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Innovation Opportunities in Potato Production in Rwanda

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Abstract

Whereas Irish potato (*Solanum tuberosum*) is a major staple food in many countries, it is one of the priority value chain crops under the CIP in Rwanda. The crop is more important in the northern and northwestern than other parts of Rwanda. After plantain and cassava, potato is the third most important staple cultivated by 52.9% of the households in Rwanda. With potato yields at 12mt/ha comparatively favored by rich volcanic soils and high altitudes, Rwanda is the second largest producer of potatoes in the EAC after Kenya and third largest in SSA. This research is aimed at highlighting the potential innovation opportunities for increased potato production in Rwanda. Irish potato has short growth cycles and can easily be integrated into existing agricultural systems, and stored relatively easily. It has excellent nutritional content and is a good source of dietary energy and micronutrients. Notwithstanding, potato production in Rwanda is faced with various constraints among which pests and diseases, limited land sizes, and high production costs (for pesticides and seeds) are major. Potato VCA conducted at the Gataraga Potato IP indicated that small-holder farmers were the main players in producing Irish potatoes and marketed by retailers in local markets and urban areas including Kigali. In spite of potato production seemingly looking attractive in Rwanda, innovation opportunities exist that can uplift and expand the VC for enhanced socio-economic benefits of the VC actors. These opportunities include but not limited to increasing farm level productivity, introducing processing of potatoes, and stabilizing farm prices through establishing appropriate business models. The expected new business model would build on existing farmer institutional frameworks such as the IP cooperative society and IP potato company with the RAB engagements, and potential credit institutions, extension service providers, buyers and processors. Such an arrangement is likely to ease constraints of high production costs and unsecure markets, while improving farm-level productivity.

Key words: Irish potato, Rwanda, Gataraga Potato IP, VCA, Innovation opportunities

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Introduction

The potato (*Solanum tuberosum*) is a major staple food in many countries. While relatively unknown and mostly regarded as a subsistence crop until recently in many developing and least developed countries, the potato is increasingly becoming popular as a source of affordable food for growing urban populations (FAO, 2010). Potato growing is in many ways attractive to farmers with little resources and limited means to manage risk. The potato plant has a short growth cycle and can easily be integrated into existing agricultural systems. Potatoes have a high per area production potential, can be stored relatively easily and, most importantly, can both be used as a staple food crop for household consumption and food security or sold as a cash crop (Tantowijoyo and van de Fliert, 2006; FAO, 2010). In sub-Saharan Africa (SSA), where the population doubles every 25 years, and average land size per household is shrinking rapidly, crops that give more food, more nutrition and more cash per unit area and time are increasingly becoming important. At the same time, rising levels of income are driving a 'nutrition transition' toward more energy-dense foods and prepared food products. As part of that transition, demand for potato is increasing (IYP, 2008).

Irish potatoes, are among the priority value chains in Rwanda, and are important in the northern and northwestern, but much less so in other parts of the country (USAID, 2010). Potato is a priority crop under the Rwanda's Crop Intensification Program (CIP), a program that aims to ensure a continued supply of fertilizer and improved seed to small-holder farmers in order to boost its production. Irish Potato is the third most important staple crop in the country, after plantain and cassava (FAOSTAT, 2016). It is cultivated by 52.9% of the households in Rwanda. 55.3% of these are found in the rural areas, where 58.7% of them cultivate less than 1ha of land (NISR, 2012). Although potato is cultivated across the country, four districts of the north-west are responsible for most of the production; Rubavu, Musanze, Nyabihu, and Burera (NISR, 2012) (Figure 1).

Rwanda is also the second largest producer of potatoes in the East African Community (EAC) after Kenya and the third largest in sub-Saharan Africa (RDB, 2016). Rwanda's potato yields at 12mt/ha are higher than regional competitors, with potential to increase these yields to 40mt/ha (MINAGRI, 2012). At an average of 8%, the annual yield growth rate from year 2000 to 2013 was the highest in the EAC [FAOSTAT, 2016] (Table 1 and Figure 2). While the rich volcanic soils, high altitude and widespread cultivation ensure continued growth, the International Potato Centre (CIP) is credited for the rapid growth in production and productivity in recent years (Bizimana *et al.*, 2012). Both land area under cultivation of Irish potato and production have significantly increased. While the total production has increased by about four-fold, the average yield of Irish potato has doubled (Kathiresan, 2012). Rwanda's regional dominance in scale of production and central location offer potential for a distribution hub for eastern and central Africa (ECA).

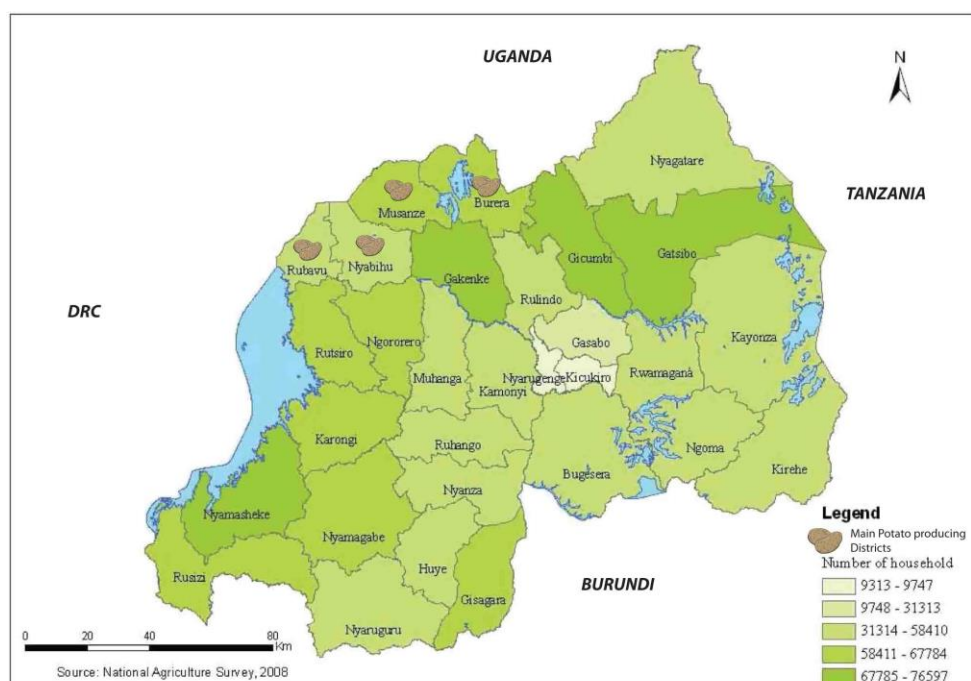
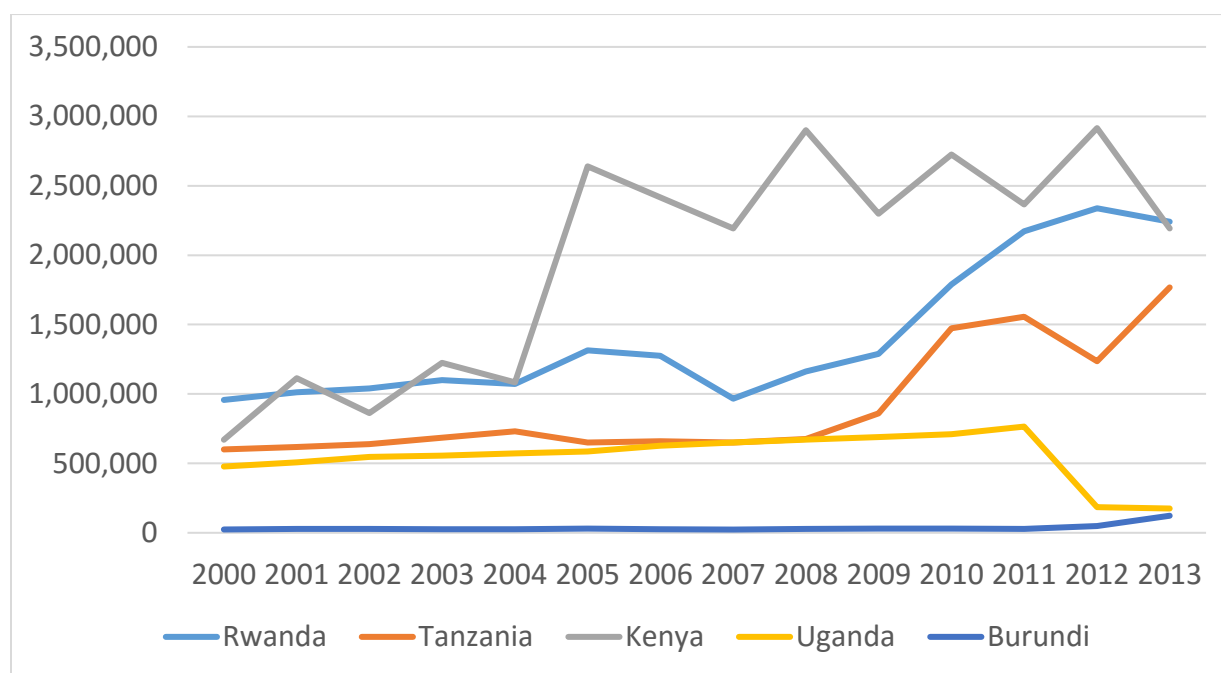


Figure 1. Map of Rwanda showing the main potato growing districts

Table 1. Irish Potato production (tons) in the EAC from 2000-2013

Year	Rwanda	Tanzania	Kenya	Uganda	Burundi
2000	957,202	600,721	670,303	478,000	24,039
2001	1,012,269	619,216	1,112,849	508,000	27,319
2002	1,038,931	637,720	861,566	546,000	27,994
2003	1,099,549	684,420	1,223,531	557,000	26,330
2004	1,072,770	731,120	1,084,412	573,000	26,091
2005	1,314,050	651,010	2,640,600	585,000	29,306
2006	1,275,585	660,000	2,415,080	628,000	26,176
2007	967,283	650,000	2,192,280	650,000	24,406
2008	1,161,943	674,962	2,900,000	670,000	28,900
2009	1,289,623	860,980	2,299,086	689,000	30,482
2010	1,789,404	1,472,560	2,725,936	711,300	29,681
2011	2,171,518	1,555,516	2,365,263	765,000	28,158
2012	2,337,706	1,235,041	2,915,067	185,000	47,841
2013	2,240,715	1,767,536	2,192,885	175,000	122,904

Source: FAOSTAT (2016)



Source: FAOSTAT, 2016

Figure 2. Irish Potato production (tons) in the EAC

Nutritional Value of Irish Potatoes

The potato has excellent nutritional content. It is a good source of dietary energy and some micronutrients, and its protein content is very high in comparison with other roots and tubers (IYP, 2008). Potato is low in fat, and although nutritious and an important staple food, balanced diets to go with it need to include vegetables and whole grain foods (IYP, 2008). Potato is thus a nutritious food security crop and a buffer to rising food prices, especially for cereals. Potato is one crop that meets these characteristics. Thus, it is increasingly considered a small-holder cash crop of the future and a pathway out of poverty (FAO, 2010).

Production Constraints and Identified Hindrances to Productivity and Profitability

Although potato has a number of advantages, it has challenges in production that hinder productivity and profitability. Potato is vulnerable to pests and diseases, implying a high risk of failure, requires substantial capital, and intensive care and attention (Tantowijoyo and van de Fliert, 2006). It has been reported that in the northern province of Rwanda, potatoes are vulnerable to disease and pest infestation, and that these are a major challenge for the potato growing areas of north and north-western province (NISR, 2010). The cost of purchasing pesticide therefore constitutes a major production cost for the producers, with consequences on profitability of the commodity. Another important cost is the cost of seed although over 80% of the farmers mostly purchase local seed and organic manure.

Limited land constrains rotation in the circumstances of high pest and disease infestation, further lowering productivity and profitability. Most farmers are small holder farmers who access up to five parcels of land for production (NISR, 2010).

Innovation Opportunities

Innovation opportunities in the potato value chain exist. These opportunities were derived from interactions with producers at the Gataraga IP, through which intervention points along the potato value chain were identified. These points include increasing productivity at farm level, establishing a new business model with potential buyers and financial service providers, and supporting private sector investors to establish processing plants in the potato growing region of North Rwanda. These would enable functional upgrading through linkages with buyers and financial services, product up grading through the production of processed potato products, and process upgrading by improving farm level production. Figure 3 illustrates the identified intervention points.

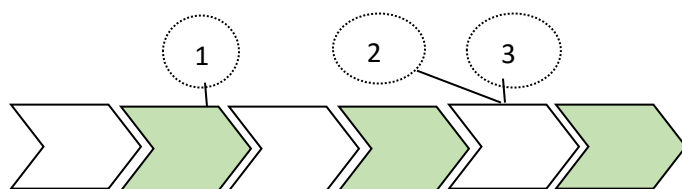


Figure 3. Value chain intervention points

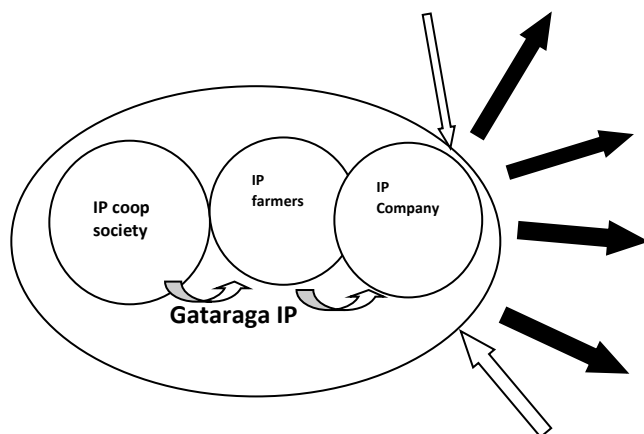
1: Increasing productivity at farm-level; 2: Establishment of a new business model with potential buyers and other service providers; 3: Support to private sector

Farm-gate prices could be improved and stabilized by establishing business models where major buyers are identified, linked to producers and financial service providers in contractual relationships. In such an arrangement, financial institutions would be obliged to provide credit to farmers, that could be recovered from their harvest sales, as well as provide payment to farmers as soon as they deliver potatoes at collection centers, which could later be recovered from the buyers. The need for ready cash and delay in payment cause farmers to sell to individual traders at any price without going to collection centers. Yet production of potatoes is heavily affected by pests and diseases and therefore the need for the producer to have a good cash flow. These business models would be similar to the models employed by commodity exchange markets, and relying on the warehouse receipt systems. Such systems are expected to increase access, benefits and stability for small scale producers, while generating consistent and reliable supplies for buyers (IIED, 2011).

In a workshop to evaluate stakeholder engagement processes at the Gataraga IP in December, 2015, the most trusted stakeholders were identified by the participants to be the Rwanda

Agricultural Board (RAB) and the IP cooperative society. The two seem to have credibly carried out their responsibilities of potato seed development and subsequent distribution to IP groups respectively. A potato company, an arm of the IP coop society sells the potatoes on behalf of the farmers at the potato collection center. This vertical integration of value chain activities, as shown in the Figure 4, on the IP ensures smooth movement of the commodity from seed development to the market. Among the producers at Gataraga IP and any other organized producers, the new business model would be established upon such an existing institutional framework, which seems to be appreciated and well trusted by the members.

Non IP members sell their potatoes at the IP collecting center.



Traders and supermarkets in Kigali, other urban areas and institutions

Figure 4. Vertical integration of activities: seed development, potato production, washing, packaging and marketing are all done by the IP

The good performance of the IP coop society in Gataraga as a distinct stakeholder category, from the IP farmers, yet a part of the IP seems to suggest a remedy for the poor farmer-private sector relationships in the future. This form of vertical integration is likely to lessen the common poor mentality and misunderstandings that farmers have about private sector.

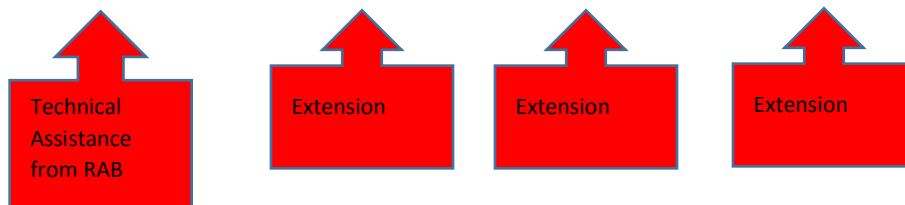
Currently, washing is the only form of value addition available, although products that could be obtained from potatoes include chips, crisps, and starch. If private sector actors are supported to invest in large and small enterprises based in the communities where the farmers are located such as in Gataraga or the Northern Province, this would widen market opportunities for farmers, and increase competition in the product market. This is the third intervention point. The Government of Rwanda (GoR) has interest to establish a potato processing plant and a modern potato storage facility in the Northern Province (MINAGRI, 2016). Otherwise potatoes are commonly sold in the local markets by retailers, and supermarkets, hotels and restaurants in Kigali and other urban areas. These innovations can enable functional upgrading through linkages

with buyers and financial services, product up grading through the production of processed potato products, and process upgrading by improving farm level production.

Value Chain Analysis

The value chain begins with seed development by the RAB (Figure 5). The seed is then obtained by the IP cooperative society for multiplication and subsequent distribution to the IP members. The members purchase the seed, although some use recycled seed. Production is then done by the members.

Processes



Services

Actors

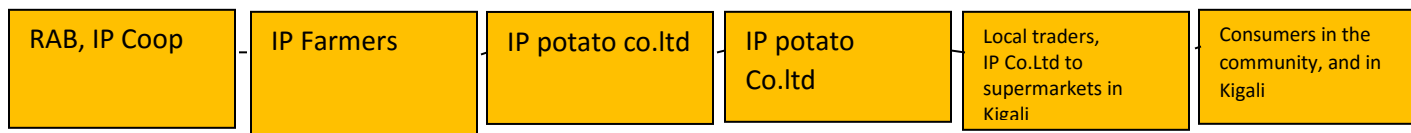


Figure 5. Mapping the actors, processes and services of the potato value chain at the Gataraga IP

The costs mostly incurred in potato production at the IP include seed, labor and pesticide. Table 2 shows components of production cost, returns, and gross margins per hectare, segregated by gender of household head. The most expensive input in potato production among the sampled households was pesticide. It has been reported that potatoes in Northern Province are vulnerable to disease and pest infestation, and that these are a major challenge for the potato growing areas of north and north-western province. The cost of purchasing pesticide therefore constitutes a major production cost for the sampled potato farmers. The second most important cost is the cost of seed although over 80% of the farmers mostly purchased local seed and organic manure during the study period. Male-headed households incur significantly higher costs in pesticide, seed and overall total cost than female-headed households. This is most likely linked to differences in affordability between the two categories of households.

Table 2. Mean production costs, returns and gross margins

	N	Men	Women	T-value
Cost of production (RwF)				
Labour cost (RwF)	107	65,900	47,000	0.734
Seed cost (RwF)	151	102,000	48,000	5.065***
Other inputs – pesticide (RwF)	150	141,000	79,900	2.459**
Av. total cost (RwF)	162	309,260	146,090	3.507***
Returns (RwF)				
Av. potato harvest (Kgs)	155	2,757.80	938.96	4.726***
Value of potato harvest (RwF)	159	407,630	129,520	4.903***
Potato harvest (kgs)/ha	139	9,404.20	4,970	2.747***
Gross margins (RwF)	161	92,417	-19,243	2.863***
Gross margins (RwF)/Ha	143	1,608,800	-192,000	2.806***
Average price (RwF)	147	133	123	1.716*

Notes: N=number; RwF=Rwanda Francs; Kgs=Kilograms; ***, **, * significant at 1%, 5%, and 10% respectively

Source: Survey data (2015)

The average potato harvest, value of potato harvest and yield were also significantly different between male-headed and female-headed households. Nonetheless, potato yield was found to be less than observed yield (BPR, 2012; MINAGRI, 2013) at 12-30mt/ha for northern and north-western Rwanda. This ought to be the first value chain intervention point; raising the yield of potato to the current yield of the province, and towards the anticipated potential of 38-40mt/ha. The challenges cited by the IP members during the survey included diseases, the high cost of pesticide, and limited land for rotation. The average household land size of 0.68ha places these farmers among the category referred to as small cultivators by NISR (2013). On average, they accessed five parcels of land for cultivation, typical of Northern Province (NISR, 2010).

Intervention at this point ought to enhance the use of improved seed, inorganic fertilizer, and optimal use of pesticide.

The main service providers are government extension service providers. This was attested by 94% of the IP member households who responded to having received extension services as compared with 67% of the non-IP households, a difference that was highly significant at the 1% level.

When potatoes are harvested, they are collected and stored before sale. The only processing that happens is washing, as the washed potatoes fetch a higher price especially in Kigali, compared with the unwashed ones. The IP has been able to acquire a storage facility within the sector, managed by the marketing committee of the cooperative (Figure6).



Figure 6. Potato store operated by Gataraga IP (in the picture is Olivier Ndagizyimana, Store Manager)

According to the government policy, the potatoes are expected to be sold at a Collection Centre. A Potato Collection Centre has therefore been established in Gataraga and operated by the IP company (Figure 7). At the collection centre, the GoR expects the potatoes to be sold at a price of at least RwF150, which is anticipated to cover the production costs of the farmer. In this study, this is the price that has been used to value the potato harvest and compute the gross margins in Table 2.

However there are many farmers who do not take their produce to the collection centre and prefer to make quick money from defaulting traders who do not buy potatoes from the centre. The traders offer a price well below the government price, as low as RwF80. On average the farmers sold potatoes at RwF120, which would make the values of gross margins lower than stated. Female-headed households significantly produced less than their male-headed

counterparts, and sold significantly at lower prices, RwF123 and 133 respectively, worsening their actual gross margins from what has been computed. This study finds that at least 70% of the farmers sold potatoes at a price below RwF150 during the study period, and hence the need for the second intervention, to stabilise the farm gate price.



Figure 7. Potato Collection Centre operated by Gataraga IP

Summary and Conclusion

Irish Potato is the third most important staple crop in Rwanda and a priority value chain in the country. However, although providing a number of advantages to small-holder farmers, potato is vulnerable to pests and diseases, implying high risks of failure, requiring substantial capital, and intensive care and attention. A new business model that builds on the existing farmer institutional frameworks such as the IP cooperative society and IP potato company with their RAB engagements, could be established to bring together potential credit institutions, extension service providers, buyers and processors, in one model with contractual arrangements. Such an arrangement is likely to ease the constraints of seed and chemical cost, as well as unsecure market, while improving farm-level productivity. Further, support to private sector investors would enable processing of potatoes in the areas of high production such as north and north-western parts of the country.

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