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NARO STRATEGIES TO ENSURE CONTINUED DEVELOPMENT AND UPTAKE OF NUTRIENT-RICH FOOD IN UGANDA.

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Acronym

<i>CIAT</i> International Center for Tropical Agriculture	<i>MAAIF</i> Ministry of Agriculture, Animal Industry and Fisheries
<i>CIMMYT</i> International Maize and Wheat Improvement Center	<i>MDAs</i> Ministries, Departments and Agencies of Government
<i>CIP</i> International Potato Center	<i>NAADS</i> National Agricultural Advisory Services
<i>CGIARs</i> Consortium of International Agricultural Research Centres	<i>NAGRIC &DB</i> National Animal Genetic Resources Centre and Data Bank
<i>CSOs</i> Civil Society Organizations	<i>NARO</i> National Agricultural Research Organisation
<i>EGS</i> Early Generation Seed	<i>NGOs</i> Non-Government Organisations
<i>IITA</i> International Institute of Tropical Agriculture	<i>R&D</i> Research and Development
<i>ILRI</i> International Livestock Research Institute	<i>OWC</i> Operation Wealth Creation

Introduction

National Agricultural Research Organisation (NARO) is a Government Agency under the that has a mandate to coordinate guide and oversee research in areas of agriculture, fisheries, forestry and livestock sub-sectors. In order to contribute to agricultural transformation, Under the National Development Plan (NDP III), NARO has focused its efforts to contribute to the following four Programmes: Agro-industrialisation; Natural Resources, Environment, Climate Change, Land and Water Management; Innovation, Technology Development and Transfer; and Regional Development. NARO strive to maintain a sustainable and client-driven research and innovation system that aims to achieve the following four strategic results: increased niche markets for communities in agricultural sector; increased research products and services suited for industry; increased use of improved agricultural technologies and innovations by communities; and institutional orientation to agricultural transformation. Most importantly, NARO has made significant progress in the biofortification and dissemination of Uganda's food staples. These advancements have great potential to enhance household nutrition and improve agro-industrial capabilities, thereby facilitating import substitution.

Strategies to support development and uptake of nutrient-rich food

NARO has contributed to unlocking the nutrition's potential, and enhancing nutrition security, of Uganda by implementing strategies to support the food systems, climate resilience and agro-industry. Efforts have

included research and development; capacity building; technology promotion and transfer; marketing, policy advocacy and support, monitoring and strategic partnership.

Strategies for Food Systems

In the past, agricultural **research and development** (R&D) targeted increasing production and productivity (Olum et al., 2020). The NARO Strategic Plan (2018-2027) provided strategies to support the food system by generating nutrient-enriched crop varieties to enhance *nutrition and food security* and contribute to *import substitution*. NARO is therefore undertaking continuous research through participatory breeding and adaptive trials to generate biofortified crops. Biofortification is the process of increasing the essential micro-nutrients content in the staple foods (Olum et al., 2020). It is one of the food approaches to increase micronutrient intake by individuals or households, and is considered more affordable and accessible by the rural people than the other three options (food fortification, nutrient supplements, or compositing). Vitamin A deficiency is the leading cause of preventable childhood blindness. Highest prevalence in Uganda was recorded in 2011 at 33% (UBOS, 2012) but it has reduced to 5% in children below the age of 5 years and 0.5% in women (USAID Advancing Nutrition, 2023). NARO has contributed to this reduction by developing over ten food crop varieties with higher pro-vitamin A including (9) orange-fleshed sweet potato, (2) maize, (1) cassava, and (1) banana. Iron deficiency causes morbidity and mortality due to Anemia in children and women of reproductive age. Nutritional-caused iron deficiency was found in 14% of children and 7% of women (UBOS and CDC, 2020). NARO has generated at least seven (7) beans, (2) millet and (1) rice varieties with higher Iron content. Phytochemicals such as Anthocyanins help boost the immune system thus protecting the body against viral infections (Nyero et al., 2023). NARO has generated purple-fleshed sweetpotato and R&D is underway to profile the phytochemical and antioxidant properties of our food crops such as fruits, vegetables and legumes. Protein-energy malnutrition (PEM) defines to a group of disorders associated with low protein intake such as marasmus and kwashiorkor. According to a UNICEF (2023) *“only 15 per cent of 6-month to 2-year-old children in Uganda consuming the minimum acceptable diet, as measured by diversity and frequency.”* NARO is contributing to increasing this percentage by generating higher proteins varieties for beans, soybean and ground nuts. All the above work has been achieved by collaborating with local and international research institutions such as CGIAR centers and local and international universities to access a broader pool of expertise, resources, and genetic materials.

NARO is tapping in new breeding techniques and modern biotechnology such as marker-assisted selection, genetic engineering, and gene editing to enhance the nutrient content and agronomic performance traits of crops. For example enhancing pro-vitamin content in banana; addressing pests and disease challenges such as Banana Bacterial Wilt and Bunchy Top virus, cassava brown streak virus, potato blight, bean root rots and anthracnose diseases to mention a few (Zawedde et al., 2018; Nkalubo et al., 2023). Using these techniques, crop varieties have been developed that are resistant to diseases, and tolerant to pests and environmental stresses. Such techniques are tapped into to address emerging and difficult challenges where conventional breeding methods and management practices are not likely to be effective. NARO has worked with local and international universities and research centers to access the techniques, tools, expertise and other resources to accelerate research and development.

Animal protein is a common component of a balanced diet. In Uganda at least 3.9 million households (58% of the population) own livestock such as poultry, cattle, goats, pigs or sheep (FAO, 2019). NARO has supported increased consumption of animal protein by introducing exotic cattle breeds with higher milk

such as Jersey and beef production traits such as with enhanced beef traits, such as improved marbling for tenderness, juiciness, and flavor. These breeds also exhibit better muscle conformation for size, shape, and distribution of muscles, faster growth rates, and greater feed efficiency. These efforts have contributed to the improvement the local cattle breeds. Research and development has also focused on improving productivity of climate resilient livestock breeds such as the locally adapted chicken and goats. Karahari goats were also introduced to improve the climate resilience of the farmers preferred breeds such as the Mubende goat and also for the drought prone areas with the Karamoja, Teso and Lango sub-regions. Livestock R&D has also focused on animal feeds formulation improvement and management of associated contaminations; addressing major pests and diseases challenges through vaccines development such as the Anti-tick vaccine, Foot and Mouth disease vaccine to mention a few.

Fish is a high protein and micro-nutrients plus low- fat food that is also considered a white meat. In Uganda, it is the main source of animal protein for over 10.2 million people (29%), and at least 3.2 million people depending at least partially on fisheries for livelihood (FAO, 2023). R&D efforts are underway to improve performance of locally adapted fish species such as the Nile Tilapia, Catfish, Angara and Pelagic fish like Mukene. Sixty percent (60%) of the people involved in small-scale fisheries are women and majority are involved in increasing the shelf life of the fish through value addition.

Urban population in Uganda increased to 12.36 million in 2022, which is consistent over 5.5% annual increment observed in the past 5 years (World Bank, 2022), and population is expected to increase to 21 million by 2040. Urban agriculture, semi-intensive and intensive animal production, aquaculture techniques are also under research and development to boost production plus access to diverse and highly nutritious foods in urban areas and settlements with highly fragmented land tenure systems. To boost climate resilience, production of indigenous and locally adapted crops such as fruits and vegetables, agroforestry trees, livestock breeds and fish species are prioritized in R&D. These technologies also reduce postharvest contamination of food that occur during transit and due to prolonged storage in the markets (Baguma et al., 2023).

Nutritional postharvest losses during home-cooking and commercial processing is very common in Uganda due to poor processing and storage conditions. For example loss of provitamin A in sweetpotato and animal protein in beef due to high temperature and prolonged cooking. Wastage of food through dumping is another global environmental, social, and economic challenge (<https://www.epa.gov/land-research/food-waste-research>). Future R&D strategies will support the food systems by generating technologies to improve post-harvest handling, processing and recycling of the above nutrient-rich foods. To reduce cooking time for beans, NARO, in collaboration with partners, is developing fast-cooking beans enriched with essential micronutrients such as iron and zinc.

Strategies for Agro-industry

The 2011 Food and Drugs (Food Fortification) (Amendment) Regulation made compulsory the fortification of manufactured food products starting with maize and wheat flours, salts, and edible oils and fats with essential vitamins and minerals (USAID, 2023). NARO supported the agro-industry by continuous research to generate products and by providing compositional analysis services NARO has generated prototypes of value added products that are/will be used in confectionary, beverages, breweries and pharmaceutical industries such as colorants from orange- and purple-fleshed sweetpotato; biofortified flour from banana, beans, cassava, maize, millet, rice, sweetpotato; wine for the brewery industry from purple-fleshed sweetpotato; banana and cassava starch, precooked bean product that can be re-cooked within 25-40

minutes, avocado and fish oil. The National Agricultural Research Laboratories in Kawanda and the Bio-analytical facility in Namulonge provide services for nutrient profiling and biochemical compositional analysis. NARO works with food processors, retailers, and food service providers to develop and test these value-added products plus innovative recipes that incorporate nutrient-rich ingredients.

These nutrient-rich products generated by NARO can contribute to increased import substitution by replacing some of the biofortified ingredients imported by the agro-industry in Uganda. For example, the precooked bean that can be re-cooked in a short amount of time (25-40 minutes), offers a convenient and nutritious option that substitute imported canned beans, flour and starch processed from nutrient dense cassava, sweet potatoes, banana and rice can reduce the need for imported wheat and other starch products.

Promotion and Marketing strategies

NARO undertakes awareness and promotion campaigns about all the nutrient rich crop, livestock and fish products mentioned above. Various media channels are used such as radio, television, newspapers, social media and other online platforms to reach wider audience. Exhibitions and community events are used to boost appreciation through the *seeing- is-believing* approach. These campaigns highlight the importance of consuming and incorporating nutrient-rich foods into daily diets to prevent micronutrient deficiencies and promote overall health. Recently, NARO is working with Makerere University Artificial Intelligence Laboratory to tap into ICT technologies that enrich and broaden the awareness and training interventions such as interactive Apps and platforms with information translated in different popular languages.

NARO through its Commercialization Office, and the business arm NARO Holdings Limited, have worked with private sector to develop marketing strategies that will increase the demand for the above mentioned nutrient-rich foods. Strategies involve branding, packaging, product profile and pricing strategies that make these foods more attractive and accessible to consumers.- NARO is continuously engaging private enterprises and industries to promote commercialization of the nutrient-rich value-added products and use of the available nutrient profiling services.

NARO, through its Zonal Agricultural Research and Development Institutes (ZARDIs), provide early generation seed (EGS) multiplication and outreach services to supports countrywide dissemination, higher production and consumption of the nutrient-rich varieties and breeds. An EGS production system has been established involving the National Agricultural Research Institutes (NARIs), ZARDIs and NARO Holding Limited. NARO collaborates with agricultural input suppliers, microfinance institutions, and MAAIF Extension Department, NAADS, OWC, NAGRIC &DB, Local Government politicians and officials, NGOs, CSOs, media houses, social media influencers, cultural and faith-based leaders to ensure that the resources and knowledge are accessed to ensure increased uptake and effective use of these nutrient-rich foods. For example, in Karamoja where 89% of region is reported to have critical levels of malnutrition (UNICEF, 2022), NARO with partners has worked with the above mentioned stakeholders to promote effective production and consumption of Iron-rich bean, millets and their products.

Youth unemployment in Uganda declined to 4.47% in 2023 (World Bank, 2024). NARO has contributed to this decline by carrying out awareness and training programs for youth on the importance of nutrient-rich foods, effective production and consumption as well as value addition to prolong shelf-life and for income generation. These programs include internships, mentorships and projects supervisions, school visits,

study tours, and providing incubation services. The programs are designed to provide a holistic package from production, post-harvest handling to value addition. NARO supported by USAID Feed the Future Project (FTF) are conducting Annual Youth Nutrition Apprenticeships, where the youth are trained on the production of the nutritious commodities and given starter seed to plant on a competitive basis and continuous technical back stopping. These youths are expected to be agents of change in their communities by sensitizing and recruiting members to produce and consume nutritious commodities.

NARO is supporting policy advocacy and implementation by working closely with MAAIF to engage policymakers, legislators, and government officials to prioritize nutrition-sensitive agriculture in national policies, strategies, and investment plans such as the *School feeding program* and the *Parish Development Model*. NARO provides evidence-based recommendations and technical assistance to inform policy decisions and ensure that they are aligned with nutrition objectives. NARO's monitoring and evaluation (M&E) systems are used to track the adoption of nutrient-rich food varieties and to obtain feedback at the household, community, and national level. NARO collaborates with government agencies, research institutions, and development partners to establish monitoring frameworks and indicators for tracking progress towards nutrition objectives.

In order to effectively implement the above strategies, NARO has established strategic partnerships and collaboration to support development and uptake of nutrient-rich foods. In addition to investment by Government of Uganda, NARO receives funding from various development partners including USAID under the Feed the Future (FtF) Agriculture Research Activity, Uganda; European Union especially the Development Initiative for Northern Uganda (DINU): Chase Hunger and Poverty project; JICA under the PRIDE Rice project; KOICA under the KOPIA and VegeSeed project to mention a few. NARO works in partnership with regional research networks, agricultural universities, and CGIAR centers including Africa Rice, CIAT, CIP, CIMMYT, IITA, ILRI to pool resources to develop and promote the above nutrient-rich food varieties. NARO has formed alliances with other agricultural research organizations such as HarvestPlus to share best practices and resources involves networking, knowledge exchange, and joint initiatives to strengthen the capacity and impact of national agricultural research systems. NARO established partnerships with private sector companies for seed production and distribution using licensing agreements, joint ventures, and technology transfer arrangements with seed companies, agro-input suppliers, and agricultural equipment manufacturers.

Collaborations have been established with government ministries including MAAIF, Ministry of Education and Ministry of Health to integrate nutrition-sensitive agriculture into national policies involves working closely with ministries of agriculture, health, education, and finance to mainstream nutrition considerations into agricultural development programs, food security strategies, and rural development initiatives. It has also collaborated with governmental and non-governmental organizations for advocacy involves partnering with ministries of health, education, agriculture, and nutrition-focused NGOs to prioritize nutrition-sensitive agriculture in national development agendas. Joint advocacy efforts aim to influence policies, mobilize resources, and promote multisectoral coordination for nutrition improvement.

Conclusion

NARO has made great strides in implementing strategies to ensure continued development and uptake of nutrient-rich food in Uganda. These included generation of crop varieties, introduction of livestock and fish breeds that are nutrient-rich in the food systems; development of value-added prototypes of bio-

fortified ingredients and providing nutrient profiling servicing to agro-industry; capacity building, promotion and marketing campaigns about these foods and products; supporting advocacy and implementation of government policies; and monitoring and evaluation of the impact of these interventions in unlocking the nutrition's potential in the country. All these has been achieved with substantial support from Government of Uganda, Development partners, MAAIF and other MDA, local government officials and target communities. With continue financial and technical support, NARO commits to improve delivery of these strategies for enhanced nutrition security in Uganda.

Reference

1. Baguma G et al., 2023. A systemic review of contaminants of concern in Uganda: Occurrence, sources, potential risks, and removal strategies. *Pollutants*, 2023, 3 (4), 544-586.
<https://www.mdpi.com/2673-4672/3/4/37>
2. FAO, 2019. Future of livestock in Uganda: Opportunities and challenges in the face of uncertainty. Food and Agriculture Organization of the United Nations, Rome.
<https://openknowledge.fao.org/items/aa93abf7-8ead-451d-9ba3-8b2faa67d2cc>
3. FAO, 2023. The contribution of small-scale fisheries to healthy food systems in Uganda. Rome.
<https://doi.org/10.4060/cc7604en>
4. NARO, 2018. The NARO Strategic Plan 2018/19 - 2027/28 themed: "Market-Oriented Research Spurring Agro-Industrialization". National Agriculture Research organization, Entebbe, Uganda.
5. Nkalubo T. S, et al., 2024. Agronomic Performance, Stability Analysis and Evaluation of Anthracnose Disease Resistance of Common Bean Lines Derived by Marker-Assisted Backcrossing in Uganda. *Agricultural Sciences*, 2024, 15, 376-397.
<https://www.scirp.org/journal/paperinformation?paperid=132245>
6. Nyero A. et al. 2023. Phytochemical composition and antioxidant activities of some wild edible plants locally consumed by rural communities in northern Uganda. *Frontiers in Nutrition*, Volume 2023 doi: [10.3389/fnut.2023.1070031](https://doi.org/10.3389/fnut.2023.1070031)
7. Olum S. et al., 2020. Agronomic biofortification from a stakeholder's viewpoint: Evidence from studies on iodine-enriched foods in Uganda. *Vitamins and Minerals Biofortification of Edible Plants*.
https://www.researchgate.net/publication/340068640_Agronomic_Biofortification_from_a_Stakeholder%27s_Viewpoint_Evidence_from_Studies_on_Iodine-Enriched_Foods_in_Uganda
8. UBOS (Uganda Bureau of Statistics) and CDC (Centers for Disease Control and Prevention). 2020. Uganda National Panel Survey (UNPS) 2018/2019 Nutrition Module Report. Kampala, Uganda: Uganda Bureau of Statistics.
https://www.ubos.org/wpcontent/uploads/publications/11_2020STATISTICAL_ABSTRACT_2020.pdf
9. UNICEF (2023). Malnutrition in mothers soars by 25 per cent in crisis-hit countries, putting women and newborn babies at risk. UNICEF Press release, March 2023.
<https://www.unicef.org/uganda/press-releases/malnutrition-mothers-soars-25-cent-crisis-hit-countries-putting-women-and-newborn>
10. Uganda Bureau of Statistics (UBOS) and ICF International Inc., 2012. Uganda Demographic and Health Survey 2011. Kampala, Uganda: UBOS and Calverton, Maryland: ICF International Inc.
<https://dhsprogram.com/pubs/pdf/fr264/fr264.pdf>

11. UNICEF, 2022. UNICEF Uganda Karamoja Response Report, September 2022. [https://www.unicef.org/media/128496/file/Uganda-Response-Report-No.6-\(Karamoja\)-September-2022.pdf](https://www.unicef.org/media/128496/file/Uganda-Response-Report-No.6-(Karamoja)-September-2022.pdf).
12. USAID Advancing Nutrition, 2023. USAID Advancing Nutrition Uganda Fiscal Year 2021-2023. Arlington, VA: USAID Advancing Nutrition. https://www.advancingnutrition.org/sites/default/files/2024-01/usaaid-an_uganda_final_report_fiscal_years_2021_2023.pdf
13. World Bank, 2023. <https://data.worldbank.org/indicator/SP.URB.TOTL?locations=UG>
14. World Bank, 2024. Youth Unemployment Rate for Uganda [SLUEM1524ZSUGA], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/SLUEM1524ZSUGA>