BACKGROUND PAPER ON THE INCLUSION OF BIOFORTIFIED CROPS IN GOVERNMENT'S INPUT SUPPORT PROGRAMS

Zimbabwe Government

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About LFSP: The Zimbabwe Livelihoods and Food Security Programme (LFSP), Agriculture Productivity and Nutrition Component (APN) is managed by the Food and Agriculture Organisation of the United Nations (FAO), with the aim of contribute to poverty reduction through increased incomes for a target 250,000 smallholder farming households. The programme is being implemented in four provinces covering 12 districts as follows: Mutasa, Mutare, and Makoni in Manicaland; Guruve, Bindura, Mazowe and Mt Darwin in Mashonaland Central; Kwekwe, Gokwe North, Gokwe South and Shurugwi in Midlands and Zvimba in Mashonaland West provinces. FAO is in partnership with three NGO consortia led by Practical Action, Welthungerhilfe and World Vision International, two Strategic Technical partners i.e. IAPRI for policy influence, HarvestPlus for biofortification, three Commercial Banks, 1 Wholesale Facility - the Zimbabwe Microfinance Fund (ZMF), 5 Microfinance Institutions (MFIs) and the USAID managed DCA Facility. To date the LFSP is funded for two phases to the tune of £72.4m.

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EXECUTIVE SUMMARY

Evidence has shown that consumption of biofortified crops could significantly improve human health and nutrition. Globally, biofortified crops are now grown and consumed by more than 48 million people. However, production and consumption of biofortified crops in Zimbabwe is still depressed. To reach optimum scale, biofortification must be integrated in public and private programmes. The major aim of this background paper is to justify and outline how pro vitamin A biofortified maize (orange maize) and iron biofortified beans (iron beans) should be included into the Government of Zimbabwe's Input Support Program. This will be a production stimulus for the consumption of these crops by households as they will be readily available.

In Zimbabwe just like in most developing countries, malnutrition in all its forms is one of the key challenges for the public health system with women and children being most vulnerable. These include micronutrient malnutrition, which is caused by diets that are deficient in essential minerals and vitamins including vitamin A, iron and zinc. In Zimbabwe, records show that in 2015, only 8% of children aged 6-23 months consumed an acceptable diet. Poor dietary intake of key micronutrients can partially explain the observed stunting prevalence (26.6%) and iron deficiency (ID) among children aged 6 – 59 months (72%) and women of reproductive age (26.8%). Iron deficiency has the following effects: impairs mental development and learning capacity, increases weaknesses and fatigue, may increase risk of women dying during childbirth; on the other hand zinc deficiency has the following effects: causes stunting, lowers immunity and increase risk of diarrheal diseases and respiratory infections. Vitamin A deficiency affects 19% of under-fives and 23% of women of reproductive age. According to the World Health Organization, Vitamin A deficiency (VAD) is the leading cause of preventable blindness in children worldwide. Children who suffer from VAD have impaired growth and development, a weakened immune system, and a 25% higher chance of severe illness and death from common childhood infections such as measles, malaria, or diarrhoea compared to those without VAD.

Biofortification is a technique whose objective is to mitigate the problem of staple crops' low micronutrient content by increasing the vitamins and minerals concentration in a crop through either conventional plant breeding, improved agronomic practices or genetic modification. Biofortification has some key advantages over the other methods of micronutrient supplementation in that it is cost-effective and has the ability to reach underserved, rural populations. Biofortification has the potential to be an effective tool to fight malnutrition in Zimbabwe, given the importance of agriculture in the economy. Based on usual eating patterns, it is estimated that for children 4 to 6 years and for non-pregnant, non-lactating women of reproductive age, biofortified iron beans can provide up to 80% of the daily estimated average requirements whilst vitamin A maize can provide up to 50% of average daily vitamin A needs.

Nutrition research evidence shows that biofortified crop varieties provide substantial amounts of bioavailable micronutrients, and consumption of these varieties can improve micronutrient deficiency status among target populations. One study has shown that iron-depleted women showed a significant increase in haemoglobin and total body iron after consuming biofortified beans for four and half months. Another study showed iron beans improve women's ability to conduct everyday physical tasks efficiently, with positive livelihood implications for them and their families. Furthermore, research has shown that Vitamin A maize is more resistant to aflatoxins which are of

great concern in Zimbabwe and other countries in Africa, since they negatively affect health and nutrition. Consumption of aflatoxin contaminated food by children results in weak immune system and increased morbidity and mortality from diseases such as malaria, reduced efficiency of use for various macro- and micro-nutrients, and stunting. On the other hand, in adults, aflatoxin is linked to cancers and weakened immune system.

Despite the progress made to date on biofortification, the process is not widespread in terms of production and consumption. The major hindrances to adoption of production of biofortified crops are unavailability of seed, poor markets and limited knowledge of the benefits of biofortification. There is therefore need to scale up biofortification efforts in the country and at the same time promote demand of the biofortified foods by integrating biofortification into public and private policies, programs, and investments. Farmers have a crucial role to play in the success of biofortification since they are both producers and consumers of biofortified foods.

One of the important avenues for stimulating both production and demand of biofortified maize and beans is the Government's Input Support Programme which has been mainly covering white maize, sorghum, millet and wheat crops. The inclusion of biofortified maize and beans into the Government's input support programs will provide a signal for seed companies and other market players to invest more resources into production and marketing of biofortified crops. It is envisaged that the inclusion of biofortified maize and beans into the Government's Input Support Program will increase the purchase of the seed and consequently land area allocated to biofortified crop production. This will subsequently contribute to the increase in production and consumption of biofortified crops.

According to HarvestPlus, the current capacity for the supply of biofortified seed is 100 MT for VAM, 400MT for HIB and 4 million OFSP vines. This is based on current seed projections less what the seed companies will need to sell in the open market. The projected growth in supply would be 75% for VAM, 100% for HIB and 100% for OFSP. Beneficiaries that could be initially targeted by the Presidential Input Scheme based on these capacities are as follows: 20,000 farming households would be reached with VAM seed (assuming each household receives 5kg pack); 400,000 households would be reached with HIB (assuming each household receives 1kg seed pack); and 12,000 households would be reached with OFSP vines (assuming that 33,000 OFSP vines would cover a hectare and each household would receive vines to cover 0.01ha). In the second year, households that would be reached with VAM and HIB seed, and OFSP vines would be 35,000, 800,000 and 24,000 respectively. This would be a great achievement by the Government in uplifting the nutrition and well-being of the vulnerable citizens.

If all the farmers targeted by the Presidential Input Scheme are provided with biofortified maize and beans inputs in the initial biofortified maize and beans sub-programme, then over 1.8 million farming households would be reached translating to over 7.2 million individuals assuming an average of 4 members per household. However, depending on the resources, the biofortified maize and beans could be introduced in phases, probably targeting a quarter or half of the beneficiaries, and then the programme could be scaled up in the following season.

Biofortification is beneficial to the country as it will address both nutritional and food security issues. At a macro level, it will reduce health related expenditure by Treasury on expenditures related to

micronutrient deficiency diseases such as anaemia, measles, eye problems, immune suppressed systems, impaired physical and cognitive development among others. The World Bank estimates that Zimbabwe loses nearly US$24 million in GDP annually to vitamin and mineral deficiencies. Biofortification represents an economically viable immediate to long term intervention to improve quality of life, health and well-being of the most vulnerable populations. Biofortification is an upfront investment with few major recurrent costs when compared to other interventions such as industrial fortification and pharmaceutical supplementation. This implies that the Government will save the much scarce foreign currency in the medium to long term given the reduced imports of certain pharmaceutical supplements such as iron and vitamin A supplements. In addition, biofortification will contribute to reduced micronutrient malnutrition related mortality and morbidity rates.

CONTENTS

Acknowledgements ii

About Authors iii

Executive Summary iv

List of Figures vii

Acronyms viii

1 Introduction 1

1.1 Background 1

1.2 Biofortification 2

1.2.1 Efficacy of biofortified varieties 3

1.2.2 Other advantages of biofortified varieties 3

1.3 Status of Biofortified Crops in Zimbabwe 4

1.4 The need to use the Government's Input Support Scheme to Scale up Biofortified Maize and Beans 5

2 Inclusion of Biofortified Maize and Beans into the Government's Input Support program 6

2.1 The Government of Zimbabwe Commitment to Fight Malnutrition at Highest Level 6

2.2 Biofortified and market operations including feeding programmes 7

2.3 Reduction in Treasury spending in social services and micronutrient malnutrition related diseases 7

2.4 Policy Support in other Countries 8

2.5 Awareness campaigns 9

2.6 Monitoring and Evaluation 9

3 Conclusions and Recommendations 10

References 11

LIST OF FIGURES

Figure 1: Rates of Iron Deficiency and Vitamin A Deficiency in Zimbabwe 1

Figure 2: LFSP Project Area Survey results on VAD Maize and High Iron Bean (A) Production of; (B) Consumption; (C) Willingness to Buy (n= 481) 4

ACRONYMS

AGRITEX	Department of Agricultural, Technical and Extension Services
CBI	Crop Breeding Institute
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CIP	International Potato Center
DR&SS	Department of Research and Specialist Services
FAO	Food and Agricultural Organization of the United Nations
FCDO	British Foreign Commonwealth and Development Office
FNSC	Food and Nutrition Security Committees
GAM	Global Acute Malnutrition
GDP	Gross Domestic Product
IAPRI	Indaba Agricultural Policy Research Institute
ID	Iron Deficiency
LFSP	Livelihoods and Food Security Programme
MLAFWRR	Ministry of Lands, Agriculture, Fisheries, Water and Rural Resettlement
MoHCC	Ministry of Health and Child Care
N4G	Nutrition for Growth
NGO	Non-Governmental Organization
OFSP	Orange Flesh Sweet Potato
SAM	Severe Acute Malnutrition
SUN	Scaling Up Nutrition
SSA	Sub-Saharan Africa
UNFSS	United Nations Food Systems Summit
UNICEF	United Nations Children's Fund
VAD	Vitamin A Deficiency
VAM	Vitamin A maize
WFP	World Food Programme
WHO	World Health Organization
ZDHS	Zimbabwe Demographic and Health Survey
ZFNC	Zimbabwe Food and Nutrition Council
ZimVAC	Zimbabwe Vulnerable Assessment Committee

1 INTRODUCTION

The consumption of biofortified crop varieties has been shown to measurably improve human health and nutrition. Globally, biofortified crops are now grown and consumed by more than 48 million people. However, production and consumption of biofortified crops in Zimbabwe is still depressed. To reach optimum scale, biofortification must be integrated in public and private programmes. The major aim of this position paper is therefore to justify and outline how biofortified maize and bean varieties should be included into the Government of Zimbabwe's Input Support Program. This will be a production stimulus for the consumption of these crops by households as they will be readily available.

1.1 Background

More than two billion people in the world, about one person in three, do not get enough essential vitamins and minerals, such as vitamin A, zinc, and iron, in their daily diets, a condition known as "hidden hunger" (HarvestPlus, 2014) or malnutrition, also known as micronutrient deficiency. Women and children are the most vulnerable. For children, micronutrient deficiency in zinc, iron and Vitamin A, have been recognized by the World Health Organization (WHO) as causal in the problems of stunting (low height-for-age), blindness, immune response suppression, and impaired cognitive ability (HarvestPlus, 2014). In sub-Saharan Africa (SSA) statistics reveal that for children under five years of age, 59 million are stunted, 14 million are wasted (low weight-for-height), and 10 million are overweight; among women of reproductive age, about 38% suffer from iron deficiency anaemia (UNICEF, WHO & World Bank Group, 2017).

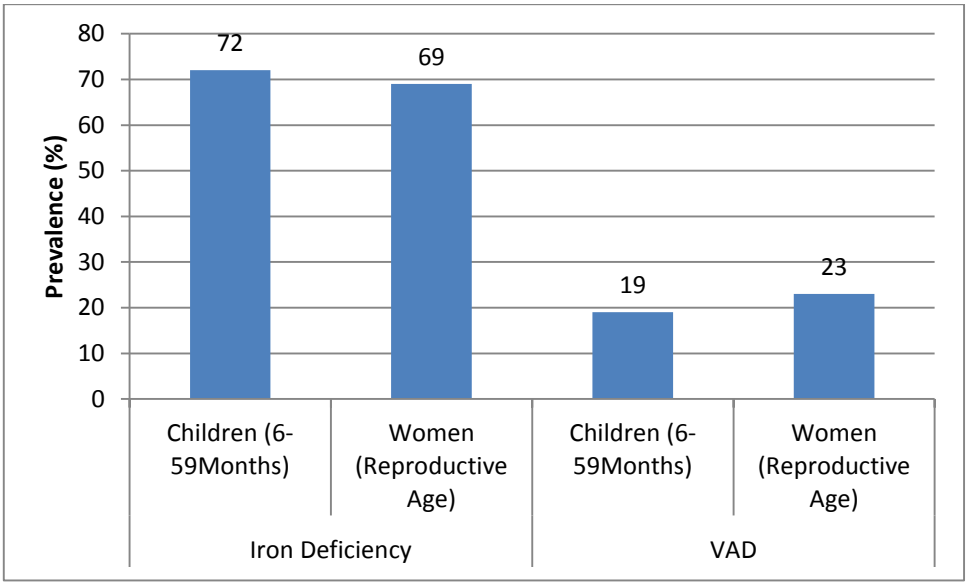

Figure 1: Rates of Iron Deficiency and Vitamin A Deficiency in Zimbabwe
Source: Zimbabwe Micronutrient Survey (2012)

Malnutrition in all its forms is a problem of public health significance in Zimbabwe, with women of childbearing age (15 – 49 years) (Figure 1) and children under the age of 5 years being the most vulnerable. The most common forms of malnutrition in Zimbabwe include stunting, iron deficiency, vitamin A deficiency (VAD), and zinc deficiency (ZDHS, 2016; MoHCC/ZFNC, 2012). According to a

survey done in 2015, only 8% of children aged 6-23 months consumed an acceptable diet (ZDHS, 2016). The observed poor diets, low in key micronutrients could partially explain the prevalence of ID (72%) VAD (19%) and stunting (26%) among children aged 6 – 59 months (Zimbabwe Micronutrient Survey, 2012; Figure 1).

Iron deficiency has the following effects: impairs mental development and learning capacity, increases weaknesses and fatigue, may increase risk of women dying during childbirth; on the other hand zinc deficiency has the following effects: causes stunting, lowers immunity and increase risk of diarrheal diseases and respiratory infections (HarvestPlus, 2014). Vitamin A deficiency affects 19% of under-fives and 23% of women of reproductive age (Figure 1). According to the World Health Organization, Vitamin A deficiency (VAD) is the leading cause of preventable blindness in children worldwide. Children who suffer from VAD have impaired growth and development, a weakened immune system, and a 25% higher chance of severe illness and death from common childhood infections such as measles, malaria, or diarrhoea compared to those without VAD. This shows the importance of nutrition to improving overall economic growth through preventing children from the following: dropping out of school, perpetually remaining in poverty, and being less productive when they grow to adulthood (Vollmer *et al.*, 2014).

1.2 Biofortification

Beyond eating a diverse, nutritious diet, which is often inaccessible or unaffordable for many vulnerable communities, there are three complementary strategies for addressing malnutrition by increasing micronutrient intakes: industrial fortification, supplementation and biofortification. Biofortification is increasing the concentration of vitamins and minerals in a crop through either conventional plant breeding, improved agronomic practices or genetic modification (Bouis et al., 2011). Biofortification has some key advantages over the other two methods: it has long-term cost-effectiveness and has the ability to reach underserved, rural populations that are often missed by the other interventions (Omari et al., 2019; Bouis et al., 2011).

The vitamin A biofortified crops that are currently available in Zimbabwe are vitamin A maize (VAM) and orange-fleshed sweet potatoes (OFSP), both of which contain high levels of proVitamin A carotenoids, which when consumed, are converted in the body to vitamin A. An adult portion of vitamin A maize can supply up to 50% of the estimated daily vitamin A needs of a non-pregnant, non-lactating women of reproductive age and 4 – 6 year old child; while that of OFSP supplies 100% (HarvestPlus, 2019a and b).

The iron biofortified varieties that are currently available in Zimbabwe are for common beans (*Phaseolus vulgaris*). An adult portion of iron beans can supply upto 80% of the estimated daily iron needs of a non-pregnant, non-lactating women of reproductive age and 4 – 6 year old child (HarvestPlus, 2019a and b). Iron biofortified beans are also high in zinc.

Given the role that biofortified maize and beans have in addressing nutritional challenges and the efficacy of biofortified crops in improving micronutrient status of vulnerable households, there is

need to incorporate biofortification in government's key policies, strategies and investment programmes.

1.2.1 Efficacy of biofortified varieties

There is overwhelming evidence in peer reviewed publications that biofortified crop varieties provide substantial amounts of bioavailable micronutrients, and consumption of these varieties can improve micronutrient deficiency status among target populations (Saltzman et al., 2017). Consumption of orange maize has been demonstrated to improve total body vitamin A storage just as effectively as supplementation (Gannon et al., 2014), and substantially improve visual function of the marginally vitamin A-deficient children (Palmer et al., 2016). An efficacy study conducted in Zambia with 5–7-year-old children showed that, after 3 months of consumption, the total body stores of vitamin A in the children who were in the orange maize group increased significantly compared with those in the control group (Gannon et al., 2014). In Rwanda, iron-depleted university women showed a significant increase in haemoglobin and total body iron after consuming biofortified beans for four and half months (Haas et al., 2016). Another study has shown that iron beans improves women's ability to conduct everyday physical tasks efficiently, with positive livelihood implications for them and their families (HarvestPlus, 2019b).

1.2.2 Other advantages of biofortified varieties

In addition, research has shown that Vitamin A maize is more resistant to aflatoxins which are of great concern in Zimbabwe and other countries in Africa, since they negatively affect health and nutrition (Surwarno et al., 2019). Consumption of aflatoxin contaminated food by children results in weak immune system and increased morbidity and mortality from diseases such as malaria, reduced efficiency of use for various macro- and micro-nutrients, and stunting (Misihairabgwi et al., 2019; Surwarno et al., 2019; Wild, 2007). On the other hand, in adults, aflatoxins are linked to cancers and weakened immune system (Misihairabgwi eat al., 2019; Suwarno et al., 2019).

Biofortified beans are environmentally friendly since they have a shorter cooking time (in some cases saving about 2 hours), are climate smart since they reduce the need for firewood and water, and higher yielding (Hummel et al., 2020; Mughi, 2017). Shorter cooking time is highly desired by consumers and has also been associated with superior iron bioavailability (Wiesinger et al., 2016).

Biofortification has the potential to be an effective tool to fight malnutrition in Zimbabwe, given the importance of agriculture in the economy. About 80% of the population's livelihoods is agriculture based, and agriculture provides formal employment to 60% of the population whilst contributing approximately 18.5% of the Gross Domestic Product (GDP) and about 33% of foreign earnings (MAMID, 2013). Biofortification provides a solution in the hands of farmers, combining increased micronutrient content with other favourable agronomic traits; thus after fulfilling the household's food needs, surplus biofortified crops can then be sold to other rural and urban markets (Omari et al., 2019; Bouis and Saltzman, 2017). Thus biofortification initiatives are a cost-effective, sustainable, health and nutrition-sensitive intervention.

1.3 Status of Biofortified Crops in Zimbabwe

Approximately over 48 million people in 9.7 million farming households across Africa, Asia, and Latin America are now growing and consuming biofortified crops (HarvestPlus, 2020). In Zimbabwe, biofortified crops were first introduced in 2012 and promoted extensively since 2015 by the FCDO funded Zimbabwe Livelihood and Food Security Program (LFSP), which was managed by FAO, with HarvestPlus as the technical lead on biofortification. The LFSP worked closely with AGRITEX to promote biofortified varieties in 12 of the country's 60 rural district, namely Guruve, Mt Darwin, Bindura, Mazowe, Zvimba, Gokwe north, Gokwe south, Kwekwe, Shurugwi, Mutare, Makoni, and Mutasa (Muvhuringi and Chigede, 2017).

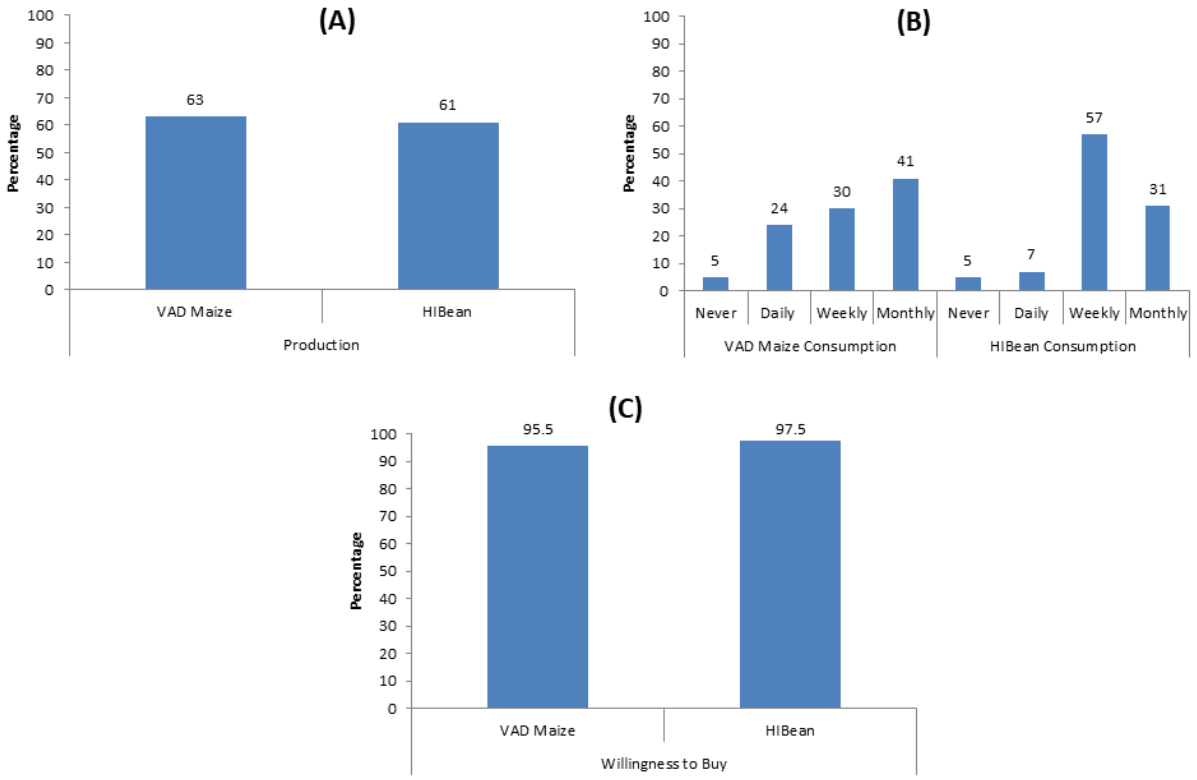

Figure 2: LFSP Project Area Survey results on VAD Maize and High Iron Bean (A) Production of; (B) Consumption; (C) Willingness to Buy (n= 481)

Source: LFSP (2020)

In a study that was carried out in the 12 LFSP operating districts, 63% and 61 % of the sampled households had grown VAM and iron beans respectively (Figure 2(A). In terms of consumption, orange maize was mainly consumed a few times in a month, while consumption of biofortified beans was mainly weekly (57%) with only 5% of the respondents reporting that they never consumed both versions of the crops (Figure 2(B), showing that the biofortified crops are popular with farmers. However, the constraint was that biofortified seeds were not readily available in the local markets (LFSP, 2020). Willingness to buy was very high, 95.5% for orange maize and 97.5% for biofortified beans (Figure 2(C)).

A separate study done in Mazowe district found that most farmers in the district were not growing biofortified crops (Muvhuringi and Chigede, 2021). There was also low consumption of VAM compared to traditional white maize varieties in the district. This is in tandem with the 2018 National Nutrition Survey findings, which indicated that only 33% of the households that were aware of biofortified crops had grown or purchased biofortified crops within a period of 6 months (GoZ, 2018). It was indicated that the major hindrances to adoption of production of biofortified crops was unavailability of seed, high cost of seed in general, poor markets and limited knowledge of the benefits of biofortification (Muvhuringi and Chigede, 2021).

There is therefore need to scale up biofortification efforts in the country and at the same time promote demand of the biofortified foods by integrating biofortification into public and private policies, programs, and investments (HarvestPlus, 2019b). Farmers have a crucial role to play in the success of biofortification since they are both producers and consumers of biofortified foods.

1.4 The need to use the Government's Input Support Scheme to Scale up Biofortified Maize and Beans

One of the important avenues for stimulating both production and demand of biofortified maize and beans is the Government's Input Support Programme through its subsidiaries the Command Agriculture and the Presidential Input Support Scheme. The Government of Zimbabwe has been implementing the Crop and Livestock Input Scheme to support farmers throughout the country. The input scheme is pro poor, development focused in nature and aimed at achieving food and nutrition security. The input scheme has been mainly covering white maize, sorghum, millet and wheat crops. The presidential Input Scheme supports over 1.8 million small-scale and communal farmers by distributing free inputs for mainly white maize production. On the other hand, the Command Agriculture scheme aims to support larger, more commercial farmers to produce approximately 2 million tonnes of maize in total, to cover Zimbabwe's annual requirement for human consumption and livestock feed.

During the 2020/2021 season, the Government implemented the climate-proofed Presidential Input Scheme under the Intwasa/Pfumvudza farming concept. Inputs received by farmers included seed of white maize, cow peas, groundnuts, cotton seeds as well as fertiliser and chemicals to help farmers yield enough produce to tackle food insecurity in Zimbabwe. Under the programme, each household received a standardised crop input package of 5kg seed, 50kg basal and 50kg top dressing fertiliser. Government adopted Intwasa/Pfumvudza to address the problem of low production and productivity, which continued to negatively affect food security in Zimbabwe.

Biofortified maize and beans are currently not part of the Government's Crop Input Scheme. The inclusion of these crops will ensure that vulnerable farmers have access to new nutrient dense varieties. This will contribute to achievement of national food and nutrition security, smallholder resilience and sustainable development (FAO, 2015). In addition, the inclusion of biofortified maize and beans into the Input Scheme will demonstrate government's commitment to playing a leading role in supporting efforts to reduce malnutrition through implementation of nutrition-sensitive agriculture interventions. The Government's input support programs will provide a signal for seed companies and other market players to invest more resources into production and marketing of

biofortified crops. It is envisaged that the inclusion of biofortified maize and beans into the Government's Input Support Program will increase the purchase of the seed and consequently land area allocated to biofortified crop production. This will subsequently contribute to the increase in production and consumption of biofortified crops (Muvhuringi and Chigede, 2021).

2 Inclusion of Biofortified Maize and Beans into the Government's Input Support program

2.1 The Government of Zimbabwe Commitment to Fight Malnutrition at Highest Level

The Government of Zimbabwe has shown commitment to address malnutrition in all its forms within a broader policy framework at the highest level. Examples are the Zimbabwe's vision 2030 in particular the National Development Strategy 1; and the United Nations Food System Summit (UNFSS) and the Nutrition for Growth (N4G). Zimbabwe's Vision 2030 reflects the collective aspirations and determination of the people of Zimbabwe towards a prosperous and empowered upper middle income society by 2030, with job opportunities and a high quality of life. The National Development Strategy 1 (NDS1) emphasizes working towards a prosperous, inclusive, diverse, sustainable and competitive agriculture sector by 2030. The priorities for NDS1 are food and security nutrition and health and well-being. The United Nations Food System Summit (UNFSS) and N4G summit stakeholders amongst them the Zimbabwean Government have pledged to end malnutrition in all its forms through use of methods such as proven nutrition-specific and nutrition-sensitive interventions.

The Government has launched of Statutory Instrument 120 of 2016 that set the platform for Zimbabwe to have capacity for three of the four key nutritional interventions to address micronutrient malnutrition. The Ministry of Lands, Agriculture, Fisheries, Water and Rural Resettlement (MLAFWRR) and the Ministry of Health and Child Care (MoHCC) are the key ministries leading the mainstreaming of biofortification in policies, strategies and programmes. It is important to note that biofortification has already been integrated into several existing nutrition, health, and agriculture sector policies in Zimbabwe. MLAFWRR is responsible for food security and the coordination of agricultural activities in Zimbabwe. Together with cooperating partners, they have launched biofortification initiatives focusing on Vitamin A orange maize, and high Iron and Zinc bean varieties (MAMID/FAO, 2016; Siamachira, 2016).

Some of the compelling reasons for MLAFWRR to consider incorporating biofortified maize and beans into the Government's Input Support Program include the following:

- Advanced stages of biofortification seed production
- Biofortification efficacy and effectiveness trials showing positive results
- Biofortified crop varieties are climate smart given that they are drought tolerant
- Biofortified crops will also be delivered to MLAFWRR programmes especially the Irrigation Programmes (such as the Smallholder Irrigation Revitalisation Programme) and School Nutrition Gardens.

- Vibrant food industry (commercial & Small and Medium Enterprises) to utilise biofortified crops to develop nutritious foods
- Nutritionists and other health professionals have endorsed the rationale of biofortification
- Integration of biofortified foods into ongoing schemes (i.e., presidential input subsidies, command agriculture and social safety nets, such as school feeding programs and food aid distribution)
- Consumer perceptions on biofortified foods would be influenced through demand creation and awareness efforts spearheaded by HarvestPlus
- The utilisation of existing community structures like the Food and Nutrition Security Committees (FNSCs). The MLAFWRR, as chair of these committees at all levels, has a key role to play in inspiring all biofortification initiatives
- Opportunity to strengthen inter-sectoral collaboration at the national level across agriculture, education, and health
- Partnerships with NGOs and public agencies to provide public nutrition awareness and advocacy for biofortified crop varieties

2.2 Biofortified and market operations including feeding programmes

According to HarvestPlus, the current capacity for the supply of biofortified seed is 100 MT for VAM, 400MT for HIB and 4 million OFSP vines. This is based on current seed projections less what the seed companies will need to sell in the open market. The projected growth in supply, based on past trends would be 75% for VAM, 100% for HIB and 100% for OFSP, although actual growth in supply may be much higher as seed companies respond to demand from government. Beneficiaries that could be initially targeted by the Presidential Input Scheme based on these capacities are as follows: 20,000 farming households would be reached with VAM seed (assuming each household receives 5kg pack); 400,000 households would be reached with HIB (assuming each household receives 1kg seed pack); and 12,000 households would be reached with OFSP vines (assuming that 33,000 OFSP vines would cover a hectare and each household would receive vines to cover 0.01ha). In the second year, households that would be reached with VAM and HIB seed and, OFSP vines would be a minimum of 35,000, 800,000 and 24,000 respectively. This would be a great achievement by the Government in uplifting the nutrition and well-being of the vulnerable citizens.

It is envisaged that after growing these biofortified crops, the farmers will consume the crops and then sell any surplus to the market. Those large-scale farmers who will venture into biofortified maize and beans will sell directly to the market. To stimulate demand ,the surplus will be sold on the open market but will also be used for Government's nutrition programmes implemented through various arms of the Government, e.g. by MoHCC, and the Ministry of Social Welfare. The biofortified foods could also be used in major institutional markets, including food relief and school feeding programmes which would also create additional demand.

2.3 Reduction in Treasury spending in social services and micronutrient malnutrition related diseases

Governments spend a lot of resources on micronutrient malnutrition induced problems such as iron deficiency anaemia, increased incidence and severity of common infections due to a compromised immune systems, impaired physical and cognitive development and night blindness among others. Production and consumption of biofortified commodities has been proven to reduce incidences and severity of some of these problems (Jones and de Brauw, 2015; HarvestPlus, 2019b). Biofortification is cost-effective and households/farmers have control on the amount of land allocation and crops they can produce. Biofortification does not have major recurrent costs compared to other interventions such as industrial fortification and pharmaceutical supplementation (Saltzman et al., 2017), this means the Government will save scarce foreign currency in the medium to long term due to reduced imports of selected pharmaceutical supplements such as iron, zinc and Vitamin A supplements. Biofortification will also help reduce mortality and morbidity rates related to malnutrition (HarvestPlus, 2019b; Saltzman et al., 2017). In addition, biofortification will contribute to increased food and nutrition security, productivity, and the quality of life for low-income and vulnerable populations.

The World Bank (2011) estimates that Zimbabwe is losing nearly US$24 million in GDP annually to vitamin and mineral deficiencies. However, it states that addressing undernutrition (incorporating malnutrition) is cost effective since scaling up core micronutrient interventions would cost less than US$8 million per year: and costs of core micronutrient interventions are as low as US$0.05–3.60 per person annually giving returns on investment as high as 8–30 times the costs (World Bank, 2011)..

2.4 Policy Support in other Countries

The following are examples of policy support in other countries as captured by HarvestPlus reports various years:

- Zambia: The Zambian government recognized the importance of biofortified crops such that it integrated biofortification into the National Food and Nutrition Strategic Plan and the Farmer Input Support Program (FISP). The FISP, is contributing to the improvement of the supply and delivery of agricultural inputs to small-scale farmers through sustainable private sector participation, and it is also ensuring timely access to inputs (including biofortified seed) by smallholder farmers and promoting agricultural diversification. In addition, during the 2020 harvest season, the Ministry of Agriculture with support from HarvestPlus identified farming area planted and farmers' expected yields of vitamin A maize. This information was then shared with crop processors so they could prepare for the procurement process and arrange for special transport.
- Colombia: The Colombia government was assisted by HarvestPlus in the distribution of more than 14 tons of biofortified maize, bean, and rice seed to farming families using public mail system which remained in service when other physical travel arrangements were restricted during the COVID-19 pandemic. Local farmers had to confirm deliveries and virtual training sessions were organized.
- Tanzania: The government issued comprehensive guidelines for biofortification activity across seed and food value chains. The guidelines act as reference point for value chain players to enable faster integration of biofortified seeds, grains, and foods in the food system.
- Guatemala: The Minister of Livestock and Food made biofortified crops to be part of the National System of Strategic Food Reserves, which is included in the government's COVID-19 Economic

Recovery Plan. The Ministry will also promote biofortified crop cultivation to help address food insecurity and malnutrition and boost families' resilience.

2.5 Awareness campaigns

Demand for the varieties would be boosted through public end-user awareness campaigns, taste tasting programmes, and value addition initiatives (new product development). The Ministry through the Department of Research and Specialist Services and partners such as HarvestPlus are already spearheading the process. The created demand will support continued involvement by private sector actors across the value chain hence ensuring sustainability of biofortification initiatives for Zimbabwe. The Food and Agriculture Organization (FAO) and other agencies are encouraging the production and consumption of biofortified crops in Zimbabwe and other countries. In addition the World Food Programme (WFP) has integrated biofortification in its local and regional procurement policies (WFP, 2019; HarvestPlus, 2019b). On another positive note the Scaling Up Nutrition (SUN) Movement in Zimbabwe is helping with building an enabling environment for biofortification by undertaking research, and strengthening the technical capacity of stakeholders.

HarvestPlus and partners have been promoting production and consumption of biofortified crops and would recommend up scaling of the initiative. Efforts should also be made to develop commercially viable private sector partnerships at all stages of the value chain to include; production, distribution, processing and retail. The initial targeting of the rural poor—vulnerable communities who stand to benefit the most from biofortification—through the Government's Input Support Program is a strategic one in the short term. However, in the long term, there will be need to tap into the potential market of urban poor and wealthier urban consumers. This will be crucial to maintain long-term demand and to trigger value chain development.

2.6 Monitoring and Evaluation

The Ministry of Lands, Agriculture, Fisheries, Water and Rural Resettlement and the Ministry of Health and Child Care already have monitoring and evaluation mechanisms to monitor and evaluate the progress of government programmes. Monitoring and evaluation is a critical factor in the sustainability of biofortification. The public and private sectors would need to actively monitor and evaluate activities to ensure that the food is biofortified at adequate levels and is properly labelled when it reaches the consumer. The monitoring system would also ensure that quick corrective actions are undertaken by relevant parties when problems are identified. Evaluation would be used to perform the following: recognizing patterns of consumer behaviour for the biofortified food purchases and consumption; tracking intake of the nutrient of interest and the contribution of the biofortified food to this intake; and impact on the public health problem being addressed.

To ensure high quality data from partners, MLAFWRR and MoHCC and partners should put in place a rigorous data quality checking system, which includes conducting periodic critical reviews, surveys, and evaluations to assess the evolution of results on the utilization of biofortified maize and beans, and processed products.

3 Conclusions and Recommendations

The evidence shows that use of biofortified crop varieties is a cost effective, sustainable and scalable strategy to prevent hidden hunger in low income rural communities (Meenakshi et.al, 2010); and in the medium to long term will penetrate to urban populations as production surpluses are marketed. Biofortification complements dietary diversification, commercial fortification and micronutrient supplementation programs. As such, it should be integrated with these and other existing strategies within a broader policy framework including the Crop and Livestock Input Support Programmes.

Biofortification is beneficial to the country as it will address both nutritional and food security issues. At macro level it will reduce health related expenditure by Treasury on expenditures related to micronutrient deficiencies. The World Bank estimates that Zimbabwe loses nearly US$24 million in GDP annually to vitamin and mineral deficiencies. Biofortification represents an economically viable immediate to long term intervention to improve quality of life, health and well-being of the most vulnerable populations. Biofortification is an upfront investment with few major recurrent costs when compared to other interventions such as industrial fortification and pharmaceutical supplementation. This implies that the Government will save the much scarce foreign currency in the medium to long term given the reduced imports of certain pharmaceutical supplements such as iron and vitamin A supplements. In addition, biofortification will contribute to reduced micronutrient malnutrition related mortality and morbidity rates.

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