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Competitiveness of smallholder legume production in South Kivu region, Democratic Republic of Congo

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This study investigated the returns to legumes (common bean and soybean) and other principal crops (cassava, sweet potato and maize) in South Kivu, Eastern Democratic Republic of Congo. Data were collected using a structured questionnaire from a randomly selected sample of 291 farmers who had participated in N2Africa project in the four Eastern D. R. Congo territories: Kabare (103), Kalehe (52), Mwenga (24) and Walungu (112). Gross margin and return on capital analysis were calculated. The study found that common bean had the highest gross margin [985,708 FC ha^{-1} (909FC = 1USD as at June 2013)] and return on labour capital (2.1 FC) compared to other principal crop enterprises. From this study, it was evident that crop enterprises had varying returns on capital which was an indicator of the differences in the importance of these crops from one territory to another. Therefore, the study recommends that as much as legume production is being promoted, the government and NGOs should also emphasize the importance of farm enterprise diversification in the study area.

Key words: Competitiveness, farm enterprises, returns, N2Africa.

INTRODUCTION

More than 30 types of grain legumes are grown across the tropics for food security, income, and improved nutrition and maintaining soil fertility. The most important grain legumes for Sub-Saharan Africa and South Asia are chickpea (*Cicer arietinum)*, common bean (*Phaseolus vulgaris)*, cowpea (*Vigna unguiculata)*, groundnut (*Vigna subterranea)*, pigeon pea (Cajanus cajan) and soybean (Abate et al., 2012). Legumes are important for the livelihoods of millions of rural and urban people throughout the tropics in Africa and East Asia. Legumes provide food and cash; they are also a source of human and animal food. They also provide a positive impact on soil quality which is a major benefit in African farming systems where soils have become exhausted by the need to produce more food per unit of input and where fertilizers are either unavailable or unaffordable for the small-scale producers (Coulibaly et al., 2009). As in other parts of Sub-Saharan Africa, legumes constitute a major part of the population's diet in D.R. Congo. Although there is evidence that D.R. Congo has adequate fertile land for legume production, it is not achieving its potential productivity of 1.6 to 2.0 ton ha^{-1} (Kadima, 2006). In D.R. Congo, legumes are among the main staples consumed. Soybean is extensively cultivated in the eastern region of the country and in the province of Bas-Congo. Soybean cultivation has been encouraged in the Recovery

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Agricultural Plan. Common bean cultivation is practiced throughout the country but good yields are obtained in the upland areas in the east of the country (Orientale Province and in North and South Kivu). In 2007, North and South Kivu provinces produced 70% while the provinces of Bas-Congo and Eastern produced 25% of the total 112,250 tons of beans produced in the country. Bean is a staple crop in the diet of the Congolese population and is commonly found in the market (FAO, 2009). In the light of the importance of grain legumes in D. R. Congo, various nongovernmental stakeholders, such as International Centre for Tropical Agriculture (CIAT) in the N2Africa project, Wageningen University and IITA have come together to address the challenges to grain legumes production and their impact on the livelihoods of the smallholder farmers in developing countries. In regard to these efforts, CIAT is creating an environment for farmers to access inputs such as high yield varieties, rhozobium inoculants, inorganic fertilizers and management information on legume cultivation in Eastern D. R. Congo.

The profitability of legume production using the technology disseminated by N2Africa project has not been compared to other principal crops available to smallholder farmers (cassava, sweet potato and maize) in Eastern D. R. Congo. Therefore, this study investigated the economic returns from the legumes common bean and soybean and the non-legume crops cassava, potato and maize in order to evaluate their competitiveness (ranked importance) and to bridge the existing knowledge gap.

MATERIALS AND METHODS

Study area

This research was undertaken in the Eastern part of DR Congo in South Kivu province, which is located approximately between 1° 36' and 5° South latitude and 26° 47' and 29° 20' east longitude. The province is bounded to the East by the Republic of Rwanda, which is separated by the Ruzizi River and Lake Kivu. In the Southeast, it borders Katanga province; to the south west and northwest Maniema Province and in the North, the North Kivu Province. The province of South Kivu has an area of 69,130 Km^2 and its population was 3,028,000 in1997 and is currently estimated at 3,500,000, with an average density of 50.6 inhabitants per km^2 (Cox, 2008).

The main factors that determine the climate of South Kivu are latitude and altitude. South Kivu province has a mountain climate with mild temperatures (average annual temperature 19°C) with a dry season lasting from 3 to 4 months (June to September) and the rainy season lasts nine months.

During the dry season high temperatures and scarcity of rain is experienced. This is the period when farmers cultivate the swampy areas. The rainy season has high precipitation (Ministry of planning DRC, 2005).

Data collection and sampling design

The sampling frame of the study was made up of small scale legume farmers who were involved in the N2Africa project for at least 2 years in South Kivu. The sampling unit was the farm household. For sampling purposes a multistage sampling technique was employed. In the first and the second stages, purposive sampling was used to select territories and counties. In the third stage systematic random sampling was employed to select the required sample size. Four territories (Kabare, Kalehe, Mwenga and Walungu) and one county in each territory were selected. The sample size of 289 was proportionately determined (Table 1) using the formula by Anderson et al. (2008) as follows:

$$n = \frac{Z^2 pq}{d^2}$$

Where *n* is the minimum sample size; *Z* is 1.96 at 95% confidence level; *P* is the population proportion, that is, the proportion of legume producers in the area. While *d* is the margin of error (acceptable error) which is assumed to be 0.01 and *q* is a weighting variable computed as (1-P).

The small scale farmers sample size has been identified using systematic random sampling by dividing the legume farmer's population with the sample size of each territory. Kabare (1328/103), Kalehe (166 /51), Mwenga (192/23) and Walungu (1339/112) indicating sampling was at the interval of 13, 3, 12 and 8 respectively, that is k^{th}+13/3/12/8 from the list provided by CIAT. Data was collected from 300 households to cater for any likely incomplete data; 9 respondents had incomplete data and were dropped thus remaining with 291 which were used for this study.

To achieve the objectives of this study, both primary and secondary data was collected. The primary data was collected through structured questionnaires. The secondary data was collected through the CIAT office in Bukavu from baseline study of N2Africa, office of the minister of agriculture in South Kivu and other related studies to establish the profitability of legume produced traditionally, that is, without the technology disseminated by N2Africa project in D. R. Congo. Secondary data gathered included cost of seeds, labour requirements, output, prices and revenue for common beans and soybean. The use of various sources of secondary data ensured validity and reliability.

Data analysis

Gross margin (GM) analysis was used to assess the economic competitiveness of common bean and soybean using the technology disseminated by N2Africa project compared to those legumes grown without improved technology and compared to cassava, potato and maize produced with locally prevailing technology. The profitability of these crops was determined by calculating the average gross margin, average labour cost, average variable cost, return to labour capital and the return to overall capital for the crops as grown by smallholder households in South Kivu.

The gross margin analysis was estimated by using the formula:

$$GM = \Sigma TR - \Sigma TVC$$

Where; GM = gross margin, ΣTR = total revenue, and ΣTVC = total variable cost.

To bring out the impact of the N2Africa project-disseminated technology, gross margins of legume production using the technology were compared to gross margin of the same without the technology as well as gross margins of competing enterprises (cassava, potatoes and maize).

According to Legesse et al. (2005), farmers engage in production of a certain crop only if the net-returns are higher compared to other alternative crops. Crops often compete for limited inputs and a

Table 1. Population of the territories.

Territories	Total population	Small scale legume farmers population	Sample size
Kabare	496169	1328	103
Kalehe	125141	166	51
Walungu	4456660	1339	112
Mwenga	31747	192	23

Source: CIAT (2011).

Table 2. Competitiveness of legume compared to other principal crops.

Farm enterprises	Average gross margin (FC/ha)	Average labour cost (FC/ha)	Average variable costs (FC/ha)	Returns to labour capital (GM/labour costs)	Returns to overall capital (GM/Variable costs)
Common beans	985,708	467,773	755,640	2.107	1.304
Beans without technology	132,393	162,391	217,607	0.820	0.608
Soy beans	669,869	538,040	629,455	1.245	1.064
Soybean without technology	417,090	558,475	582,910	0.746	0.715
Cassava	203,797	364,744	461,098	0.559	0.442
Potatoes	259,023	145,339	164,663	1.782	1.573
Maize	280,438	188,087	215,358	1.491	1.302

FC, Congolese Franc. 909FC = 1USD as at June 2013.

rational farmer engages in the production of a certain crop only if it remains relatively competitive. Zulu (2011) noted that gross margin analysis appears to be a frequent method used to find out the profitability for different crops in the farming management. Further, Elad and Herbohn (2011) emphasize that farm gross margin provides a simple way for comparing the performance of enterprises. It is also an important and practical tool to indicate farm profit in terms of farm management, budgeting and estimating the likely returns or losses of a particular crop. Similarly, Erbaugh (2008) found that gross margin was a more precise tool to estimate the profitability compared to other budgeting techniques because it includes a determination of costs of each farmer on a per hectare basis on the specific enterprise as well as the revenue earned for each farmer considering the differences in prices. Whereas other techniques such as total revenue or value of farm production include fixed costs of the whole farm, thus tend to overestimate the profit of each enterprise.

Returns to labor and capital for each farm enterprise were used in this study to establish the performance of different farm enterprises. According to Whittaker et al. (1995), partial measures such as; gross margin, budgeting analysis and returns per unit of an input can be used. However, these partial measures do not follow the law of diminishing returns to scale but can be chosen because of their simplicity and flexibility. The returns were estimated by using the formula below:

RC = AGM/ ALC

and

R0C = AGM/ AVC

Where; RC = returns to labour capital, R0C = returns to overall capital, AGM = average gross margin, ALC = average labour cost and AVC= average variable cost.

RESULTS AND DISCUSSION

Average gross margin of legumes (common beans and soybeans) grown with improved technology was higher than legumes or other principal crops grown with prevailing technology (Table 2). However, the average labour cost and the average variable costs were higher for legume production than for other crops. In comparing the various enterprises, the results of the study showed that common beans had the highest returns to labour capital followed by potato, maize and soyabeans and cassava. The return to overall capital was highest for potato followed by maize and common beans. The result showed also that common beans and soybean produced by the technology disseminated by the N2africa project had higher average gross margin, return to labour capital and return to overall capital compared to the legume produced traditionally (without the technology).

For every 1 Congolese Franc (FC) invested in common bean labour there was a return of 2.1 FC (Table 2). For every 1 FC invested in overall capital in common bean production there was a return of 1.3 FC. According to Negash (2007) the gross margins of the improvement technology can be influenced by the accessibility of labour. The farmers with access to a lot of labour are expected to be in a position to try and continue using a potentially profitable new technology and it is expected to influence adoption positively. Choudhary et al. (2011) noted that the gross margin is helpful for the farmer to pinpoint his enterprise issues and improve his specific

Table 3. Profitability of legumes compared to other crops in Kalehe.

Farm enterprises	Average gross margin (FC/ha)	Average labour cost (FC/ha)	Average variable costs (FC/ha)	Returns to labour capital (GM/labour costs)	Returns to overall capital (GM/Variable costs)
Common beans	529824	201504	346254	2.63	1.53
Soybean	770099	328479	346954	2.34	2.22
Cassava	290320	86344	162949	3.36	1.78
Potatoes	182335	71767	72344	2.54	2.52
Maize	85460	15385	16987	5.55	5.03

*FC, Congolese Franc.

Table 4. Profitability of legumes compared to other principal crops in Kabare.

Farm enterprises	Average gross margin (FC/ha)	Average labour cost (FC/ha)	Average variable costs (FC/ha)	Returns to labour capital (GM/labour costs)	Returns to overall capital (GM/Variable costs)
Common beans	1427374	708596	1153039	2.01	1.24
Soybean	609310	546979	621175	1.11	0.98
Cassava	49290	727275	770282	0.07	0.06
Potatoes	164623	268707	353009	0.61	0.47
Maize	571973	194797	250126	2.94	2.29

farm program. The high return to labour capital for common bean production with the new technology shows this crops competitiveness for labour input compared to the other crops studied. However, the return to capital for common bean production was less than potato and about equal to maize indicating this crop is highly competitive for capital but not the highest.

The results of the study also showed that common bean and potato had high return on the overall capital. Nevertheless, potato is not marketable in the study area. Most of the respondents indicated that potato takes a long time to sell in the market and it is not considered as a staple food in the area. According to respondents in the study area, consuming potato 'is not eating'; this means that even after eating potato, people can still eat other foods. Potato meal is not considered a complete meal. According to Kibet et al. (2011), the farmer's profit maximization goal cannot be achieved if the crop chosen is not the most advantageous. Therefore, for farmers to make informed decisions regarding farm enterprise, it is important to understand gross margins of the different crops available to them and the market preference for crops if to be sold as a cash crop.

Common bean production using the traditional technology (without the technology disseminated by N2Africa project) had lower returns on labour and overall capital compared to production using the technology (Table 2) since 1 FC invested resulted to 0.8 and 0.6 FC respectively. Tshering (2012) in a study of profitability analysis of bean production in Honduras found that common beans produced by modern technology had a return of 118 US dollars per hectare while the beans produced traditionally had a return of 70 US dollar per hectare. This is an indicator of the benefits associated with improved production technologies.

When crop production economics are viewed by territory in Kalehe soybean had a high average gross margin as well as average labour cost and average variable cost (Table 3). In comparing the returns to labour capital, maize had the highest return followed by cassava and common beans. Further, the results showed that in comparing the returns to overall capital, maize had the highest return followed by potato and soybean.

In Kabare common beans had the highest average gross margin, while common beans and cassava had the highest average labour cost as well as in average variable cost (Table 4). Maize had the highest returns to labour capital and overall capital followed by common bean and soybean.

In Mwenga (Table 5) soybean had the highest average gross margin, average labour cost and average variable cost followed by maize and common beans. Common beans had the highest return to labour capital and return to overall capital followed by cassava. This could be explained by the low common bean production in these provinces thus supply tends to be lower hence influencing price to be higher. This raised the market value of common bean in this territory and consequently higher return compared to other principal crops. According to the laws of demand and supply, higher

Table 5. Profitability of legumes compare to other principal crops in Mwenga.

Farm enterprises	Average gross margin (FC/ha)	Average labour cost (FC/ha)	Average variable costs (FC/ha)	Returns to labour capital (GM/labour costs)	Returns to overall capital (GM/Variable costs)
Common beans	478296	253863	367086	1.88	1.30
Soybean	1275208	1500324	1648269	0.85	0.77
Cassava	49591	42703	48245	1.16	1.03
Potatoes	57942	59083	73692	0.98	0.79
Maize	503789	777115	809253	0.65	0.62

Table 6. Profitability of legumes compared to other principal crops in Walungu.

Farm enterprises	Average gross margin (FC/ha)	Average labour cost (FC/ha)	Average variable costs (FC/ha)	Returns to labour capital (GM/labour costs)	Returns to overall capital (GM/Variable costs)
Common beans	899923	415766	663508	2.16	1.36
Soybean	549309	420913	549914	1.31	0.99
Cassava	482251	229610	403439	2.10	1.20
Potatoes	281042	84527	53808	3.32	5.22
Maize	54995	135879	148221	0.40	0.37

supply of a commodity leads to a lower price (Ahuja, 2006).

In Walungu (Table 6) common beans, soybeans and cassava had the highest average gross margin as well as the average labour cost and average variable cost. Potato had the highest return to labour capital as well as returns to overall capital followed by common beans and cassava.

According to Chagwiza (2008) the use of gross margin allows the orientation of areas where significant improvement needs to be made in order to optimize production. This is more helpful in the farm management for analysis and planning purposes. However, return to labour measures is important in determining where return on investment could be highest. As a result combining gross margin analysis and return on capital aspects in investment appraissals would boost enterprise selection.

The differences in returns of various crops grown across the four territories (Mwenga, Kabare, Kalehe and Walungu) were a clear indicator of how each of them is important in the livelihoods of the small scale farmers. Farmer crop enterprise diversification ensures compliments in terms of provision of the required nutrients and food security to the households in Eastern D.R. Congo. In addition, diversification of on-farm enterprises reduces production risks associated with agricultural production, for example in case of crop failure. Further, diversification promotes monetary interdependence among the farm enterprises whereby one enterprise can raise capital for initiation of another enterprise or adoption of a new technology. This eases the economic burden on small scale farmers who are mostly resource constrained and have limited access to credit (Msuya et al., 2008; Karani-Gichimu, 2013). It is noteworthy that sometimes farmers do not undertake agricultural activities for profit purposes only but rather for sustenance especially where production can be undertaken without incurring monetary costs by using family labour, household land and low external input technique. This practice is common in Eastern D.R. Congo.

CONCLUSIONS AND RECOMMENDATIONS

From this study, it was evident that different crop enterprises had different returns on capital which was an indicator of the importance of these crops from one territory to another. In the light of this, the study recommends that as much as legume production is being promoted, the government and NGOs should work towards emphasizing the importance of farm enterprise diversification. This would avert the likely effects of legume production failure on small scale farmers.

Conflict of Interest

The authors have not declared any conflict of interest.

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