Potential for Value Chain Improvement and Commercialization of Cape Gooseberry (*Physalis peruviana* L.) for Livelihood Improvement in Uganda

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Research

Abstract

Physalis peruviana L., commonly referred to as cape gooseberry, is an important crop for income, food, and medicinal applications. The plant is native to Latin America but has since been naturalized in other parts of the tropics. In Uganda, this species grows naturally in abandoned bush fallows. While cape gooseberry has been recently identified as a priority plant for commercialization, little is known about its value chain and potential as a cash, food, and or medicinal plant in Uganda. The objectives of this study were therefore to document and characterize the plant's value chain, assess its demand and supply, and evaluate the contribution of the plant's trade to the income of traders in Uganda. Primary and secondary data were collected using a market survey, focus group discussions, field observations, and key informants. A total of 120 value chain actors were interviewed in all the major markets of the city of Kampala, Uganda. The study reveals that the value chain of the plant is short but developing with gatherers/farmers, retailers/petty traders, processors, wholesalers, and consumers being the major stakeholders. Most of the cape gooseberry fruit on the market were coming from the districts of Kabale, Mpigi, and Wakiso, with 85% coming from cultivated gardens and 5% collected from the wild. The cape gooseberry fruit were found to have a high demand on the market, with 67% of the value chain actors rating the demand as high. The average weekly sales for the traders interviewed stood at 49 kg. The supply of the fruit to the market was found to be high as well with 86% of the value chain actors rating supply as high. Supply sustainability rating was significantly positively correlated with economic importance rating of the plant at 99% confidence level (Kendall K = 0.545, P < 0.01, n = 120). The mean value of demand rating was not significantly differently to that of supply at 95% level of significance (P < 0.001). Economic potential of cape gooseberry fruit was found to be high with profit margins of 95% recorded for some cape gooseberry products along the value chain. The government of Uganda ought to promote this plant in a poverty reduction campaign due to its high economic potential.

Introduction

Physalis peruviana L. (Solanaceae), commonly referred to as cape gooseberry, is a herbaceous, perennial plant. It is popular for its berries and associated derivative products such as juice, jam, and wine (Katende *et al*. 1999, Motooka *et al*. 2003). The crop is native to Latin America but has been widely introduced in tropical, subtropical, and even temperate areas of the world.

The plant is useful for income, food, and medicinal applications. Cape gooseberry fruit have been found to be a good source of provitamin A, vitamin C, vitamin B-complex, and several minerals of nutritional importance (McCain 1993). Epidemiological studies indicate that increased consumption of fruit and vegetables of cape gooseberry could lead

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Ethnobotany Research & Applications 12:131-140 (2014)

Published: 18 March 2014

www.ethnobotanyjournal.org/vol12/i1547-3465-12-131.pdf

to lower risk of chronic degenerative diseases (Reddy *et al*. 2010). The fruit contains 15% soluble solids (mainly sugars), and its high level of fructose makes it valuable for diabetics. Polyphenols in the fruit demonstrate anti-inflammatory and antioxidant properties (Franco *et al*. 2007, Wu *et al*. 2006). The crude extract of the cape gooseberry fruit has been shown to have antihepatoma and anti-inflammatory activities (Wu *et al*. 2006). The extract has exhibited anti-diabetes and anti-hypertension properties *in vitro* (Pinto *et al*. 2009) and anticancer activity (Lan *et al*. 2009).

In folk medicine, *P. peruviana* has been used as a medicinal herb to treat cancer, leukemia, malaria, asthma, hepatitis, dermatitis, and rheumatism (Wu *et al*. 2009). Many other medicinal properties of the plant have been reported. They include use as antiasthmatic, antiseptic, strengthener for the optic nerve, treatment of throat infections, and elimination of intestinal parasites, amoebas, and albumin from kidneys (Arun & Asha 2007). It is also reported that *P. peruviana* has an anti-ulcer activity and is effective in reducing cholesterol levels (Arun & Asha 2007).

Given its value, the plant is increasingly becoming an important crop in functional food production and represents an emerging market of growing economic importance (Ramadan & Mörsel 2007). A single plant of *P. peruviana* can yield 300 fruit, and carefully tended plants can provide 20 to 33 tons/ha (Ramadan 2011). This high yield coupled with a long shelf life of fruit potentially raises its demand globally.

While *P. peruviana* has been known for centuries, exploration of its potential for intensive cultivation is recent particularly after realization of its nutritional, industrial, and unique storage properties that make it a suitable plant for different food and medicinal applications (Ramadan 2011). In South Africa, the plant is commercially cultivated; its fruit are used for jam manufacturing and canning for local and export markets. The plant is also cultivated on a small scale in Gabon, other parts of Central Africa, and Egypt (Ramadan & Mörsel 2007).

In Uganda, *P. peruviana* is still regarded as a less important and/or underutilized plant species, growing mainly on its own in the wild on abandoned fallows. Recently, however, interest in the plant has been growing with smallholder farmers domesticating the plant and others collecting the fruit from the wild for sale in markets as well as supplementary consumption at household level (Agea *et al*. 2011, Akankwasah *et al*. 2012a).

Little is known about *P. peruviana* economics in Uganda, and the Ugandan value chain of this plant has neither been documented nor characterized. The demand and supply potential of this plant remains largely unknown in Uganda, thus its economic potential in the country is not well understood (Akankwasah *et al*. 2012b). Consequently, government policies and initiatives for commercialization of agriculture have so far left this plant out of their lists of priority species for promotion.

The overall goal of this study was therefore to assess the commercialization potential of the plant. Specific objectives were to (i) document and characterize the value chain of the plant in Uganda, (ii) assess the demand and supply of the plant in Uganda, and (iii) evaluate the contribution of the plant's trade to the income of the traders.

Materials and Methods

Study area

The study was conducted in all major markets of the Ugandan capital Kampala. These were Owino and Nakasero in Central Division, Nakawa in Nakawa Division, Natete in Rubaga Division, Kalerwe in Kawempe Division, and Ndeeba in Rubaga Division. Kampala Capital city markets were chosen based on the fact that they are the best representatives of commercial markets in Uganda since products are brought from all over the country.

Kampala City is situated in Central Uganda. According to Uganda Bureau of Statistics (2005), Kampala City has resident a population of 1.6 million people, but the city has a daily transient population of about 2.3 million people. Annual city population growth rate of Kampala is at 3.9% (mean density = 51 inhabitants/ha). The major economic activity in the city is trade.

Data collection

Informed consent of respondents was obtained first by introducing the research and the research team to the local leaders and then to the respondents with the help of the local leaders. No respondent was interviewed without first introducing the study and obtaining verbal consent to be interviewed.

Both qualitative and quantitative methods were employed in this study. A market survey, key informant interviews, and field observations were used in data collection. The study commenced with a desk review of literature and training of research assistants on how to undertake the market survey. A reconnaissance market survey using a structured questionnaire was then done in Owino, Kalerwe, and Nateete markets of the capital city in June 2011. The structured questionnaire was then revised to conform to the findings of the reconnaissance.

Following the refinement of the questionnaire, data was then collected between July 2011 and May 2012 through a market survey in which face-to-face interviews with gooseberry traders were conducted. After the market vendors survey, two key informant interviews were held with

selected farmers in Kabale District to augment the traders survey and understand the entire value chain of the plants in line with the methods of da Silva and de Souza Filho (2007). Kabale was chosen because the market survey had indicated that Kabale District was supplying the biggest proportion of cape gooseberry fruit on the markets under study. Famers were selected on the basis of their availability and willingness to participate in the discussion.

Key informant interviews were also held with cape gooseberry exporters, staff of Makerere University Food Science and Technology Incubation Centre, and staff of National Organic Agricultural Movement of Uganda (NOGAMU). NOGAMU unites farmers, producers, processors, exporters, and other key stakeholders in the promotion of organic agriculture in Uganda. These were selected due to the important role they play in cape gooseberry value chain development.

A total of 120 respondents were interviewed using a snowball non-parametric sampling method as described in Giuliani and Padulosi (2005) and De Caluwe (2011). In this sampling method, the researcher identifies all respondents by reference from other previous respondents until the sample becomes saturated. This non-parametric sampling method was useful in reaching a population that was not known or hard to find and to capture information across a variety of sites and groups (Giuliani & Padulosi 2005). All the traders (100%) in the study area that were trading in cape gooseberry during the study period were covered by this study.

Each respondent was asked about the source of supply; costs involved in selling and buying; perceived demand, supply, and economic importance on a scale on 1–5; challenges; and suggested ways forward for the improvement of the plant value chain. Perceived demand and supply were used because the informal nature of the trade could not allow obtaining exact data on incomes given the informal nature of the trade. Besides, incomes and prices are not known to be good determinants of demand and supply of food products due to existence of other influential factors such as physical need, availability, and tastes (Saxon 1975).

Data analysis

Data collected were coded, entered in spreadsheets, and later imported into Statistical Package for Social Sciences (SPSS 17) for descriptive and inferential analysis. Social economics characteristics were summarized into frequency percentage tables while key informant interviews were condensed in the form of quotes and expressions (Agea *et al*. 2011).

The value chain was mapped by identifying actors and then creating a flow diagram to show their linkages as described in te Velde *et al*. (2006) and Vermeulen *et al*. (2008). Perceived demand and supply ratings on a scale of 1–5 and weekly sales were reduced to aggregate percentages.

Correlations were calculated using Spearman's rank correlation at 95% confidence level. Where 95% confidence level was not positive, 99% was used to confirm or reject the result. Profit margins were derived from the expression PM = SP - (PP + OC), where PM was the profit margin, SP was selling price, PP was the purchase price, and OC was the operational costs of transport and labor (De Caluwe 2011). Reasoned estimations were made in accordance with De Caluwe (2011) where it was difficult to obtain exact data on incomes.

Results

Cape gooseberry value chains in Uganda

The study reveals that most of the value chain actors (76%, n = 120) in the cape gooseberry trade were women and most women possessed low formal education. A majority of traders (35%) in the value chain were married, and 76% of them were family heads. Most of the value chain actors (59%) were above 40 years of age, and the highest level of education for the majority of the value chain actors (50%) was primary level (Table 1).

Value chain actors were found to have reasonable experience with selling cape gooseberry. Average number of years spent in the cape gooseberry trade was 6 years. The shortest time was one year while the longest period of experience was 14 years.

The study established the chain actors in the gooseberry value chain to be gooseberry gatherers, farmers, retailers in organized markets, mobile vendors, wholesalers, transporters, processors, and consumers. Gatherers pick cape gooseberries from bush fallows while farmers were mainly small-scale farmers who applied labor as their major input. A detailed product flow map of the value chain of gooseberry and associated products is given in Figure 1.

Retailers consisted of market vendors in market stalls and mobile vendors. Mobile vendors mainly operated along busy roads selling the fruit to motorists and pedestrians. Wholesalers brought bags of cape gooseberry fruit for distribution mainly to mobile vendors and retailers in organized markets.

There were both primary and secondary processors in the value chain. Primary processing involved removal of husks making the fruit ready for consumption. This was done at the farm/collection points by farmers and gatherers. Secondary processing involved further processing of the fruit into pulp for export and/or for making wine, juice, and jam locally. Secondary processing was mainly done

Table 1. Characteristics of cape gooseberry value chain actors (N=120) in Kampala, Uganda.

Variable	Response (%)
Sex	
Male	24
Female	76
Age (Years)	
Below 20	5
21–30	15
31–40	21
41–50	20
Above 50	39
Marital Status	
Married	35
Divorced	18
Never married	12
Widow	18
Widower	17
Education	
No formal education	15
Primary (PLE)	50
Uganda Certificate of Education (UCE)	23
Uganda Advanced Certificate of Education (UACE)	06
University degree	03
Vocational qualification	03
Status in family	
Family head	76
Non-family head (wife)	21
Non-family head (child)	03

by exporters and the Food Technology Business Incubation Centre (FTBIC) which targeted the local market.

The dominant source of cape gooseberry fruit was smallholder gardens (85%) as opposed to collection from the wild or bush fallows (15%). Cape gooseberries found in the markets were harvested from a few upcountry districts. Most of the fruit came from Kabale (46%), Mpigi (24%), and Wakiso (19%) districts (Table 2). Most of the cape gooseberry fruit (59%) reached the market through middle men along the value chain while 41% reached the market directly from collectors/farmers.

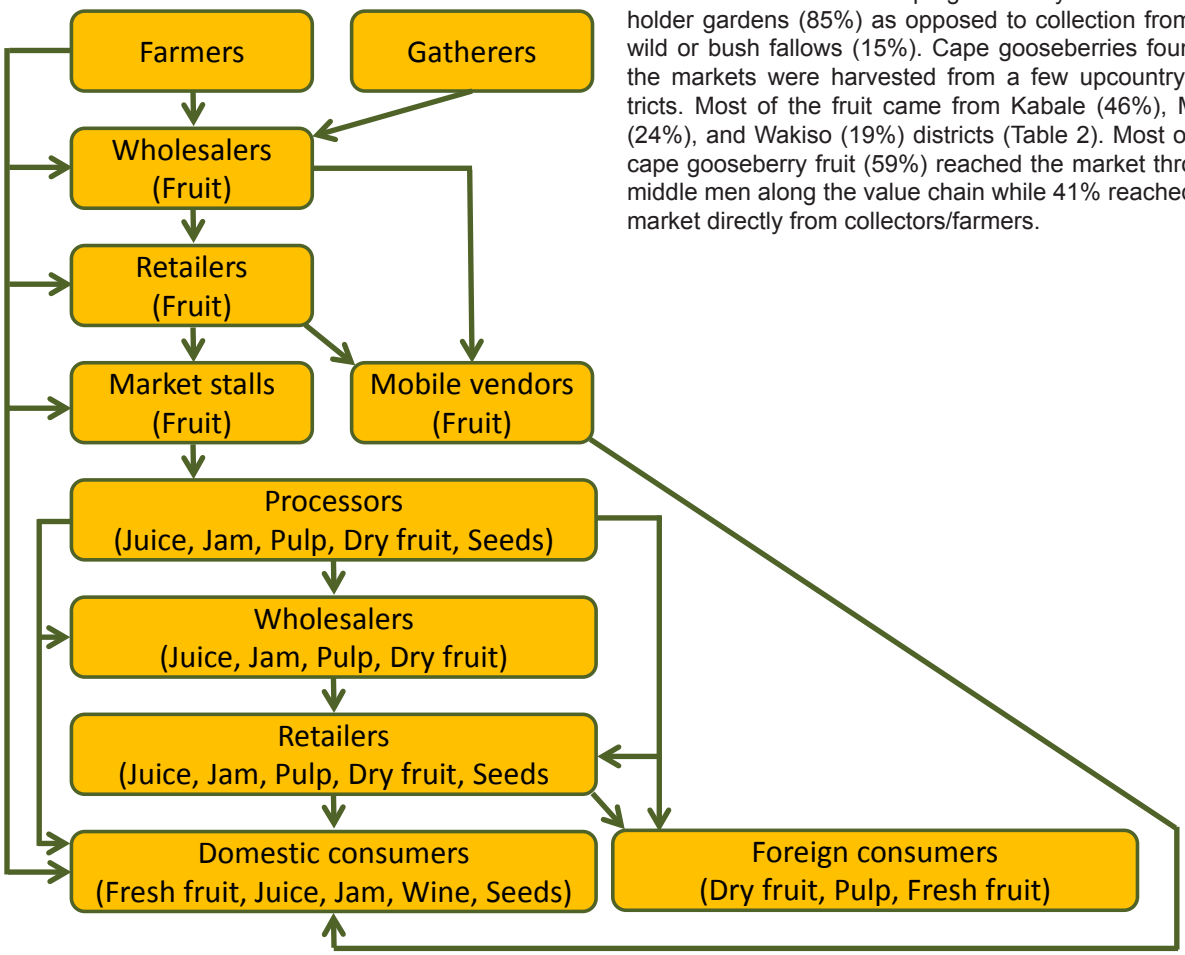

Figure 1. Cape gooseberry value chain in Kampala, Uganda.

Table 2. Districts of Districts of Uganda, supplying cape gooseberry fruits to the Kampala city markets.

District	Percentage (%)
Kabale	46
Mpigi	24
Wakiso	19
Masaka	5.5
Mityana	3
Kayunga	1.5
Butambala	1
Total	100

The most common use of *P. peruviana* in Uganda was food as fruit (40%), followed by use as medicine (38%), juice (13%), and industrial food pulp (10%). The industrial pulp was used to produce juice, wine, and jam. As measured in Uganda shillings (UGX), seeds of gooseberries were reported to be on demand at UGX 10,000 per kg, equivalent to 4.00 U.S. Dollars (USD).

Value addition to gooseberries was found to be inadequately low with 90.6% sold as unprocessed fruit while 9.4% came to the market as processed products. Main products processed from the fruit were industrial pulp, juice, jam, wine, and dried fruit for export. Food Technology Business Incubation Centre was the only stakeholder currently processing cape gooseberry products for domestic market.

An international market for cape gooseberries from Uganda was found to be emerging in Denmark and The Netherlands. Dried fruit, pulp, and fresh fruit were being exported to the two countries (Figure 1) upon prior certification facilitated by NOGAMU. Annual certification fees for exporters stood at USD 15,800.

Problems identified by the study as bottlenecks to the development and growth of cape gooseberry value chain included lack of extension services on pre- and post-handling good practices and lack of market information on both prices and markets themselves (Table 3). The requirement of certification by countries of export was hurting the small scale business entrepreneurs as this process is expensive. General lack of knowledge about economic value of the crop was also observed among the chain actors.

Table 3. Challenges in the cape gooseberry value chain as reported by value chain actors (N=120) in Kampala, Uganda. Percentages represent proportion of respondents who mentioned a specific challenge.

Challenges	%
Limited market information	76
Lack of appropriate processing technologies	62
Limited appropriate storage facilities	54
Lack of extension and advisory services	53
High transport costs	10

Demand and supply of gooseberries in Uganda

The study reveals that the demand for cape gooseberry products in Uganda is high. Of the 120 traders interviewed, a majority (50%) rated the demand as very high, 18% as high, and 18% as moderate (Table 4). Overall, this study recorded a high demand for the products of *P. peruviana*.

Individual traders sold between 5–600 kg of cape gooseberries in a week, averaging 49 kg per week. Demand was significantly positively correlated with trader experience as measured by number of years spent in cape gooseberry trade (Kendall's tau_b = 0.155; P = 0.032) and education of traders (Kendall's tau_b = 0.158; P = 0.040) at 95% confidence level (2-tailed).

Supply rating of cape gooseberry was reported to be moderately high. Of the 120 traders interviewed during the market survey, a majority (26%) rated supply very high, 15% as high, and 20% as moderate (Table 4). Like demand rating, supply rating was also significantly positively correlated with level of education (Kendall's tau_b = 0.436; P < 0.001; 99% confidence level, 2-tailed) and years spent in trade (Kendall's tau_b = 0.235; P = 0.001; 99% confidence level, 2-tailed). Supply rating was also positively correlated with weekly profits made from the trade (Kendall's tau_b = 0.196; P = 0.19; 95% confidence level, 2-tailed). Comparing mean values of demand and

Table 4. Demand, supply and economic importance ratings of cape gooseberry products in Kampala, Uganda.

Rating on a scale of 1–5	Percentage(%, N=120)		
	Demand availability	Supply availability	Economic importance
(1) Very low demand	5	13	16
(2) Low demand	9	20	8
(3) Moderate demand	18	26	16
(4) High demand	18	15	25
(5) Very high demand	50	26	35

supply did not yield any significant difference at 95% confidence level.

Economic potential of cape gooseberry trade in Uganda

The market survey revealed that the majority of value chain actors rated cape gooseberry as high economic importance with 35% rating it as very high importance and 25% as high economic importance (Table 4). Economic importance rating was significantly positively correlated with education (Kendall's tau_b = 0.190; P = 0.013; 95% confidence level, 2-tailed) and number of years spent in cape gooseberry trade (Kendall's tau_b = 0.162; P = 0.023; 95% confidence level, 2-tailed).

On average, 1 kg of fresh gooseberry fruit was being supplied to the market at UGX 4000 (USD 1.60) with a range of UGX 2500 (USD 1.00) to UGX 5000 (USD 2.00). On the other hand, average selling price was UGX 5750 (USD 2.30) with a range of UGX 4500 (USD 1.80) to UGX 10,000 (USD 4.00) (Table 5).

Average monthly profit reported by the value chain actors from cape gooseberry trade was UGX 287,000 (USD 115). Average monthly income was recorded for the period at UGX 579,000 (USD 232) per person. Contribution of cape gooseberry trade to income was therefore 49.6%.

Discussion

Cape gooseberry value chains in Uganda

Value chain of *P. peruviana* has a reasonable level of participation of different value chain actors including women, various ethnic groups, and various age groups. According to Delacote (2007), effective development of a value chain requires multi-stakeholder participation. Participation of various stakeholders in the cape gooseberry value chain gives the chain good prospects for further development. Elsewhere, this has been observed in value chains with potential for development in Mali and Benin (De Caluwe 2011) and Uganda (Agea *et al*. 2011). De Caluwe (2011) argues that different actors play different roles in a value chain which collectively determines how successful commercialization of a species becomes.

The dominance of women in the value chain is a good indicator for the value chain to contribute to livelihood improvement. Women constitute part of the vulnerable segment of society in Uganda. A value chain that has potential to improve the livelihood of such a segment is therefore valuable and should be prioritized. Women were found to be important value chain actors in value chains of underutilized plants in West Africa (De Caluwe 2011) and East Africa (Agea *et al*. 2011, Akankwasah *et al*. 2012b).

The number of years spent in trade that was reported by the chain actors in this study is indicative of a chain that is fairly young. Given a reasonable number of nodes ranging from farmers, retailers, wholesalers, processers, exporters, and domestic and international consumers, it is plausible that the value chain is growing at a good rate. In Ethiopia, years of experience of value chain actors was found to positively influence volumes in trade and production in general (Weldeslassie 2007). The present study therefore points to the fact that cape gooseberry value chains have good prospects for growth, hence justification to invest in development of the value chain.

The study results suggest that the value chains of cape gooseberry in Uganda would be much more developed if it were not for some bottlenecks. Most of the bottlenecks identified in this study are not unique to the value chains of cape gooseberry but are rather overarching and similar to those reported by both Agea *et al*. (2011) for the agroforestry products trade in Uganda and Akankwasah *et al*. (2012b) for the underutilized plants trade in Uganda.

Elsewhere, inadequate market information was found to be a significant constraint to commercialization of underutilized plants (Neumann & Hirsch 2006). Low levels of formal education were found to be a bottleneck for efficient access to market information by Gizachew (2006). Addressing these bottlenecks would therefore catalyze further growth and development of cape gooseberry value chains.

Table 5. Economic potential of cape gooseberry trade in Kampala, Uganda (based on 1 kg of fruit). N/A = Data not available. The average exchange rate over the study period was 1 USD = 2500 Uganda shillings (UGX). *Profit margin calculated on operational costs given by Uganda Food Technology Business Incubation Centre.

Products	Prices (USD)				*Net profit margin
	Farm gate	Selling in ordinary markets	Selling in supermarkets	Export	
Fresh fruits	1.6	1.8	2.8	13.1	50%
Juice	N/A	N/A	2.7	N/A	67%
Wine	N/A	N/A	12.2	N/A	185%
Jam	N/A	N/A	6.0	N/A	79%

Demand and supply of gooseberries in Uganda

The perceived demand and supply ratings and weekly sales indicate that the demand for *P. peruviana* and its derivative products is high. According to Lawrence (2003), awareness about a plant and its uses increases its demand. The high demand for cape gooseberry products probably indicates that cape gooseberry is increasingly becoming popular in Uganda. People are increasingly becoming aware of the food and medicinal value of the crop. Elsewhere, demand for agricultural products has been found to be associated with food properties (Weldeslassie 2007). The high nutrient value for *P. peruviana* could potentially be responsible for its high demand recorded in this study.

The high demand for *P. peruviana* and its products recorded in Kampala markets could also be due to good trading performance and commercial networks normally associated with urban areas. Ros-Tonen and Wiersum (2003) reported that urban areas are normally associated with more efficient commercial networks compared to rural areas. The high demand recorded in the present study could therefore be due to the fact that the study markets were majorly urban. A comparative study about cape gooseberry value chain with special emphasis in rural markets could therefore be necessary to further confirm the present findings.

Presence of *P. peruviana* in various markets of Kampala is indicative of a plant whose demand is not only high but also whose supply is ample. Cunningham (2001) argues that if demand for a species or product is high and its supply is still available, then the species will be offered for sale in many market places. Given emerging demand locally and internationally for products of this crop, higher production of the plant to meet this demand is necessary if full commercialization of the plant is to be realized.

The high proportion of the chain actors reporting their source of supplies as cultivated gardens as opposed to wild collection is a sign that the plant is experiencing increased cultivation in Uganda. More cultivation ensures a sustainable supply of the plant and its derivative products to the value chain. Rehima (2007) reported that supply of a product is influenced by access to the markets, production level, extension services, and market information. Interventions to promote these factors will be necessary to further develop *P. peruviana* in Uganda.

The high demand and supply of *P. peruviana* recorded in this study is very important for livelihoods of the value chain actors. According to Fisher (2000) and Kilchling *et al*. (2009), increasing demand for underutilized plants is associated with more income, employment, and livelihood improvement in general. The findings of this study therefore point to an existing potential of *P. peruviana* in improving livelihoods and contributing to economic development in general.

Economic potential of cape gooseberry trade in Uganda

The price per kilogram of fresh gooseberry fruit, the gross profit margin per unit sold, and the real weekly profit reported in this survey clearly demonstrate *P. peruviana* as an economically important plant with high value. The value of fruit, juice, jam, and wine made from gooseberries reflects a big potential for generating household cash income and subsequent improvement of people's livelihoods.

The value of 1 kg of gooseberries recorded in this study is higher than most of the conventional food and cash crops on the market including maize, beans, rice, tea, coffee, cassava, or Irish potatoes (Infotrade 2012) which are all highly promoted as poverty-alleviation crops under the National Agricultural Advisory Services (NAADS) for Uganda. There is therefore an evident income opportunity being missed by farmers not commercializing *P. peruviana*. These findings are consistent with those of Narendran *et al*. (2001) and Ambrose-Oji (2003) who both established that underutilized plants are capable of generating substantial economic returns that may be higher than those from conventional crops.

The weekly profits from gooseberry sales translate into a monthly income average of UGX 287,000 (USD 115) which is about 52% of an average graduate government worker's monthly salary in Uganda (The Independent 2009). Moreover, this is in addition to other sources of income as the study did not record exclusively specialized gooseberry dealers. These findings confirm earlier studies (Ramadan & Mörsel 2007) that reported *P. peruviana* as a plant capable of generating significant economic benefits in South Africa, Egypt, and some parts of Gabon.

Conclusions and Recommendations

It is very important to study the value chains of neglected plants like *P. peruviana* not only because of their economic and livelihood significance but also as a way to justify conservation of its genetic resources for posterity. This study documented the value chain and assessed demand, supply, and economic potential of the plant. To my knowledge, this is the first detailed study on value chains of this plant in Uganda.

Physalis peruviana is increasingly being recognized as an economically important crop in Uganda. The value chain of the plant is steadily developing, with market chains ranging from farmers and collectors to retailers, wholesalers, processors, and exporters, and finally to consumers. Value addition of the plant along the value chain is

emerging with fruit now being processed into juice, jam, and wine.

The demand for the plant and its derivative products is very high at local and international levels. Supply of the plant is relatively sustainable with farmers now cultivating it. Rapidly growing demand may, however, soon outweigh supply in the near future. The economic value of the plant is very high, outweighing market values of conventional crops on the market. The return on investment on processing of gooseberries is very high, even beyond 100% for some products.

Commercialization of the plant in Uganda has very good prospects for income generation, employment creation, and consequent livelihood improvement and poverty reduction. It is recommended that (i) the government of Uganda and other stakeholders take up and promote growing of gooseberries given their high economic value, high return on investment, and existing demand and supply potential; (ii) cape gooseberry farmers benefit from utilizing available agriculture extension services to improve their knowledge on modern cape gooseberry farming practices; (iii) government should promote processing of gooseberries to increase benefits from the plant; (iv) incentives including soft loans, training, and provision of gooseberry pulp processing equipment should be extended to cape gooseberry farmers to boost their production capacities; and (v) more education and awareness on the health benefits and economic potential of the plant and its derivative products should be created to catalyze full commercialization of the plant. Further in-depth research on value chain development of individual segments of the *P. peruviana* value chain and soil suitability mapping for the plant is recommended to facilitate full-scale commercialization of the plant.

Acknowledgements

I wish to acknowledge the two research assistants Ms. Nakiberu Hajara and Mr. Mulindwa Daniel who were instrumental in collecting data for this study. Sincere gratitude also goes to the German Academic Exchange Service (DAAD) for funding this study.

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