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

Business Case

Reducing post-harvest losses and promoting product differentiation in the cooking banana value chain

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
Enoch Kikulwe	Bioversity	Coordinator- Bioversity focal point
Godfrey Taulya	IITA	Agronomist-IITA focal point
Michael Batte	IITA	Breeder-Cultivar identification
Kephas Nowakunda	NARO	Food scientist- NARO focal point
Justus Mugisha	KAIKA investco	Marketing and product development-Private sector
Susan Ajambo	Bioversity	Gender and value chain development
Julius Barigye	Consultant	Farmers' group coordinator-NGO
James Ssemwanga	Ssemwanga Center	Value chain development-Private sector
Christophe Bugaud	CIRAD	Physical, chemical and sensory attributes
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A. Business Case

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, e.g. low profitability of RTB, opportunities to increase household incomes, increased farm productivity,)*

Cooking banana is the main staple crop in Uganda with a total production of 4.0 million mt, as compared with other staple crops such as Cassava (2.9 million mt) and sweet potato (1.8 million mt). It is mainly produced by smallholders who depend on it as a source of food (60% of total production is auto-consumed) and income (35% is sold to rural and urban consumers), while 5% is given away to neighbours or relatives (UBOS, 2010). Ugandans have the highest per capita consumption of cooking

banana in the world (Clarke, 2003), accounting for 17% of total daily per capita caloric food intake as a single most important source of calories among Ugandans (Fiedler et al., 2013).

However, actors along the cooking banana value chain in Uganda face risks of high postharvest (PH) losses due to short green life of bananas and damage arising from poor post-harvest handling. On-farm postharvest losses are about 40% of production for farms far from markets (>30 km from paved roads) (TRIAS, 2012), 3-6% of production for farms close to markets, and 10-27% at trader level (Market Study, 2014; FGD, 2014)[1]. For instance, at retailer/trader level losses accrue from ripening (60%), bruises (21.4%), thefts (20.2%), weight loss as a result of delayed selling (15%) and diseases (4%) (Table 3, Appendix 2). The forms in which bananas are handled and marketed after harvest promote losses; the bananas are transported to markets mainly as bunches on bicycles or stacked on trucks and unprotected. They are also transported as fingers tightly packed in poorly aerated polythene bags that build up heat around the bananas in transit. The bunches are supplied to retailers operating in an open space, where they are subject to loss causative agents (Market study, 2014). Unit prices are determined by visual inspection, which is subjective and arbitrary and therefore presents risks for economic loss. Losses due to ripening are also associated with production gluts, which are partly due to seasonal scheduling of follower sucker selection. Gluts cause drastic price reductions and lead to surplus production being fed to livestock, used as mulch/manure and /or just disposed off.

In order to reduce postharvest losses, traders prefer varieties with intrinsic long shelf-life traits that are less susceptible to physical damage and weight loss such as Kibuzi, Nakitembe and Mbwazirume (Market study, 2014, Table 2 of Appendix 2). These varieties are also preferred for their culinary qualities (Nowakunda, 2000; Nowakunda et al., 2001; Gold et al., 2002). However, these varieties are not widely grown because farmers base their choice of varieties on bunch size, cultural connotation, local availability, rather than market demand. Other strategies to reduce postharvest losses include transporting at night when temperatures are low to prevent ripening and, diversification of the units in which bananas are sold such as fingers (peeled and unpeeled) and clusters as alternative to bunches to reduce bruising and finger damage that happens during handling and promote faster sales (Market study, 2014). Moreover, smallholder producers get the least share of the profits in the banana value chain due to a large number of middle men (about 5 to 7 according to Ngambeki et al., 2010). According to the New Vision newspaper (August, 2014), for a 40kg bunch sold at UGX 25,000 in Kampala, its farm gate price is UGX 4,000, yet the transport costs for the same bunch is UGX 2,000.

A market study, carried out between July and August 2014 in several parts of the country, underscored the need for reducing postharvest losses and improving marketing. Transparency, for example, can be increased by introducing a weight-based pricing system that not only responds to producer needs, but also to changing consumer preferences for smaller units of banana in view of increasing urbanization (4.8% per annum, UBOS 2011) with smaller household sizes (3.6 household members in Kampala and 5.2 in rural areas, UBOS 2010) and higher rates of women employment (between 2006 and 2010, proportion of working women increased from 70% to 76%, UBOS, 2010). The study also showed that 51% of the retailers (Table 5, of Appendix 2) and two major supermarkets (Uchumi and Quality Shoppers) in Kampala and 41% of consumers (Table 6 of

[1] During the scoping study different studies were conducted: Market study, focus group discussions (FGD), literature review, and key informant interviews. For this business case, these studies are referred to as Market Study 2014, FGD 2014 and Key Informant Interviews 2014

Appendix 2) are interested in the weight-based pricing system where banana are sold in kilograms that increases transparency. Women consumers particularly referred peeled fingers because it reduces drudgery (peeling is a traditional role for women) (Market study, 2014).

This business case lays out opportunities for reducing post-harvest losses and promoting product differentiation in the cooking banana value chain through upgrading storage, transport, and marketing, with the final aim to increase farmers' margins and the value added along the chain.

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*

We have selected two districts in Southwest Uganda where we will pilot the project activities: Isingiro and Rakai. This region produces 68% of the cooking bananas in Uganda, with Isingiro district being the main producer (UBOS, 2010) providing a daily average of 37,000 bunches of marketed bananas in Uganda (NewVision August, 2014). In these districts, we have selected two sites[2], the sub counties of Rugaga in Isingiro and Dwaniro in Rakai district, based on the following criteria: major cooking banana growing areas with bananas as their major source of income (Kalyebara et al., 2006), and the presence of private sector involved in transporting and marketing of bananas who have shown willingness to trade in bananas using the weight-based system (such as Kaika limited).

In value chain development for stimulating economic growth and fighting rural poverty, there is the building of mutually beneficial links between smallholders and other chain actors, such as processors, exporters and retailers that interact for the production and marketing of a given product (Donovan et al., 2013). This implies bringing together in a participatory way, a wide spectrum of actors (private and public), innovations (commercial and institutional) and capacities for broad social and economic change. To achieve this, 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 PH strategies. PMCA is a flexible value chain approach that allows for continuous identification of actors as and when the need arises (Bernet et al., 2006; Donovan et al., 2013). During scoping (FGD,2014, Market Study 2014, and Key Informant Interviews 2014), we used it to identify some of the cooking banana value chain actors by gender (see VC Map, Appendix 3) and we will continue to use it to identify more actors and bring them together as the need arises. Guided by its processes, the actors will be mobilised, brought together at sub-county level and facilitated to form thematic groups (such as supply system to supermarkets, retail outlets in markets, and export) and business opportunities. Information about the cooking banana marketing systems and the market demands will be shared and collectively evaluated. Market linkages for differentiated cooking banana in line with consumer demand will then be established.

PMCA will provide a framework for the implementation of the project activities following the approaches below: (1) Reduction of post harvest losses through promotion of varieties with intrinsic longer shelf-life and better PH handling practices; (2) Increase market access and transparency in unit pricing through product differentiation and piloting the weight-based pricing system; (3) Promotion of sucker staggering for evening-out banana production across seasons; and (4) Link the

[2] A site will be a sub county in the selected district. In Uganda a sub county is the smallest unit of all government interventions with an average population of about 30,000 households

different actors along the value chain to benefit from emerging untapped market opportunities based on product differentiation.

1. Reduction of post-harvest losses through promotion of varieties with intrinsic longer shelf-life and better PH handling properties

The project will work with farmers to increase access to cooking banana varieties with intrinsic longer shelf-life and low susceptibility to bruising and weight loss, which were identified during the Market Study 2014 Market Study 2014 . These varieties also had high consumer demand: Nakitembe (48%), Kibuzi (31%) and Mbwazirume (9%).

We will, together with all chain actors, share and evaluate information about the market demanded varieties as a basis for identifying market opportunities related to them. The reasons why such cultivars are not yet widely grown, yet, they are known to have better postharvest attributes and high consumer acceptability will be elucidated. The output from the sharing will be a buy-in and/or co-investment by other actors and adding/subtracting on the list of varieties. The selected varieties will be multiplied to get planting materials for the establishment of mother gardens in the two pilot sites.

At each site five mother gardens will be established, which will act as training sites for macro-propagation techniques, planting material access based on NARO models (Smale and Tushemerirwe, 2007), and better PH handling practices including cushioning while transporting and transporting clusters instead of bunches. The agreed upon seed distribution model will cater for the terms and modes of access. The macro-propagation technique is low cost easy-to-use technology which can be used and afforded by low income earners like women. All the participating farmers will be trained in the macro-propagation techniques and maintaining the quality of the seed. Host farmers will be selected in a participatory way. Based on the data that 30% of the land owners are women (FGD, 2014), at least two of the mother gardens will be managed by women.

2. Increased market benefits and transparency in unit pricing through product differentiation and piloting the weight-based pricing system

The project will conduct an in-depth market study to capture the actual and potential demand for different cooking banana presentation forms and sale units and results will be used to inform differentiation. It will promote weight-based pricing which is more transparent compared to the existing subjective visual determination of prices. This will involve finger and cluster removal from the peduncle at harvest, graded by variety, finger size, shape, colour and packed in cushioned (using locally available materials) wooden or plastic crates before transportation to identified market segments. Kaika Limited, a trading company active in wholesale/transportation and retail of cooking-banana, has expressed great interest in piloting a weigh-based pricing system along the whole value chain (from farmer to consumer).

The project will also promote the production and marketing of peeled and preserved bananas, creating income generating opportunities for especially women and youth. Under this project, already known preservatives and packaging methods will be evaluated to understand the length of storage as well as temperature and humidity regimes required for proper storage of unpeeled and peeled banana. The associated costs and benefits will be analysed to identify the most cost effective combination for marketing and postharvest losses reduction. In addition, we will build on existing efforts to develop waste utilisation options. Currently, wastes are used to feed livestock and as a source mulch and manure. In this project, we will use wastes in form of ripened banana as a source of raw material to make pancakes (locally known as *Kabalaga*). All the chain actors will be trained in

sorting, grading, packaging, records keeping, weighing scales calibrations and utilisation of rejects and wastes.

3. Promotion of sucker staggering for smoothing out banana production across seasons to avoid sudden price drops and to obtain off-season price premiums

Normally, farmers defer sucker selection to a period of the year when labour demands from competing activities are low, usually at the end of the rainy season. In this case farmers select the most vigorous sucker as follower, and they do this for all suckers in the same time period. As a consequence they all give mature bunches in the same time of the year which leads to surplus production and market gluts. The solution to this is the use of an alternative sucker selection regime through which production is evened out over the year and harvest is staggered so off-peak price premiums can be obtained. The project will promote this technique through in-field training in order to be able to identify which sucker (s) to remove (leave) to even-out production enabling farmers to sell through the year and get premium prices.

4. Collective action among value chain actors for upgrading storage, transport and marketing

Addressing bottlenecks identified in the value chain and fostering interaction among farmers, transporters, and traders, opportunities for value chain upgrading will be identified and capacities to implement these will be strengthened, with the ultimate goal to increase benefit capturing by farmers and generate higher value added along the chain. Collaboration will be based on a good understanding of both the market chain actors and the conceptual and practical market dynamics (Market survey, 2014). The process will also focus on building trust among the chain actors (Bernet, Thiele and Zschocke, 2006). In so doing, the chain actors will acquire skills in working together and negotiating for better market opportunities.

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

MAIN QUESTION: To what extent can cultivar choice, improved harvesting, product differentiation, introduction of a weight-based unit pricing system and innovative follower sucker selection contribute to reducing post-harvest losses and increasing incomes along the cooking-banana value chains in Uganda?

a) Can smallholders smooth out supply across seasons through sucker staggering and/or use of diverse varieties?
b) What current and future opportunities exist for product differentiation, and which capacities do value chain actors need to respond effectively?
c) What is the cost-benefit ratio of different cooking banana presentations in response to consumers' preferences and their willingness to pay?
d) What is the feasibility of upgrading options related to storage, transport and marketing to reduce PH losses?
e) Can value chain efficiency be increased through a weight-based pricing system, and what is needed to be accepted by producers, traders, and consumers?

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

Research output/deliverable	Delivered output	Expected time (year/quarter)	Next user
1. Increased access of farmers to cooking-banana varieties with preferred quality attributes and intrinsic long shelf life traits	Workshop (PMCA), seed distribution model, list of preferred varieties and intrinsic attributes by VC actors,	Year 1/Quarter 4	NGOs, CG, government extension, NARO
2. Convenient presentation forms of cooking bananas reducing postharvest losses and acceptable to different market segments promoted	Gender-disaggregated market study, report, publication, training, workshop, waste utilisation options, storage temperature protocol, Fair-pricing mechanisms protocol	Year 2/Quarter 4	NGOs, CG, government extension, NARO
3. Sucker staggering for evening-out banana production across seasons practised by producers to obtain premium prices	Gender-responsive guidelines, report, publication, training	Year 2/Quarter 1	NGOs, Extension workers, NARO, CG
4. Technologies, market information and regulations for increased market access and fair pricing mechanisms promoted	Gender-responsive IEC (information, education and communication) materials	Year 2/Quarter 4	NGOs, Extension workers, NARO
5. Improved practices, (dis)enabling environments, norms and culture to foster mutual understanding along the value chain	Social and gender analysis, Best-practices protocol, gender-responsive Policy briefs, Workshop	Year 2/Quarter 4	NARO, CG, government extension, policy makers

Note: Appendix 4 shows the details (Gantt Chart)

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*)

The project outputs will be promoted through various technology uptake pathways such as extension systems, publications, print and electronic media. Through adopting market preferred varieties, postharvest reduction technologies and weight-based unit pricing, it is expected that after 10 years up to 500,000 farmers in Western and Central Uganda will have increased their food security and their income from banana production by 10% and 15%, respectively. Another 50,000 actors along the banana value chain will have increased their incomes by at least 15%. The PHL will reduce to an average of 5% among the adopting VC actors.

Equitable and inclusive participation of all actors of the value chain: during project implementation specific needs of male and female actors will be identified and addressed to enable them participate effectively in the innovations. According to cost benefit analysis (Table 3), middlemen, the majority of whom are men (60%), achieve the highest margins while margins are lowest in retail market which is dominated by women (69%) (See the VC map, appendix 3). Deliberate efforts will be made to increase access of women to participate in chain-links with highest margins and to increase margins in links where they dominate (retail). This will be done through identifying and addressing the constraints that hinder women from participating in those chain links and providing them with support for effective participation.

Different forms of presentation of cooking bananas, including detaching fingers from the peduncles and sorting them into different grades prior to packaging on-farm in preparation for distribution to market outlets, is expected to reduce nutrient exports from the farms in banana peduncles and other crop residues and therefore limit soil depletion. No negative environmental impacts are anticipated in relation to the proposed interventions.

Consumers have increased access to high quality cooking banana of preferred varieties throughout the season in different quantities / forms of presentation.

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 behaviour 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 and other effects*)	**Gender equity** (*inclusiveness and benefit sharing among women, men and youth*)	**Environmental performance** *(increase of positive or reduction of negative impacts on the environment)*
1. Increased access to cooking-banana planting materials with preferred quality attributes	Farmers	500,000	1. Increase by 25% of farmers growing the preferred cultivars through increased access to planting materials	Direct due to lower postharvest losses and indirect through increased production and income: Incomes and food security along the value chain increase by 10% and 5%, respectively, through reduced postharvest losses and selling consumer preferred	1. The proposed technologies are low cost and affordable for poor people and specifically made accessible to women and youth 2. This project will introduce income generating activities targeting women and youth. 3. For activities known to be dominated by	Positive; Less residues transported off-farm resulting in lower nutrient exports from the farm. Residue is beneficial for replenishing soil nutrients. Better utilisation of waste through using the ripe bananas as raw material for making pan cakes
	Seed producers	50	2. Increase by 20% of seed producers using macro-propagation technique to produce cultivars with desired attributes			
2. Convenient presentation forms of cooking bananas reducing postharvest losses acceptable to different market segments promoted	Farmers	500,000	1. 10% of the farmers grade and sell bananas in different presentation forms			
	Traders	50,000	2. 20% of banana traders deal in the graded and different presentation forms of cooking banana			
	Consumers	180,000	3. 15% of the urban consumers buying preferred diversified forms of cooking banana			

3.Sucker staggering for evening-out banana production across seasons practised by producers for premium prices	Farmers	500,000	1. 25% of farmers staggering their production with a view to even-out production across seasons	varieties	men, the project will deliberately include women 4. In the process of project implementation specific needs for men, women and youth will be identified and addressed to enable their effective participation	
4. Technologies, market information and regulations for increased market access and fair pricing mechanisms promoted	Farmers	500,000	1. 25% of farmers sell in weight-based pricing and graded forms			
	Traders	50,000	2. 20% of banana traders and retailers buy weight-based unit pricing and graded forms			
	Consumers	180,000	3. 15% of urban consumers buy weight-based and graded cooking bananas			
5. Improved practices, (dis)enabling environments, norms and culture to foster mutual understanding along the value chain	Women	120,000	1. 20% of women participating in chains with high margins, practicing sucker selection, and peeling banana fingers for sale			
	Youth	30,000	2. 5% of unemployed youth participate in de-handing of bananas, peeling, and grading as a source of income			
	Men	300,000	3. 55% of men participating in all chains, sucker selection and producing consumer preferred cooking bananas			

7. FEASIBILITY:

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

Farmers, retailers and long distance banana traders and exporters report that they minimise some of the risks of banana ripening in transit through careful selection of cultivars with long green life. This implies that cultivar selection can contribute to increasing the green life longevity of bananas (Market study, 2014; FGD, 2014, Aked et al., 2000).

Differentiation of cooking bananas through presentation forms including fingers, clusters, peeled and unpeeled bananas is already being done by a private company Afribanana in Uganda, though at a small scale. Also some traders in major markets across the country (Table 4 of Appendix 2) and supermarkets (Key informant interviews, 2014) are selling bananas in fingers (35%) and clusters (11%) (Market survey, 2014) and fingers are increasingly demand by consumers (49%, Table 5 of Appendix 2). There are two supermarkets already selling using weight-based unit pricing for peeled bananas (Key informant interviews, 2014). Similarly, consumers and traders/supermarkets are willing to pay for good quality banana on weight-based unit pricing (Market survey, 2014, Tables 4 & 5 of appendix 2). In Isingiro and Rakai districts, farmers are already using weight-based pricing system with traders who export the banana (Kibuzi) to Rwanda and South Sudan. There are exporters (such as Fresh grown) who buy graded, de-handed (or clusters) and packed in perforated boxes in Uganda. In addition, transportation by cushioning is also happening especially for the desert bananas. Elsewhere, in South America, banana exporters grade, de-hand and pack in plastic crates (Fyffes, 2002, Spilsburg, et. al. 2002). Private sector partners involved in trade and retail of cooking banana such as KAIKA Investments with whom this project idea was conceptualised have shown their strong interest in introducing KG weight based system. The recent Market Study 2014 indicates that 41 % of consumers would buy bananas sold in weighted units while 51% of traders would use the weight-based unit pricing in their transactions (Tables 5 and 6 of Appendix 2).

At institutional level, there are a number of institutions with experiences in the proposed intervention areas. For instance, Mbarara District Farmers' Association (MBADIFA) specialises in collective marketing, extension services, linking farmers to markets, and advocacy. TRIAS is working on capacity-development of small and medium size enterprises, linking farmers to agricultural financing and other value chain actors. BIOVERSITY has expertise in consumer preference studies, market studies, value chain development and gender integration. IITA has expertise in banana macro-propagation and sucker management. NARO has expertise in market studies, post-harvest handling, consumer studies and value addition/packaging. KAIKA investment has experience in trading in cooking bananas and linking producers to retailers. Ssemwanga Group ltd has cold storage facilities that can be used to understand the required temperature and humidity regimes for peeled banana, and experience in network and value chains in Agriculture. NARO, IITA and Makerere University have experience in graded, de-handed and packed cooking bananas in perforated boxes. At farm level, some farmers are already growing the preferred varieties and they are practising sucker staggering for agronomic purposes. Project partners have been and will continue to be trained in the PMCA approach and will use their insights to guide the project. This project will also result in developing guidelines and protocols which will be packaged for use by extension and other development agencies.

Economic feasibility

To understand 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 during the production and marketing of cooking bananas, which were used to develop partial budgets for introducing the proposed changes. The potential costs and benefits that accrue to different value chain actors were extrapolated over a period of 10 years, the appraisal period of this project, and discounted to present value 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 table 3.

Table 3. cost-benefit analysis of monetary costs and benefits at the public sector discount rate of 10%

	FARMER	**WHOLESALER**	**RETAILER**
Appraisal period (years)	10	10	10
Present Value of Benefits	$62,448	$1,460,354	$153,125
Present Value of Costs	$8,244	$104,544	$101,273
Benefit Cost Ratio	7.58	13.97	1.51
Net Present Value	$54,204	$1,355,810	$51,852

Source: Market study 2014; FGD 2014; key informant interviews 2014; TRIAS, 2012.

The discounted present values of benefits are greater than the discounted present value of costs and benefit cost ratios are all greater than 1 (i.e., at farm level (5.58), wholesale level (13.97) and retail level (1.51)), indicating the worthiness of undertaking the project.

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

During the scoping study many value chain actors (farmers, traders, consumers, supermarkets, etc) were approached and showed strong willingness to work together on the proposed innovations.

Banana cultivation is embedded in the culture of many Ugandan communities. During the FGD (2014), farmers revealed that social status depends on owning a well managed cooking banana plantation in their community. They further revealed that Nakitembe, which is one of the preferred cultivars, is widely used for various cultural ceremonies. Another variety, Kibuzi, is known for its long shelf-life by value actors and it's preferred for export. Similarly, most of the traders (bicycle and retailers) know and can visibly identify them while purchasing cooking bananas for (re)stocking. This implies that the preferred cultivars are known and appreciated among the value chain actors, though they are not widely produced (occurrence of the preferred cultivars is less than 10% at farm level) because production is not market oriented.

All value chain actors experience some sort of postharvest losses and they are trying to reduce such losses using different ways including presenting cooking bananas in different forms, travelling at night when temperatures are low to avoid the effect of the heat from the sun, among others. In addition, using a weight-based unit pricing is not new in the cooking banana chain but it is mainly used by traders who export the bananas though it is on a very small scale. An FGD (2014) with farmers, who have experienced with this pricing system, revealed that they were happy with the transparency it presents and were willing to continue using it. The traders (including retailers) too, particularly Kaika limited, were willing to invest in a weight-based pricing system because of the opportunity of accessing new market segments (Key informant interviews, 2014). Similarly, the consumers were willing to buy cooking banana using a weight-based pricing system; though some feared that they might be cheated. For instance, one consumer said, "Using a kilogram system is good, but retailers might cheat us. Some weighing scales are not well calibrated, which could be a source of cheating". Promoting (through all forms of education and public awareness) and adopting the weigh-based system will focus on changing this mind-set.

The participation of both men and women in the proposed project is feasible because they are present at all levels of the chain, including hidden actors (VC map, Appendix 3). However, a gender analysis at the beginning of the project will help us to identify the constraints and solutions to mitigate them

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

The Market Study 2014 provides evidence that the cooking banana value actors prefer varieties with longer green and less susceptible to damage but are in short supply (table 2 of appendix 2). For examples, Kibuzi, one of such cultivars is produced by only 15% of banana producers and form 6% of the total number of banana plants (mats) in Uganda.

- The actors (producers and traders) are aware of the causes of postharvest losses and are willing to pay for technologies that can reduce such losses (Market study, 2014).
- Some supermarkets (Mega and Uchumi) want weighed peeled bananas but lack suppliers (Key Informant interviews, 2014).
- Different markets across the country are selling banana in different forms preferred by consumers (Table 4 of appendix 2). 51% of the retailers interviewed in such markets would be willing to pay a premium to purchase cooking bananas from farmers with consumers' preferred attributes and long shelf-life (table 6 of appendix 2).
- 41% of consumers would be willing to purchase bananas on weight-based unit pricing and high quality bananas and would be willing to pay UGX1,200/Kg (compared to current UGX 650/kg when sold as bunches and low quality), which equivalent to about 1,200,000 urban consumers (Table 5, Appendix 2)
- At farm level, farmers are very positive at adopting the weigh-based unit pricing to a replace determination of prices based on subjective visual inspection (FGD, 2014). Linking farmers with bulk

buyers and selling using weight-based unit pricing would allow them to earn UGX26000 ($10) for a 40kg bunch of cooking banana compared to current UGX4000 ($1.5) of the same weight (NewVision, August 2014).

- The elasticity of demand for cooking bananas is 1.16 for high income households and 1.38 for low income households, indicating that the demand for cooking banana increases with increase in income (FAO, 2005).

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Appendices

Appendix 1: Methodology

During the development of the initial business cases we identified several knowledge gaps in relations to our outputs and outcomes that we wanted to address in this scoping study. These included to: (1) identify the various market segments and the banana attributes required; (2) estimate the percentage PH losses in the different segments of the value chain; (3) identify consumers who will benefit from the KG system; (4) assess the willingness of different VC actors to adopt the KG system; (5) estimate the costs and benefits of the KG system vs. other alternatives; (6) identify the other initiatives being done by VC actors in promoting KG system; and (7) assess the accessibility to engage in innovation for different VC actors. To address those gaps we used different methods, including Market study, focus group discussions (FGDs), Key informant interviews, and literature review. The market study was conducted in different markets across the country, including the great Kampala region (Kampala and Entebbe cities), the northern region (Lira, Gulu and Hoima towns), the eastern region (Jinja, Iganga and Mbale towns) and the south-western region (Masaka, Mbarara and Kabale towns). In Kampala region (with the largest urban consumers of marketed banana) 10 markets were visited, while three markets were visited per region in other regions. In each market, 10 consumers, 5 traders, and 1 market master were interviewed. Data was collected using different tools: focus group discussions for producers; a structured questionnaire was administered to both traders and consumers, while checklists were used to gather information from key informants (including a tissue culture banana supplier, market masters, retailers using weigh-based system, and supermarket representatives). In greater Mbarara region, one of the farmers' groups under the collective marketing arrangement was engaged in a focus group discussion and one tissue culture banana operator was interviewed as a key informant.

Appendix 2: Tables of results scoping study

Table 1: Cooking banana, cassava, sweet potatoes, and potatoes production and their disposition in metric tons (Mt)

RTB Crop	Production (Mt)	Disposition type in Mt (%)			
		Sold (%)	Consumed (%)	Stored (%)	Others (%)
Cooking banana	4,000,000	1,400,000 (34.6%)	2,400,000(59.8%)	24,755 (0.6%)	2001,164 (5%)
Cassava	2,900,000	643,622 (22.2%)	1,800,000(60.9%)	283,025(9.8%)	205,583 (7.1%)
Sweet potatoes	1,800,000	220,709 (12.1%)	1,400,000(76%)	83,292(4.6%)	130,223(7.2%)
Potatoes	154,000	62,412(40.5%)	60,373(39.1%)	10,502(6.8%)	19,874(12.9%)

Note: Percentage of disposition types is in parentheses

Source: UBOS (2010)

Table 2: Cultivars preferred by traders and consumers (in percentages)

Cultivars	Consumers	Traders
Kibuzi	43.9	43.1
Nakitembe	39.0	26.4
Mbwazirume	7.3	18.1
Others	9.8	12.4

Table 3: Causes of postharvest losses and the levels where such losses occur for traders/retailers

Cause of postharvest losses	%	Where losses occur	%
Ripening	59.5	Offloading	11.9
Bruises	21.4	Storage	44.8
Theft	6.0	On sale (stall)	19.4
Overstaying	9.5	Transportation	23.9
Disease	3.6		

Table 4: consumers' preferred presentation forms and post harvest losses at retail level

		All markets	Kampala (Central)	Eastern Markets	Northern Markets	Western Markets
Preferred forms by consumer at retail level (%)	Unpeeled fingers	29.2	28.1	58.8	17.4	17.6
	Peeled fingers	9.0	9.3	11.7	13.0	0
	Finger sacks	1.1	3.1	0	0	0
	All fingers	**34.8**	**34.4**	**64.7**	**26.1**	**17.6**
	Clusters	**11.2**	**3.1**	**5.9**	**34.8**	**0**
	Bunches	57.3	65.6	29.4	47.8	82.4
Postharvest losses (%)	Scarcity period	10.2	8.1	11.0	19.8	0.4
	Surplus period	27.3	29.6	32.2	40.0	0.9
	Overall	18.7	18.8	21.6	29.9	0.7

Table 5: Consumers of differentiated cooking banana products and presentation forms

	Different forms purchased by consumers (%)			All
	Fingers (49)	Bunches (44)	Clusters (7)	
Gender (% of women)	70.0	66.7	90.9	70.1
Age	28.1 (30)	33.6 (32)	30.7(28)	30.7
Household size	4.9 (4)	5.0(5)	5.5(5)	5.0
WTP for KG system (% of YES)	47.4	43.7	8.8	**40.7**
WTP price per kg for consumers (UGX)	1203.8	1050.0	1625.0	1200.0

Note: standard deviations are in parentheses.

Table 6: Traders' willingness to buy/sell using the weighted unit price system

	Men	Women	All
WTP for KG system % of YES)	46.9	53.1	**50.8**
WTP purchasing price per kg (UGX)	535.7	800.0	667.9
WTP selling price per kg (UGX)	1035.7	1450.0	1256.7

Table 7: Number of retail stalls and total volumes of cooking banana offloaded in the 19 surveyed market per week

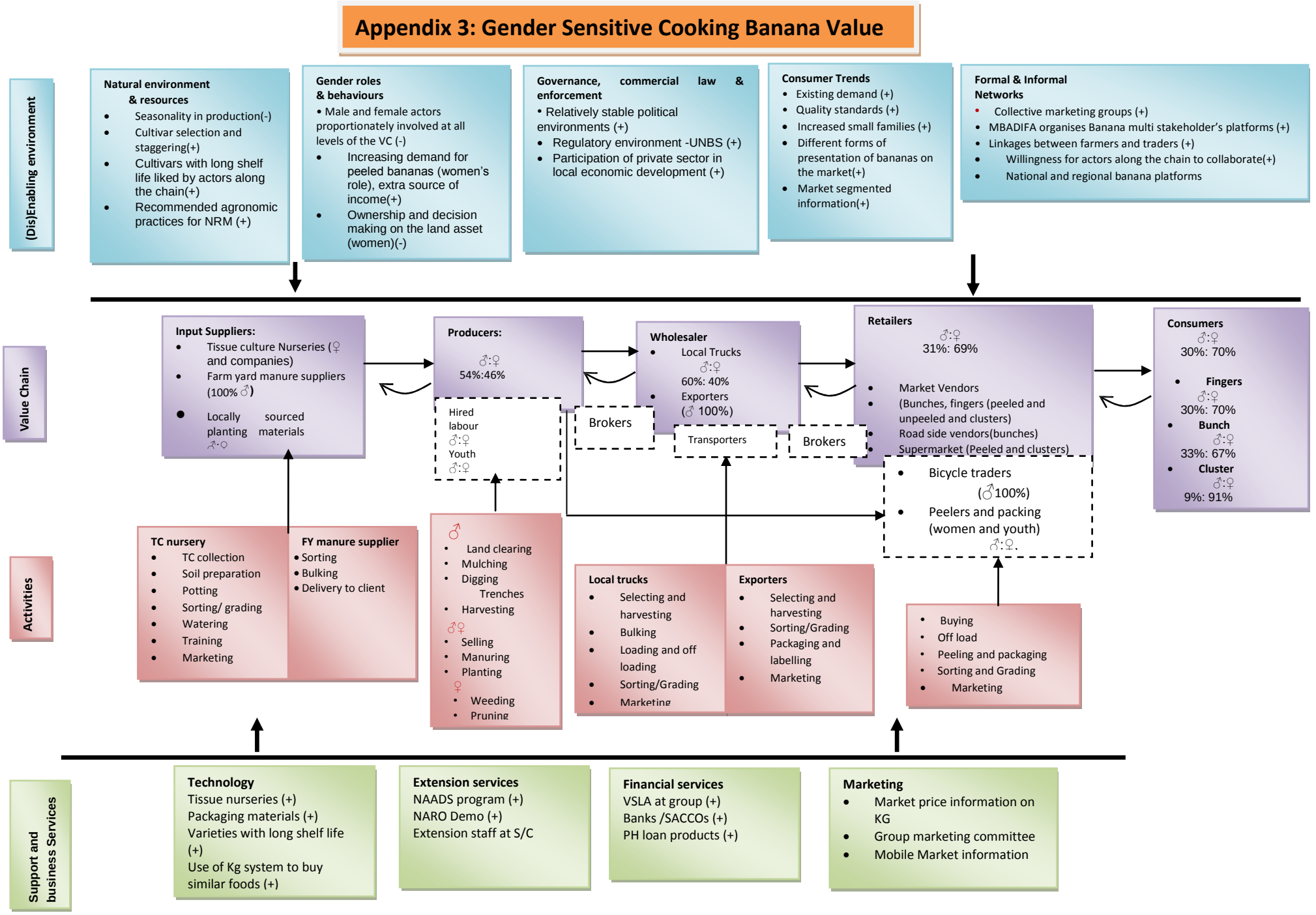
	All markets	Kampala (Central)	Eastern Markets	Northern Markets	Western Markets
All retailers	66	73	103	23	45
Women retailers	46	54	67	13	32
Men retailers	20	19	36	10	13
No. of bunches offloaded per week per surveyed market	1825	2433	1133	1150	1300
No. of finger sacks offloaded per week/ surveyed market	333	273	340	0	2

Appendix 3: Gender sensitive cooking banana value chain map

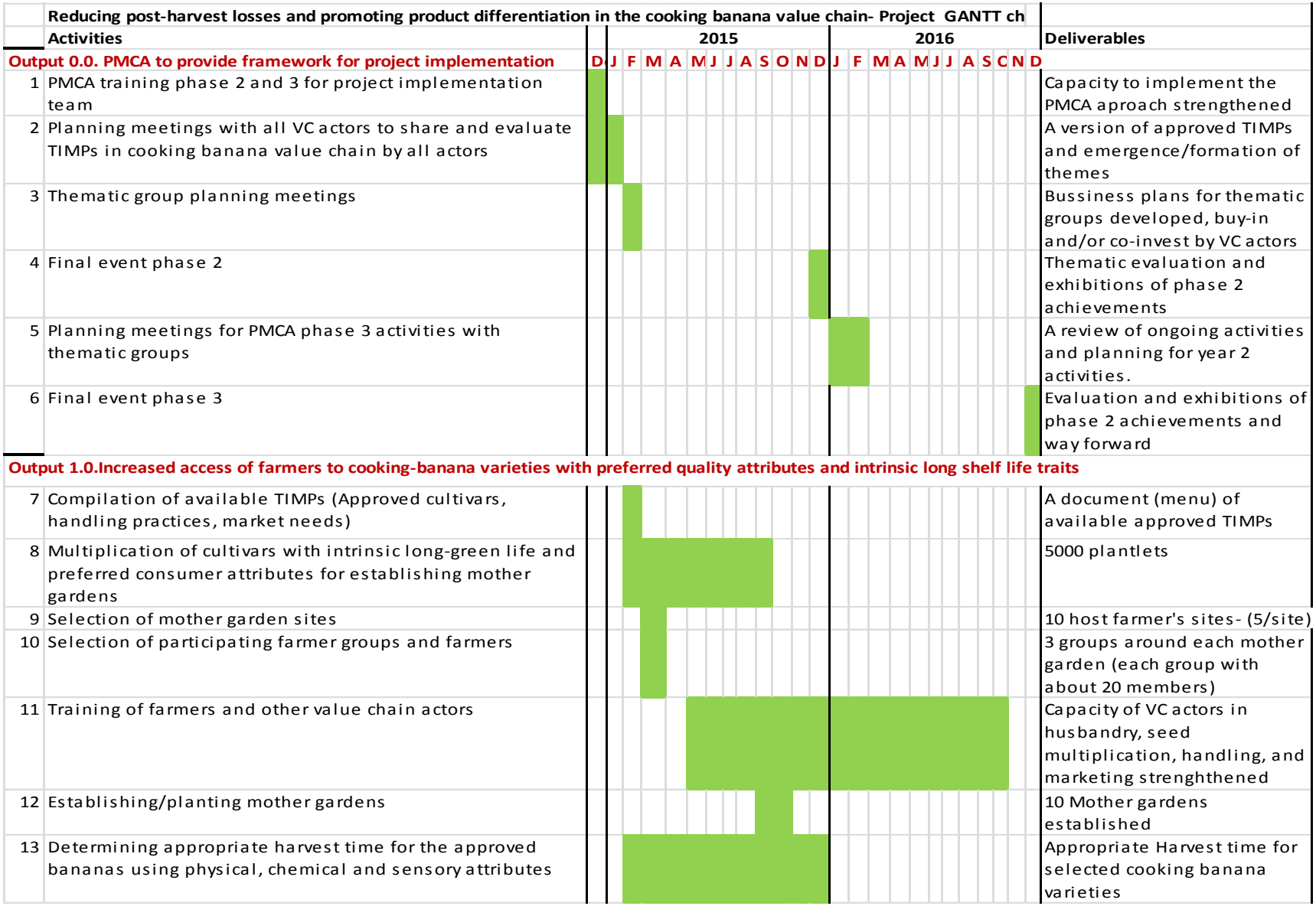
This map reveals all the chain actors disaggregated by gender; it shows a representation of both men (♂) and women (♀) in terms of percentages. It shows:

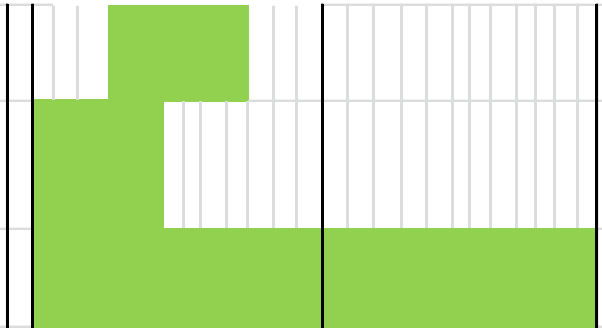
1. the value chain itself, including both visible and hidden (in broken boxes) actors
2. The (dis)enabling environment (including natural environment, gender roles and behaviours, governance, commercial law and enforcement, consumer trends and the (in)formal networks), denoted by a plus (+) and minus (-) signs for enabling and disenabling environment, respectively;
3. Activities performed by different actors at various levels ; and
4. The support and business services (including technology, extension services, finance services, and marketing), denoted by a plus (+) or minus (-) signs if such services are in existence or not, respectively.

Appendix 3: Gender Sensitive Cooking Banana Value



Appendix 4: Gantt chart



14	Meeting of all actors in seed production to develop a community based seed system to increase access of cleaning planting materials		A seed distribution model
15	A situation analysis of the VC (Baseline)		A detailed inventory and status of the chain actors against which impact will be assessed
16	Periodic reviews and planning of the performance of the activities		A learning based management to allow for adjustments
OUTPUT 2: Convenient presentation forms of cooking bananas reducing postharvest losses and acceptable to different market segments promoted			
17	An in-depth market study to capture actual and potential demand for the different presentation forms of cooking banana		Markets, their requirements, and potential demand
18	Training of thematic group chain actors (harvesting, weighing and calibration of weighing scales, sorting & grading, preservation for peeled fingers, and packaging)		Skilled chain actors in cooking banana product differentiation
19	Evaluating the different preservatives, packaging, and storage temperature regimes for peeled and unpeeled cooking bananas		Cost-effective preservative and packaging system for peeled and unpeeled
20	Conducting market trials for the different cooking banana differentiated products		Different forms of cooking banana presentation
Output 3. Sucker staggering for evening-out banana production across seasons practised by producers to obtain premium prices			
21	Selection and training of farmers participating in the sucker staggering trial (50 experimental and 50 control)		Field trials for sucker staggering
22	Data collection, analysis and reporting		Banana production and prices evened-out across seasons
Output 4. Technologies, market information and regulations for increased market access and fair pricing mechanisms promoted			
23	Develop and produce information dissemination materials to sensitise the masses on TIMPs that enhance market access		TIMPs information materials
24	Avail the information materials to key chain actors		Access to information
25	Promote the market enhancing TIMPs using print and electronic media		Mass access to information
Output 5. Improved practices, (dis)enabling environments, norms and culture to foster mutual understanding along the value chain			
26	Data collection and analysis of the context in which the cooking banana VC operates (consumer trends, resource use, policies and the bussiness support services)		Documentation VC influencers
27	Gender analysis of the VC		Documentation of best practices