African Journal of Science, Technology, Innovation and Development

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rajs20

Value chain and marketing margins analysis of watermelon: An insight from Northern Uganda

Jemima Alla Houessou, Basil Mugonola & Walter Odongo

To cite this article: Jemima Alla Houessou, Basil Mugonola & Walter Odongo (2022) Value chain and marketing margins analysis of watermelon: An insight from Northern Uganda, African Journal of Science, Technology, Innovation and Development, 14:2, 359-367, DOI: 10.1080/20421338.2020.1829353

To link to this article: https://doi.org/10.1080/20421338.2020.1829353

African Journal of Science, Technology, Innovation and Development, 2022
Vol. 14, No. 2, 359–367, https://doi.org/10.1080/20421338.2020.1829353

Value chain and marketing margins analysis of watermelon: An insight from Northern Uganda

Jemima Alla Houessou, Basil Mugonola and Walter Odongo *

Department of Rural Development and Agri-business, Gulu University, Gulu, Uganda
*Corresponding author email: *odongo78@gmail.com*

Watermelon is one of the emerging market oriented agricultural products with potential of improving rural livelihoods and alleviating poverty. Consequently, watermelon is attracting attention and gaining a bigger market share as a cash crop. This paper analyzed the value chain and marketing of watermelon in Northern Uganda. Data was collected through a cross sectional survey of 300 watermelon value chain actors (100 producers, 100 wholesalers and 100 retailers). Data was analyzed using descriptive statistics, value chain mapping, ordinary least squares regression and gross margin analysis. Results shows that the watermelon value chain in Northern Uganda involves six actors embedded within eight differentiated channels. The producer-wholesaler-retailer-consumer channel was the dominant watermelon marketing channel, handling 77% of marketed watermelon per month. Marketing margin analysis shows that watermelon marketing is a profitable venture to all value chain actors, with producers having the highest marketing margins (98%) compared to wholesalers (58%) and retailers (64%). The study finds that watermelon marketing margins are significantly influenced by access to credit, access to marketing channels information and labour costs. Results of this study call for policy interventions that enable access to low-cost credit facilities for watermelon value chain actors. Additionally, there is need to improve the dissemination of watermelon marketing information to enable value chain actors make informed marketing decisions.

Keywords: value chain, marketing channels, marketing margins, Northern Uganda, watermelon

Introduction

Fruits and vegetables offer great nutritional values to the human diet (Idah, Ajisegiri, and Yisa 2007) as they provide essential nutrients such as calcium, vitamin A, Vitamin C, iron, protein, fibre, magnesium and potassium (Ada-Okugbowa and Egbodion 2017; Onyemauwa 2010; Paris 2016). Watermelon (*Citrullus lanatus*) is one of the most important vegetables in the world grown for its nutritious fruit and the vegetative parts (Ajewole 2015; Schippers 2000; Ukwuaba, Agbo, and Adesun 2018). Watermelon belongs to the cucurbit family commonly referred to as *Cucurbitaceae* (Huh, Choi, Solmaz, and Sari, and Kim 2014; Paris 2016) and is a warm-season crop related to cantaloupe, squash, cucumber and pumpkin (Ukwuaba, Agbo, and Adesun 2018). As of 2016, global watermelon production stood at 117 million metric tons (m/t), with China, Iran, Turkey, Brazil and Egypt leading in production (Huh et al. 2014). Africa contributes about 5% of the world watermelon production (FAO 2008). Compared to the other cucurbits, watermelons' global consumption is the highest (Adeoye, Usman, and Badmus 2011; Ajewole 2015; Baba, Yelwa, and Sanchi 2014; Paris 2016).

Extant literature have indicated that production of exotic vegetables such as watermelon generates higher profits, and provides more employment and income for farmers compared to indigenous vegetables (Adeoye, Usman, and Badmus 2011). Production of watermelon can therefore serve as an important source of revenue for farmers and other value chain actors (Ajewole 2015; Dovie, Witkowski, and Shackleton 2003; Wongnaa et al. 2014). Uganda is a tropical country with a great production potential for fruits and vegetables such as watermelon. Consequently, fruit and vegetables production have potential of providing foreign exchange earnings and creating job opportunities. This in turn can contribute to food and income security and general economic development in the country (Uganda IPC Technical Working Group 2017). Watermelon is therefore one of the emerging market oriented agricultural products with potential of improving rural livelihoods and alleviating poverty amongst smallholder farmers in Uganda (Jemima 2020). However, for this to be realized, there is need to understand how the markets for watermelon can work better for the poor, smallholder farmers (Odongo and Etany 2018; Wongnaa et al. 2014).

Despite its economic importance and potential, watermelon marketing in Uganda has not received much attention over the last two decades (Okiror et al. 2017). Anecdotal reports suggest that watermelon marketing in Uganda is inefficient due to inadequate storage and processing facilities, high transport cost, high perishability, and inefficient transport facilities. Most of the available literature on watermelon marketing in Uganda is based on newspapers reports, with no scientific evidence to back up the reportage. Like most vegetables, watermelon's unique characteristics such as perishability, bulkiness, standardization requirements and seasonality makes its marketing complex and challenging; hence a need to analyze and understand its marketing dynamics (Okiror et al. 2017; Wongnaa et al. 2014). The need to understand the marketing of watermelon is further justified by the fact that although watermelon is predominantly produced in remote rural areas in Uganda, it is highly demanded and consumed in urban areas. As such there is need for watermelon to be quickly moved to the market before it deteriorates. This study thus sought to examine the marketing of watermelon by assessing the existing marketing channels and trade routes; determining the marketing margins that accrues to each value chain actor; and assessing the factors influencing marketing margins of watermelon value chain actors in Northern Uganda.

Methodology

Study area

The study was conducted in Gulu and Nwoya districts of Northern Uganda. The districts were purposively selected for this study because of their potential in fruit and vegetable production in Uganda. Within Northern Uganda, these two districts have the highest production of watermelon. The main economic activities in the two districts is agricultural production. Agricultural production in Northern Uganda is dominated by smallholder farmers with common beans, cowpeas, cassava, being the major food crops. They also produce cash crops like rice, maize, sorghum, soybeans and fruits and vegetables. These smallholder farmers are also the major contributors to the district's economy (UBOS 2017). Gulu is located between 02°38′N 32°00′E. It is bordered by Omoro in the east, Amuru and Nwoya in the west, and Kitgum in the north. The population of Gulu is 297,000 (UBOS 2017). Nwoya district is bordered by Amuru District to the north, Gulu district to the north-east, Oyam District to the east, Kiryandongo District to the south-east, Masindi district to the south, and Buliisa district to the south-west. It is located between 02°38′N 32°00′E. The population of Nwoya district is estimated at 175,000 (UBOS 2017).

Sampling design

A cross-sectional research design to sampling and data collection was adopted in the study. A combination of purposive, stratified and simple random sampling techniques was used to select the study respondents. The first step involved purposive selection of Gulu and Nwoya districts due to the predominance of watermelon production. The second step involved a purposive selection of eight urban markets where watermelon is sold in relatively large quantities in the two districts. The third step involved the stratification of value chain actors into producers, wholesalers and retailers according to the volume of produce handled. For producers, the landholding size (at least 1 acre) was considered. The last step involved a purposive selection of 100 producers from the rural areas surrounding the eight selected urban markets; 100 wholesalers; and 100 retailers from the selected eight urban markets in the two districts, giving a total sample size of 300 respondents.

Data collection

Primary data collection took place between the months of November and December 2018. Data was collected with the aid of a semi-structured questionnaire. The questionnaire was pretested and adjustments made before production of the final version. The questionnaire was structured into three main sections; the first section focused on the production to consumption pathway for watermelon. i.e. actors, their activities and functions performed. The second section focused on marketing of watermelons including buying and selling price, quantity and marketing cost incurred by value chain actors. The third section looked at the value chain actors' characteristics including land holding, experience, access to credit and market information amongst others.

Data analysis

Watermelon value chain was analyzed using the value chain mapping approach (Kaplinsky and Morris 2000). Here, the different value chain actors were identified, different channels used by the chain actors as well as their role in the value chain were described. The mean monthly volume of watermelon marketed by each category of actor (producers, wholesalers and retailers) to their potential buyers was ascertained. The percentage of watermelon fruit that moved through each channel was determined by summing up the percentage of watermelon fruit handled by each and every actor within the channel. Channel comparison was then made based on the percentage of fruits that flow through each channel.

Marketing margins were calculated through getting the difference between the farm gate price and the cost of production for the producers; and the difference between the selling prices and buying prices for the traders. For the different value chain actors, the marketing margins were calculated as follows:

For producers

$$\mathrm{MM}_P = \mathrm{SP} - \mathrm{UP} \tag{1}$$

MM_P: Producers marketing margins; SP: Average selling price of producers; UP: Average unit production cost of watermelon by producers.

For wholesalers

$$\mathrm{MM}_W = \mathrm{SP} - \mathrm{BP} \tag{2}$$

where MM_W: Wholesalers marketing margins; SP: Average selling price of wholesalers; BP: Average buying price of wholesalers.

For retailers

$$\mathrm{MM}_R = \mathrm{SP} - \mathrm{BP} \tag{3}$$

where: MM_R: Retailers' marketing margins; SP: Average selling price of retailers; BP: Average buying price of retailers.

For the influence of socio-economic characteristics on the marketing margins, an Ordinary Least Squares (OLS) regression model was estimated for each of the value chain actors. The OLS model was specified as:

$$Y_i = b_0 + b_1 X_1 + \ldots + b_n X_n + \mu_i \tag{4}$$

where: Y_i = Marketing margin from watermelon marketing (UgX/kg); b_0 = regression coefficient; b_i = coefficient of the explanatory variables; X_i–X_n = vector of explanatory variables (X_1 = age of respondents, X_2 = household size, X_3 = production experience, X_4 = land size, X_5 = access to credit, X_6 = purchase price, X_7 = loading cost, X_8 = labour cost, X_9 = communication cost, X_{10} = off-loading cost, X_{11} = market trend and X_{12} = marketing channel); and μ_i = random error.

Table 1: Socio-economic characteristics of watermelon value chain actors ($N = 300$).

Variables	Producers (%)	Wholesalers (%)	Retailers (%)	Total (%)
Categorical variables				
Gender				
Male	74	31	24	43
Female	26	69	76	57
Marital status				
Married	84	74	69	75
Single	3	7	20	10
Divorced	8	15	10	11
Widowed	4	4	1	3
Widower	1	–	–	1
Education level				
Primary school	30	56	69	52
Secondary school	57	44	30	44
Tertiary	13	–	1	5
Continuous variables (means)				
Household size	6	7	7.2	7
Age	37	37	31	35
Experience	3	3	5	3
Landholding	2	–	–	–
Access to credit	29	58	77	55

Results

Characteristics of watermelon value chain actors

Majority (57%) of watermelon actors were women. Although women dominated the marketing of watermelon, men were dominant at the production level. Most (55%) of the value chain actors had access to credit. However, access to credit was mainly for traders (wholesalers and retailers) and not producers (Table 1).

Watermelon value chain

Watermelon value chain and marketing channels were mapped to provide a concise information on watermelon flow from production to consumption point, actors involved and the function(s) performed by each actor. Results show that trading in watermelon took place amongst six major actors, i.e. producers, wholesalers, retailers, exporters, institutional consumers and consumers. These actors perform different, but complementing functions along the value chain of watermelon. The different actors and the marketing channels are presented in Figure 1.

Producers

Producers were mainly smallholder farmers who produced on average two acres of watermelon per season. The major functions performed by producers included growing, harvesting, grading, sorting and selling of water melon. Producers grew different varieties of watermelon such as *sugar baby*, *sweet rose*, *sukari* F1, *tiger F1* and *maradady*. Producers sold their watermelon to wholesalers, retailers, and directly to individual and institutional consumers as whole fruits. They also add value to the watermelon through grading by size, quality and varieties as well as slicing and selling pieces of water melon to consumers. Transactions between producers and the other value chain actors are mostly done at farm gate, village markets or along road side markets.

Exporters

Watermelon exporters were mostly from Kenya. The Ugandan watermelon exporters buy mostly from producers on a monthly basis. On average, an exporter handles 30 metric tons of watermelon a month. The main value chain function performed by the exporters included gathering, sorting, transporting, and selling. Ugandan watermelon exporters purchased and market different varieties of watermelon and sell to wholesalers, retailers and consumers in fresh form (selling to both local markets in Uganda and external market in Kenya). They grade watermelon by size, quality and varieties. Transaction between producers and exporters take place mostly at the farm gate.

Wholesalers

Watermelon wholesalers were mostly from Gulu City. They buy watermelon in bulk from producers and sell it on to retailers, institutional consumers and individual consumers (Figure 1). On the average, the monthly quantity of watermelon handled by wholesalers was about 15 metric tons. The main value chain functions performed by wholesalers included gathering, transporting, grading and selling. Wholesalers marketed different varieties of watermelon to either retailers, institutional and individual consumers as whole fruit. They also grade watermelon by size, quality and varieties and thus sold in pieces, heaps or in form of value addition (slices). Transactions between wholesalers and the various actors take place mostly in town or road side markets.

Retailers

Watermelon retailers are located within Gulu City. They buy watermelon either from producers or wholesalers. On the average, the monthly quantity handled by retailers was about 12 metric tons. They market the same varieties like producers and wholesalers directly to final (individual) consumers. Retailers usually adds value to the watermelon fruit through grading for size and quality, and

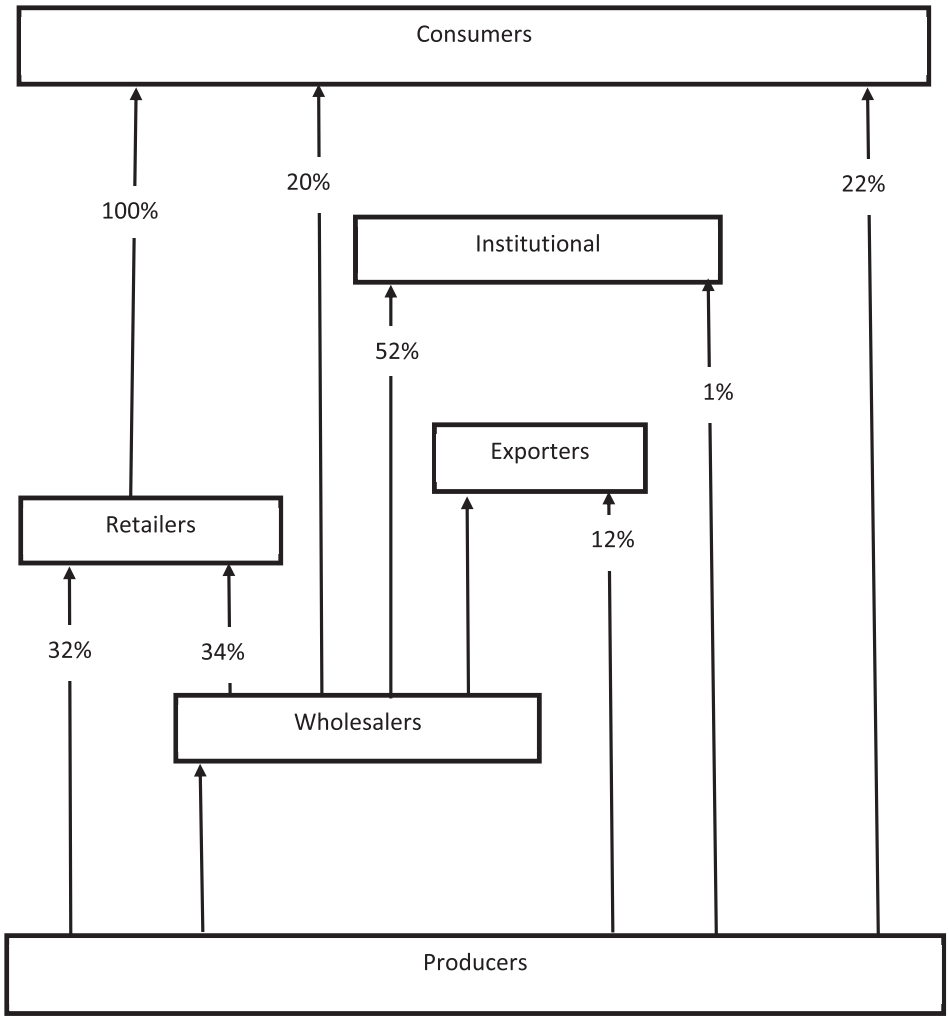

Figure 1: Watermelon value chain.
Source: Adapted from Jemima 2020

cutting the fruit and selling slices. Transactions between retailer and consumers are done in either town markets or road side (Figure 1).

Institutional consumers

Institutional consumers are located mainly in Gulu City. They are mostly hotels, and restaurants. They purchase watermelon from either wholesalers or producers in medium quantities for direct consumption by their clients either as juice or salads. On the average, the monthly quantity marketed to institutional actors was about seven (7) metric tons. Institutions generally add value to the water melon through processing it into juices and fruit salads.

Individual consumers

Consumers are final buyers of watermelon and mostly located in Gulu City. They included individuals and households who buy for final consumption purpose. On the average, the monthly quantity bought by consumers was 13 metric tons. The main functions of consumers involved buying and consumption in the form of juice, slices, salads or whole fruits. Transactions between producers and consumers; wholesalers and consumers; and retailers and consumers take place at farm gate; village markets; town or along road side markets (Figure 1).

Watermelon marketing channels

Value chain analysis revealed eight differentiated marketing channels for watermelon in the study area (Figure 1). Channel comparison was made according to the monthly volume of watermelon that passed through each channel and the multiple responses given by each category of actor. The percentages (%) indicate the amount of watermelon marketed as they pass through each of the channel from the producers to the ultimate consumers. The most important channels are described in the following paragraphs.

The first channel, producer-wholesaler-retailer-consumer was the major and the most important channel in the watermelon value chain. Throughout this channel, watermelon moved as whole fruit. Producers supply watermelon to wholesalers who sell to retailers, who in turn retail to the ultimate consumers. The transaction of watermelon from producers to wholesalers was done at farm gate, along road side or in village markets. On the average, the monthly volume of watermelon sold by producers was 142 metric tons, representing 77% of the total volume of watermelon marketed per month. The average

retail price received by producers through this channel was UgX 2,233 (0.61 USD) for a piece of watermelon giving a profit of UgX 2,208 (0.60 USD) per fruit.

The second most important channel was the producer-retailer-consumer channel. Here, producers sold watermelon to retailers who in turn deliver to consumers always as whole fruit. Additionally, retailer could add value to the watermelon through slicing and selling pieces. Transaction of watermelon between retailers and consumers took place in village markets, urban markets or along the road side markets. On the average, the monthly volume of watermelon sold by retailers was 1.580 metric tons, representing 66% of the monthly watermelon sales. Retailers purchased a piece of watermelon at UgX 2,559 (0.70 USD) and could sell it at UgX 6,992 (1.91 USD) on average giving a profit of (1.21 USD) per piece.

The third most important channel involved producers selling to wholesalers, who later on supply institutional consumers. Institutional consumers in turn process and sell watermelon to their customers as either salads, juice or slices. Transactions between institutional consumers and end consumers are mainly done in hotels and restaurants. On the average, the monthly volume of watermelon sold by wholesalers was 11 tons, representing 43% of monthly watermelon sales. Wholesalers purchased a piece of watermelon at UgX 2,233 (0.61 USD) and could sell it at UgX 5,330 (1.53 USD) on average giving a profit of (0.84 USD) per piece.

The fourth channel was the producer-wholesaler-consumer where producers supply wholesalers, who in turn sell to institutional consumers who later on sell to the ultimate consumers. This channel handles 27% of the total monthly watermelon sales. The transaction between wholesalers and institutional consumers was mostly done in town, village or along the road side markets.

Marketing margins of watermelon

Marketing margin (MM) was estimated by getting the difference between the buying price and selling price (for wholesalers and retailers), and unit production costs and selling price (for producers). Findings show that on the average, producers received UgX 2,208 (0.61 USD) per fruit with the highest percentage marketing margins of 99%. Wholesalers received on the average UgX 3,097 (0.84 USD) per fruit with 58% as percentage marketing margins, whilst retailers received UgX 4,433 (1.21 USD) with 64% as percentage marketing margins in the sale of watermelon (Table 2).

One-way analysis of variance (ANOVA) was estimated to determine if the differences in the mean marketing margins of watermelon for producers, wholesalers and retailers were significant. Post hoc tests were performed with *P-value* being significant at 5% (Appendix 1). The study finds that producers received a significantly higher margin ($p = 0.01$) than wholesalers and retailers (Table 3).

Table 3: One-way ANOVA for mean MM of value chain actors.

Chain actors	Mean ± SD
Producers	2208.890 ± 222.370^{a}
Wholesalers	3096.830 ± 149.870^{b}
Retailers	4432.700 ± 75.670^{c}

Mean value with different subscripts indicate significant difference at 5%
p-value ≤ 0.005

Determinants of watermelon marketing margins

The influence of socio-economic factors on watermelon value chain actors' marketing margins was analyzed using OLS regression in STATA. The Breusch-Pagan test for heteroscedasticity had an insignificant X^2 value of 0.2, ruling out any chances of heteroscedasticity (Appendix 2). Additionally, the Variance Inflation Factor (VIF) test had a mean value of 1.19, suggesting that there was no multicollinearity amongst the independent variables. Further evidence of lack of multicollinearity was provided by the tolerance values of all independent variables which were all below 10 (Appendix 3). The correlation matrix also showed all the independent variables had a pair-wise correlation coefficient of less than 0.45 (see Appendix 3).

For producers, the estimated OLS model explained 28% of variation in producers marketing margins and had a significant F-Ratio (3.40) indicating that the model was adequate. Results show that age (*p-value* = 0.056); production experience (*p-value* = 0.04); marketing trend (*p-value* = 0.002); access to credit (*p-value* = 0.1); labour cost (*p-value* = 0.155); loading cost (*p-value* = 0.051); marketing channels (*p-value* = 0.005) and off-loading cost (*p-value* = 0.1) were the significant determinants of producers' marketing margins (Table 4). For instance, access to credit decreased producers' marketing margins by UgX 2,486; while a unit increase in labour cost increases producer marketing margins by UgX 0.01; and access to information on marketing channel increases producers' marketing margins by UgX 8,843 (Table 4).

For wholesalers, the OLS model was significant (*F-ratio* = 1.59) and explained 14% of variations in wholesaler marketing margins. Results indicate that age (*p-value*

Table 2: Mean marketing margins of watermelon value chain actors.

	Marketing margin (MM) components			
Value chain actor	Buying price	Selling price	MM	% MM
Producers	24	2,233	2,209	99
Wholesalers	2233	5,330	3,097	58
Retailers	2559	6,992	4,433	63

Calculation based on selling price by each actor
All calculations are in Uganda shillings (UgX)
Exchange rate used: 1 USD = UgX 3,669

Table 4: Determinants of marketing margins of watermelon value chain actors.

	Producers		Wholesalers		Retailers	
Variables	Coefficient	P ≥ t	Coefficient	P ≥ t	Coefficient	P ≥ t
Age	1.82	0.056**	4.42	0.038**	−8.97	0.005***
Household size	−3.19	0.208	−5.93	0.261	3.37	0.633
Production experience	−7.15	0.041**	–	–	–	–
Access to credit	−24.86	0.130*	−32.00	0.395	117.20	0.022**
Loading cost	–0.01	0.051**	0.02	0.128*	–	–
Labour cost	0.01	0.155*	−0.01	0.864	−0.01	0.064*
Communication cost	−0.01	0.506	0.01	0.098*	0.22	0.152*
Off-loading cost	−0.01	0.128*	−0.03	0.100*	–	–
Market trend	72.72	0.002***	11.08	0.855	121.85	0.332
Marketing channel information	88.44	0.005***	89.90	0.075*	103.86	0.498
Constant	2,182.98	0.000	2,949.61	0.000	4,578.94	0.000
R^2	0.28		0.14		0.18	
Adjusted R^2	0.20		0.05		0.12	
F-Ratio	3.40		1.59		2.92	
Prob > *F*	0.001		0.130		0.008	

= 0.03); marketing channel (*p-value* = 0.07); communication cost (*p-value* = 0.09); loading cost (*p-value* = 0.1) and off-loading cost (*p-value* = 0.1) were the significant determinants of wholesaler marketing margins (Table 4). For instance, a unit increase in off-loading cost decreases wholesalers' marketing margins by UgX 3; and information on marketing channel increases their marketing margins by UgX 8,989 (Table 4).

For retailers, the model was significant (*F*-ratio = 2.92) and explained 18% of variations in retailer marketing margins. The results show that age (*p-value* = 0.005); labour cost (*p-value* = 0.06); access to credit (*p-value* = 0.02) and communication cost (*p-value* = 0.1) were significant determinants of retailers marketing margins. For example, a unit increase in age decreased retailers' marketing margins by UgX 897; access to credit increases retailer marketing margins by UgX 2; and a unit increase in the cost of labour decreased retailers' marketing margins by UgX 6 (Table 4).

Discussions

This study examined the marketing of watermelon in Gulu and Nwoya districts of Northern Uganda. This was done through mapping the value chain, identifying the marketing channels of watermelon, determining the marketing margins of the different chain actors as well as the socio-economic and institutional factors that influence their marketing margins. It was observed that watermelon value chain involved six actors embedded within eight differentiated channels. The producer-wholesaler-retailer-consumer channel was the most used and the longest chain with 77% of marketed watermelon passing through it. The predominance of the longest channel in watermelon marketing shows that watermelon marketing employs many people, in form of intermediaries along the value chain. While this creates business opportunities for traders, it may result into increased prices for the final consumer as each actor seeks to maximize their profits. As the number of actors within the chain increases, the price of watermelon increases from one actor to another and thereby increasing the price paid by the final consumer. This observation also suggests that watermelon marketing is a profitable business that attracts many actors along the chain.

It was observed that producers earned the highest percentage marketing margins (99%), followed by retailers (65%) and wholesalers (58.1%). This result implies that marketing of watermelon either as whole fruit, in value added form (slices and juices) or graded forms makes business sense for all value chain actors. Producers having the highest marketing margins could be explained by the fact that they take advantage of the cheap family labour, hence incur lower unit production cost of watermelon (UgX 24). Additionally, producers were selling watermelon from the firm gate and as such eliminate extra marketing costs such loading, off-loading, license and transport. This observation highlights the market potential of watermelon production and its potential to improve livelihoods of rural households and thereby poverty alleviation.

The high percentage of marketing margins obtained by retailers compared to wholesalers could be attributed to the fact that retailers sourced watermelon from wholesalers hence, do not incur additional marketing cost associated with transport and on-loading/off-loading. Wholesalers usually move far distances gathering and transporting watermelon to urban centres and as such incurs the transport related marketing costs. Additionally, retailers have the option of selling watermelon either as whole fruit, or cut it into pieces and sell slices. When sliced into pieces, one watermelon fruit usually fetch a higher price than when sold as whole fruit. This value-adding activity of slicing watermelon therefore increases the returns to retailers. Wholesalers do not have this option of slicing and hence have to work with predefined unit selling prices for the whole fruit. This also underscores the fact that the economic value of watermelon in Uganda can be increased and ameliorated through value addition (Odongo and Etany 2018). The result is consistent with the findings of Obetta (2015) who observed a higher percentage marketing margins for banana retailers (14%) than wholesalers (11%); and a higher percentage marketing margins for plantain retailers (22%) compared to plantain wholesalers (12%) in Nigeria. The low percentage marketing margins obtained

by wholesalers could be justified by the fact that they sourced watermelon directly from producers, who are located in distant rural areas. As such they usually incur higher transaction (on-loading, off-loading and transport), which increases their marketing costs. In addition, because they operate from fixed sales points, wholesalers incur other costs associated with taxes and rent (Odongo and Etany 2018), which most retailers and producers do not incur.

It was observed that access to credit reduces producers marketing margins while it increases retailers marketing margins. The negative effect of credit access on producers marketing margin can be explained by the high interest rate charged by commercial banks and micro-finance institutions which increases the cost of production for the smallholder farmers. Smallholder farmers' financial needs are best served through belonging to self-help group such as Village Savings and Loans Associations (VSLA), or farmers' groups. These self-help groups offer affordable credits to farmer-members compared to commercial banks and microfinance institutions. With affordable credits, credit access should be able to improve farmers' productivity and hence increase their marketing margins (Karane 2016). Additionally, the limited (34%) access to extension services, especially marketing information could imply that farmers are not aware of the prevailing market conditions, hence unable to obtain low interest loans or access high value markets for their products.

Furthermore, increase in labour costs was observed to decrease retailers marketing margins, while increasing the producers marketing margins. The reasoning could be that increasing the amount of labour on the farm (labour cost) implies better field management and hence increased watermelon productivity. Increased productivity will result into higher revenues and increased marketing margins for producers. This result corroborates the findings of Balogun et al. (2018) who reported a significant and positive effect of labour cost on watermelon producer's marketing margins in Nigeria. For retailers, the negative relationship between labour costs and marketing margin is due to the fact that most retailers operate as sole proprietors, and usually handles all business activities by themselves. As such, any addition of labour for purposes such as on-loading and off-loading will increase their operating costs and hence a reduction in marketing margins. A similar explanation holds for the observed negative effect of off-loading cost on wholesalers marketing margins. For retailers and wholesalers, any additional marketing cost will only serve to reduce their profits and hence a reduction in marketing margins. Previous studies such as by Ajewole (2015) and Wongnaa et al. (2014) also observed a negative relationship between retailers gross margin and labour costs.

Access to information on marketing channels increases both producers and wholesalers marketing margins. Knowledge of marketing channel allows producers and wholesalers to make informed decisions regarding the choice of the channels, whom to sell within the different channels and at what price. Consequently, with market channel information available, value chain actors are able to choose marketing channels with the highest prices and hence the observed positive relationship between access to market information and marketing margin. This result find support in previous studies by Balogun et al. (2018) and Ukwuaba, Agbo, and Adesun (2018) who observed a positive relationship between access to market information and marketing margins.

Age had a negative effect on retailers marketing margins, and a positive effect on producers and wholesalers marketing margins. As sole proprietors, retailers rely on their personal skills, innovative mindset, and energy to drive the business. As age increases, this physical and mental capacity to run the business and cope with the challenges decreases. This will ultimately affect the quantity of products sold and hence a decline in marketing margins. Producers rely on family labour and as such, as the head of the family ages, the children are still able to continue with the production activities normally. The result concurs with the findings of Ikpeazu and Moguluwa (2017) who reported a negative effect of age on yams retailers marketing margins in Nigeria and (Wongnaa et al. 2014) who reported a negative effect of the age on the retailers marketing margins in Ghana. This therefore suggests that entrepreneurial capacity decreases as the age of the entrepreneur increases (Nwaru, Nwosu, and Agommuo 2011).

Conclusions and recommendations

This study examined the marketing of watermelon in Northern Uganda. Value chain analysis reveals eight differentiated marketing channels involving six value chain actors (producers, wholesalers, exporters, retailers, institutional-consumers and consumers). The producer-wholesaler-retailer-consumer was the longest and dominant channel. Marketing margins analysis showed that producers obtained the highest marketing margins, followed by retailers and wholesalers. Further, we find that age, labour cost, access to market information and access to credit were the major determinants of watermelon marketing margins.

In conclusion therefore, while trade in watermelon is profitable for all value chain actors, it appears more profitable for producers. This implies that watermelon commercialization has the potential to improve income and hence improve the livelihoods of small-scale farmers and traders. Producers can increase their profitability by expanding their production and hiring more production labour. Additionally, farmers' profitability can be improved through increased access and utilization market information especially on marketing outlets and low-interest production credits. For wholesalers and retailers, increasing profitability will entail venturing into value-added products through processing and selling watermelon slices and juice. Similar to producers, wholesalers and retailers can improve their profitability if they have access to marketing channel information and trade credit. This study therefore underscores the importance of socio-economic factors such as access to marketing channel information, credit access in improving the marketing of vegetables.

Policies should be put in place to enhance access to low-interest credit for watermelon value chain actors. Such policies would encourage watermelon farmers to join and/or start VSLA groups or cooperatives. Watermelon value chain partners and extension service providers could also include the dissemination of watermelon marketing information in their service delivery as this will serve to inform value chain actors and other stakeholders of the profitable market opportunities for water melon marketing.

Despite its scholarly contributions, this study is not without limitations. First, the study analyzed the marketing of watermelon using cross-sectional survey data from two districts of Gulu and Nwoya in Northern Uganda. Generalization of the findings beyond its scope should therefore be done cautiously. Future studies could therefore replicate the study in other watermelon producing areas in Uganda (eastern, central and western) to test the validity of the results. Second, data for this study was conducted during dry season, during which watermelon is in short supply and hence demand and prices were higher. There is likely to be variations with the rainy season, when supply in high and hence low prices. Future studies could therefore be undertaken in rainy season to test the validity of the results across seasons.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

Jemima Alla Houessou was supported by a Masters scholarship from the Mastercard Foundation Nurturing Grant Project, through the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) grant number RU/2017-MCF-01.

ORCID iD

Walter Odongo http://orcid.org/0000-0001-5811-5132

References

Ada-Okugbowa, C. I., and J. Egbodion. 2017. "Technical Efficiency Analysis Among Small Scale Watermelon Farmers in Uhunmwode Local Government Area Edo State, Nigeria." *FUW Trends in Science & Technology Journal* 2 (2): 720–724.

Adeoye, I. B., J. M. Usman, and M. A. Badmus. 2011. "Economic Analysis of Watermelon Based Production System in Oyo State, Nigeria." *ARPN Journal of Agricultural and Biological Science* 6 (7): 53–59.

Ajewole, O. C. 2015. "Income and Factor Analysis of Watermelon Production in Ekiti State, Nigeria." *Journal of Economics and Sustainable Development* 6 (2): 67–73.

Baba, M. D., J. M. Yelwa, and I. Sanchi. 2014. "Comparative Profitability Analysis of Watermelon and Pepper Production in Danko-Wasagu Local Government Area of Kebbi State, Nigeria." *Review of Knwoledge Economy* 1 (3): 39–47.

Balogun, O. L., O. S. Akinboro, O. T. Akinwole, and E. E. Osuji. 2018. "An Economic Analysis of Watermelon Marketing." *International Journal of Vegetable Science* 00 (00): 1–7. doi:10.1080/19315260.2018.1519625.

Dovie, D. B. K., E. T. F. Witkowski, and C. M. Shackleton. 2003. "Direct-Use Value of Smallholder Crop Production in a Semi-Arid Rural South African Village." *Agricultural Systems* 76 (1): 337–357.

FAOSTAT. 2008. *Crops*. FAOSTAT. Food and Agriculture Organization of the United Nations. (Database). http://faostat.fao.org/site/567/default.aspx#ancor.

Huh, Y. C., H. S. Choi, I. Solmaz, N. Sari, and S. Kim. 2014. "Morphological Characterization of Korean and Turkish Watermelon Germplasm." *Korean Journal of Agricultural Science* 41 (4): 309–314.

Idah, P. A., E. S. A. Ajisegiri, and M. G. Yisa. 2007. "Fruits and Vegetables Handling and Transportation in Nigeria." *AU Journal of Technology* 10 (3): 175–183.

Ikpeazu, C. P., and C. S. Moguluwa. 2017. "Factors Affecting Marketing of Yam: Wholesalers and Retailers Marketing Margin Analysis in Idah LGA of Kogi State." *IOSR Journal of Computer Engineering* 19 (6): 56–68. doi:10.9790/0661-1906035668.

Jemima A. H. 2020. "Analysis of Watermelon Marketing in Gulu and Nwoya Districts of Northern Uganda." Unpublished MSc Thesis, Gulu University, Uganda.

Kaplinsky, R., and M. Morris. 2000. *A Handbook for Value Chain Research*. Vol. 113. Brighton: University of Sussex, Institute of Development Studies.

Karane, S. V. 2016. "Factors Influencing on-Farm Common Bean Profitability: The Case of Smallholder Bean Farmers in Babati District, Tanzania." Msc Thesis submitted to the Department of Agriculture Economics and Agribusiness Management, Egerton University, Kenya.

Nwaru, J. C., A. C. Nwosu, and V. C. Agommuo. 2011. "Socioeconomic Determinants of Profit in Wholesale and Retail Banana." *Journal of Sustainable Development in Africa* 13 (1): 200–211.

Obetta, A. E. 2015. "Banana and Plantain Marketing in Enugu State, Nigeria." An MSc Dissertation submitted to the Department of Agricultural Economics, University of Nigeria, Nsukka.

Odongo, W., and S. Etany. 2018. "Value Chain and Marketing Margins of Cassava: An Assessment of Cassava Marketing in Northern Uganda." *African Journal of Food, Agriculture, Nutrition and Development* 18 (1): 13226–13238. doi:10.18697/ajfand.81.15955.

Okiror, P., P. Balitta, J. Godfrey, A. Jolly, J. Ocan, J. B. Lejju, J. Bahati, G. K. Rugunda, and C. I. Sebuuwufu. 2017. "Local Knowledge of Maturity Indicators for Priority Fruits and Vegetables in Uganda." *Journal of Agricultural Extension and Rural Development* 9 (July): 143–154. doi:10.5897/JAERD2017.0878.

Onyemauwa, C. S. 2010. "Marketing Margin and Efficiency of Watermelon Marketing in Niger Delta Area of Nigeria." *Agricultura Tropica Et Subtropica* 43 (3): 196–201.

Paris, H. S. 2016. "Overview of the Origins and History of the Five Major Cucurbit Crops: Issues for Ancient DNA Analysis of Archaeological Specimens." *Vegetation History and Archaeobotany* 25 (4): 405–414.

Schippers, R. R. 2000. *African Indigenous Vegetables, an Overview of Cultivated Species*. Chatham: Natural Institute ACP – EU Technical Centre for Agricultural and Rural Cooperation.

UBOS (Uganda Bureau of Statistics). 2017. *Statistical Abstract*. Kampala: UBOS.

Uganda IPC Technical Working Group. 2017. *Report of the Integrated Food Security Phase Classification Analysis for Uganda*. Kampala: Uganda Bureau of Statistics.

Ukwuaba, E. C., F. U. Agbo, and K. P. Adesun. 2018. "Socio-Economic and Institutional Determinant of Watermelon Marketing in Enugu State Nigeria." *Journal of Agricultural Extension* 22 (3): 161–173.

Wongnaa, C. A., S. O. Mensah, A. Ayogyam, L. Asare-kyire, Z. Kwame, and S. Anthony. 2014. "Economics of Tomato Marketing in Ashanti Region, Ghana." *Russian Journal of Agricultural and Socio-Economics* 2 (26): 3–13.

Appendix 1: Post-hoc tests for differences in marketing margins amongst value chain actors.

Dependent variable: marketing margins						
					95% Confidence interval	
(I) Actor category	(J) Actor category	Mean difference (I-J)	Std. Error	Sig.	Lower bound	Upper bound
Retailer	Wholesaler	1,335.833	22.750	.000	1,291.061	1,380.606
	Producer	2,223.775	22.750	.000	2,179.003	2,268.548
Wholesaler	Retailer	−1,335.833	22.750	.000	−1,380.606	−1,291.061
	Producer	887.942	22.750	.000	843.169	932.715
Producer	Retailer	−2,223.775	22.750	.000	−2,268.548	−2,179.003
	Wholesaler	−887.942	22.750	.000	−932.715	−843.169

**The mean difference is significant at the 0.05 level*

Appendix 2: Heteroscedasticity test.

hettest

Breusch/Cookweisberg test for Heteroscedasticity
Variables: Fitted values of MM
Chi2 (1) = 1.32
Prob > chi2 = 0.2507

	Age	Housh~e	Prodc~e	Credit~o	Tot~lab	Load~t	Commu~t	Offload~t	Mrkt~en	Mrk~el
Age	1.0000									
Households~e	0.3502	1.0000								
Production~e	0.2404	0.1050	1.0000							
Credit info	0.0436	0.0580	−0.2207	1.0000						
Totalcost~bor	0.1114	0.0848	0.4173	−0.0973	1.0000					
Loading~cost	0.0763	0.0709	0.3162	−0.2884	0.2424	1.0000				
Comunicat~t	0.776	0.0637	0.0894	−0.1325	0.0365	0.1734	1.0000			
Off-Loading~t	0.0520	0.0061	0.1371	−0.1454	0.0672	0.1825	0.1593	1.0000		
Marketinf~nd	0.0928	0.1597	0.0826	0.0464	0.0285	0.0444	0.2745	0.0262	1.0000	
Marketinfo~l	0.0822	0.0971	0.0387	0.1973	−0.0466	0.0627	−0.0144	−0.0422	0.2562	1.0000

Appendix 3: Correlation matrix and variance inflation factors (VIF) among variables used in the OLS models.

Cor Age Household~size Production~experience Credit~info Totalcostofhired~labor Loading~cost Communication~-cost Offloadingcost Marketinfo~trend Marketinfomarketchannel

Vif

Variables	VIF	1/ VIF
Age	1.40	0.0716629
Household~e	1.34	0.745752
Marketinfo~nd	1.24	0.804256
Communicat~t	1.22	0.818613
Creditinfo	1.18	0.846181
Marketinfo~l	1.15	0.868284
Production~e	1.14	0.876648
Loading~cost	1.09	0.921482
Totalcost~bor	1.08	0.926180
Offloading~t	1.03	0.970385
Mean VIF	1.19	