



INITIATIVE ON
West and Central African
Food Systems Transformation



Transforming Agrifood Systems in West and Central Africa Initiative (TAFS-WCA)

INVESTMENT ACTION PLAN FOR ORANGE-FLESHED SWEETPOTATO PROCESSED PRODUCTS USING MANUAL EQUIPMENT IN RWANDA



December 2023

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Acknowledgments

This work is part of the CGIAR Research Initiative on [Transforming Agri-Food Systems in West and Central Africa \(TAFS-WCA\)](#). The TAFS-WCA initiative is a collaborative effort of nine centers, including six CGIAR centers, namely the Africa Rice Center (AfricaRice), the International Institute of Tropical Agriculture (IITA), the Alliance of Bioversity International and the International Center for Tropical Agriculture (Alliance Bioversity-CIAT), The International Water Management Institute (IWMI), the International Center for Potato (CIP) and the WorldFish and three international centers namely the West and Central African Council for Agricultural Research (CORAF), The World Vegetable Center (WorldVeg) and The International Centre of Insect Physiology and Ecology (ICIPE). The Initiative further collaborates with national partners in different countries.

The Initiative's leadership thanks all funders for supporting this research through their contributions to the [CGIAR Trust Fund](#), particularly the Governments of the Netherlands and Belgium, for their financial support.

Scientists from the International Potato Center led this work in collaboration with Euro Ingredients Ltd, who designed the machines, and the Rwanda Agricultural Board. Training on *Accelerating Investments in High Readiness CGIAR Solutions in West and Central Africa* was provided at a four-day workshop held in Kigali, Rwanda, 11-14 July 2023, organized by Dr. Murat Sartas under the International Institute for Tropical Agriculture (IITA) and Dr. Jan Low of the International Potato Center (CIP).

DOI: 10.4160/cip.2023.12.020

Citation

Herve Mwizerwa, Sylvester Ojwang, Jan Low, and Murat Sartas (2023). Investment Action Plan for Orange-Fleshed Sweetpotato Processed Products Using Manual Equipment in Rwanda. International Potato Center, Nairobi, Kenya, 24 pages. DOI:10.4160/cip.2023.12.020

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This publication is an output of the CGIAR Research Initiative on Transforming Agri-Food Systems in West and Central Africa (TAFS-WCA). Any opinions expressed here belong to the author(s) and are not necessarily representative of or endorsed by the Center or CGIAR.

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CALL TO INVEST

There is convincing evidence that consumers like vitamin A-rich orange-fleshed sweetpotato (OFSP) products like bread, mandazi (a form of fried donut), and chips and crisps. So why are there not more enterprises making these products in Rwanda? The reason might be drudgery. For women in small-scale enterprises in Rwanda, processing sweetpotato by hand is a pain. The golden color of OFSP chips and crisps attracts customers, but cutting a sweetpotato root is much harder than cutting a potato. Or it used to be. The Puree Pro and Cut-a-Chip manual machines are game-changers for women engaged in small enterprises, freeing them from the drudgery of processing and increasing the number and volume of products they produce in the same amount of time. Even better, food waste is reduced as the skin can be left on when using the machines, improving profits and adding more dietary fiber, iron, and zinc into the final products. OFSP puree (steamed and mashed roots) also improves the nutritional and starch quality in baked products, replacing 30-60% of imported wheat flour in baked products, saving hard currency. Best of all, the large-scale expansion of OFSP enterprises gives the considerable group of farmers in Rwanda the markets they seek, addressing the biggest complaint of OFSP farmers. Do not miss your opportunity to participate in transforming the livelihood of many farmers and invest in higher quality, more profitable sweetpotato processed products. Please help us reduce waste, provide more jobs, empower women, provide more choices to consumers, and create more sustainable markets for Rwanda.

INTRODUCTION

Agriculture is the mainstay of the Rwandan economy, contributing about 32% of the GDP and engaging about 2.3 million (80.1%) of the total households in the country. This "Investment Action Plan for orange-fleshed sweetpotato (OFSP) processed products using manual equipment" addresses three critical issues that constantly affect the economy: malnutrition, economic underdevelopment, and drudgery women farmers face. The plan is built on an innovative approach to exploiting the potential of vitamin A-rich orange-fleshed sweetpotato (OFSP) to combat micronutrient malnutrition and poverty. Sweetpotato is the primary food security crop in the country, but farmers complain of inadequate markets since most households have access to sweetpotato roots. However, being able to diversify market opportunities through the creation of high-value-added products, especially those demanded by growing urban centers, is a promising way to create better income-earning opportunities for sweetpotato producers. The focus on manual processing equipment is designed to ensure accessibility and affordability for small-scale entrepreneurs to benefit from such product diversification.

This document outlines a strategy that capitalizes on a market analysis for OFSP products, a new manual for OFSP processing technologies, training programs for local producers, and marketing strategies. It also provides a detailed financial analysis and identifies potential funding sources. The plan concludes with a monitoring framework to ensure long-term sustainability and effectiveness in improving health and economic conditions. The plan acknowledges the commitment of the Rwandan government to using agriculture as an engine for economic empowerment, and their acknowledgment of the potential benefit of biofortified crops like OFSP to address nutritional as well as economic empowerment objectives concurrently.

The Innovations:

Small-scale agro-processing enterprise development in Rwanda using manually operated machines to process sweetpotato roots has the potential to be a game-changer— opening up market opportunities for the vast majority of smallholder farmers who grow sweetpotato year-round. The critical challenge to processing sweetpotato roots into puree chips or crisps is the drudgery of producing these value-added products by hand. Two answers to this problem are *manually operated machines* specifically designed to process sweetpotato roots. Target users of the first one, *Puree Pro*, are small-scale agro-processors with limited financial resources, operating where reliable power supply from the primary grid is a significant challenge or too costly. Firstly, the *Puree Pro* machine (Figure 1) allows the crushing of the whole steamed root including the skin, and produces very high-quality puree. In contrast, when using a typical meat grinder, clogging and poor-quality puree is the likely result. One can also steam and mash by hand, but this requires peeling the roots, resulting in economic loss (often 15-25% of the weight of the roots is lost) and lower nutritional value of the puree.



FIGURE 1: PUREE PRO

Secondly, unlike the usual potato chips cutting machine, the *Cut-a-Chip* machine (Figure 2) is designed to withstand the toughness of sweetpotato roots. It is also multifunctional, using two blades – one that can cut the standard-size sweetpotato "fry-type" chips and the other for crisps. Using manual machines for sweetpotato processing is a win-win for women and youth seeking to start an agro-processing enterprise as sweetpotato is abundant, and they do not need to go through the pain of hand processing.

Regarding Scaling Readiness, these machines are still at level 6, the proof-of-concept stage (see Annex A for assessing the entire innovation package). It is established that the *Puree Pro* makes a high-quality puree and that tested recipes for many products are acceptable to consumers. However, access to the machines requires outside support as they are imported from Italy and cost around 750 USD. This implies that their initial use needs to be supported logistically and subsidized to ensure access by small enterprises. Identifying a regional manufacturer would be highly desirable if the established value chains prove profitable and sustainable.

The *Cut-a-Chip* machine makes crisps of the size and shape that are pretty competitive with other products. The chip size can be variable, depending upon the shape of the roots put into the machine. Again, as quality stainless steel is used in its production and imported from the same company in Italy (Protea), it is expensive (around 1100 USD). Hence, initial use must be subsidized while local manufacturing options are developed. Both manual machines were designed upon request from the International Potato Center by Euro Ingredients Ltd.

Many parts of Africa have a vibrant informal agro-processing sector based on locally made equipment. Often, such equipment does not meet desired food safety standards, as meeting those standards requires the use of expensive inputs such as stainless steel. However, low-cost, locally made equipment often has the disadvantage of a much shorter lifespan than its more expensive counterparts.

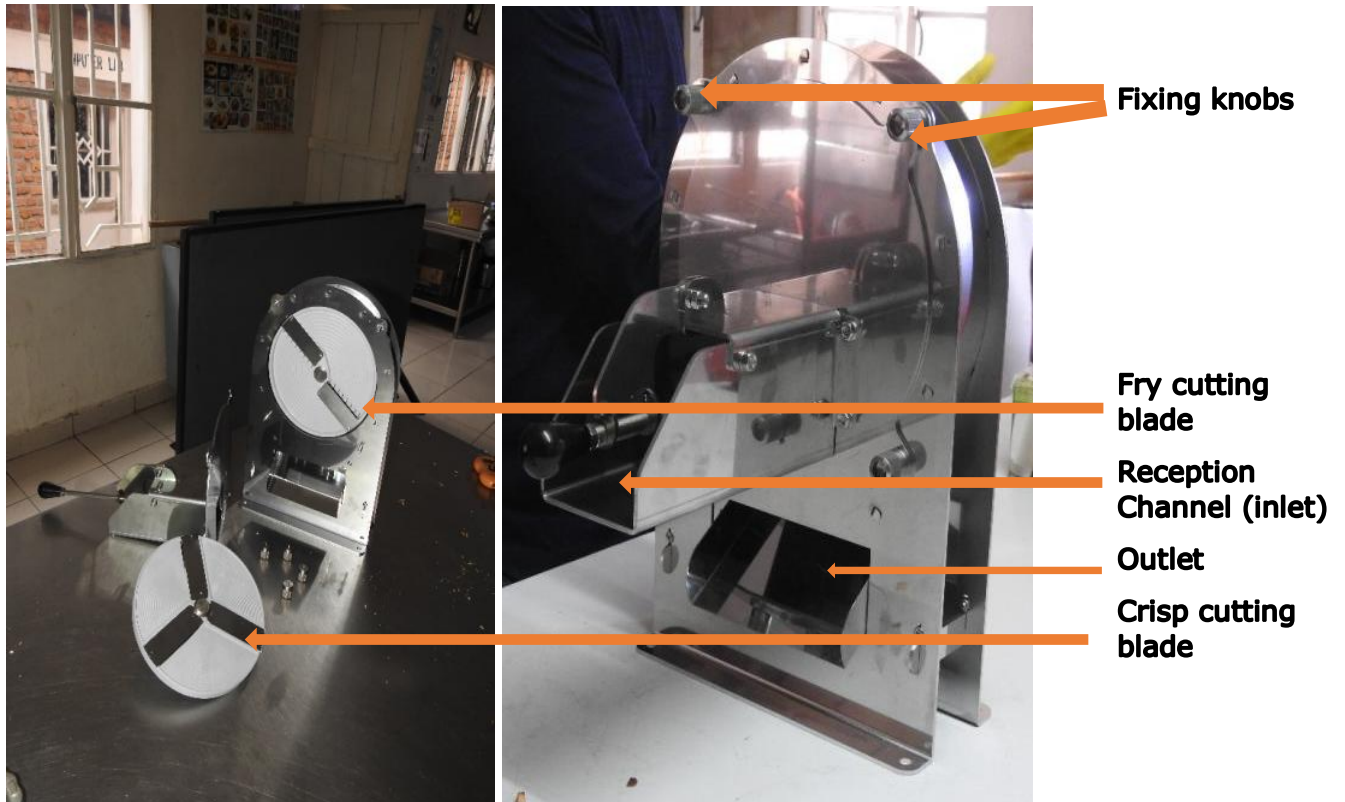


FIGURE 2: CUT-A-CHIP MACHINE WITH MAJOR COMPONENTS IDENTIFIED.

TARGETED INVESTORS

The investment action plan for promoting orange-fleshed sweetpotato (OFSP) processed products in Rwanda, utilizing manual processing equipment, aims to attract a specific set of investors aligned with the project's objectives. These objectives include enhancing nutritional intake, supporting small-scale confectionery traders, especially women and youth, and aligning with Rwanda's development goals. The plan identifies the most suitable investors and outlines a strategic approach for engagement and outreach.

Our ideal investors are entities committed to agricultural innovation, food security, nutritional improvement, and sustainable development. They appreciate the value of biofortified products like OFSP and understand the significance of research and development in agriculture. These investors are willing to support initiatives that align with Rwanda's strategic development policies, particularly in health, economic empowerment, and environmental sustainability.

Identifying the most suitable investors and tailoring our engagement strategies to match their interests and funding cycles is critical to our investment action plan. Here's how we've mapped out our approach for each top investor:

1. [United States Agency for International Development \(USAID\)](#): Our strategy is to align closely with USAID's critical interests in agricultural development and food security. We'll underscore how our project can significantly boost nutrition and economic empowerment in Rwanda. We plan to engage with USAID during their specific funding cycles, focusing on their agriculture and food security initiatives.
2. [The World Bank](#): For The World Bank, we'll showcase how our project aligns seamlessly with their objectives of reducing poverty and promoting sustainable agriculture. The timing is crucial here; we intend to approach them when they open calls for agricultural development projects, emphasizing those aimed at Sub-Saharan Africa.
3. [International Fund for Agricultural Development \(IFAD\)](#): With IFAD, our focus will be on demonstrating the potential of our project to enhance rural livelihoods. This aligns well with IFAD's mission of transforming rural economies. We will be on the lookout for IFAD's calls for proposals in agricultural development and rural transformation, aiming to apply during these periods.
4. [Deutsche Gesellschaft für Internationale Zusammenarbeit \(GIZ\)](#): Our strategy for engaging with GIZ revolves around highlighting the sustainable development aspects of our project, especially its economic and environmental benefits. We plan to connect with GIZ during their funding cycles, particularly those focused on agricultural and environmental projects.
5. [Foreign, Commonwealth and Development Office \(FCDO\)](#) of the United Kingdom: Regarding FCDO, we'll emphasize how our project contributes to food security and economic development, which are vital areas of focus for them. We will engage with

FCDO through their development funding programs that support agricultural innovation.

General Investor Engagement and Outreach Plan

- ***Tailored Proposals:*** Develop customized proposals for each investor, highlighting specific aspects of the project that align with their unique objectives and interests.
- ***Evidence-based Approach:*** Utilize statistics and data to substantiate the project's potential impact on nutritional improvement, economic empowerment, and sustainability. For example, reference Rwanda's nutritional and agricultural statistics to demonstrate the project's relevance.
- ***Partnership Building:*** Attend international and regional conferences related to agriculture, nutrition, and development to network with potential investors and partners.
- ***Leveraging Local Success Stories:*** Present case studies or pilot project results from Rwanda to illustrate the tangible benefits of the Initiative.
- ***Policy Alignment:*** Clearly articulate how the project aligns with Rwanda's national strategies, such as the Vision 2020 and the Strategic Plan for Agricultural Transformation, making it a strategic fit for investors interested in supporting government-aligned projects.
- ***Multi-stakeholder Forums:*** Organize or participate in forums involving government, private sector, and NGOs to showcase the project and foster collaborative partnerships.

This investment action plan, tailored to attract and engage critical investors like USAID, the World Bank, IFAD, GIZ, and FCDO, presents a comprehensive and compelling case for supporting the OFSP processing project in Rwanda. By strategically aligning our objectives with the goals of these investors and leveraging evidence-based, policy-aligned proposals, we aim to secure the support needed to significantly improve nutrition, boost economic development, and promote sustainable agricultural practices in Rwanda.

TOWARDS WINNING THE HEART OF INVESTOR USING A COMPELLING INVESTMENT STORY

Transformation Statement

We envision a future where Rwanda, aspiring to upper-middle-income status by 2035, harnesses the humble orange-fleshed sweetpotato (OFSP) as a cornerstone of its economic and nutritional transformation. The manual processing machines, *Puree Pro* and *Cut-a-Chip*, stand at the forefront of this change, bridging the gap between the technological advancements of already established OFSP value addition-oriented companies like the Carl Group, Duhange Limited, and the Urwibutso Enterprises Limited and the accessibility needs of small-scale processors in Kigali's City and other towns throughout the country.

These manual frugal innovations promise to revolutionize sweetpotato processing, offering an efficient, cost-effective alternative to electrically powered sweetpotato processing machines. While the orange-fleshed types will be prioritized because they are the only flesh type with vitamin A, we will note that these machines can process any flesh type. These machines are poised to create substantial job opportunities, especially for women and youth, in a nation with a high demand for puree just as in neighboring countries such as Kenya, where the demand is valued at over USD 5 million annually.¹

Rwanda's journey towards this transformative vision aligns with its [National Strategies for Transformation](#) and the UN's Sustainable Development Goals. These manual processing technologies embody the entrepreneurial spirit and resourcefulness required to propel Rwanda's private sector, crucial for sustaining high investment rates and accelerating growth, as highlighted by the World Bank Group's [Country Partnership Framework](#)².

Investing in these technologies is a strategic move toward a resilient, inclusive, and nutritionally secure Rwanda. Every sweetpotato processed and every job created weaves into the nation's growth narrative, heralding a future where economic prosperity and nutritional security go hand in hand.

Investors' call for action

We invite our esteemed investors - led by partners at the USAID, the World Bank, and IFAD - to join us in transforming Rwanda's agricultural landscape with our innovative manual processing machines for Orange-Fleshed Sweetpotato (OFSP). This Initiative aligns perfectly with the investors' current operational strategies and development focuses on Rwanda, specifically in enhancing agricultural productivity, supporting small and medium enterprises (SMEs), and promoting nutritional well-being.

¹ <https://cipotato.org/cip-50/innovations/orange-fleshed-sweetpotato/>

² <https://www.worldbank.org/en/country/rwanda/overview#:~:text=The%20World%20Bank%20Group%E2%80%99s%20,Intensified%20Urban%20Agglomeration>

[USAID](#) is passionately committed to boosting agricultural productivity and expanding livelihoods in Rwanda. Their expertise and partnership will be invaluable in scaling this project, significantly leveraging their successful Feed the Future initiatives.

The [World Bank Group](#)'s focus on improved human capital and private sector development resonates with our goal of creating job opportunities and empowering local entrepreneurs through this innovation. The Bank's infrastructure and agricultural commercialization support will be a cornerstone of this project's success³.

[IFAD](#)'s investment focus on sustainable agricultural productivity and the development of climate-resilient export value chains aligns with our aim to add value to OFSP and generate employment in rural areas. For instance, their [Agribusiness Capital Fund \(ABC\)](#) offers a perfect platform for collaboration, providing loans and equity investments tailored to the needs of rural SMEs, farmers' organizations, agri-entrepreneurs, and rural financial institutions.

We propose to engage with our esteemed investor partners through briefings, face-to-face discussions, and field visits to highlight the tangible impacts of our project and discuss potential collaborations. Our project addresses a crucial nutritional need in Rwanda and opens avenues for economic empowerment and job creation, especially among women and youth. The investors' partnership in this venture will contribute to Rwanda's development and set a precedent for agricultural innovation and sustainability in Africa.

³ <https://documents1.worldbank.org/curated/en/645111594605654868/pdf/Rwanda-Country-Partnership-Framework-for-the-Period-of-FY21-FY26.pdf>

TOWARDS WINNING THE MIND OF THE INVESTORS

The Economic Potential of OFSP Processing Using Manual Machines

The *Puree Pro* and *Cut-a-Chip* machines are at the forefront of the OFSP processing revolution, offering significant financial potential. A detailed industry study, including cost-benefit analyses of investing in the machines at six small-scale baked and fried products processing enterprises, reveals return on investment (ROI) potentials ranging from 59% to an astounding 3000%, with payback periods from as short as one month to two years even with the manual processing equipment cost included (refer to Annex B for details). Notably, small-scale mandazi processors using these machines for an OFSP-Mandazi recipe could save 17% to 42% of ingredient cost by substituting 40% of wheat flour with OFSP puree. In addition, it would take approximately one third less time and less physical effort to prepare 10 kg of slightly boiled fresh OFSP roots into puree or raw chips.

However, the initial cost of these machines - USD 1100 for the *Cut-a-Chip* and USD 750 for the *Puree Pro* - represents a sizable portion of the total initial investment, 89%, and 58%, respectively, among the interviewed small-scale enterprises. The high cost of the machine could hinder their adoption of the machines. To address this, a proposed subsidy reduces the cost of each machine to USD 250, bringing down the investment percentage to a more manageable 65% and 36%, respectively. Alternatively, a financing mechanism through a bank or other entity would need to be arranged. This strategic move not only enhances accessibility for small-scale processors but also shortens the payback period, making it a highly attractive investment opportunity.

Enhancing Agricultural Productivity and Household Income

The processing of OFSP roots is perfectly aligned with Rwanda's Vision 2050, transitioning from traditional subsistence farming to technology-intensive commercial agriculture. This transition is more than a technological leap; it is a direct pathway to enhancing agricultural productivity and household income. Enhanced market opportunities from OFSP processing will incentivize farmers to invest in improving their agricultural practices. The existing yield gap in sweetpotato cultivation in Rwanda as in other sub-Saharan African countries, particularly about a 10-fold yield difference between subsistence (6-12 tons/ha) and commercial producers in South Africa (producing 70-90 tons/ha), highlights significant potential for growth. As farmers gain access to profitable markets - owing to the envisioned widespread growth of small-scale OFSP processing in the cities and small towns - they will be nudged to invest more in quality seeds, locally adapted improved varieties, and adopt improved agronomic practices. This is expected to not only bridge the yield gap but also ensure a steady supply of quality produce for processing. Therefore, the integration of OFSP in Rwanda's broader agro-processing sector is a strategic move, reflecting the country's commitment to economic diversification and sustainability. It underscores the potential of the agricultural sector to transition from a subsistence level to a more commercially viable and technology-driven enterprise, thus contributing to increased household incomes and overall economic resilience.

Moreover, all classes of farmers can produce sweetpotato. Aggregating output from the smallest producers will be critical to ensure their market inclusion.

Nutritional Impact and Social Transformation

The OFSP processing initiative goes beyond economic metrics, delving into nutritional enhancement and social transformation. Training programs have emphasized the nutritional benefits of OFSP, particularly its high beta-carotene content, which is crucial in combating vitamin A deficiency. The integration of OFSP puree into various bakery products has improved their nutritional quality and market appeal due to the golden color of the final product. For example, OFSP baked bread retains 50% of the beta-carotene and improves the texture of the product while lowering its glycemic index and has longer shelf-life than 100% wheat flour bread⁴. In addition, the manual OFSP root processing equipment does *not* require root peeling, reducing wastage and delivering even more nutritious products. This focus on nutrition aligns with national health goals, particularly in addressing the needs of children and vulnerable populations⁵.

Engagement and Empowerment of Young Entrepreneurs

OFSP processing has also catalyzed entrepreneurial spirit among Rwanda's youth, with youth run companies such as the CARL Group making OFSP bread and other products. With an enhanced market for OFSP-based products, we expect to empower a growing number of young entrepreneurs to engage in OFSP farming and processing, exploring business opportunities in diverse products like bread, cakes, biscuits, and mandazi. This potential surge in entrepreneurial activity signifies a shift towards innovative agribusiness models, fostering economic independence and skill development among the youth. Such engagement is pivotal for the long-term sustainability of Rwanda's agricultural sector.

A Convergence of Opportunity and Impact

Investing in OFSP processing in Rwanda offers a unique convergence of financial opportunity and socio-economic impact. It aligns with national development strategies, promising substantial returns while contributing to agricultural innovation, food security, and nutritional improvement. At its proof-of-concept stage, this venture stands as a catalyzer of transformative change, setting a precedent for sustainable, nutrition-focused agricultural practices in the region. Stakeholders in this Initiative are investing in a financially sound venture and becoming part of a more significant movement towards a sustainable and diversified agricultural future in Rwanda.

Investing in manual Orange-Fleshed Sweetpotato (OFSP) processing in Rwanda is not just a financial venture; it's a step towards achieving broader socio-economic goals. This investment aligns with Rwanda's national development strategies, offering significant returns while fostering agricultural innovation, enhancing food

⁴ Wanjuu C, Abong G, Mbogo D, Heck S, Low J, Muzhingi T (2018) The physiochemical properties and shelf-life of orange-fleshed sweet potato puree composite bread. Food Sci Nutr 6(6):1555–1563. <https://doi.org/10.1002/fsn3.710>.

⁵ <https://cipotato.org/research/sweet-potato/towards-increased-utilization-orange-fleshed-sweetpotato/>

security, and improving nutrition. At its core, this project is a pioneering effort in sustainable, nutrition-focused agriculture in the region.

Currently, the project is at the proof-of-concept stage, with five equipment units being tested by a diverse group of small-scale agro-processors. These processors are utilizing the equipment to produce OFSP puree for mandazi (a local donut) and OFSP chips, demonstrating the versatility and potential of the technology. The proposed budget for expanding and popularizing this technology is USD 3,313,460 (see Table 1). This investment aims to scale up the Initiative, ensuring that small-scale entrepreneurs across various contexts are equipped and motivated to procure these machines and expand the processing of OFSP-based products throughout the city. The investment covers a range of activities, including trader and consumer capacity building, essential for successfully adopting the technology. During this period, we would actively explore local manufacturing capacity within the East African region. We will initially target markets in Kigali, the capital, Musanze in the Northern Province, Muhanga and Huye in the Southern Province, and Karongi in the Western Province.

With this investment, the project aims to move the innovations to a high level of scaling readiness within a 5-year timeframe in Rwanda. This progression signifies a shift from proof-of-concept to widespread adoption and impact, marking a significant milestone in Rwanda's agri-food sector. Investors in this Initiative will not only see financial returns but will also be contributing to a sustainable and diversified agricultural future in Rwanda, positively impacting countless lives through improved nutrition and economic opportunities.

TABLE 1: PROPOSED PROJECT BUDGET

#	Activity	Quantity	Years	Unit Cost (USD)	Total Cost (USD)
1	Procurement of promotional manual equipment for OFSP puree production				
2	Cut-a-Chip machine	100	1	1,100	110,000
3	Puree Pro machine	100	1	750	75,000
4	Installation and equipping the machines with Stainless steel bowls and a supporting table	200	1	125	25,000
5	Training and capacity building for small-scale agro-processors				
6	Training workshops on OFSP puree production and product development	10	1	10,000	100,000
7	Training materials and handouts	200	1	50	10,000
8	Demonstration and promotion of OFSP puree-based baked/fried products and OFSP puree crisps and chips				
9	Demonstration events and tastings	20	1	5,000	100,000
10	Promotional materials (brochures, posters, etc.)	5,000	1	50	250,000
11	Monitoring and evaluation				
12	Data collection and analysis	2	1	35,000	70,000
13	Evaluation reports	2	1	5,000	10,000

14	Staff cost				
15	Salaries and benefits for project staff	5	5	50,000	1,250,000
16	Implementation partners cost				
17	Consulting fees for implementation partners	2	5	60,000	600,000
18	Vehicle procurement				
19	Purchase of 3 vehicles	3	1	30,000	90,000
20	Vehicle mileage and administration overhead costs				
21	Vehicle mileage reimbursement	2	5	12,500	125,000
22	Contingency fund				43,500
	Sub-total Direct Costs				2,858,500
23	Administration overhead costs (16%)				454,960
	Total				3,313,460

CONCLUSION

For investors seeking a promising opportunity in Rwanda's agri-food sector, this Investment Action Plan for manual OFSP processing equipment stands out as a strategic and impactful choice. The plan's focus on OFSP, a nutrient-rich crop crucial for addressing vitamin A deficiency, aligns with significant health and economic benefits. Key to this Initiative is the cost and time efficiency of manual processing equipment. Compared to mechanized alternatives, manual processing reduces ingredient costs by 17 to 42%, a crucial factor in a sector dominated by smallholder farmers. This affordability enhances the project's scalability, making it accessible to a broader range of producers, especially women and youth.

The cost-benefit analysis reveals compelling figures. With a modest initial investment, the projected increase in productivity and sales of OFSP products could yield a return on investment of around 25% within the first two years. This is underpinned by the potential reduction in production costs and the expected growth in the OFSP market, driven by increasing awareness of its health benefits.

The total budget for the project is strategically set, considering the socio-economic context of Rwanda and the need to make the innovations ready for scaling. By investing in this plan, investors tap into a growing market with promising returns and contribute to a broader social impact. This Initiative promises to empower local communities, focusing on including women and youth, which is crucial for sustainable development.

In conclusion, these OFSP processing investments offer more than just financial returns; they present an opportunity to be part of a transformative impact in Rwanda's agri-food sector. Beyond commerce and income, this solution will also help eradicate the longstanding misconception about sweetpotato as a "poor man's crop." With each bite of nutritious OFSP bread, mandazi, cakes, crisps, and chips, hearts will open, and minds will be transformed. Sweetpotato will rise as a symbol of resilience, a crop that sustains not just bodies but an entire community's spirit. The stigma will crumble, replaced by a collective embrace of its significance in nurturing livelihoods, fueling health, and offering sustenance to all.

Investors are invited to join this journey towards economic growth and social upliftment, leveraging agriculture for a healthier and more prosperous Rwanda.

Annex A. Scaling Readiness Analysis for Innovation Package Using Manual Sweetpotato Processing Machines

Principle outcome for innovation package		Improved Incomes (Processed Product)	
Key target group(s)		Micro and Small scale Processors	
Countries where deployed		Rwanda	
Number of innovations within the package		14	
Gender-responsive innovation package components	Core or Complementary	Readiness	Use
1.0 New OFSP-adapted varieties acceptable to consumers, bioavailability confirmed	Complementary	9	8
2.0 Training package on good agronomic and post-harvest practice	Complementary	8	8
3.0 Network of primary and tertiary planting material multiplication	Complementary	8	8
4.0 Business-oriented root enterprises	Complementary	6	3
5.0 Demonstration of varietal performance in puree, crisps & chips production	Complementary	8	4
6.0 Suitability of the Manual puree making and chipping machine	Core	3	2
7.0 Access of small-scale processors to the manual machines	Core	0	0
8.0 Select cost-effective and environmentally acceptable packaging and supplying companies	Complementary	2	0
9.0 Marketing and demand creation for the manual machines	Complementary	4	1
10.0 Training small-scale processors on how to use manual machines	Core	4	2
11.0 Training small-scale processors on how to produce SP value-added products	Core	4	2
12.0 Product (puree, crisps & chips) for commercialization	Core	3	2
13.0 Laboratory services for confirming vitamin A levels of products	Complementary	9	7
14.0 Nutrition awareness/demand creation campaign on the processed SP products	Complementary	8	4
15.0 Government policy supports biofortification	Complementary	9	5
SCALING READINESS SCORE (LOWEST READINESS SCORE X LOWEST USE SCORE)		0	
AVERAGE SCALING READINESS SCORE (AVERAGE READINESS SCORE X AVERAGE USE SCORE)		20.9	

Annex B: Report on the Economic Feasibility Study of Manual OFSP Processing Machines in Rwanda

Introduction

The Rwandan small-scale baked and fried products processing sector is witnessing the introduction of the *Puree Pro* and *Cut-a-Chip* machines, designed for processing Orange-Fleshed Sweetpotato (OFSP). We set out to do an economic feasibility study of the manual machines in the context of small-scale OFSP processing into crisps, chips or mandazi in the suburbs of Kigali City and other towns in Rwanda. This brief report presents the findings from a comprehensive industry study that analyzed the economic benefits and costs of these machines in five small-scale enterprises.

We used semi-structured questionnaire to elicit production cost and sales data from 6 small-scale snack processing enterprises identified in Kigali City, Eastern, and Northern provinces. Two of the enterprises (Igihozo and Dusangire) currently produce crisps using the portable hand-held slicer, while the other four (Appetina, Didier, Stafford Coffee, and Hitimana) are all mandazi producers who could use the *Puree Pro* machine to produce OFSP puree to be integrated into their product line and produce OFSP puree-Wheat flour mandazi. The report excludes data from one enterprise, Hitimana, a mandazi processor, due to challenges with verifying some cost data after the physical interview. Thus, the report focuses on the five enterprises whose data were verified. We also conducted experiments to establish the efficiency of the *Puree Pro* and *Cut-a-Chip* machines compared to current practice or related alternatives.

Machine Overview

1. *Puree Pro* Machine (currently sold at USD 750) (Figure B1) is used for making puree without peeling steamed roots.



FIGURE B3: A PUREE PRO MACHINE INSTALLED ON A TABLE

-
- A stainless steel meat slicer is mounted on a stand in a tiled room. The slicer has a large, flat stainless steel table with a lower shelf. The slicer itself is mounted on the right side of the table, featuring a vertical blade and a handle. The room has white tiled walls and a tiled floor.

Machine alternatives

A collection of various kitchen grating tools, including a large clear plastic grater, several small green and white graters, and a white handheld grater, all arranged on a dark surface.

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Manual mashing of steamed roots into puree by hand is the alternative for making OFSP puree using the *Puree Pro* (Figure B4). However, it is tedious and quite time-consuming and delivers puree of poor quality due to the uneven texture, and often the presence of lumps. An effort to improve the smoothness of the puree while using hand mashing would mean peeling the roots and steaming the roots for an extended period (Figure B5). These would lead to losses in quantity and some of the nutritional quality of the puree.



FIGURE B6: MANUAL MASHING OF SLIGHTLY STEAMED SWEETPOTATO ROOTS BY HAND INTO PUREE



FIGURE B7: HAND MASHED UNEVEN-TEXTURED PUREE IN THE FIRST FRAME AND SMOOTH EVEN-TEXTURED PUREE FROM PUREE PRO MACHINE IN THE SECOND FRAME



The other alternative to *Puree Pro* machine is using **an electric mixer** (Figure B6), which demands a stable supply of electricity and has a high installation and maintenance cost.



FIGURE B8: A 20L CAPACITY ELECTRIC MIXER SOLD AT USD 493

Detailed Enterprise Analysis

The study included detailed analyses of the six enterprises: Igihozo, Dusangire, Appetina, Didier, and Stafford Coffee. Each enterprise presented unique financial dynamics, which were carefully examined. The report includes granular data such as Net Present Value (NPV), Payback Period (PBP), and Discounted PBP under both the original and subsidized cost scenarios. The following assumptions were made when doing financial forecasting over 10 years:

1. **Sales Growth:** Sales remain the same as estimated together with the entrepreneur in the current year. Further, in the subsequent years, sales are expected to grow by an average of 10% annually, reflecting increasing customer acceptance of OFSP products.
2. **Cost Increment:** Costs, starting from Year 1 projections, are expected to increase by 5% annually, accounting for factors like competition and inflation.
3. **Market Skepticism and Marketing Expenses:** Initial skepticism towards OFSP products necessitates higher marketing expenses in Year 1.

Details about the enterprises and the granular financial results from the cost-benefit analysis are broken down by enterprise in Table B1.

Table B2: Enterprise Profiles and Cost-Benefit Analysis Results

Business name	Igihozo	Dusangire	Diedier	Stafford Coffee	Appetina
Location	Kigarama, Kigali City	Kanombe, Kigali City	Kyuvu, Musanze, Northern	Kayonza, Eastern province	Musanze, Northern Province
Product	OFSP-Crisps	Yellow-SP Crisps	OFSP Mandazi	OFSP Mandazi	OFSP Mandazi & Buns
Already using manual machine	No	No	No	No	Yes
Already using OFSP roots	Yes	Sometimes	No	No	Yes
Setting	Home production; purchases made at home	Home production; distribute to mini-super-markets, also produce potato and banana crisps	Produce in a small shop in a small, distribute to local shops and sell openly at the shop.	Home production; sell at the coffee shop near a petrol station to locals and people in transit.	Kitchen is within the school complex; sell to students and teachers of the Wisdom Group of Schools (primary and secondary boarding school) on a daily during school days (8 months a year)
Output per day	60 packets	85 packets	750 pieces	50 pieces	320 pieces
% Wheat flour to be replaced by puree	n/a	n/a	40%	40%	43%
% change in daily ingredient cost if 40% wheat flour replaced with puree*	n/a	n/a	17%	42%	n/a
Daily operating profit margin	24%	37%	57%	38%	36%
Total initial investment including the cost of manual OFSP processing machines	USD 1,213	USD 1,255	USD 922	USD 1,126	USD 2,964
Current cost of the manual machines as share of total initial investment cost**	91%	88%	81%	67%	25%

Business name	Igihozo	Dusangire	Diedier	Stafford Coffee	Appetina
Location	Kigarama, Kigali City	Kanombe, Kigali City	Kyuvu, Musanze, Northern	Kayonza, Eastern province	Musanze, Northern Province
When they purchase the machines at the current prices USD 1100 (Cut-a-Chip) and USD 750 (Puree Pro)					
NPV	USD 5,818	USD 28,631	USD 236,756	USD 20,744	USD 67,245
PBP	1 yr 8.3 mos	3.7 mos	1 mo	4.8 mos	3 mos
Discounted PBP	2 yr 1.4 mos	4.4 mos	1 mo	5.7 mos	4 mos
IRR	78%	338%	3663%	267%	363%
When the prices of the machines are subsidized to USD 250					
NPV	USD 6,385	USD 29,197	USD 237,089	USD 21,078	USD 67,578
PBP	8 mos	1.2 mos	1 mo	2.7 mos	3 mos
Discounted PBP	9.4 mos	1.4 mos	1 mo	3.2 mos	3 mos
IRR	185%	996%	7976%	460%	435%

*Analysis involved adjusting the mandazi recipes to OFSP-wheat-based mandazi recipes developed by Mr. Antonio Magnaghi of Euro Ingredients and shared with a section of the traders in a few field demonstration events. Changes in daily ingredient cost reflect the changes in cost between their current recipe without the OFSP puree and the new recipe which integrates OFSP puree into the mandazi.

**Small-scale snack business is a very low capital venture, and the current cost of the machines averages 66% and 89% of the total initial investment costs which could be a great hindrance to uptake. Subsidizing the manual machines costs will therefore be a great intervention to drive adoption.

Findings

Economic Benefits of the Puree Pro and Cut-a-Chip machines over the alternatives.

Time and effort saving. Results from an experiment revealed that it takes 1 hour to make puree out of 10 kgs of slightly steamed, non-peeled OFSP roots using the *Puree Pro* machine and 1 hour 30 min when mashing by hand. Thus, using the *Puree Pro* machine reduced production time by 33% and delivered better quality puree.

On the other hand, an experiment on slicing 10kg of slightly steamed OFSP roots into crisps revealed that it takes 40 min using the *Cut-a-Chip* machine and 1 hour using the handheld slicer. Again, the Cut-a-chip machine reduced the time taken to prepare the crisps by 33%.

Foregone service cost of electric machines. Using a very low-capacity electric mixer would need power installation cost and a reliable machine requires a 3-phase electricity installation, a monthly power cost of at least USD 1.5 per month and an annual machine maintenance cost of approximately USD 41. A user of the manual *Puree Pro* machine does not incur any electricity installation and operation costs.

Financial Potential and Efficiency Analysis

The study revealed a range of Return on Investment (ROI) potentials for these machines, varying from 59% to as high as 3000%. Clearly, these figures represent a spectrum of possible outcomes based on the data collected from the participating enterprises. There are major economic benefits to producing more units per day.

Regarding payback periods, the study found that they could be as short as one month, extending up to two years. This range is contingent upon several factors, including the scale of operation and market dynamics.

In the context of mandazi processors, the study suggested that substituting wheat flour with OFSP puree could lead to ingredient cost savings between 17% and 42%. Additionally, the machines reduce the time and physical effort required to prepare OFSP by about 33%. However, these figures may vary based on the specific conditions and practices of each enterprise.

Initial Cost Considerations

The initial investment cost is a critical aspect of the study. The *Cut-a-Chip* machine is priced at USD 1100, while the Puree Pro machine costs USD 750. These costs represent a substantial portion of the total initial investment for the enterprises studied, ranging from 58% to 89%.

To address the potential financial barrier posed by these costs, a subsidy that reduces the price of each machine to USD 250 for instance would lower the investment percentage to 65% and 36% for *Cut-a-Chip* and *Puree Pro*, respectively. This proposal could make the machines more accessible to small-scale processors. In addition, considering alternative financing through banks or other entities could facilitate the adoption of these machines by easing the financial burden.

Challenges faced by the enterprises include:

1. **Capital Constraints for Expansion:** One of the most heartfelt challenges shared by these businesses is the struggle to find enough capital for expansion. Most have a vision of where they want to go – more production, wider markets – but there is a financial gap they just can't bridge. This isn't just about numbers; it's about dreams being put on hold.
2. **High cost of quality processing equipment:** Another hurdle that comes up often is how expensive good quality processing machines that meet modern food safety standards are. For these enterprises, it is like knowing the key to efficiency and better products is out there, but again the access to finance to overcome the barriers is a major problem and truly a barrier to their aspirations of excellence.
3. **Limited OFSP Root Availability and Accessibility:** Regular reliable supply of enough OFSP roots seems to be a consistent headache. For instance, Dusangire opted to work with the yellow-fleshed sweetpotato due to the scarcity of the OFSP roots. The Igihozo team gets their OFSP roots at RWF 700 - RWF 800 per kg on an order basis from one trader. However, the white-fleshed varieties, lacking in pro-vitamin A, are trading at RWF 400 – RWF 600 per kg and are sold by many traders in their local market. It's not just about lack of availability; it's also how hard it is to get these roots

consistently. This challenge speaks to a deeper need for stability and predictability in their operations.

4. **Limited Knowledge of Business Formalization and Quality Certification Processes:** The small-scale processors reported that they are often confused concerning business registration and do not know how to approach getting the Rwanda Standards Board (RSB) mark of quality. Their negative image of how steep the bureaucratic hurdles and regulations may be often leads them not to pursue more formal market linkages, for example with supermarkets. This limits their customer base to those who do not need more assurance of the products quality and safety.

Conclusion

The study's findings suggest that the *Puree Pro* and *Cut-a-Chip* machines have the potential to significantly impact the efficiency and cost-effectiveness of OFSP processing in Rwanda. However, it's essential to consider the variability in the results, which could be influenced by factors such as enterprise size, market conditions, and operational efficiency. The proposed subsidy and alternative financing options are potential pathways to mitigate the high initial cost, but their actual implementation and impact would require further analysis and validation. These findings offer insights into the machines' capabilities and economic implications but should be considered within the context of the specific conditions of each enterprise and the broader market environment.



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