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Building Resilience to Climate Change through the Adoption of Grain and Vegetable Amaranth in Binga District of Matabeleland North, Zimbabwe

Francis Muromo[1,*], Tendai Madanzi[2], Pepukai Manjeru[2], Innocent Isaac[3], Jephias Matunhu[1]

[1]Tugwi Mukosi Multidisciplinary Research Institute (TMMRI), Midlands State University, Zvishavane Campus
[2]Department of Agronomy and Horticulture, Faculty of Agriculture and Natural Resource Management, Midlands State University, Main Campus, Gweru
[3]Ntengwe For Community Development (NCD), Victoria Falls, Zimbabwe
*Corresponding author: muromof@staff.msu.ac.zw

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Abstract This paper seeks to popularize and commercialize grain and vegetable amaranth (*mowa in Shona, imbuya in IsiNdebele and bboonko in Tonga*) by local farmers in Manjolo and Sikalenge wards in Binga District of Matabeleland North Province, Zimbabwe. The paper is based on a baseline survey of randomly selected 74 farmers in the two wards. The paper argues that the introduction of grain and vegetable amaranth in Binga District, will improve nutrition security for humans and livestock. Findings of the study indicate that the majority of the respondents knew the local vegetable amaranth types (various weedy species) but did not know the white version (*Amaranthus hypochondriacus*) grown also for its grain value. Results also indicate that the weedy species germinate naturally in the District and local communities in the two wards viewed these as a weed and had therefore not bothered about the crop because the knowledge about its potential markets was not known. The paper recommends the adoption of grain and vegetable amaranth in arid areas such as Binga because of its higher nutritional quality and quantity than traditional crops.

Keywords: *drought, food insecurity, rain-fed, nutritional resilience*

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1. Introduction and Background

This paper seeks to popularize and commercialize grain and vegetable amaranth (amaranthus hypochondriacus). The crop known as '*mowa' in Shona, imbuya in IsiNdebele and 'bboonko' in Tonga*) has been introduced to local farmers in Manjolo and Sikalenge wards in Binga District of Matabeleland North Province, Zimbabwe by Ntengwe for Community Development (NCD) in partnership with Christian Aid Zimbabwe (CAZ), the Tugwi Mukosi Multidisciplinary Research Institute (TMMRI) of the Midlands State University (MSU) and the Agricultural Extension and Technical Services (AGRITEX) Department of the Government of Zimbabwe with funding support from the New Zealand High Commission in Pretoria.

It is hoped that the introduction of the grain and vegetable species in the two wards will build community resilience to nutritional shocks caused by climate variability through a multi-stakeholder and a multi-sectoral participation. The grain and vegetable amaranth has a C4 photosynthetic pathway which allows it to tolerate droughts and rainfall variability better than cereals like maize. The paper argues that the introduction of grain and vegetable amaranth in Binga District will improve food and nutrition security for humans and livestock.

The grain and vegetable amaranth project started in January 2020 and will end on 31 December 2020 in the two wards of operation. The project initially targeted 40 young farmers particularly women but ended up with 47 participants at inception with some elderly men and women joining the project.

2. Literature Review

Throughout history, wild vegetables played a significant role in the daily diet of the indigenous people of Zimbabwe. It is sad therefore that even up to now, this role has not yet been recognized by academia and policy makers resulting in avoidable malnutrition especially among poor communities.

Amaranth is an indigenous resource which is climate smart and readily available in the marginal areas. Ignoring

it in favour of exotic vegetable species cannot be a sustainable and environmentally sensitive development strategy. Fragmented attempts in the past by the National Agricultural Extension Services Unit of the Government of Zimbabwe to implement nutrition programmes through village gardens have been a step toward addressing household food availability, but the focus has been to encourage farmers to grow crops of exotic origin requiring high levels of inputs, which are not always available and are costly.

The list of recommended winter vegetables reads: cabbage (Brassica oleracea), rape (Brassica napus), carrot (Daucus carota), tomato (Solanum lycopersicum), onion (Allium cepa), spinach (Spinacia oleracea), lettuce (Lactuca sativa), maize (Zea mays), beans (Phaseolus vulgaris, pumpkin (Cucurbita, okra (Abelmoschus esculentus) and sweet potato (Ipomoea batatas). The only indigenous vegetable in this list which is okra (derere), but in fact it is not the traditional material that is being recommended but a hybrid.

Household food and nutrition insecurity remains a significant challenge perpetuating a cycle of poverty and income disparity of millions of low income groups in Zimbabwe and other African countries (SNV, undated). This is exacerbated by climate change and variability. Climate variability refers to the climatic parameter of a region varying from its long-term mean while climate change is attributed to both natural variability and human activities. According to SNV (undated) over 2 billion people globally, suffer from micronutrient deficiency, a condition called hidden hunger. Therefore, the production and consumption of grain and vegetable amaranth will help alleviate food and nutrition security challenge of the resource poor people of Binga District. The resource poor farmers have the capacity to produce vegetables but they lack access to formal and organised markets, which pay well hence the need to link them with such markets.

The changing climate has caused adverse effects such stunted growth in children to the local communities in Binga thus undermining their food and nutrition security. According to Temidayo, [1] adaptation to climate change impacts on agriculture has therefore become a major concern to various stakeholders in sub-Saharan Africa. Due to this, special emphasis has been directed on how to assist farmers to improve their adaptive capacity. Manjeru, [2] points out that most resource poor people rely on rain fed agricultural systems for their livelihood. As a result of that, they are highly depended on climatic conditions.

The above has been exacerbated by recent evidence and projections by the Intergovernmental Panel on Climate Change [3] that indicate that global climate change is likely to increase the incidence of natural hazards, including the variability of rainfall, temperature and occurrences of climatic shocks. In 2010 the United Nations Development Programme (UNDP) estimated that that by 2020 between 75 and 250 million people were likely to be exposed to increased water stress and that rain-fed agricultural yields could be reduced by up to 50% if practices remain unchanged in some countries in Africa.

These changes have placed additional pressure on the already overstretched food supply systems in African drylands thereby undermining the livelihoods of the poor farmers in those areas with high temperatures but low and erratic rainfall. For Svodziwa [4], there is need to come up with viable strategies to adapt and to mitigate the effects of climate change and variability, which is causing shifts in the rainfall patterns in many parts of the world. The introduction of amaranth in Binga District is therefore going to promote nutritional security and adaptation to climate change.

In Binga District, where agriculture is the main source of livelihood, responding to climate change should be a priority. Empirical findings indicate that Zimbabwe is getting more vulnerable to climate change, and the local climatologists predict that there would be reduced productivity of crop-livestock systems in the country's marginal rural areas [5]. Zimbabwe is particularly vulnerable due to its heavy dependence on rain-fed agriculture and climate-sensitive resources [6,7]. According to UNDP report [8] climate change is rapidly taking place in dry land regions and it is causing serious reductions in agriculture production whilst agriculture and its linked activities are the backbone of the rural economy.

Most farmers in arid regions similar to Binga, such as Chiredzi District, have experienced multiple climate risks and have confronted them with a diverse range of coping mechanisms [9]. Crop diversification is one of the strategies proposed to minimise impacts of climate change and variability among resource poor farmers [10]. Food and nutrition security are promoted by resilient local crops. These would expand dietary diversity and taking a whole-family approach to behaviour change on nutrition. There is therefore need to create sustainable markets through inclusive business strategies that involve low-income groups in value chains as producers, distributors or consumers. This would allow them to adopt a 'market systems' perspective in value chain development interventions.

3. The Study Area

Binga District, where this project is located, is predominantly occupied by the minority BaTonga people, who are both geographically and socially marginalised. The district is remote and very poor, with a poverty prevalence of 88.3% in 2012 [11], which is high even for Zimbabwe, where the national average was 72% in the same year. This concentration of people living in poverty has been attributed to high levels of deprivation, illiteracy and recurrent droughts.

Binga District is faced with chronic poverty, food insecurity, malnutrition, environmental and climate change related hazards negatively affecting women, children and youths. The area is characterized by highly erratic and low rainfalls (less than 450 mm/year) and poor soils predominantly the Kalahari sandy soils, which have failed to improve food and nutrition security when crops are planted leading to food insecurity. This has led to the cultivation of exotic vegetables during the cool season only using irrigation water.

Figure 1. Location of Binga District

4. Research Methodology

This multi stakeholder and multi sectoral approach integrated both qualitative and quantitative data. This enabled triangulation, explanation and contextualization of the findings. The approach started with the training of 47 farmers on the production of grain and vegetable amaranth at Ntengwe Drop-In Centre in Binga. Data collection was done in three forms that is household questionnaires, interviews with key informants and focus group discussions. Also as part of the launch of this project, a baseline survey of 74 farmers was conducted which included the trained 47 farmers and 27 non-trained farmers in both Manjolo and Sikalenge wards as well as Binga Centre.

Key Informant interviews were conducted at Binga Centre with the Binga Hospital Nutrition Department, Agritex, the Grain Marketing Board, the District Development Coordinator, 3 informal market traders, 1 lodge and 1 supermarket owners as well as the Social Services Officer of Binga Rural District Council. The survey sought to solicit information from the farmers and stakeholders on what information to include in the Information Communication Technology Application for the basic management of the grain and vegetable amaranthus by the farmers in the two wards.

In addition to the above, two Focus Group Discussions (FGDs) were held with two separate groups of farmers mainly those who responded to the questionnaires on their own because they were literate and those who could not respond to the questionnaire on their own because they were illiterate. Focus groups discussions comprised of 8 to 20 people and the data collection team ensured all target groups that i.e. women and youths were included in the discussions.

A purposive sampling method was used in the selection of respondents. This was done to ensure groups targeted by the programme i.e. young women were sampled. Since the majority of the beneficiary population targeted by the programme are young women, a total of 56 respondents from the household questionnaires were women while 18 were men.

Data entry and analysis was primarily done using the Statistical Package for Social Sciences (SPSS) for computing frequencies, relationships and correlations between the variables under investigation. Thematic content analysis was used for qualitative data from key informants and focus group discussions.

5. Research Findings

The major finding is that all the respondents knew the wild vegetable species of the amaranth family but did not know the white one and its grain value. They indicated that the wild vegetable species was not cultivated in Binga District but germinates naturally and the local community viewed it as a weed. As for the gain and vegetable species (i.e. the white one), all the respondents had therefore not grown it and had neither knowledge about its grain value nor potential markets. The farmers indicated the need for an Information Communication Mobile Technology

application that would assist with information on how to cultivate the crop and link it to potential markets. The following are the demographic as well as socio-economic findings of the study.

6. Demographic Data

6.1. Distribution of Respondents by Wards

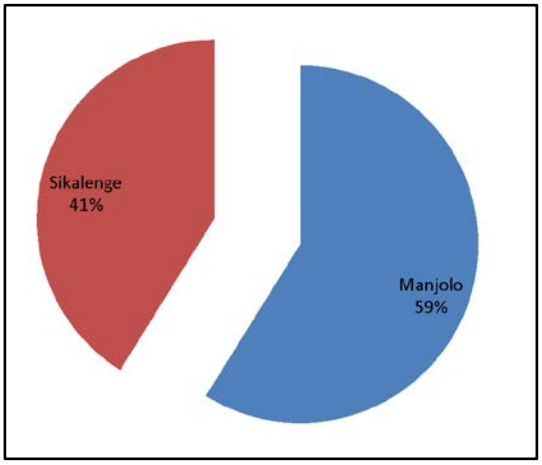

Figure 2. Distribution of respondents by wards

Of the two wards (Manjolo and Sikalenge) 74 respondents were interviewed. This figure included 47 farmers who trained at Manjolo-Drop-In Centre and 27 farmers who did not do the training. As shown by Figure 2, the majority of the respondents (59%) were from Manjolo and 41 % were from Sikalenge. A large number of respondents from Manjolo can be attributed to the proximity of the training venue to the ward. Many farmers from Manjolo had less than 20 minutes walking distance from the venue.

6.2. Household Designation of Respondents

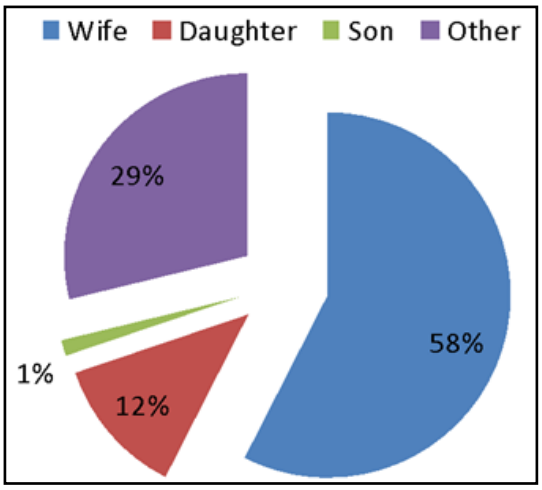

Figure 3. Role of respondents in the household

As presented in Figure 3, the majority of the respondents were women (house wives-58%) while young women) constituted (12%), the boy child (1%) with the rest or other (29%) included elderly male farmers in the two wards. The project mainly targeted women and youths hence the higher percentage of female respondents. The young women either widowed or divorced had children to look after hence their interest in the project.

6.3. Educational Background of Respondents

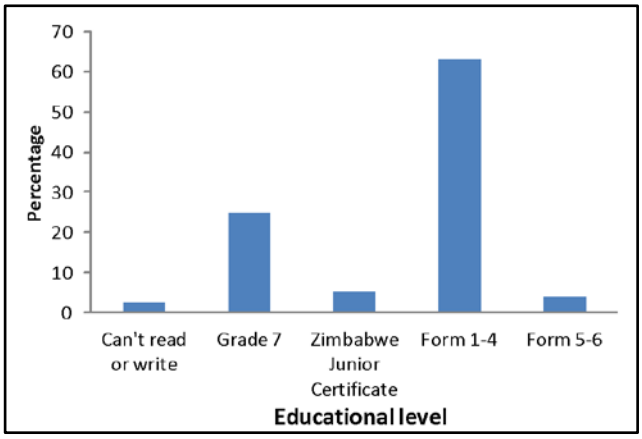

Figure 4. Educational background

Figure 4 presents the educational background of the farmers. Most of the respondents had secondary education (66%) and those who went up to Grade 7 constituted 25%. This meant that training the farmers was a bit easier as the majority of them could read and write. This meant more time was devoted to those who could not read and write.

6.4. Food Security and Adoption of Climate Agriculture Production Methods

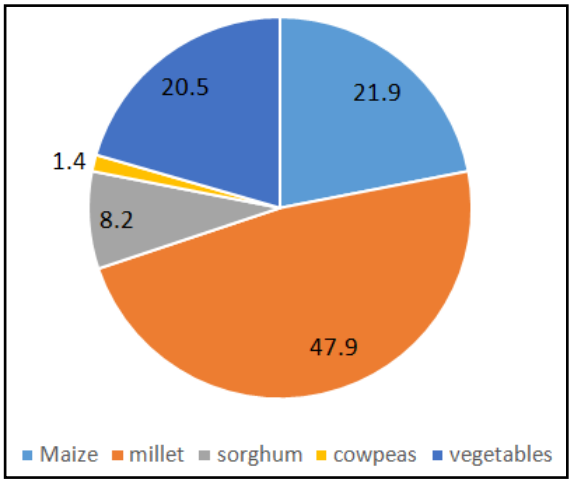

Figure 5. Food security and adoption of climate agriculture production methods

Figure 5 indicates that most farmers in Manjolo and Sikalenge wards (47.8 %) grew pearl millet followed by maize (21.9 %). Other crops like sorghum and cowpea were considered minor at 8.2 % and 1.4 % respectively. Those who grew vegetables constituted 20.5 % of the respondents. The majority of the households obtained between one to five bags of grain (67. 1 %) while 24.7 % obtained five to ten bags of grain in a season. Only 8.2 % obtained more than 11 bags of grain. A grain bag weighs approximately 50 kilograms. This information was corroborated by information from key informant interviews (KIIs) of the Department of Agricultural

Technical and Extension Services (AGRITEX) indicated that Binga was ± 75 % food insecure. The food insecurity was attributed to climate change and variability including shifts in rainfall seasons, shortening of the rainfall season, uneven distribution of rainfall where 800mm to 1000 mm of rainfall could be received in just two weeks of the season. There were also incidences of high temperatures causing high levels of evapo-transpiration (ET). This was further exacerbated by the reliance of farmers on seed handouts from government and development partners such as non-governmental organisations (NGOs) as the farmers lacked skills in seed production and storage.

The study also sought to determine farmers' general knowledge on other climate smart agricultural production practices besides conventional farming that had been advocated by AGRITEX for decades and conservation agriculture that is promoted by NGOs. Results indicated that there was a general appreciation of the use of mulching (20. 5 %) and basins (16.4 %). Other practices that have been proven to be the best in building farmer resilience and advocated for in agro-ecological farming in areas more prone to extreme weather events like regular droughts and flooding including the following; contours (13.7 %), pot holing (9.6 %), swales (4.1 %), diversion drains (8.2 %), terracing in sloppy areas (2.7 %), reduced tillage (9.6 %). 15.1 % of the farmers were not practising and water or soil conservation. Both the farmers and the key informant interviewees (KIIs) indicated the need to deepen adoption of agro-ecological farming as compared to conservation or conventional farming as compared to traditional belief farmers

. Both AGRITEX and organisations such as Ntengwe for Development need to consider agro-ecology as advocated by the Food and Agricultural Organisation (FAO). Diverse, severe, and location-specific impacts on agricultural production are anticipated with climate change especially in Africa. Climate-induced changes in temperature, water availability, insect, pest, pathogen and weed population dynamics and invasiveness could compound such effects in dominant industrial driven conventional farming systems.

Agro-ecological farming systems have the potential to strengthen the resilience of farmers and rural communities through diversification of agro-ecosystems in the form of polycultures, agroforestry systems, and crop-livestock mixed systems accompanied by organic soil management, water conservation and harvesting, and general enhancement of agro-biodiversity and could be adopted by Ntengwe in Binga and other Districts in Matabeleland North.

As the main thrust of the baseline survey was to determine farmers' knowledge on production of grain amaranth, the formal survey results indicated that the majority of farmers had never heard or seen the crop (71.2 %). The farmers indicated that they did not know where to market it (98 %) or how to process the crop (100 %). The Agritex Office highlighted that the project on growing grain and vegetable amaranthus is entirely new in Binga district and that the office is keen to work on the project and to learn from its outcomes. Agritex noted that vegetable amaranth known as *bboongo* in Binga germinated naturally and was not traditionally cultivated as a crop. They also emphasized on the need to promote and localize the vegetable for domestic use in terms of its nutritional value apart from income generation. KIIs with AGRITEX indicated that they had information that grain amaranth had shown promise and could complement sorghum and pearl millet in improving household food security in Binga. They indicated need for training on seed multiplication and distribution as well as market development and utilisation to enable its higher adoption. The majority of respondents (98.6%) say there are no ready markets for Amaranth, and 2.7% say there is a market. Hence, there is need to carry out market research survey and study the possible value chain of the crop. About 4% of respondents say local people are the potential customers of amaranth, and 96% has no idea of the potential market in towns and holiday resort centres.

6.5. Main Sources of Income

The main sources of income in Manjolo and Sikalenge wards are selling vegetables from family gardens, fish from the nearby Zambezi River, wild fruits (Busika - Tamarind and Nkula), livestock as well as traditional beer. These sources of income show that these people rely mainly on what they get from their locality which means they are less resilient to the persistent droughts in the district. There is need to diversify sources of livelihood for the residents of the two wards.

6.6. Cell Phone Application for the Farmers

To embark on this new livelihood portfolio, the respondents indicated that they want a cell phone application which they hope will greatly capacitate them. The application should have the following information:

- Empirical information on the amaranths production including the other small grains that they grow in their area;
- Knowledge on available markets for their products;
- Accurate weather predictions;
- Information on pest control;
- Climate change information - mitigation and adaptation
- Input prices

7. Conclusion and recommendations

From the above findings the following conclusions and findings are made;

a) The existing cropping system in the two wards and Binga district in general has nutritional deficiencies with most crops being cereals deficient in micronutrients. For example, pearl millet, maize, cowpeas and vegetables constitute less than 25 % of total cropping in the two wards. Addition of crops like grain and vegetable amaranth with higher nutritional quality and quantity than traditional crops such millet and sorghum in the district is handy and must be expanded.

b) There is a limited diversity of crops and sources of income for farmers in the two wards. Diversity of crops is encouraged for it gives nutritional resilience while wider income sources build resilience to extreme weather conditions such as droughts.

c) Farmers in the two wards and Binga in general have unreliable seed sources. They depend on handouts from government and non-governmental organisations (NGOs). The adoption of agro-ecological farmer practices that advocate for seed and food resilience using traditional farmer farming methods is essential.

d) Information on production practices that reduce vulnerability to climate change is offered in a piece meal approach by NGOs. Ntengwe For Community Development can adopt agro-ecological farming practices by copying from organisations such as the Transformation for Sustainable Use of Resources Organisation (TSURO) and Chikukwa Ecological Land Use Community Trust (CELUCT) in Chimanimani District in the eastern highlands of Zimbabwe.

e) Farmers have poor access to weather, production, pest control, input sources and market information therefore, the development of a Ntengwe Farmers' cell phone Application that addresses these needs is essential in building productivity in Binga

f) Both AGRITEX and organisations such as Ntengwe for Development need to consider agro-ecology as advocated by the Food and Agricultural Organisation (FAO). Diverse, severe, and location-specific impacts on agricultural production are anticipated with climate change especially in Africa. Climate-induced changes in temperature, water availability, insect, pest, pathogen and weed population dynamics and invasiveness could compound such effects in dominant industrial driven conventional farming systems.

g) Agro-ecological farming systems have potential to strengthen the resilience of farmers and rural communities through diversification of agro-ecosystems in the form of polycultures, agroforestry systems, and crop-livestock, mixed systems accompanied by organic soil management, water conservation and harvesting, and general enhancement of agro-biodiversity and could be adopted by Ntengwe For Community Development in Binga and other districts in Matabeleland North as well as Zimbabwe at large.

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