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Marketing of baobab pulp in Kenya: Collectors' choice of rural versus urban markets

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Abstract

Baobab products provide cash income and supplement diets for local communities living in marginalised, arid and semi-arid regions. However, these products are neglected by research, selectively traded and considered underutilised. This study endeavours to narrow this information gap by analysing the determinants of baobab collectors' choice of marketing channels in Kenya. A multinomial logit was employed, using a dataset of 268 baobab collectors from three counties. The results show that the majority of baobab collectors sell their baobab pulp through rural markets (assemblers and rural wholesalers), as opposed to urban buyers (urban wholesalers, retailers and processors). Export channels are conspicuously missing from the chain. Human capital and transactional and institutional factors significantly influence the collectors' choice of marketing channels. The results reveal that building capacity around market development, research and education, road networks and institutional services is essential to create more profitable channels for generating income, enhancing food security and reducing malnutrition.

Key words: underutilised crops; indigenous fruits; non-timber forest products; marketing channel; market development

1. Introduction

Markets play an important role in a value chain by offering market actors a platform to participate in the exchange of goods and services (Krafft *et al.* 2015). Marketing channels facilitate the movement of goods and services from the point of production to the point of consumption (Bellin 2016), hence bridging the time, place and possession gaps between those who own the goods and services and those who use them (Kotler & Armstrong 2012). Like agricultural products, indigenous fruits and other non-timber forest products (NTFPs) in Sub-Saharan Africa (SSA) are commonly traded locally in formal and informal markets, depending on the level of government regulation and taxation (Ferrand *et al.* 2004). These markets are familiar to and easily accessible by small producers (Lowore & Boa 2001). Products are traded in small quantities through intermediaries (assemblers, wholesalers, processors and retailers), who are the link to the final consumers (Shackleton *et al.* 2007; De Caluwé 2011). Whereas the local value chains provide low-income consumers with low-cost functional foods (Shackleton *et al.* 2007), global value chains facilitate access to functional foods

and beverages in the importing countries through exporters (Lee *et al.* 2012). However, local markets, especially for NTFPs, tend to be neglected in SSA (Shackleton *et al.* 2007), and more emphasis is given to products that are sold in national and international markets (Mahonya *et al.* 2019). This may be because of low levels of public investment in agricultural research (Hatzenbuehler 2019). Baobab research has received little attention in Kenya (Gebauer *et al.* 2016), creating a knowledge gap in many areas, including harvesting, consumption, marketing, specialisation and value addition. Our study attempts to fill this gap by analysing the determinants of choice of marketing channel among baobab collectors in Kenya.

The livelihoods of many communities living in arid and semi-arid regions in developing countries depend partially on NTFPs to supplement local diets, nutrition and household incomes (Marshall *et al.* 2006; Shackleton & Pullanikkatil 2018). Income generation is particularly important among the poorest of households living in remote settings (Mahonya *et al.* 2019), thus preventing them from slipping further into poverty. Indigenous fruit trees (IFTs) promote rural development and support sustainable landscape management (Mithöfer & Waibel 2008). The baobab tree (*Adansonia digitata* L.), found in the wild in SSA, is an example of an undomesticated IFT that is underutilised (Wickens & Lowe 2008; Buchmann *et al.* 2010; Coe *et al.* 2013). In Kenya, the trees grow in the marginal arid and semi-arid regions, characterised by few cash-generating activities, such as charcoal burning and honey harvesting.

Baobab is a multipurpose tree that is not only adapted to severe climatic conditions, in which droughts and famine are constant hazards, but also yields in years when crops fail (Haq *et al.* 2008). Buchmann *et al.* (2010) documented more than 300 traditional uses of the tree. Edible products are consumed locally in the form of pulp and leaves (Kaboré *et al.* 2011). The pulp, a cream-colored farinaceous powder embedded in the baobab seed (pulp on seed) is extracted from a hard-shelled baobab fruit by breaking the kernel using a machete or hard object. The pulp on seed, referred to in this study as baobab pulp, is the main baobab product traded by collectors in Kenya (Jäckering *et al.* 2019). Globally, the pulp has increasingly been recognised for its high nutritional and polyphenolic content (Sidibe & Williams 2002). It contains significant amounts of protein, fibre, potassium, calcium, magnesium, sodium, phosphorous, iron manganese and vitamin C (De Caluwé *et al.* 2010; Kamatou *et al.* 2011; Muthai *et al.* 2017). Although empirical studies of baobab demand are scarce, the extant literature indicates increasing use of the pulp and seed oil as ingredients in the food, medical and cosmetic industries, resulting in increased global demand for raw baobab material (Kamatou *et al.* 2011; Rahul *et al.* 2015; Jäckering *et al.* 2019). In European markets, more than 300 products containing baobab are available on the shelves (Gebauer *et al.* 2016). The sector has the potential to become a billion-dollar industry employing over 2.5 million households in Africa (Sanchez *et al.* 2010). Observations in the markets show that formal processing of baobab products is rare in Kenya, and only a few informally processed products are commonly sold on a limited scale.

Despite the importance of baobab on a local and international scale, baobab pulp markets remain underdeveloped in Kenya (Jäckering *et al.* 2019). There is limited knowledge of baobab production, utilisation and marketing, and its potential for commercialisation in East Africa and particularly in Kenya, due to a lack of adequate research (Gebauer *et al.* 2016). Even after the acceptance of baobab pulp as a food ingredient by the European Commission (2008) and the Food and Drug Administration ([FDA] 2009), coupled with the growing demand for the product in international markets (Kamatou *et al.* 2011; Jäckering *et al.* 2019), the marketing channels for baobab pulp are not understood well. Baobab collectors in Kenya continue to derive low value from local baobab trade (Jäckering *et al.* 2019), and no export markets have yet been identified (Gebauer *et al.* 2016). Marshall *et al.* (2006) point out that a lack of market information, and capacity to act on it, is the hindering factor for accessing and holding on to crucial markets, especially where policies and legislation specific to the NTFPs are missing. This study provides empirical information on the determinants of marketing channels among baobab collectors in Kenya using the multinomial logit model. Gaining insight into

collectors' market participation not only enhances an understanding of the multiple effects of commercialisation (Ouedraogo 2019) on livelihoods, but also guides policy formulation towards sustainable production and efficient marketing of the product.

2. Materials and methods

2.1 Theoretical and empirical models

This study is based on random utility theory and transaction cost economics (TCE) theory. Each household participating in the market incurs transaction costs in the form of market taxes, transport and other marketing costs (Bellemare & Barrett 2006). From the TCE perspective, the absence of institutions that govern a formal exchange, and the presence of intermediaries that take advantage of the situation, raise transaction costs for farmers. Farmers react by choosing outcomes that lower their transaction costs (Woldie & Nuppenau 2011). Random utility theory assumes that the decision maker tries to maximise his or her utility and will prefer an alternative that derives more utility (Manski 1977). Because the researcher does not know the utility of the decision maker with full certainty, part of the component of this theory is treated as random variables and the other as systematic. Manski (1973) notes that the random component is due to unobserved attributes, unobserved taste variations, measurement errors and instrumental variables. The random component is assumed to be independently and identically distributed according to a particular probability distribution (Ben-Akiva *et al.* 1985). Different assumptions about the forms of this probability distribution lead to different choice models. The multinomial probit (MNP) model disregards the assumption that the errors are identically and independently distributed (IID). The multinomial logit (MNL) assumes that the disturbances are independent across alternatives, thus imposing the property of independence of irrelevant alternatives (IIA) on the decision maker (Alvarez & Nagler 1994).

Both MNL and MNP are examples of random utility models (Alvarez & Nagler 1994). Unlike the binary choice models, which are suitable for choices involving only two categories, multinomial choice models involve modelling a single outcome from multiple alternatives (Cameron & Trivedi 2010). MNP, however, is more complex than MNL (Wittink 2011) and lacks optimality for approximating the choice probabilities when the number of alternatives is large (McFadden 1981). Nonetheless, it is still recommended and used in several fields (Alvarez & Nagler 1994). MNL has the capacity to analyse a choice set of multiple alternatives with larger data sets (Wittink 2011) and is simpler in terms of computation and interpretation (Cameron & Trivedi 2010). This study adopts the MNL model to estimate the determinants of choice of marketing channel by baobab pulp collectors in Kenya.

Following Wulff's (2015) specification, the probability (Y_i) that an i^{th} baobab collector faced with j marketing channel options will choose option j ($j = 0, 1, 2$) given x_i determinants of the market channel and b_j vector of parameters associated with the marketing channel alternative j , is:

$$Prob(Y_i = j) = \frac{\exp(x_i b_j)}{\sum_{j=0}^2 \exp(x_i b_j)} \quad (1)$$

The dependent variable representing each of the marketing channel takes the values 0 for sale through assemblers, 1 for sale through rural wholesalers and 2 for sale through urban buyers. Of the three (j) equations, only two ($j-1$) can be estimated. To guarantee identification, one of the choice categories is set to zero to represent the base category from which coefficients are interpreted. The predicted probabilities yield:

$$p_{ij} = Prob(Y_i = j) = \frac{\exp(x_i b_j)}{\exp(x_i 0) + \sum_{j=1}^2 \exp(x_i b_j)} = \frac{\exp(x_i b_j)}{1 + \sum_{j=1}^2 \exp(x_i b_j)} \quad (2)$$

while that of the base category is:

$$p_{ij} = \text{Prob}(Y_i = 0) = \frac{\exp(x_i 0)}{\exp(x_i 0) + \sum_{j=1}^2 \exp(x_i b_j)} = \frac{1}{1 + \sum_{j=1}^2 \exp(x_i b_j)}. \quad (3)$$

When using multinomial logit regression, marginal effects better measure the expected change in probability of choosing a particular channel with respect to a unit change in an independent variable from the mean (Greene 2003; Wooldridge 2010). The marginal effects are computed as follows:

$$ME_{ij} = \frac{\partial p_{ij}}{\partial x_{ik}} = p_{ij} (\beta_{kj} - \beta_i), \quad (4)$$

where $\beta_i = \sum_{m=1}^2 \beta_{km} \Pr(y = m)$ is a probability-weighted average of the coefficients for different choice combinations, β_{km} .

2.2 Hypothetical determinants of marketing channels

Hypothetically, a baobab collector may sell his/her baobab pulp to assemblers, rural wholesalers, urban wholesalers, retailers, processors, exporters and consumers (see Figure 1).

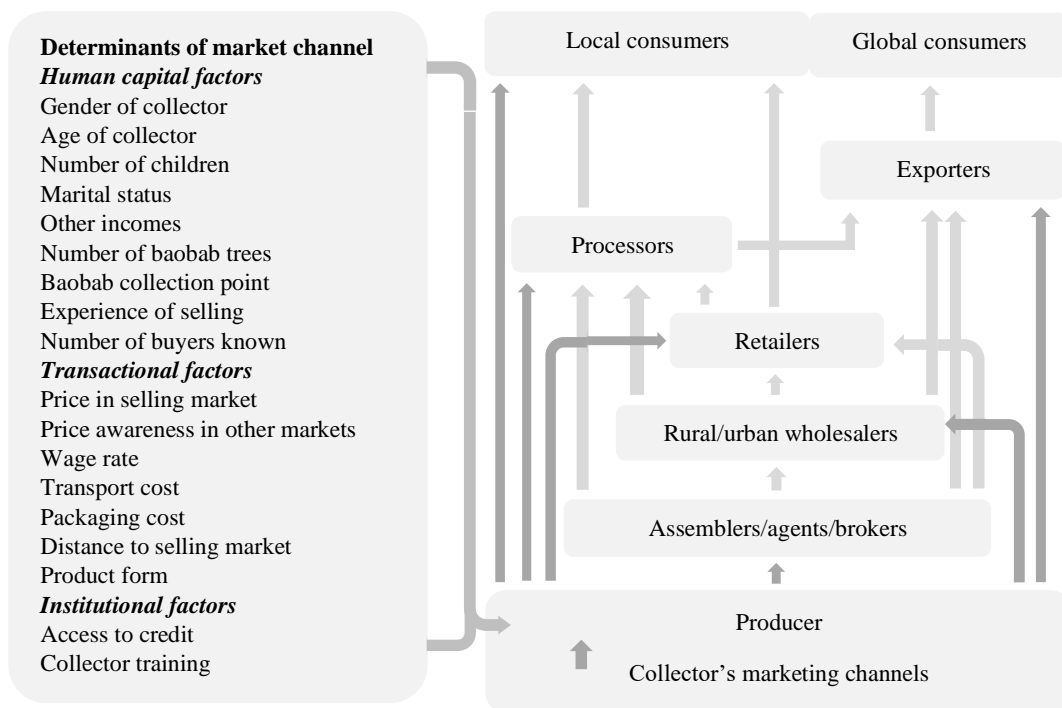


Figure 1: Factors influencing baobab collectors' choice of marketing channel

Source: Authors' conceptualisation based on literature review

Assemblers constitute small buyers of baobab pulp from collectors, acting independently or as an agent on behalf of a larger actor. Assemblers buy produce brought to their homes, but may also traverse their villages buying baobab from collectors' homes and interior rural markets. They sell baobab mainly to rural wholesalers, but also to urban buyers. They are characterised by a limited number of resources, small trading quantities and the use of simple means of transportation, such as motorbikes. In Kenya, they are also referred to as brokers. *Rural wholesalers* are situated in rural markets and buy from collectors, assemblers and other traders in the rural market with the aim of building volumes to sell in bulk to urban wholesalers or in smaller quantities to urban retailers and processors. They are also referred to as collecting wholesalers. *Urban wholesalers* buy in bulk from

rural wholesalers and assemblers with the intention of accumulating large stocks for storage to deal with seasonality or resale to retailers and processors. They are situated in urban towns and cities and are also referred to as distributing wholesalers. *Retailers* constitute the final link to the baobab consumer. Rural retailers are stationed in rural areas, while urban retailers are stationed in urban areas. Both rural and urban retailers buy baobab pulp in small quantities from collectors, assemblers and wholesalers to sell to processors and consumers. *Processors* refer to actors who add value to baobab pulp by changing its form in a manner that enhances its value. Processors buy baobab pulp from collectors, assemblers, wholesalers and retailers. *Exporters* buy baobab pulp with the aim of selling outside the country of origin. They may buy their produce from any of the actors, as long as it satisfies their requirements.

The factors determining a baobab collector's choice of marketing channel are grouped into human capital, transactional and institutional factors. This categorisation is based on Donkor *et al.*'s (2018a) study on promoting value addition among cassava farmers in Nigeria. Variables categorised under human capital include the collector's gender, age, number of children, marital status, other incomes, number of baobab trees, baobab collection point, experience of selling baobab and number of known buyers. Transactional factors include price in selling market, price awareness in other markets, labour cost, transport cost, packaging cost, distance to selling market and product form. Institutional factors are access to credit and collector training.

2.4 Model specification

The determinants of the baobab collector's choice of marketing channel are specified as:

$$Baomcc_{ij} = \beta_0 + \sum_{l=1}^9 \beta_{jl} Human\ capital_{ijl} + \sum_{l=10}^{16} \beta_{jl} Transactional_{ijl} + \sum_{l=17}^{18} \beta_{jl} Institutional_{ijl} + \varepsilon_i, \quad (5)$$

where β_0 is the constant and β_{jl} is the set of coefficients for each of the l explanatory variables influencing an i^{th} collector's choice of baobab channel j (Table 1). ε_i is the error term.

2.5 Survey design

Data was collected from the counties of Kitui, Makueni and Kilifi in Kenya. The target population consisted of households that participated in baobab collection for commercial purposes. Multistage purposive sampling was used to select baobab-growing counties and markets. In the selected markets, a list of 1 074 collectors was compiled by traders who had been identified by local administration officers and the snowball method. Linear systematic random sampling was then applied to select 270 collectors from the listed collectors with a probability proportional to the size of the collectors listed in each market. A structured questionnaire was administered to baobab collectors in their homes by research enumerators. Focus group discussions and desktop reviews were also used to gather information. Two of the questionnaires were dropped due to inadequacy, thus only 268 responses by collectors were analysed.

Table 1: Description of variables

| Variable | Description | Units of measurement |
|------------------------------|---|--|
| <i>Baomcc</i> | Baobab pulp-marketing channel choices | Assemblers = 0, Rural wholesalers = 1, Urban buyers = 2, Retailer = 3, Processors = 4, Exporters = 5 and Consumers = 6 |
| Human capital factors | | |
| <i>Gender</i> | Gender of collector | Female = 0, Male = 1 |
| <i>Age</i> | Age of collector | Years |
| <i>Nchildln</i> | Number of children | Number |
| <i>mstatus</i> | Marital status | Single = 0, Married = 1, Divorced = 2, Widowed = 3, Separated = 4 |
| <i>oaincmnl</i> | Other incomes | KES |
| <i>Treesln</i> | Number of baobab trees | Number |
| <i>Colpoint</i> | Baobab collection point | My farm = 1, Neighbour's farm = 2, Communal field = 3, Forest = 4 |
| <i>Sellyrsln</i> | Experience in selling | Number of years |
| <i>nbuyerln</i> | Number of buyers | Number |
| Transactional factors | | |
| <i>Pbln</i> | Price at location of sale | KES |
| <i>Mktinfo</i> | Awareness of price at other locations of sale | No = 0, Yes = 1 |
| <i>Pln</i> | Labour cost | KES/bag |
| <i>Ptln</i> | Transport cost | KES/bag |
| <i>Ppln</i> | Packaging cost | KES/bag |
| <i>distmrktln</i> | Distance to location of sale | Kilometres |
| <i>productsell</i> | Product form | Whole fruit = 1, Baobab pulp = 2, both = 3 |
| Institutional factors | | |
| <i>Credit</i> | Access to credit | No = 0, Yes = 1 |
| <i>Training</i> | Access to training | No = 0, Yes = 1 |

NB: Average exchange rate for November to December 2017: 1USD = 103 KES

Note: KES is Kenyan shilling

3. Results and discussion

3.1 Marketing channels for baobab collectors

Baobab collectors in Kenya use five marketing channels to sell their baobab pulp (Figure 2). The channels comprise of assemblers, rural wholesalers, urban wholesalers, retailers and processors.

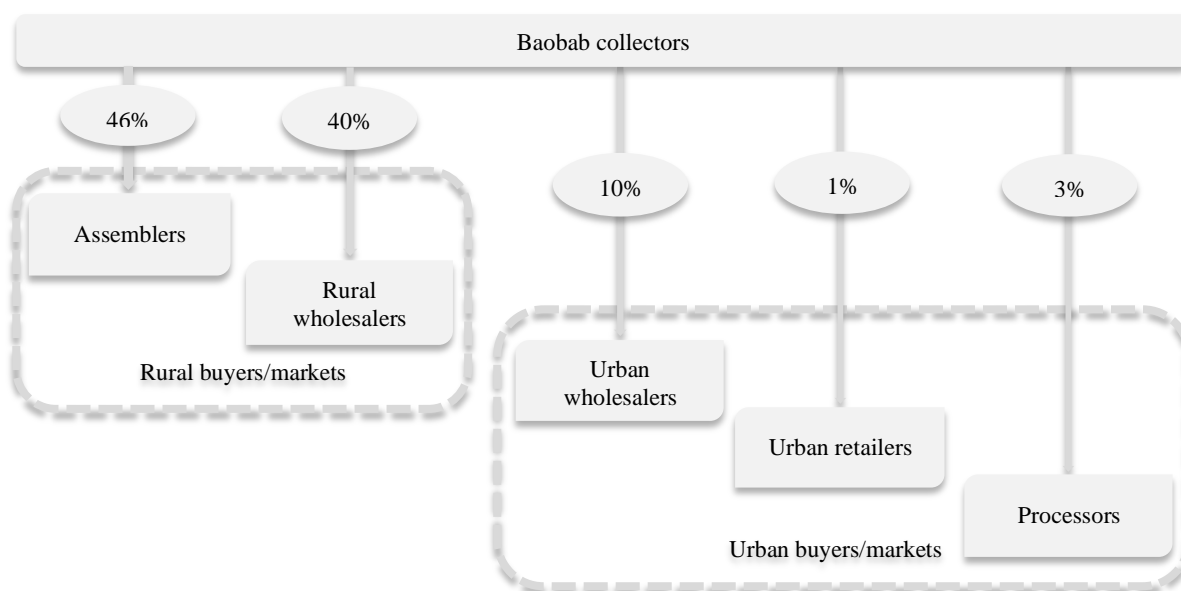


Figure 2: Marketing channels for baobab collectors

Source: Authors' computation based on baobab survey data (2017)

Figure 2 shows that 46% and 40% of the baobab collectors sold their baobab pulp through assemblers and rural wholesalers respectively, which implies that 86% of collectors sold baobab pulp through rural markets. Only 10% of the collectors sold through urban wholesalers, while 1% and 3% sold through urban retailers and processors respectively. No export buyers were identified by the collectors, showing that they were not directly connected to export markets. The results confirm those of Lowore and Boa (2001) and show that most small-scale producers sell their products in local markets as opposed to international markets, because local markets are the most understood and are easily accessible.

The majority (70%) of the collectors indicated that they sold baobab to the same buyer throughout the season. Table 2 presents results for the reasons for this. In the Likert scale results, a weighted average value above 3 is considered an agreement with the statement and vice versa. The results indicate that collectors prefer reliability in buyers, i.e. buyers who pay in cash (4.4), pay on time (4.3), are readily available (4.2), and those who both assure them of sale (4.1) and buy all their produce (4.4).

Table 2: Reasons for the choice of marketing channel

| Reason | Observations | Responses in percentage (%) | | | | | Weighted average |
|--|--------------|-----------------------------|------|-----|------|------|------------------|
| | | SA-5 | A-4 | N-3 | D-2 | SD-1 | |
| Gives me better prices for my baobab (price) | 268 | 7.0 | 18.7 | 7.3 | 16.8 | 50.2 | 2.2 |
| Proximity/nearer to my home (access) | 268 | 42.1 | 28.9 | 1.5 | 9.2 | 18.3 | 3.7 |
| I feel safer and more secure selling to him/her (security) | 268 | 23.1 | 42.9 | 1.1 | 17.6 | 15.4 | 3.4 |
| S/he is the only buyer I know | 268 | 24.2 | 12.8 | 1.5 | 26.4 | 35.2 | 2.7 |
| Buyer pays in cash (cash) | 268 | 54.6 | 37.4 | 0.7 | 5.1 | 2.2 | 4.4 |
| Buyer pays on time (timeliness) | 268 | 45.4 | 47.3 | 0.0 | 6.6 | 0.7 | 4.3 |
| I am assured of sale (assurance) | 268 | 29.3 | 61.2 | 1.8 | 5.9 | 1.8 | 4.1 |
| Buyer offers to collect my baobab (convenience) | 268 | 24.2 | 21.6 | 0.4 | 16.1 | 37.7 | 2.8 |
| Buyer buys all my produce (reliability) | 268 | 49.8 | 43.6 | 0.4 | 4.0 | 2.2 | 4.4 |
| Buyer takes all my baobab irrespective of quality | 268 | 2.9 | 5.1 | 0.7 | 29.3 | 61.9 | 1.6 |
| Buyer provides a price premium for quality | 268 | 2.6 | 4.8 | 1.1 | 24.2 | 67.4 | 1.5 |
| Readily available (availability) | 268 | 43.2 | 46.9 | 2.2 | 4.4 | 3.3 | 4.2 |
| Personal relations and contact (trust) | 268 | 17.6 | 39.6 | 2.6 | 21.2 | 19 | 3.2 |
| Presence of legal contract | 268 | 0.4 | 1.8 | 0 | 23.1 | 74.7 | 1.3 |
| Communication and information sharing | 268 | 1.5 | 48 | 1.8 | 22.3 | 26.4 | 2.8 |

*Key: abbreviations for items on Likert scale: SA-Strongly agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly disagree
Source: Authors' computation based on baobab survey data (2017)

Other important factors considered by collectors include feeling of safety and security (3.4), trust (3.2) and buyers' proximity to the collectors (3.4). For example, some collectors explained that "... I sell to this buyer because I know him, am promoting him because I know that at the time of need he will be there for me". "He is always prompt in payment and pays in cash, I have never heard anyone complaining, and he is very trustworthy" "This buyer will always take all my produce and sometimes will come for it at my home" The rural buyers possess most of these traits.

3.2 Summary statistics for selected variables

The five marketing channels above have been condensed into assemblers, rural wholesalers and urban buyers. Retailers and processors, both of whom buy from the urban markets, have been combined with the urban wholesalers to form urban buyers. Assemblers and rural wholesalers are kept as separate channels because they operate under different rural settings. A summary of the means, standard deviation and an independent group t-test for the selected variables is presented in Table 3.

3.2.1 Human capital factors

More female than male collectors sold their baobab pulp through assemblers (59%) and rural wholesalers (71%), while more males (54%) sold through urban buyers. A significantly higher proportion of male collectors ($P < 0.01$) sold pulp through urban buyers rather than through rural wholesalers. The average age of collectors selling baobab pulp through assemblers, rural wholesalers and urban buyers was 44, 47 and 48 years respectively. Collectors selling baobab through assemblers were significantly younger ($P < 0.10$) than those selling through rural wholesalers. Approximately 76%, 78% and 65% of collectors selling through assemblers, rural wholesalers and urban wholesalers respectively were married. Thus, significantly higher proportions of married collectors sold through assemblers ($P < 0.10$) and rural wholesalers ($P < 0.10$) than through urban buyers. In contrast, the proportion of widowed collectors who sold their baobab through urban buyers (32%) was significantly higher than those selling through assemblers (20%) and rural wholesalers (16%), at a level of significance of 10% and 5% respectively (Oduol *et al.* 2017). Based on gender participation in markets, the results imply that the majority of married collectors operating in the rural markets were female.

Baobab collectors selling through urban buyers had a significantly larger share of other incomes than their counterparts selling through assemblers ($P < 0.05$) and rural wholesaler ($P < 0.05$). Thus, a larger share of other incomes provides the capital needed to facilitate trade in baobab. Baobab income contributed approximately 5%, 4% and 12% of the total household income among collectors who sold baobab through assemblers, rural wholesalers and urban buyers respectively. The ratio of baobab income to total household income for collectors selling through urban outlets is statistically different vis-à-vis those selling through assemblers ($P < 0.01$) and rural wholesalers ($P < 0.01$). The number of trees on the farms of collectors selling baobab through assemblers and urban buyers was significantly higher ($P < 0.01$) than those selling through rural wholesalers. This is treated as sheer coincidence, since baobab trees grow naturally on farms. However, collectors can increase the number of trees under their control by renting or harvesting from the forest.

A larger proportion of baobab pulp sold is harvested from collectors' own farms as opposed to neighbours' farms, communal lands and forests. Significantly higher proportions of collectors ($P < 0.01$) harvesting baobab from their own farms sold through assemblers (97%) compared to through rural wholesalers (88%) and urban buyers (78%). However, a higher proportion of collectors harvesting baobab from their neighbours' farms sold through urban buyers than through rural wholesalers ($P < 0.05$) and assemblers ($P < 0.01$). Likewise, a significantly higher proportion of collectors ($P < 0.01$) harvesting from neighbours' farms sold through rural wholesalers compared to through assemblers. This may be attributed to the need to cover the rental costs for the baobab trees. Collectors selling baobab through urban buyers had significantly more experience selling baobab (10 years) than those selling through assemblers (eight years) or rural wholesalers (six years), at a 10% and 1% level of significance respectively. The experience of baobab pulp trading was significantly longer ($P < 0.05$) for collectors selling through assemblers than for those selling through rural wholesalers.

Table 3: Summary of selected variables (independent group t-test analysis)

| Marketing channel | | Assemblers | | Rural wholesalers | | Urban buyers | | Mean comparison | | |
|--|--------------|------------|------------|-------------------|------------|--------------|------------|-----------------|-----------|-----------|
| | | A | | B | | C | | A-B | A-C | B-C |
| Variable | Observations | Mean | Std. dev. | Mean | Std. dev. | Mean | Std. dev. | t-value | t-value | t-value |
| <i>Human capital factors</i> | | | | | | | | | | |
| Gender: Male | 268 | 0.41 | 0.49 | 0.29 | 0.45 | 0.54 | 0.51 | 1.94* | -1.43 | -2.84*** |
| Age | 268 | 43.88 | 15.34 | 47.29 | 14.92 | 47.59 | 16.52 | -1.71* | -1.27 | -0.11 |
| Number of children | 268 | 4.22 | 2.29 | 4.07 | 2.22 | 4.41 | 1.92 | 0.40 | -0.98 | -1.27 |
| Marital status: Single | 268 | 0.02 | 0.15 | 0.02 | 0.14 | 0.03 | 0.16 | 0.29 | -0.10 | -0.31 |
| Married | 268 | 0.76 | 0.43 | 0.78 | 0.42 | 0.65 | 0.48 | -0.32 | 1.35* | 1.56* |
| Divorced | 268 | 0.01 | 0.09 | 0.04 | 0.19 | 0.00 | 0.00 | -1.53 | 0.54 | 1.18 |
| Widowed | 268 | 0.20 | 0.40 | 0.16 | 0.37 | 0.32 | 0.47 | 0.84 | -1.58* | -2.21** |
| Separated | 268 | 0.01 | 0.09 | 0.01 | 0.10 | 0.00 | 0.00 | -0.10 | 0.54 | 0.58 |
| Other incomes | 268 | 107 306.40 | 111 408.40 | 111 760.80 | 129 567.20 | 168 766.80 | 209 131.20 | -0.28 | -2.35** | -1.95** |
| Ratio of baobab income to total household income | 268 | 0.05 | 0.08 | 0.04 | 0.05 | 0.12 | 0.13 | 1.19 | -3.69*** | -4.78*** |
| Number of trees | 268 | 11.21 | 10.02 | 6.96 | 7.72 | 11.57 | 13.17 | 3.58*** | -0.18 | -2.57** |
| Collection point: Own farm | 268 | 0.97 | 0.18 | 0.88 | 0.33 | 0.78 | 0.42 | 2.61*** | 3.91*** | 1.43 |
| Neighbour's farm | 268 | 0.01 | 0.09 | 0.07 | 0.26 | 0.23 | 0.42 | -2.64*** | -5.22*** | -2.42** |
| Communal land | 268 | 0.02 | 0.13 | 0.05 | 0.21 | 0.00 | 0.00 | -1.35 | 0.77 | 1.33 |
| Forest | 268 | 0.01 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.93 | 0.54 | |
| Experience of selling | 268 | 7.82 | 5.90 | 6.10 | 6.08 | 9.73 | 6.65 | 2.18** | -1.68* | -3.06*** |
| Number of buyers | 268 | 2.47 | 1.32 | 2.40 | 1.04 | 3.51 | 2.01 | 0.47 | -3.70*** | |
| <i>Transactional factors</i> | | | | | | | | | | |
| Price at location of sale | 268 | 10.91 | 1.60 | 11.54 | 2.55 | 22.97 | 7.05 | -2.26** | -17.73*** | -14.39*** |
| Awareness of price at other locations of sale: Yes | 268 | 0.49 | 0.50 | 0.48 | 0.50 | 1.00 | 0.00 | 0.10 | -6.19*** | -6.27*** |
| Quantity sold in kilograms | 268 | 321.61 | 635.02 | 234.37 | 554.34 | 1 376.57 | 3 060.26 | 1.11 | -3.62*** | -3.73*** |
| Labour cost | 268 | 212.77 | 72.45 | 206.48 | 73.97 | 241.27 | 118.54 | 0.65 | -1.79* | -2.09** |
| Transport cost | 268 | 63.21 | 24.91 | 66.57 | 44.18 | 151.27 | 80.69 | -0.73 | -10.67*** | -7.99*** |
| Packaging cost | 268 | 35.82 | 17.52 | 42.81 | 25.42 | 53.21 | 33.62 | -2.47** | -4.19*** | -1.97** |
| Distance to location of sale | 268 | 2.87 | 2.19 | 5.06 | 23.87 | 102.96 | 116.08 | -1.02 | -9.71*** | -8.32*** |
| Product form: Whole fruit | 268 | 0.08 | 0.27 | 0.01 | 0.10 | 0.05 | 0.23 | 2.55** | 0.53 | -1.65* |
| Baobab pulp | 268 | 0.92 | 0.27 | 0.99 | 0.10 | 0.86 | 0.35 | -2.55** | 1.01 | 3.41*** |
| Both | 268 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.28 | | -3.30*** | -3.05*** |
| County: Kitui County | 268 | 0.90 | 0.31 | 0.75 | 0.44 | 0.35 | .48 | 2.99*** | 8.21*** | 4.67*** |
| Makueni County | 268 | 0.03 | 0.18 | 0.25 | 0.44 | 0.24 | 0.44 | -5.14*** | -4.37*** | 0.08 |
| Kilifi County | 268 | 0.07 | 0.26 | 0.00 | 0.00 | 0.41 | 0.50 | 2.88*** | -5.42*** | -8.52*** |
| Profits per kilogram | 268 | 5.29 | 2.28 | 5.72 | 2.48 | 13.01 | 7.85 | -1.40 | -9.76*** | -8.53*** |

| | | | | | | | | | | |
|-------------------------------------|-----|----------|----------|----------|----------|-----------|-----------|-------|----------|----------|
| Profits per collector | 268 | 1 455.54 | 2 041.71 | 1 179.75 | 2 063.75 | 14 130.43 | 23 277.62 | 1.02 | -6.05*** | -5.75*** |
| <i>Institutional factors</i> | | | | | | | | | | |
| Access to credit: Yes | 268 | 0.34 | 0.47 | 0.35 | 0.48 | 0.54 | 0.5052 | -0.25 | -2.27** | -2.04** |
| Access to training: Yes | 268 | 0.02 | 0.15 | 0.06 | 0.25 | 0.00 | 0.0000 | -1.52 | 0.95 | 1.59 |

* Authors' computation based on baobab survey data (2017)

3.2.2 Transactional factors

Baobab pulp prices varied considerably between marketing channels. Urban buyers offered significantly ($P < 0.01$) higher prices (KES 23) for a kilogram of baobab pulp than assemblers (KES 11) and rural wholesalers (KES 12). Rural wholesalers' prices were also significantly ($P < 0.05$) higher than assemblers' prices. The variations in price result from differences in regions, market levels, seasonal effects, quality effects and price knowledge (Rao 1989; Chung *et al.* 2005). Collectors selling through urban markets were significantly ($P < 0.01$) more aware of prices in other locations of sale (100%) than those selling through assemblers (49%) and rural wholesales (48%). A significantly higher quantity ($P < 0.01$) of baobab pulp was supplied by households selling through urban buyers (1 377 kg) compared to those who sold through assemblers (322 kg) and rural wholesalers (234 kg).

Input cost variables indicate that there are statistically significant variations in labour, transport and packaging costs among collectors selling baobab through assemblers, rural wholesalers and urban buyers. Labour costs for baobab collectors selling through urban buyers were significantly higher than for collectors selling through assemblers ($P < 0.10$) and rural wholesalers ($P < 0.05$). Similarly, collectors selling to urban buyers incur significantly ($P < 0.01$) higher transport costs (KES 151) than their counterparts selling through rural wholesalers (KES 67) and assemblers (KES 63). This may be attributed to the greater distances to urban markets in comparison to rural markets. On average, collectors selling in urban markets covered significantly longer distances (103 km) to destination markets than those selling to rural wholesalers (5 km) and assemblers (3 km). The variations in the distances are statistically significant for collectors selling through urban buyers in comparison to those selling through rural wholesalers ($P < 0.01$) and assemblers ($P < 0.01$).

The packaging costs for collectors selling through urban buyers (KES 53) were significantly higher than for those selling through rural wholesalers (KES 43) and assemblers (KES 36), at $P < 0.05$ and $P < 0.01$ respectively. This may be attributed to the choice of packaging materials for the different markets. Packaging costs were also significantly ($P < 0.05$) higher for collectors selling through rural wholesalers than through assemblers.

The results also show that the proportion of collectors selling baobab pulp as opposed to whole fruit through rural wholesalers (99%) is significantly higher than of those selling through assemblers (92%) and urban buyers (86%), at a 5% and 1% level respectively. Collectors who traded in baobab fruit mainly sold through assemblers, who also acted as agents for industrial processors.

Kitui County had the highest proportion of collectors selling baobab through assemblers (90%) and rural wholesalers (75%), while in Kilifi urban buyers were used the most (40.5%). Makueni County had the lowest proportion of collectors selling baobab through assemblers (3.2%) and urban buyers (24.3%). This can be explained by the geographical location of the counties in terms of road infrastructure and proximity to major urban baobab outlets. In Kitui County, a significantly higher proportion of collectors sold baobab pulp through assemblers rather than through rural wholesalers ($P < 0.01$) and urban buyers ($P < 0.01$). In addition, the number of collectors selling baobab pulp through urban buyers was significantly ($P < 0.01$) lower than that of those selling through rural wholesalers. This could be explained by the fact that urban markets are far away and rural wholesalers are relatively large and can absorb transaction costs transferred to them by collectors and assemblers. In Makueni County, a significantly higher proportion of collectors sold their baobab pulp through rural wholesalers ($P < 0.01$) and urban buyers ($P < 0.01$) than through assemblers. The preference for rural wholesalers and urban buyers could be attributed to price differences between the channels. Moreover, Makueni County is located centrally, on the highway between Nairobi and Mombasa, and collectors and traders benefit from cheaper modes of transport. In Kilifi County, a significantly higher proportion of baobab collectors sold their baobab through urban buyers in comparison to those who

sold through assemblers ($P < 0.01$) and rural wholesalers ($P < 0.01$). Rural wholesalers were virtually missing from this chain due to the proximity of Kilifi County to Mombasa City where major urban wholesalers and processors were based.

Baobab pulp profits per kilogram were highest among collectors who sold through urban buyers (KES 13.00) than through assemblers (KES 5) and rural wholesalers (KES 6), at $P < 0.01$ each. Profits are computed as revenue from baobab sales net of all cash costs of collection, marketing and transport, including labour costs. Profits are approximately 48%, 50% and 57% of the price of baobab in the assemblers', rural wholesalers' and urban buyers' outlets respectively. The average profit per collector was higher among collectors selling baobab through urban buyers (KES 14 130) than through assemblers KES (1 456) and rural wholesalers (KES 1 180), and significant at 1% for both. This is because collectors selling through urban buyers handled greater quantities and sold at higher prices than their counterparts.

3.2.3 Institutional factors

Approximately 54% of the baobab collectors who sold their baobab pulp through urban buyers had received some form of credit, compared to 33.6% and 35.2% of those who sold through assemblers and rural wholesalers respectively. The variations in participation in the different market outlets among credit holders were significantly higher for collectors selling through urban buyers vis-à-vis those selling through assemblers ($P < 0.05$) and rural wholesalers ($P < 0.05$).

3.3 Determinants of baobab collectors' choices of marketing channels

Multinomial logit results (Table 4) indicate that the model fit is good, with the pseudo R^2 equal to 0.48. The Wald χ^2 (36) of 550.92 is statistically significant ($P < 0.01$), implying that the regressors jointly explain the choice of marketing channels. Heteroscedasticity is ruled out by the χ^2 value of 0.34 for the Breusch-Pagan/Cook-Weisberg test, which is insignificant ($P > 0.10$). Similarly, multicollinearity is not a problem, as is evident from the mean value of the variance inflation factor (VIF), of 1.42, which is far less than the maximum accepted value of 10 (Gujarati 2004). Multinomial coefficients and relative risk ratios are difficult to interpret. Hence, marginal effects were computed from the multinomial logit coefficients to evaluate the effects of the covariates on the outcome probabilities, as recommended for policy purposes (Cameron & Trivedi 2010; Wulff 2015). The marginal effects are presented in Table 4.

Table 4: Determinants of baobab collectors' marketing channels

| Marketing channel | Assemblers | | Rural wholesalers | | Urban buyers | |
|---|------------|------|---------------------------------|------|--------------|------|
| Variables | dy/dx | S.E. | dy/dx | S.E. | dy/dx | S.E. |
| Human capital factors | | | | | | |
| Gender Male | 0.04 | 0.06 | -0.07* | 0.06 | 0.03* | 0.02 |
| Age | -0.23*** | 0.09 | 0.18* | 0.09 | 0.06** | 0.03 |
| Number of children | -0.03 | 0.05 | -0.06* | 0.05 | 0.08** | 0.04 |
| Marital status (Single) | | | | | | |
| Married | -0.05 | 0.18 | -0.00 | 0.18 | 0.06** | 0.03 |
| Divorced | -0.36* | 0.21 | 0.34 | 0.21 | 0.02*** | 0.01 |
| Widowed | -0.04 | 0.19 | -0.10 | 0.19 | 0.14*** | 0.03 |
| Separated | -0.29 | 0.22 | 0.28 | 0.22 | 0.01 | 0.01 |
| Other incomes | 0.02 | 0.03 | 0.01** | 0.03 | -0.02* | 0.01 |
| Number of trees | 0.11*** | 0.03 | -0.11** | 0.03 | 0.01 | 0.01 |
| Baobab collection point (Own farm) | | | | | | |
| Neighbour's farm | -0.31** | 0.13 | 0.32 | 0.13 | -0.02 | 0.01 |
| Communal land | -0.25*** | 0.09 | 0.12* | 0.10 | 0.13*** | 0.03 |
| Forest | -0.15 | 0.13 | -0.38** | 0.03 | 0.53*** | 0.12 |
| Experience selling | 0.11*** | 0.03 | -0.12** | 0.03 | 0.01 | 0.01 |
| Number of buyers | -0.13** | 0.06 | 0.18* | 0.05 | -0.05* | 0.03 |
| Transactional factors | | | | | | |
| Price of baobab | -0.60*** | 0.21 | 0.38 | 0.22 | 0.22** | 0.10 |
| Other price awareness | -0.09* | 0.05 | -0.09* | 0.06 | 0.18*** | 0.03 |
| Labour cost | -0.08 | 0.07 | 0.02* | 0.07 | 0.06** | 0.03 |
| Transport cost | 0.01 | 0.09 | 0.02* | 0.09 | -0.02 | 0.02 |
| Packaging cost | -0.15** | 0.07 | 0.11* | 0.07 | 0.04* | 0.02 |
| Distance to market | -0.04 | 0.03 | -0.02** | 0.03 | 0.06** | 0.03 |
| Product form (Whole fruit) | | | | | | |
| Baobab pulp | -0.33* | 0.09 | 0.28* | 0.09 | 0.05*** | 0.01 |
| Both | -0.47 | 0.12 | -0.02 | 0.10 | 0.49*** | 0.07 |
| Institutional factors | | | | | | |
| Access to credit Yes | 0.00* | 0.05 | -0.02* | 0.05 | 0.02 | 0.02 |
| Access to training Yes | -0.18 | 0.14 | 0.23 | 0.14 | -0.05 | 0.03 |
| Multicollinearity: Variance Inflation factor (VIF) test | | | Number of observations = 268.00 | | | |
| VIF = Mean (1.42); Max (2.84); Min (1.05) | | | Wald χ^2 (36) = 550.92 | | | |
| Heteroscedasticity: Breusch-Pagan/Cook-Weisberg test | | | Prob > χ^2 = 0.00 | | | |
| Chi ² (1) = 0.34; Prob > χ^2 = 0.56 | | | Pseudo R ² = 0.48 | | | |
| | | | Log pseudo likelihood = -137.96 | | | |

Note: dy/dx for factor levels is the discrete change from the base level

* Authors' computation based on baobab survey data (2017)

3.3.1 Human capital factors

The marginal effects of gender are statistically significant for collectors selling through rural wholesalers ($P < 0.10$) and urban buyers ($P < 0.10$). This empirical evidence suggests that males were 0.07% less likely to sell through rural wholesalers and 0.03% more likely to sell through urban buyers than females. The reason for this could be that men enjoy greater freedom of movement and are able to travel further away from home for marketing purposes. These results confirm the findings of Oduol *et al.* (2017), namely that the majority of female avocado producers in Kandara (Kenya) chose to sell to local brokers despite low prices. Our results support their findings that men are increasingly moving into farming with previously neglected fruit trees that were the domain of women traders.

A collector's age significantly influenced their choice of marketing channel. A one-year increment in the age of the collector significantly ($P < 0.01$) reduced the probability of selling baobab pulp through assemblers by 0.23%, and increased the probability of selling through rural wholesalers ($P < 0.10$)

and urban buyers ($P < 0.05$) by 0.18% and 0.06% respectively. The results imply that younger collectors tend to sell their baobab pulp through assemblers, while older collectors sell through rural wholesalers and urban buyers. This is probably because assembler outlets entail lower barriers to entry for youthful starters. These barriers include lower transaction costs, the need for capital assets and baobab-specific marketing information.

Increasing the number of children by 1% significantly increased the probability of participation through urban buyers by 0.08% ($P < 0.05$) and reduced participation through rural wholesalers by 0.06% ($P < 0.10$). These results imply that number of children motivated baobab collectors to participate in urban outlets, where prices and profits are higher, hence increasing family income. These results corroborate those of Donkor *et al.* (2018b) that household size positively influences cassava sales in high-end markets in Nigeria.

Widowed and divorced collectors, the majority of whom were female, were the most likely ($P < 0.01$) to sell their baobab products through urban markets. Divorced collectors were the most unlikely to sell through assemblers ($P < 0.01$). Increasing participation by widows and divorcees in urban markets could be attributed to their assumption of the responsibility of being a household head, including making decisions on production, sales and use of proceeds (Oduol *et al.* 2017). The majority of widowed and divorced collectors indicated that they started baobab trading after their spouses died or left them. For example, some women said: “I have to work hard to feed my family that is why I brave the harsh weather and risk in the cities ...” “... Am the bread winner of my family ...” Being married, on the other hand, provided the couple, especially the male counterpart, with opportunities to participate in urban markets ($P < 0.05$) due to the flexibility arising from sharing responsibilities.

The marginal effects of other incomes are significantly positive ($P < 0.05$) and negative ($P < 0.10$) for collectors who sold their baobab pulp through rural wholesalers and urban buyers respectively. These results imply that collectors with relatively larger sources of other incomes tend to sell their baobab through rural wholesalers rather than through urban buyers. These results contradict our earlier expectation that higher incomes from other sources would provide an incentive to sell in urban markets. Davis *et al.* (2009) notes that rural nonfarm incomes are key determinant of input purchase, especially where credit is not accessible.

An increase in the number of baobab trees on the farm by 1% significantly increased ($P < 0.01$) the probability of selling baobab pulp through assemblers, by 0.11%, and decreased ($P < 0.05$) the probability of selling the pulp through rural wholesalers, by 0.11%. A plausible explanation for this observation is that failure to harvest all baobab trees in one go as a crop can contribute to selling through assemblers to save on transaction costs resulting from frequent visits.

Harvesting from neighbours' farms and communal lands as opposed to the collectors' own farms significantly reduced the probability of selling baobab through assemblers, by 0.31% ($P < 0.05$) and 0.25% ($P < 0.01$) respectively. Moreover, harvesting from communal lands and forests significantly ($P < 0.01$) increased the probability of selling through urban buyers, by 0.13% and 0.53% respectively. This is probably because baobab collected outside an owner's farm is likely to incur additional access fees and charges that compel the collector to participate in urban markets, which offer better prices and therefore cover the costs and maximise profits.

Collectors with more experience in terms of years of selling baobab pulp preferred assembler outlets ($P < 0.01$) to selling through rural wholesalers ($P < 0.05$). A one-year increment in selling experience increased the likelihood of selling through assemblers by 0.11% and reduced the probability of selling through rural wholesalers by 0.12%. The results are contrary to our expectation, but the findings may be attributed to transactional risk avoidance associated with the movement of baobab from home to marketplace.

Knowing a variety of buyers significantly increased the chance of selling through rural wholesalers ($P < 0.10$) and reduced the likelihood of selling through assemblers ($P < 0.05$) and urban buyers ($P < 0.10$). Many collectors preferred rural wholesalers to urban buyers in order to minimise the transaction costs and risks associated with urban marketing, while getting significantly higher prices than from assemblers (Table 3).

3.3.2 Transactional factors

An increase in the price of baobab pulp by 1% significantly increased ($P < 0.05$) the probability of selling baobab pulp through urban buyers, by 0.22%, and reduced ($P < 0.01$) the probability of sale through assemblers, by 0.60%. Due to the significant differences in baobab prices between assembler and urban buyer outlets (Table 3), a 1% increase in price translates into a greater quantitative change in the urban outlets than in the assembler outlet, and hence the likely shift to urban outlets.

Price awareness in other locations of sale significantly increased ($P < 0.01$) the probability of selling baobab through urban buyers, by 0.18%, and decreased ($P < 0.10$) the likelihood of selling through assemblers and rural wholesalers, by 0.09% each. These results are consistent with our expectations and are in agreement with Donkor *et al.* (2018b), who found that farmers who have access to price information are the most likely to sell their cassava through processors.

Labour, transport and packaging costs are the most important input costs influencing baobab collectors' choice of marketing channels. Collectors who incurred higher labour costs preferred to sell their baobab pulp through urban buyers ($P < 0.05$) and rural wholesalers ($P < 0.10$). However, as transport costs increased, collectors tended to sell their baobab pulp through rural wholesalers to cut down the costs of urban markets. Transport costs constitute one input cost that baobab collectors can control because it varies according to the distance to market. The results agree with Donkor *et al.* (2018b), who found that an increase in transportation cost reduced the farmer's probability of selling cassava to processors in Nigeria, most of whom are based in urban markets. An increase in the packaging cost significantly reduced the probability of selling to assemblers ($P < 0.05$) and increased the likelihood of selling through rural wholesalers ($p < 0.10$) and urban buyers ($p < 0.10$), where baobab prices are higher.

Distance to selling market correlates positively with selling baobab through urban buyers ($P < 0.05$), and negatively with selling through rural wholesalers ($P < 0.05$). The higher prices offered in urban markets cover the transport costs to markets. Within rural markets, collectors reduced sales through rural wholesalers as the distance to market increased, probably opting to sell through assemblers who were closer to them to save on transport costs. In rural markets, motorbikes are the most commonly used mode of transport and, being limited in carrying capacity, charge relatively more per kilometre than conventional transport systems, such as trucks and commuter buses connecting to towns and cities.

Selling baobab in the form of pulp as opposed to whole fruit tended to positively influence selling through rural wholesalers ($P < 0.10$) and urban buyers ($P < 0.01$) and reduce sale through assemblers ($P < 0.10$). Those selling both forms of baobab tended to sell through urban buyers ($P < 0.01$).

3.3.3 Institutional factors

Contrary to the study expectation, collectors who had access to credit were more likely to sell their baobab through assemblers ($P < 0.10$) and unlikely to sell it through urban buyers ($P < 0.10$). The inclination towards using assemblers could be attributed to collectors' preference for buyers who are readily available, nearer to their homes, and those that they feel are safe and trustworthy to deal with (Table 2). Training was not considered a significant factor influencing the choice of marketing channel.

4. Conclusion and policy implications

This study concludes that there are five marketing channels available to baobab collectors. They are assemblers, rural wholesalers, urban wholesalers, urban retailers and processors. The majority (86%) of the collectors participated through rural markets (assemblers and rural wholesalers). Only 14% of the collectors traded through urban buyers (urban wholesalers, urban retailers and processors). Export channels are conspicuously missing from the chain, while participation through processors and retailers is minimal. The results show that the total quantities supplied through assemblers and rural wholesalers (rural markets) are higher than those supplied through urban markets. However, on an individual basis, collectors selling through urban buyers supplied larger quantities of baobab. Higher prices in urban markets can be expected to cover the greater operational costs involved compared to local markets. Human capital and institutional factors, except training, significantly influenced the choice of marketing channels at various levels of significance. These conclusions are consistent with Barrett's (2008) findings that commodity prices are not the only factors that affect farmers' participation in the market. Collectors satisfy different interests through participation in the different channels. Rural markets provide smaller profits but are more easily accessible to female collectors and younger collectors. The results further show that collectors would rather do business with reliable traders with whom they have interacted before than go for high prices in unknown market outlets.

The results reveal the need for national and county governments to undertake capacity building initiatives to expand marketing outlets. This can be achieved through training collectors on quality standards and certification procedures to increase participation in global markets, where prices are the highest, and linking processing firms to collectors to facilitate the increased use of baobab as an ingredient in food, cosmetic and medical products. Consumers and collectors also need to be sensitised to baobab prices in alternative markets and cost reduction strategies to enable them to participate in more profitable markets. Moreover, collectors should be trained in and sensitised to the nutritional benefits of baobab so as to increase consumption and create new markets. Furthermore, rural roads and other physical infrastructure need to be improved to enhance access to all markets and facilitative services, such as access to credit and marketing information. Traders need to be sensitised to the preferences of collectors in terms of reliable trading arrangements.

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References

- Alvarez RM & Nagler J, 1994. Correlated disturbances in discrete choice models: A comparison of multinomial probit models and logit models. Social Science Working Paper 914, California Institute of Technology, Pasadena CA.
- Barrett CB, 2008. Smallholder market participation: Concepts and evidence from eastern and southern Africa. *Food Policy* 33(4): 299–317.
- Bellemare MF & Barrett CB, 2006. An ordered Tobit model of market participation: Evidence from Kenya and Ethiopia. *American Journal of Agricultural Economics* 88(2): 324–37.
- Bellin H, 2016. Which marketing channel is right for your company? *Journal of Marketing Channels* 23(3): 157–61.
- Ben-Akiva ME & Lerman SR, 1985. Discrete choice analysis: Theory and application to travel demand. Cambridge MA: MIT Press.
- Buchmann C, Prehler S, Hartl A & Vogl CR, 2010. The importance of baobab (*Adansonia digitata* L.) in rural West African subsistence – Suggestion of a cautionary approach to international market export of baobab fruits. *Journal of Ecology of Food Nutrition* 49(3): 145–72.
- Cameron AC & Trivedi PK, 2010. Microeconometrics using Stata. Revised edition. College Station TX: StataCorp LP.
- Chung C, Dong D, Schmit TM, Kaiser HM & Gould BW, 2005. Estimation of price elasticities from cross-sectional data. *Agribusiness* 21(4): 565–84.
- Coe SA, Clegg M, Armengol M & Ryan L, 2013. The polyphenol-rich baobab fruit (*Adansonia digitata* L.) reduces starch digestion and glycemic response in humans. *Nutrition Research* 33(11): 888–96.
- Davis B, Winters P, Reardon T & Stamoulis K, 2009. Rural nonfarm employment and farming: Household-level linkages. *Agricultural Economics* 40(2): 119–23.
- De Caluwé E, 2011. Market chain analysis of baobab (*Adansonia digitata* L.) and tamarind (*Tamarindus indica* L.) products in Mali and Benin. PhD dissertation, Ghent University, Ghent, Belgium.
- De Caluwé E, Halamová K & Van Damme P, 2010. *Adansonia digitata* L.: A review of traditional uses, phytochemistry and pharmacology. *Afrika Focus* 23(1): 11–51.
- Donkor E, Onakuse S, Bogue J & De los Rios-Carmenado I, 2018a. Promoting value addition among farmers in the cassava food value chain in Nigeria. *British Food Journal* 120(9): 2047–65.
- Donkor E, Onakuse S, Bogue J & De los Rios-Carmenado I, 2018b. Determinants of farmer participation in direct marketing channels: A case study for cassava in the Oyo State of Nigeria. *Spanish Journal of Agricultural Research* 16(2): e0106.
- European Commission, 2008. Commission decision: Authorizing the placing on the market of baobab dried fruit pulp as a novel food ingredient under Regulation (EC) No. 258/97 of the European Parliament and of the Council. Official Journal of the European Union. Available <https://eur-lex.europa.eu/legal-content/HR/TXT/?uri=CELEX%3A32008D0575>
- Food and Drug Administration (FDA), 2009. Agency response letter GRAS, Notice No. GRN 000273, 25 July 2009. Silver Spring MD: US Food and Drug Administration. <http://www.fda.gov/food/ingredientspackaginglabeling/GRAS/NoticeInventory/ucm174945.htm>
- Ferrand D, Gibson A & Scott H, 2004. Making markets work for the poor: An objective and an approach for governments and development agencies. Woodmead: Commark Trust.
- Gebauer J, Adam Y, Cuni Sanchez A, Darr D, Eltahir M, Fadl K, Fernsebner G, Fre, M, Habte TY, Hammer K, Hunsche M, Johnson H, Kordofani M, Krawinkel M, Kugler F, Luedeling E, Mahmoud T, Maina A, Mithöfer D & Kehlenbeck K, 2016. Africa's wooden elephant: The baobab tree (*Adansonia digitata* L.) in Sudan and Kenya. A review. *Genetic Resources and Crop Evolution* 63(3): 377–99.
- Greene WH, 2003. Econometric analysis. Fifth edition. Upper Saddle River NJ: Prentice Hall.
- Gujarati D, 2004. Basic econometrics. Fourth edition. Boston: The McGraw-Hill Companies.

- Haq N, Bowe C & Dunsiger Z, 2008. Challenges to stimulating the adoption and impact of indigenous fruit trees in tropical agriculture. In Akinnifesi FK, Leakey RRB, Ajau OC, Sileshi G, Tchoundjeu Z, Matakala P & Kwesiga FR (Eds.), *Indigenous fruit trees in the tropics: Domestication, utilization and commercialization*. Wallingford: CAB International.
- Hatzenbuehler PL, 2019. Barriers to trade in Sub-Saharan Africa food markets. *African Journal of Agricultural and Resource Economics* 14(1): 1–13.
- Jäckering L, Fischer S & Kehlenbeck K, 2019. A value chain analysis of baobab (*Adansonia digitata* L.) products in Eastern and Coastal Kenya. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS)* 120: 91–104.
- Kaboré D, Sawadogo-Lingani H, Diawara B, Compaoré CS, Dicko MH & Jakobsen M, 2011. A review of baobab (*Adansonia digitata*) products: Effect of processing techniques, medicinal properties and uses. *African Journal of Food Science* 5(16): 833–44.
- Kamatou G, Vermaak I & Viljoen A, 2011. An updated review of *Adansonia digitata*: A commercially important African tree. *South African Journal of Botany* 77(4): 908–19.
- Kotler P & Armstrong G, 2012. *Principles of marketing*. Fourteenth edition. Upper Saddle River NJ: Pearson Education.
- Krafft M, Goetz O, Mantrala M, Sotgiu F & Tillmanns S, 2015. The evolution of marketing channel research domains and methodologies: An integrative review and future directions. *Journal of Retailing* 91(4): 569–85.
- Lee J, Gereffi G & Beauvais J, 2012. Global value chains and agrifood standards: Challenges and possibilities for smallholders in developing countries. *Proceedings of the National Academy of Sciences of the United States of America* 109(31): 12326–31.
- Lowore J & Boa E, 2001. *Bowa markets: Local practices and indigenous knowledge of wild edible fungi*. Egham UK: CABI Bioscience.
- Mahonya S, Shackleton CM, and Schreckenberg K, 2019. "Non-timber Forest Product Use and Market Chains Along a Deforestation Gradient in Southwest Malawi", *Frontiers in Forests and Global Change*, Vol. 2 No. 71.
- Manski C, 1973. The stochastic utility model of choice. School of Urban and Public Affairs, Carnegie-Mellon University, Pittsburgh.
- Manski C, 1977. The structure of random utility models. *Theory and Decision* 8(3): 229–54.
- Marshall E, Schreckenberg K & Newton AC, 2006. Commercialization of non-timber forest products: Factors influencing success. Lessons learned from Mexico and Bolivia and policy implications for decision-makers. Nairobi: UNEP/Earthprint.
- McFadden D, 1981. Econometric models of probabilistic choice. In Manski C & McFadden D (eds.), *Structural analysis of discrete data with econometric applications*. Cambridge MA: MIT Press.
- Mithöfer D & Waibel H, 2008. Economics of on-farm production of indigenous fruits. In Akinnifesi FK, Leakey RRB, Ajau OC, Sileshi G, Tchoundjeu Z, Matakala P & Kwesiga FR (Eds.), *Indigenous fruit trees in the tropics: Domestication, utilization and commercialization*. Wallingford: CAB International.
- Muthai KU, Karori MS, Muchugi A, Indieka, AS, Dembele C, Mng'omba S & Jamnadass R, 2017. Nutritional variation in baobab (*Adansonia digitata* L.) fruit pulp and seeds based on Africa geographical regions. *Food Science & Nutrition* 5(6) 1116-29.
- Oduol JBA, Mithöfer D, Place F, Nang'ole E, Olwande J, Kirimi L & Mathenge M, 2017. Women's participation in high value agricultural commodity chains in Kenya: Strategies for closing the gender gap. *Journal of Rural Studies* 50: 228–39.
- Ouedraogo SA, 2019. Smallholders' agricultural commercialisation, food crop yield and poverty reduction: Evidence from rural Burkina Faso. *African Journal of Agricultural and Resource Economics* 14(1): 28–41.
- Rahul J, Jain MK, Singh SP, Kamal RK, Naz A, Gupta AK & Mrityunjay SK, 2015. *Adansonia digitata* L. (baobab): A review of traditional information and taxonomic description. *Asian Pacific Journal of Tropical Biomedicine* 5: 79–84.
- Rao JM, 1989. Agricultural supply response: A survey. *Agricultural Economics* 3(1): 1–22.

- Sanchez AC, Osborne PE & Haq N, 2010. Identifying the global potential for baobab tree cultivation using ecological niche modelling. *Agroforestry Systems* 80: 191–201.
- Shackleton CM & Pullanikkatil D, 2018. Considering the links between non-timber forest products and poverty alleviation. In Pullanikkatil D & Shackleton CM (eds.), *Moving out of poverty through using forest products: Personal stories*. Heidelberg: Springer.
- Shackleton S, Shanley P & Ndoye O, 2007. Invisible but viable: Recognising local markets for non-timber forest products. *International Forestry Review* 9(3): 697–712.
- Sidibe M & Williams J, 2002. *Baobab: Adansonia digitata*. Southampton University, Southampton UK: International Centre for Underutilised Crops.
- Wickens GE & Lowe P, 2008. *The baobabs: Pachycauls of Africa, Madagascar and Australia*. Berlin: Springer Science and Business Media.
- Wittink L, 2011. *Choice modelling: An overview of theory and development in individual choice behaviour modelling*. BMI Paper, Frije Universiteit Amsterdam, Amsterdam, The Netherlands.
- Woldie GA & Nuppenau E, 2011. A contribution to transaction costs: Evidence from banana markets in Ethiopia. *Agribusiness* 27(4): 493–508.
- Wooldridge JM, 2010. *Econometric analysis of cross section and panel data*. Second edition. Cambridge MA: The MIT Press.
- Wulff J, 2015. Interpreting results from the multinomial logit model. *Organizational Research Methods* 18(2): 276–99.