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Profitability of sorghum-legume cropping practices among households in Eastern Uganda

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Abstract

Sorghum (*Sorghum bicolor* L.moench) is a staple food in Uganda and is particularly intercropped with legumes like groundnut (*Arachis hypogea*) and cowpea (*Vagina unguiculata*) in the eastern and northern parts of Uganda. A lot of research has been carried out on the agronomic and productivity aspects of sorghum-groundnut and sorghum-cowpea intercropping, leaving little to refer to in terms of the profitability of these intercropping systems. This study was aimed at determining the profitability of sorghum-cowpea and sorghum-groundnut intercropping practices and comparing the profitability of the intercrops and there component sole crops. A house hold survey on 150 randomly selected households which practiced sorghum-legume intercropping in the districts of Soroti and Kumi was conducted. Data collected was entered in SPSS and Excel computer soft ware for analysis. Gross margin was computed to determine the profitability of the intercrops and sole component crops. Gross margin was subjected to analysis of variance using SPSS and results showed that the gross margin of sorghum-cowpea and sorghum-groundnut intercropping systems were not different (LSD at P<0.05, not significant). Gross margin of the two intercrops were significantly higher than those of the component crops. It was concluded that, sorghum-cowpea and sorghum-groundnut were equally profitable and advantageous.

Key words: Gross margin, intercropping, sole crops

Introduction

Farmers have embraced a number of strategies in order to intensify production in an effort to improve their livelihoods and home food security using the available meager resources. Intercropping, the growing of two or more crops simultaneously on the same field (Andrews and Kassam, 1976), among other strategies, has been highly appreciated by the small scale and low resource endowed farmers (Njaimwe and O'neil, 1990). Intercropping has been widely accepted for its many advantages among which is, providing higher productivity per unit land area and greater diversity of food and income sources (Temple, 1976), reduce the risk of crop failure (Obuo *et al.*, 1997) spreads labour needs more evenly and nitrogen-fixing in the case of legumes, erosion control, suppresses weeds, pest and disease management (Ogenga-Latigo, 1997), diversifies diet and maximizes use of water, light and nutrients (Zoufa *et al.*, 1992).

However, whether the strategy of intercropping different types of crops is profitable, there is little awareness. Sorghum-legume intercrop in Uganda has received limited research attention though elsewhere, considerable research has been done (Rooney *et al.*, 1986; Obuo *et al.*, 1998). Much of the research has concentrated on pure (sole) stand of sorghum and less on sorghum-legume intercrop, which incidentally is a predominant practice in the eastern region. The economics aspect of the system has been inadequately addressed yet yield advantages are being documented most. Experimental studies have shown the yield advantage of intercropping (Osiru *et al.*, 1992) while leaving a knowledge gap on profitability of the systems. According to Sabiti (1994), cowpea growing is more profitable than groundnut production. A related study by Azam-Ali *et al.* (1990) on sorghum-groundnut intercrop, showed that productivity of the intercrop was more than that of the sole crops combined.

The main objective of the study was to evaluate the profitability of sorghum- groundnut and sorghum-cowpea intercrop practices and their component sole crops. The specific objectives were: (i) To determine the profitability of sorghum-groundnut and sorghum-cowpea intercropping practices; (ii) To compare the profitability of sole sorghum, cowpea, groundnut and sorghum-legume intercrops.

Methodology

A conceptual frame work based on the notion that households are considered as unified units of production (Backer, 1965) and thus taken as the planning and resource base units in agricultural production was developed. In computing gross margin for a specific cropping practice, it was envisaged that potential socio-economic and environmental impacts have to be taken into account. According to Norman *et al.* (2002), such impacts could be considered by assigning values to

socio-economic and environmental benefits and costs and including them in gross margin analysis. Such values were not considered to the cumbersome process of computing such attributes. As a result, high gross margins in return will increase household acquisition of resources hence broadening the resource base. Kumi and Soroti are among the agrarian districts where sorghum-legume cropping system is practiced.

This study was conducted in Kumi and Soroti districts in eastern Uganda. Soroti district is located about 300km from the capital city of Kampala. It is bordered by the districts of Kaberamaido, Lira, Kumi, Katakwi, Kamuli and Pallisa covering an area of 3,879km^2 (Rwabwoogo, 1997). Kumi, on the other hand, is bordered by the districts of Katakwi, Moroto, Nakapirpirt, Sironko, Pallisa, Mbale and Soroti and covers a land area of 2,457km^2. The major food crops grown in the area include cassava, sorghum, millet, maize, beans, soyabeans, cowpea, groundnuts and sweet potatoes (Rwabwoogo, 1997).

A multi stage simple random sampling strategy was used to select the districts, counties, sub counties, parishes, villages and the respondents. In each of the districts, a county, sub county, parish were randomly selected. In the sampled parish, three villages were randomly selected from which the sorghum-legume farmers were obtained. Using a random number tool from MS Excel soft ware, a list of seventy five sorghum-legume respondents was obtained. In total, a sample of 150 farmers was selected.

Data were collected using pre-tested formal semi structured questionnaires. Data collected included socio-economic characteristics such as; age of household members, education level of household members, family size; constraints in production, amount of seed used, variety of seed, amount and type fertilizer used, amount and type of pesticides, yield per unit area, unit price of output, total available land, land size under sorghum-legume intercrop and sole component crops, labour and capital used in the sorghum-legume production system. Secondary data were obtained from publication in journals and other relevant sources. Data collected were cleaned, coded and entered in a Statistical Package for Social Scientists (SPSS) spread sheet and MS Excel software where it was subjected to analysis. In Excel soft ware, gross margin was computed and in SPSS, data was subjected to descriptive, graphical and analysis of variance (ANOVA).

Data analysis was carried out using gross margin analysis (GMA).Gross margin was used to show the profitability of the different cropping practices (sorghum-groundnut, sorghum- cowpea, sole sorghum, groundnut and cowpea) was determined using gross margin analysis. Gross margin was also analyzed basing on the different production seasons (1st and 2nd), cropping method and individual crops in the intercrop. Gross margin was computed using the following model and

$$GM_i = TVP_i - TVC_i \quad \text{.....(1) and}$$

$$TVP_i = \frac{Q_i}{A_i} * P_i^q \quad \text{.....(2)}$$

$$TVC_i = \frac{X_i}{A} * P_i^x \quad \text{.....(3)}$$

Where,

$_i$ = Indexes cropping practice

GM= Gross margin per hectare for a given cropping practice (Ushs/ha)

TVP = Total value product per hectare for a given cropping prcatice (U Shs/ha.)

TVC = Total variable cost per hectare for a given cropping practice (U Shs/ha.)

A = Land area in hectare under given cropping practice

Q = Total output quantity in a cropping practice (kg)

P^q = Unit price of output for a crop in a cropping practice (U Shs.)

X = Quantity of inputs used in each cropping practice (kg or l)

P^x = Unit cost of inputs in each cropping practice (U Shs.)

The cost on seed, fertilizers, chemicals, hired plough/tractor and hired labour on the farm were treated as variable costs. Labour used on the farm was computed in person-hours (i.e. Number of people x Number of hours spent working on the farm). Costs on farm implements were regarded as fixed costs and not considered. A cropping practice was considered profitable if it had a positive gross margin.

Some data was subjected to land equivalent ration (LER), where the productivity of sorghum-cowpea and sorghum-groundnut intercrops were compared with those of their component sole crops. The following frame work was used to compute LER (Gocio 2001).

(Intercrop yield of sorghum/sole sorghum yield) + (Intercrop yield of the legume/sole legume yield)

If the LER is greater than one, then there is an advantage of growing the intercrop over the sole crop.

Results and discussion

Profitability of the sorghum-legume cropping practices

Profitability of each cropping practice was determined based on the following variables; the average unit price of output, variable costs, yield per unit area and land equivalent ratio (LER) (Table 1). The LER is a method that is used to assess intercrop productivity as compared to pure stand yields (Gocio, 2001) and subsequently gives a reflection of profitability. From the economic theory, profits can be increased by increasing yield or price, provided all other factors remain constant.

Unit prices varied from crop to crop in the system with groundnut fetching the highest price and sorghum the least (Table 1). This is in agreement with FAO (2002), legume

Table 1. Parameters used in profitability determination

Cropping practice	Price (U shs per kg)	Variable costs (U shs per ha)	Yield (kg/ha)	LER*
Sorghum	198	1,268	305.6	
Cowpea	645	7,344	194	
groundnut	1,085	34,143	214	
Sorghum-cowpea		10,491		2.17
sorghum			344	
cowpea			202	
Sorghum-g.nut		28,624		1.65
Sorghum			194	
g.nut			215	

LER* is the land equivalent ration, which is a measure of productivity

Table 2. Average gross margin from the cropping practices

Cropping practice	Gross margin (U Shs. per ha)
Sorghum-cowpea intercrop	187,616
Sorghum-groundnut intercrop	253,411
Cowpea	115,506
Groundnut	220,377
Sorghum	63,956

Table 3. Average seasonal gross margin in the sorghum-legume cropping practices in region

	Mean Gross margin (U shs per hectare)					
Districts	Kumi		Soroti		Overall	
Season	First	Second	First	Second	First	Second
Cropping practice						
Sorghum-cowpea	-	340548.8	194,323.6	158,452	194,323.6	188,801.5
Sorghum-g.nut	211,637	314,076.2	303,042.7	255,211.7	234,936.5	295,346.6
Cowpea	-	-	110,906.3	121,142.8	110,906.3	121,142.8
Groundnut	188,008.1	181,788.6	206,610.3	82,903.2	202,317.5	119,985.2
Sorghum	47,743.9	278,711.8	67,751.0	70,141.2	61,082.0	11,650.3

crops were considered as high value crops. According to Ekiyar (2003), groundnuts in Kumi were fetching a price between Ushs 546 – 1280 and cowpea, Ushs 235- 877 per kilogram. Besides that, groundnut and sorghum-legume intercrops incurred the highest variable costs which could have negatively affected their gross margins. Corresponding gross margins from the different enterprises were generated as shown in table 2. Analysis of variance on the Gross margin of sorghum-cowpea, sorghum-groundnut and sole groundnut showed that they were not significantly different ($P < 0.05$). However, an increase of 30% gross margin would be obtained if a farmer grew sorghum-groundnut in preference to sorghum-cowpea.

On the other hand, the LER of sorghum-cowpea (2.17) and sorghum-groundnut (1.65), were above the ratio one (1). This implied that there was a yield advantage realized (Gocio 2001) from both intercropping practices. The ratio 2.17 explains that, the yield produced in the total intercrop of sorghum-cowpea, would have required 117% more land if planted in pure stands. Similarly, the ratio 1.65 explains that, the yield from the total intercrop of sorghum-groundnut would have required 65% more land if planted in pure stands. This was probably because factors like spatial arrangement, plant density, maturity dates of crops being grown and plant architecture which are important aspects of intercropping were taken into consideration.

Comparison of gross margin of the cropping practices

Gross margin of the different cropping practices among sorghum-legume farmers in the study area varied (Figure 1). Analysis of variance on the gross margins of Sorghum-cowpea and groundnut cropping practices showed that they were not significantly different ($P<0.05$) in each of two districts of Kumi and Soroti. However, there was a significant difference ($P<0.05$) in sorghum-cowpea intercrop between the districts.

Figure 1. Profitability of cropping practices by district

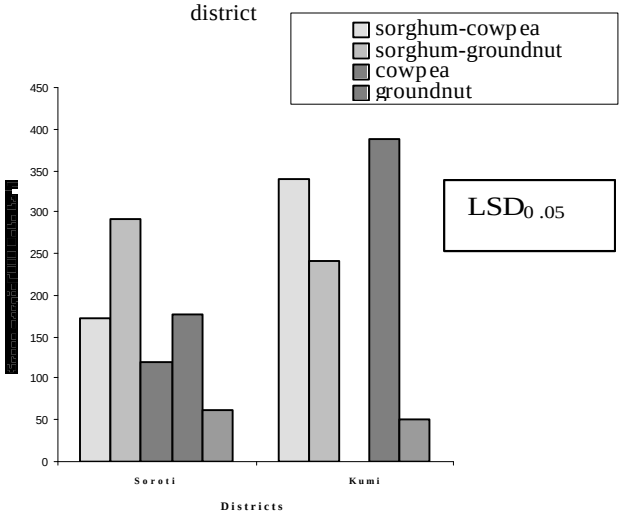


Figure 2. Gross margins of sorghum-legume and sole cropping practices in eastern region

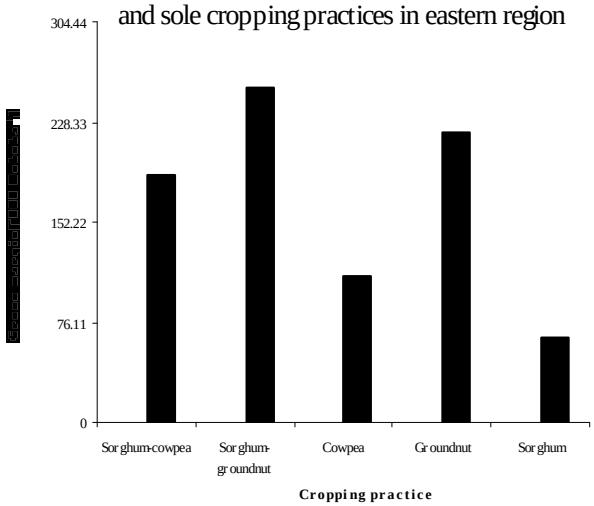
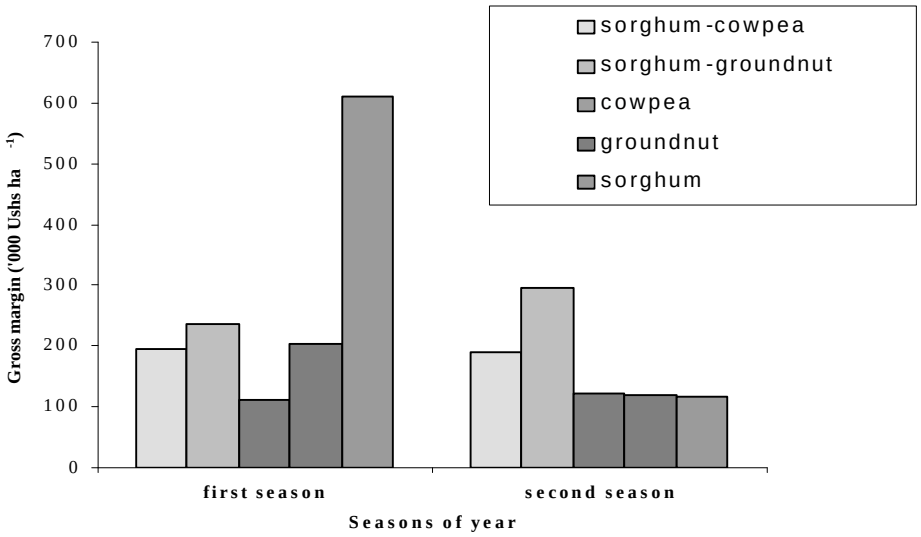


Figure 3 Gross margin of the cropping practices in a season



The difference in profitability of Sorghum-cowpea between the districts may have been due to the high yielding advantage of Ebelat variety (Adipala *et al*., 1997) which was grown highly in Kumi by a number of farmers (66.7%) compared to Soroti (39.3%). Similarly, the gross margins of groundnut between the districts were significantly different (P<0.05). Kumi district had higher gross margins than Soroti because of the varietal differences grown in the districts. Fewer farmers (35%) in Kumi, grew improved variety of Igola while in Soroti, majority (65.7%) grew India (Table4). On the other hand, gross margin of Sorghum, sorghum-groundnut, and cowpea cropping practices were not significantly different between and within the districts.

Figure 2 shows the comparison of gross margins of individual crops and their corresponding intercrops in the eastern region. The results of the analysis of variance on the gross margins of the sole crops (sorghum, cowpea and groundnut) and intercrops (sorghum-groundnut and sorghum-cowpea) were significantly different (P<0.05). Among the sole crops, gross margins of cowpea and sorghum were not significantly different. However, gross margins of groundnut were different (P<005) from those of cowpea and sorghum. On the other hand, gross margins of intercrops were not significantly different (P>0.05).

Profitability of the intercrops was higher than that of the individual sole crops. Hence, the yield advantage and higher legume prices in the intercrop caused the difference in the gross margins of sorghum-legume and the sole crops. Studies by Obuo (1997) showed that total yields of both cowpea-sorghum were higher than either of the two crops grown in pure stands. The difference in gross margin between cowpea, groundnut and sorghum could have been attributed to the advantages enjoyed by leguminous crops over sorghum, which is a cereal. Legumes are high value crops (U Shs. 600-1500 per kg) unlike sorghum, which fetches very low prices (U shs 150-250 per kg). Legumes serve as cover crops reducing weeding regimes, fixing nitrogen, checking erosion, and retain moisture in the soil (Zuofa *et al.,* 1992), which

attributes contribute significantly to yield. The gross margin of groundnut (161,151 shillings per hectare) was 39% higher than that of cowpea but did not differ significantly (P>0.05). Similar findings were reported by Sabiti (1994). Therefore it was more profitable to intercrop sorghum with legumes than to grow them in pure stand.

A comparison between gross margins of sorghum-groundnut and sorghum-cowpea showed that both intercrops were equally profitable. This is probably because groundnut and cowpea are both legumes and legume crops enhances grain yield (Bationo *et al.*, 2000). Therefore there was no superiority of growing one intercrop over the other. Besides that, there was a higher correlation (r =0.73) between yield and gross margins of the intercrops. This implies that yield played a great deal in contributing to higher profits in addition to price. Further analysis of the crop margins in relation to the planting season was carried out.

Seasonal comparison gross margin for the cropping practices in the study area

Comparisons between gross margins per hectare that were obtained in the different sorghum-legume cropping practices between seasons in each district are shown in table 3. It was seen that farmers in Kumi obtained higher gross margins from the two intercrops in the second season than in the first season. Contrary to that, sorghum-groundnut gross margins were much higher than those of sorghum-cowpea intercrop in both seasons in Soroti. Analysis of variance on the gross margins from the two districts between seasons for the different crops in the system were not significantly different (P<0.05). This implied that season never had much influence on the gross margins of the cropping practices. This is further illustrated in figure 3. Having these enterprises in either season was equally profitable.

Profitability of the different cropping practices was determined by computing gross margins. It can be concluded that intercropping does not only increase gross margins but also yield advantage. Sorghum-groundnut and sorghum-cowpea intercropping practices were equally profitable implying that, choice of the type of intercrop would depend on other factors (agronomic) and not necessarily on profitability. Further more, intercropping is still regarded as superior to sole cropping due to the higher gross margins obtained. However, further analysis on optimization is still needed before the profitability of the different cropping practices can be thoroughly judged.

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