and financial capitals) and the 'production to consumption' aspects. The triangle represents the household and its elements; the rectangles touching the triangle represent elements of household enterprise production, while the large disjointed rectangle at the base of the figure shows the external institutional environment and its influence on the household enterprise production factors.

Within F2M linkages, the extent of influence and broadness of the institutional intervention is shown by the large shaded arrow and the size of the rectangle. Household production is driven by the external environment, institutions and organizations that operationalize smallholder commercialization policies enacted to induce institutional and smallholder participation in market activities. However, these institutions (NAADS and SG, 2000), integrate their activities into the resource, consumption, and production aspects of the household.

The smaller arrowheads represent the influences and the directional effect that they have on the respective elements. Consumption factors influence households through household decision making; the food security status while the influence the household has on their NRM and use of resource management levels is mainly governed by the household perceptions of the soil fertility levels, the actual fertility level and household income.

At the household level, the variables that are likely to influence the value of sales from the market can be clustered around four major themes: household, farm level, socio-economic and market factors. The hypothesized relationships of the participation and value of sales from the market with the explanatory variables are shown in Table 1.

Household level factors

In Table 1, household factors relate to the level of household human capital endowments and experience that influence the value of sales from the market, and include gender of the household head, household size, and the education of the household head. It is anticipated that the gender of the household head shall have a mixed impact on both the participation and the value of sales from the market because in Uganda, household production is segregated by gender, with women mainly producing cereal food crops (Nkonya et al., 2004:65). Other studies have found that women headed households were less likely to be associated with higher levels of market participation (Makhura et al., 2001; Govereh and Jayne, 2003). Higher education levels of the household decision makers had a positive influence on access to credit, which increased production, and consequently household incomes (Govereh and Jayne, 2003; Pender et al., 2004).

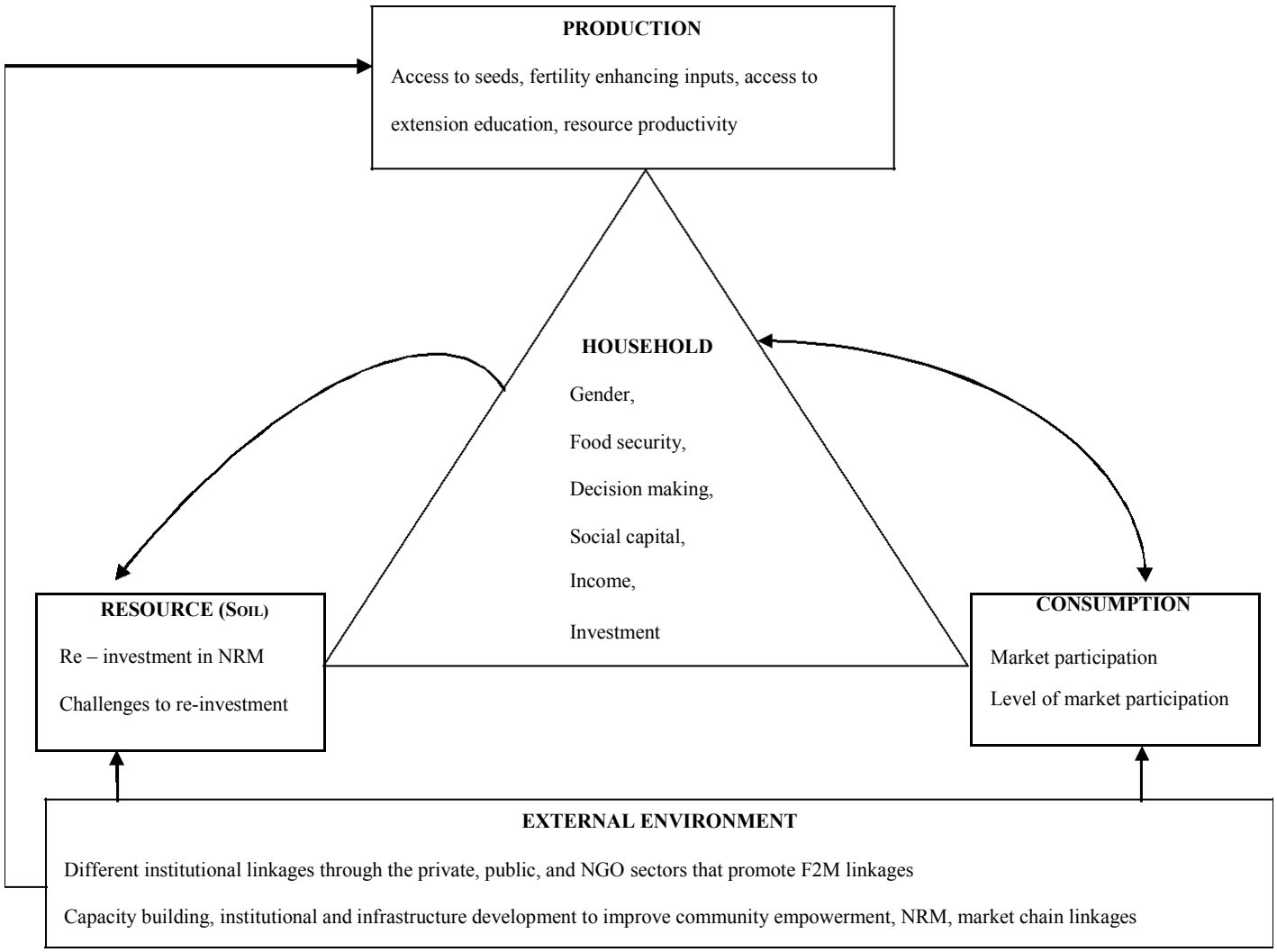

Figure 1. The resource to consumption conceptual framework. (Adapted from Kaaria and Ashby, 2001).

Farm level factors

Farm level factors relate to the level of farm resource ownership and management that influence the value of sales from the market and they include farm size, management, land cultivated, and yield from crop production received by the household (Table 1). Farm size is expected to have a positive impact on production, and thereby directly influencing market participation and the value of sales from the market. The influence on the amount of land cultivated is expected to be enterprise specific (Warning and Key, 2002). Evidence from various studies have found that farm size positively motivated participation in- and the value of sales from the market, for high value, fresh produce, contract farming (Masakure and Henson, 2005), dual food and cash crop (maize) sales (Makhura et al., 2001) and cotton commercialization (Govereh and Jayne, 2003). Given the crop diversification culture of smallholder production in Uganda, especially export producers, we hypothesize that larger farm sizes stimulate larger allocation of land for enterprise production hence stimulating higher value of sales from the market. In addition, external institutional support to enterprise producers is hypothesized to increase value of sales from the market. A study found that farmers who owned larger sizes of land devoted higher proportions to export crop production because they were motivated by access to services, inputs, and market information, (such as market availability, and price) which were facilitated through the F2M linkages (Makhura et al., 2001).

Natural resource management

We hypothesize the use of external inputs, such as, inorganic and organic fertilizer, to be low in Uganda, despite the linkage to markets. Nkonya et al. (2004)

Table 1. Description of the variables included in the models.

Variable description	Variable	Participation decision	Participation level
Dependent variable			
Participation in the market	Mktexp3		
Level of participation in the market	Totval3usdol		
Independent variable			
Household factors			
Gender of the household head (female)		?	?
Household size	Hhsizecat2	?	?
Education (years of schooling)	Numhhsch	+	+
Production factors			
Region	Districtcoll1	?	?
Farm size (acres)		+	+
Land cultivated (acres)	Landcultivout	?	?
Ownership of agricultural equipment		?	?
Food production	Maize, beans	-	-
Enterprise crops	Pineapple	+	+
Use of inorganic fertilizers	Inorgfert	+	+
Use organic inputs	Orgfert	+	+
Use of agro forestry	Agroforest	?	?
Yield (kg)	Yieldout	+	+
Number of extension visits	Nexvi06cat1 and 2	+	+
Socio economic factors			
Payment of membership fee	Hooftmemb4	+	+
Market information	Mktinfo	+	+
Market linkages	Mktlink	+	+
Market distance	Lnmktdist	-	-

found that the use of the different land management practices (crop rotation, agroforestry and soil conservation methods) to be location specific based on the agro ecological regions. Other factors that influence adoption of NRM technology is affiliation of farmers to institutions and programs that build capacity on NRM practices (Walaga et al., 1999; Pender et al., 2004).

Socio economic factors

Socio-economic factors are associated with the strength of farmer institutions and other related social capital factors (Table 1). Farmer group structures create social networks and transform social resources into tangible and intangible assets (Gotschi, 2006: 177), such as access to services that include extension, credit and markets (Shepherd, 2007; Sartorius et al., 2007: 651; Barham, 2007). Technical skills provided to farmer groups on crop specific production methods are hypothesized to have a positive influence on income (Pender et al., 2004; Masakure and Henson, 2005: 1727).

Higher intensity of social capital factors within farmer groups (such as belonging to groups, paying membership fee, and number of meetings held), is likely to enhance access to markets, through improved economic viability of marketing. However, other studies have reported the contrary (Makhura, 2001; Warning and Key, 2002: 259; Govereh and Jayne, 2003).

Affiliation to an institution or sector (NGO, NAADS, or private sector) is expected to have a positive influence on value of sales to the market. It was established that different institutions use different methodologies of service provision within market linkages that may be more effective in service provision (Pali et al., 2007).

Market factors

Market factors include information that ensures improved market access, (market information), number of market channels a farmer sells to for different crops, distance to the market (Table 1). These are likely to have a multi directional effect on participation in markets and the value

of sales from the market. Knowledge of the market price alleviates uncertainties associated with market price (Maltsoglou and Tanyeri-Abur, 2005) while the number of market linkages for a single product is likely to increase the participation and value of sales from the market. In Uganda, information asymmetry was found to be a major challenge (Nkonya, 2002; Collinson et al., 2002). However, affiliation to organizations which facilitated market linkages improved access to market information including product price, quality, quantity, and which markets to sell to, although this market information provided by these institutions is often specific to the mandate crop of the institutions. Distance to the market is hypothesized to have a negative impact on participation in the market and value of sales from the market because further distances discourage participation in the market. The distance to the market had a large negative impact on cotton commercialization (Govereh and Jayne, 2003: 46), while households sold outside the local area if transaction costs related to good road access were lower. Evidence from other studies is location specific; Makhura et al. (2001) did not find any significant effect of the distance to the market on participation and value of sales to the maize markets, while Nkonya et al. (2004) found a positive association between income and distance from an all weather road in Uganda.

Trade-offs between food and cash crop production

The production of food crops is hypothesized to have an inverse relationship with the value of sales from the market given the competitive nature of food crops sold to the market with household consumption. Govereh and Jayne (2003) found no strong indication of increase in total food grains in households involved in commercial cotton in Zimbabwe. Large household sizes, engaged in enterprise production of edible crops had a negative influence on the value of sales from the market due to competing household food security needs (Makhura et al., 2001), while large household sizes that were engaged in non edible cash crop production (such as cotton) had a positive influence on the sales from the market[1].

MATERIALS AND METHODS

Study area

This study was conducted in Lira and Luwero districts in northern and central Uganda, respectively. The two districts predominantly practice subsistence low external input agricultural production; however, they are different in proximity to regional and national markets, crops grown and agro-ecological zones.

Lira comprises an area of 7,200 km^2, with a population of 757,763 (82.8% rural) and a population density of 81.4 persons km^{-2}. It has a population growth rate of 2.7%. Twenty eight percent of the land (6,151 km^2) is under agricultural use with 78% of households engaged in subsistence farming on an average land holding of 0.54 ha. The agro-ecology supports cassava- millet production, and it is a major producer of oil crops such as sesame, sunflower and shea nuts. Cotton is the major cash crop. The soils are predominantly red sandy loam soils. The average rainfall is 1300 mm. Livestock comprises mainly goats and cows. Lira has one tarmac road that links it to Masindi and Kampala districts and a well developed road network with a district road length of 815 km.

Luwero district has an area of 5,693 km^2, a population of 341,317 people (91% rural) and a density of 53 person's km^{-2}. The population growth rate is 2.3% per year. Luwero has a bi modal rainfall which averages between 1,000 to 1,250 mm pa. Sixty seven percent of the land is under subsistence production. The agro ecology sustains the intensive banana-coffee lake shore system and forest-savannah mosaic banana-system with predominantly red, sandy loams which support the production of a diversity of crops mainly cash crops (pineapples, coffee, and tomatoes). Foreign exchange earnings from the fruit and vegetables exports amounted to US$ 0.1 million in 1999 (DIP Luwero, 2007). The main tarmac road, which is about 60 km from Kampala, provides various trade opportunities including merchandise sold in Kampala, along the Kampala-Gulu highway leading to southern Sudan and accessibility to infrastructure and services. A total road network of 735.8 km exists in the district with half comprises feeder roads.

Background to enterprises selected

This study focused on three specific crop enterprises: Cotton, Pineapples, and Rice:

Cotton

Cotton has a more developed institutional and organizational structure from national to producer level than pineapples and rice because of its nature as a traditional cash crop. The Cotton Development Organization (CDO) provides the regulatory framework to ensure quantity and quality cotton production, by issuing export licenses, promoting external input use and seed distribution through the Uganda ginners and cotton exporters association (UGCEA). The two institutions also collaborate to set a pre- and mid season non-binding indicative price of cotton. Conventional cotton production is largely purchased by Dunavant Uganda Ltd although there are several other cotton buyers (Twin brothers, Jitco, Jaber, etc). The key competitor of Lango Organic Farmers' Promotion (LOFP) in Lira was Eco Organic, a subsidiary of Dunavant. LOFP and Dunavant support cotton production through crop finance to purchase cotton (example, BoWeevil, a private company that provides crop finance for organic produce from LOFP), subsidized inputs (example, Dunavant provides MAP, DAP, while LOFP provides Neemicide, liquid soap which is a pesticide adhesive) and extension services. Dunavant partnered with The Agricultural Productivity Enhancement Program (APEP), to organize and train farmers in groups and provide ploughing services. LOFP works with out growers and runs programs on organic cotton productions which are aired on local radio stations. The comparative advantage of certified organic cotton in Lira is the low use of chemical fertilizer and the predatory black ant (Lepisiota spp) which is highly effective in pest control. Certified organic cotton production is regulated by European organic standards and the product receives a 15 to 25% premium price over conventional cotton. All cotton produce is destined for the export market. Phoenix logistics, a local company, purchases organic cotton from BoWeevil and exports to South Africa, Europe, India and USA. Conventionally produced cotton is sold to local buyers, buying centres, ginneries

[1] Govereh and Jayne, (2003) reported a small positive impact on cotton commercialization.

Table 2. Sample selection for the cross sectional survey.

Region	**Northern Uganda**		**Central Uganda**		
District	Lira		Luwero		
Sector	Private	NGO	Public	NGO	NGO
Organization	Bo Weevil	CLUSA	PMA	SG 2000	VEDCO
Crop	Cotton	Cotton	Rice	Rice	Rice
# of groups	5	5	5	5	5
# of farmers/ group	20	20	20	10	10
Total	100	100	100	50	50

Region	**Central Uganda**		
District	Luwero		
Sector	Private	Public	NGO
Organization	Amfri farms	PMA	VEDCO
Crop	Pineapples	Pineapples	Pineapples
# of groups	1	1	1
# of farmers/ group	20	20	20
Total	20	20	20

Source: Pali (2008).

and cooperative societies and is ultimately exported to Europe or China.

Rice

Rice production has more than doubled following the introduction of the New Rice for Africa (NERICA) variety into Uganda. Due to its versatile production requirements and support institutions, such as, NGO's which have been involved in widespread seed distribution. In Luwero, the Volunteer Efforts for Development Concerns (VEDCO), Sasakawa Global 2000 (SG 2000) and NAADS support rice production through seed and credit provision, capacity building in technical, farm business skills and credit. On-farm threshing is carried out as a primary processing activity while private traders in Luwero own rice mills for secondary processing (de-husking). The price of rice is predominantly based on demand and supply. The rice markets include private local processors, traders', consumers and the institutions markets located in Kampala, such as, Makerere University and Uganda Grain Traders Limited (UGTL).

Pineapple

Organic certified pineapple production has principally been supported by the private organic sector in Uganda; however the local demand is high. Amfri farms, a private company, VEDCO and NAADS provide inputs (such as grass for mulching, Calliandra, fertilizers, herbicides, coffee husks, and animal manure), technical advice and capacity building to pineapple producers in Luwero. VEDCO links farmers to markets and builds collection centres on a cost sharing basis with farmers, promotes bulk production and provides credit. Amfri farms provide the technical advice, certification. AMFRI purchases produce at a premium price but the open market pricing system is regulated by demand and supply. A diverse market exists for pineapple production from the study sites, which includes private export organic companies that require certified organic production (Bio fresh, Amfri Farms and Suruma foods) and Icemark. In Luwero, local markets include Kasana town daily market and a weekly market in Wobulenzi town and the St Balikuddembe market in Kampala. The regional markets include the Ugandan trucks destined for southern Sudan, and Kenya along the Kampala-Gulu highway.

Initial analysis of organizational types that link farmers to markets led to the identification of three broad categories, the public, NGO and the formal private organic sectors. The NGO and the public sectors facilitated market linkages, while the private sector provided the market linkage. Non Governmental Organizations built social and human capacities in a wide range of subjects which included markets and group development. The public sector facilitated collaboration between institutions and organizations involved in service provision and provided blanket services to build capacities and develop infrastructure to improve market chains.

Sampling frame

Table 2 presents the sampling frame used in the study. We sampled a total of 450 households from Lira and Luwero districts. Households were stratified by their market affiliation: Government, NGO and private organic sectors. Respondents were then selected randomly from each of these market affiliation sectors. All respondents were members of mixed (men and women) groups. For each enterprise, data were collected across at least two of the market affiliation sectors to allow for comparison across the sectors. Pineapple growers were selected across the three sectors, however for both Rice and Cotton, data was collected from only two of the market affiliation sectors: Public and NGO for Rice, and private and NGO for cotton. For rice and cotton, 20 farmers each from five mixed groups were randomly selected in each sector. For pineapples, a total of 50 farmers were interviewed because it was also common to find a farmer holding dual membership in two groups across the three sectors. All households surveyed had been actively involved in marketing for at least five years.

A household questionnaire was administered to collect information about the household and group characteristics, production and management information for the year 2006 (production at plot and crop level, the inputs and soil fertility management), marketing of the enterprises and expenditure for

year 2006, and household food security. The data on the coping strategies during food shortages and the positive and negative changes associated with selling to the market were captured, as were gender and intra household dynamics.

Model specification

This study used a combination of the Heckman's two-step estimation procedure (Heckman, 1979) and the ordinary least squares (OLS) regression equation models to assess the relationship between value of sales to the market with household, socioeconomic, production and marketing variables. The value of sales was measured using income of the household from sale of the enterprise crops to the market in 2006. The Heckman sample selection model was used to account for any possible sample selection bias resulting from sample selection decisions. The selection bias from this study resulted from a censored dependent variable (value of sales to the market) from farmers who did not participate in selling to the market in 2006.

The functional form of the sample selection model is presented in Equations (1) to (3). The Sample selection model is a limited information maximum likelihood which comprises the outcome and the sample selection equations. Equation (1) shows the outcome equation component of the sample selection model:

$$Y_i = X_i'\beta + u_i \quad (1)$$

We assume that the value of agricultural output from the sale of enterprise crops (Y_i) is a function of a vector of covariates for unit i (X_i'), such as, gender of the household head, household size, and education of the household head (household factors). The production factors include region, farm size and land cultivated, ownership of agricultural equipment, production of enterprise and food crops, use of NRM technologies (organic, inorganic, soil conservation, agro forestry practices) and yield. Socio-economic factors are sector, the number of extension visits received by the household, payment of membership fee, received market information, number of market linkages a farmer sells to and the distance to the market. β= vector of coefficients which determine the volume of sales u_i= random disturbance for unit i for outcome equation.

The selection of Equation 2 observes the positive outcome for participation in the market (z_i*), as a dummy variable. Equation 2 generates the inverse mills ratio (IMR) which is used as an explanatory variable in the ordinary least squares (OLS) sub-sample of observations with positive coefficients to obtain the estimates of the OLS. Equation1 uses the IMR to determine whether there is a selectivity bias from the estimation of the value of market sales without consideration of the participation in the market (Heckman, 1979: 156; Puhani, 2000: 55):

$$z_i^* = w_i'\alpha + \varepsilon_i \quad (2)$$

z_i* is a function of a vector of covariates for unit i which determine participation (w_i') these factors are as outlined in the Equation1, α = vector of coefficients which determine participation ε_i= random disturbance for unit i for selection equation. The model is reformulated as seen in Equation (3):

$$\text{Selection mechanism: } Z_i* = w_i\gamma_i + u_i \quad (3)$$

z_i =1 if Z_i*> 0 and 0 otherwise

Given the result of an insignificant IMR, a full information maximum likelihood (FIML) OLS is used to independently determine the impact of market linkages on livelihoods to compare the robustness of these estimates with the outcome equation estimates. Limitations of the sample selection models exist (Melino, 1982; Puhani, 2000; Kennedy, 2003), however, the OLS is recommended where these limitations prevail.

RESULTS AND DISCUSSION

Household characteristics

We present the results of the descriptive analysis (Tables 3 and 4) across the enterprise crop grown, in the introduction as a prelude to the results of the econometric analysis (Table 5).

On average, the age of the household heads was 42 years (Table 3). The ages of the household heads were significantly different from each other across the enterprise crop, with pineapple and cotton farmers being younger (40 years) compared to the rice farmers (44 years). The average number of years of education of the household head and across crops and districts was eight years. The respondents owned an average of seven acres of land; however, only four acres were cultivated in 2006. On average, 5 acres was cultivated for cotton, four acres for rice and 3 acres for pineapples, with 1.5 acres less being cultivated in Luwero compared to Lira. An average of three cattle and goats were owned by all households, irrespective of the enterprise crop grown, with exception to pineapple growers who owned four goats.

The average household income in 2006 was US$330. However, the household income differed significantly across the crop; the pineapple producers received the highest income (US$ 465) while cotton farmers received the lowest income (US$ 216; Table 3) from the sale of enterprises and household assets.

Access to service provision

Access to services by households that were linked to markets is seen in Table 4. Twenty four percent of the households accessed credit; however, only 26% accessed loans from the formal sector, although they obtained a higher average amount (US 344) for business, farming, and school fees. By contrast, 59% of farmers received an average loan of US$ 25 from friends and family which was predominantly used for household items, medical bills, court cases, school fees and farming. On average, the respondents sold two crops in two marketing channels. The first channel was mainly the buyer for the enterprise crop, such as, Dunavant, LOFP, AMFRI farms, while the second channel comprised various buyers (example, local road side traders near the village or at the local trading centre's and towns). Farm gate transactions were also made. Market information, - mainly on price information for the enterprise crop was

Table 3. Household characteristics.

District	Overall		Lira		Luwero		Luwero		Significance level†
			Cotton		Rice		Pineapple		
Household characteristic	**Mean**	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**	
Age of household head (hh)	42	15.1	40	17.3	44	12.6	40	14.3	4.181**
Age of spouse	33	11.7	32	11	34	12.5	30	11.1	3.030**
Number of years of schooling of household head	8	3.3	8	3.2	8	3.2	8	3.8	0.059ns
Number of years of schooling of spouse	8	7.6	6	3.5	9	10.3	8	2.8	7.497***
Number of adults in the household	3	1.3	3	1.3	2	1.3	3	1.7	1.780ns
Household size	7	2.6	7	2.8	7	2.4	7	2.8	0.054ns
Land owned (acres)	7	7.6	7	8.7	6	6.9	7	4.8	0.490ns
Land cultivated in 2006 (acres)	4	7.6	5	3.2	4	11	3	2.2	1.704ns
Number of local cows owned	3	3	3	2.6	3	2.6	3	2.7	0.171ns
Number of goats owned	3	2	3	2.3	3	1.9	4	3.0	0.351ns
Number of marketing channels	2	0.71	2	0.79	2	0.65	2	0.61	1.012ns
Total Income (US$)§	330	261	272	216	376	277	465	334	11.892***

(Source: survey data, 2007).§ 1 US Dollar = 1,750 Uganda shillings; † Signifies students F-test significance levels; *, **,***- show significance levels of 10, 5 and 1% respectively.

accessed by 79% of the respondents, - from the institution that supported enterprise production. Compared with price information, market requirements (the quantity, quality of the enterprise crop and which market to sell to) was accessed by a small number of respondents.

Extension education was received by 89% of the respondents. District comparisons showed that 97% of the respondents from Luwero compared to 80% from Lira district received extension. The subject of extension and training was mainly on aspects of crop production (improved methods of production (73%), disease and pest control (6%)), however, only five and one percent received extension training on marketing and postharvest handling respectively. In this study, lack of training in enterprise production and marketing was found to be a key challenge facing farmers. Evidence has shown that the value of crop production can be improved through extension and training in marketing (Nkonya et al., 2004). More respondents used land management practices (crop rotation, soil erosion, and agroforestry practices) compared to organic and inorganic inputs. Sixty percent of the pineapple and rice farmers in Luwero district used soil erosion control practices compared to 36% who used agroforestry practices in Lira district. Studies (Nkonya et al., 2004) have shown that different agro ecological zones are associated with the use of different land management practices in Uganda. 10 and 22% of the respondents used organic and inorganic inputs, respectively. Animal manure and mulching with coffee husks were commonly used by pineapple farmers (38%) to enhance soil fertility and to suppress weed growth. In 2006, an average of 23 and 29 kg of DAP and urea respectively was used by thirty five percent of rice farmers supported by SG 2000. The challenge of low input use in Uganda has been widely reported (Nkonya, et al., 2004b; Benin et al., 2007).

Trade-offs between food and cash crop production

Sixty five percent of the respondents who were involved in enterprise production faced food shortages in 2006 (Table 4). The cotton farmers were the most food insecure (81%), compared to 37% of the pineapple farmers. The critical periods of food shortages were the months of June, July and August. During the food shortages the number of meals that were consumed per day was reduced from three, to two meals. Another coping strategy was to consume less preferred foods. As expected, the income of the respondents who did not face food shortages was significantly higher than the income of the respondents who did face food shortages. These results are consistent with ongoing debates about the tradeoffs between enterprise production and food security.

The impact of F2M linkages on livelihoods

The Heckman's sample selection model, the OLS and the instrumental variation (IV) models were run to find out the determinants of the participation, and the value of sales to the market. The insignificant result of the inverse mills ratio (IMR) implied the absence of sample selection bias which resulted from the small censored sample of 23

Table 4. Access to service provision and investment in natural resource management (NRM).

Household characteristics		Overall		Lira Cotton		Luwero Rice		Luwero Pineapple		Significance level[T]
Access to service provision		**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	
Experienced food shortages	Yes	292	65	162	81	111	56	19	37	46.97***
	No	158	35	38	19	87	44	33	63	
Accessed to credit	Yes	110	24	53	27	47	24	10	19	1.276ns
	No	340	76	147	74	151	76	42	81	
Accessed to market information	Yes	354	79	155	78	152	77	47	90	4.842*
	No	96	21	45	23	46	23	5	10	
Received extension information	Yes	401	89	160	80	190	96	51	98	30.989***
	No	49	11	40	20	8	4	1	2	
Use of natural resource management practices										
Used of crop rotation	Yes	402	89	186	93	170	86	46	88	5.372*
	No	48	11	14	7	28	14	6	12	
Used of agroforestry	Yes	145	32	72	36	59	30	14	27	2.508ns
	No	305	68	128	64	139	70	38	73	
Used of soil erosion	Yes	201	45	50	25	120	61	31	60	56.353***
	No	249	55	150	75	78	39	21	40	
Used of organic material	Yes	45	10	15	8	10	5	20	38	53.582***
	No	405	90	185	93	188	95	32	62	
Used of inorganic material	Yes	97	22	25	13	69	35	3	6	38.054***
	No	353	78	175	88	129	65	49	94	

Source: Survey data (2007). [†] Signifies chi square significance levels; *, **, *** - show significance levels of 10, 5 and 1% respectively.

respondents who did not participate in the market in 2006. Rho appeared to be 0.79, showing high correlation between the error terms of the outcome and the selection equations of the sample selection model. This weakness has been identified with the sample selection model with small censored samples. The variables used in both the sample selection and the outcome equation were varied. The likelihood ratio test also showed that the outcome and the selection equations of the sample selection model were highly correlated ($p<0.01$). The shortcomings

Table 5. Computation of household income computed by access to service provision and investment in NRM.

District		Overall				Lira		Luwero		Luwero		Level of Significance
						Cotton		Rice		Pineapple		
Household characteristic		US$	(S.D.)	Level of significance		US$	(SD)	US$	(SD)	US$	(SD)	
Food shortages experience	Yes	300	243.9	-3.336***	Yes	261	215	366	268	241	342	5.756***
	No	396	289.2		No	304	224	388	288	543	302	4.687***
Accessed credit	Yes	414	319.9	3.504***	Yes	303	271	545	313	549	431	7.555***
	No	302	237.1		No	257	192	330	247	441	310	7.497***
Accessed market information	Yes	328	259.0	0.374ns	Yes	267	217	388	280	465	334	11.069***
	No	314	256.2		No	275	216	332	265	0	0	1.150ns
Received extension information	Yes	337	261.0	1.462ns	Yes	273	210	375	276	465	334	9.946***
	No	275	258		No	253	243	404	332	0	0	1.791ns
Use of crop rotation	Yes	332	260.0	0.405ns	Yes	272	217	384	280	447	315	10.513***
	No	314	275.1		No	235	217	321	254	606	524	2.399ns
Use of agroforestry	Yes	338	248.3	0.420ns	Yes	273	207	411	264	428	343	5.245**
	No	326	267.3		No	267	222	361	281	478	339	7.502***
Use of soil erosion	Yes	392	274.7	4.146***	Yes	287	213	435	277	441	348	5.234***
	No	283	240.0		No	263	218	287	253	499	327	5.160***
Use of organic material	Yes	381	273.7	1.163ns	Yes	312	147	446	364	420	327	0.774ns
	No	325	259.7		No	265	221	372	272	495	346	11.223***
Use of inorganic material	Yes	376	283.5	1.759*	Yes	417	301	354	276	730	0	1.173ns
	No	318	253.9		No	250	196	387	277	455	336	15.014***

Source: Survey data (2007). Utilization of NRM practices.

mentioned previously led us to prefer the results of the OLS model.

Various tests of endogeneity (instrumental variable model and the Durbin-Wu-Hauseman test) found the choice variables use of organic and inorganic fertilizers to be exogenous.

Determinants of the value of sales from the market

These results showed that household and production factors influenced the level of participation in the market (Columns (b), (c) and (d) of Table 6).

Household sizes that are between one and three persons, decreased the level of participation in the market by US$79. This is explained by the status quo of these household sizes. Households with one to three respondents comprised 10% of

Table 6. Determinants of market participation and level of market participation.

Variables	Sample selection		Ordinary least squares (c)	Instrumental variables (d)
	Selection (a)	Outcome(b)		
	Market participation		Total value of crop sales to the market (US $[a])	
	Coefficients	Df/dx	Coefficients	
Household characteristics				
Age of household head (between 46 and 55) [§]		17.205	-16.854	5.235
Household size (1-3 persons) [§]	-0.404	-0.037	-88.862*	-79.388**	-95.052
Education of the household head (years)	0.070**	0.004	15.280***	12.649***	12.997***
Production characteristics				
Amount of land cultivated (2006) (acres)	0.080	0.005	9.734	7.231	10.824**
Amount of loan received	-0.029	-0.002			
Lira district[§]	0.802***	0.054	-40.127	-66.202*	-37.192
Pineapples[§]	0.059	0.004	224.994***	220.720***	313.017***
Maize[§]	0.170	0.011	-50.424	-59.168**	-71.962**
Beans[§]	-0.067	-0.005	-67.001**	-62.852**	-73.098**
Use of organic fertiliser			87.919	86.897	-194.537
Use of inorganic fertiliser	-0.022	-0.002	-9.301	-10.161	118.505
Use of Agro forestry practices	-0.160	-0.012			
Yield (kg)			0.100***	0.101***	0.100***
Paid membership fee once a year[§]			95.761***	96.470***	76.119*
Did not receive extension visits[§]			-93.417***	-84.407***	-88.133*
Received 1 or 2 extension visits[§]	0.454	0.024			
Market characteristics					
Received market information[§]	0.803**	0.103			
Ln (market distance)	0.050	-0.003	-21.747**	-21.397**	-28.380*
Sold to more than one market[§]			15.899	16.663	2.365
Intercept	0.099		94.731	151.159***	169.28**
Inverse mills ratio			245.622		
N	450	450	450	427	427
Censored observations			23		
Uncensored observations			427		
R^2				0.2967	0.2381
Adjusted R^2					0.2103
X^2	193.37***				

Source: Survey data (2007). *,**, *** mean reported coefficient is statistically significant at 10, 5, and 1% level respectively. [a] 1 US $ is equivalent to 1,750 Uganda Shillings; [§] signify dummy variables where one represents the respective variable shown in Table 3 and zero signifies otherwise. Otherwise constitutes Luwero district, no pineapple, bean and maize production, no use of fertilizer and organic inputs and the received extension visits, did not receive between one and two extension visits, no market information received, and did not sell to more than one market. These variables were all dropped to avoid the dummy trap.

the total sample, however, they were younger (30 years), had less access to services, lower incomes, and assets. The education of the household head significantly increased the total value of sales to the market as hypothesized. This result is consistent with studies on market linkages (Makhura et al., 2001; Govereh and Jayne, 2003, Pender et al., 2004: 181).

The production of pineapples increased the value of sales to the market by US$ 220. Pineapple producers were from Luwero district and formed 10% of the sample. Larger pineapples were sold through the local, national and regional markets due to the high market access nature of Luwero district, however, the export organic markets such as AMFRI farms and Suluma foods purchased small sized pineapples at an organic premium price. The nature of pineapples as a high value crop also contributed to the large impact on the value of sales to the market.

If the farmers were not exposed to any form of extension, the total value of sales would decline by US$ 8. Other studies on market linkages report consistent findings (Bingen, 2003; Masakure and Hanson, 2005:1726; Bolwig and Odeke, 2007). The human capacity development is a critical factor in participation in the contract or other types of markets, which often involves new production methods of crops, including new crops which producers are unfamiliar with. Extension is critical to demonstrating improved, organic, inorganic crop management and production and marketing methods for new and old enterprise crops.

If the membership fee was paid once a year, the value of sales to the market was likely to increase by US$96. The payment of membership fee signifies a type of cognitive social capital where group members invested their time and money into group activities because of high level of trust, group cohesion and benefits derived from group activities. One hundred and seventeen farmers paid membership fee to the groups that they belonged to, once a year, however, 95% of these farmers were affiliated mostly to the NGO sector (VEDCO, SG 2000), and NAADS. The organization into groups was more prominent for the farmers affiliated to the NGO sector to capitalize on the economies of scale in service delivery. The Lira district variable was significant in the OLS model showing that farmers from Lira observed reduced values of sales compared to Luwero. The difference in the findings of the IV and the OLS model showed that the value of sales to the market variable was higher for the respondents from Luwero as hypothesized. This was because of the proximity to urban and other markets that Luwero had and therefore, a variation in market channels compared with Lira which had higher market access through an accessible internal road infrastructure.

The use of NRM technologies did not significantly affect the value of sales to the market. However, these results also did not show robustness in the IV model. The non significant result of NRM technologies was consistent with Nkonya et al. (2004). The insignificant result is attributed to only 10 and 22% of farmers using organic and inorganic technologies respectively with the result of a limitation of the statistical power to discern the effect of organic and inorganic fertilizer in the regression equations.

Conclusions and implications

This paper supports the argument that smallholder livelihoods are being improved as a result of market affiliation implemented through institutions; further, we argue that there is a potential of F2M linkages in smallholder market integration and chain empowerment.

Farmers in Uganda engage in surplus production. This is evident from this study where the farmers have engaged in marketed surplus, in addition to the enterprise production; this is an indication of the much anticipated commercialization that GoU advocates for. Institutions facilitate market linkages and smallholders to sell produce, however more can be done to increase smallholder activities in the market chain. Higher market access increased the participation in the market evident from the variety crops that were grown in Luwero significantly affecting participation in the market. Improving the market access through the improvement in road and other physical infrastructure can by far improve the market access and the level of participation in the market seen by the total volume of sales to the market. The improvement in the participation of the poorer households though adult literacy programs can result in increased market participation and value of sales from the market. Institutional staff capacities in the business development aspects in the respective sectors are equally important.

Households that are linked to the markets are more likely to be educated and to respond to extension education on improved production methods targeted to market crops. Human capital building increased the level of participation in the market because it increases the level of understanding of the different market factors, transactions in the market place, understanding of, and access to services provided by institutions and other complexities of the market chain. It also increases the likelihood of access to extension services and participation in institutional F2M linkages, however; the inclusion of households with higher education is likely to exclude the poor. This suggests the importance of base programs such as adult literacy programs in addition to technical and formal capacity building, that could be provided by governmental and NGO institutions.

The synergy between cash and food crop production are shown in this study through the diversity of crops produced by different households for different purposes and the levels of sales made for the respective crops. However, ‘new production techniques’ required by high

value crops and the competition for food crop production required for household needs are tradeoffs that result between the food and high value crop production at advanced levels of commercialization. On the contrary, this study shows food shortages as a result of market linkages. Low value crops increase the market access, seen by the sale of the second crop to local markets, while high value crops significantly increase the value of sales from the market.

Social capital was improved with smaller groups that paid membership fees and observed other group requirements. The improvement in social capital through group formation and group strengthening factors in conjunction with the vertical and horizontal organization of groups is essential to penetrate into bigger, national, regional and more complex markets beyond village and local markets.

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