

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

### Proposed Business Case

## Post-Harvest Innovations for better access to specialized ware potato markets

### 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)*

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## 1. DEVELOPMENT PROBLEM/OPPORTUNITY

Potato production in Uganda was estimated at 775,000 tons in 2013 up from 573,000 tons in 2004 with an on-farm yield of about 7 tons/ha (FAOSTAT, 2014). Prominent potato producing areas include Kabale district in South Western Uganda and the Elgon zone in Eastern Uganda which comprises of Kapchorwa, Kween, Sironko, Manafwa and Mbale districts. Mbale is the central assembling hub for potato produced in Eastern Uganda and occasionally receives supply from Kenya. Potatoes are traded from Mbale to Kampala and other regions of Uganda including towns across borders in South Sudan.

Potatoes are produced twice a year during the rainy seasons resulting into excess supply during harvest periods and shortage in supply during periods when the crop is in the gardens. Considering that 95% of ware potato is traded as fresh tubers in the local market, the intermittent supply causes seasonal price fluctuations which have a negative impact on farmers as well as traders and consumers. In seasons of harvest, farmers are forced to sell at very low prices since they lack means of prolonging the shelflife to take advantage of the better prices during the growing seasons. Excess supply of potato in Kapchorwa and Mbale mainly occurs in June, July, August, December and January while scarcity mainly occurs in February, March, April, September and November. At farmgate, prices drop to as low as Ugx200 per Kg (\$ 0.08) which hardly covers their production costs and subsequently, traders are also forced to lower their prices and margins in order to sell as much during the harvest seasons. Consumers gain some short lived benefits when prices drop but after the glut extinguishes, scarcity of potatoes sets in again sending wholesale prices up to as high as Ugx 1,000/Kg (\$0.4) and in Kampala, wholesale prices tend to be high in June, August and November while reaching the highest peak of Ugx 1,100/Kg (\$0.44) in September and this impacts negatively on the consumers. Consequently, when wholesale prices rise, traders are forced to lower their margins in order to sell since demand is quite elastic (Figure 1).

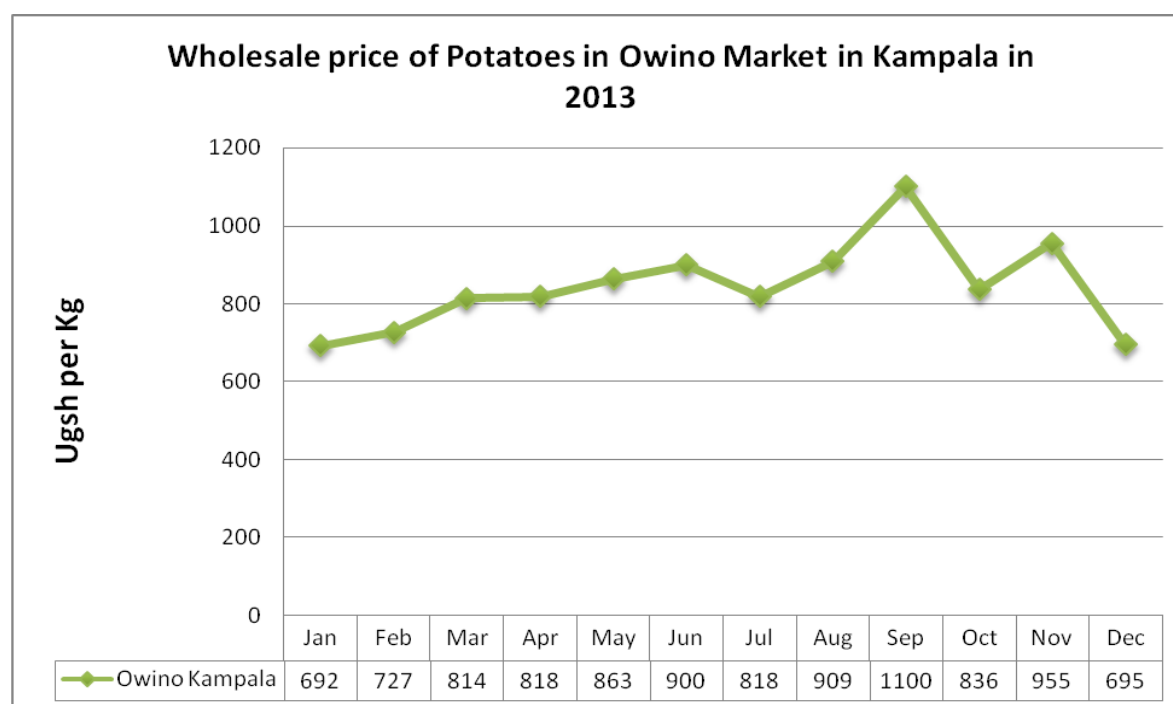


Figure 1: Wholesale prices of potatoes in Owino market (Kampala) and Kabale in 2013.  
Source: Farmgain Africa, 2014

Besides price fluctuations, most farmers find it difficult to find buyers since every other farmer would also be selling potatoes and as a result, some losses occur. This situation is exacerbated by lack of appropriate storage facilities as well as the environmental conditions such as warmth and humidity which speed up the rotting process.

This project is therefore intended to introduce storage innovations at individual farmer level, farmer association level and at wholesale trade level to ensure safe storage of potatoes for longer periods in order to enable farmers to obtain better prices and to ensure steady supply of potatoes to the market. This intervention contributes directly towards the attainment of MDG 1 (Extreme Poverty & hunger Eradication). Consistent buyers of potatoes (e.g. operators of fast food outlets, crisp makers and hoteliers) shall benefit from an assurance of steady supply while traders shall be able to stock up in seasons of plenty and release back into the market in seasons of scarcity hence evening out their gains. For instance, despite the fact that 70% of total production in Kapchorwa constitutes the Victoria variety which is very susceptible to rotting (<2weeks after harvest), farmers stand a chance to benefit from such technologies as findings from the scoping study revealed that farmers in Kapchorwa and Mbale are willing to store up to 50% of their harvest for sale at a later date in order to benefit from the better prices offered.

## 2. APPROACH

The project will build capacity of various chain actors in pre and post-harvest handling techniques (i.e. dehauling, proper harvesting, sorting, grading, packaging and transportation) which extend shelflife of potato to target different market segments. Using the Participatory Market Chain Approach (PMCA), opportunities emerging from challenges and ideas observed in the scoping study shall be synthesized with involvement of the value chain actors concerned as stipulated in PhaseII of the manual (Bernet et. al, 2006). Potato quality can be affected by duration and condition of storage which is determined by the variety produced and utilization of the potato. The benefits accruing from use of various potato storage methods in terms of social, economic, gender or physical consumer acceptability will be tracked and documented at each stage of evaluation. A three-tier approach to address post-harvest loss reduction along the ware potato value chain shall focus on the following storage innovations.

- i. At household level, the project proposes to evaluate and improve indigenous ambient stores constructed using local materials i.e. thatch grass, poles and dried reeds (Annex 1). This kind of storage involves keeping light away to prevent greening while allowing for ample air circulation and very cool temperatures to slow down physiological processes. It is raised from the ground to avoid predators and flowing water which may also damage the stored items. Such storage may have capacity of about 2 - 4t and may be utilized by small scale farmers producing about 7t of which 50% is stored for sale at a later date. Construction of such a store (4 x 5 meters) may be estimated at a cost of US\$400. Such storage is more likely to be affordable and accessed by women who mostly sell at farmgate as opposed to men who usually take produce to markets as revealed in the scoping study. This will contribute directly towards attainment of MDG 3 on gender Equality.
- ii. At farmer association level, improved ambient stores will be promoted since they are of capacity 30 – 60t and they are designed to keep light away while allowing for ample air circulation and very cool temperatures. The walls are constructed using bales of dried grass stack together and plastered with a thin layer of cement on the inner and outer surfaces (Annex 1). The structure is roofed with iron sheets mounted on wooden poles. Estimated cost of such storage may be about US\$15,000 – \$25,000. This kind of storage is proposed for

collection centers managed by farmer associations (20–30 members) with mechanisms and management capacity in place to jointly collect, store and market produce. For instance, KACOFA has demonstrated a successful storage management mechanism which this project can draw lessons from.

- iii. At wholesale trade level mainly in urban markets, a coolbot is proposed. It is basically a container with insulated walls seated on a raised platform and it has an air conditioning system (solar powered) to ensure maintenance of required temperatures as well as rotating vent to ensure ample air circulation (Annex1). Such a unit is capable of storing about 20–40t of potatoes and its construction may cost about US\$4,000–5,000 depending on the size of container.

All the 3 technologies have been introduced and used in Western Kenya and also in Bangladesh on a project a USAID-funded project led by CIP and the World Vegetable Center (AVRDC) together with an NGO called BRAC. In this project, approximately 44 farming families using ambient type stores to keep their table potato for 3-4 months obtained an increase of about 50% in price compared to the price during harvest (CIP 2014).

The project shall be implemented in the following sites namely; Kapchorwa (1,800m), Kween-Benet (1,900-2,300m), Wanale (1,800-2,000m), Mbale (1,200m) and Kampala (1,200m). Evaluation and promotion of the 3 proposed technologies shall be held in selected sites to enable farmers and other targeted users obtain appropriate knowledge on their establishment, functioning, management and utilization.

Using the Participatory Market Chain Approach, interests and challenges of the value chain actors shall be scrutinized then the 3 types of technologies shall be introduced as a solution to challenges relating to storage. Small scale individual farmers shall be exposed to the household ambient storage technologies as well as other agronomic practices which contribute to ensuring storage of high quality potato

### 3. MAIN RESEARCH QUESTIONS

The following are the questions this project shall seek to address:

- a) What are the pre/post-harvest and in-storage practices that are required to maintain ware potato quality and consumer acceptability?
- b) How long can we store potatoes under different cost-effective technologies and what is the effect on different varieties?
- c) What innovative methods can male and female value chain actors employ to ensure consistent potato supply through manipulating varietal differences in maturity and dormancy periods?
- d) What appropriate mechanisms and gender-based strategies can enhance the uptake and utilization of recommended ware-potato storage facilities and practices along the value chain?
- e) What are the gender sensitive strategies to enable value chain actors to engage effectively, competitively and sustainably in the identified market opportunities?

#### 4. OUTPUTS/DELIVERABLES

<b>No</b>	<b>Research output/Deliverable</b>	<b>Deliverable Output</b>	<b>Expected time (year/quarter)</b>	<b>Responsible Agency</b>	<b>Contributing partners</b>	<b>Next Users</b>
1	Current status and ware potato marketing system in Eastern Uganda mapped and gender based market constraints and opportunities identified, analyzed along the potato value chain	<ul style="list-style-type: none"> <li>- Potato production, post-harvest and storage status report</li> <li>- Potato market structure report</li> <li>- A report on gender based constraints and opportunities in ware potato along the value chain</li> </ul>	Year 1, Q2	CIP	BugiZARDI Makerere	Researchers, Extension Institutions, NGOs, Traders, and Processors
2	Testing and validation of pre-harvest and storage methods by potato variety under different ambient conditions developed taking into account technical, economic and social aspects as well as consumer acceptability	<ul style="list-style-type: none"> <li>- Protocols on quality by variety and storage conditions for different altitudes</li> <li>- A report on socio-economic and consumer acceptability aspects of different storage practices.</li> <li>- Appropriate store designs for different stakeholders</li> <li>- Report on potential impact of the technology on women and households</li> <li>-Three MSc theses</li> </ul>	Year 2, Q3	CIP	BugiZARDI Makerere	Researchers, Extension Institutions, NGOs, Farmers, Traders, and Processors
3	Capacity in ware potato pre-harvest and storage methods for producers, traders, researchers and extension agents strengthened	<ul style="list-style-type: none"> <li>- Guidelines on ware potato post-harvest and storage techniques</li> <li>- A report on the trainings on better pre-harvest and appropriate storage management techniques</li> </ul>	Year 2, Q3	BugiZARDI	CIP	Extensionists Farmers NGOs Processors Traders Researchers
4	Skills in	<ul style="list-style-type: none"> <li>- Guidelines on association/</li> </ul>	Year 2: Q3	Selfhelp	CIP	Traders

	entrepreneurship, agribusiness and collective action developed for selected actors (men, women and youth) in specialized ware potato markets	group development for ware potato agri-business - A report on the training on entrepreneur skills and ware potato marketing				Producers Extensionists Processors Financial institutions
5	Recommendation for extending shelf-life, increased utilization and reduction of post-harvest losses along ware potato value chain disseminated	- Protocol on best bet business model for reducing post-harvest losses along ware potato value chain - Workshop reports	Year 2, Q4	BugiZARDI	CIP, Selfhelp	Producer associations Researchers Extensionists Trader associations Processors Financial institutions

Research output/Deliverable	Activities	Year I				Year II			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1.Current status and ware potato marketing system in Eastern Uganda mapped and gender based market constraints and opportunities identified, analyzed along the potato value chain	1.1. Organizing a project initiation stakeholder workshop								
	1.2: Assessment of ware potato production, post-harvest, storage, consumption and trade in Eastern Uganda and identification of gender based constraints and opportunities along the value chain as well as project implementation locations								
	1.3: Establish a Multi-stakeholder innovation platform for strengthening project implementation and sustainability of outputs								
2. Testing and validation of pre-harvest and storage methods by potato variety under different ambient conditions developed taking into account technical, economic and social aspects as well as consumer acceptability	2.1. Capacity building in Farmer-Research-Extension Group (FREG) in PHH experimental management at trial host sites/group								
	2.2. Bulking of test varieties at research station (Buginyanya) and with groups								
	2.3. Construction of individual and association ambient stores								
	2.4. Evaluating potato varieties under different ambient storage conditions and duration								
	2.5 Evaluating varieties to extend the growing and marketing season by exploiting differing maturity and dormancy periods								
	2.6. Construction of coolbot stores in selected locations								
	2.7. Socio-economic studies (cost-benefit analysis, return of investment and social acceptability including potential impact on women and households)of different storage options								
	2.8. Periodic consumer acceptability analytic studies								

	for each storage method.								
	2.9. Promotion and validation of quality aspects of stored ware potato with selected consumers.								
3.Capacity in ware potato pre harvest and storage methods for producers, traders, researchers and extension agents strengthened	3.1. Developing training materials for appropriate pre-harvest and storage methods								
	3.2. Training and validation on pre-and post-harvest management of ware potato								
4. Skills in entrepreneurship, agribusiness and collective action developed for selected actors in specialized ware potato markets	4.1. Mobilizing selected value chain actors with ware potato business interest for skills improvement								
	4.2. Developing relevant training materials and strategies								
	4.3. Participatory skills development workshops and training in entrepreneurship, agribusiness and collective action aspects.								
	4.4. Introduction of access to credit options for financing the storage options or business ideas in ware potato								
5. Recommendation for extending shelf life, increased utilization and reduction of post-harvest losses along ware potato value chain disseminated	5.1. Manuals and reports on best ware potato storage practices								
	5.2. Stakeholder workshops to identify strategies for scaling out recommendations								

## 5. DEVELOPMENT GOAL

About 5,000 commercial potato producers and dealers (45% being women) are expected to directly utilize improved ware potato post-harvest techniques especially ambient stores and pre storage techniques in response to the diversified market opportunities created by the project. It is envisaged that 100,000 value chain stakeholders (50% are women) will have access to the improved storage through stronger value chain linkages and a structured ware potato market. These benefits will accrue from the extended ware potato shelf life by an average of 3 months compared to the current 2 weeks. Improved ware potato storage will even out the rather elastic market prices if there is more inclusive and gainful participation of all value chain actors especially through contractual marketing. This in turn is expected to increase household income of youth, women and men from participation in various aspects of ware potato production and marketing by 15%. This will have a ripple effect in increasing investment in improved ware potato production techniques especially use of seed potato of high value market choice varieties that require less agro-chemicals such as fungicides. Availability of high quality potato in constant supply is hoped to trigger investment in farm based cottage processing industries' such as snacks



and frozen chips. These are industries that can attract women and youth into their employ and thus improve livelihoods of the whole family and community in urban Centre's. Owing to institutional constraints, farmers in developing countries typically are not innovative when it comes to marketing their products. In the poorest countries, potatoes are usually marketed through fragmented chains that lack coordination and information exchanges, giving rise to high supply risks and high transactions costs. The capacity built in entrepreneurship, agri-business management and standards linked with access to credit and greater ware potato utilization of market acceptable varieties is expected to improve uptake of outputs of the project. Private sector can buy into the organized stakeholder groups with improved knowledge of standards required in the market and thus a pull effect into co-investing with the individuals or groups. The scoping study had already highlighted the desire and willingness for individuals and groups such as KaCoFa and Mbale Potato traders association together with a private dealer Ssemwanga center to explore options for co-investment. A discussion with Centenary Bank, Agricultural credit head also highlighted that the Bank was in the process of developing innovative packages for agricultural finance as part of their expanding service to its clientele. This was identified as an opportunity for stakeholders to use the crop as collateral as is currently used in the cereals warehouse receipting system. All these deliberate steps will culminate into a sustainable ware potato business model that is hinged on improved storage and quality of product.

6. EXPECTED OUTCOMES

<b>Research output/deliverable</b>	<b>Users/beneficiaries</b> <i>(e.g., producers, small-scale processors, retailers)</i>	<b># of Users/ Beneficiaries after 10 years</b>	<b>Outcomes</b> <i>(expected use of technical and other innovations; e.g. farmers using on-farm storage technology, processors applying new procedures)</i>	<b>Food security</b> <i>(direct effects through products, or indirect effects through increased income and other effects)</i>	<b>Gender equity</b> <i>(inclusiveness and benefit sharing among women, men and youth)</i>	<b>Environmental performance</b> <i>(increase of positive or reduction of negative impacts on the environment)</i>
1. Current status and ware potato marketing system in Eastern Uganda mapped and gender based market constraints and opportunities identified, analyzed along the potato value chain	private sector, transporters, traders, producers, processors, researchers, extension, academicians	100,000	Enhance understanding of the constraints at various nodes and opportunities available in ware potato	Increased access and availability of ware potato	Improved participation through employment at various value chain activities for men, women and youth	Reduced wastage due to awareness of ware potato opportunities
2. Testing and validation of pre-harvest and storage methods by potato variety under different ambient conditions developed taking into account technical, economic and social aspects as well as consumer acceptability	Producers, transporters, traders, researchers, extension, processors, financiers	100,000	Increased availability of quality ware potato with stability in prices for the market	Increased income and availability of quality ware potato throughout the year	Improved participation and benefit of men, women and youth involved in pre storage and storage practices	Reduced wastage of ware potato and other crop products

3. Capacity in ware potato pre-harvest and storage methods for producers, traders, researchers and extension agents strengthened	Producers, transporters, extension agents, researchers, processors and traders	100,000	Increased awareness of improved potato varieties, pre-storage, storage management techniques and quality attributes for the market	Improved access and availability to quality ware potato for consumption	Increased income and participation of women and youth in quality ware potato value chain	Reduced spoilage of ware potato and better utilization of wastes
4. Skills in entrepreneurship, agribusiness and collective action developed for selected actors in specialized ware potato markets	Producers, researchers, extension agents, processors, traders, academicians, policy makers, transporters, and financial institutions	50,000	Increased investment in pre-storage and storage technologies across the value chain	Increased availability and access improved food security due to availability of food and improved incomes	Women, men, youth and elderly participating in different market segments according to ability	Reduced spoilage of ware potato and better utilization of wastes along the value chain
5. Recommendation for extending shelf life, increased utilization and reduction of post-harvest losses along ware potato value chain disseminated	All value chain actors	200,000	Increased utilization of pre and post-harvest techniques for extending potato shelf life	Improved access and availability to potato all season	Inclusive participation of women, men and youth according to capabilities in various activities	Reduced post-harvest loss of potato due to improved storage and handling

## 7. FEASIBILITY:

### a) Technical feasibility

Ferris et al., (2001) reported that potato in Uganda has a short shelf life because of the high water content of tubers at harvest as a result of not dehauling by majority of farmers. However, findings from the scoping study show that shelf life may also be determined by variety of crop, pre-storage practices and storage management techniques.

To guarantee a top-quality product, storage conditions must be well controlled. Storage should minimize physiological losses and losses due to mechanical damage. Control of ambient temperature, air flow and light intensity coupled with proper physical handling of ware potatoes leads to prolonged shelflife. Storage interventions can therefore, be applied at individual farm-level, collective producer-level and at market/trade level (Walingo and Lungaho 2003).

The proposed storage interventions have been piloted and adopted in Bangladesh, Cameroun and Kenya. These include improved ambient stores for individual farmers as well as ambient stores with bigger storage capacity for farmer groups and coolbots which are mostly used in urban markets (CIP 2014). Kabira and Saint (2013) indicated that crisping quality of potato in Mt. Kenya was not affected when stored at ambient temperatures of 12<sup>0</sup>C to 17<sup>0</sup>C. This was also confirmed by findings in Bangladesh where small ambient type potato storage with capacity of 6 – 8MT effectively stored ware potato for 3 – 4 months and farmers obtained a 50% increase in price compared to what they would have got if they had sold during peak harvest.

However, it is important to note that effective storage is enhanced if other pre-storage practices and conditions are accorded due attention. This project intends to work with all value chain actors (men, women and youth) to ensure attainment of desired results through skills and capacity development.

### b) Economic feasibility

At farmer level, preliminary analysis reveals that male farmers in Kapchorwa are able to increase their profit margins from 27% to about 59% if they invested in household storage while women can improve their margins from 19% to 55%. This is illustrated using the figures obtained from farmers interviewed in Kapchorwa during the scoping study (Table1).

**Table 1: Gross margin comparisons of storage interventions among male and female farmers in Kapchorwa, Uganda**

Scenario	Men selling all their produce at harvest	Women selling all their produce at harvest	Men selling after storing for 2-3 months	Women selling after storing for 2-3 months
Production cost (Ugx/acre)	1,780,000	1,976,000	1,780,000	1,976,000
Production cost per Kg	254	282*	254	282
Average storage costs* (Ugx)			250,000	250,000
Yield (Kg/acre)	7,000	7,000	7,000	7,000
Farmgate price (Ugx)	350	350	700	700
Gross revenue (Ugx)	2,450,000	2,450,000	4,900,000	4,900,000
Gross profit (Ugx)	670,000	474,000	2,870,000	2,674,000
Profit per Kg	96	68	410	382
Margin (%)	27%	19%	59%	55%

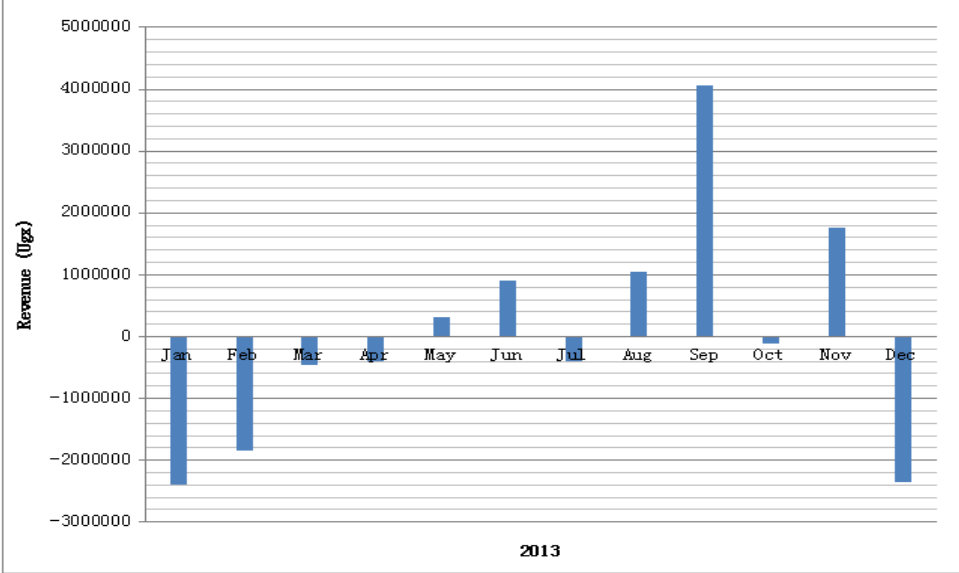
**Note:**

Household storage is assumed to last 2 years with capacity of 4MT at a cost of Ugx1.0million

1US\$ = Ugx2600 \*This cost is for the entire period of storage 2 – 3 months

\*Women production costs tend to be higher due to low bargaining power when buying inputs or hiring labour

Similarly at processing level, using information obtained from a processor who makes potato crisps and sells them in Kampala (Tomcris Ltd), the analysis reveals that when a processor who utilizes 600Kg of potatoes daily invests in any form of storage, they would be able to save about Ugx 8,037,480 per annum as a result of prices fluctuating above the annual average wholesale price of Ugx 844 per Kg in Owino market. Such savings would be made in the months of May, June, August, September and November when the price of ware potatoes tends to higher than average.



**Figure 2: Potential revenue gained or lost by a processor due to deviations of wholesale price of ware potato in Owino market**

c) Social feasibility

Although agricultural extension service in Uganda tends to be male dominated as observed by Opio (2003), this can be a disincentive to potential female beneficiaries at household level. This project intends to use a participatory approach which shall specifically target organized and interested women and youth in the technology adoption processes.

Findings from the scoping study in Mbale revealed that women and men more or less equally engaged in production of potatoes. However, women tended to engage more in farmgate sales whereas men tended to target bigger sales in urban markets, export and other institutional buyers. Installing storage facilities at farm-level is therefore likely to accord women better control of household produce and hence increases their chances of benefitting from revenue obtained from sales. Furthermore, considering the fact that the scoping study showed that potato is a key staple in most households, improving storage at farm-level shall enhance food availability to households over longer periods hence enhancing their food security status.

At trade level, evidence from the scoping study findings in Kampala and Mbale shows that wholesale trade in ware potato is male-dominated (60-70%) while retail trade is female dominated (70%). Targeting organized retailers with coolbot storage is likely to accord more benefits to women who are often excluded in male dominated produce trade.

## 8. DEMAND FOR THE INNOVATION

At farm level, findings from the scoping study in Mbale revealed that farmers are forced to harvest and sell ware potatoes within 3 days or else they would lose all their produce. Despite having some traditional storage practices such as open storage, findings show that such practices are not efficient enough to maintain quality of the tubers as they tend to turn green and degenerate in taste. Furthermore, existing storage practices and methods can only cater for limited quantities and hence are not sufficient to handle what is produced. Current storage practices include packing potatoes in polythene bags, spreading potatoes on the floor, thatching the bags tops with dried grass and merely covering bags with papyrus mats.

Another aspect compelling farmers to sell immediately after harvest is the urgent need for cash to meet other obligations such as school fees, clothing and medical expenses which becomes more pressing especially when farmers have limited sources of alternative income.

Introducing the proposed technologies would enable farmers store excess potatoes without compromising quality and enable them to obtain better prices when sold in months of scarcity. This would counter the current situation where prices fluctuate from peaks of Ugx1,100 per Kg (\$0.42) in seasons of scarcity to about Ugx 200 per Kg (\$0.07) in seasons of plenty.

For a processor who purchases and utilizes potatoes on a daily basis, investing in such storage technologies would enable them forego the excess price they would pay in the months when potatoes tend to be scarce (June, September, October and November) while reaping benefits of buying potatoes at a relatively lower price in seasons of harvest then store for use later.

For traders, such technology would enable them stock up potatoes in seasons on plenty then release in seasons of scarcity hence balancing out the margins obtainable while maintaining a steady supply to the satisfaction of their clientele.

At policy level, the local government leaders visited during the scoping study in Mbale expressed willingness to support construction of post-harvest handling facilities by helping in finding a suitable site in urban areas. Local leaders perceive this as a means of reducing losses which result from inadequate storage (greening, rot due to warmth, exposure to theft).

## 9. PROPOSED BUDGET

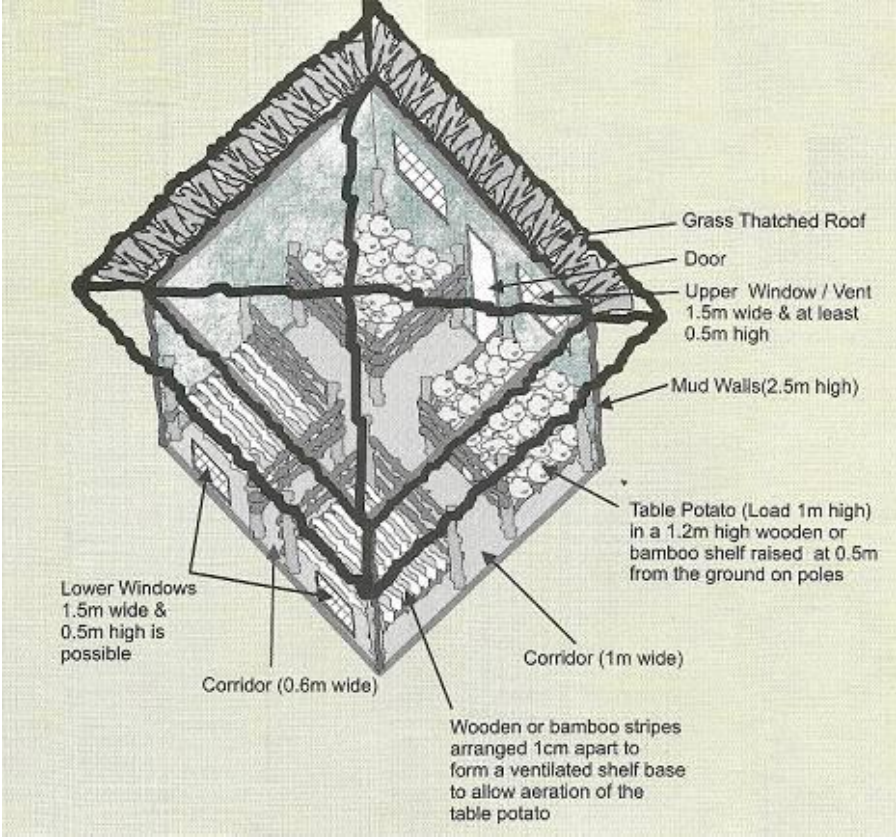
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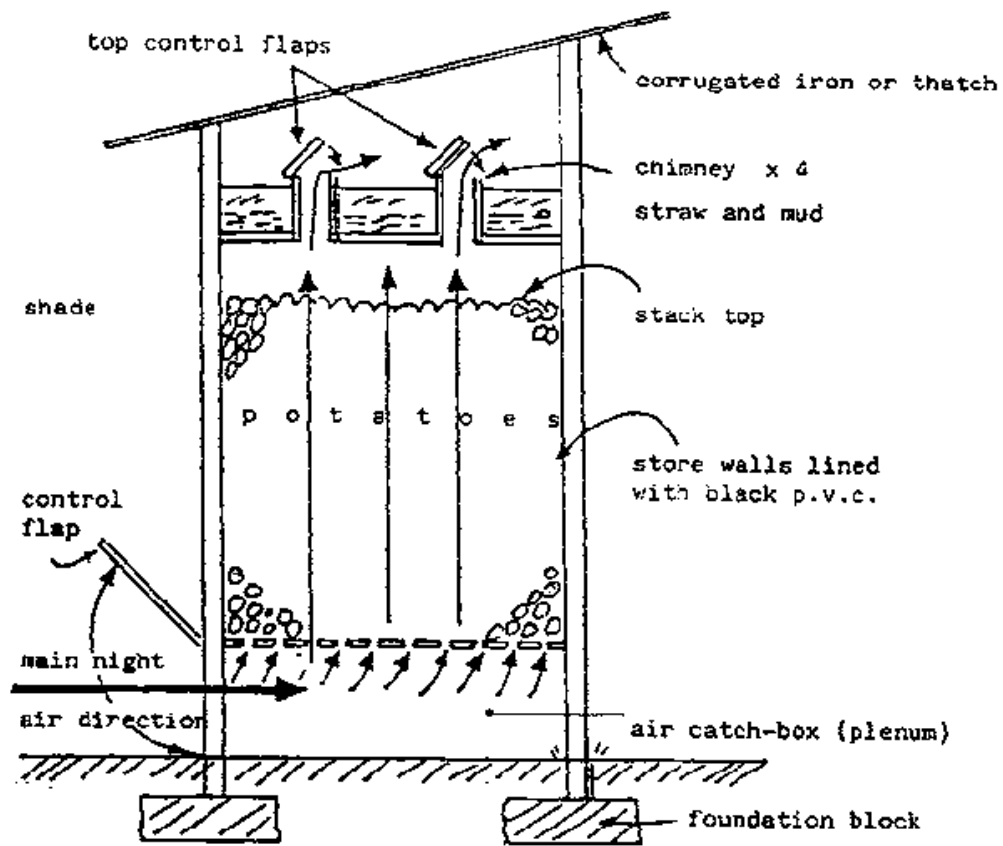
**Appendices**

**Appendix 1: Proposed storage technologies**



**Photograph 1a: A household ambient store design from aerial view**  
Source: AT Uganda





Photograph 1b: Typical design of an ambient store  
 Source: Hunt, 1982



Photograph 2: An improved ambient store  
 Source: Kisima foundation



**Photograph 3: A coolbot in use in Bangladesh**