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Economic viability of Hass avocado (*Persea Americana*) production by small-scale farmers in Wakiso district, Central Uganda

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Abstract

This paper evaluates, using descriptive and profit margin analyses, the economic viability and the socio-economic factors that influence farmers' decisions to adopt hass avocado (*Persea Americana*) growing. Primary data were obtained through household survey conducted in Namayumba, Masuliita and Kakiri sub-county of Wakiso district, central Uganda between June to December, 2022. A sample of 55 farmers was selected and interviewed during the month of July – December 2022. The data obtained was analyzed used descriptive statistics, gross margin analysis and log linear regression analysis. The The analyses demonstrate that the average gross margin earned by the farmers was UGx. 8,775,000 per acre per season. Hass avocados mature after 2 years and a single mature tree can produce more than 3000 (500kgs) fruits under good agronomic management practices. An Acre requires 166 trees at maximum, on planting spacing of 6x4m of which production estimate is over 450,000 fruits (75,000kgs). From one avocado tree that's about five years old, a farmer can harvest 3,000 fruits in a year, that's about 500 kilograms. And, as direct export, a kilogram is sold at $2. The household size, market type, farm size and distance to the nearest market significantly affected the profitability of the enterprises. To promote greater adoption of hass avocado growing, particular attention should be placed on the use of appropriate socioeconomic characterization, to better target the enterprise to areas with greater adoption potential. Given the study findings, it is recommended that since the farm size had a positive and significant coefficient, the farmers should increase on the land under cultivation of hass avocado so as enjoy the economies of scale associated with large production. The ministry of Agriculture and other farming organizations should provide subsidized or free inputs so as to encourage production on a commercial scale.

Keywords: Hass avocado; Economic viability; Profitability; Central Uganda

1 Introduction

The agricultural sector is the largest employer in Uganda and it remains essential to secure the livelihood of the Ugandan population. (UBOS et al., 2019). About 80% of the agricultural households engage in crop and livestock production both for own consumption and to generate income, therefore, agriculture remains a backbone in securing subsistence and income to a large portion of the population (UBOS et al., 2019). With that background, agriculture is still viewed an important engine of economic growth for developing countries (Gurmis & Melese, 2022). Therefore considering Avocado (*Persia Americana*) as an important world crop.(George et al., 2018).

Avocado varieties were believed to have been brought from Singapore to Uganda in the early20th century. The Ugandan avocados are diverse when it comes to size, variety, flavour, colour and shape. Some are oval, pear and elongated and that is how they are distinguished from each other. They are grown in different areas of the country mainly on small scale (farmingug.com/avocado).

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Currently Uganda is setting her feet deep into the Hass avocado market with the aim of occupying at least ten percent of the global supply. In 2021, avocado exports totalled $7billion, a figure Uganda hopes to tap into if more Ugandans embrace avocado (African news, Raziah Athman, 2022). Though there is high demand or avocado on the international market, there is still little avocado commercial growing in Uganda leaving the country at 73rd position in the word with the world export earnings worth$7000 in 2017 (Juma et al., 2019). Ugandan soils and climate are considered more favorable compared to Kenya's, yet tops in the ten best exporters. (African news, Raziah Athman, 2022).Compared still to some other top exporters, Uganda wins in terms of favourable climate yet is considered to be engaging in avocado production mainly for domestic consumption.

Government through the National Agricultural Advisory Services (NAADS) has distributed planting materials worth Ugx.4bn for macadamia and Hass avocado to farmers across the country following the start of the rainy season. Currently, macadamia and Hass avocado are some of the Uganda's emerging non-traditional cash crops with enormous potential to contribute not only to the growth of the agricultural sector but increase the country's foreign exchange earnings and improve household incomes.

Currently, over 100,000 farmers have established orchards of hass avocado on a total acreage of 5,340 hectares, and a total production of 47 million kilograms annually. If avocados are to become a significant way through which livelihoods of households are to be improved, farmers need to expand their orchards (Kamau Kabbucho,2004). Improving the quality of avocado farming groups and offering training in avocado cultivation would both be effective means of increasing export markets inclusiveness, along with provision of seedlings to increase the number of avocado trees (Muhhuweyi et al., 2020).

Uganda is one country that has just embarked on its own Hass avocado journey with the aim to become a major player in exports to Europe and beyond.(Searle, 2023).However, avocado potential in Uganda unlike neighbouring countries like Kenya and Rwanda is still under exploited (UEPB, 2014**).** Due to that undesired position, campaigns are on-going to increase hass production both from the government and other stakeholders in the different parts of the country (NAADS, 2023) with a viewed aim that hass avocado growing can be one way of eradicating poverty amongst households (Madeleine Walker, 2021), through increasing the revenue of Ugandans on both local and international market as profitable and marketable crop. Therefore, the objective of this study was to assess the economic viability of hass avocado enterprise, and examine the farmers adaptability of this strategic crop in the three sub counties of Namayumba, Masuliita and Kakiri, Wakiso district, Central Uganda.

2 Materials and methods

2.1 Study area

The three sub-counties of Namayumba, Masuliita and Kakiri are found in Busiro County in Wakiso district within the central region of Uganda. Namayumba is made up of ten parishes with seventy-two villages, Masuliita is made up of eleven parishes and fifty-nine villages and Kakiri Sub County is made up of ten parishes and one hundred twenty-nine villages.

The study used descriptive research design. Descriptive research design involved obtaining information concerning the status of phenomena and to describe what exists with respect to variables in a condition. It also helped to provide answers to questions of who, what, where and how associated with their particular research problems.

A total of 55 households were sampled using the snowballing technique was mainly used basing on the probability that each sampled individual had the willingness to refer or introduce others. This technique was used despite its implications due to the scattered nature of the Hass avocado farmers. Each household provided one respondent herein referred to as the farmer.

The study used primary data that was collected through issuing semi structured questionnaires to respondents. The secondary data which was also used in the study came from newspapers and journals. The aim of collection of secondary data was to gather essential information which is to guide the conduct and the study in order to confirm or reject the primary data collected.

The study used semi structured questionnaire as the data collection method for primary data. The selection of this method was guided by the nature of data to be collected, the time available and the objectives of the study. As a researcher my main concern was the views, opinions, perceptions and attitudes of the avocado small holder farmers of in Namayumba and Masuliita and sub counties.

The data collected in this study was analyzed using three analytical methods to achieve the desired results on each of the objectives. The objective one "characterizing Hass avocado producing farmers" was achieved using the descriptive statistics method. The method involved the use of means, percentages, standard deviations and other statistical statistics such as pie-charts and descriptive tables to clearly describe Hass avocado farmers based on their socio-economic and production characteristics.

The objective two "assessing the profitability of Hass avocado production" in the three sub-counties of the study was achieved through calculating the gross margin.

$$Total\ costs = total\ variable\ costs + total\ fixed\ costs \text{..... (i)}$$

$$Gross\ margin = total\ revenue - total\ variable\ costs. \text{..... (ii)}$$

$$\pi = GM - TFC \text{ ..... (iii)}$$

The third objective "determining the factors affecting the profitability of the Hass Avacado enterprises" in the three sub-counties of the study was achieved by the use of a log linear regression analysis model. The log linear regression analysis model was used for the transformation of the skew data set into a normally distributed data set, and the log linear regression model was given as below;

$$Ln\pi = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + A \text{..... (iv)}$$

Where;
Lnπ = profits generated from Hass avocado growing.
X_1 = Immediate market provider.
X_2 = Unit price of the Hass avocado at the farm gate.
X_3 = Access to credit by the farmer. (Yes/No)
X_4 = Market type sold to by the farmer.
X_5 = Sex of the household head (Male/Female)
X_6 = Household size (Members).
X_7 = Farm size (number of acres planted)
A = stands for Erroneous constant.
And;
$\beta 0$ = y-intercept (constant).

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8$: are the coefficients of the independent variables.

3 Results and discussion

3.1 Characterizing hass avocado farmers

3.1.1 Socioeconomic characteristics of the avocado farmers

The results from this study showed that the majority of the respondents, 36% were from Kakiri, 35% from Namayumba and only 26% from Masuliita. This implies that Kakiri sub county has got the highest number of early adopters of Hass avocado farmer amongst the three sub counties (Table 1).

Over 35% of the respondents were in the 40-50 age group and this indicates that the majority of the avocado farmers are in the middle age, which is known to be more economically productive age group. The 30-40 age group consisted 25% while > 50 comprised of 33% and 7% of the respondents were found to be in the 20-30 age group. This indicates that the enterprise is dominated by people in the middle age with adequate access to resources to carry out hass avocado growing seconded by those above 50 years who may perceive the enterprise as security to old age.

About 11% of the farmers had acquired primary level education, 40% acquired secondary level education and the majority, 49% had acquired tertiary level of education. This implies that the bigger portion of the farmers' population attained formal education, which explains why the farmers where able to properly answer questionnaires, take up Hass avocado enterprise after digging into the availed information about the crop and gaining willingness to take up the venture.

The majority of the farmers (93%) were married, 6% were single and that 1% of them were widowed. The large portion of married farmers indicates that marriage provides extra support both in terms of labor and finance in the farming activities.

The majority of farmers got to know about hass avocado farming through friends (46%), 24% through extension services, and 31% through other media such internet, radio and television shows.

Table 1 Socioeconomic characteristics of the Hass avocado farmers

Parameter	Frequency	Percentage (%)
Location		
Kakiri	20	36
Masuliita	16	29
Namayumba	19	35
Age		
20-30	4	7.3
30-40	14	25.5
40-50	19	34.5
>50	18	32.7
Sex		
Male	46	83.6
Female	9	16.4
Education Level		
Primary	6	10.9
Secondary	22	40
Tertiary	27	49
Marital Status		
Single	3	5.5
Married	51	92.7
Widowed	1	1.8
Awareness Toward Hass Avocado		
Friends	25	45.5
Extension	13	23.6
Others	17	30.9

3.1.2 Production characteristics of the avocado farmers

The findings on production characteristics represented in table 2 below show that the average land owned by the avocado farmers in the three sub counties was 2.5 acres, with a standard deviation of 2.7. This indicates that there are few farmers with land acreage varying far from the mean, meaning that the majority of the farmers own land that is around 2.5 acres. This explains that farmers chose to grow hass avocado due to having adequate land.

From one five year old hass avocado tree, a farmer can harvest 3000 fruits in a year, that's about 500 kilograms. And, as direct export, a kilogram is sold at $2. That compared to a cane farm of the same size means that the avocado farmer is earning six times more but we observed that sufficient export volume needs at least 10,000 more farmers to grow the fruit (Gurmis and Melese, 2022).

Hass avocados mature after 2 years and a single mature tree can produce more than 3000 (500kgs) fruits under good agronomic management practices. An Acre requires 166 trees at maximum, on planting spacing of 6x4m of which production estimate is over 450,000 fruits (75,000kgs). The majority of the farmers (88%) had been in the enterprise for less than five years with most of the farmers having newly established gardens and the rest having orchards just starting to fruit and already fruiting. About 12% had spent more than five years in the enterprise. On average, an acre carries 154 avocado trees, with a standard deviation of 12. This implies that there are relatively small variations from the mean plant population. This shows that regardless of the farmers' spacing, the plant population remains around and close to the average plant population per acre.

The majority (55%) of the farmers intercropped the avocado with perennial crops such as coffee and bananas while 44% of the respondents intercropped avocado with annual crops such as legumes and vegetables in order to reduce on the costs of production in terms of keeping orchards weed free, provide quick income and also proper utilization of space especially in the early stages of avocado growing. The only 2% of the farmers grew the avocado in pure stands whereby they disposed off other crops when the avocado trees became mature and with more canopies (Berhanu (2013).

Over 70% of the farmers sell the avocado to the assemblers in the area. This is because there is a ready market from the surrounding areas of Wakiso, Kampala in each most of the Hass avocado suppliers and exporters are based. The 20% of the farmers sold to the collectors in the village whereas only 13% sold their avocadoes to final consumers. None of the farmers exported their avocadoes due to having no access to the market and having low standards.

Table 2 Production characteristics of the avocado farmers

Parameter	**Mean (%)**	**Standard Deviation**
Land Size	2.5	2.7
Plant Population	154	12.5
Experience		
<5 years	87.3	
5-10 years	12.7	
Gardening System		
Pure Stands	1.8	
Mixed With Annual Crops	43.6	
Mixed With Perennials	54.5	
Source Of Seedlings		
Donation	10.9	
Bought	21.8	
Bought At Subsidized Price	67.3	
Market		
Assemblers	70	
Collectors	17.3	
Final consumers	12.7	

3.2 Economic viability and profitability of the Hass Avocado enterprise

Uganda's soils and climate favour avocado growing and are considered among the best even compared to the world's top ten exporters including neighbour Kenya. The average total costs of the hass avocado growing was Uganda Shillings (UGx) 1,445,000 (Table 3). On average, the total revenue generated by the hass avocado growing farmers was UGx. 9,875,000. The total variables and the revenue are the major components of determining the gross profits obtained by

the farmers, as it is the difference between the two components. The hass avocado growing enterprises is regarded profitable if the total revenues generated surpass the total costs of production incurred.

In 2021, the national avocado exports totalled $7 billion, a figure Uganda hopes it can tap into if more farmers embrace avocado. The average gross profit generated by the farmers in the three sub-counties per acre was obtained as UGx. 8,775,000 with a standard deviation of UGx. 2,280,000 which indicated that, on average hass avocado farmers are making profits out of this enterprise. The large standard deviation also implied that the gross profits earned by these farmers are widely spread form one farmer to another. This can be attributed to a number of factors which may include, the farm size cultivated by a farmer, the type of the market sold to by a farmer, the type of labor used on the farm among others.

Table 3 The descriptive statistics on the gross margin of the Hass avocado enterprises

Parameter	**Mean**	**standard dev.**
Output per acre (kg)	3950	2.649
Farm gate price (per kg)	2500	949.145
Revenue generated (Ug.x shs)	9875000	214000
Fixed costs		
Cost of seedlings (Ug.x shs)per acre	770000	32834.65
Variable costs		
Pest and disease control per acre	250000	236000.5
Labour costs (Ug.x shs).per acre	550000	91294.19
Fertilizer costs (Ug.x shs).per acre	300000	532493.7
Total Costs.	14450000	3995347
Gross profits (Ug.x shs /season).	8775000	2280000

3.3 Factors affecting the profitability of Hass avocado growing

Results in the Table 4 presents that, the R-squared obtained is 0.8513 (85%), which implies that, 85% variation in the dependent variable (Ln gross margin) is explained by the independent variables included in the model and only 15% is explained by other variables not included in the model.

The results further showed that, the coefficient of gender for male had a positive coefficient of 0.012 but not significant at all levels of significance. The size of the farm cultivated by a farmer had a positive coefficient of 0.048 and significant at 5% level. The coefficient of the unit price sold at by a farmer at the farm gate is 0.000 and not significant. The type of the market had a negative and significant coefficient of 0.429, while the coefficient of the household size was positive and significant at 5% level. The nearest market provider has a negative and significant coefficient of 0.058 and lastly results showed that the coefficient of the access to credit was positive 0.146 but not significant.

The farm size had a positive and significant coefficient of 0.048, which implies that, an increase in the size of the garden under Hass avocado growing will increase the profitability of the enterprise by 4.8%, provided other factors are being held constant. This can be explained on the basis that, an increase in the farm size will automatically lead to increase in output realized by the farmer, thus increase revenue generated since revenue is the product of the output and price.

The market type had a negative coefficient of 0.429 and significant at 5% level. This implies that, farmers selling their avocado on the local markets experience a decrease in their profits generated by 43%, while other factors are being held constant. This can be explained in the line that, local markets are usually characterized by the low prices and low purchasing powers from a small and low earning customer base. Therefore, farmers selling at local markets will realize quite lower profits as compared to farmers selling at the international markets.

The household size as a variable had a positive and significant coefficient of 0.068 which indicated that, an increase in size of the household by one member while keeping other factors constant will boost the profitability of the Hass avocado growing by 6.8%. this is because, small holder households usually rely on the family labour to carry garden

activities and this implies that, when the family size increases, there will be more labor available, thus more acreage cultivated.

Lastly, results showed that, the coefficient of the distance to the nearest market provider had a negative and significant coefficient of 0.058 which implied that, while other factors are being held constant, an increase in the distance to the nearest Hass avocado market provider by one kilometer will decrease the profits generated by 5.8%. This is because, as the distance increases, farmers will experience more expenses in terms of transportation costs, which will be compromising the overall profits generated.

Table 4 The log linear regression analysis model for the factors influencing the profitability of Hass avocado enterprises

Ln gross margin	**Coefficient**	**Standard error**	**P>(t)**
Gender (male)	0.012	0.219	0.955
Farm size (acre)	0.048	0.019	0.013**
Unit price (Ug.x)	0.000	0.000	0.258
Market type (local market)	-0.429	0.162	0.011**
Household size (members)	0.068	0.019	0.001***
The nearest market provider (km).	-0.058	0.025	0.024**
Access to credit (yes)	0.146	0.171	0.397
Constant.	17.836	0.308	0.000***

R-squared = 0.8513, ** and *** are significant at 5% and 1% respectively.

4 Conclusion

The results from this study show that majority of the hass avocado farmers were from Kakiri Sub County this implies that many farmers in the sub-county participated the hass avocado farming enterprise. The farmers were made aware of this profitable enterprise through interactions among friends and media such as radios and television shows. Government of Uganda through NAADS is supporting the implementation of an intervention for scaling of emerging high value strategic commodities notably, hass avocado and macadamia under the nucleus farmer partnership strategy. The gross margin analysis indicated that the farmers on average made a gross profit of UGx. 8,775,000 seasonally. This shows that the hass avocado enterprise is an economically viable enterprise, which led to the conclusion that the enterprise is a profitable venture. The results from the multiple log linear regression indicated that the factors, house hold size, market type, farm size and the household head significantly affect the profitability of the hass avocado enterprise in Wakiso district, Central Uganda.

Recommendations

- Basing on the conclusions drawn from the study, we recommend the following to be done to improve the profitability of hass avocado enterprises in wakiso district:

Farmers should increase on the land under cultivation of Hass avocado, since farm size had a positive and significant coefficient so as to enable them enjoy the economies of scale associated with large production.

The national goal should be to promote Hass avocado for export, but also have value-addition because vegetable oil is extracted from Hass avocado so the nucleus farmer will act as the off-taker, the buyer from the grass root farmers in the sub-counties but also act as a value adder.

Farming organizations should put in more effort in distributing subsidized or free seedlings to the willing farmers. This will increase the area under hass avocado production in the area and satisfy the increasing national, regional and international demand.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors confirm and declare that there are no known conflict(s) of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study

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