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Research Article

WOMEN AND PERMACULTURE: TOWARDS RESILIENT PERI-URBAN COMMUNITIES IN KUTAMA, ZIMBABWE

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This article explores a women-led permaculture intervention known as *Mapfihwa* to reinforce peri-urban resilience in Kutama, Zimbabwe. The intervention falls at the intersection between permaculture and women's empowerment. The aim was to determine the effectiveness of the permaculture approach. The objectives were to explore the micro-level dynamics and resilience parameters of the *Mapfihwa* Project in Kutama, Zimbabwe. Using both qualitative and quantitative methods, the project review targeted women participants in the *Mapfihwa* Project, underpinned by a quasi-experimental approach. Qualitative data captured micro-level dynamics of permaculture, while quantitative data provided descriptive data on resilience parameters such as yield per area, income from the produce, asset base change, and household social mobility. Resilience was further measured through livelihood enhancement amidst socio-ecological challenges faced in the community. The findings suggest that women-led permaculture interventions improve community resilience by reducing food insecurity, revitalizing ecosystems, empowering women, and enhancing sustainable livelihoods in peri-urban Zimbabwe. The article concludes that undertaking women-led permaculture interventions in peri-urban settings improves resilience. The study provides a scalable and replicable community-based permaculture model tailored to the needs of vulnerable women in Zimbabwe.

***Keywords*:** Permaculture, women, resilience, peri-urban, food security, agro-ecology

***JEL Classification codes*:** Q18, O13, H43

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1. INTRODUCTION

Permaculture, a holistic design approach, offers a promising solution to build resilient peri-urban communities in Zimbabwe (Holmgren, 2002). By promoting agroecological practices, permaculture provides a new way of enhancing biodiversity, improving soil fertility and increasing crop yields, consequently contributing to food security, sustainable livelihoods and community resilience (Ndhlovu, 2018; Rubio, 2023). Moreover, permaculture empowers women farmers to take control of their natural resources, improving their social and economic status (Ferguson & Lovell, 2013). It is a design system for creating sustainable and self-sufficient human settlements, modelled on the patterns and relationships found in natural ecosystems. Its success can be observed in a variety of projects around the world, ranging from small-scale urban gardens to large-scale farms and community initiatives. Examples of success stories of permaculture include the Melliodora project in Australia. This project involves a two-acre homestead in Hepburn Springs, Australia, co-owned by David Holmgren, one of the co-originators of permaculture. It is a well-documented and widely known demonstration site. Permaculture is a powerful tool for improving food security and livelihoods in developing countries. A notable example is the work of organizations in Malawi, where permaculture farmers have, on average, better food security, larger dietary diversity, and higher crop yields than conventional farmers.

Permaculture systems, with their focus on biodiversity and water conservation, help communities withstand the effects of climate change and environmental degradation. By promoting a variety of crops and livestock, permaculture helps to combat malnutrition. Permaculture projects often empower local communities by teaching them sustainable practices that are tailored to their specific environment and culture. Many permaculture ventures are financially successful without relying solely on teaching or design fees.

In Zimbabwe, permaculture has been recognized as a valuable approach to building resilient peri-urban communities (Moyo et al., 2016). However, despite the potential of permaculture, women farmers in Zimbabwe face significant challenges in accessing and utilizing permaculture-based solutions (Pretty, 2002). Limited access to education, training, and resources hinders women's ability to adopt and benefit from permaculture practices (Karekezi et al., 2017).

Permaculture, however, faces a range of challenges, from its intensive initial setup to legal and societal barriers. While the system is designed to create self-sustaining ecosystems, the journey to get there often requires significant effort, knowledge, and patience. Permaculture is a complex design system that requires a deep understanding of ecology, soil science, water management, and local climate. For a beginner, the amount of research needed to create an effective plan can be overwhelming. The 'low-maintenance' promise of a mature permaculture system often comes after a lot of initial hard work. Tasks like building swales, creating terracing, or constructing hugelkultur beds are physically demanding and can be discouraging for those who want quick results. While successful on a small, homestead scale, permaculture faces criticism for not being able to feed a large, global population. Competing with the low costs of industrial agriculture can be difficult, making it challenging for permaculture farms to be financially viable without diverse income streams like education or consulting. Unlike conventional gardening, which yields results in a single season, permaculture systems like food forests take years to mature and become truly productive. This long-term commitment requires a different mindset and a great deal of patience. This article seeks to explore the diagnostic potential of permaculture in contributing to food security efforts in Zimbabwe, a highly food-insecure country in Southern Africa.

This article (i) explores the micro-level dynamics and (ii) examines resilience parameters of the *Mapfihwa* Project in Kutama, Zimbabwe. The study offers insights for policy makers in Zimbabwe on how to mobilized citizens to ensure household food security. It can also inform donors on the areas to target when working with households engaging in food production activities. Politicians can also find the article interesting, particularly considering Zimbabwe's distribution of farming inputs to farming communities in rural areas.

2. LITERATURE REVIEW

The use of permaculture in agriculture

With the adoption of permaculture in the 1970s by its proponents Bill Mollison and David Holmgren in the 1970s, permaculture has since been recognized as a holistic design model that incorporates sustainable agricultural practices to address social, economic and environmental aspects of sustainability (Didarali & Gambiza, 2019). LeVasseur (2014) refers to permaculture as a set of design principles centred around simulating or directly utilizing the patterns and features observed in natural ecosystems. Consequently, Mollison and Holmgren (1991) reveal that Australian permaculture practitioners have developed systems integrating native plants, water conservation techniques, and soil regeneration practices. Besides its ability to foster social cohesion, Hemenway (2009) states that permaculture principles in Portland and Los Angeles have been used for food production and community engagement.

Permaculture Association UK (2021) indicates that European countries have embraced permaculture through educational initiatives that increased awareness of ecological issues among communities. In Australia and the United States, Henfrey (2017) demonstrates the use of permaculture education as ecology of the mind and as a philosophy and practice of celebrating and making practical use of diversity. Fukuoka (1992) postulates that in Asia, permaculture has been integrated into traditional farming practices as the concept of "natural" farming, which emphasizes minimal intervention and working with nature rather than against it. This approach enhances soil fertility and crop resilience (Gliessman, 2013). In Latin America, Gonzalez et al. (2016) observed a rise in permaculture projects to restore ecosystems while providing livelihoods for local communities. Initiatives such as agroforestry systems combine trees with crops to create more resilient agricultural landscapes (ICRAF, 2020). Research by Jackson (2002) shows that these systems significantly increase biodiversity while providing economic benefits to farmers.

In Africa, permaculture practices have been instrumental in addressing food insecurity and promoting sustainable land management. For instance, in Sub-Saharan Africa, the World Food Program (2020) has implemented food security and livelihood programs, inclusive of permaculture practices, to empower vulnerable communities to improve their access to food. In addition, permaculture practices such as the keyline design for water management have been practised in Africa to improve agricultural productivity while conserving water (Lawton, 2010).

Permaculture Practices in Sub-Saharan Africa

ICRAF (2020) observed agroforestry permaculture practices in Kenya, Tanzania, and Malawi as practices that involved integrating trees into agricultural landscapes. In the form of conservation agriculture, permaculture in Zambia and South Africa involves minimizing soil disturbances, maintaining soil cover, and promoting crop rotation to improve soil health and reduce erosion (FAO, 2019). In Ghana, Nigeria, and Ethiopia, permaculture is viewed by CGIAR (2020) as a sustainable intensification that involves improving crop yields and reducing environmental impacts using improved crop varieties, integrated pest management, and precision agriculture. Ecological restoration efforts have been adopted as permaculture practices in Kenya, Tanzania, and Mozambique, which include restoring degraded lands, promoting biodiversity, and improving ecosystem services (IUCN, 2019; Ndhlovu, 2025). In Uganda and Rwanda, permaculture is termed Climate-smart agriculture by the FAO (2020), which improves agricultural productivity and resilience in the face of climate change.

Permaculture is based on three core ethics: care for the earth, care for people, and fair share (Holmgren, 2002). In Zimbabwe, these principles are manifested through various practices such as water conservation techniques and organic farming (Ndhlovu, 2024). Research indicates that permaculture can enhance soil fertility and biodiversity while reducing dependency on chemical fertilizers (Altieri, 1999). For instance, integrating bees into agricultural systems improves plant reproduction and provides additional income sources through honey production (Garbuzov, 2015). In Zimbabwe, organizations like Chikukwa Ecological Land Use Community Trust (CELUCT) support community-based permaculture projects, contributing significantly to practitioners' income.

The Impact of Permaculture on Food Security in Zimbabwe

Due to economic instability and climate change, food security remains a critical issue in Zimbabwe. Studies have shown that permaculture practices can significantly improve food production at the household level. According to Garbuzov (2015), permaculture households reported increased crop yields compared to conventional farming methods. The use of techniques such as companion planting and mulching helps conserve moisture and suppress weeds, which are vital in arid regions of Zimbabwe (Moyo et al., 2019; Ndhlovu, 2017; Ndhlovu & Dube, 2024).

Community involvement is essential for the successful implementation of permaculture projects. Various NGOs have initiated training programs aimed at educating farmers about sustainable practices. For example, the Permaculture Research Institute of Zimbabwe has provided workshops that empower local communities with knowledge about ecological farming methods (Altieri, 2002). These educational initiatives enhance agricultural productivity and foster community resilience against climate variability.

Women and Permaculture in Zimbabwe

In Zimbabwe, Kumar and Quisumbing (2015) observe that women have been empowered to control agricultural activities by their involvement in permaculture practices. By adopting permaculture practices, women have been able to increase their crop yields, improve their food security, and generate income from the sales of their products. Mutopo (2014) postulates that women in areas of Zimbabwe, such as the Mwenezi district, have formed networks and cooperatives to share knowledge on permaculture practices.

Despite the wide adoption of permaculture at global and local levels, Didarali and Gambiza (2019) state that women in Zimbabwe continue to face challenges in implementing permaculture. This is because they have limited capacity to access land, credit, and markets for their permaculture products. However, the government of Zimbabwe has made initiatives to promote women's access to land, agricultural resources and opportunities to participate in permaculture to improve their livelihoods (World Bank, 2019).

The women-led permaculture project, 'Mapfihwa, supports women in adopting permaculture practices, enhancing their capacity to manage natural resources sustainably, and improving food security. By fostering women's leadership and collective action, this study aims to build resilient rural communities capable of adapting to climate change, poverty, and other challenges. This initiative contributes to the achievement of the Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 5 (Gender Equality), and SDG 13 (Climate Action). The study's outcomes offer valuable insights into the potential of permaculture and women's empowerment to drive transformative change in rural Zimbabwe.

3. METHODOLOGY

Research site

This study was conducted in Kutama, a drought-prone area in Zvimba District of Mashonaland West Province in Zimbabwe, a low-income area found on the Western boundary of Harare. Its inhabitants survive through informal trading activities at the centre of Harare town. They also thrive on market gardening, a rampant source of household primary food. Agricultural practices in the area are conventional and rainfed with limited irrigation. Farmers in this area practice mixed farming, where both animal and crop husbandry are done in the same household. Their plots have residential space, farming space, and pasture space. The approximate size of their residential space is 0.5 hectares, 6 hectares of farming land, and 15 hectares of communal grazing land. The population size is estimated at 23011 with 6138 households. The level of unemployment, poverty, and food insecurity is very high. This is where the Mapfihwa training hub, a community laboratory point, is located, where permaculture training, experiments, and observations are made.

Sampling Procedure

Participants for the study are exclusively women living within a 7 km radius of the Mapfihwa community laboratory centre. A community stakeholder consultation was done as a mobilization process to introduce the project to the community as a whole. A call was made to volunteers wanting to participate in the intervention. Only women who live within a boundary of less than or equal to 7km (walkable distance) from the Mapfihwa community laboratory centre were purposively selected from these volunteers. A random selection of 15 volunteers was made from these. The participants are women willing to work on the project for 3 years.

Only women subsistence farmers were selected for the permaculture practice. The selection was informed by observations made from current interventions in the developing countries' communities, where occasionally food handouts are provided to migration-stricken households, where women are the spouses left behind. Often, the handouts comprise limited dietary requirements. These handouts are also not consistent; hence, dry food spells are experienced during some periods of the year. Such challenges might be addressed through permaculture.

Procedure

The findings of this article are basically project activities in the form of practices and methods that were implemented during the project. A total of 15 participants were given two equal beds with measurements of 8m in length and 1 meter wide in width within the Mapfihwa community laboratory centre. Plot A was for the permaculture activities, where permaculture activities were practised. Plot A was the control bed where non-permaculture agricultural activities and conventional sources of plant nutrients and pesticides were used. According to this article, permaculture practices involve the use of liquid poultry fertilizer, Azolla water as a source of nitrogen, vermicompost as a source of nutrients, and carbon and dolomitic lime to correct soil pH levels. Mulching and limited tillage were used as soil and water conservation methods. Organic pest management for the permaculture beds included rabbit urine and pepper juice as pesticides, crop rotation, and companion cropping as disease control strategies.

Data Collection Method and Analysis Procedure

Data was collected using semi-structured questionnaires designed to gather a wide range of information. These questionnaires included sections on demographic details, socio-economic characteristics before the permaculture intervention, details of the permaculture practices adopted during the intervention, and an assessment of the impacts resulting from these practices. Quantitative data were analyzed using descriptive statistics and presented using tables and figures. Meanwhile, qualitative data derived from responses to open-ended questions in the semi-structured questionnaires underwent content analysis. This involved cleaning and organizing the qualitative responses to identify recurring patterns. Statistical Package for the Social Sciences (SPSS) version 21 was employed for the quantitative analysis. This software facilitated rigorous statistical analysis, allowing for a comprehensive examination of the data and providing insights into the effectiveness and outcomes of the permaculture intervention.

4. PRESENTATION OF FINDINGS

This section presents findings on how permaculture contributes to a convenient supply of healthy food, increased resilience to environmental shocks, reduced costs of inputs and the social status of Maphihwa project members.

Demographic Data

Age Distribution

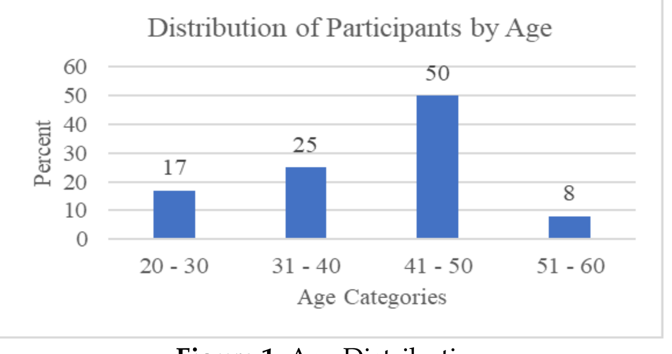


Figure 1. Age Distribution

Figure 1 shows the age distribution of the Mapfihwa project participants. The participants' ages range from 20 to 60 years, with the majority (50%) concentrated in the 41 – 50 age group, highlighting a predominance of middle-aged members in the project.

Marital status

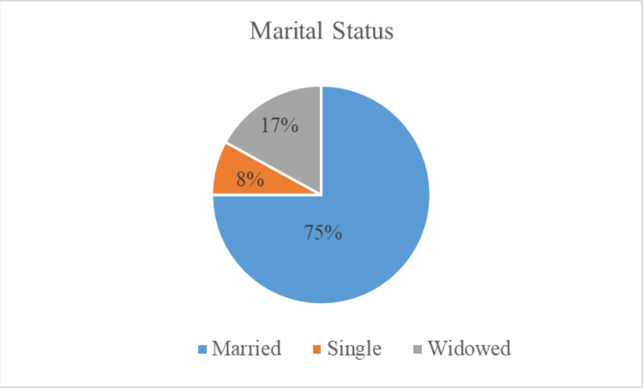


Figure 2. Marital Status

Figure 2 illustrates the marital status distribution within the group. Most participants (75%) are married, 17% are widowed, and 8% are single.

Level of Education

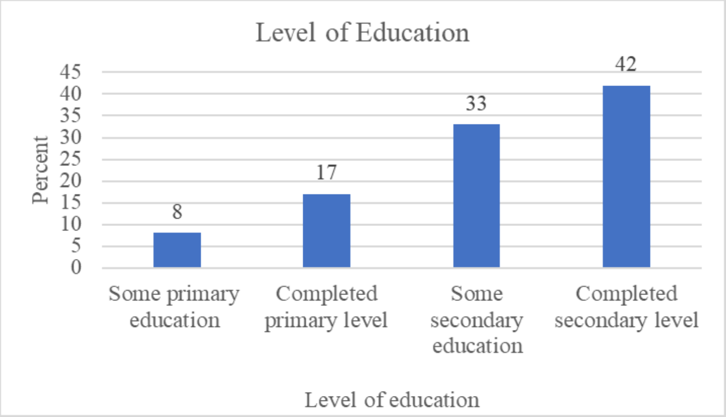


Figure 3. Level of Education

The results presented in Figure 3 show that 8% of participants received some primary education, 17% completed primary education, 33% received some secondary education, and the majority (42%) completed secondary education.

Sources of Income for Project Members

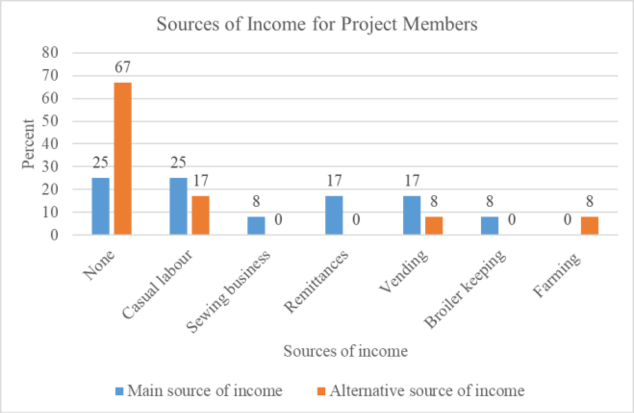


Figure 4. Sources of Income for Project Members

Figure 4 shows the primary and alternative sources of income for Mapfihwa project members. The Figure illustrates that 25% of the participants have no primary source of income. In comparison, 25% rely on casual labour (both agricultural and non-agricultural), 8% engage in the sewing business, 17% depend on remittances, 17% are involved in vending (selling vegetables, other relishes, bread and second-hand clothes), and 8% practice broiler farming.

On the other hand, 67% of the participants reported having no alternative sources of income. Among those with alternative sources, 8% depend on vending, specializing in second-hand clothes, 17% engage in casual labour, and 8% rely on farming. These findings highlight the limited income diversification among participants.

Income from Selling Produce from the Crops

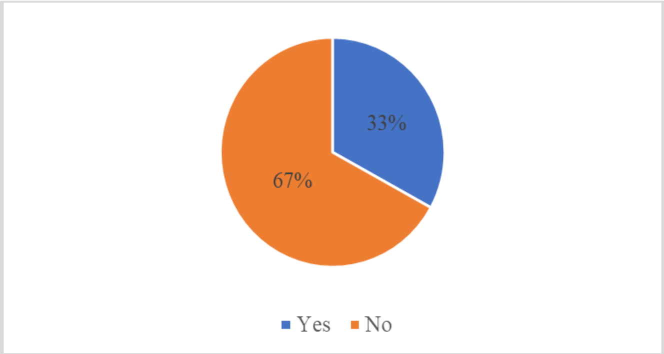


Figure 5. Income from the Selling of Produce from the Crops

Figure 5 shows that 33% of the participants sold produce from their fields. Among those who sold their crops, 75% sold them on-site, 25% sold by the roadside and 25% sold at St Bernard College. The income generated from selling crop produce ranged from USD30 to USD120, with an average income of USD77. This income was used to pay school fees, buy household food, clothes, kitchen utensils, farm inputs, pay hospital bills and pay for grinding mealie meals.

Sources of Income for Project Members' Spouses/Household Members

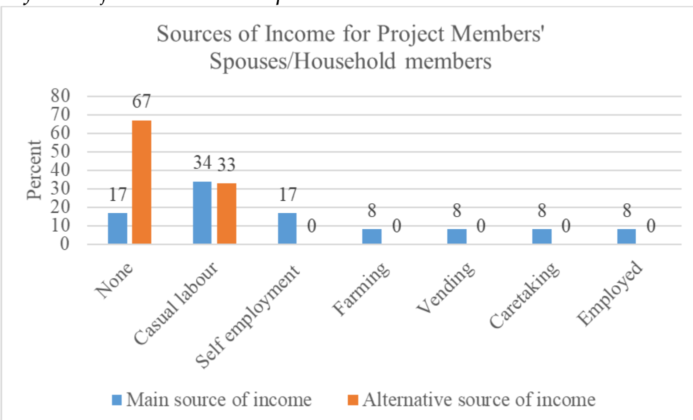


Figure 6. Sources of Income for Project Members' Spouses/Household Members

Figure 6 presents the primary sources of income for project members' spouses/household members. The Figure shows that 17% have no primary source of income, 34% depend on casual labour, 17% are self-employed (engaged in activities such as painting and plumbing), 8% depend on farming, 8% on vending, 8% caretaking (managing other people's broiler projects), and 8% are formally employed. Those who are self-employed are engaged in activities such as painting and plumbing. On the other hand, participants reported that 67% of their spouses or household members do not have alternative sources of income. In comparison, 33% depend on both agricultural and non-agricultural casual labour as alternative sources of income.

Socio-Economic Attributes Before Permaculture Intervention

Table 1. Types of Crops Grown

History of Gardening	Type of crop	Proportion of those who grew the crop

	Covo	88
	Rape	38
67%	Shallots	25
	Tsunga	25
	Tomatoes	75
	King onion	25
	Peas	13

Table 1 shows that among the 67% who have been engaged in gardening in the past 5 years, the majority (88%) cultivated covo, followed by 75% who were growing tomatoes, and 38% growing rape. Peas were the least cultivated crop, grown by only 13% of participants who were engaged in gardening in the past 5 years. Participants explained that crops such as covo, shallots, and king onions were preferred because they are drought-resistant and last long in the field. Rape and tsunga were favoured for their fast growth and ability to quickly provide relish. Some were just experimenting with crops such as peas.

Table 2. Sources of Nutrients

Source of nutrients	Proportion	Source of nutrients	Proportion
Cattle manure	63	Own kraal	80
		Neighbors/fellow villagers	60
Goat manure	25	Own kraal	100
Fertilizer	25	Presidential input scheme	50
		Bought	50
Chicken manure	13	Own fowl run	100

Table 2 shows that among those practicing gardening in the past 5 years, 63% used cattle manure to provide nutrients to their crops, 25% used goat manure, 25% used fertilizer, and 13% used chicken manure. About 80% of participants used cattle manure sourced from their kraals, while 60% obtained it from their neighbors or fellow villagers. All those using goat and chicken manure sourced it from their kraals or fowl runs. About 50% purchased it, and the other 50% received it for free through the Presidential Input Scheme. Those who purchased fertilizer for gardening spent a total of USD 20.

Source and Availability of Water for Gardening in the Past 5 Years

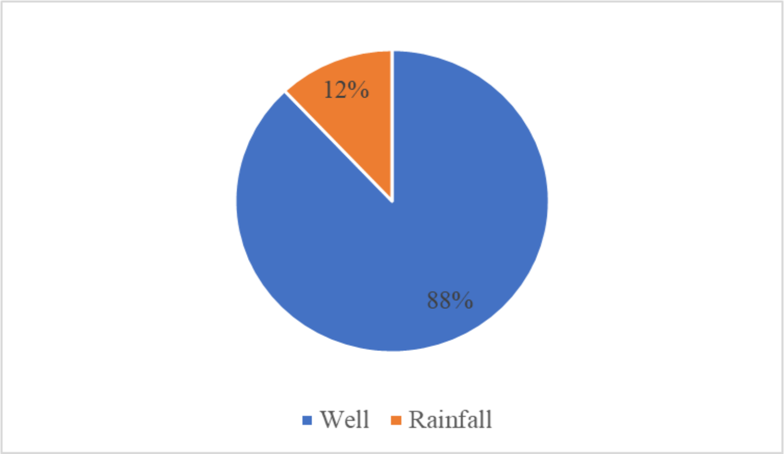


Figure 7. Source of Water for Gardening

Figure 7 shows that 88% of the participants practicing gardening in the past 5 years were using water from wells, and only 12% were practicing rain-fed gardening. All participants (100%) indicated that gardening water was unavailable throughout the year. They reported that water is usually available between January and July, with rare instances of availability extending to September.

Source of Water for the Crops

All the participants (100%) indicated that the water source for their crops is rainfall, which comes at no cost. However, participants highlighted the challenges posed by climate change and rainfall variability. They noted that rainfall is often highly unpredictable and insufficient, with most rainfall received between November and March. Although it is rare, rainfall starts as early as October and extends into April.

Average Water Uses per Week

On average, participants watering their gardens used about 17 twenty-litre buckets of water, translating to 340 litres of water per week. None of the participants incurred any cost for water used in their gardening activities.

Income from Gardening

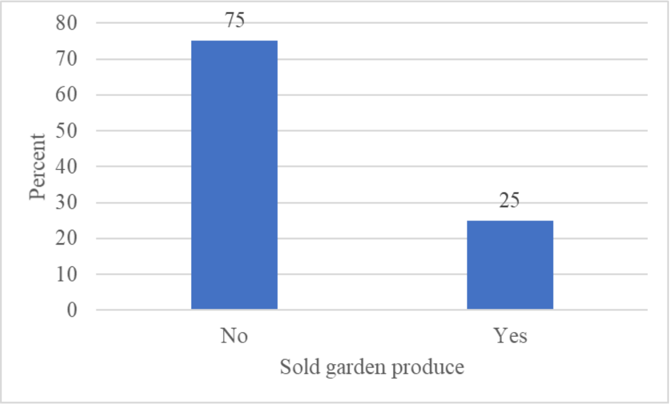


Figure 8. Income from Gardening

Figure 8 shows that 25% of those who were practicing gardening in the past 5 years managed to sell produce from their gardens. They sold their produce on-site and generated an average of USD25. The income generated from gardening was used to pay school fees, buy kitchen utensils, clothes, farm inputs, pay hospital bills and cover milling costs for maize meals.

Other Types of Farming

Table 3. Crop Production

Type of farming	Proportion	Types of crops grown	Proportion
Crop production	100	Maise	100
		Groundnuts	67
		Roundnuts	50
		Cowpeas	17
		Sweet reeds	8
		Pumpkins	17
		Sweet potatoes	33
		Beans	8

Table 3 illustrates that all participants (100%) were practicing crop production. Among those practicing crop production, 100% were growing maize. Other crops grown included groundnuts by 67%, groundnuts by 50%, and sweet potatoes by 33%. Cowpeas, pumpkins, sweet reeds, and beans were less frequently grown crops.

Participants reported that they favored the above-highlighted crops for several reasons, including that they are relatively easy to grow, require minimal labor, and ensure a steady food supply with the potential to sell surplus. In addition, the crops were suitable for the participants' soil types and the agroecological conditions. Some participants grew these crops without options, while others had access to seeds. The ease of managing legumes, mainly due to their low fertilizer requirements, was also noted as a significant factor in the participants' crop choices.

Table 4. Source of Nutrients for the Crops

Source of nutrients	Proportion	Source of nutrients	Proportion	Average cost
Fertilizer	100	Presidential input scheme	67	-
		Bought	67	USD81
Cattle manure	33	Own cattle	67	-
		Neighbors	17	-
		Parents	16	-
Goat manure	17	Own goats	100	-
Chicken manure	8	Own fowl run	100	-
Compost	8	Own compost	100	-

Table 4 highlights that all participants (100%) were using synthetic fertilizer, with 67% having obtained it for free through the presidential input scheme and 50% purchasing it. About 33% of the participants used cattle manure, with 67% getting it from their kraals, 17% from neighbors and 16% from their parents' kraals. About 17% of the participants used goat manure, all of which came from their kraals, while 8% used chicken manure from their fowl runs. Approximately 8% of participants used compost, which they produced at home. The cost of fertilizer purchased by participants ranged from USD 10 to USD 189, with an average expenditure of USD 81.

Table 5. Poultry Production

Type of farming	Proportion	Type	Proportion
Poultry production	75	Road runners	100

Table 5 shows that 75% of participants practiced production at home, with all the participants practicing production near roadrunner chickens. Only one participant sold their chickens, generating USD20, which was used to buy household food.

Table 6. Livestock Production

Type of farming	Proportion	Type of livestock	Proportion
Livestock production	50	Cattle	50
		Goats	50

Table 6 highlights that 50% of the participants were involved in livestock production. Among those involved in livestock production, 50% kept cattle and 50% kept goats. About 50% sold their livestock and generated income ranging from USD 30 to USD 350, with an average income of USD 162. The proceeds from selling livestock were used to pay school fees and buy household food and clothes.

Household Food Supply in the Past 5 Years

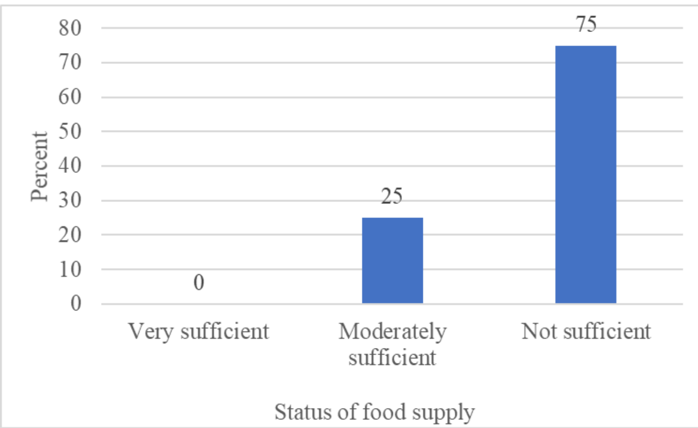


Figure 9. Household Food Supply in the Past 5 Years

Figure 9 presents household food supply status in the past 5 years. About 75% of the participants reported experiencing food shortages, while 25% indicated having moderately sufficient food. No participants reported having a sufficient food supply in the past 5 years.

Table 7. Empowerment Status of Women in the Past 5 Years

The proportion who Felt Empowered in the Past 5 Years	The proportion of those participating in Decision-making in the Past 5 Years	Type of Decision	Proportion
33%	67%	Food management	67
		Asset purchasing	67
		Farming	67
		Family events	58
		Going for casual labor	8

Table 7 shows that 33% of the participants felt empowered in the past 5 years. The results show that 33% of participants reported not having permission to make important household decisions in the past 5 years. While 67% of the participants are now participating in decision-making, participants highlighted that these changes are recent, as it was once tricky for many participants to be involved in decision-making. Among those allowed to participate in decision-making, 67% make food management, asset purchasing, and farming decisions. About 58% are allowed to make decisions regarding family events and functions, while 8% reported being allowed to decide which casual work to engage in for income generation.

Permaculture Intervention Practices

Understanding of permaculture by women

Though participants demonstrated a general understanding of permaculture, their understanding of permaculture varied and reflected personal sentiments about the project.

Technical understanding: Participants described permaculture as the practice of growing crops in the same bed and using restorative methods such as the use of organic fertilizer and biological pest control techniques. In addition, permaculture was viewed as small-scale farming that minimizes costs, emphasizing organic practices and incorporating other crops and foodstuffs to prevent pests.

Personal sentiments: Permaculture was viewed as a farming practice for sustenance and income generation. Some participants said that permaculture is a project aimed at empowering women, reducing domestic violence and decreasing the reliance of project members on their spouses for sustenance.

Table 8. Crop Varieties Planted for the Summer Crop at Mapfihwa Training Hub

Crop variety for summer	Mentioned	Mentioned for the winter season
Green pepper	9	1
Tomatoes	10	2
King onions	8	2
Covo	9	2
Sugarloaf	5	3
Rape	10	2
Parsley	2	-
Sweet cabbage	2	-
Marigold	1	-
Basil	1	-
Peas	-	2
Potatoes	-	1

Table 8 presents the crops grown by participants during the summer and those lined up for the winter season. Summer crops mentioned by the participants included green pepper (9), tomatoes (10), king onion (8), covo (9), sugar loaf (5), and rape (10). The least mentioned summer crops were parsley (2), sweet cabbage (2), marigold (1), and basil (1). For Mapfihwa winter crops, participants mentioned green pepper (1), tomatoes (2), king onion (2), covo (2), sugar loaf (3), rape (2), peas (2) and potatoes (1). The low number of winter crops mentioned was largely attributed to participants either forgetting, yet planning or intending to consult their notebooks, or relying on advice to determine suitable crops for the winter season.

Table 9. Bed sizes and number per person

Bed	Bed size	Number of Beds
Permaculture	8m x 1m	1
Conventional	8m x 1m	1

Due to challenges in accurately estimating bed size, participants reported that the lengths of their permaculture beds ranged from 8 metres to 15 metres and widths of 1 metre. For conventional beds, participants reported sizes ranging from 10 metres x 1 metre to 25 metres x 1 metre. Upon verification, it was established that permaculture and conventional bed sizes are 8 metres x 1 metre. Each person had two beds.

Table 10. Differences in the Practices Applied to Beds

Mentioned Practices	Bed A – Permaculture	Bed B – Conventional	Comment
Mulching	✓	X	
Improved manure used	✓	X	
Direct poultry manure	X	✓	
Pesticides	X	✓	
Herbicides	X	✓	
Synthetic fertilizer	X	✓	
Companion crops	✓	X	Group 1: tomatoes, green pepper, king onions; Group 2: shallots, rape covo, sugar loaf,
Intercropping	✓	✓	Group 1: Tomatoes, green pepper, king onions, marigolds Group 2: Shallots, rape covo sugar loaf, parsley, basel,
Household foodstuff	✓	X	

Table 10 highlights the differences in Bed A (permaculture) and Bed B (conventional) practices. The table shows that practices such as mulching, using liquid or improved manure, using herbs and household foodstuffs to repel pests, intercropping, and companion cropping are applied in the permaculture beds. On the other hand, practices such as synthetic fertilizer, direct use of manure, use of pesticides, herbicides and intercropping are applied in the conventional beds.

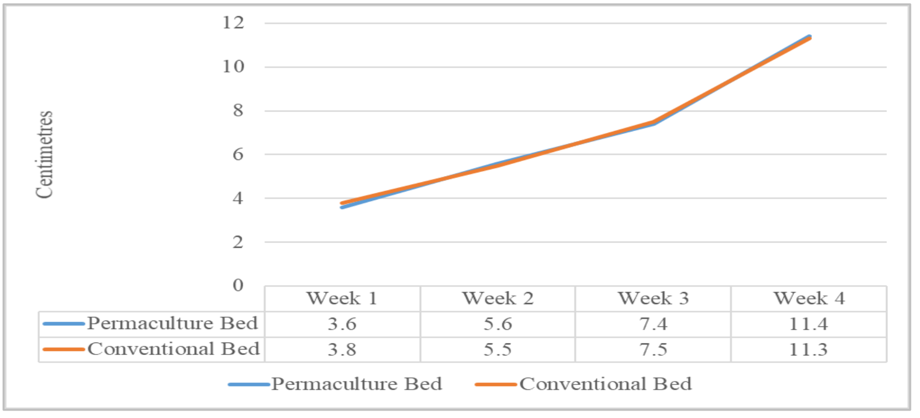
For companion cropping, participants are using two groups of crops: Group 1, consisting of tomatoes, green pepper, and king onions, and Group 2, which includes shallots, rape covo, and sugar loaf. For intercropping, participants are also using two groups of crops: Group 1 included tomatoes, green pepper, king onions and marigold, while Group 2 included shallots, rape covo sugar loaf, parsley, and basil.

Table 11. Standard Spacing for Main Crops

Crops	Standard spacing – Bed A	Bed B
Leafy vegetables	10cm	7cm
Tomatoes	30cm	20cm

The participants highlighted varied standard spacing for main crops. However, the standard space for permaculture beds was 10cm for leafy vegetables and 30cm for tomato crops, with companion crops in between the spaces. For conventional beds, spacing was not standardized, and it ranged from 3cm to 30cm for leaf vegetables and 5cm to 30cm for tomatoes, with an average spacing of 7cm for leafy vegetables and 20cm for tomatoes.

Average Leaf Growth for Covo under Permaculture and Conventional Practices



	Week 1	Week 2	Week 3	Week 4
Permaculture Bed	3.6	5.6	7.4	11.4
Conventional Bed	3.8	5.5	7.5	11.3

Figure 12. Average Leaf Growth for Covo under Permaculture and Conventional Practices

Figure 12 shows that covo in the permaculture bed started at 3.6 cm in Week 1, steadily increasing each week, reaching 11.4 cm by Week 4. Similarly, the conventional bed started slightly higher at 3.8 cm in Week 1 and showed consistent growth, ending at 11.3 cm in Week 4. Although there is not much difference, the permaculture bed slightly outperforms the conventional bed in terms of growth by the end of the observation period.

Average Leaf Growth for Rape under Permaculture and Conventional Practices

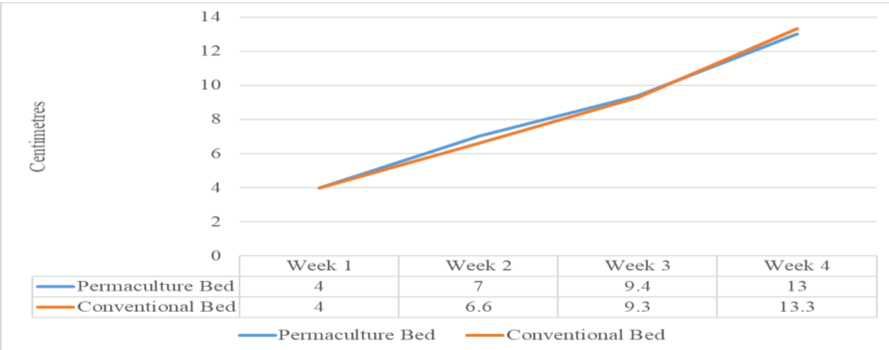


Figure 13. Average Leaf Growth for Rape under Permaculture and Conventional Practices

Figure 13 shows that rape in the permaculture bed started at 4 cm in Week 1, increasing each week, reaching 13 cm by Week 4. Similarly, the conventional bed started at 4 cm in Week 1 and showed growth, ending at 13.3 cm in Week 4. Although there is not much difference, the conventional bed slightly outperforms the permaculture bed in terms of growth by the end of the observation period.

Average Water Consumption for the Crops per Week

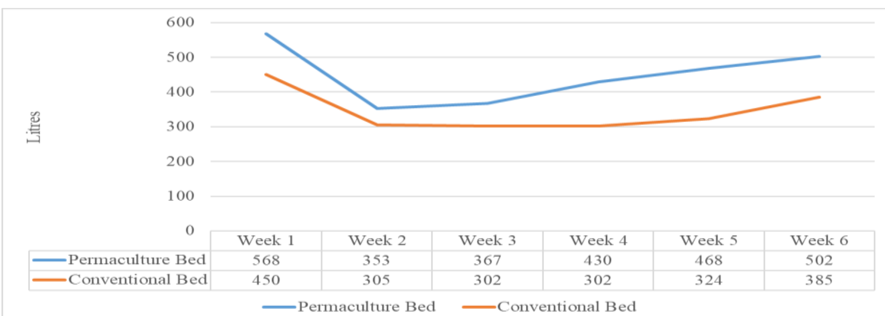


Figure 14. Average Water Consumption for the Crops per Week

Figure 14 shows that the permaculture beds consumed an average of 568 litres of water in Week 1, with fluctuations observed throughout the six weeks, culminating in an average consumption of 502 litres in Week 6. In comparison, the conventional beds started with 450 litres in Week 1, also fluctuating, and ended with 385 litres in Week 6. Overall, the permaculture beds consistently recorded higher water consumption than the conventional beds, largely due to the larger cultivated area in the permaculture beds.

Participants noted that water consumption typically starts high under normal circumstances and gradually decreases as plants establish. However, water usage increased significantly during hotter periods, contrary to expectations, higher water consumption should mainly occur when plants are still small and vulnerable.

Source of water for Mapfihwa Gardening

All participants indicated that the water used for Mapfihwa gardening is obtained from a borehole, which is consistent with the researchers' observations.

Water Availability

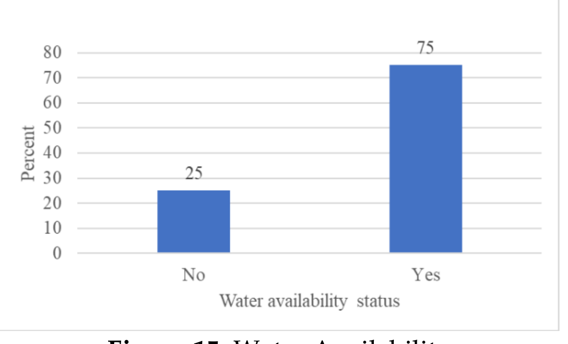


Figure 15. Water Availability

Figure 15 shows that only 25% of the participants reported that borehole water for the Mapfihwa gardening project is not always available.

Water Use Challenges

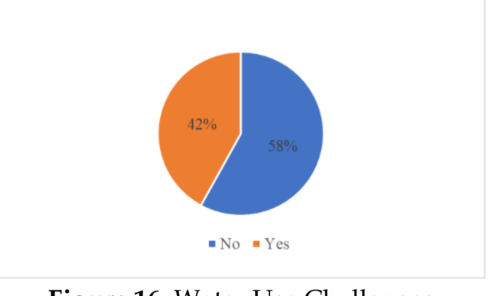


Figure 16. Water Use Challenges

Figure 17 indicates that about 42% of the participants reported facing challenges in using Mapfihwa water for gardening. About 25% of the participants highlighted that they are facing delayed water filling and water shortages when it is overcast, affecting the efficiency of solar panels. About 17% of the participants reported having to take turns to water their gardens since they only have two horse pipes and taps.

Poultry Management at Mapfihwa Training Hub

All participants (100%) mentioned practising poultry management at the Mapfihwa training hub.

Table 12. Poultry Varieties Kept at Mapfihwa Training Hub

Type of poultry	Number of times mentioned	Usefulness
Layers	11	Manure, eggs
Roadrunner chickens	8	Manure, meat
Ducks	11	Manure, meat

Table 12 shows the types of poultry kept at the Mapfihwa training hub. The types of poultry mentioned are layers, roadrunner chickens, and ducks. Participants reported that the poultry is useful for the project because it provides the much-needed manure, meat, and eggs. Participants also said that eggshells are an important ingredient for insect repellent. However, it was mentioned once that participants have yet to see poultry's usefulness in the Mapfihwa gardening project.

Table 13. Other Useful Activities at Mapfihwa Training Hub

Activities	Number of times mentioned	Number of times usefulness is mentioned
Livestock production	0	
Bee keeping	10	Honey (5), money (5), pollination (3)

All participants (100%) reported not keeping any livestock at the Mapfihwa training hub. Nonetheless, though beekeeping was mentioned 10 times by the participants after they were prompted, they could not remember the direct usefulness of beekeeping to the crops. After prompting the participants, they mentioned that beekeeping brings honey and money. Thus, many were not sure of the benefits to crops and were hoping to learn soon.

Impacts of the Mapfihwa Intervention

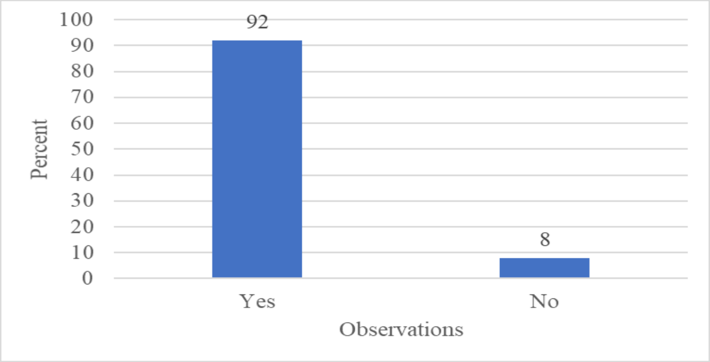


Figure 17. Difference in Crop Growth Rate Between Household and Mapfihwa Gardens

Figure 18 shows that 92% of respondents observed differences in crop growth rates between their household gardens and the *Mapfihwa* garden. Participants noted that crops grown under permaculture practices in the *Mapfihwa* garden took longer to grow but lasted longer once established.

Approximately 67% of participants attributed the better and faster crop growth at the *Mapfihwa* training hub to consistent and reliable access to water. This resource was often limited in their home gardens. Additionally, participants highlighted that permaculture vegetables remained fresh for longer, exhibited high quality, and had the potential for regeneration.

Table 14. Differences in Crop Management Practices Between the Household Garden and the Mapfihwa Garden

Practices	Mapfihwa/ Garden	Household garden
Improve organic manure	✓	X
Pesticides	X	✓
Herbicides	X	✓
Companion cropping	✓	X
Intercropping	✓	X
Biological pest control	✓	X
Pruning and trimming	✓	X

Raised beds	✓	X
Consistent watering	✓	X

All participants noted significant differences in crop management practices between their household gardens and the Mapfihwa garden. Participants exclusively used organic manure in their permaculture beds, including liquid manure, avoiding synthetic fertilizers entirely. They also refrained from spraying pesticides and herbicides, instead relying on companion planting and simple foodstuffs to repel insects naturally. Participants reported regularly pruning and trimming vegetables in their permaculture beds to enhance growth and productivity. Raised beds were also implemented to prevent flooding during the rainy season. Furthermore, crops in the permaculture beds were better safeguarded against domestic animals by installing a security fence.

Prospects for Mapfihwa and Permaculture

About 92% of the participants were optimistic that the Mapfihwa garden will most likely yield more produce than their household gardens, mainly because of water availability for watering. However, they lamented that land under cultivation is still tiny.

Table 15. Projections on Vegetable Use

Vegetable benefits	Proportion
Household nutritional addition	25
Household food security	83
Income	83
Sharing with friends	50
Value addition	33

Participants expressed optimism about the benefits of vegetables from the Mapfihwa garden. Approximately 25% anticipated that the vegetables would improve household nutrition, while 83% believed they would enhance household food security and support income generation. Additionally, 50% of participants planned to share the vegetables with friends and relatives, and 33% intended to add value by drying the vegetables for future use.

Income Expectations

Participants are hoping to earn considerable income from the Mapfihwa garden. Income projects from participants ranged from USD20 to USD500, with an average of USD188 per person.

Table 16. Projected Income Expenditure

Projected Expenditure	Proportion
Re-investment	42
School fees	33
Buying stationery	17
VSLA	8
Household food	25
Kitchen utensils	8

Table 16 indicates that 42% of participants plan to reinvest the income generated from Mapfihwa into projects such as tuckshops, broiler production, and goat farming, aiming to upscale and diversify their income sources. Additionally, 33% of participants intend to use the funds to pay school fees, 17% to purchase stationery, 8% to circulate the money through Village Savings and Loan Associations, 25% to buy household food, and 8% to acquire kitchen utensils.

Position of women in the Mapfihwa project

All participants (100%) reported that their roles and positions within their households have improved due to the *Mapfihwa* project. Participants shared that their spouses and other household members now respect them, as they are perceived as hardworking and organized due to their ability to access and provide vegetables. They also noted that this newfound respect stems from their contributions to household food supply, as they are now bringing food to the table, staying occupied, and avoiding gossip and other social issues. Additionally, the project has alleviated financial pressure on household income, as money previously allocated for purchasing vegetables can now be redirected to other household needs. As a result, women expressed a sense of value and empowerment, feeling appreciated for their contributions brought about by the project.

All participants (100%) reported positive changes in their social standing within the community as a result of the *Mapfihwa* project. Previously, they were often perceived as beggars or individuals unable to be self-reliant. However, this perception has changed significantly. Members of the *Mapfihwa* project are now held in high regard by the community, being seen as knowledgeable in gardening and as individuals who have achieved improved livelihoods.

Some participants highlighted that the community now believes they are generating income from their gardening activities. This perception has contributed to upward social mobility, with participants feeling more esteemed and valued. They also reported improved social interactions and noted that they are now more approachable and respected within their communities.

The findings of the *Mapfihwa* project align with existing literature on the transformative potential of permaculture, particularly its role in enhancing food security, improving soil health, and empowering women. The project demonstrates how adopting permaculture principles fosters resilience among peri-urban communities in Zimbabwe. This discussion juxtaposes the results of the *Mapfihwa* intervention with findings from similar studies globally and highlights key areas of convergence and divergence.

Globally, permaculture has been recognized for its adaptability and scalability across diverse contexts. The *Mapfihwa* project's success mirrors initiatives in Latin America, where agroforestry systems integrate trees and crops to create resilient landscapes (ICRAF, 2020). Similarly, the use of indigenous knowledge by *Mapfihwa* participants aligns with Fukuoka's (1992) concept of "natural farming" in Asia, emphasizing minimal intervention. In Africa, agroforestry and conservation agriculture have shown comparable benefits, particularly in addressing food insecurity and land degradation (FAO, 2019). However, unlike some large-scale initiatives, *Mapfihwa's* focus on women-led, community-based approaches underscores the importance of local agency in driving sustainable change.

Food Security

Before the permaculture intervention, Mapfihwa participants reported severe food insecurity, with 75% experiencing shortages and 25% having only moderate sufficiency. These findings echo Chikozho et al. (2021), who highlighted the critical role permaculture plays in increasing food production at the household level. The Mapfihwa intervention improved food availability through companion planting and mulching, which conserve moisture and enhance soil fertility. The observed longer shelf-life and higher quality of vegetables grown under permaculture practices further confirm Moyo and Nyoni's (2020) assertion that agroecological methods are crucial for resilience in arid regions. In addition, a wide range of crops were reportedly grown during the summer crop year cycle, with key crops such as rape, king onion, covo and tomatoes being on the list. Having such a wide range of crop varieties enhances sustainable intensification and precision agriculture, as supported by similar studies done in Ghana, Nigeria and Ethiopia by CGIAR (2020). Besides improving biodiversity and ecosystem services, growing various crops gives room for companion planting, a technique Ndhlovu (2017) also promoted as helpful in conserving moisture and weed suppression. Resultantly, permaculture promotes garden yields and improves household nutrition.

Social and Economic Empowerment

The Mapfihwa intervention enables participants to generate income through gardening, with projections going up to USD 500 per person. These earnings have the potential to diversify household incomes, reducing reliance on precarious sources such as casual labour. This supports findings by the World Food Program (2020), which emphasized the economic benefits of permaculture in Sub-Saharan Africa. Additionally, the income generated allows participants to reinvest in small-scale enterprises, illustrating the scalability and sustainability of such initiatives, as suggested by the Permaculture Association UK (2021).

Women's empowerment through the Mapfihwa project aligns with the literature on gender and permaculture. Participants reported improved household decision-making roles, with 67% now involved in managing food, assets, and farming activities. Mutopo (2014) similarly documented the role of women in the Mwenezi District, forming cooperatives to share permaculture knowledge, thereby enhancing their agency. These changes challenge traditional power dynamics and support the hypothesis that permaculture interventions can drive gender equity, as proposed by Karekezi et al. (2017).

The Mapfihwa intervention transformed participants' social standing and economic contributions. Previously marginalized, these women are now viewed as knowledgeable and capable contributors to household and community wellbeing. This shift mirrors findings from Bungu (2019), who noted that women's involvement in permaculture elevates their status and fosters social cohesion.

Agricultural Practices and Contribution to Resilience

Before the intervention, most participants relied on conventional farming methods using synthetic fertilizers and pesticides. These practices are resource-intensive and environmentally degrading. In contrast, the permaculture beds utilized organic inputs like liquid poultry manure, Azolla water, and vermicompost, demonstrating improved crop yields and soil health. These findings support Didarali and Gambiza's

(2019) observation that permaculture reduces dependency on chemical inputs while enhancing biodiversity.

Participants highlighted water scarcity as a significant challenge before the intervention. Under Mapfihwa, mulching and raised beds improved water retention, reducing weekly water consumption. This resonates with findings from Lawton (2010) on the effectiveness of permaculture's keyline design in conserving water in Africa. However, water use efficiency at Mapfihwa may require innovative solutions to ensure sustainability.

The contribution of permaculture to resilience is therefore evident in agroecological, economic and social resilience**.** Using organic fertilizers and pest control methods reduced soil toxicity and improved water retention, fostering a more sustainable agricultural ecosystem. This aligns with Gliessman's (2013) assertion that permaculture enhances ecosystem services. The income generated from permaculture gardening can lead to diversified livelihoods, providing a buffer against economic shocks. Participants' plans to reinvest earnings demonstrate the potential for long-term economic stability. The empowerment of women through decision-making roles and increased respect within their households and communities fosters social cohesion, a critical component of resilience, as Santos (2022) highlighted.

The regenerative dimension of the Mapfihwa project

The Mapfihwa project proved its regenerative characteristics in many ways. Firstly, integrating crops and small livestock (chickens and ducks) reflects regenerative instrumentalism as such combinations would allow interdependence, which is pivotal to intact and self-sustaining ecosystems. For instance, all participants (100%) mentioned practising poultry (chicken and ducks) management at the Mapfihwa training hub. Participants reported that the poultry was useful for the project because it provided the much-needed manure for the crops, meat, and eggs for human nutrition. Participants also said that eggshells were an important ingredient for insect repellent. These practices can be described as regenerative since they contribute to ecological revitalization. Such ecological integration and restoration efforts have also been adopted as permaculture practices in Kenya, Tanzania, and Mozambique, promoting biodiversity.

In addition, a significant number of participants mentioned the use of bees in the permaculture model. This technique was reported by IUCN (2019) to be useful in improving ecosystem services and, hence, regenerative. Accordingly, Garbuzov (2015) argues that integrating bees into agricultural systems improves plant reproduction and provides additional income sources through honey production. In Zimbabwe, such practices have been successfully implemented by organizations such as Chikukwa Ecological Land Use Community Trust (CELUCT), which supports community-based permaculture projects, contributing significantly to practitioners' income. Thus, permaculture is organically and economically regenerative, contributing to soci-ecological development of the community.

Also, continued use of liquid manure, avoiding synthetic fertilizers entirely, refrained participants from spraying pesticides and herbicides; instead, they relied on companion planting and aversive herbs to repel pests naturally. This proved to be regenerative as it relied on locally available resources. This practice was consistent with Holmgren's (2002) core ethics of permaculture, based on care for the earth, care for people, and fair share, by enhancing soil fertility, human nutrition and biodiversity while reducing dependency on chemical fertilizers (Altieri, 1999).

5. CONCLUSION & RECOMMENDATION

The Mapfihwa project highlights the transformative potential of women-led permaculture initiatives in enhancing resilience within peri-urban communities. By addressing critical challenges such as food insecurity, gender empowerment, and ecological sustainability, the project provides a comprehensive model for sustainable development in Kutama and similar contexts. Through integrating organic farming practices, efficient water management, and social empowerment, Mapfihwa has demonstrated how resource-efficient solutions can create lasting impact. The scalability and replicability of the Mapfihwa model are supported by the low-cost and resource-efficient nature of permaculture practices, combined with a strong focus on capacity building through training. Establishing community hubs based on the Mapfihwa approach, which leverages local resources and knowledge, could enable replication in other peri-urban areas.

Several recommendations are proposed to build on the Mapfihwa project's success and amplify its impact. Enhancing water resources is crucial to ensure efficient usage. The introduction of drip irrigation systems can optimize water use efficiency, reduce wastage and ensure more consistent crop growth. To meet the growing demand for fresh produce, increasing production space is necessary. The expansion of cultivated land within the Mapfihwa project will accommodate more participants and boost vegetable output, thus enhancing the project's capacity.

Diversifying income streams is another important strategy to ensure economic resilience. Participants should be encouraged to explore complementary projects, such as broiler production, which can provide alternative revenue sources. Microloans or grants could be offered to support the start-up costs of these initiatives, making them more accessible. In addition, addressing resource limitations is vital for sustained productivity. Efforts should focus on improving resource allocation by addressing seedling shortages and enhancing seedling distribution. If drip irrigation is difficult to establish, increasing the number of waters taps and hoses would make irrigation more efficient, saving time and effort for participants. An integrated approach to domestic and agricultural water use can enhance resource efficiency. Exploring dual-use water systems and ensuring that borehole systems are equipped to handle increased demand will help prevent resource depletion and sustain long-term productivity.

Scaling and replication should be prioritized to maximize the reach and impact of the Mapfihwa model. Establishing additional community training hubs modelled after Mapfihwa will expand outreach, while partnerships with local governments and NGOs can secure funding and technical support for scaling up. Developing a replicable framework tailored to different communities will ensure the broader applicability of the Mapfihwa approach. Finally, active involvement and feedback are critical for the continued success of the permaculture projects. Regular engagement with participants to identify areas for improvement and incorporate their suggestions into project planning ensures responsiveness to their needs.

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