Scientific Research Publishing

Open Journal of Business and Management, 2023, 11, 3343-3360
https://www.scirp.org/journal/ojbm
ISSN Online: 2329-3292
ISSN Print: 2329-3284

Profitability of Avocado Production for Export Trade amongst the Smallholder Farmers in Rungwe and Hai Districts, Tanzania

John Boniphace[1], Reuben M. J. Kadigi[2], Joseph Rajabu Kangile[3]

[1]Department of Policy, Planning, and Management, Sokoine University of Agriculture, Morogoro, Tanzania
[2]Department of Trade and Investment, College of Economics and Business Studies, Sokoine University of Agriculture, Morogoro, Tanzania
[3]Department of Agricultural Economics and Agribusiness, College of Economics and Business Studies, Sokoine University of Agriculture, Morogoro, Tanzania
Email: johnnymapunda@gmail.com

How to cite this paper: Boniphace, J., Kadigi, R. M. J., & Kangile, J. R. (2023). Profitability of Avocado Production for Export Trade amongst the Smallholder Farmers in Rungwe and Hai Districts, Tanzania. *Open Journal of Business and Management, 11,* 3343-3360.
https://doi.org/10.4236/ojbm.2023.116182

Received: July 20, 2023
Accepted: November 25, 2023
Published: November 28, 2023

Abstract

The growth of an investment with perfect cash flow is the aim of every investor. Avocado is emerging as one of the important "new export crops" in developing countries and smallholder farmers are expected to benefit enormously from the production and selling of the crop. Based on this proposition a study was conducted to investigate the profitability of avocado production among the smallholder farmers in Hai and Rungwe districts in Tanzania. The study employed a multistage random sampling method to select the sample households and primary data were collected from 120 smallholder farmers producing avocado for exportation. The Cost and Benefit Analysis (CBA) approach was employed to analyse the viability of avocado production in the study areas. Specifically, the Net Present Value (NPV), Benefit Cost Ratio (BCR), and Internal Rate of Return (IRR) were used as metrics of economic viability. These metrics were calculated using the discounted rate of the Bank of Tanzania (BoT) for fixed accounts. The study findings suggest that the production of avocado for exportation yielded high NPV, BCR, and IRR. Its IRR ranged from 11.11% to 14.60% which was far higher than the BoT rate for fixed accounts of 2.16% indicating that the investment in avocado production for foreign trade was economically viable.

Keywords

Avocado, Tanzania, Profitability Analysis, NPV, BCR, IRR

1. Introduction

Agriculture and trade play an important role in economic growth and poverty reduction, especially in developing countries like Tanzania (Asfaw et al., 2012; Mwasaga, 2018). In Tanzania for example, agriculture is renowned as the backbone of the national economy serving as the major source of livelihood that creates direct employment for many of the agrarian communities in the country (Irz et al., 2001; Ogundipe et al., 2016; Osabohien et al., 2019; Poole, 2017). The sector contributes nearly one-third of the GDP and it employs about 61% of the labour force in the country (URT, 2021a).

Avocado is a shiny green fruit with a large pi and dark leathery skin that possesses a large amount of fat and oil (Stephen & Radhakrishnan, 2022; Araújo et al., 2018). Moreover, avocado contains several vitamins, minerals, lipids sugar, carbohydrates, and water, which make it to be one of the most important fruits and the fifth most traded fruit in the world. The available statistics show that the annual global trade for the crop was valued at $9.1 billion in 2016 (REPOA, 2018).

Tanzania has a favorable agroclimatic condition for avocado cultivation, the prominent avocado-producing areas in the country include Kilimanjaro, Tanga, and Arusha (in the northeast part of Tanzania), and Njombe, Mbeya, Iringa, and Songwe (in the southeast) (Mwakalinga, 2014). The majority of smallholder farmers in these areas own avocado trees in their homesteads as well as in their distant farms and many of them produce avocado varieties which is meant for export. However, there are also short shelf-life varieties that are mainly sold in domestic markets (Juma et al., 2019).

Varieties like Hass, Fuerte, and Waisal have long shelf lives and are termed "commercial cultivars" and are sold both at domestic and foreign markets. Africado, based in the Kilimanjaro region, and Rungwe Avocado, in the Mbeya region, are the major avocado exporting companies in the country. They produce and export avocados and they support more than 6000 smallholder producers by buying their avocados (mainly Hass variety) and providing them with inputs, seedlings, and technical advice (Mwakalinga, 2014; Juma et al., 2019).

The producer prices for avocados produced in Tanzania have generally increased due to increasing demands not only in foreign markets but also at the local and national markets making avocado emerge as one of the important commercial crops in the country (REPOA, 2018; Juma et al., 2019). However, little is known about the long-term viability of avocado production and trade in the country. Though most of the recent studies, including that by Mwakalinga (2014) and Juma et al. (2019) underscore the importance of avocado as a new global value chain a thorough assessment of its profitability is scant. Therefore, this study was conducted in an attempt to fill this knowledge gap. Specifically, the study investigated the profitability of avocados produced by smallholder farmers in Hai and Rungwe districts and exported to other countries in developed countries.

1.1. Theoretical Framework

Production and profitability as well as access to resources constitute some of the key concepts that are used to define the types of producers, whether smallholder or large-scale producers (Eshetu et al., 2018).

Smallholder farmers have been defined as producers who earn their income via farm activities under structural constraints like limited access to resources, technology, and markets (Khalil, Conforti, Ergin, & Gennari, 2017). Other scholars have compared, in terms of endowments, with other relatively well-off farmers in the agriculture sector (Dixon et al., 2003), and others have characterized and dubbed them as marginalised farmers because of their limited access to resources, information technology, capital, and assets (like Brooks et al., 2009; Murphy, 2012). However, it is important to note that, as rational decision-makers, their overriding goal is to maximise profit (Mendola, 2005). With respect to avocado production for the export trade, as for any other entrepreneurs, farmers would act in self-interest to maximize profits from avocado production, and in so doing increase the aggregate benefits to society (Hornby, 1995) in line with the maximization theory, which postulates the main objective of any business as that of making profit sustain as a long-term investment (Shipley, 1981; Jobber & Hooley, 1987).

Profitability is a primary measure of the overall success of any investment. It is a measure of income or the operating success of a company for a given period. An investment income or lack of it is the ability to obtain debt and equity financing its liquidity positions and its ability to grow cannot be determined (Ali & Flinn, 1989; Wang et al., 1996). Profitability has been and will always be a main concern to all investments, as this is the key to their survival and development; striving for profitability means managing costs and revenues. According to Adam Smith, the father of economics, "profit is the sum remaining after the payment of all wages in economics and includes the payment to officers of corporations, to proprietors, to partners and to farmers as well as to what we today term labour and rent on the unimproved value of land, as the return to capital" (Smith, 1909). This means an investment must have the ability to earn a return on investment through its business activities.

Regarding profitability, customer relationship management is an important area to consider (Grant & Schlesinger, 1995). Realising customers' full profit potential aims to maximise the long-term value of relationships between producers (or sellers) and buyers that in turn have the potential to generate better returns (Reinartz & Kumar, 2000). It should be noted that every investor expects a higher rate of return on their investments, as for workers who expect higher wages and creditors who want to secure their loans and interest, and the same in avocado production for export trade. The producers and exporters of avocados from Tanzania should continue to get reasonable and "fair" earnings from their invested capital if the crop value chain has to be sustainable (Karuga, 2009).

1.2. Literature Review

Analysing the profitability of an investment requires choosing the right approach and metrics that would provide a clear picture regarding the feasibility of an investment. Different scholars have used different approaches and metrics to analyse the viability or profitability of investments. Examples of these measures include the Gross Margin (GM); Return on Investment (ROI); Cost Benefit Analysis (CBA), which uses Net Present Values (NPVs), Benefit-Cost Ratios (BCRs or B/C), and Internal Rate of Return (IRR) as metrics of investment worthiness; and Marketing Margin (MM) (Turuka, 2000). However, as also argued by Kotler and Armstrong (2006) none of these measures can be considered adequate. In their study, Kotler and Armstrong (2006) found that 68% of marketing studies had difficulties in examining the profitability of an investment and 73% reported that there were adequate profitability measurement tools.

CBA an approach that is widely used to examine the exact expenses the business will accrue and if those expenses will lead to beneficial results (Johannesson & Jönsson, 1991; Farber, 2009). It can help businesses identify if the choice is good for them to make and it allows the analyst to lay out the potential risks and rewards of a business (Lind, 1995). It entails the process of comparing projects to inform the decision of whether it makes sense to invest in a certain business or other projects, that is, whether the business or project is financially feasible and hence worth undertaking (Lind, 1995; Mouter et al., 2013). Because of its advantages, it is one of the commonly used profitability measures and it is further recommended that CBA should factor in the analysis of the opportunity cost of the chosen project into the decision-making process (Mouter et al., 2013; Harrison, 1991).

Examples of research papers that have used the CBA method are numerous and the idea is not to present a comprehensive list of them here but a mention of a few empirical studies will suffice. The study by Jayanthakumaran (2003), for example, investigated the performance of export processing zones (EPZs) in selected countries of Asia using the CBA framework. The study found that the EPZs in South Korea, Malaysia, Sri Lanka, China, and Indonesia were economically efficient and generated returns well above the estimated opportunity costs. The study also found that the heavy infrastructure costs involved in setting up the EPZ in the Philippines resulted in a negative NPV. Elsewhere, the literature Isa et al. (2019) investigated the profitability of small-scale broiler production using the CBA approach. Their findings revealed that the investment in broiler production in Johor was more viable and profitable compared to Johor due to high feed cost and low profit due to gross margins between production cost and the ex-farm selling price (Isa et al., 2019). Furthermore, the findings of the study by Isa et al. (2019) indicate that the Sabah broiler contract farming was more sensitive to variations in feed prices as such, the study recommended the execution of a zero-tax inducement for small-scale broiler contract farmers, especially in Sabah. According to Isa et al. (2019), this inducement or incentive would help

to enhance the sustainability of the industry.

Another study by Wambua and Johanneson (2018) investigated the economic profit of the Fish Farming Enterprise and Productivity Programme (FFEPP) which was being implemented in Meru Count in Kenya. They also employed the CBA approach to calculate the NPV, BCR, and IRR of the programme. Their findings showed that the FFEPP would result in significant economic gain for the Meru communities because the NPV was positive estimated at KSh 59 million and the BCR and IRR were 1.05% and 10% respectively. In north-western Bangladesh, Rahman et al. (2016) evaluated the profitability of growing maize using the CBA approach and they concluded that maize production was globally competitive and, therefore, would successfully substitute its importation. The CBA study by Kurniawati (2013) which assessed the profitability of eco-labeling coffee of Indonesian smallholder farmers found that certified plantations generated a higher NPV than non-certified plantations.

2. Methodology

2.1. Data Collection, Sampling Procedures, and Sample Size

This paper is based on data gathered from a sample of 120 smallholder farmers in Tanzania who produced avocados for exportation. The study applied a multistage sampling method comprising four main stages. The first stage entailed the purposeful sampling of two regions in the country that produced Hass avocado for exportation (i.e. Kilimanjaro and Mbeya). The second stage involved the selection of districts (one district from each region) which were selected using three main criteria namely the quantity of Hass avocado produced; the number of out-growers engaged in the production of the crop; and the existence of companies that buy Hass avocado from out-growers and export it overseas. The third stage entailed a random selection of sample wards based on their importance in producing avocados for exports (Hass avocado). The fourth and last stage involved randomly selecting smallholder avocado producers in selected wards (three wards in Hai district, and four wards in Rungwe district were chosen).

Determination of sample size (S) in this study took into consideration all other important factors including time available for the accomplishment of the study (Chander, 2017) 120 smallholders were selected (48 in Hai and 72 in Rungwe district) since a minimum of 30 respondents is enough to conclude a statistical inference for a research study (Altunışık et al., 2004).

Primary data were collected through interviews using a semi-structured questionnaire to get information on capital cost, costs, and benefits acquired by smallholder farmers, and data were collected from smallholder producers with the help of an Android application GeoODK.

2.2. Data Analysis

Data were analysed using SPSS (Statistical Package for Social Science) V25 and

Excel software packages. Descriptive statistics were used to summarise the socioeconomic characteristics of avocado producers, including sex and age of heads of household, size of planted or harvested area, household income, investment cost and output prices, productivity, and revenues. These formed the key inputs in the analysis of the profitability of avocado production using the CBA method to estimate the NPV, BCR, and IRR of investing in avocado production.

2.2.1. Net Present Value (NPV)

As already mentioned, NPV is one of the metrics of project worthiness that determines the net return after discounting the streams of benefits and costs using the appropriate discounting rate and time horizon (project period or lifetime). The metrics if often used in capital budgeting and investment plans to analyse the profitability of projected investment (Gittinger, 1982a, 1982b, 1984). A project with an NPV greater than zero is economically considered worth undertaking (Gittinger, 1984; Chandra, 1998). NPV is calculated using the formula presented in Equation (1).

$$\text{NPV} = \sum_{k=0}^{n} \frac{B_k - C_k}{(1+w)^k} + \cdots + \frac{B_n - C_n}{(1+w)^n} \tag{1}$$

where, $(B-C) = A$, that is the periodic net cash inflow (Benefit less Cost), B is the benefit, C is the cost, w is the annual discount rate, n = is the time horizon of the project, and k = is the periodic time or time horizon or lifespan of the project.

2.2.2. Benefit Cost Ratio (BCR)

BCR is an indicator that shows the relationship between the relative benefits and costs of the project in question, expressed in monetary or qualitative terms. It is calculated by dividing the discounted total cash flows of benefits by the discounted total cash cost flows over the lifetime or stipulated time of the project. The formula used for calculating BCR is given in Equation (2).

$$\text{BCR} = \frac{\sum_{k=0}^{n} \frac{B_k}{(1+w)^k}}{\sum_{k=0}^{n} \frac{C_k}{(1+w)^k}} \tag{2}$$

where; B_k is the project's benefit in year k, where k is the base or investment year (year 0) and n is the last year in the project horizon, C_k is the project's costs in year k, the total number of years or lifespan of the project, and w is the discount rate.

A BCR over 1.0 suggests that on a broad level, a project should be financially successful (i.e. the production and exportation of avocados is worth undertaking). A BCR of 1.0 would suggest that the benefits of producing and exporting avocados equal the costs, and a BCR below 1.0 would suggest that the costs trump the benefits and that the production and exportation of avocados would

accordingly be worth undertaking.

2.2.3. Internal Rate of Return (IRR)

IRR is a metric used in capital budgeting to estimate the profitability of a potential investment at a discount rate that makes the NPV of all cash flows of a project equal to zero. The formula for calculating IRR is given in Equation (3).

$$\text{IRR} = r_1 + (r_1 - r_2) * \frac{\text{NPV}_1}{|\text{NPV}_1 - \text{NPV}_2|} \tag{3}$$

where r_1 is the lower discount rate, r_2 is the higher discount rate, NPV_1 is the NPV at the lower discount rate, and NPV_2 is the NPV at the higher discount rate.

The following assumptions were applied in evaluating the profitability of avocado production using the CBA technique:

1) Capital costs or costs incurred before the project were assumed to be paid during the first two years before the project started to earn returns. These costs included the cost of land, land preparation cost, seedling cost, planting cost, and the cost of purchasing and applying fertilisers, and pesticides.

2) Producers were assumed to start earning income from avocado production during the third year of investment when they started to harvest and sell the avocado fruits.

3) The annual variable costs included the costs of purchasing and applying fertilisers and agrochemicals such as pesticides, and the costs of weeding, and harvesting.

4) A discount rate of 2.16%, which was the fixed deposit rate recommended by the Bank of Tanzania (BOT) in 2021 was used as a reference discount rate (URT, 2021b).

5) A time horizon or project life span, and cash flow projection of 20 to 50 years were assumed, after which production of avocados started to decline. Oxfarm (2023), shows that the Hass avocado can produce returns for 50 years. We assumed the investment capital recovery to be twenty years (ibid).

3. Results and Discussion

3.1. Socioeconomic Characteristics of Sample Households

The key characteristics of sample households, including the sex of household heads and other socioeconomic characteristics are summarised in **Table 1** and **Table 2** respectively. It was important to analyse the distribution between male- and female-heads of households because in many societies gender influences roles and responsibilities that in turn impact the production in agriculture. It is further argued that gender diversity and gender equality are critical elements in influencing social and institutional changes in society that may lead to either sustainable or unsustainable development in terms of equity and economic growth, resulting from changes in production and income generation (Romania et al., 2018).

Table 1. Sex of household heads.

Sex	District		Total
	Hai	Rungwe	
Male	79.2	69.4	73.3
Female	20.8	30.6	26.7
Total	**100.0**	**100.0**	**100.0**

Table 2. Social economic characteristic of the sample households in Hai and Rungwe Districts.

Statement	Hai		Rungwe		Overall		Differences	
	M	STDV	M	STD	M	STDV	t	Sig.
Age	44.71	10.549	44.85	9.600	44.79	9.947	−0.073	0.942
Acres	1.0585	1.64061	0.7633	2.36534	0.8814	2.10292	0.807	0.421
Years of production	2.0833	1.21748	3.6806	1.24274	3.0417	1.45750	−6.982	0.000*
Income	5149239.83	5749830.66	7182005.83	7669487.71	6368899.43	7010883.194	−1.657	0.100
Investment cost	5589283.84	2538779.16	1963473.35	822455.39	3413797.5474	2476069.94904	9.566	0.000*
Production	1101.1412	608.82226	1534.4100	501.55677	1356.1025	587.00764	−4.375	0.000*

As shown in Table 1, the female-headed avocado-producing households in Hai and Rungwe Districts were fewer (20.8% and 30.8% of the total households respectively) than the male-headed households. This result supports the argument by FAO (2010) that women are also actively engaged in farming contributing substantially to agricultural production and hence the enhancement of the livelihoods of their families. Being engaged in planting avocado trees they also contribute to the mitigation of biodiversity loss.

As shown in Table 2 the mean age of respondents in both districts was close to 45 years and the results indicated no significant difference between the ages for the two study districts (Hai and Rungwe) Since t = −0.073 (p = 0.942), the study showed that the middle-aged farmers were more involved in avocado production than the other groups of farmers. This means that the majority of heads of avocado farming households were mature people who could actively engage in the production of the crop to generate sufficient income for their livelihood and take care of their families. The capacity of generating income within the community was influenced by age. This is in line with the argument by Regnard (2006) who asserted that wealth accumulation and production within society are likely to depend on the age of an individual and conditions that enable workers to operate properly in their working environment. One should bear in mind that humans are an organization's most valuable resource when they are in the middle ages (Dixon et al., 2016).

Household income has great implications on avocado production and because of good household income farmers will be able to handle all the activities and

requirements for avocado production and this will contribute to production (Babatunde & Qaim, 2010; Emran et al., 2021; Iraoya & Isinika, 2022). The study findings also show that the average household income in both districts was TZS 6368899.43, and there was no significant difference in income between Hai (mean of TZS 5149239.83, and Standard Deviation (StDev) of TZS 5749830.66); and Rungwe (mean of TZS 7182005.83, and StDev of TZS 7669487.71) ($t = -1.657$, $p = 0.100$). This is the standard income that a smallholder would be able to invest in Hass avocado production since the average investment cost in Hai and Rungwe was TZS 5589283.84 and TZS 1963473.35. The results in Table 3 imply that smallholder farmers in both districts were able to invest in Hass avocado production and take care of all the running costs before the investment started to give returns.

The average land sizes under Hass avocado cultivation were 1.059 and 0.76 acres for the Rungwe and Hai districts respectively, and the average size for the pooled sample was 0.8814 acres. The mean average avocado production in Hai was TZS 1088.64 (StDev = 608.82) and it was TZS 1534.41 (StDev = 501.55677) in Rungwe and the difference in production was statistically significant ($t = -4.375$, $p = 0.000$). The results imply that the production of avocados in the Rungwe District was relatively higher than that of the Hai District.

3.2. Capital Cost for Avocado Production

Table 3 shows the actual budget (capital cost) required for investing in one acre of avocado production. The pre-harvest costs, including investment costs, amounted to TZS 5589283.84 per acre and TZS 1963473.35 per acre in Hai and Rungwe Districts respectively. Of the total pre-harvest costs, in Hai District, the main operating cost elements constituted the purchasing and application costs of fertilisers (5.37%), pesticides (0.70%), and weeding costs (2.05%). The same

Table 3. Capital cost per one acre of avocado production.

Item of Cost	Hai (Cost in TZS)	Rungwe (Cost in TZS)
Land	4558831.86	1263164.46
Land preparation	231993.98	97743.59
Seedling	257551.8655	105873.5382
Planting	87585.31	74525.09
Fertiliser (Before harvesting)	200000.00	140000.00
Fertiliser application	100000.00	70000.00
Pesticides	14000.00	15000.00
Pesticide application	25000.00	20000.00
Weeding (Before harvesting)	114320.83	177166.67
Total	**5589283.84**	**1963473.35**

items also constituted the main costs in Rungwe District, with shares of 10.70%, 1.77%, and 9.02% respectively in the total operating costs. The results also show that the fixed costs were for land cost, land preparation, and seedling and planting. These constituted respectively, 81.56%, 4.15%, 4.61%, and 1.57% of the total pre-harvest costs in Hai District. In Rungwe District, they constituted 64.33%, 4.98%, 5.39%, and 3.80% respectively. These results are not surprising, given the fact that land was the most expensive item in both districts. The results are also in line with those of Aikaeli and Markussen (2022) who also argued that the land cost was often the function of its market value.

3.3. The Variable Cost for One Acre of Avocado Farm

Table 4 shows the variable costs of an investment in avocado production for exportation. The total variable costs included the costs of fertilisers, application of fertilisers, pesticides, application of pesticides, and weeding which, on average summed to TZS 453320.83 and 422166.67 for Hai and Rungwe Districts respectively.

3.4. Avocado Production in Hai and Rungwe Districts

The avocado yields were 9.18 kg and 12.79 kg per tree for Hai and Rungwe Districts respectively which corresponded to 1101.14 kg and 1534.41 kg per acre respectively. With the producer price of TZS 1600 and TZS 1400 per kg in Hai and Rungwe Districts, avocado farmers earned an average income of TZS 1741825.92 and TZS 2,148,174 per acre respectively (Table 5).

Table 4. Variable cost for running one acre of Hass avocado.

Item of Cost	Hai (Cost in TZS)	Rungwe (Cost in TZS)
Variable Cost		
Fertilisers	200000.00	140000.00
Fertiliser application	100000.00	70000.00
Pesticides	14000.00	15000.00
Pesticide application	25000.00	20000.00
Weeding	114320.83	177166.67
Total	**453320.8333**	**422166.67**

Table 5. Hass avocado production and revenue per acre.

Item	Hai	Rungwe
Production per tree (kg)	9.18	12.79
Production per Acre (kg)	1101.14	1534.41
Price per Kg (TZS)	1600	1400
Total Revenue (TZS)	**1761825.92**	**2,148,174**

3.5. Cash Flow Projection for Avocado (Hass) Project in Rungwe and Hai Districts

The expected returns from avocado production in Rungwe and Hai Districts were established using the production return rate proposed by Oxfarm (2023). Avocado (Hass variety) harvest in the earlier years after investment was estimated to average 1101.14 kg and 1534.41 kg per acre for Hai and Rungwe Districts respectively. The average yield of Hass avocados in Rungwe District was relatively higher than that of Hai District by 39.35% (**Figure 1**). The yields attain a maximum or constant harvest level at 10 years after investment (Oxfarm, 2023).

3.6. Profitability of Avocado in Hai and Rungwe Districts

As already mentioned, the avocado project was evaluated whether it was worthwhile undertaking in the study areas. The future flows of costs and revenues were discounted and the reference discount rate of 2.16% (the BoT fixed account depositing interest rate) was adopted. The results of CBA are presented in **Table 6**.

The results show that the NPVs in the Rungwe District were relatively much higher than those in the Hai District (**Figure 2**). Avocado farmers started realising returns in the third year of investment. Using a discount rate was 2.16%,

Table 6. NPV, BCR, and IRR in Hai and Rungwe Districts at the normal rate of production.

Discount rate (%)	Hai		Rungwe	
	NPV	BCR	NPV	BCR
1	481334307.6	35.98	601024420.8	63.73
2	376548750.2	31.61	471356091.6	58.25
3	264994725.9	25.73	333301023.1	50.29
4	170861860.8	19.32	216789591.7	40.62
5	103087563.9	13.46	132883673.6	30.64
6	59339178.03	8.89	78702048.48	21.81
7	32949434.64	5.70	45999740.99	14.93
8	17542940.61	3.63	26891403.19	10.06
9	8603285.192	2.34	15790258.98	6.77
10	3357492.982	1.54	9265555.869	4.61
11	213935.7545	1.04	5347569.898	3.19
12	−1719296.365	0.71	2932048.521	2.25
13	−2941826.936	0.50	1400047.656	1.62
14	−3736829.307	0.36	400484.3238	1.18
15	−4267754.396	0.26	−269498.3192	0.88
16	-	-	−729775.6666	0.66
IRR (%)	11.11		14.60	

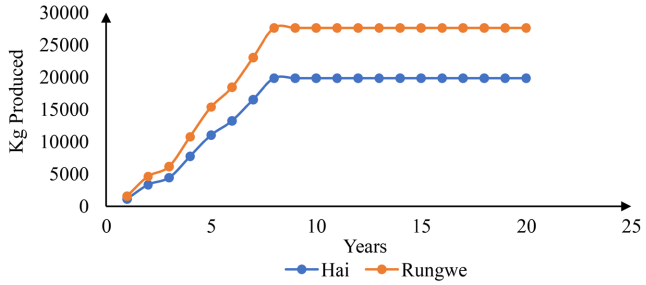

Figure 1. Trends of avocado yields after investment.

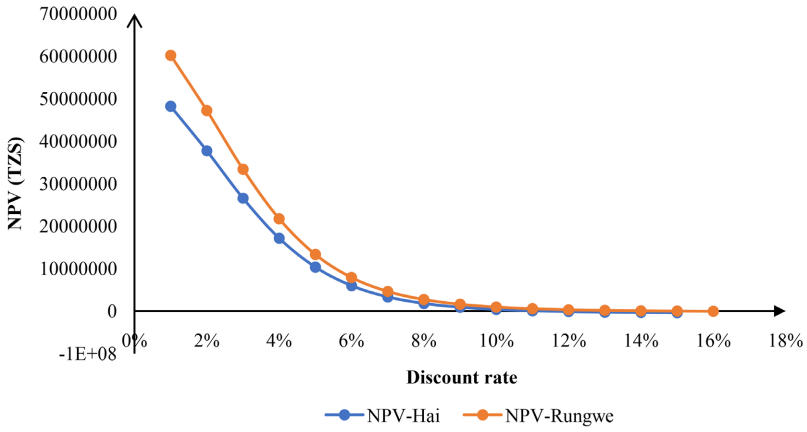

Figure 2. NPVs of avocado production in Hai and Rungwe Districts.

which was the country's Central Bank's (BoT) fixed account deposit interest rate at the time of the survey, the NPVs were TZS 280426822.20 and TZS 352400147.70 per acre in Hai and Rungwe Districts respectively. The internal rates of return (IRR) were 11.11% and 14.60% respectively. However, as Paul (1971) argued considering fixed depositing investment as being viable compared to other investments cannot be concluded only by performing CBA and finding it to have higher net returns, it is important to compare the IRR and BCRs too (Sigman, 2005). The BCRs were greater than 1 and 3 for Hai and Rungwe Districts respectively, implying that the Hass avocado production project was feasible in both districts and the IRR exceeded the reference (Central Bank) interest rate.

3.7. Sensitivity Analysis

Our CBA showed that the avocado project in the study areas was profitable, yet carrying out a sensitivity analysis was crucial as it identifies how independent inputs into the project can impact the NPVs, and therefore the potential profitability or desirability of the project. We assumed constant avocado yields of 1101.14 kg and 1534.41 kg per acre, providing net returns of TZS 1741825.92 and TZS 2,148,174 per acre in Hai and Rungwe Districts respectively. The results of the sensitivity analysis showed that the NPVs and BCR were sensitive and unfavourable at discount rates of more than 6% and 10% for Hai and Rungwe Districts respectively (**Table 7**).

Table 7. Results of sensitivity analysis.

Discount rate (%)	Hai		Rungwe	
	NPV	BCR	NPV	BCR
1	17662502.95	2.28	29183283.40	4.05
2	13545019.48	2.10	23667739.28	3.87
3	9057983.13	1.84	17657163.36	3.61
4	5119825.90	1.55	12381834.36	3.26
5	2102033.16	1.25	8339372.71	2.86
6	−36624.96	0.99	5474549.25	2.45
7	−1506109.95	0.79	3506111.64	2.06
8	−2519576.31	0.62	2148530.37	1.72
9	−3234555.58	0.50	1190785.26	1.44
10	−3753383.73	0.39	495792.88	1.19
11	−4139936.66	0.32	−22011.19	0.99
12	−4434403.87	0.26	−416462.53	0.82
13	−4662799.02	0.21	−722407.54	0.68
14	−4842519.37	0.17	−963150.59	0.56
15	−4985561.59	0.14	−1154761.72	0.46
IRR (%)	5.98		10.96	

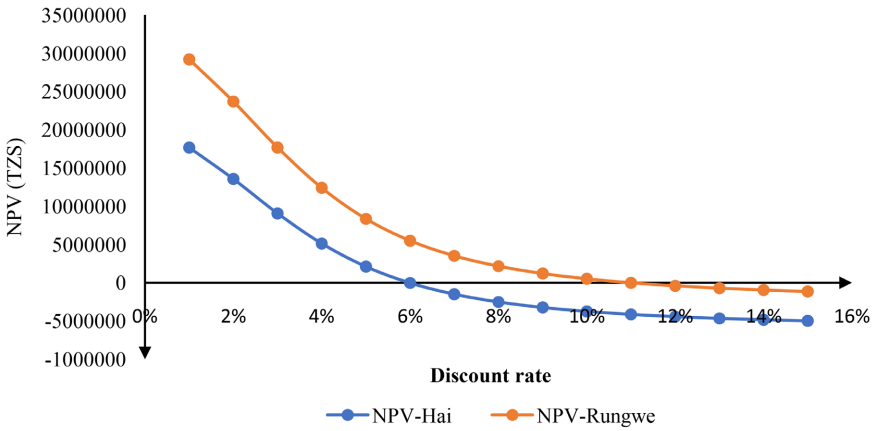

Figure 3. NPV-Hai and Rungwe district at a constant production rate.

The internal rates of return (IRR) were 5.98% and 10.96% for Hai and Rungwe Districts respectively. These were higher than the Central Bank's fixed deposit account interest rate of 2.5%, implying that the avocado investment in the study areas was feasible.

4. Conclusion and Recommendation

A study was conducted in the Hai and Rungwe Districts of Tanzania to assess the profitability of avocado production for exportation using the CBA approach (**Figure 3**). Specifically, profitability was evaluated using the Net present value (NPV), Benefit-cost ratio (BCR), and internal rate of return (IRR) metrics over a time horizon of 20 to 50 years of avocado production. The study found that avocado production resulted in positive NPVs up to IRR of 11% and 14% for Hai and Rungwe Districts respectively, at which the BCRs were both greater than one. The internal rates of return (IRR) were higher than the reference rate (i.e. 2.16% offered by the BoT for fixed accounts at the time of the survey) implying that investing in the production of avocado for exportation was more economically profitable than depositing the capital in a BoT fixed account. Based on the study findings, it is recommended that smallholder farmers in the study areas should be encouraged and supported to invest more in the production of avocados for export trade by expanding the area under the crop as this is more likely to offer them good prices and returns and hence lift them out of poverty.

Acknowledgements

This paper used the data collected as part of research activities under the Trade, Development and the Environment Hub Project (Project number ES/S008160/1) financed by the United Kingdom Research and Innovation (UKRI)—represented by the Research Councils UK (RCUK) Economic and Social Research Council (ESRC) with funds from the Global Challenges Research Fund (GCRF), A UKRI Collective Fund. We are grateful to the funder and to the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) for leading the consortium members and to all project partners who reviewed the initial draft of our paper.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Aikaeli, J., & Markussen, T. (2022). Titling and the Value of Land in Tanzania. *Journal of International Development, 34,* 512-531. https://doi.org/10.1002/jid.3615

Ali, M., & Flinn, J. C. (1989). Profit Efficiency among Basmati Rice Producers in Pakistan Punjab. *American Journal of Agricultural Economics, 71,* 303-310. https://doi.org/10.2307/1241587

Altunışık, R., Coşkun, R., Bayraktaroğlu, S., & Yıldırım, E. (2004). *Sosyal bilimlerde araştırma yöntemleri* (3. bs). Sakarya Kitabevi.

Araújo, R. G., Rodriguez-Jasso, R. M., Ruiz, H. A., Pintado, M. M. E., & Aguilar, C. N. (2018). Avocado By-Products: Nutritional and Functional Properties. *Trends in Food Science & Technology, 80,* 51-60. https://doi.org/10.1016/j.tifs.2018.07.027

Asfaw, S., Kassie, M., Simtowe, F., & Lipper, L. (2012). Poverty Reduction Effects of Agricultural Technology Adoption: A Micro-Evidence from Rural Tanzania. *Journal of Development Studies, 48,* 1288-1305. https://doi.org/10.1080/00220388.2012.671475

Babatunde, R. O., & Qaim, M. (2010). Impact of Off-Farm Income on Food Security and Nutrition in Nigeria. *Food Policy, 35,* 303-311. https://doi.org/10.1016/j.foodpol.2010.01.006

Brooks, J., Cervantes-Godoy, D., & Jonasson, E. (2009). *Strategies for Smallholders in Developing Countries: Commercialisation, Diversification, and Exit* (No. 696-2016-47668, 70 p).

Chander, G. N. (2017). Sample Size Estimation. *The Journal of Indian Prosthodontic Society, 17,* 217-218. https://doi.org/10.4103/jips.jips_169_17

Chandra, P. (1998). *Projects: Planning, Analysis, Selection, Implementation, and Review* (4th ed., 270 p). Tata Mcgraw-Hill Publishing Company.

Dixon, J., Taniguchi, K., & Wattenbach, H. (2003). Approaches to Assessing the Impact of Globalization on African Smallholders: Household and Village Economy Modeling. In *Proceedings of a Working Session on Globalization and the African Smallholder Study.* FAO (Agricultural Support Systems Division [AGS] and Agricultural and Development Economics Division [ESA]) and the World Bank. Food and Agriculture Organization of the United Nations.

Dixon, L., Hassell, B., Gale, S. F., & Kalman, F. (2016). *Talent Is the World's Most Valuable Resource. It's Time for Leaders to Elevate Its Strategic Importance*. CLO. https://www.chieflearningofficer.com/2016/12/02/talent-valuable-resource/

Emran, S. A., Krupnik, T. J., Aravindakshan, S., Kumar, V., & Pittelkow, C. M. (2021). Factors Contributing to Farm-Level Productivity and Household Income Generation in Coastal Bangladesh's Rice-Based Farming Systems. *PLOS ONE, 16,* e0256694. https://doi.org/10.1371/journal.pone.0256694

Eshetu, S. B., Pretzsch, J., & Mekonnen, T. B. (2018). Financial Analysis of Smallholder Farmers Woodlot and Homestead Agroforestry Systems and Its Implications for Household Income Improvement, the Case of Hawassa Zuria District, Southern Ethiopia. *Journal of Agricultural Science and Food Research, 9,* Article 1000236.

Farber, D. A. (2009). Review: Rethinking the Role of Cost-Benefit Analysis. *The University of Chicago Law Review, 76,* 1355-1406. https://www.jstor.org/stable/27793407?casa_token=aCVjPm-gMnwAAAAA%3ArGuMSDwmYz-xu1_cJCMsQ0qj1SnVqCdPy2QuNGugRBmab8vzLaedxEK6R7LMP9RwOM18f5xHF9_MysHMljWSem-Y9yfGZcIQzUvXRD7ApvtMBYBGKYjU4oQ

Food and Agricultural Organisation of the United Nations (FAO) (2010). *The Role of Women in Agriculture* (4 p). https://doi.org/10.2139/ssrn.1324388

Gittinger, J. P. (1982a). *Economic Analysis of Agricultural Projects* (340 p). The World Bank.

Gittinger, J. P. (1982b). *Economic Analysis of Agricultural Projects* (2nd ed., 523 p). John Hopkins University Press.

Gittinger, J. P. (1984). *Economic Analysis of Agricultural Projects* (2nd ed., 505 p). John Hopkins University Press.

Grant, A. H., & Schlesinger, L. A. (1995). Realize Your Customer's Full Profit Potential. *Harvard Business Review, 73,* 59-72.

Harrison, K. (1991). Cost Benefit Analysis: A Decision-Making Tool for Physiotherapy Managers. *Physiotherapy, 77,* 445-448. https://doi.org/10.1016/S0031-9406(10)61820-2

Hornby, W. B. (1995). Economics and Business, the Theory of the Firm Revisited: A Scottish Perspective. *Management Decision, 33,* 33-41. https://doi.org/10.1108/00251749510075400

Iraoya, A. O., & Isinika, A. C. (2022). Income Diversification and Agricultural Intensification of Rural Households in Nigeria: Synergies and Tradeoffs. *Journal of African Development, 23,* 112-131. https://doi.org/10.5325/jafrideve.23.1.0112

Irz, X., Lin, L., Thirtle, C., & Wiggins, S. (2001). Agricultural Productivity Growth and Poverty Alleviation. *Development Policy Review, 19,* 449-466. https://doi.org/10.1111/1467-7679.00144

Isa, A. H. M., Ismail, M. M., Samsuddin, N. S., & Abdurofi, I. (2019). Profitability of Broiler Contract Farming: A Case Study in Johor and Sabah. *International Journal of Business and Society, 20,* 521-532.

Jayanthakumaran, K. (2003). Benefit-Cost Appraisals of Export Processing Zones: A Survey of the Literature. *Development Policy Review, 21,* 51-65. https://doi.org/10.1111/1467-7679.00198

Jobber, D., & Hooley, G. (1987). Pricing Behaviour in UK Manufacturing and Service Industries. *Managerial and Decision Economics, 8,* 167-171. https://doi.org/10.1002/mde.4090080211

Johannesson, M., & Jönsson, B. (1991). Economic Evaluation in Health Care: Is There a Role for Cost-Benefit Analysis? *Health Policy, 17,* 1-23. https://doi.org/10.1016/0168-8510(91)90114-D

Juma, I., Fors, H., Hovmalm, H. P., Nyomora, A., Fatih, M., Geleta, M., Carlsson, A. S., & Ortiz, R. O. (2019). Avocado Production and Local Trade in the Southern Highlands of Tanzania: A Case of an Emerging Trade Commodity from Horticulture. *Agronomy, 9,* Article 749. https://doi.org/10.3390/agronomy9110749

Karuga, S. (2009). *Dairy Value Chain Analysis Timau Milk Shed for Micro Enterprises Support Programme Trust* (42 p). Business Services Department.

Khalil, C. A., Conforti, P., Ergin, I., & Gennari, P. (2017). *Defining Small-Scale Food Producers to Monitor Target 2.3 of the 2030 Agenda for Sustainable Development* (17 p). Food and Agriculture Organization of the United Nations.

Kotler, P., & Armstrong, G. (2006). *Principles of Marketing* (11th ed., 740 p). Prentice Hall.

Kurniawati, N. (2013). *Impact of Eco-Labelling on Indonesia's Smallholder Coffee Farmers* (No. rr2013032). Economy and Environment Program for Southeast Asia (EEPSEA). https://ideas.repec.org/p/eep/report/rr2013032.html

Lind, R. C. (1995). Intergenerational Equity, Discounting, and the Role of Cost-Benefit Analysis in Evaluating Global Climate Policy. *Energy Policy, 23,* 379-389. https://doi.org/10.1016/0301-4215(95)90162-Z

Mendola, M. S. (2005). *Farm Households Production Theories: A Review of 'Institutional' and 'Behavioural' Responses*. https://www.researchgate.net/publication/5175216_Farm_Households_Production_Theories_A_Review_of_'Institutional'_and_'Behavioural'_Responses

Mouter, N., Annema, J. A., & Van Wee, B. (2013). Attitudes towards the Role of Cost-Benefit Analysis in the Decision-Making Process for Spatial-Infrastructure Projects: A Dutch Case Study. *Transportation Research Part A: Policy and Practice, 58,* 1-14. https://doi.org/10.1016/j.tra.2013.10.006

Murphy, S. (2012). *Changing Perspectives: Small-Scale Farmers, Markets and Globalisation* (Revised ed., 39 p). IIED/Hivos.

Mwakalinga, H. A. (2014). *A Report on Value Chain Mapping in Siha and Jombe District* (85 p). The United Nations Development Programme.

Mwasaga, B. G. (2018). The Contribution of MIVARF in the Promotion of Agricultural Value Chain in Tanzania. In G. F. Kinyashi, E. Mwang'onda, T. R. K. Mdendemi, C. G. Mandara, & E. Hauli (Eds.), *Conference Proceedings for an International Conference on Planning and Development*. IRDP. https://www.researchgate.net/publication/343274749_The_Contribution_of_MIVARF_in_the_Promotion_of_Agricultural_Value_Chain_in_Tanzania

Ogundipe, A., Oduntan, E. A., Adebayo, O., & Olagunju, K. (2016). Agricultural Productivity, Poverty Reduction and Inclusive Growth in Africa: Linkages and Pathways. https://doi.org/10.2139/ssrn.2856449

Osabohien, R., Matthew, O., Gershon, O., Ogunbiyi, T., & Nwosu, E. (2019). Agriculture Development, Employment Generation, and Poverty Reduction in West Africa. *The Open Agriculture Journal, 13,* 82-89. https://doi.org/10.2174/1874331501913010082

Oxfarm (2023). *Hass Avocado Farming*. http://www.oxfarmorganic.com/tag/hass-avocado-farming/

Paul, S. (1971). Investment in Agriculture: A Cost-Benefit Analysis: Rejoinder. *Economic and Political Weekly, 6,* A194-A196.

Poole, N. (2017). *Smallholder Agriculture and Market Participation*. Food and Agriculture Organization of the United Nations (FAO). https://doi.org/10.3362/9781780449401

Rahman, S., Kazal, M. M. H., Begum, I. A., & Alam, M. J. (2016). Competitiveness, Profitability, Input Demand, and Output Supply of Maize Production in Bangladesh. *Agriculture, 6,* Article 21. https://doi.org/10.3390/agriculture6020021

Regnard, C. (2006). *Immigration et Présence Etrangère en France* (260 p). Rapport annuel de la Direction de la Population et des Migrations, Ministère de l'Emploi, de la Cohésion Sociale et du Logement.

Reinartz, W. J., & Kumar, V. (2000). On the Profitability of Long-Life Customers in a Noncontractual Setting: An Empirical Investigation and Implications for Marketing. *Journal of Marketing, 64,* 17-35. https://doi.org/10.1509/jmkg.64.4.17.18077

REPOA (2018) *Improving Tanzania's Competitiveness of Avocado ('Green Gold') Value Chain and Exports: A Case for Targeted Regulatory, Policy and Institutional Reforms*. Policy Brief. http://www.repoa.or.tz/documents/AVOCADO_value_chain.pdf

Romania, M., Njenga, M., & Mendum, R. (2018). *Gender as Key in Community Participation* (101 p). Nairobi.

Shipley, D. D. (1981). Pricing Objectives in the British Manufacturing Industry. *The Journal of Industrial Economics, 29,* 429-443. https://doi.org/10.2307/2098256

Sigman, K. (2005). *Internal Rate of Return, Bonds, Yields.* https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Sigman%2C+K.+%282005%29.+Internal+Rate+of+Return%2C+Bonds%2C+Yields.&btnG=

Smith, A. (1909). *An Inquiry into the Nature and Causes of the Wealth of Nations* (564 p). P. F. Collier.

Stephen, J., & Radhakrishnan, M. (2022). Avocado (*Persea americana Mill.*) Fruit: Nutritional Value, Handling and Processing Techniques, and Health Benefits. *Journal of Food Processing and Preservation, 46,* e17207. https://doi.org/10.1111/jfpp.17207

Turuka, F. M. (2000). Methodology for Agricultural Research Impact Assessment. Food Security and Household Income for Smallholders Farmers in Tanzania. Applied Research with Emphasis on Women under the Project, TAPP II-SUA. In *Proceedings of a*

Workshop under the Project, TARP II-SUA (pp. 14-22).

URT (2021a). *National Sample Census of Agriculture Key Findings Report* (45 p). Minister for Agriculture.

URT (2021b). *Bank of Tanzania. Annual Report* (264 p). Minister for Finance and Planning.

Wambua, M. M., & Jóhannesson, S. (2018). *A Cost-Benefit Analysis of the Fish Farming Enterprise Productivity Program Project in Kenya. The Case of Implementation of the Aquaculture Development Component in Meru County* (38 p). United Nations University Fisheries Training Programme.

Wang, J., Cramer, G. L., & Wailes, E. J. (1996). Production Efficiency of Chinese Agriculture: Evidence from Rural Household Survey Data. *Agricultural Economics, 15,* 17-28. https://doi.org/10.1111/j.1574-0862.1996.tb00417.x