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## The participatory market chain approach: Stimulating innovations along the indigenous African leafy vegetables market chain

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### ABSTRACT

Indigenous African Leafy Vegetables (ALVs) play a significant role in alleviating hidden hunger and malnutrition and contribute to income security for smallholder farmers. However, their potential to contribute to food, nutrition and income security has not been fully realized due to dysfunctional market chains. The Participatory Market Chain Approach (PMCA), which aims to stimulate gender-responsive innovations in commodity chains, was used to improve the performance of ALVs market chains in central Uganda. This paper presents the results of applying the PMCA in a phased manner on the ALV commodity chain in the context of a collaborative research project implemented in central Uganda. Phase 1 of the project interfaced with 121 chain actors and subsequently, 70 and 103 actors and stakeholders participated in phase 2 and phase 3 activities, respectively. Through this collaborative process, iterative learning, stronger linkages and trust were built amongst the chain actors leading to synergies that resulted in benefits to all. Commercial, technical and institutional innovations were generated including new products such as a nutritional powder made of dried *Solanum aethiopicum*, Baghia and an enriched peanut butter. A platform of 54 chain actors was formed to jointly address challenges and harness opportunities in the future. Process facilitators' capacity to broker multi-stakeholder innovations was improved. New research areas related to cultivar descriptors for selected ALVs, postharvest management and business development support services emerged that triggered new research projects. The PMCA contributed to change in perceptions about ALVs, better incomes, knowledge and skills among market chain actors, establishment of beneficial linkages and improved capacity for innovation. The research re-emphasises the importance of a market approach towards improving and uplifting value chains of low profile crops which play a major role in sustaining livelihoods of smallholders farmers and women.

**Key words:** Central Uganda, innovations, leafy vegetables, value chains

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## **RÉSUMÉ**

Les légumes-feuilles indigènes africains (LFIA) jouent un rôle important dans la réduction de la faim et de la malnutrition et contribuent à la sécurité du revenu des petits agriculteurs. Cependant, leur potentiel de contribution à la sécurité alimentaire, nutritionnelle et au revenu n'a pas été pleinement réalisé en raison de dysfonctionnements des chaînes de commercialisation. L'approche participative des chaînes de commercialisation (APCC), qui vise à stimuler les innovations sensibles au genre dans les chaînes de valeur des produits, a été utilisée pour améliorer les performances des chaînes de commercialisation des dans le centre de l'Ouganda. Cet article présente les résultats de l'application progressive de l'APCC dans les filières de LFIA dans le cadre d'un projet de recherche collaborative mis en œuvre en Ouganda. La phase 1 du projet a impliqué 121 acteurs de la chaîne et, par la suite, 70 et 103 acteurs et parties prenantes ont respectivement participé aux activités de la phase 2 et de la phase 3. Grâce à ce processus collaboratif, un apprentissage itératif, des liens et confiance renforcés ont été établis entre les acteurs de la chaîne, ce qui a permis de créer des synergies à effets bénéfiques pour tous. Des innovations commerciales, techniques et institutionnelles ont été générées, notamment de nouveaux produits tels qu'une poudre nutritionnelle à base de *Solanum aethiopicum* séché, de Baghia et un beurre d'arachide enrichi. Une plate-forme de 54 acteurs de la chaîne a été créée pour relever conjointement les défis et exploiter les opportunités à l'avenir. La capacité des facilitateurs à négocier des innovations multipartites a été améliorée. De nouveaux domaines de recherche liés aux descripteurs de cultivars pour les LFIA sélectionnés, la gestion post-récolte et les services d'appui au développement des entreprises ont émergé et ont déclenché de nouveaux projets de recherche. L'APCC a contribué à changer les perceptions sur les LFIA, à améliorer les revenus, les connaissances et les compétences des acteurs de la chaîne de commercialisation, à établir des liens bénéfiques et à améliorer la capacité d'innovation. La recherche accentue l'importance d'une approche de commercialisation pour améliorer les chaînes de valeur des cultures négligées, qui jouent un rôle majeur dans le maintien des moyens de subsistance des petits exploitants, agriculteurs et femmes.

Mots clés: Ouganda central, innovations, légume-feuilles, chaînes de valeur

## **INTRODUCTION**

Globally, horticulture production provides opportunities for smallholder farmers, especially women, to increase their income and improve their health and nutrition status at household level (Bioversity International, 2013). Weinberger *et al.* (2011) noted that indigenous African Leafy Vegetables (ALVs) are a vital component of the rural economy and contribute to livelihoods through consumption and income resulting from vegetable marketing. They are valued for their taste, high nutritional quality, medicinal and culinary properties (Mary, 2007). In Sub-Saharan African (SSA),

ALVs have long been known to be important ingredients in traditional sauces that supplement carbohydrate food staples. The WHO and FAO jointly recommended a minimum daily intake of 400g of fruits and vegetables in the sub-continent (Smith and Eyzaguirre, 2007) to address associated risks of malnutrition. Indeed ALVs have been reported to have higher nutritive value compared to exotic vegetables and are rich in micronutrients such as vitamins A, C, zinc and iron. Additionally ALVs are a major source of ascorbic acid as well as proteins that are essential for normal growth and human health (Rubaihayo, 2003; Uusiku *et*

al., 2010). If promoted, ALVs could serve as an alternative source of cheap protein, thus playing an important role in improving protein malnutrition among preschool children particularly in the rural areas.

In Uganda, 22% of the rural population engaged in agriculture are involved in fruit and vegetable growing (UBOS, 2015). Recently, there has been an increase in food and nutrition security awareness amongst the population which has created incentives for increased production and marketing of fruits and vegetables. Within the vegetable sub-sector, the demand for indigenous ALVs is on the increase as more people become aware of their nutritional and health benefits. Moreover ALVs also play an important role as a source of food and income in the peri-urban areas of Uganda due to their short maturity period. This has led to increased cultivation and market value of ALVs especially in urban and peri-urban areas with the majority of these vegetables being sold in both local and high end markets. In central Uganda, the most common indigenous vegetables grown and consumed are *Solanum aethiopicum*, *Amaranthus dubius*, *Amaranthus lividus*, and *Cleome gynandra* (Rubaihayo, 1994; 1996; Magala et al., 2009). The major production areas for ALVs include Mukono, Mpigi and Wakiso districts because of the favourable climatic conditions and easy access to Kampala centre city that serves as the major market for the vegetables.

Despite the benefits and potential to contribute to livelihoods, indigenous ALVs are largely neglected and underutilized species and in most cases characterized and/or perceived as low value crops (Gotor and Irungu, 2010; Padulosi et al., 2013). Production, marketing and trading of ALVs is largely in the hands of the smallholder farmers particularly women (Magala et al., 2009; Weinberger et al., 2011; Bioversity International, 2013). Devaux et

al. (2013) reported that smallholder farmers are disadvantaged due to their limited access to market information, services, technology and capital. Yet, horticultural production is considered to be knowledge intensive requiring an effective flow of both long-term technical information and dynamic market information (Lumpkin, Weinberger and Moore, 2005). These limitations render farmers vulnerable to unexpected events and rapid changes, such as crop and market failure, which are further exacerbated by climate change. The potential of vegetable producers to benefit from existing opportunities in the ALVs market chain depends on their ability to access markets and collaborate effectively with other market chain actors. Promotion, marketing and commercialization of indigenous ALVs through collective and collaborative processes becomes an essential factor to enhancing food, income and nutrition security among smallholder farmers.

### **The participatory market chain approach and its application to the indigenous ALVs.**

Following the horticultural outreach activities implemented by the University of California, Davis in collaboration with Rural Agency for Sustainable Development (RASD) in Nkokonjeru, Buikwe District, Uganda since 2007, a number of challenges were identified limiting ALV production and marketing. These included limited access to markets, low productivity (due to erratic weather, poor soils and high disease and pest incidences), and limited access to training and proven technologies, among others. It was also observed that most extension and advisory services focused on traditional cash crops (coffee and cooking banana). In a bid to address the market related challenges and stimulate production, the Participatory Market Chain Approach (PMCA) (Bernet et al., 2006) was identified as a value chain development approach to explore for enhancement of the competitiveness of indigenous ALVs.

The PMCA engages market chain actors and public and private service providers in facilitated processes in which market opportunities are identified and exploited, leading to commercial, technological and institutional innovations (Mayanja *et al.*, 2012). The approach involves a structured process with three phases (Bernet *et al.*, 2006). An R&D organization initiates the PMCA process by selecting the market chains on which to work, identifying potential R&D partners and carrying out exploratory, diagnostic market research in Phase 1. In Phase 2, the R&D organization facilitates meetings that are designed to foster mutual trust and knowledge sharing among participants and to identify potential market chain innovations. In Phase 3, the market chain actors collaborate in practical innovation processes, with support from R&D organizations. The PMCA is a flexible approach of engaging diverse market actors in collective processes to identify and exploit potential business opportunities for equitable benefits in a given market chain (Horton *et al.*, 2010; Mayanja *et al.*, 2012; Devaux *et al.*, 2013). It seeks to strengthen beneficial linkages among diverse market chain actors to explore potential market opportunities. The PMCA was developed by the Papa Andina Initiative of the International Potato Center (CIP). It was first applied in the Andean region to increase the competitiveness of potato market chains and improve the livelihoods of smallholder farmers (Bernet *et al.*, 2006; Bernet *et al.*, 2008). Following successful application in the Andes, the approach was introduced to Uganda through a South-South collaboration by CIP and PRAPACE (the French acronym for the Regional Network for the Improvement of Potatoes and Sweet Potatoes in Eastern and Southern Africa) with funding from the Department for International Development (DFID). In Uganda, the PMCA was first applied on potato, sweet potato, tomato and hot pepper market chains (Horton *et al.*, 2010; Mayanja *et al.*, 2012).

Consequently, with PMCA being a novel approach for generating technological, commercial and institutional innovations along commodity market chains (Mayanja *et al.*, 2014), it was considered suitable for stimulating interest, increasing trust and establishing linkages among indigenous ALV market chain actors. The approach was thus adopted and applied in the research study initiated under the Horticulture Innovation Lab, funded by United States Agency for International Development (USAID) and led by University of California, Davis. The programme aimed at enhancing the competitiveness of the ALVs market chain in central Uganda.

Specifically, the project aimed at improving market access for smallholder farmers (particularly women) in the ALV market chain. The project's lead institution was Mukono Zonal Agricultural Research and Development Institute (MUZARDI) of the National Agricultural Research Organization (NARO). MUZARDI initiated and facilitated application of the PMCA on the indigenous ALVs value chain.

## **METHODOLOGY**

The research was undertaken in the districts of Buikwe, Mukono and Kampala, in the central region of Uganda and was implemented over a period of two years (April 2011 - May 2013). Buikwe and Mukono districts were selected based on prior participation in previous research interventions of MUZARDI while Kampala was selected because of the high concentration of markets where the ALVs are sold. The materials, methods and tools used to implement this action research were based on the three generic phases of the PMCA (Bernet *et al.*, 2006) as illustrated in Figure 1. MUZARDI initiated the Value Chain Development (VCD) by conducting a diagnostic study to characterize the market chain (Phase 1).

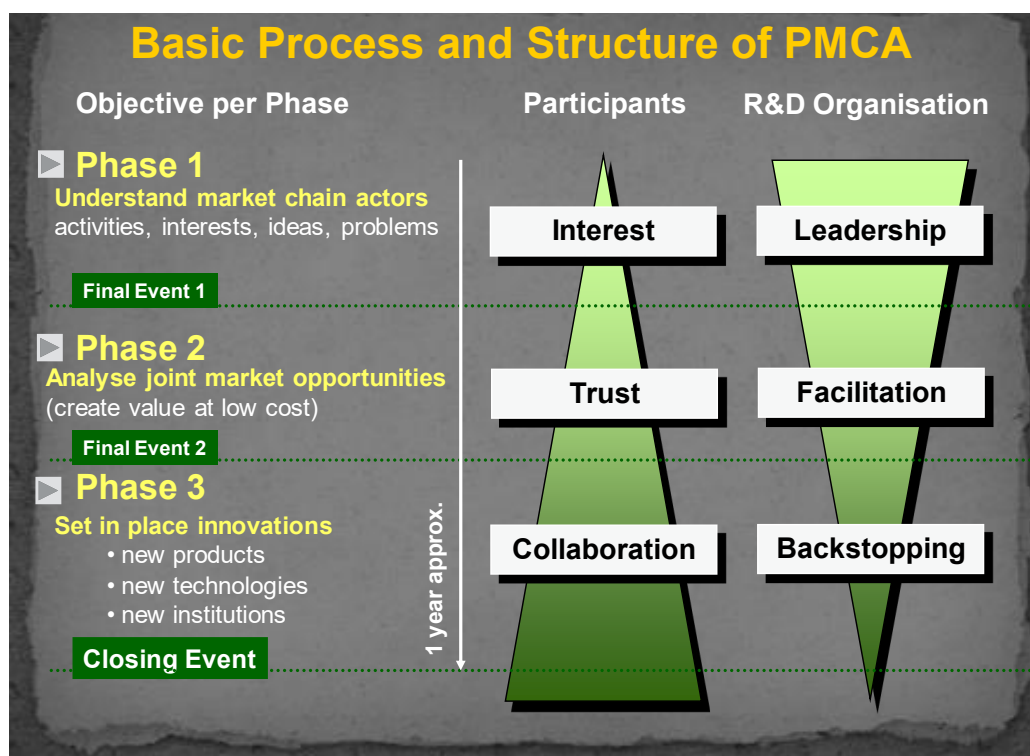


Figure 1. Structure and objectives of the three phases of PMCA (Source: Bernet *et al.*, 2006).

**Phase 1. Familiarization with the market chain and the key actors.** This phase sought to understand the nature of the ALV chain through a diagnostic study and review of relevant literature. The key goals were to become familiar with the market chains and market chain actors, and to motivate market chain actors to participate in the PMCA process (Mayanja *et al.*, 2012). MUZARDI as the lead R&D organization conducted an exploratory market study which sought to understand the chain actors' activities, interests, ideas and problems. Participatory qualitative methods including Focus Group Discussions (FGDs) and key informant interviews (KIIs) were used. Interview guides and discussion checklists targeting different chain actors were developed and used to collect data. Both purposive and random sampling procedures were used in selection of respondents for the study. Eight FGDs, comprised of 10-15 participants each

and 99 farmers in total, were conducted with randomly selected farmer groups in the study area. A total of 22 key informants that included commercial vegetable farmers, traders, market masters, transporters, processors, consumers (restaurant owners), extensions agents and researchers were interviewed. The actors were selected based on their role in the ALVs value chain. Various markets including those in the urban (Kalwere, Nakawa and Jinja Central Market), Peri-urban (Seeta, Mukono, Lugazi and Jinja Napier) and local (Nkonkojeru) areas were visited. The markets were selected based on their level of involvement in ALV marketing and information provided by farmers during the FGDs on where most of the vegetables were sold. The research team thus visited the markets and conducted face-to-face interviews with the traders. In total, the team interfaced with 121 chain actors and supporters (Table 1). Data were collected on key production activities,

challenges and existing marketing opportunities along the leafy vegetable market chain. Data obtained were synthesized and analysed using thematic – content analysis and results were shared during a final event of Phase 1 to which most of the respondents were invited to attend. During the final event, three thematic groups were identified with a focus on: i) seed production and processing; ii) fresh leafy vegetable production and; iii) leafy vegetable processing and value addition. Each group was comprised of 15 - 20 actors representing the various nodes of the chain, but in line with the market opportunities. The thematic groups briefly met to agree on tentative leadership and a plan of action for Phase 2.

**Phase 2. Joint analysis of potential business opportunities.** Phase two sought to foster mutual trust and knowledge sharing among participants with an aim of analysing and selecting potential joint market opportunities. MUZARDI as the lead R&D organization facilitated thematic meetings that aimed to foster collaborations. The actors who showed interest in the identified market opportunities at

the end of Phase I were invited by MUZARDI for the first thematic meeting that aimed at initiating the process of analysing potential market opportunities and sharing experiences. During this phase, four thematic meetings were held for each thematic group, every two weeks. Each thematic group was composed of different actors along the market chain (Table 2). Expert facilitators oversaw the process and used participatory analytical tools to ensure inclusion and ownership. Within each thematic group, the proposed market opportunities were subjected to a SWOT analysis. After the analysis, the thematic group members weighted (on a scale of 1 to 10), ranked and selected one or two feasible opportunities to pursue. In instances where extra information was required to substantiate a potential opportunity, Rapid Market Appraisals (RMA) were conducted. For instance, three major seed companies and local seed enterprises were approached to explore seed market opportunities and two of these accepted to join the seed thematic group. Subsequently, a meeting for all three groups was held where a representative of each thematic group presented and justified their

Table 1. Categories of actors interviewed during the market study in the project districts

Actor category	Men	Women	Total
Smallholder farmers*	32	67	99
Traders	2	8	10
Commercial farmers	3	0	3
Extension agents	3	0	3
Researchers	0	1	1
Market masters	3	0	3
Processors	0	1	1
Transport	1	0	1
Total	44	77	121

\* Total for farmer groups that participated in FGDs during the market study while the other categorises listed were involved in the key informant interviews.

business and workplans for operationalizing the opportunity. These plans were presented at an event to which potential funders and other R&D actors were invited.

**Phase 3. Development of market-driven innovations.** During this phase, thematic groups were facilitated to jointly develop the market opportunities, which resulted in specific innovations. Market concept development, RMAs, focus groups and business plans (Bernet *et al.*, 2006) were some of the tools that were used in this phase. The Marketing Concept Development Tool was used to identify, weight and visualize perceived consumer purchasing attributes. Focus groups comprising six to eight target consumer groups were used to evaluate various attributes of the prototypes. For efficiency, the thematic groups formed smaller working groups of two to three people to undertake focal activities. The smaller groups met more frequently and prepared a debrief

report to the entire thematic group which met once a month. Practical demand-driven training sessions were conducted to aid in innovation development. For instance, the processing group attended a short training on preparation of an ALV-supplemented peanut butter, while the seed groups were instructed on packaging. Innovation prototypes – the new, un-tested products and their marketing concept-were developed and tested in the market. Sensory analysis was done at Makerere University's Food Science and Technology (FST) Sensory Analysis Lab. The product prototypes developed were scored against existing products on the market. After a concerted period of product development, market trials, branding, packaging and promotion, the innovations were launched at a final event. The thematic group members presented their innovations and also shared their learning journey with the public, media and other ALVs stakeholders.

Table 2. Thematic group composition by actor categories and number

Thematic group	Number of participating actors	Distribution by market chain actor							
		Farmers	Traders	Processor	Seed processors	Extension	Research	SACCO	Transporters
Seed	16	3	1	0	2	5	5	-	-
Fresh vegetables	23	9	9	0	0	1	3	-	1
Processing	15	5	1	2	0	3	3	1	-
<b>Total</b>	<b>54</b>	<b>17</b>	<b>11</b>	<b>2</b>	<b>2</b>	<b>9</b>	<b>11</b>	<b>1</b>	<b>1</b>

## RESULTS AND DISCUSSION

**Understanding the context.** The findings (Table 3) of the market study indicated that the most common indigenous ALVs species grown in the target area included; *Solanum aethiopicum*, *Amaranthus lividus*, *Amaranthus dubius*, and *Cleome gynandra* (Nasirumbi *et al.*, 2012). Among these, *Solanum aethiopicum* (referred to as Nakati in the local luganda language) was the most important indigenous ALVs in the central region and had a higher demand compared to

*Celocia argentea* (Bugga), *Cleome gynandra* (Jjobyo) and *Amaranthus dubius* (Ddodo Omuganda).

Vegetables were appreciated for their contribution to household nutrition security due to their medicinal and nutritional properties and these also helped minimize household expenditure on food items since these could be served as sauce (Nasirumbi *et al.*, 2012). The ALVs were found to be normally broadcasted and grown as an



intercrop in mixtures of vegetables to maximize land utilization, Notably, others reported that ALVs added beauty to their homes once they were planted in home or kitchen gardens. Results further showed that over 90% of the farmers grew ALVs on small pieces of land of less than 0.125 ha by mainly women farmers. Poor seed quality, pests and diseases and low soil fertility were identified as the major constraints limiting optimal production of ALVs while lack of market, low product prices, lack of market information, high transaction costs and lack of knowledge on processing and value addition were the most limiting factors in marketing of ALVs.

Further, findings of the market study showed that the main chain actors along the indigenous ALVs market chain were producers, researchers, traders, transporters, extensionists, processors and consumers, among others (Nasirumbi *et al.*, 2012). The actors performed different activities but in an uncoordinated way. Rarely were the actors at one segment aware of the activities performed by other actors, or connected with them, which implied limited interaction and numerous knowledge gaps. As expected, farmers were largely involved in production of vegetables for home consumption with a few (less than 10%) selling excess or surplus output for income to their fellow farmers, road side markets, restaurant proprietors and traders passing-by and in trading centers in their vicinity. The interviews with the farmers revealed that farmers rarely sold their produce

to urban markets around Kampala city due to high transaction costs, low production and long distances. Only one leafy vegetable processor existed in the area and unfortunately was not active in operation. While the NGOs operating in the area (particularly Rural Agency for Sustainable Development (RASD) and Youth Association for Rural Development (YARD)) played a significant role in provision of extension services, there were no formal seed sources for ALVs in the area. This limited access to quality seed as the most important production input. Farmers tended to save their own seeds and these were generally of poor quality. There were, however, agricultural input shops that served to provide the farmers with required fertilizers and pesticides.

The most significant marketing channels were producers to consumers; and producers to traders (mainly retailers). Across the markets, women were the main retailers of ALVs and mainly traded local doodo, nakati, bugga, jjoby, ggobe, okra, lettuce, sukuma wiki and pumpkin leaves. The findings concur with those of Agea *et al.* (2013) who found that 73-82% of the traders in Bunyoro-Kitara region of Uganda were women. This scenario necessitates strategies to support women producers and traders along the ALVs value chain. Across all markets, vegetables were sold in varied bundles, so standardizing the quantities sold was a challenge. Truckloads of different capacities were used to estimate the inflows ranging between 4-6 and 2 tonne trucks during the wet and dry seasons respectively. The

Table 3. Major vegetables grown

Vegetable crop and species	Local name (Luganda)	Average rank across groups
<i>Solanum aethiopicum</i>	Nakati	1
<i>Celocia argentea</i> ( <i>Amaranthus lividus</i> - <i>A. blitum</i> )	Bugga	2
<i>Amaranthus spp</i> ( <i>A. dubius</i> )	Ddodo	3
<i>Cloeme gynandra</i> ( <i>Spider plant</i> )	Jjoby	4
<i>Solanum</i> (Bitter berries)	Ntula	5

Source: Market Study data

busiest months were November and December due to frequent festivities while Friday, Saturday and Monday were the busiest days of the week.

Across the value chain, indigenous ALV production, processing and marketing were constrained by several factors. At the farm level, main production constraints included pests and diseases, drought, lack of quality seed, inadequate working capital for investment, and low soil fertility, among other constraints (Figure 2). These constraints were coupled with limited production knowledge and contributed to low leafy vegetable production. Farmers were reported to have major knowledge gaps in planting methods, seed rate and use and application of fertilizers and pesticides.

The most limiting factors in marketing included limited access to markets (especially for fresh vegetables) due to long distances, price fluctuations, lack of market information on consumer/market requirements, and limited linkages and interaction among actors in the vegetable market chain. Farmers had limited collaborations and linkages with other partners which affected the competitiveness of the leafy vegetable sub-sector. However, several actors

and institutions with interest in leafy vegetables including NGOs (YARD and RASD), some traders, researchers in NARO, and National Agricultural Advisory Services (NAADS) existed. Local government extension officers and local leaders and politicians in the area were also identified as important as their collaboration could improve the contribution of leafy vegetables to socio-economic development of target groups. Strengthening collaborations was recognized as potentially enhancing access to better product markets, improving interactions and sharing of knowledge that would result into increased production and marketing of indigenous leafy vegetables.

The findings of the market study attested to the various constraints and challenges faced along the ALV value chain that necessitated exploration of existing opportunities to their full potential. This required renewed interest among research and development partners to enhance production, processing, utilization and marketing of leafy green vegetables. Guided by the results of the market study, the chain actors that attended the Phase 1 final event agreed to share ideas for possible business opportunities. Key areas identified for strategic interventions

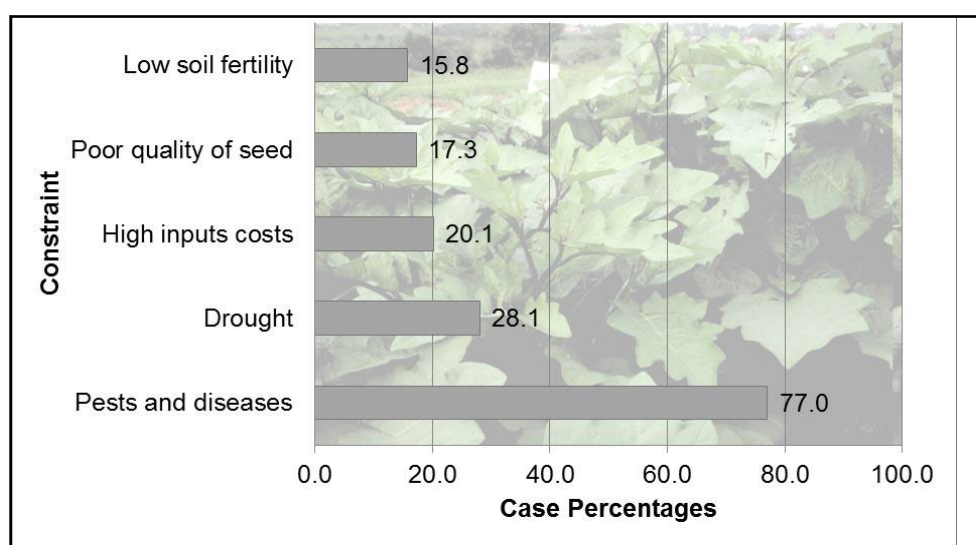


Figure 2. Major constraints to ALVs production in selected districts of Central Uganda

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included access to better and improved varieties, improving seed quality, improving market access, research on soil requirements for ALVs, pest and disease control, value addition by processing ALVs, and enhancing collaboration and linkages among market actors. To this end, actors felt the need to identify those strategic opportunities that could best and most sustainably address the challenges identified.

**Stimulating innovations to address gaps in the ALVs market chain.** An innovation platform for interaction and sharing experiences and knowledge was formed and this brought together 54 actors in the ALV market chain. The platform membership was based on the actors in the thematic groups that actively participated in the platform core activities. The research concur with the studies by Horton *et al.* (2010) and Mayanja *et al.* (2012) which confirmed the approach to attract over 100 market chain actors

for potato, sweet potato and vegetable value chains to actively interact through the process. The actors recognised the approach as a novel mechanism for sharing and accessing new information. Across the thematic groups, about six market opportunities (MOs) were identified (Table 4). After a thorough analysis, three market opportunities viz; seed production and processing for the local market, leafy vegetable processing, and improving quality of leafy green vegetables for the local market was selected. A work plan for each selected market opportunity were developed to guide implementation of the selected business idea.

The process triggered innovation processes in which both women and men actors successfully engaged in development of commercial and institutional innovations. The ALVs PMCA platform had 50% representation of women which was pertinent for creating space for

Table 4. Market opportunities selected by the Thematic Groups

Thematic group	Constraint (s) addressed	Business opportunity	Innovation/area of focus	Main actors involved
1. Seed	Poor quality seed and limited availability of seed for ALVs	1.1 Seed production and multiplication with proper packaging and branding at farmer level	• Production, processing, Packaging/branding and marketing	• Farmers, seed processors, traders, extensionist and researchers
2. Fresh	Low production and limited market access	2.1 Supplying existing markets by increasing production through contract farming	• Production and marketing	• Farmers, traders, extension, transporters and research
3. Processed	Limited value addition and product diversification on the market	3.1 Processing leafy vegetable powder with groundnuts paste for the local market	• Processed Nakati powder with groundnut paste • Packaging and branding	• Processors, farmers, traders, extension, researchers and microfinance institution
		3.2 Processing Nakati Baghia for the local market	• Nakati Baghia branded	

interaction and trust building among actors and subsequently, fostered joint innovations.

A community based ALVs seed group, “Nkokonjeru Seed Farmers’ Group”, was formed and registered. Prior to joining the PMCA project, farmers in the project area reported that they had no idea that nakati seed can be produced for sale. Access to vegetable seed by the farmers was through home-saving and exchange of unprocessed seed. The farmers revealed that through PMCA capacity building activities, they identified seed production as an opportunity. They learnt that nakati seed can be produced and sold to farmers and these can be undertaken as a business entity. They acquired practical and technical knowledge in vegetable agronomy practices (line planting and fertilizer application, use of clean seed, timely planting), soil and water management. The experiences shared during the PMCA meetings complimented the knowledge acquired from the Farmer Field Schools (FFS) implemented by RASD. They also noted that they gained skills and knowledge for identifying different types of nakati, and the cycle for planting and harvesting. The group focuses on production, processing and supply of quality ALVs seed. At the community level, the farmers collectively packaged their seed in small packages which are labeled for the local market. The label used was jointly developed during the thematic meetings. Through the platform, the group was linked to seed companies that were interested

in seed for ALVs. In a period of one year, the group produced and collectively marketed 1,240 kg of leafy vegetable seed (Table 5). The seed supplied to seed companies was packaged in different weights and branded for the market. Though the group was contracted to supply up to 0.5 tons of ALVs seed seasonally, their capacity was affected by erratic weather conditions and limited postharvest handling and storage facilities.

Processing leafy green vegetables as a way of adding value was one the business opportunities identified by the actors. This led to the emergence of a thematic group focusing on processed products that offer a variety of vegetable-based products to consumers, like powder and snacks. The lead actor for this group was a food technologist from Makerere University. Most of the processed products targeted nakati since it emerged as the most important leafy vegetable on the platform. One product developed was nakati powder that can be added as an ingredient to preparation of meals or used to process nakati-based products. Another product from mixing nakati powder with groundnut paste was a nutritious enriched peanut butter which could be consumed directly, as sauce, or used as a bread spread. A third product was nakati baghia (a snack) which could be produced from mixing the powder with wheat flour, cassava flour, soya powder, sugar, salt plus baking powder and water.

Table 5. Quantity of seed marketed by Nkokonjeru Seed Farmer Group (2013-2014)

Type of vegetable	Quantity marketed (KG)	Average price (UGX)	Total Income (UGX)
Nakati ( <i>Solanum aethiopicum</i> )	1,183	20,000	23,660,000
Ntula (Bitter Berries)	30	35,000	1,050,000
Bugga ( <i>Celocia argentea</i> )	15	25,000	375,000
Joby (Spider plant)	12	25,000	300,000
Total	1,240		25,385,000

1 US\$= averaged Ug. Sh 2,600 at the time of the study

Nutritional content analysis was conducted for two of the processed nakati products. The analysis showed that the products contained high levels of micro nutrients, particularly vitamin A and iron (Table 6). Nakati powder consisted of 41.0% protein, 26.7% carbohydrates, 12.7% crude fiber, 6.2% fat and each 100gm of the powder contained 475 IU vitamins and 325 Kcal energy. The baghia contained 13.3% protein, 51.7% carbohydrates, 26.4% fat and 3.4% crude fiber. This provided important health information for promoting consumption of the nakati based processed products.

Results of the sensory analysis indicated that the product prototypes developed during the PMCA process were relatively acceptable to users as compared to the existing products on the market (Figure 2a and 2b). Thus, the products - nakati

leafy power, Vicris nakati baghia and composite nakati peanut butter identified as viable products were fully developed and branded for the local market (Figure 3). However, despite its potential to contribute to reduction of malnutrition among the children, youth and women, who are the main consumers of baghia in Uganda, the colour of the nakati baghia product was of concern among the consumers. Although the taste was acceptable, consumers did not like the colour. Most consumers are accustomed to the yellow baghia which is common in the market. Commercialization of these products would require promotion as natural products which should be coupled with awareness and sensitization campaigns. The peanut butter product will also need certification by the Uganda National Bureau of Standards (UNBS) if it is to gain entry to various potential markets.

Table 6. Nutritional content of nakati products\*

Content	Nakati Powder	Nakati Baghia
Protein (%)	41.0	13.3
Carbohydrates (%)	26.7	51.7
Energy value (Kcal)	326.4	497.7
Crude fibre (%)	12.7	3.4
Fat (%)	6.2	26.4
Vitamin A (IU/100gm)	475	1650

\*Analysis done by Chemiphar (U) Ltd

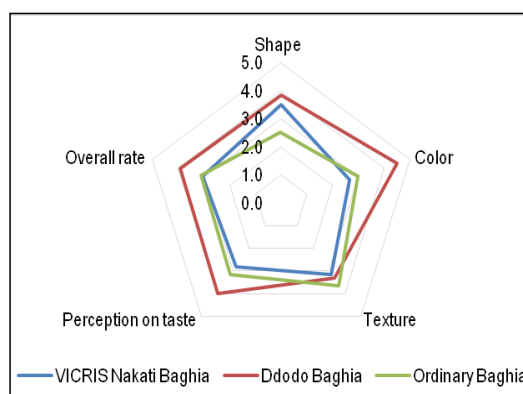


Figure 2a: Average scores for consumer perception about baghia products before tasting

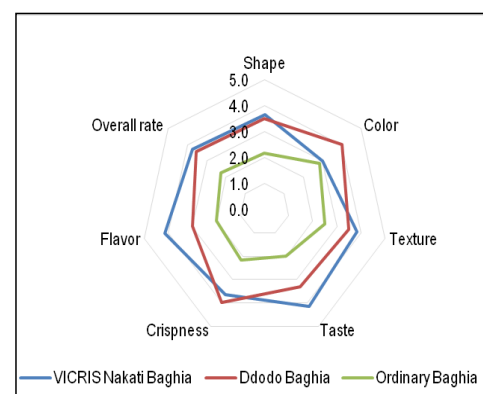


Figure 2b: Average score for baghia products after tasting



Figure 3. Products developed and branded by the processed thematic group

**Beneficial networks and linkages.** Social Network Analysis was carried out during the PMCA meetings to determine how relationships evolved and impacted on business undertakings of actors in the leafy vegetable chain. The results indicated that actors that participated in the ALVs PMCA platform were able to make new business links (Figure 4). Participants made business links with participants within and outside their thematic groups. More participants began working through ‘key’ players, who coordinated information flow. For instance, the seed farmers through their umbrella group (Nkokonjeru Seed Farmer Group) established linkages with the Simlaw Seeds Company Uganda Limited, an associate of Kenya Seed Company Limited, and Busiba Seed Packers, a local seed processor. Cumulatively, this group was able to produce, bulk and collectively supply up to 860 kg of nakati seed at an average price of UGX 20,000 (\$8) per kilo to Simlaw Seeds Company between April 2013 and July

2014. This assured the farmers both a better price and market for seed. Other buyers with whom the group established contact included farmers within their community, Grow More Seeds, East African Seeds, the NAADS, the NAADS program and NGOs within the area. Through the platform, farmers were able to establish connections with other research and development organizations. The farmer group benefited from an emerging research project by CABI International implemented in collaboration with the National Crops Resources Research Institute (NaCRRI) and MUZARDI to have their seed business certified for quality seed production and to also document their experiences. Other studies have reported that involving actors like seed companies and National Bureau of Standards are essential to the strengthening of commodity value chains through support and market services (Nederlof *et al.*, 2011).



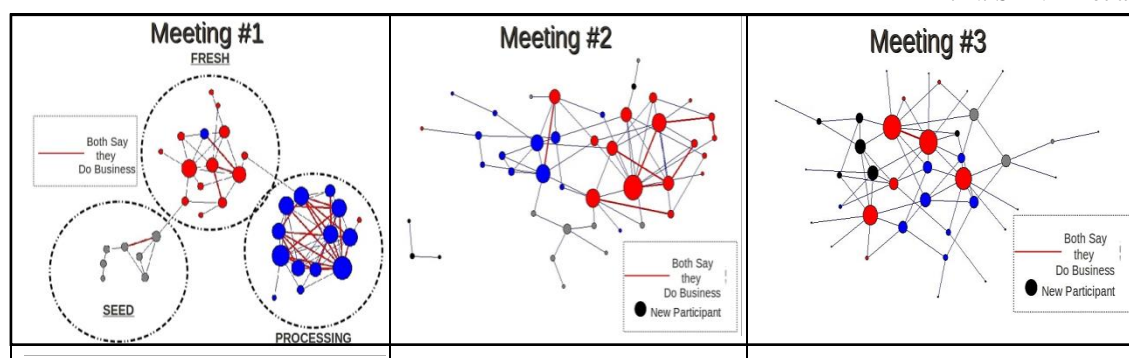


Figure 4. Linkages and relationship among the actors on the PMCA platform

**Improving livelihoods through ALVs innovations.** As a result of the innovations triggered by the PMCA, farmers, processors and market agents were able to increase their incomes and, in some cases, acquired productive assets including farm tools like sprayers, watering cans and hoes. This improved their market earnings and family welfare and increased the empowerment of smallholder farmers particularly, women farmers. The following quotation from a female farmer shows how some of the smallholder farmers have benefited: “...my interest in Indigenous vegetables dates right from 1997 when I had just gotten married as I grew vegetables for consumption and marketing. However, the HortCRSP project through the PMCA process has facilitated me to improve on production skills, link with other actors in the chain and above all, interested me to take on indigenous leafy green vegetables as a business enterprise. I have realized several benefits and opportunities. I am now assured of 90,000 – 130,000 UGX of weekly income from vegetable sales. I am able to educate my children from the income gained. Importantly, I have also interested the youth in my community to engage in vegetable growing since it’s a short term crop suitable for them as they are able to realize income in a short period. In the near future, I intend to set up demonstrations where the youth, farmers, students and pupils can come

and learn”. Narrative of a female farmer from Tterere village, Nakisunga sub-county, Mukono District.

**Enhanced knowledge and skills.** Before the start of the project, farmers in the area had limited knowledge as to how to maximize crop productivity. Farmers believed that vegetables could only be grown in swamps or charcoal mounds locally referred to “ekyokero” due to the perceived high fertility of these kind of soils. More than 90% of the farmers in the area only grew ALV for home consumption and did not consider them to be a viable business opportunity. However, this changed as farmers learnt about other larger-scale farmers who were engaged in commercial production of fresh vegetables. The experienced farmers shared their experiences during platform meetings and this encouraged small-scale farmers to change their practices. Ultimately, perception of farmers towards seed production as a business changed, to the effect that they now pay more attention to producing quantities of quality seed and work in teams to do so. Currently they grow nakati in both wetlands and upland. Farmers revealed that prior to the PMCA programme, they planted seeds by broadcasting. After training they now plant in rows as well as applying manure to maximize yields. The use of poultry manure to fertilize the Nakati gardens is now widely

perceived as a viable option to increasing the yield and quality. Application of pesticides was not considered important, but this practice has changed to now spraying the crop in response to pests and disease attack. These changes in attitude helped encourage more seed and vegetable producers to engage in production. Farmers started to produce fresh vegetables and seed for ALVs specifically targeting the market and some farmers practiced dry season planting to maximize profitability from the enterprise.

There was an observed increase in the average acreage dedicated to seed production on a farm. On average, individual farmers increased their acreage to about 0.125 - 0.25 acres of vegetables. The main vegetable planted for seed production was nakati with less than 30% of the farmers growing bugga, jobyo and bitter berries (Ntula). Farmers that would plant fields specifically for seed though get temptations to sell fresh. However, farmers learnt to thin their vegetables along the rows to achieve the recommended spacing to create enough space for proper and healthy seed formation. The thinned vegetables would then be sold on the fresh market.

**Learning new skills for communication and facilitation by PMCA facilitators.** The PMCA is an approach characterized by greater interaction between diverse actors since it is intended to stimulate action research. Actors are given an opportunity to interact, share information, learn and apply the knowledge and skills acquired. The approach thus integrates the principles of innovation platforms which are perceived as governance mechanisms for enhancing multi-stakeholder interaction and learning, capacity development, coordination and linkages (Kilelu *et al.*, 2013; Cullen *et al.*, 2014). To enhance learning among all actors, facilitators of the process also need to be learners since they need to be innovative, creative and knowledgeable to guide the innovation process.

Therefore, facilitators acquired soft skills for facilitating market actors with diverse interests to work together to achieve the desired goal. Such communicative and social skills have been found to be essential to all stakeholders to enable collective action (Dusengemungu *et al.*, 2016). Indeed in the Andes and Uganda, the PMCA approach was observed as a strategy for action learning as participants reflect on their own actions and experiences to improve performance (Horton *et al.*, 2010). The competencies of facilitators in mobilizing, problem solving and guiding as well as encouraging champions to contribute new ideas were enhanced. Individual members recognised and appreciated the value of their colleagues and actors during the process and endeavoured to work as a team.

## CONCLUSION AND RECOMMENDATIONS

This research demonstrated that joint planning and enhanced collaboration among actors can improve the competitiveness of commodity chains. Results from the study have shown that collaboration in the ALV chain resulted into synergies which led to quick wins, stronger relations and improved functionality at the node and chain level. Farmers were able to access tailored services from research and extension which improved their productivity, while linkages to processors and traders improved sales and income. Improved linkages amongst the chain actors instituted a traceability 'system' which improved quality and consistency of supply to downstream actors. The joint innovations generated (Nakati powder, Baghia and composite peanut butter) diversified the utility of ALVs but also led to greater visibility, acceptability and improved perception of ALVs. The 54 member innovation platform that was established during the project is a sustainability measure which provides space for strengthening innovation capacity. Notably, the process facilitators became accomplished brokers of multi-stakeholder innovation processes. Future



research could focus on improving the efficiency of the PMCA process in terms of time and resources. Technical research on selection and evaluation of variety descriptors for *Solanum aethiopicum*, multiplication of foundation seed, commercialisation and improvement of shelf-life of vegetable prototypes would significantly contribute to ALV improvement. Further research could also assess how farmers' participation in the vegetable market value chain impacts the availability of ALV for consumption at household level.

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### STATEMENT OF NO-CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this paper.

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