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## VALUE CHAINS AND CLIMATE CHANGE MITIGATION STRATEGIES: A CASE OF NUTRITIONAL GARDENS IN ZIMBABWE

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### Abstract

High incidence of drought and donor fatigue in Zimbabwe calls for more sustainable measures of ensuring food security. This study analyzed the impact of nutritional gardens in the two drought-prone districts of Mudzi and Mutoko. In line with attaining Sustainable Development Goals (SDGs) targeted to be achieved by 2030, nutritional gardens were identified as a sustainable way to mitigate climate change and address the 'hidden hunger' challenge. Primary data was collected using a baseline framework adopting a triangulation methodology of questionnaires, interviews and focus group discussions (FGDs) across 100 households and key informant stakeholders. Data for 48 households was usable. Results indicated that majority are low-income earners. There are high levels of deforestation and siltation, low water table and low harvest due to frequent droughts. Main crops are drought resistant crops such as millet, sorghum and legumes like groundnuts. Gardens present great potential for food and nutrition supplement and income from the sale of horticultural products. COVID-19 increased vulnerability of all stakeholders across the whole value-chain. The study recommends more drought-resistant varieties, horticultural products, solar powered boreholes and value-adding processes like peanut butter and yoghurt production to optimize local resources.

**Keywords:** Climate Change, Nutrition, Community Gardens, Zimbabwe, Sustainable Development Goals (SDGs), Value-Chains, Sustainability

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### 1. Introduction

The unavoidable incidence of population increases and climate change has affected almost every country across the globe in varying degrees. In Sub-Saharan Africa (SSA), the increased rate of infrequent rains, flush floods and droughts continue to pose a major constraint towards the broad agenda of the Sustainable Development Goals (SDGs) of 'leaving no one behind'. The worsening

situation in SSA has resulted in Nigeria recently overtaking India to become the poverty capital of the world and many African countries becoming food insecure in recent years.

Zimbabwe was not spared by the climate change effects. As an agro-based economy and a former breadbasket of Southern Africa, the nation has been generally characterized as food insecure in the past twenty years. Inconsistent rains compounded with unreliable hydro-energy has resulted in many marginalized communities becoming even more vulnerable. Most communities spent an average of 80% of the day without electricity which not only affect their domestic consumption patterns like cooking and lighting but also the whole value chain in all economic sectors. The consequence was an exponential increase in the rate of exposure for vulnerable groups including persons with disabilities (PWD). To mitigate on the effects of climate change and contribute to the attainment of SDGs, it is envisaged that nutritional gardens and woodlots could provide sustainable means for rural communities. The overall goal is to improve nutrition and food security levels in the community whilst at the same time improving the rate of social inclusion through a reverse integration process since these gardens will benefit both PWDs and persons without disabilities.

Nutrition gardens are not a new phenomenon. They have their roots in the Victory Gardens of WWII, were revived in the 1960s and 1970s and started experiencing some grassroots resurgence in the early 2000s when the Millennium Development Goals (MDGs) were introduced in 2000 before being restructured and renamed into the current SDGs (2015-2030). According to Ge *et al.* (2022), definition of community gardens are closely related to culture and society which implies that different regions and countries have different meanings, a sentiment shared earlier by Ferris, Norman and Sempik (2001) who highlighted that offering a precise definition would be impose arbitrary limits on creative communal responses to local need. Nevertheless, for the purpose of objectivity, this paper attempts to define community gardens shared spaces where individuals (or households) garden together to grow fresh, healthful, and affordable fruits and vegetables. In America, community gardens were more common in suburban as opposed to rural settings due to shared properties. The terms 'nutrition' and 'community' gardens will be used interchangeably in this study. This is because although the aim is to improve nutrition levels, the gardens are being run at the community level with various community stakeholders involved in the project planning, implementation and sustainability.

Nutritional gardens feed directly and in several ways in to the SDGs. They provide a pragmatic and cost effective way of improving community welfare. By their very nature, the SDGs are intricately intertwined in such a manner that addressing one goal usually leads to positive changes in several other goals through transmission and multiplier effects. For instance, nutrition gardens will significantly contribute towards poverty reduction and hunger (Goals 1 &2), promotion of responsible production and consumption (Goal 12) while simultaneously improving good health and wellbeing (Goal 3) through supplementary food, which will add to the nutritional components of their diets. Micronutrient or under nutrient deficiency also referred to as 'hidden hunger' is substantially higher in rural areas affecting more than half of the women and around 24% of men (Lacey *et al.* 2009). Malnutrition can manifest itself as overweight or underweight. The World Health Organization (WHO, 2020) reported that 464 million adults are underweight while 1.9 billion adults are overweight globally. For children under five years, WHO figures reflected that 41 million are overweight while 528 million experience stunted growth and 29% of women affected by anemia. Half would be amenable through iron (or nutrition) supplementation but the challenge is that many families cannot afford or access nutritious foods like legumes, meat, milk, fresh fruits, and vegetables.

Thus, dietary diversification strategies including home gardens, livestock and dietary modifications showed improved hemoglobin and serum retinol concentrations for children (1-59 months). Moreover, the members will also benefit from these gardens through educational programs (Goal 4) which will be provided by support services such as Agricultural Extension (Agritex) services and Environmental Management Agency (EMA) officers and through peer-to-peer knowledge exchanges within their garden groups. Proceeds from the gardens will also add to their disposable incomes, which implies them affording to pay school fees for their children and dependents.

Clean water (Goal 6) from boreholes which is powered either using bush pumps or solar energy systems also implies there is a decent work environment (Goal 8) which has affordable clean energy (Goal 7) thereby significantly pointing towards sustainability of both the project and livelihoods. The integration of men, women, youth and PWD in the nutritional gardens also implies that there is not only gender equality (Goal 5) but also reduced inequalities across the whole community (Goal 10). Both nutritional gardens and woodlots are aimed at cushioning the community from the adverse effects of climate change (Goal 13) which compounded already existing challenges of low rainfall in the area. Thus, nutritional gardens are fundamental economic growth and empowerment tools, which should be scaled up and promoted in order to attain inclusive, equitable and sustainable opportunities for all.

In recent years, the promotion and development of community gardens as a strategy of improving responsible community-wide consumption of fruits and vegetables has grown significantly. Twiss *et al.* (2003) postulated that community gardens not only promote quality public health through enhanced nutrition, but also improved physical activity. They also enhance opportunities to build social capital by incorporating local leadership and resources, members, partner institutions, and opportunities to build skills. These initiatives also stimulated the enactment of policies for complimentary water and land use, increased public consciousness on public health due to increased access to produce and also reinforced communities due to improved interactions.

Literature on the impact of agricultural interventions on nutritional status of populations indicated that nutritional or community gardens had higher success rates than other types of agricultural interventions. Gardens, which had various plant species, led to significant behavioral change due to multiple utility, which include but not limited to increased nutritional awareness, herbs, and cultural significance (Pradhan *et al.* 2018; Keatinge *et al.* 2012). Case studies<sup>1</sup> in various communities whether advanced economies such as the United States of America or developing economies such as India, Burkina Faso, South Africa and Lesotho indicated that nutritional or community gardens have significantly influenced behavioral change in terms of both eating and spending habits. Communities became more conscious of their eating habits and started taking more fruit and vegetables and less milk and meat due to direct access. This is important in addressing the macro challenge of nutrient deficiency popularly known as 'hidden hunger'. Indigenous fruits and vegetables are generally a cheaper source of vitamins and minerals, are a high food source for the poorest families can be easily and effectively incorporated into nutritional gardens. Additionally, nutritional gardens can also provide an additional income source, which assists the poor households in meeting their basic needs.

The two nutritional gardens are located in Mudzi and Mutoko districts, in the Mashonaland East Province, Zimbabwe. The former is located in the far eastern part of the country covering approximately 4,075 km<sup>2</sup> of communal land with a population of around 135,513. The district of Mutoko neighbours the Mudzi district on the South-western end of the province. It covers 4,092.5 km<sup>2</sup> with an estimated population of 129,402. Mutoko is the designated growth point center and it has electricity, a hospital, a post office and few banking facilities. The center also has a Grain Marketing Board (GMB) depot and a cotton storage facility. However, there are no perennial rivers or streams in the district and the main source of clean water is from boreholes. There are also some water harvesting activities in the area where streambeds are dammed to catch seasonal run-off. The main source of livelihood is agriculture with the majority operating at subsistence level. The main crops from the two districts are groundnuts, maize, sunflower seeds, millet and sorghum.

The objective of this paper was to understand the current status of nutritional gardens and, secondarily, to verify if food security and inclusion can be ensured by nutritional gardens. The case study of households for Mutoko and Mudzi districts were used as benchmarks due to their vulnerability to droughts, cyclones and other natural disasters as highlighted earlier. The paper will fill in the literature a gap, as there is generally no known literature or case studies covering this field and region. Thus, the results from this study were able to provide the demographic structure which, among others reflects that households are general low income

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<sup>1</sup> These case studies are discussed in greater detail in the literature review section

earners, 70% earn less than USD 20.00 and the modal household has an average of between five (5) and nine (9) members. The highest level of education for the majority of households was observed to be primary and secondary with less than 5% having some vocational training course. Knowledge on conservation agriculture, environmental conservation, climate change and related aspects like greenhouses gases are generally low. Drought resistant and leguminous crops, which thrive in these regions, were also identified. More details are discussed in the results section.

The paper is structured as follows: Section 2 discusses the theoretical and empirical literature followed by the research methodology in Section 3. Research findings are then highlighted followed by a discussion of those results and recommendations in Section 4.

## 2. Literature review

Extrapolating from the theoretical rationale of (Mankiw *et al.* 1992; Nelson and Phelps, 1996), community programs such as nutrition gardens can minimize developmental lags through technological adoption. In this case, the use of solar powered boreholes will accelerate growth through the 'catch up' effect as described in the Solow (1956), Swan (1956) frameworks. The positive externality, therefore, will be increased in physical capital and labor productivity (Adelowotan, 2021; Lucas, 1998) through improved competencies as, for instance, PWD will become more productive due to use of solar systems, assistive devices and construction of accessible structures.

On the other hand, economic growth is affected by growth through four main channels: education, labor supply, productive efficiency and capital formation. In general, healthier society is more productive, creative, can learn better and have a more proclivity to save and invest throughout their lifetime, which in turn improves on overall economic growth and development through multiplier effects (Ware, 2017; Pasara *et al.* 2020). With regards to the impact of gardens in advanced economies, it is important to highlight that community gardens especially the USA were more common in urban settings compared to rural settings in low income countries. In their investigation on the perception of teachers in school gardens, Graham and Zidenberg-Cherr (2005) highlighted that 47% of the teachers in California perceived gardens were somewhat very effective in influencing behavioral change, which included healthful eating habits, language arts, physical activity and academic performance. When people have nutrition knowledge, their dietary habits also change. This research was conducted after the California initiative named "A Garden in Every School" which was recommended by the Centers for Disease and Prevention to establish school environments, which support regular physical activity and healthy eating habits. The study recommended that nutrition education should be provided in both schools and communities since increase in nutrition knowledge affects consumption preferences for vegetables, that is, change in consumption behavior. Households who participated in community gardens consumed 4.4 times per day fruits and vegetables compared to those who did not participate who consumed only 3.3 times per day. Moreover, the former group had 33.3% of their servings with vegetables whereas the latter group only had 18%. This study was significant because it was conducted in an underserved area where access to fruits and vegetables was limited.

Earlier study by Blair *et al.* (1991) evaluated the effects of Philadelphia Urban Gardening Project on dietary habits in gardeners using a sample size of 144 compared to matched non-gardening controls of 67. Overall, nearly 5,000 households benefited from 560 gardens. In relation to the control group, those with gardens consumed fewer milk products and sweetened beverages thereby complementing the findings that gardens not only lead to behavioral change but also improved variety in terms of diet. Similar results were also observed by Lacey *et al.* (2009) for the University of Wisconsin Cooperative Extension and Johnson *et al.* (2004) for the breastfeeding facilities in Mose Lake, MA. The latter observed that of the 61 community gardens, more than 50% reported eating more fruits and vegetables while 81% of the beneficiaries stretched food dollars with the garden.

Other studies did not just focus on the gardens themselves, but how garden markets could also stimulate behavioral change and improve community welfare? Kunkel *et al.* (2003) assessed the impact of a coupons program on consumption. Some 62.8% indicated that coupons

for farmers' market changed their eating habits as they could now afford fresh produce and 54.6% highlighted that buying fruits and vegetables even after exhausting their coupons. For Balsam *et al.* (1994), a survey of 400 participants with 124 respondents indicated that 68% had never shopped at farmers' markets before. Quality of fruits and vegetables at farmers' markets was perceived to be much better (27%), better (29%), or the same (38%) as grocery stores. After using their coupons, 38% continued shopping at the farmers' market. This study is relevant because it informs us that coupons tailor-made for the community gardens would allow for increased income flow within the community thereby increasing growth prospects through multiplier effects. The coupons will stimulate behavioral change in spending patterns as consumers source their fruits and vegetables from the gardens.

In terms of African experiences, Laurie *et al.* (2017) conducted an assessment of food gardens as nutrition tool in primary schools in South Africa. They focused on assessing the perceptions, knowledge and practices among students, teachers, and also garden management. The cross-sectional sample included 10 primary schools from 9 provinces in the National School Nutrition Program. Data was collected from 66 garden administrators, 55 garden workers, 687 educators and 2,547 learners. Results indicated that 66 (73%) of schools had a food garden with sizes varying from 100m<sup>2</sup>- 6,000m<sup>2</sup>. There were more vegetables grown but very few fruits. Challenges included technical support (50%), lack of funds (59%), garden workers (53%) and tools and infrastructure (47%). Around 54% of students participated and a third of the schools provided fresh garden produce at least twice a week. 68.4% of students and 86.4% of teachers indicated that they like to eat vegetables every day. Study concluded that there is need to strengthen school food gardens by training both teachers and garden personnel and support by external stakeholders was key in ensuring sustainability.

In Lesotho, Makhotla and Hendriks (2004) observed that irrespective of the significant link between home gardens and reduced incidences of wasting and underweight, the overall nutritional status of children was poor in the sampled area. Almost 29% of children with household gardens were underweight, 49% were stunted and 24% indicated signs of wasting because households did not have sufficient capacity. All these are challenges associated with 'hidden hunger' enshrined in the SDGs (2030). Schreinemachers *et al.* (2019) investigated on the impact of school gardens and complementary nutrition education in Burkina Faso. The results indicated showed a slight but significant knowledge improvement for sustainable agriculture (+5%) and food and nutrition knowledge (+6.6%). However, there were no observed increases in other outcome indicators. Pasara *et al.* (2020) postulated that although Zimbabwe boasts of a highly educated population, the paradox emerges in that it is characterized by a poor health system and suppressed economic growth. This is inconsistent with the general postulations of a positive link between the three indicators, which are key towards the attainment of the 17 SDGs. A case study from Zimbabwe by Mapira *et al.* (2014) observed that nutritional gardens could positively impact household livelihoods through supplementary incomes in addition to curbing diet-related diseases.

### **3. Materials and methods**

#### **3.1. Research design**

This study was conducted in a baseline framework to derive as much primary information as possible on nutritional gardens in the two districts of Mudzi and Mutoko in Mashonaland East in Zimbabwe. A triangulation methodological approach of questionnaires, interviews and focus group discussions (FGDs) was employed to inform the researchers on the demographic status of beneficiary households, their level of training and managerial and institutional capacity of supporting organizations among other factors. This was aimed at filling a literature and statistical gap since no known similar study had been conducted in the country.

#### **3.2. Study area and sample**

Zimbabwe has five (5) natural farming regions. Mudzi and Mutoko regions fall under region (IV) which is the biggest with an area of 147,800 km<sup>2</sup>, approximately 38% of the total land area in

Zimbabwe. This is a semi-arid region (together with region V), which is prone to droughts and thus, is in need of sustainable methods of farming. Thus, it was selected due to its idiosyncratic characteristics with regards to sustainable farming and development.

A mixed method was used for sample structuring. In the case of households, stratified random sampling was used from garden beneficiaries. Although the actual sample was finally reduced due to feasibility and relevance, the original sample stratification was guided by the traditional model:

$$ss = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p(1-p)}{e^2 N}\right)}$$

where N = Pop size, ss = sample size, e = argin of error, z= z-score.

The researchers ensured that the sample was representative enough by also including people with disabilities (PwDs), Families/Caregivers, traditional leaders and community members, who were either part of the direct group (beneficiaries) or indirect group (non-beneficiary stakeholders).

Structured questionnaires were given to members from both nutritional gardens, that is, Huyoyo-Mangondo and Masarakufa villages. Structured questionnaires covered the following thematic areas: demographic data such as (i) livelihoods, (ii) education, (iii) health, (iv) social and (v) empowerment. Moreover, additional data also included level and administration of contributions and stage at which the respondent is involved in the value chain. The other aspects also included the level of knowledge in terms of agricultural and environmental conservation and general aspects such as the impact of climate change and COVID-19 pandemic. In the case of key informant interviews, a combination of identified stakeholders and snowballing was also employed to optimize on the responses since the study was conducted in a baseline framework. Tailored questionnaires were also used to capture technical information from officers and administrators in the district. The respondents to the structured questionnaires and interviews were (i) 48 household members of nutritional gardens, (ii) District Administrative Officer – Department of Social Development, Mudzi District, (iii) Nutritionist, (iv) Agritex Officer, (v) Executive Officer-Social Services Mutoko, and (vi) the Provincial Officer.

### 3.3. Data validity, trustworthiness, analysis and ethical considerations

The data collected was then captured through the Census and Survey Processing System (CSPro) software. The CSPro software allows complex survey data to be entered, tabulated and disseminated in a way, which is useful for comprehension and analysis. Quality and validity of the process was ensured by sending questionnaires for quality control with other experienced researchers. Secondly, interviews and FGDs were scheduled in advance to ensure quality attendance and discussions on data collection. Finally, feedback was sent to respondents through emails after the transcription process was completed.

Several processes were used to ensure objectivity and moral integrity is attained. Firstly, the structured questionnaires were sent for quality control to Jairos Jiri Association (JJA) and the ethics committee. In addition, participants were notified that participation was voluntary and interviews were conducted in a formal setting. Finally, participants were notified that their personal information would remain anonymous.

## 4. Results and discussion

### 4.1. Demographic information

This section indicates some of the key findings, which were observed by the researcher using survey questionnaires and interviews. A total of 48 responses were gathered out of the 100 households from the two nutritional gardens. Thus, the researcher deems the sample size to be

representative enough to represent the whole. The following results were captured and analyzed using CS Pro 7.4.

Table 1 indicates that the modal age ranges are 20 to 39 years, which consists of 11 males and 7 females and the 40 to 59 years consisting of 8 males and 12 females. Those above 60 years are 2 males and 7 females. Using this simple statistics, one may infer that the participation of males in community projects diminishes as age increases. Of the 7 respondents who responded yes to the orphan/widow category, there was only 1 male. There were 17 responses, who are in the PWD category. These include: (i) (Partial) blindness/visual impairment, (ii) (Partial) deafness/hearing impairment, (iii) Brain disturbed/mental health disability, (iv) Walking difficulty (crawling), (v) Urinary outlet blocked, (vi) Stammering, (vii) Foot impairments/deformed foot/legs, and (viii) Stroke. A closer look at the figures indicates that 5 of the 17 PWD who responded were either orphans or widows. This implies that their level of vulnerability was much higher than others. This sentiment is shared by Matlaka *et al.* (2021), who described various challenges experienced when dealing with victims and survivors of natural disasters.

**Table 1. Household demographics by respondent(s)**

	Total	Male	Female
<b>Age</b>			
Total	48	22	26
0 to 19	1	1	-
20 to 39	18	11	7
40 to 59	20	8	12
60+	9	2	7
<b>Orphan/Widow</b>			
Total	48	22	26
Yes	7	1	6
No	41	21	20
<b>PWD</b>			
Total	48	22	26
Yes	17	6	11
No	31	16	15

Source: Author's computations using CS Pro.

The results in Table 2 indicate that 19 households earn less than USD 10.00 per month and around 18 households earn between USD 10.00 and USD 20.00 with majority of families having between 5 and 9 members, that gives an average income range of less than USD 2.00 per person per month. These findings confirm indications by other studies such as Adelowotan (2021); Altiner and Toktas (2017) that rural communities are dominated by low income earners and least educated people. This may be due to rural-urban migration (Pasara *et al.* 2021).

**Table 2. Monthly income by family members**

Monthly Income (USD)	Family members			
	Total	0-4	5-9	10+
Total	48	14	34	-
0 to 9	19	6	13	-
10 to 20	18	3	15	-
20 to 50	1	-	1	-
50 to 100	4	1	3	-
100 to 200	6	4	2	-
over 200	-	-	-	-

Source: Author's computations using CS Pro.

As reflected in Table 3, majority of the people travel an average distance of between 5 to 10 km to access their nearest health facility. Similar results were also observed in terms of

distance to the nearest market. However, both the health facilities (usually clinics) and markets are too small and lack capacity to service the community. The next alternative is either the Kotwa or Mutoko center, which is between 20km and 45 km or the Mbare Musika market in Harare, which is at least 150km away. The Mukwaira garden is led by a female chairperson whilst the Mangondo is led by a male. The members for the former are currently meeting once a month while the members for the latter are meeting every fortnight. Garden A members indicated that they have both land and equipment as assets while the Garden B members indicated that their group currently owns land. With regards to the stage of the value chain which the respondent will be involved in, majority of them (36, 75%) indicated that they will be involved in the whole value chain. Thus, there will be no division of labor or specialization in the early phases of the implementation of this program. In a South African context, Adelowotan (2021) also highlighted the need to integrate the fourth industrial revolution to ensure sustainability of small and medium enterprises.

**Table 3. Age, hospital (km), market (km), by sex, orphan/widow, PWD**

	Sex			Orphan/Widow			PWD		
	Total	Male	Female	Total	Yes	No	Total	Yes	No
<b>Age</b>									
Total	48	22	26	48	7	41	48	17	31
0 to 19	1	1	-	1	-	1	1	1	-
20 to 39	18	11	7	18	1	17	18	3	15
40 to 59	20	8	12	20	3	17	20	7	13
60+	9	2	7	9	3	6	9	6	3
<b>Hospital (km)</b>									
Total	48	22	26	48	7	41	48	17	31
0 to 4	4	1	3	4	2	2	4	2	2
5 to 10	42	21	21	42	4	38	42	14	28
11 to 20	2	-	2	2	1	1	2	1	1
20 +	-	-	-	-	-	-	-	-	-
<b>Market (km)</b>									
Total	48	22	26	48	7	41	48	17	31
0 to 4	32	10	22	32	5	27	32	11	21
5 to 10	15	11	4	15	2	13	15	6	9
11 to 20	1	1	-	1	-	1	1	-	1
20 +	-	-	-	-	-	-	-	-	-

Source: Author's computations using CS Pro.

Table 4 indicates the level of knowledge with regards to conservation matters. The researcher, however, notes that a low level was considered if the respondent could not relate at all with the subject line, medium if at least a definition and example could be given and high if more technical information could be given. In general, the level of knowledge with regards to conservation agriculture was medium which had 33 respondents. This was mainly because of the frequent interactions and knowledge sharing sessions which are usually conducted by the local Agritex officers in the area. They indicated that they are, among other things, also practicing *pfumvudza*, a conservation farming strategy promoted and adopted by the Government of Zimbabwe with the support of the Food and Agriculture Organization (FAO) and the Foundations for Farming (FfF). On average, an Agritex officer covered seven (7) villages per ward and there are usually three (3) officers in a ward. Annual training sessions are also conducted which cover aspects on conservation agriculture. The modal response on environmental conservation was low. Interestingly, this concurs with the response from the EMA officer who indicated that there was a lot of environmental damage due to several factors (to be discussed in subsections below). Approximately half of the respondents indicated that their knowledge level on climate change was low while the other half indicated that it was medium but the rest of the respondents indicated low on greenhouse gases. Most of the respondents (26 of 47) indicated that they will implement the



conservation techniques in the garden while 14 responded that they will implement it in all areas, that is, home, community/woodlots and the garden.

**Table 4. Level of knowledge on conservation, environment, climate change and location of implementation**

	Total	48
<b>Conservation agriculture</b>	Low	13
	Medium	33
	High	2
	Total	47
<b>Environmental conservation</b>	Low	32
	Medium	15
	High	-
	Total	47
<b>Climate change</b>	Low	25
	Medium	22
	High	-
	Total	47
<b>Greenhouse gases</b>	Low	47
	Medium	-
	High	-
	Total	47
<b>Location of implementation</b>	Home	1
	Community	6
	Garden	26
	All	14
	Total	47

Source: Author's computations using CS Pro.

In terms of education, only 1 of the 47 respondents had reached a level of education beyond secondary level with the majority, that is, 36 having been secondary school educated. However, not all respondents reached the Ordinary level and neither of them reached Advanced level. The remainder, 16, only had primary education level. In addition to agriculture, respondents had some different technical skills in fabrication, tailoring, carpentry and building. Some also indicated that they had ICT skills but further inquiry revealed that they referred to their ability to use smartphones. Lastly, most of them received informal training mainly from the Agritex officers.

The main sources of income were (i) horticulture and other agricultural activities, (ii) small business enterprises and (iii) artisanal work (building, carpentry, art, craft).

#### 4.2. Biodiversity, livelihoods, and social inclusion

The results in Table 5 presents a summary of results for the type of biodiversity, livelihoods, land use, and social inclusion. In terms of flora and fauna, the area is characterized by erratic rains, seasonal wetlands. Mahogany and Mukwa trees are mainly used for firewood and timber whilst the dominant indigenous fruit trees are Baobab and Masawu, which are used for fruits and yoghurt. The key crops and their respective targeted outputs are maize (0.5 t/ha); groundnuts (0.35 t/ha); tomatoes (1.5 t/ha); sorghum (0.6 t/ha) and beans (1.2 t/ha). In addition, the type of livelihoods, and level of social inclusion are also included to provide a comprehensive outlook of the districts.

**Table 5. Biodiversity, livelihoods, land use & social inclusion**

	<b>Biodiversity</b>	<b>Biodiversity &amp; land use</b>	<b>Social inclusion</b>
<b>Respondent</b>	EMA Officer	Agritex Officer	Executive Officer, Social Services, District Development Officer, Nutritionist
<b>Description</b>	<p><b>Flora &amp; fauna</b></p> <ul style="list-style-type: none"> <li>-Erratic rains</li> <li>-Temperatures 22.5°C -25°C</li> <li>-Seasonal wetlands in some wards</li> <li>-Mahogany &amp; Mukwa for timber</li> <li>--Baobab and Masawu for fruits &amp; yoghurt</li> </ul>	<p><b>Key crops &amp; targeted production</b></p> <ul style="list-style-type: none"> <li>-Maize (0.5 t/ha)</li> <li>-Groundnuts (0.35 t/ha)</li> <li>-Tomatoes (1.5 t/ha)</li> <li>-Sorghum (0.6 t/ha)</li> <li>-Beans (1.2 t/ha)</li> </ul>	<p><b>Key services</b></p> <ul style="list-style-type: none"> <li>-Providing nutritional expertise to communities; Identifying true beneficiaries of projects and programs; Assessment of vulnerability status of groups; Assisting refugees and asylum seekers who come through the Nyamapanda border post; Child welfare and protection services (investigating child abuse, child protection); PVO registration and monitoring; Administration of the BEAM and harmonized cash transfer programs.</li> </ul>
<b>Awareness &amp; Access Level</b>	<p><b>Community knowledge</b></p> <ul style="list-style-type: none"> <li>-Medium in terms of general community knowledge</li> <li>-Some trainings were provided</li> <li>- Farmers practice crop rotation, traditional methods of pest control using natural herbs, early planting, weed control, tolerant cultivators &amp; organic farming</li> <li>-Medium in terms of pesticide management</li> <li>-Acts and regulations in place constrain farmer behavior</li> <li>-Agritex Officers constantly educate farmers</li> </ul>	<p><b>Value addition</b></p> <ul style="list-style-type: none"> <li>-Low in terms of processing and marketing knowledge</li> <li>- Farmers not involved in value addition processes</li> <li>- Most products sold locally and not branded.</li> <li>-Information asymmetry (few reliable and consistent sources)</li> </ul>	<p><b>Health, Education &amp; Security</b></p> <ul style="list-style-type: none"> <li>-Low in terms of access and quality, most households are food insecure</li> <li>-Facilities between 5km to 20km; expensive</li> <li>--Social security was deemed medium in terms of access and quality</li> <li>-Lack of specialized equipment in both schools and clinics/hospitals</li> <li>-Most households are food insecure, get food assistance from government and NGOs but are inconsistent</li> <li>-Level of lobbying was deemed low, lack of representation especially for vulnerable groups.</li> </ul>

Source: Author

Key social services include but not limited to providing nutritional expertise to communities; identifying true beneficiaries of projects and programs; assessment of vulnerability status of groups; assisting refugees and asylum seekers who come through the Nyamapanda border post; child welfare and protection services (investigating child abuse, child protection); PVO registration and monitoring; administration of the BEAM (Basic Education Assistance Module) program and harmonized cash transfer programs. Most of the information in this section was derived from the key informants described in the methodology section. Subsequent to that is

Table 6, which shows an overview of the challenges faced by various stakeholders in the two districts under consideration in this study.

**Table 6. Overview of challenges**

Community challenges	Challenges for PWDs	Organizational challenges
<p>-Mudzi and Mutoko are food insecure districts due to low rainfall</p> <p>-Community leaders derail programs</p> <p>-Lack of land for activities due to lack of support for land ownership</p> <p>-Limited finances to venture in mainstream developmental activities</p> <p>-Limited capacities in hospitals and schools resulting in social exclusion especially for PWDs</p> <p>-Deforestation, gullies, siltation</p> <p>-High population densities which result in pressure on natural resources</p> <p>-Restrictions on movement due to COVID-19 affected the whole value chain (access to fields, schools and markets) which further threatened the food security position in the region</p> <p>-Lack of PPE especially during COVID-19 outbreak</p> <p>-High unemployment in the two districts</p> <p>-Farmers lost many cattle last season due to drought</p> <p>-High incidences of hunger and poverty</p> <p>-Lack of safe and clean water for human consumption and watering gardens</p> <p>-Adequate water to irrigate their crops</p> <p>-No fencing material to fence their gardens, hence they use brushwood</p>	<p>-Acceptance is low in some households (there is pointing fingers witchcraft, divorce).</p> <p>-Limited access to services especially for PWDs. Pay double transport fare because of wheelchair thus compounding the disadvantage.</p> <p>-Lack of support to display their skills especially PWDs at local rural level.</p> <p>-Lack of transport and other equipment such as wheelchairs or specialized equipment</p> <p>-Lack of support to pursue education</p> <p>-No assistive devices, sunscreen lotions for people with albinism</p> <p>-Morbidity challenges</p> <p>-Access to school-hearing or speech impairment – no qualified teacher for sign language, they just go and play</p> <p>-Children with mental illness, they need teachers with specialized classes for their conditions so they just go and play.</p> <p>-Students with eye impairment- no brail. Parents cannot afford to go to Harare to look for assistive devices which is a major challenge</p> <p>-Government procurement procedures are cumbersome, need three quotations and you have to pay for transport for yourself and this is a challenge for PWD who not only have challenges with mobility but also have to pay double. Moving around with that child looking for quotes is not easy and sometimes not feasible. In most cases, the conditions deteriorate before the equipment or service can be procured.</p> <p>-Access costs, access fees, mobility and provision of specialized services are not available for PWD</p>	<p>-Fewer supplies to support programs and projects</p> <p>-Lack of transport for mobility to monitor operations</p> <p>-Mobility affecting coverage</p> <p>-Housing shortage for staff members in the ward</p> <p>-Shortage of stationary and equipment e.g. pegging equipment</p> <p>-Lack of funding to implement environmentally friendly projects</p> <p>-Lack of proper coordination with partner organizations. Sometimes certain key government departments are bypassed in some processes</p> <p>-Lack of information dissemination with stakeholders such as reports, operational policies</p> <p>-Inadequate finances and unstable policies. For instance, too many changes in the monetary policies hinder progress of programs. The Convention on the Rights of Persons with Disabilities CRPD has not yet been domesticated which makes it difficult to implement in some issues</p> <p>-Disability issues are not well funded due to policy shortcomings</p> <p>-Monitoring and evaluation (M&amp;E) shortfalls mainly due to the COVID-19 pandemic, which slowed down activities. Some M&amp;E targets need face to face interface which could not be implemented due to the lockdown</p> <p>-Majority of partners and key service providers had also shut down due to the lockdown</p> <p>-Lack of conducive legislature. The Zimbabwe Constitution (especially Section 83) states that services to persons with disabilities can ONLY be provided when resources are available</p> <p>-The Disabled Persons Act (1992/96) does not mandate Government to construct accessible structures. Other entities usually follow government trends. This makes awareness difficult to implement. Prior to the recent approval of the Disability Policy in February 2021, it was relatively challenging to enforce certain issues due to lack of detail and specificity</p>

Source: Author

## 5. Discussion and conclusion

The study provides an overview of the Mudzi and Mutoko districts with a focus on the nutritional gardens in Hoyuyu-Mangondo and Chatsaka village. Overall, the two areas are drought prone areas characterized by under capacitated subsistence farmers. Majority of these households earn less than USD 20.00 per month against a backdrop of between 5-9 family members resulting in extremely low per capita income levels. A survey of 48 household representatives of the 100 garden members indicated that there are low levels of understanding climate change and other environmental conservation measures as signaled by high activities of streambank cultivation, siltation of water bodies and unsustainable deforestation rates. The community largely produce drought resistant small grain crops such as sorghum, millet, and leguminous crops.

Thus, the nutritional gardens will significantly contribute in several ways towards improving community welfare. Firstly, by complementing their staple diets with fruits and vegetables thus addressing the perennial challenge of 'hidden hunger' and significantly contributing towards achieving SDGs. Secondly, nutritional gardens lead to behavioral changes in terms of both production and consumption patterns. Similar results were also observed by Laurie *et al.* (2017); Lackey *et al.* (2009); Lucas, (1998) who observed behavioral changes as discussed earlier. Thirdly, behavioral changes will be observed in terms of environmental conservation. Gardens make it easier and convenient for officials to access community members and disseminate information while simultaneously stimulating peer-to-peer interactions, which promotes social inclusion. Other exogenous challenges such as COVID-19 affected all stakeholders across the value chain. Generic challenges included lack of financial resources, poor project coordination by partner organizations due to lack of transparency on matters such as reports and implementation policies. This is consistent with observations by Denhere and Mhlanga (2021) who highlighted that the use of surrogate currencies in Zimbabwe led to the emergence of bad money (Gresham's law) which then increased the complexity in transaction especially in marginalized rural communities. However, Chiwira (2021) provided a possible solution and proposed that financial inclusion initiatives as reflected by increased bank deposits can sustainably promote development.

Thus, the study recommends that community gardens and woodlots should be promoted because they provide several additional benefits apart from nutritional supplements, which include but not limited to physical and mental fitness through increased activities, reverse integration as they stimulate social acceptance as persons without disabilities constantly interact with PWDs. Within the gardens themselves, there is also a dire need to replace the installed bush pumps on boreholes with solar powered ones and ensure an inclusive water delivery system from borehole to individual plots within the gardens. These will accommodate vulnerable groups such as the elderly and PWDs. Thus, solar energy systems will allow for optimization of the skills and abilities of PWDs leading to increased harvest and more food secure livelihoods. It is critical to conduct due diligence and thoroughly assess status in terms of land ownership when conducting projects such as nutritional gardens. Community projects are usually delayed or derailed by several key people, who may be keen to distort the project. This argument was also raised by Mathlaka *et al.* (2021), who argued that strategic people should be given resources and proper training since role ambiguity and lack of inter-professional collaboration may interfere with progress. Complementary to this, Pasara *et al.* (2021) highlighted that training improves both administrative capacity and scope of rural projects, which in turn leads to sustainability whilst Altiner and Toktas (2017) postulated that human capital development leads to economic growth. Moreover, communities should own land in writing especially those giving and the recipients should also receive in writing that we have received the land for community gardens. Tenure should be clearly defined to avoid future disputes of a land nature.

There is also need for frequent community consultations for project buy-in. Most projects fail because of a top-down approaches without a proper understanding of community structures and needs. Despite their consumption, people who responded especially in interviews did not show much interest in indigenous fruits compared to the conventional exotic fruits. Research revealed that perceived disadvantages of indigenous fruits were lack of improved planting material, lack of production material, poor image challenges in propagation and slow growth rate

leading to long waiting periods before the tree bears fruit. Thus, partners who specialize in finding innovative ways of improving indigenous seeds could be very value adding. The study also recommends proper Environmental Impact Assessment (EIA) process before implementation. There was a case in one of the villages in Mudzi where a borehole was drilled and was drawing water from the base of the dam and yet it appeared as the water table was very high. There is also need to intensify afforestation programs in the community. Additionally, educational programs should be increased in frequency, intensity and coverage. Moreover, organic farming should be promoted because it is cheap, locally available and user friendly. In the previous season, most farmers adopted the 'pfumvudza' farming method and this resulted in improved output levels this season. However, it should also be noted that this season was characterized with above average rains compared to the previous five years. At present, the community is not optimizing on existing value chains. Thus, processing, packaging, marketing and other value adding processes should be adopted with urgency.

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