



The Power of Orange: Catalyzing Delivery of Vitamin A Maize in Zambia





Executive Summary

- The HarvestPlus program of the CGIAR has worked with the International Maize and Wheat Improvement Center (CIMMYT), the International Institute of Tropical Agriculture (IITA), Zambia's Ministry of Agriculture, and crop research and seed sector partners in Zambia to develop yield-competitive hybrid varieties of vitamin A-biofortified orange maize (VAM).
- The principal aim of the VAM program is to address high rates of vitamin A deficiency in the country—particularly among children and women—and the serious health problems caused by it, including vulnerability to infections such as diarrhea, sight impairment, and poor pregnancy outcomes.
- The first three VAM seed varieties were released in Zambia in 2012, followed by another three in 2015, and five more in 2018. Successive varieties have had improved nutrition and agronomic traits.
- Production of both VAM seed and grain has been growing steadily in recent years despite logistical and economic disruptions from the COVID-19 pandemic.
- HarvestPlus is catalyzing this growth through a holistic food systems-based approach focused on commercialization of VAM. This includes capacity strengthening of national agricultural research and extension programs as well as seed and food value chain actors; raising awareness and changing behavior among farmers and consumers; and risk-sharing mechanisms to drive market development.
- A key success factor on the supply side has been a significant reduction in the time to advance from seed development to market introduction, primarily by fostering collaboration in the process between public breeding institutions and private seed companies.
- HarvestPlus also facilitated mechanisms to distribute seed and know-how to hard-to-reach farming households who are not readily serviced by commercial seed companies—for example, through women farmers' groups and school feeding programs.
- On the demand side, a variety of behavior change activities sensitized Zambians to accept and demand orange-colored maize in a market dominated by white maize, and amid negative perceptions associated with colored (yellow) maize at the time of introduction.
- In addition, effective engagement of decision makers catalyzed supportive policy and regulatory reforms, and high-level championing of biofortification.
- HarvestPlus is currently looking to accelerate VAM growth through a proven food-basket biofortification approach, which is aligned with government and funder priorities. HarvestPlus is promoting VAM in tandem with iron-biofortified bean and vitamin A-biofortified orange sweet potato (a high iron bean variety was released in 2012, while eight varieties of vitamin A orange sweet potato (OSP) have been released since 2014).
- Orange VAM and other biofortified crops are now widely accepted products and poised for scaling in Zambia, if given the right support. To achieve increased impact and long-term sustainability, more investment is needed to fully mainstream nutrient targeting in Zambia's crop breeding system, and engage more private sector actors in seed and food value chains to increase the uptake and help address malnutrition.



The Nutrition Challenge

Over half of Zambian children ages 6 months to 5 years are vitamin A deficient, a condition that increases vulnerability to infections such as diarrhea, sight impairment, and other health problems. Women of reproductive age also are susceptible to vitamin A deficiency, which can lead to poor pregnancy outcomes. Vitamin A and other nutritional deficiencies prevent children from reaching their full potential in school and beyond, which also hinders development of their communities and countries. The World Bank has estimated that productivity losses from hidden hunger in Zambia are equivalent to about 1 percent of GDP annually.

Maize is the leading staple crop in Zambia but the market is dominated by white maize, which benefits from significant market support by public authorities. However, white maize contains no pro-vitamin A (the precursor to vitamin A). Vitamin A is more commonly found in leafy green vegetables, fruits, and animal source products (such as milk, liver, and fish), but these food sources are often unavailable or unaffordable for millions of resource-constrained Zambian households.

The Biofortification Response

The HarvestPlus program of the CGIAR has contributed to the fight against malnutrition and the improvement of food and nutrition security for Zambians by providing technical assistance and strategic leadership on the development and

delivery of nutrient-enriched biofortified crops. The primary target beneficiaries are smallholder farming households, for whom biofortified crops are an affordable, accessible source of better nutrition in familiar staple foods.

VAM is also the anchor in a multi-crop HarvestPlus approach to promoting biofortification, which also includes iron bean and vitamin A orange sweet potato (OSP). The VAM program has also created new economic and livelihood opportunities for farmers and numerous entrepreneurs operating in seed and food value chains.

When consumed regularly, VAM can provide up to 50 percent of daily vitamin A requirements for children and non-pregnant women, and has been shown to be a cost-effective and safe way of improving nutrition and strengthening immune systems. Efficacy studies have shown that VAM improves vitamin A status and visual function in children, which increases their chances of achieving their potential in school. Research has also shown that consumption of VAM by pregnant or lactating mothers increases the vitamin A content of their breast milk—a potentially important nutrition boost for nursing children, especially during the critical first 1,000 days of their lives.

Meanwhile, regular OSP consumption provides between 80 and 100 percent of vitamin A requirements per day, while iron bean provides about 80 percent of daily iron needs. The latter is notable for Zambia, where an estimated 58 percent of children under five years old and 40 percent of pregnant women are anemic (iron deficiency is a leading cause of anemia).

An Ecosystem Approach

HarvestPlus has taken an ecosystem approach to catalyzing the full integration of VAM as well as iron bean and OSP in Zambia's food system, with the aim of enabling all Zambians to access and benefit from this naturally nutritious maize.

This approach is partnership-focused; HarvestPlus strengthens capacities and provides strategic and technical assistance to more than 60 partners in Zambia so far, spanning government; private seed companies; crop processors; food businesses; UN agencies; and civil society organizations involved in agriculture and nutrition interventions. Key institutional partners in this effort are the International Center for Tropical Agriculture (CIAT), the Ministry of Agriculture (MoA), the Ministry of Community Development and Social Services (MoCDSS) and the Ministry of Health (MoH).

For VAM, HarvestPlus has focused on having all elements of value chain sustainability in place and fully functioning. This means working with crop research agencies and private seed companies to ensure a reliable supply of quality VAM seed, and with extension providers, seed companies, and NGOs to educate and empower farmers on growing, harvesting, and processing VAM. It also hinges on establishing farmer linkages to post-harvest markets that include viable VAM food businesses, and a supportive enabling environment through policy engagement.

HarvestPlus works with various partners in nine provinces of Zambia to promote the cultivation and dissemination of VAM, as well as HIB and OSP. For example, under the Integrated Food Systems Approach to Build Nutrition Security project, funded by the Government of Canada, we have been responding to urgent nutritional needs triggered by the COVID-19 pandemic. We provide technical support, biofortified crop inputs, capacity strengthening, and market linkages for tens of thousands of smallholder farming households—many of which are led by women.

We also prioritize reaching particularly vulnerable communities in Zambia who can benefit most from biofortified products but may not have the means to access these products commercially. For example, under the same Canada-funded project—in

partnership with UN organizations and a woman-run food business—we are reaching refugee and host communities with training and farm inputs, as well as providing market linkages for them.

Drivers for a VAM Delivery System

Above all, sustainable VAM delivery hinges on ensuring that farming households and other actors are enabled and incentivized to participate in the VAM value chain. Importantly, HarvestPlus and partners were able to lead development of VAM varieties that perform as well if not better than non-biofortified maize varieties in certain growing environments in Zambia—in terms of yield, drought tolerance, and other traits demanded by farmers—in addition to the plant's nutritional value.

VAM has to be a viable product from a farmer and consumer perspective—and this is being born out in research conducted in Zambia. Farmer-focused studies show a high level of satisfaction with VAM varieties' agronomic traits in comparison to non-biofortified varieties, particularly in terms of relative yield, early maturity, drought tolerance, cob size, and cob fill. Research on foods made with VAM elicit high grades from consumers on the important factors of taste, texture, and aroma in comparison to foods made with white maize; consumers are also willing to pay more for VAM foods than white maize alternatives. However, more investment is needed to fully realize VAM's potential in Zambia.

Key drivers of developing a delivery system:

Capacity Strengthening: The priority objective of all HarvestPlus activities in Zambia is to make biofortification self-sustaining through the full empowerment of a range of relevant national partners. HarvestPlus crop research and development experts are working hand in hand with the **Zambia Agricultural Research Institute (ZARI)**, the country's leading crop research and development body, since 2004 to strengthen the capacity of ZARI staff in testing, certification, and release of biofortified crop varieties.

One notable achievement: A significant reduction in the time required to move a new seed variety from development through to market introduction, which facilitated the rapid release of eight new VAM varieties over the 2015-2018 period. Early-stage collaboration between ZARI, private seed companies and farmers, particularly in the variety testing phase, accelerated the variety release process and timelines. In addition, with private seed companies involved early on in the variety release process, they were able to familiarize themselves with the newly developed hybrids and were thus willing to enter the market earlier and with larger seed volumes they would have otherwise.

Thanks to intensive collaboration with seed companies, they are equipped to efficiently multiply and **market high-quality hybrid VAM seed varieties**. HarvestPlus has also worked closely with national and NGO-led farmer extension services to integrate training and support for biofortified crop cultivation. In collaboration with **extension services** as well as seed companies, HarvestPlus also established “lead farmer” systems to facilitate farmer-to-farmer training on growing biofortified crops, with lead farmers’ fields effectively serving as local demonstration plots.

Generating Demand: Given VAM’s orange color, its introduction and ongoing promotion required concerted effort by HarvestPlus and partners to educate and sensitize farmers and consumers about its nutritional, health and agronomic benefits. This is especially the case in Zambia due to a persistent mistrust of non-white maize varieties, stemming from negative experiences with yellow maize grains distributed as relief food during a severe drought in the 1990s. That said, HarvestPlus, in conjunction with its VAM breeding partners, intentionally opted to make VAM orange in order to differentiate it from the less-trusted yellow maize. It was still necessary, however, to familiarize farmers and value chain actors with the orange maize and its positive attributes.

To interest seed companies and their agro-dealers in selling VAM seed, HarvestPlus actively promotes the benefits of VAM to farmers and consumers through a variety of channels. Awareness-raising efforts among farming households includes regularly exhibiting VAM seed and products at key market venues such as the Zambia National Agriculture show, the Zambia International Trade Fair, and various similar fairs around the country. HarvestPlus widely disseminates promotional materials such as brochures, flyers,

posters and t-shirts containing information on VAM, as well as ongoing public marketing campaigns through radio, television, billboards, online videos, and other platforms.

At the grassroots level, VAM “field days” held at village, district and provincial levels, have been highly effective at familiarizing smallholder farmers with the agronomic and health benefits of VAM, as well as its cooking and taste attributes. At the community level, HarvestPlus also identifies lead farmers who receive VAM seed to grow on their plots, which effectively serve as demonstration plots for other nearby households to observe and learn from. In addition, HarvestPlus has prioritized engagement of rural women through local women’s farming groups, health centers where women take children for monitoring and immunization appointments, and through schools. Parents of school children receive seed packs to grow at home.

Engagement of prominent, well-respected champions is another important element in generating interest among farmers and others in Zambia. One such champion is Senior Chief Nzamane of the Ngoni people in the Chipata region of eastern Zambia. He leads by example by growing VAM himself, and he invested in a small milling plant on his property that employs 12 people and supplies the community with large quantities of VAM.





Risk Sharing: Risk-sharing has been an essential element in increasing uptake of VAM in a market overwhelmingly dominated by white maize, which is supported through government systems. Given that seed companies and agro-dealers were wary of making significant up-front investments for an untested VAM seed product, HarvestPlus devised ways to reduce their investment risks.

For example, in the case of seed companies, this included exclusive rights to produce and sell particular hybrid VAM varieties so that each seed company could ensure product differentiation and ownership in the market. HarvestPlus also offered to finance initial rounds of seed production, a cost that the companies could reimburse after the seed was sold. Seed companies also received support in designing, marketing and packaging materials. HarvestPlus also runs promotion campaigns for biofortified crops on radio, TV, and other channels to create awareness and stimulate demand for the seed companies.

HarvestPlus also works closely with agro-dealers and processors to understand what they need to generate demand among their farmer clients. Key measures include providing small volumes of trial grain for product formulation, seed sampling packs for free distribution, colorful flyers, and sponsored programming on local TV and community radio stations, as well as TV ads to raise local awareness about VAM and its benefits.

Post-Harvest Market Development: Interest from farmers in growing VAM also hinges on their ability to readily sell surplus harvest to support their livelihoods—hence the need for a vibrant post-harvest market. HarvestPlus has engaged and trained numerous Zambian SME entrepreneurs in crop processing and food products, providing technical assistance in processing VAM, designing food products, and marketing these products to consumers. For example, one of the largest industrial millers in Zambia was an early adopter and produces several VAM products such as breakfast meal, grits, and *samp*.

One SME partner is Shais Foods, founded and led by Mirriam Chipulu (pictured above). Smallholder farmers are supplying 70 percent of her company's raw material needs, and Chipulu soon expects to be working with as many as 5,000 VAM farming households to supply her newly expanded processing mill. Sylva Foods Solutions, led by another woman entrepreneur, Sylvia Banda—who regularly works with over 25,000 smallholder farmers for supply of VAM, dry vegetables, and fruits—is also engaging over 1,000 smallholder OSP farmers and 200 HIB farmers to supply her expanding business with new products. Sylva Foods produces Moringa Instant Cereal that is 98 percent VAM and is appropriate for children as young as six months.

Policy Engagement: Engaging decision makers has helped foster a supportive enabling environment for uptake of biofortified crops and foods, with biofortification directives and guidelines integrated in key government policies. Notably, the Government of Zambia has encouraged adoption of VAM by including the crops in the **Farmer Input Support Programme** (FISP) subsidy scheme, and both VAM and HIB as free inputs in the **Food Security Pack** (FSP), which ensures that VAM and HIB reach vulnerable farming households in remote areas who are not supplied by private seed companies. Inclusion of biofortified crops in the **Zambia Nutrition Policy** means that they are included in implementation of nutrition-sensitive agriculture programs. Biofortification was also included in the **Government's 8th National Development Plan** (under the rubric of fortification).

Policy engagement also compelled the Government to set **product standards** for orange VAM, encouraging buy-in from Zambian seed, crop, and food value chain actors who need assurance about product quality and consistency. Producers and traders in Zambia can also now apply new a global standard (a [Publicly Available Specification](#)) for vitamin A enriched grains that was developed by the British Standards Institute in partnership with HarvestPlus.



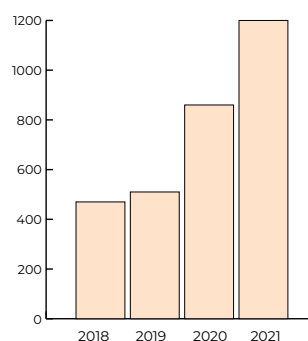
Results

- **A total of 11 varieties of VAM have been released** by the Government so far with the support of HarvestPlus. As the figures below illustrate, the volumes of VAM seed and grain produced have both increased markedly in recent years. Trends in VAM seed output for 2022 pointed to a year-on-year increase of at least 30 percent, though it may be greater if weather and other conditions remain favorable.
- **By the end of 2021, an estimated 333,000 smallholder farming households in Zambia were growing VAM**, while 209,000 households were growing HIB, and about 100,000 were growing OSP. These households now have access to better nutrition as well as livelihood improvement through sales of surplus VAM harvest.
- **In 2021, of the estimated 304,000 people in Zambia who received training and/or indirect technical support from HarvestPlus, about two thirds were women.** Women from the Chikoka Women's Club in Kafue District were the first group in Zambia to grow VAM, as well as iron beans. Club members reported that the VAM yields brought greater health, prosperity and opportunities to their families. Chikoka Women's

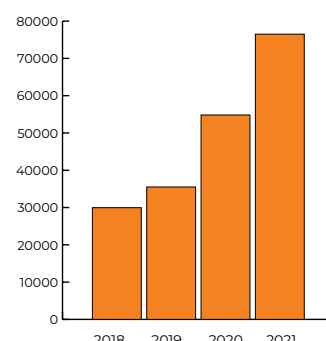
Club Chairperson Idah Kapaipi said VAM is one of the most highly sought-after crops, and customers appreciate its nutritional value.

- **Engagement with SME entrepreneurs is also generating a strong market for farmer's surplus VAM and HIB harvests**—by HarvestPlus' latest count, a total of 27 millers and food businesses are processing VAM and selling food products made with it.

Quantity of Vit. A Maize Seed Produced (MT)



Quantity of Vit. A Maize Grain Produced (MT)





“

This is the chance for Zambia to start moving out of white maize and adopt a more nutritious and tastier orange maize.”

– Chance Kabaghe, Former Deputy Minister of Agriculture; Chair, Seed Co. Zambia

The Path Forward

Thanks to the efforts of HarvestPlus in close collaboration with national partners, VAM now has a firm foothold in the country's food system, and is well-positioned for rapid scaling. However, to achieve long-term sustainability, more investment is needed in efforts to mainstream nutrient targeting in crop development and crowd-in additional private sector partners in seed and food value chains. HarvestPlus is ready and able to expand its catalyzation efforts in Zambia in order to make this happen, and is seeking additional like-minded partners to join this important initiative. HarvestPlus is also focusing on the following objectives to accelerate VAM scaling in Zambia:

- Ensure VAM is purchased through official food reserve and other public-sector procurement programs (similar to white maize).
- Integrate VAM, HIB, and OSP in social protection programs (i.e. school, hospital in-patient feeding) to drive health and livelihood improvements for the most vulnerable populations.
- Advance adoption & application of available product standards for biofortified grains to increase farmer and value chain actor confidence.
- Strengthen and expand OSP vine production to operate year-round and meet growing demand.

Partners in Zambia Activities

Government Ministries: Agriculture, Community Development, Education, Health • **CGIAR Centers:** International Institute of Tropical Agriculture (IITA), International Maize and Wheat Improvement Center (CIMMYT), International Potato Centre (CIP) • **Other Partners in Zambia:** Civil Society Organisation on Scaling Up Nutrition (CSO-SUN), Development Aid From People to People (DAPP), Indaba Agricultural Policy Research Institute (IAPRI), Land O' Lakes, National Food and Nutrition Commission (ZNFNC), National Institute for Scientific and Industrial Research, Peace Corps, ProfitPlus, Programme Against Malnutrition (PAM), Star Milling, Tropical Disease Research Centre, University of Zambia, World Vision, Zambia Agriculture Research Institute (ZARI), Zambia Seed Traders Association (ZASTA), Iowa State University, Johns Hopkins Bloomberg School of Public Health, Michigan State University, Micronutrient Malnutrition Taskforce, Purdue University, SEED Solutions, SEED Infotech Ltd, University of California, University of Wisconsin-Madison, World Food Programme (WFP), International Fund for Agriculture Development (IFAD), United Nations High Commission for Refugees (UNHCR), AfriSeed, Advanta Seed, Kamano Seed, SeedCo, ZamSeed, 260 Brands, Shais, Fanyate Milling, Sylva Food Solutions, Zambian Fertilizer/FTG, Aurum Quiver, Novatek, Rwazim Limited, Twala Farms, Van Burdet, Musika, Tiland, 260 Brands, Tundwe Milling, Yoyo, Share Africa

Funders: The work of HarvestPlus to promote vitamin A maize in Zambia has been supported by funding from the Bill & Melinda Gates Foundation, the UK Foreign Commonwealth & Development Office, the John D. and Catherine T. MacArthur Foundation, and the Government of Canada.

Contact: Emely Mwale Banda, Zambia Country Representative, HarvestPlus; e.banda@cgiar.org

HarvestPlus improves nutrition and public health by developing and promoting biofortified food crops that are rich in vitamins and minerals, and providing global leadership on biofortification evidence and technology. Contact us for partnership opportunities: harvestplus@cgiar.org.

HarvestPlus is part of the CGIAR and is based at the International Food Policy Research Institute (IFPRI), a CGIAR research center.

Copyright © 2022 HarvestPlus.

