

Expanding utilization of RTB crops and reducing their post-harvest losses

Proposed Business Case

Demand-Driven Approach to Enhance Banana Juice and Beer Production and Marketing

The Team

(It is expected that most of these individuals and institutions will also participate in implementation, though some changes in roles and participation are to be expected)

Name	Institution	Role
Anne Rietveld	Bioversity	Coordinator – Bioversity focal point
Kephas Nowakunda	NARO	Incubation centre coordinator – NARO focal point
Micheal Batte	IITA	Breeding and productivity – IITA focal point
Dan Jakana	Jakana Foods	Private industrial processor – Jakana owner and focal point
Jesca Ssendagire	BUCADEF	Promotion – BUCADEF focal point
Enoch Kikulwe	Bioversity	Costs/benefit analysis / Economist
Susan Ajambo	Bioversity	Value chain Development / gender
Miriam Kisamba Bwengye	NARO	Food technologist / incubation
Elizabeth Khakasa	NARO	Food technologist / consumer preferences

1. DEVELOPMENT PROBLEM/OPPORTUNITY *(specify in 1-2 paragraphs the development problem or opportunity related to postharvest or expanding utilization that this technical innovation will address)*

Beer and juice made from banana are traditional products in Uganda and the larger Great Lakes region, and both offer good market prospects for improvements in view of consumer and demographic trends and high potential for income generation among farmers and rural entrepreneurs. Both products are mainly processed by men and women at the homestead of smallholder banana growers, often under very basic conditions (see appendix 4). Banana juice and beer are both characterized by a short shelf-life and poor product presentation (sold in re-used jerry-cans) and are therefore mainly sold in low-end markets. There are few (semi-) industrial processors and they struggle with high costs, inconsistent supply of raw materials and low capital for product promotion. The main cause for inconsistent supply is the high incidence of banana diseases which significantly compromise raw material supplies. Artisanal processing of banana for juice and beer has to a large extent

been replaced by the more profitable, unlicensed processing for Waragi, a high-alcohol-content gin, with long shelf life and large local and urban demand which is associated with alcohol abuse. The resulting negative image affects the other banana-based beverages, juice and beer, which hampers investment in the sector. The scoping study identified 5 main bottlenecks that present opportunities for upgrading banana production, processing and marketing through an integrated, demand-driven approach:

- 1) Ugandan production of beer-banana varieties is characterized by low productivity, poor agricultural management of traditional cultivars, high disease incidence and limited knowledge of alternative beer-cultivars and appropriate disease-management. As a result, low and inconsistent supply of raw materials and poor quality of processed products negatively affect both artisanal and semi-industrial processing.
- 2) Lack of standardized artisanal processing practices, reflected for instance in poor hygienic measures and labour-intensive processing, limit both the volume and quality of finished juice and beer products which inhibits consumer acceptability. Semi-industrial processors prioritise cost-effectiveness over product quality,
- 3) Inappropriate (low quality) packaging and presentation of the products compromises shelf-life, marketability and traceability, translating into low returns to farmers and high risks to entrepreneurs.
- 4) Improved processing methods are inaccessible for men and women in rural areas due to low access to information / knowledge and capital.
- 5) Public investment (government, NGO's, research institutes) in processing of beer-bananas has been limited. Beer-banana is either associated with alcohol abuse / problems or funding is directed to cooking-banana which is an important staple crop in the region.

2. APPROACH (*indicate in 3-4 paragraphs how the proposed technical and other innovations address this problem/opportunity, and how the research builds on existing knowledge, ongoing/recent initiatives*)

The project will use the Participatory Market Chain Approach (PMCA) to link the different actors along the VC chain to analyze the potential and select optimal production and marketing strategies. During scoping (FGD 2014; and Key Informant Interviews 2014) we used PMCA to identify some of the banana beverage value chain actors by gender (appendix 4) and will continue to identify more during project implementation as the need arises. Guided by the PMCA protocol, the identified actors will be mobilised, brought together at sub-county level and facilitated to form thematic groups. Information sharing will include technical aspects about processing technologies that have been tried and tested, which will encourage a buy-in and co-investment by actors. Government and non-governmental organisations involved in consumer protection, food safety and enforcement of standards such as UNBS, MAAIF, MoH, UCPA will use the same platforms to popularise beverage standards, sensitize chain actors about the hazards associated with poor quality beverages and alcohol abuse.

PMCA will provide the basis and promote the implementation of the five key elements of the project approach: 1) Farm-level upgrading for improved raw material supply through improved varieties, increased productivity, and improved post-harvest handling; 2) Improved processing of banana juice and beer and use of waste (by-products) among semi-industrial processors ; 3) Improved artisanal processing practices for juice and beer; 4) Supporting banana juice and beer enterprises through incubation; and 5) Market linkages for banana juice and beer products in line with consumer demand.

- 1) Farm-level upgrading for improved raw material supply, increased productivity and improved post-harvest handling: Together with end-users, the project will promote alternative beer banana varieties that have already been tested (see appendix 2, table 3). The potential of these hybrids will be demonstrated to end-users with respect to their optimal harvesting time and stage of ripening, high juice yielding potential, and end-user acceptability. Mother-gardens will be established in both sites (see end of section) using initial planting material multiplied in the national research station of Uganda (NARO). The mother gardens will also serve as training sites for macro propagation techniques, disease and agronomic management, post-harvest handling (optimal time of harvesting and storage) and will be used to distribute planting materials for wider accessibility. Participatory approaches will be used to select the host farmers who will include both men and women. Good plantation management practices will be demonstrated on existing farmers' fields in the pilot sites.
- 2) Improved processing of banana juice and beer and use of waste among semi-industrial processors:— We will assess production processes and productivity with selected semi-industrial processors of juice and beer. Based on the bottlenecks identified, we will propose improvements for optimizing extraction and filtration for higher juice yield and sanitary quality, and extended shelf-life. This includes the selection of innovative enzymatic preparations used as processing aid and appropriate membrane filters. Some semi-industrial processors are currently utilising by-products of the juice extraction into commercial products. We will build on these efforts to develop more waste utilisation options including sweets and manure.
- 3) Improved artisanal processing methods and practices for banana juice and beer: The project partners together with selected other chain actors will collectively assess processing methods of both banana juice and beer to identify constraints and critical control points (areas within the process that require careful monitoring). They will then propose improvements to be tested (see output 4), including low cost hygienic juice extraction, shelf-life extension, packaging and standardisation of the processes. In order to get price premiums for the end-product and increased returns to farmers and processors, improved product presentation and market segmentation is essential. Therefore, PMCA thematic groups will work on developing differentiated products to ensure that new products quality and presentation are tailored to the needs of the different market segments.
- 4) Supporting banana beer and juice enterprises through incubation: The project will use the incubation approach to support the development of enterprises producing juice and/or beer. A participatory approach will be used to identify potential entrepreneurs in two selected sites (seen end of section). We want to target mainly participants that have no or limited access to land as this project, unlike many rural/agriculture-based projects, is not based on a land requirement for the rural poor to significantly increase their income. In practice, the people with limited access to land will mainly be married women and young men and women. Capacities of entrepreneurs related to business, technical skills and market linkages will be strengthened responsive of their needs. In each site, two enterprises will be supported and will graduate as self-sustaining enterprises by the end of the 2nd year.
- 5) Market linkages for differentiated banana beverages in line with consumer demand: To foster market access of banana juice and beer, the project will facilitate fruitful linkages among the different value chain actors including cultural institutions like Buganda Cultural and Development Foundation (BUCADEF) using the PMCA

approach. Through such linkages, market opportunities are expected to arise which will translate into improved market access for the developed products. Collaboration will be based on a good understanding of the needs and interests of the value chain actors and the conceptual and practical market dynamics. A market study facilitated by a market expert will be undertaken in the initial stages of the project. The process will also focus on building trust among the chain actors.

Pilot sites

We have selected two districts in central Uganda where we will pilot all the proposed activities. These districts are Mpigi and Nakaseke, the major producers of juice/beer bananas in Central Uganda, with Mpigi producing about 24,124 Mt and Nakaseke producing 12,482 Mt (UBOS, 2010). Within these districts, we have selected the sub counties of Muduuma in Mpigi and Semuto in Nakaseke. These sub counties are major banana-juice and -beer producing areas with high interest in the proposed enterprises (FGD 2014). They also have access to the national power grid and road network to facilitate processing and assure ready market access.

3. MAIN RESEARCH QUESTIONS *(indicating the knowledge gaps to be addressed):*

- a) How and to what extent can smallholder banana growers increase beer-banana production through better varieties, improved farm management and post-harvest handling (time of harvesting, storage, transport, and ripening)?
- b) How and to what extent do upgrading of processing methods; increased access to raw materials; product promotion; and utilisation of wastes, increase market participation and profitability for artisanal and semi-industrial processors?
- c) How does improving product presentation and differentiation (organoleptic properties, packaging, pricing, and distribution channels) promote market acceptability for artisanal processed banana juice and beer?
- d) What are critical success factors for the establishment of small-scale enterprises for banana-beer and/or juice during and after incubation?

4. OUTPUTS/DELIVERABLES *(specify the outputs/deliverables to be produced and indicate when they will be available within a 2 year time frame)*

Outputs	Expected time (yr/qr)	Next users	End users
1) Farmers access and grow high yielding disease resistant juice/ beer varieties [5 NARITAs + M3 + FHIA 25]	Y2, Q1	NARO, Government extension, NGO's, Farmers' organizations	Farmers, Processors, Seed producers and enterprises
2) Farmers strengthen capacities in banana management for improved productivity and PH quality	Y1, Q4	NARO, Government extension, NGO's, Farmers' organizations	Farmers, Processors, Seed producers and enterprises
3) Recommendations made for optimization of unit operations and waste management to semi-	Y2, Q4	NARO, Environment and regulatory bodies, researcher, NGOs	Semi-industrial processors, consumers

industrial processors.			
4) Improved artisanal processing methods for juice or beer developed, documented and compiled in learning guides	Y2, Q4	NARO, NGO's, Government extension services	Farmers, artisan processors, traders, consumers, equipment fabricators
Outputs	Expected time (yr/qr)	Next users	End users
5) Marketing strategy developed based on identification of new market segments for differentiated banana beverages and product presentation in close collaboration with private sector partners guided by the PMCA protocol	Y2, Q4	NARO, NGOs, extension	processors, traders, retailers, consumers
6) Relation between local processing of beer-banana for low-alcoholic beverages (beer) and alcohol abuse in the locality assessed and recommendations for risk reduction developed.	Y2, Q4	Researchers, NGOs, Policy makers, gender activists, Schools and other educators	Consumers, processors, traders
7) Incubated enterprise's capacities strengthened with regards to business and technical skills	Y2, Q3	Researchers, regulatory bodies, NGOs	Entrepreneurs, Equipment fabricators

5. DEVELOPMENT GOAL (indicate in one paragraph the overarching goal to be achieved after 10 years, for example: [number] producers and [number] small-scale processors of [crop] in the [name] region have improved their food security by [number] percent and their agricultural income by [number] percent. Explain the gender equity and environmental aspects of your goal as well)

In 10 years, banana juice and beer are popular products in different market segments in Uganda and the Great Lakes region with total volume output from artisanal and semi-industrial production growing by 10% per annum. Poor women and youth in rural areas improve their livelihoods through participation in small-scale rural enterprises producing consumer acceptable and safe products. Incomes for owners/members of these rural enterprises will increase by 100%. At least 200 individuals are engaged in sustainable environmental-friendly production and marketing of banana beer and juice. The local population is informed on health risks of alcohol and knowledgeable of what constitutes responsible alcohol consumption.

Semi-industrial processing enterprises increase profit margins translating in increased demand for employees and higher returns to a potential 50,000 smallholder banana growers in Central Uganda who improve their farm management and post-harvest handling to ensure consistent supply of high quality raw materials. Enterprises increase juice and beer yields by 15%. Banana beers and juices produced meet national standards and consumer preferences.

6. EXPECTED OUTCOMES (for each research output mentioned above, indicate the principal outcomes to be achieved after 10 years through scaling out and up the proposed innovations, and their likely effects on food security, gender, and the environment; outcomes are understood as change of behavior of actors inside and outside of the value chain)

Research output/deliverable	Users/beneficiaries (e.g., producers, small-scale processors, retailers)	# of Users/ Beneficiaries after 10 years	Outcomes (expected use of technical and other innovations; e.g. farmers using on-farm storage technology, processors applying new procedures)	Food security (direct effects through products, or indirect effects through increased income)	Gender equity (inclusiveness and benefit sharing among women, men and youth)	Environmental performance (increase of positive or reduction of negative impacts)
1. Farmers access and grow high yielding disease resistant juice/beer varieties[5 NARITAs + M3 + FHIA 25]	Farmers, artisanal and semi- industrial processors	Farmers: = 50,000 HHs [Approximately 300,000 HH in Central Uganda currently growing Kayinja. Adoption rate 15%] Artisanal commercial processors; = 30,000 HHs [10% of estimated total number processors] Semi-industrial processors ; 4 [20% of 20 processors]	15% of the farmers in pilot sites grow high yielding disease resistant juice/beer banana varieties. 10% of artisanal processors in pilot sites will shift from waragi [gin] production to juice and/or beer production due to increased consistence supply of raw material 20% of the semi-industrial processors increase the volumes of juice and /or beer produced due to increased consistence supply raw material	Artisanal entrepreneurs and juice/beer banana producers increase incomes Increased access to high quality banana juice	Both male and female farmers host mother-gardens of planting material Planting material for new Juice/beer banana varieties are both accessible for men and women Appropriate training on use and management of new planting material will be designed and conducted for both male and female famers	New juice/beer varieties introduced in banana plantations help sustain the 'kayinja' banana systems with lower risks on soil degradation through erosion than annual cropping systems
2. Farmers strengthen capacities in banana management for improved productivity and PH quality	Farmers	Farmers: = 50,000 HHs [Approximately 300,000 HH in Central Uganda currently growing Kayinja. Adoption rate 15%]	Farmers in pilot sites improve productivity and quality of beer/juice banana	Producers of beer/juice banana (farmers) increase incomes through increased returns from beer/juice banana plantations	Appropriate training on use and management of new planting material will be designed and conducted for both male and female famers	Improved management of banana plantations coupled with increased returns helps sustain the 'kayinja' banana

				Beer/juice banana can be consumed fresh or cooked in times of food insecurity (although other varieties are preferred for fresh consumption)		system lower soil degradation through erosion annual cropping system
3. Recommendations made for optimization of unit operations and waste management to semi-industrial processors.	Semi-industrial processors	Semi-industrial processors ; 4 [20% of 20 processors]	20% of semi-industrial processors use recommended practices to increase efficient disposal of wastes and improve processing in order to increase profitability			Waste semi-industrial processing reduce and/or for alternative products
4. Improved artisanal processing methods for juice or beer developed, documented and compiled in learning guides	Artisanal processors and extension services and investors (Public and private)	20 enterprises in Central Uganda (average 10 staff) and 10 enterprises elsewhere in Uganda and other East-African countries with tradition of banana juice and beer production such as Rwanda, Burundi and Eastern-DR Congo	Artisanal processing enterprises improve quality banana products (beer and juice), fetch premium prices and increase volumes sold.	Entrepreneurs increase incomes Entrepreneurs contribute to increased access population to high-quality banana juice, a favourite for school-going children.	Processing methods are accessible to both men and women (consider labour intensiveness and drudgery) Training guides consider specific conditions of men and women	Increase efficiency processing leads waste unit production

<p>5. Marketing strategies developed based on identification of new market segments for differentiated banana beverages and product presentation in close collaboration with private sector partners guided by the PMCA protocol</p>	<p>Processing enterprises, Supplying enterprises and other private sector companies, Traders & retail, Consumers</p>	<p>20 processing enterprises in Central Uganda (average 10 staff), 3 medium-scale supplying private companies [new] Products sold in 100 outlets (retail & restaurants/bars) in Central Uganda 300,000 persons consume products on regular basis</p>	<p>Processing enterprises sell several products to different outlets catering for different market segments Processing enterprises sign supply contracts for inputs with suppliers of raw material and other inputs (e.g. packaging material) 10% of middle and high end-consumers in Central Uganda regularly buy improved artisanal juice and beer products</p>	<p>Contributing to accessibility to high-quality banana beer and juice products</p>	<p>Marketing strategies target different consumers groups such as school-going children, teenagers and male or female beer-consumers without enforcing gender stereotypes</p>	<p>Packaging material use will be taken into account to protect the environment and ensure safety</p>
<p>6. Relation between local processing of beer-banana for low-alcoholic beverages (beer) and alcohol abuse in the locality including assessed and recommendations for reducing risks developed</p>	<p>Consumers</p>	<p>All chain actors involved in new banana-beer value chains including consumers Contributing to national discussion and education on risks of alcohol use and abuse</p>	<p>Employees of processing enterprises, direct partners (suppliers raw material) and other community members are familiar with the risks of alcohol consumption Alcohol percentage and other relevant information concerning consumption of banana-beer is printed on packaging of beer products Processing enterprises partner with public initiatives to sensitize public on risks associated with alcohol consumption</p>	<p>Recommendations concerning risks of alcohol consumption will emphasize the relation between alcohol-abuse of HH member(s) and reduced HH resources to meet needs (incl. food) of other HH-members</p>	<p>Assessment will consider gender differences in alcohol consumption, risks and problems associated with alcohol abuse. Recommendation will cater for both men and women taking also age into account</p>	
<p>7. Incubated enterprise's capacities strengthened with regards to business and technical skills</p>	<p>Entrepreneurs Staff/employees enterprises Supplier of raw material</p>	<p>20 processing enterprises in Central Uganda (average 10 staff)</p>	<p>70% of enterprises is self-sustaining at the end of the second year of incubation</p>	<p>Entrepreneurs and staff/employees increase incomes</p>	<p>Selection of participants for incubations will focus on rural-based persons with limited access to land. These are often married women and young men and women</p>	

7. FEASIBILITY:

a) Technical feasibility (*provide evidence that the proposed innovation is likely to be effective at an experimental level; e.g. that it has worked elsewhere*)

Output 1: Farmers access and grow high yielding disease resistant juice/ beer varieties [5 NARITAs + M3 + FHIA 25] IITA and NARO have screened the proposed varieties, and they are ready for introduction in farmers' fields (see appendix 2, table 3). IITA, NARO and Bioversity have successfully promoted new varieties in East-Africa before such as the benchmark studies in Luwero and Masaka (Tushemereirwe et al., 2005; Katungi, 2006), and have experience with development of training guides (Tushemereirwe et al., 2003; (Karamura et al., 2008). NARO and IITA have experience with development of varieties dissemination models for farmers and other agri-business actors (Tushemereirwe and Smale, 2007).

Output 2: Farmers receive training to strengthen capacities on banana management

Bioversity, IITA and NARO have vast experience in agronomic management and post-harvest handling of banana in many countries including Uganda. Good agricultural practices have already been established for cooking bananas in Uganda. Examples of projects in which partners have successfully trained farmers on different aspects of banana-management are: Bioversity's ADA project, and Bioversity's, NARO's and IITA's projects on BXW management (Tinzaara et al., 2006; Biruma et al., 2007; Kubiriba et al., 2014 and Karamura et al., 2006).

Output 3: Recommendations for optimization of unit operations and waste management to industrial processors

NARO has experience in fine-tuning processing technologies for optimal unit productions and waste management. They also have improved processing technologies including membrane filters, extractors, and setting-up small and medium size production units in developing countries. Jakana Foods has experience in banana juice and beer processing and, together with other private sector actors, is interested to improve process efficiency (Key informant interviews, 2014).

Output 4: Improved artisanal processing methods for juice or beer developed, documented and compiled in learning guides

NARO has experience in fine-tuning processing technologies for optimal unit productions. NARO is working with small-scale enterprises on their research station to optimize artisanal processing methods. IITA and Bioversity both have experience in developing curricula / learning guides for farmers.

Output 5: Marketing strategies developed based on identification of new market segments for differentiated banana beverages and product presentation in close collaboration with private sector partners guided by the PMCA protocol. Bioversity and NARO have experience with consumer surveys focusing on packaging, pricing (willingness to pay), and distribution channels for differentiated products. NARO has experience in sensory and consumer testing of products. Bioversity has experience with facilitating market linkages between smallholder farmers, processors, and traders, including the banana beverage chain in Uganda (Bar and hotel survey, 2014) (Rietveld et al., 2013) Proposed staff of this project has followed training on Participatory Market Chain Analysis (PMCA) approach that will be used to guide the activities under this output.

Output 6: Assessment of relation between local processing of beer-banana for low-alcoholic beverages (beer) and alcohol abuse in the locality including recommendations for reducing risks

Bioversity and NARO have conducted FGDs with men and women in communities where processing for banana-beer and gin is common and are thus familiar with common issues concerning processing and associated consumption of alcohol (Banana Beverage diagnostics study, 2014). In the scoping study, contacts have been made with BUCADEF an organisation promoting and fostering social and economic development in the Buganda kingdom and Uganda Bureau of Standards (UNBS) who are willing to collaborate with the project on the activities planned under this output.

Output 7: Incubation of enterprises processing banana juice and/or beer

NARO has proof of concept for incubation of enterprises processing banana for beer and juice products on their research station and is motivated to take this approach off-site to the rural communities. The Agribusiness Incubation Program at the National Agricultural Research Laboratories, (NARL) Kawanda is a semi-autonomous unit created to support private actors access research generated technologies, innovations and management practices and develop them into sustainable agri-enterprises. The incubator creates an environment where actors in technology generation interact with entrepreneurs to identify technologies, innovations and management practices with potential for commercialization. The incubator, working with partners, then hand-holds the entrepreneurs to develop the technologies, innovations and management practices into commercial products. The NARO incubator is currently supporting eight start-ups. The start-up companies include Variety Plus 'U' Ltd (banana snacks and cassava based confectionery) and Super Products, 'U' Ltd (producing banana juice and beer). NARO, IITA, Bioversity and TRIAS all have experience in working with small-scale rural based enterprises in Uganda.

b) Economic feasibility

To assess the economic feasibility of the proposed project, a simple cost benefit analysis was conducted to quantify the economic viability of the intervention. During the scoping study, we gathered all the economic costs incurred and benefits received by farmers, artisanal processors, semi-industrial processors and trader during the production, processing and marketing of banana juice and beer. The estimated costs and benefits were then used to develop partial budgets for all the chain actors involved for the proposed changes. The potential costs and benefits that accrue to different value chain actors were extrapolated over the appraisal period of 10 years and discounted using a common public sector discount rate of 6%. The discounted present values of benefits and costs, the Net Present Values (NPV), and benefit cost ratios were then calculated as indicated in appendix table 1.

Considering the total expected benefits of the proposed interventions in comparison with the costs associated over the appraisal period of 10 years, cost-benefit ratios are 2.64 for farm level upgrading (output 1-2), 9.19 for semi-industrial interventions (output 3) and 5.11 for artisanal interventions (Outputs 4-5, 7). Output 6 has not been included in this cost-benefit analysis but based on literature we argue that reduction in alcohol abuse leads to increased resources for households and reduced violence resulting in higher labour availability and financial resources for the household (Tumwesigye NM and Kasirye R., 2005; Wolff B et al., 2006).

c) Social feasibility *(indicate if socio-cultural norms or practices facilitate or hamper adoption of technical and other innovations, considering gender and intergenerational differences)*

Banana juice and beer are traditional products with high cultural value, especially for the Baganda, a people dominant in Central Uganda. Banana-beer is consumed during traditional ceremonies related to marriage and

burial. Banana-juice is a product with which children grow up as many banana-producing households regularly produce for home-consumption. During the scoping study individual actors and BUCADEF expressed their interest in high-quality banana juice and beer products.

The planting materials multiplied and promoted under output 1 will be made accessible to both male and female banana-producers. Capacity-building on banana-management under output 2 will consider different conditions of male and female banana-producers.

Although the project will target poor people with limited access to land with special reference to women and young people, other community members (land-owners or artisanal processors) also benefit through increased value of their beer/juice banana plantations and/or increased supply of high-quality beer/juice bananas. We therefore don't expect any conflict nor are we privileging any social group.

Focus group discussion (2014) revealed that alcohol consumption is not linked to local processing as different kinds of other (cheap) alcoholic beverages are widely available in the rural areas of Uganda. The main product consumed by alcoholics was moreover not banana-beer but the banana-gin (waragi) and other distilled products with high alcohol content. Banana-beer is currently mostly consumed by elder people and during cultural events.

Most farmers growing banana will cultivate both cooking and beer varieties, and the relative numbers will depend on their location. We don't expect much competition between the two varieties (cash over food) as having a cooking banana plantation is culturally extremely important for especially (Buganda) men.

8. DEMAND FOR THE INNOVATION *(provide evidence that there is immediate demand for the proposed technical innovations by targeted users/beneficiaries)*

Banana-producers

Beer-banana varieties are main crops in farming systems in Central and Western Uganda with some varieties especially, better adapted to rougher environmental conditions in Central Uganda, where pests, soil infertility and drought prevail, than cooking-banana varieties. Key-informant interviews (2014) estimated 65-80% of households in Nakaseke and Mpigi districts (our proposed pilot sites) produce juice/beer banana varieties. Existing juice/ beer cultivars (Kayinja/ *Pisang awak*) and Mbide are being wiped out by the disease Banana Xanthomonas Wilt (BXW). Volumes produced have reduced significantly in the production areas and plantations have been destroyed and replaced with annual crops (Karamura et al., 2006; FGD, 2014; Key-informant interviews, 2014; Banana Beverage diagnostics study, 2014; Rietveld et al., 2013). Annual crops are more labour-intensive and don't necessarily generate more income. Another constraint is the low bunch weight of juice/beer banana bunches which translates in low prices to producers (Banana Beverage diagnostics study, 2014). The low bunch weight results from sub optimal plantation management and choice of cultivar. Good management practices have been established for cooking bananas in Uganda but not for juice/beer banana farming systems. Banana-producers have expressed their interest in technical innovations that address these constraints (BXW & sustainability production and Low bunch weight) (FGDs 2014).

Juice/beer-banana processors

Key-informant interviews (2014) estimated that two thirds of the beer/juice banana producers also engage in processing, which is in line with literature (Rietveld et al., 2013). Artisanal processing is one of the few activities that generates cash to the household (member) and has the potential for wealth creation. In addition this income is generated year-round which sets it apart from another main sources of cash income in

the central region (Katungi et al., 2006; FGDs, 2014). Both men and women are involved in processing and can control the process and income. 57% of female processors surveyed for the banana beverage diagnostics study (2014) made all decisions concerning processing and income generated independently.

Following reduced yields caused by BXW, the majority of the processors (80%) identified inconsistent supply of raw materials their main constraint (Banana Beverage diagnostics study, 2014). One coping strategy is to shift from beer to gin (waragi) production where banana raw materials can be replaced to a certain extent by sugar molasses (Key-informant interviews, 2014; Rietveld et al., 2013). Artisanal processors indicated that they would opt for the less cumbersome juice and beer production (FGD, 2014) if supply of raw bananas was sufficient.

Another regular complaint heard from artisanal processors is the drudgery of the process; processing requires heavy labour in the form of fetching water and especially squashing and extraction (FGDs scoping study). The latter is done manually, using hands and feet and apart from being laborious it's also unhygienic. Especially elderly people mention this as a reason to have stopped processing (Rietveld et al., 2013; Beer-banana diagnostic, 2014).

Some 40% of artisanal processors identify the short shelf-life of juice and beer (tonto) as a serious drawback for commercial production when compared with gin (waragi) production (RTB beer-banana diagnostic; Rietveld et al., 2013). Another major constraint experienced by industrial and commercial-oriented artisanal processors is the lack of packaging material resulting in poor or expensive product presentation (key-informant interviews, 2014). Industrial processors also mention constraints with regards to product promotion for which they lack the human and financial resources (key-informant interviews, 2014).

Traders and retailers

A survey conducted with bar and hotel owners in Kampala showed that banana juice has market potential in the different market segments (high, medium and low end) as long as it is standardized, well packaged, labelled and presented (Bar and hotel survey, 2014) and that bars and hotels have strong willingness to pay for such products. Where 73% of the low-end bars was trading in banana-beer, only 20% medium-end bars and 0% of high-end bars was. The major constraints for trading banana-beer were identified as; low shelf life (67%) and poor product presentation (58%), which is in line with Rietveld et al. (2013). All the interviewees expressed strong willingness to pay a premium for well packaged and good quality beer. They indicated that they would be willing to pay about \$0.25/0.5L compared to the current prices of \$0.2/0.5L.

Consumers

A consumer preference study (2014) was conducted to assess the interests and preferences of consumers regarding banana juice and beer (see appendix 2). Artisanal juice didn't perform well implying that processing methods in addition to shelf-life enhancement (current shelf-life for juice is one day) are main areas for improvement from a technical processing point of view. Artisanal beer scored, apart from its appearance, highest in flavour, taste, aroma, mouth feel and overall acceptability compared to industrial banana-beers. This implies that the main area of improvement lies with improving appearance and presentation.

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Appendices

Appendix 1: Scoping study Methodology

During the development of the initial business case several knowledge gaps were identified and consequently addressed in this scoping study. These included: 1) General information gaps in relation to exact percentages of population growing juice/ beer varieties, household member controlling production, percentage of processors, volumes currently produced, family and hired labour used; 2) Market studies; demand for improved banana-beer and juice, market segments and consumer studies; 3) More precise constraints and opportunities to artisanal and semi-industrial processors; 4) Assess interest/ willingness of farmers to invest resources in juice/ beer varieties production; 5) Identification of criteria for site and participant selection incubation; 6) Identifying most suitable varieties for screening; 7) Potential trade-offs in terms of gender, alcohol consumption and conflict; 8) Income derived from processing or production from raw material; 9) Capacity needs for producers in relation to sound agronomic management for improved productivity and quality Kayinja. To address these gaps we used different methods, including survey for bars and hotels, focus group discussions (FGDs), Key informant interviews, consumer preference (sensory evaluation) studies and literature review.

Bar and hotel surveys: The objective was to assess the perceptions, market opportunities and demand for the banana juice and beer in the different market segments. The survey was conducted in the five divisions of Kampala district: Central, Kawempe, Nakawa, Makidye and Rubaga, in high end, medium end and low end bars and hotels. A total of 25 (11 hotels and 15 bars) were included in the survey. The survey was used to also explore current trade in banana juice and beer, the willingness of the bars and hotels to invest in the products, preferences for packaging and how much they would be willing to pay per unit and the reasons for trading or not trading in the products. Findings of the survey are presented in appendix 2.

Consumer preference (sensory evaluation): The objective was to assess acceptability for the banana beverages (juices and beers) available on the Ugandan market. To achieve this, the banana beverages on the market were identified and five juices and two beers (from different processors) were selected for the exercise. The local artisanally produced juice and beer were used as control. To capture market segmented preferences; the exercise was conducted in Nakyesanja primary school Kawanda (juice only), in Capital shoppers supermarket Ntinda and in Makerere university. In each site, 40 (total of 120) panellists (customers present in the supermarket at the time of the sensory testing, male and female pupils and male and female university students and teaching staff) were voluntarily recruited to assess the products. They were given the juice or beer to taste and give their judgement by filling in a pre- designed questionnaire. Full results are presented in appendix 2.

Key informant interviews: The objective was to identify and understand constraints and know processes used by semi-industrial processors of banana-beer and juice. Three industrial processors were interviewed: Nature's choice (Kampala); Eshandy (Bushenyi) and Excel Horticulture (Mbarara). Earlier visits had been made to Jakana Ltd (Kampala). Interviews were also conducted with BUKADEF, to establish their interest, capacity and willingness to collaborate with the project.

FGDs: The objective were 1) to assess interest of beer-banana producers and processors in the pilot sites for the proposed interventions; 2) identify and understand artisanal processing procedures, constraints and roles

of men and women and 3) To explore the relationship between local processing and alcohol abuse. These FGD were done separately with men and women in the pilot sites (1) and other sites in Central Uganda (2 and 3).

Literature review: The objective was to collect and review literature related to the knowledge gaps that were identified.

Appendix 2: Tables of results

Bar and hotel survey

Table 1: Willingness to pay (average price) for banana juice in the preferred presentation forms (per unit).

Presentation	Volume packaged (mls)	Purchasing price	Selling price
Plastic bottle	100mls	500	1000
	200mls	1000	2000
	250mls	1500	2500
	500mls	1750	3000
	1000mls	2000	3200
Glass bottle	100mls	700	1200
	200mls	1200	2000
	250mls	1700	2200
	500mls	2000	3000
	1000mls	2500	3500
Disposable cups	100mls	500	800
	200mls	1000	1500
	250mls	1500	2000
	500mls	1800	2500
	1000mls	2000	3000

Table 2: preferred form of presentation for banana juice and beer (ranked in order of 1st-4th; 1st being the most preferred form)

	beer	Juice
Plastic bottle	2nd	1 st
Glass bottle	1st	3nd
Big glass	3rd	4th
Medium glass	4th	2rd

Table 3. New juice/beer banana hybrids pre-selected by IITA and NARO

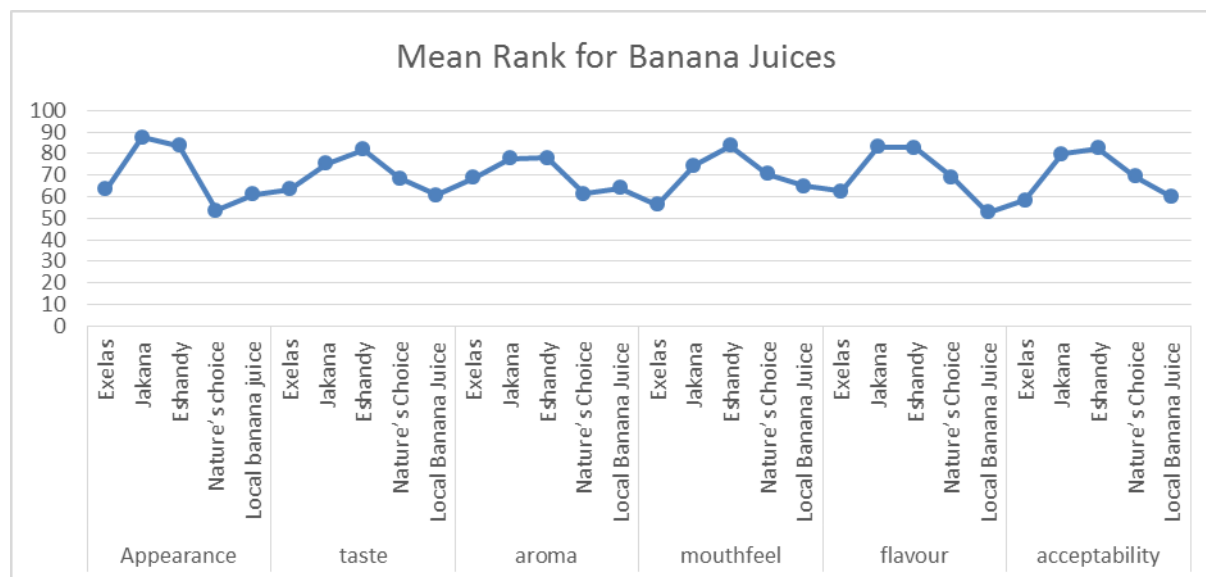
NAME	BWT(KG)	DTM	BRIX (%)	FUSARIUM WILT	SURVIVORS HIP	REMARKS
NARITA3	22.75	149		Resistant	6 mats	Drop
NARITA8	22.75	136	20	Resistant	10 mats	Advance
NARITA9	24.33	167	16.5	Resistant	9 mats	Advance
NARITA10	18.67	155	18.6	Resistant	8 mats	Advance
NARITA13	17.29	145	18	resistant	8 mats	Advance
NARITA16	15.25	130	16.4	resistant	4 mats	Drop
NARITA21	24	154	20.5	resistant	9 mats	Advance
FHIA 25	41.4	201		resistant		Advance
M3	22.9	138		resistant		Advance
KAYINJA	13	160	22 – 25	susceptible		local check

DTM = DAYS TO MATURITY (FRUIT FILLING)

BWT = BUNCH WEIGHT

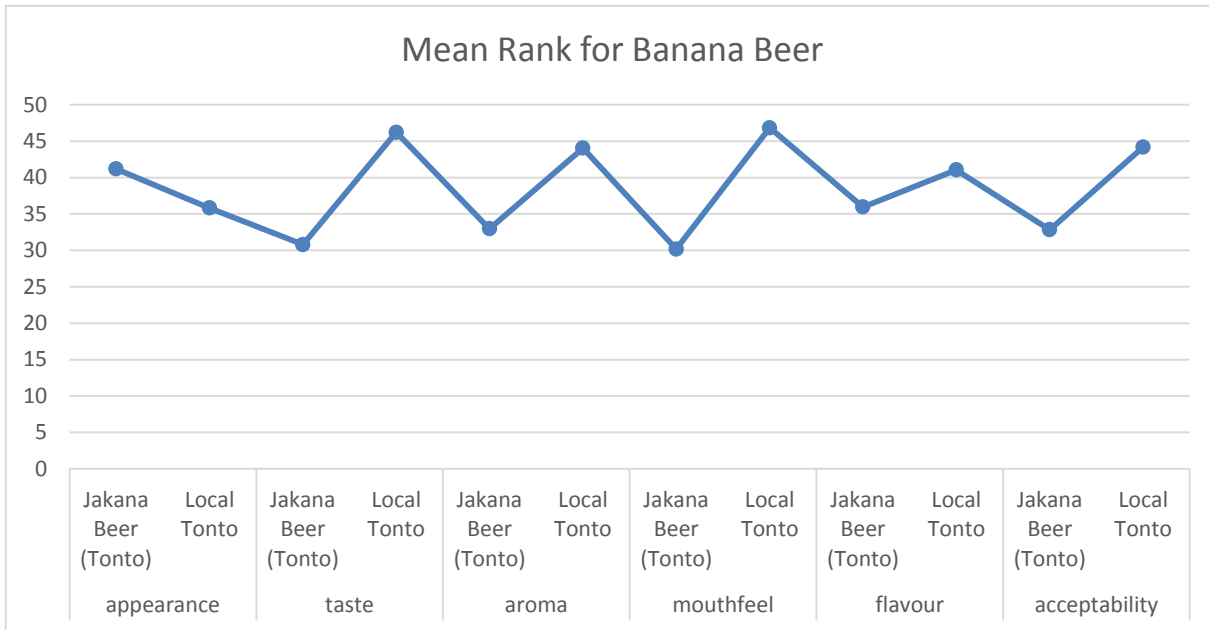
SURVIVORSHIP = NUMBER OF MATS PRESENT AFTER 4 YEARS OF PLANTATION EXISTENCE, OUT OF THE 10 PLANTED MATS

Table 4: Mean rank for Banana juices (sensory testing)



Jakana and Eshandy juices scored highest all the attributes: appearance, taste, aroma, mouthfeel and flavour while the local banana juice scored least in taste and flavour. Overall acceptability of the juices was: Eshandy (82.52%); Jakana (79.89%); Nature's Choice (69.33%); Local Banana (59.95%); Exelas (58.29%). This implies that local banana juice needs to be further processed to improve on its attributes for enhanced market access.

Table 5: Mean rank for banana beer (sensory testing)



Jakana tonto scored highest (41.18) in product appearance compared to the local tonto (35.82). However, for the rest of the attributes, local tonto scored highest and overall, it was more acceptable with a mean score of (44.16) compared to Jakana tonto (32.84). This implies the market potential of the local beer.

Appendix 3: VC actors Map and processing flow chart

VC actors map (below)

This map reveals all the chain actors disaggregated by gender; it shows a representation of both men (♂) and women (♀) actors along the banana beverages value chain in terms of percentages and activities performed. It also shows the invisible (hidden) actors (in broken boxes).

The (dis)enabling environment (including natural environment, gender roles and behaviours, governance, formal and informal networks and consumer trends), denoted by a plus (+) and minus (-) signs for enabling and disabling environment, respectively. The enabling environment presents opportunities that can be built on to upgrade the value chain while the dis enabling environment shows the anticipated constraints.

The support and business services (including technology, extension services, and marketing), denoted by a plus (+) or minus (-) signs if such services are in existence or not, respectively.

Gender Sensitive Banana Juice and Beer Value Chain Map

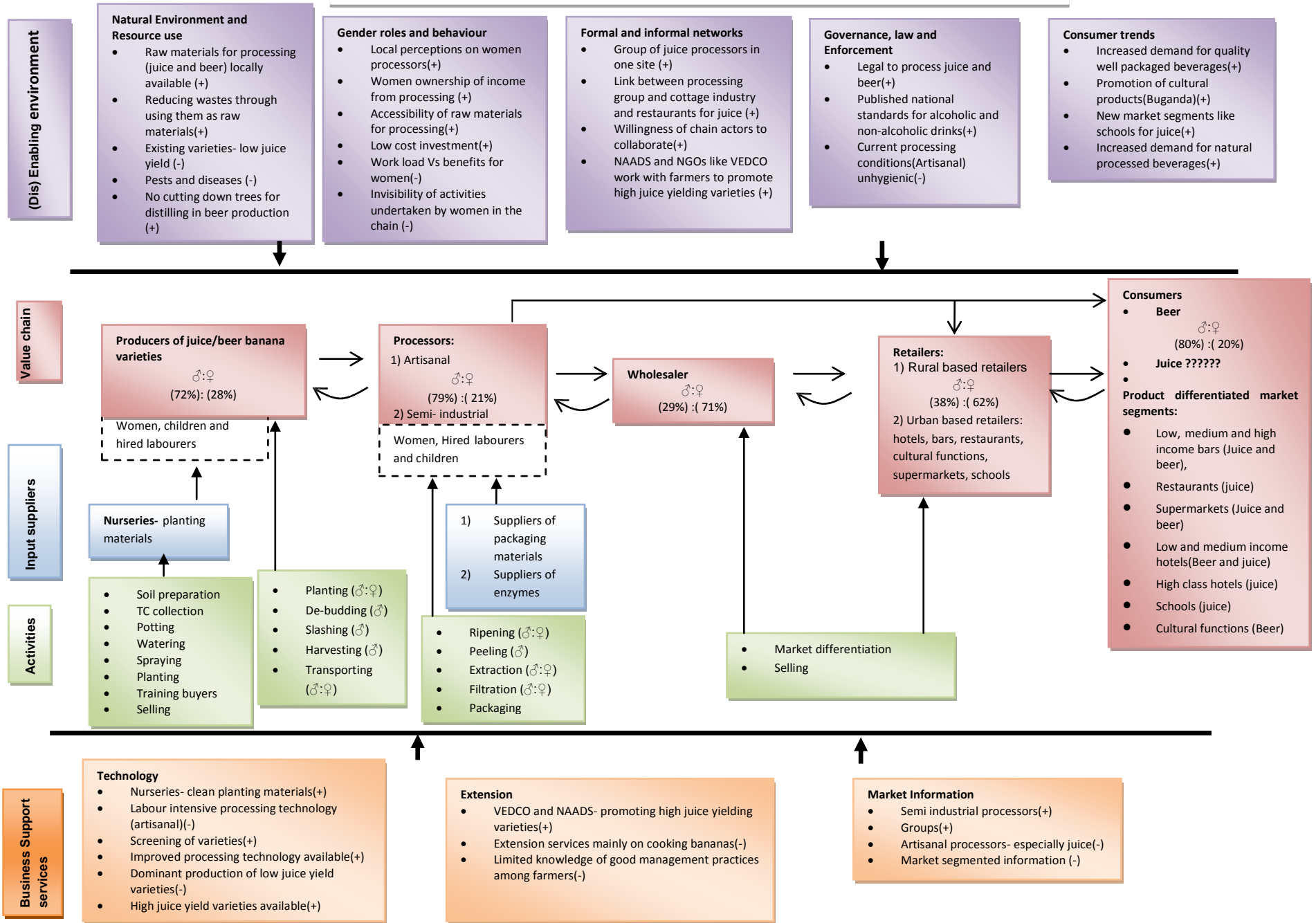


Figure 1: Banana Beverages Value chain actors map

Source: FGDs, 2014; key-informant interviews, 2014; banana beverages diagnostics, 2014

Appendix 4: Banana beverages processing Flow chart

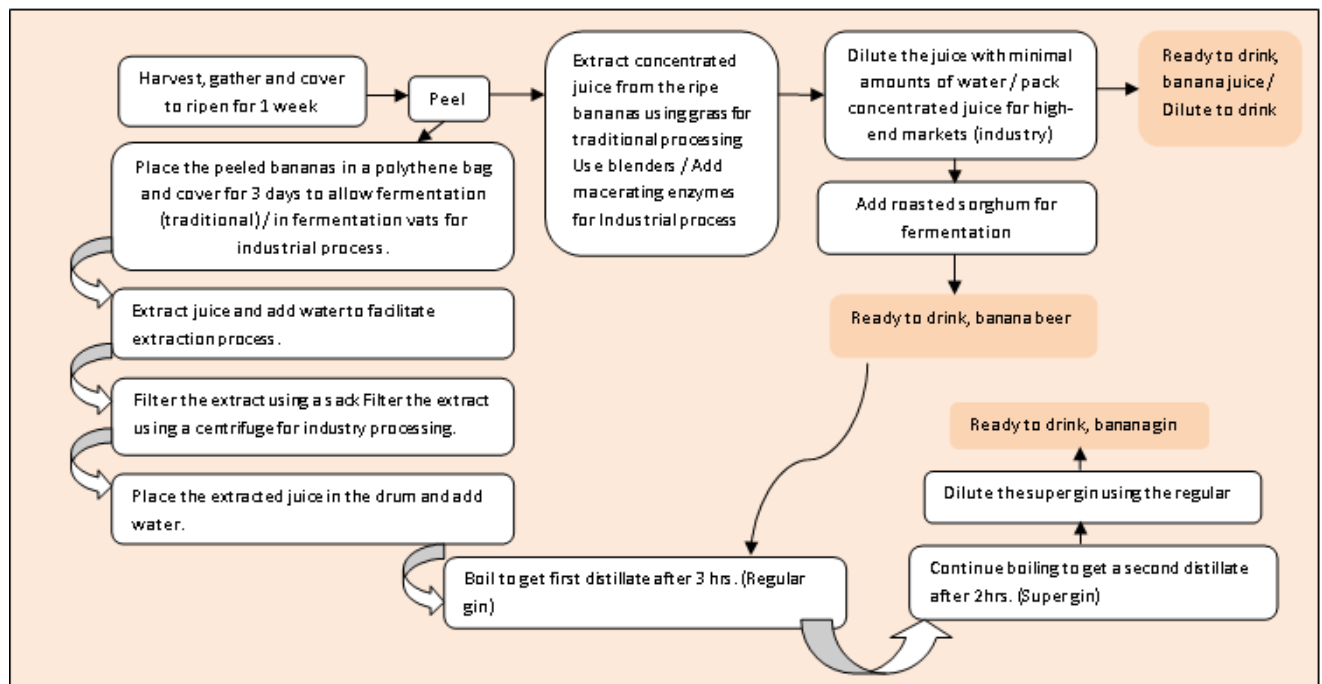


Figure 2: Flow chart for artisanal production of banana-juice, banana-beer and banana-gin

Source: FGDs, 2014; key-informant interviews, 2014; banana beverages diagnostics, 2014

Appendix 5 economic feasibility

Table 1

	FARM LEVEL	SEMI- INDUSTRIAL	ARTISANA L
Appraisal period (years)	10	10	10
Cost-benefit analysis of monetary costs and benefits at the Public Sector Discount Rate of 6%			
Present Value of Benefits	\$7,211	\$960,243	\$55,082
Present Value of Costs	\$2,730	\$104,544	\$10,782
Benefit Cost Ratio	2.64	9.19	5.11
Net Present Value	\$4,481	\$855,699	\$44,300