



Socio-cultural Dynamics and Production Methods of Horned Melon (*Cucumis metuliferus*) Landraces in Zimbabwe

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ABSTRACT

Background: As agriculture intensifies and traditional varieties are neglected, agrobiodiversity is declining. This subsequently threatens global food security and reduces farming systems' ability to meet future challenges. Therefore, this study aimed to analyze the socio-cultural, production and diversity characteristics of local horned melon landraces in Mutoko district of Zimbabwe's Mashonaland East Province.

Methods: Utilizing a mixed-methods design, it gathered quantitative and qualitative data through interviews, observations and semi-structured questionnaires from 135 randomly selected smallholder farmers, with quantitative data analyzed using SPSS.

Result: The majority of horned melon farmers are male (53.4%), married (69.5%) and aged 35-44, primarily relying on traditional knowledge. Agriculture serves as their main occupation (78.0%) and principal income source (85.6%). Horned melon is cultivated for both consumption (94.1%) and income generation (100%), with farmer preferences driven by traits such as sweetness, pulp color and taste. Cultivar selection criteria encompass both qualitative aspects (e.g., shape, color, thorniness) and quantitative traits, notably fruit weight (94.1%) and days to harvest (69.5%), reflecting priorities for yield and early maturity. Farmers exclusively use organic practices (100%) and widely employ intercropping (85.6%), relying primarily on phenotypic selection. Despite these practices, a significant majority (81.4%) cultivate only one local landrace and formal conservation systems are absent. The limited adoption of grading and fertilizers may also constrain yields and market access. The study thus emphasizes the critical need to integrate traditional practices with scientific approaches to enhance productivity and conserve genetic diversity.

Key words: Agrobiodiversity, Landrace, Production dynamics, Socio-economics, Traditional knowledge, Underutilized species.

INTRODUCTION

Amid escalating global food insecurity and the homogenization of agricultural practices, traditional crops and agrobiodiversity are increasingly recognized for their critical role in sustainable food systems (Kaur and Sangha, 2025; Muluneh, 2021; Mburu *et al.*, 2016). Despite being overshadowed by commercial species, traditional crops are vital in developing regions, enhancing food security, dietary diversity and resilience to climate change (Ndlovu *et al.*, 2024; Mabhaudhi *et al.*, 2019). These crops are well-adapted to local conditions, require few inputs and provide essential nutrients, particularly for marginalized communities (ulAbideen *et al.*, 2025; Chivenge *et al.*, 2015). Agrobiodiversity, the genetic variation within and among plant and animal species used in agriculture, is integral to the stability and long-term viability of farming systems (Mutetwa *et al.*, 2025; Ranjan, 2024; Meena *et al.*, 2022). Yet, agricultural intensification and the displacement of traditional varieties threaten this diversity, undermining food security and adaptive capacity (Muluneh, 2021). Consequently, understanding, conserving and promoting traditional crops and associated agrobiodiversity are essential for resilient and sustainable agriculture.

Cucumis metuliferus Naudin, commonly known as horned melon, kiwano or African horned cucumber, is a native African species within the Cucurbitaceae family. Originating in sub-Saharan Africa, it serves as a vital food source, valued for its spiky orange rind and refreshing,

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gelatinous green pulp. It is nutritionally rich in vitamins, minerals and antioxidants (Soare *et al.*, 2024) and exhibits strong tolerance to drought and pests, highlighting its potential for climate-resilient farming, particularly in arid and semi-arid zones (Sebati *et al.*, 2024; El Bilali *et al.*, 2022). Similar adaptive traits have been documented in

other underutilized species, which thrive under marginal conditions with minimal external inputs (Manikandan *et al.*, 2025). For smallholder farmers, it offers income opportunities through both local and international markets.

Southern Africa hosts diverse landraces of *C. metuliferus*, shaped by natural selection and farmer preferences over generations, resulting in variations in fruit size, color, shape and flavor (Odongo *et al.*, 2023; Grumet *et al.*, 2021). These landraces are adapted to varied agroecological and cultural contexts. In Zimbabwe, where it is known locally as 'Gaka' or 'Magaka', the crop supports rural diets and livelihoods, especially during dry seasons when alternative foods are limited (Maroyi, 2013). However, the diversity of Zimbabwean landraces remains poorly documented and is increasingly at risk due to the adoption of modern cultivars and shifting farming practices (Mutetwa *et al.*, 2022).

Zimbabwe's agricultural system is dualistic, comprising commercial farming and widespread smallholder production based on staples like maize, sorghum and millet, complemented by traditional crops. Within this national context, Mashonaland East Province, in northeast Zimbabwe, presents a microcosm of these dynamics, where diverse agroecological conditions, driven by climate, soils and farming methods, support a range of crops, including indigenous species such as *C. metuliferus*. The rural majority in the province depends on agriculture for subsistence and income. Anecdotal evidence suggests *C. metuliferus* contributes significantly to food and economic security, especially during climatic stress. While its national importance is acknowledged, detailed studies on its diversity, distribution and use at the provincial level are lacking. Although general literature underscores the value of traditional crops and mentions *C. metuliferus*, information on local landraces within smallholder systems in Mashonaland East remains sparse. This study aims to generate essential data to inform targeted conservation and sustainable use strategies for *C. metuliferus* and other traditional crops in Zimbabwe.

MATERIALS AND METHODS

Study area description

The investigation, carried out between 2023-2024, targeted three wards (20, 21 and 27; outlined in orange) within Mutoko District, Mashonaland East Province (Fig 1). Mashonaland East, spanning 32,230 km² and home to approximately 1.73 million residents (85% literacy rate) as per 2022 Zimstats, encompasses nine districts under its jurisdiction (ZIMVAC, 2021), with Marondera as the administrative capital. The province's economy is anchored in agriculture, mining, tourism, horticulture and animal husbandry. Notably, it ranks as a leading maize-producing region and a key contributor to national agricultural output. Heri (2006) highlights that smallholder farmers in these districts actively engage in vegetable cultivation for commercial markets. Diverse marketing channels, including urban markets (e.g., Mbare Musika), farm-gate sales, rural service centers and roadside stalls, support these efforts (Bindu and Chigusiwa, 2013).

A district prioritizing smallholder horticulture was intentionally selected, followed by random sampling of households cultivating horned melon. Sharma (2017) notes that purposive sampling leverages expert judgment, often utilizing strategies like homogeneous or typical-case sampling, enabling context-specific insights despite its non-probability nature. Eligibility criteria restricted participation to households directly involved in horned melon production with in-depth local expertise. Given the study's case-based focus (Yin, 2018; Patton, 2015), purposive sampling concentrated on information-rich clusters within the three wards, prioritizing depth over breadth.

Adhering to Creswel (2009), the study integrated quantitative and qualitative approaches. Semi-structured surveys, administered to randomly selected farmers across the wards, generated numerical data and preliminary qualitative insights. These were supplemented by in-depth

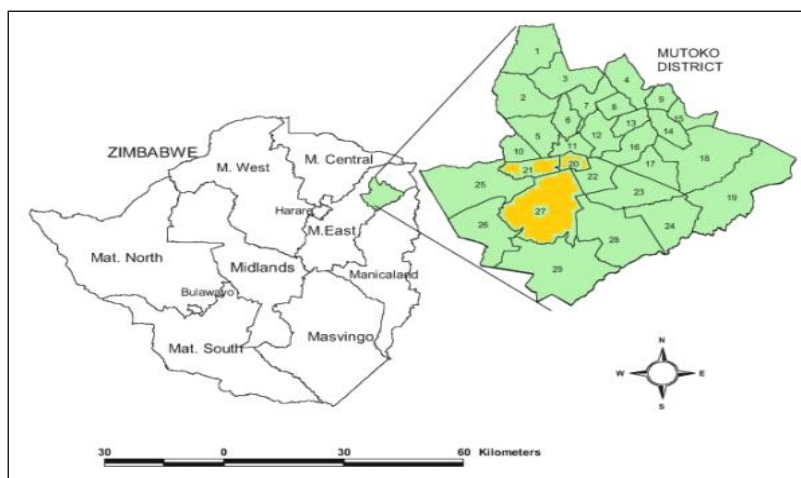


Fig 1: Map of Zimbabwe's provinces showing the study area in Mutoko.

interviews and discussions with farmers and extension officers, using open-ended probes to explore socio-cultural significance, production challenges and conservation strategies. While quantitative tools provided structured metrics, qualitative narratives contextualized local practices. Given the paucity of prior research on horned melon in the region, primary data, gathered *via* face-to-face interviews, self-completed questionnaires and community engagement, were purposefully emphasized.

A revised, pre-tested questionnaire formed the central instrument, complemented by semi-structured interviews and direct observations. A pilot study refined the tool's clarity and conciseness, ensuring 118 valid responses from the

distributed surveys. Interviews allowed open-ended discussions aligned with the questionnaire. Observations documented cultivation and marketing practices, while language support *via* local assistants ensured accessibility. Rigorous ethical protocols were followed: informed consent, confidentiality assurances and voluntary participation were strictly maintained.

Quantitative data, coded for analysis in SPSS 21, were summarized using descriptive statistics (frequencies, percentages) to characterize socio-cultural dynamics and production practices. Qualitative data underwent content analysis, with findings presented in tabular and graphical formats to enhance interpretability.

Table 1: Demographic information of the respondents.

Characteristic assessed	Description	% (N=118)
Socio-demographic information		
Gender	Male	53.4
	Female	46.6
Age class	18-246	3.4
	25-34	22.0
	35-44	50.8
	45-54	20.3
	55-64	3.4
	5+	-
Ethnic group	Ndebele	8.5
	Shona	78.8
	Kalanga	7.6
	Tonga	5.1
Civil status	Single	18.6
	Married	69.5
	Divorced	1.7
	Widowed	10.2
Education level	No formal education	9.3
	Primary level	52.5
	Secondary level	30.5
	Tertiary level	7.6
Household size	1-3	17.8
	4-6	65.3
	7-9	15.3
	10-12	1.7
Religion	Christians	84.7
	Traditional	10.2
	Muslim	3.4
	No affiliation	1.7
Vocation	Farming	78.0
	Trading	9.3
	Employment	12.7
Main source of income	Farming	85.6
	Wages	5.9
	Employment	8.5
	Pension	0

RESULTS AND DISCUSSION

The comprehensive findings on horned melon production and farmer characteristics, covering socio-demographics, preferred traits and farming practices, serve to illustrate the farming system and challenges in the study area. These results offer valuable insight into the current state of cultivation and its development potential.

The demographic information on the socio-cultural characteristics of the respondents is shown in Table 1. Respondents were mainly male (53.4%) with females at 46.6%. Age distribution showed 3.4% aged 18-24, 22.0% aged 25-34, 50.8% aged 35-44, 20.3% aged 45-54, 3.4% aged 55-64 and 0% aged 65 and above. Ethnically, Shona dominated (78.8%), followed by Ndebele (8.4%), Kalanga

(7.6%) and Tonga (5.1%). Most were married, with primary education as the highest attainment. Family sizes varied: 17.8% (1-3 members), 65.3% (4-6), 15.3% (7-9) and 1.7% (10-12). Christianity prevailed (84.7%), while 10.2% identified as Traditional, 3.4% Muslim and 1.7% unaffiliated. Farming was the primary occupation (78.0%) and income source (85.6%), with dependents mainly children, spouses and relatives.

Table 2 summarizes horned melon farming practices. Cash cropping dominated (94.1%) compared to home gardens (5.8%). Cultivation relied mainly on natural regeneration (78.0%), with deliberate planting at 22.0%. Farm sizes were small (<0.1-0.9 ha), with nearly half (47.5%) allocating 0.3-0.5 ha. Most farmers (44.9%) had 1-3 years'

Table 2: Farm production and management characteristics of the respondents.

Characteristic assessed	Description	% (N=118)
Farm production information		
Farm type	Home garden	5.8
	Cash crop farm	94.1
Cultivation method	Natural regenerated	78.0
	Cultivated	22.0
Total production area	<0.1 ha	4.2
	0.1-0.3 ha	28.0
	0.3-0.5 ha	47.5
	0.5-0.7 ha	7.6
	0.7-0.9 ha	12.7
	>0.9 ha	0
Production years	< 1 yr	7.6
	1-3 yr	44.9
	4-6 yr	31.4
	7-9 yr	8.5
	< 9 yr	7.6
Source of knowledge	No prior knowledge	16.9
	Other farmers	29.7
	Ext. Officers	11.9
	Folk knowledge	40.7
	Borrowed from related crops	30.5
Seed source	Own seed	17.8
	Family/Relative	50.8
	Non-relative/Neighbour	31.4
Planting time	Purchase	0
	Dry land planting	100.0
	After the rains	0
Cropping system	Sole cropping (SC)	14.4
	Intercropping (IC)	85.6
Main selling method	Retail	78.8
	Wholesale	21.2
*Selling place of produce	On-farm sales	100.0
	Other farmers	67.8
	Community market	50.0
	Street selling	17.8
	Roadside/Highways	28.0

*These were a multiple-response questions.

experience. Family or relatives were the main sources of both knowledge and seed (50.8%), while 17.8% saved their own seed. Dryland planting was universal, with intercropping practiced by 85.6%. Retail sales of the fruits dominated (78.8%), mainly on-farm, with outlets including other farmers (67.8%), community markets (50.0%), highways (28.0%) and streets (17.0%).

Fig 2 shows planting spacing as the most common assistance (43.2%), followed by postharvest handling (40.7%), planting dates (33.1%), fertilizer application (29.7%) and landrace selection (26.3%). The least reported assistance received regarding horned melon by the farmers was on appropriate soil pH (0%), harvesting period (6.8%), pest (13.6%) and disease management (15.1%), while 18.6% received support in produce marketing.

The bar graph (Fig 3) presents the agronomic and postharvest practices adopted by the surveyed farmers. A key finding is the universal application of organic manure by all farmers (100.0%). This contrasts sharply with the

limited use of chemical fertilizers, adopted by only 16.9%. Postharvest practices show varying adoption rates: storage is common (85.0%), packing is utilized by over half the farmers (56.3%), while grading is less frequent (26.3%).

An analysis of the socio-demographic characteristics of horned melon producers reveals critical socioeconomic and cultural dynamics shaping production practices. Gender distribution among producers is nearly balanced, with men (53.4%) and women (46.6%) equally engaged, a pattern corroborating findings from Moyo *et al.* (2024).

This near-equitable participation in horned melon cultivation may reflect the crop's status as a supplementary income source that aligns with women's traditional roles in food production, while men's involvement likely stems from its commercial potential. However, gendered disparities in agricultural participation persist more broadly, influenced by entrenched norms assigning men primary farming roles and women domestic responsibilities (Mukwedeya and Mudhara, 2024). The labor force is

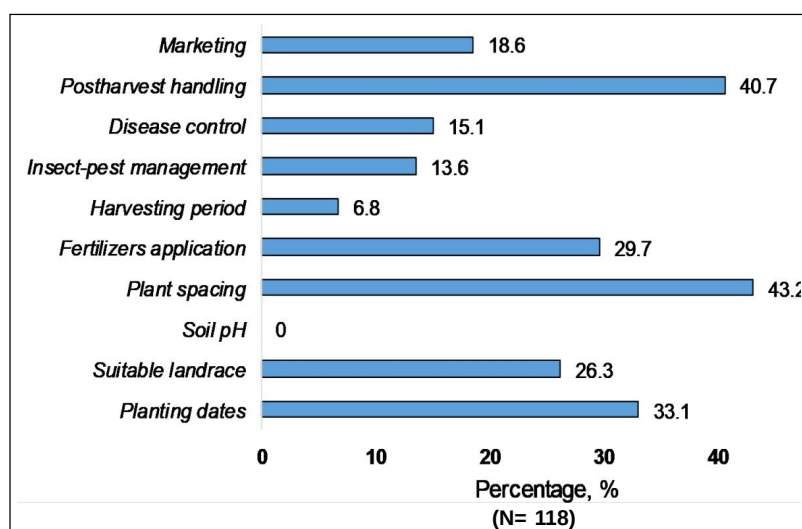


Fig 2: Response distribution on the assistance received by farmers.

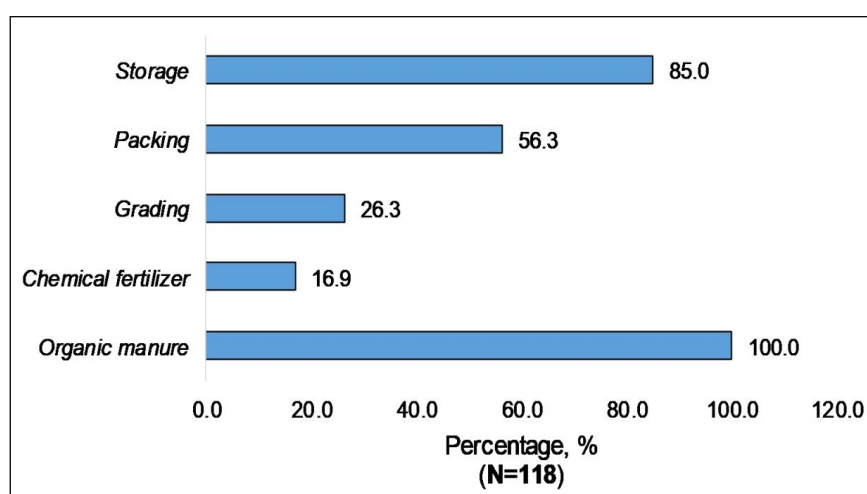


Fig 3: Response distribution on the agronomic and postharvest practices adopted by farmers.

predominantly middle-aged (35-44 years), emphasizing reliance on experienced workers who possess indigenous knowledge of traditional crop management. Youth engagement remains minimal (3.4%), reflecting intergenerational challenges in skill continuity (Mukwedeya and Mudhara, 2024), likely driven by rural-urban migration and youth perceptions of agriculture as economically unviable. Ethnicity is largely Shona, with educational attainment predominantly at primary levels, compounded by barriers such as financial constraints, low exam performance and inadequate career guidance (Chipfupa and Tagwi, 2021). These limitations necessitate culturally sensitive extension services employing accessible, non-written formats and local languages to ensure effective knowledge transfer. Most farmers are married, with household labor derived from nuclear families (4-6 members), though single or widowed farmers, particularly women, face heightened resource-access challenges due to limited social capital and labor shortages. Farming serves as the primary livelihood, with limited economic diversification, mirroring rural unemployment trends in sub-Saharan Africa (Magagula and Tsvakirai, 2019). High household dependency ratios and vulnerability to climatic and economic shocks further strain livelihood resilience, explaining farmers' risk-averse strategies and preference for low-input traditional crops.

Horned melon cultivation is primarily a cash crop, with 100% of surveyed farmers prioritizing income generation over subsistence (Muthoni and Shimelis, 2024). This commercial orientation likely reflects growing market demand for indigenous fruits and the crop's comparative advantage in generating cash during dry seasons when other income sources dwindle. Production is typically low-input and confined to small plots, with over 75% relying on natural regeneration. This informal propagation method, while cost-effective, risks inconsistent yields and genetic quality, as commercial seed availability remains limited (Munyaka *et al.*, 2015). Farmers' preference for natural regeneration over purchased seed likely stems from both affordability constraints and confidence in locally adapted landraces. Cultivation methods are rain-dependent, aligning with seasonal planting cycles, which exposes crops to climate variability and explains yield fluctuations across seasons. Intercropping dominates over monoculture, reflecting smallholder strategies to optimize land use, diversify diets and mitigate risk (Mihrete and Mihretu, 2025; Toker *et al.*, 2024), though this may reduce horned melon yields if poorly managed due to competition for resources. Seed acquisition remains local and informal, heightening concerns about genetic erosion and disease transmission (Spielman *et al.*, 2021), while also indicating weak integration into formal seed systems.

Marketing remains localized, with 80% of farmers engaging in direct-to-consumer sales via informal channels such as roadside stalls or community markets. This reliance on spot marketing rather than contractual

arrangements reflects limited integration into formal value chains and inadequate infrastructure, which constrain income potential, findings consistent with Pagare *et al.* (2022) and Wolanin (2013). Structural market failures and weak institutional frameworks further impede competitive positioning, explaining why farmers cannot capture premium prices despite the crop's niche market potential.

Data on agricultural aid highlight pronounced disparities in resource allocation. Essential tasks like planting and postharvest management receive substantial backing, whereas critical domains, soil pH monitoring, pest/disease control and marketing, remain underserved (Nkosi, 2022). This imbalance likely reflects extension services' historical focus on staple crops and production basics rather than market-oriented support for indigenous crops. Sub-Saharan smallholder farmers, constrained by inadequate extension services and information (Waje *et al.*, 2024), persist in traditional practices, hindering modern input adoption and yields. Timely, accurate guidance on seed varieties, fertilizers and techniques is vital to improve productivity. However, obstacles such as poor infrastructure, weak extension systems and barriers to information uptake and innovation adoption (Mugonya *et al.*, 2021; Maredia *et al.*, 2018) undermine progress. These gaps in support mechanisms threaten both farmer incomes and agricultural sustainability by perpetuating low-productivity cycles.

Survey findings reveal key farming system characteristics emphasizing sustainability focus, resource accessibility and market preparedness. All farmers rely on organic manure to enhance soil fertility, a cost-effective, locally sourced practice rooted in generational knowledge. This universal preference reflects either unavailability or unaffordability of chemical fertilizers in rural areas (Wasil *et al.*, 2023), combined with indigenous understanding of manure's soil health benefits. Postharvest storage is widespread, aiding market timing and food security, though storage types remain unspecified and may vary in efficacy (Mpala and Simatele, 2024). Nearly half of farmers engage in packaging, recognizing its role in value addition and market competitiveness (Mibulo *et al.*, 2020), while others lack materials or training, creating quality disparities. Only 25% practice grading, likely due to local market norms that do not reward quality differentiation or technical constraints in applying standards, which limits access to premium markets. Minimal chemical fertilizer use (Berlie and Tegegne, 2024) stems from high costs, scarcity and potential disinterest in synthetic inputs by extension services or policymakers prioritizing organic production. These practices underscore reliance on low-input systems and highlight systemic barriers to resource access and income growth, while also demonstrating farmers' adaptive strategies to resource constraints.

CONCLUSION

The study shows farming is primarily an income source (85.6%) and strongly influenced by Shona cultural traditions

(78.8%). Formal education is limited (7.6% tertiary), but community knowledge, folk wisdom (40.7%) and farmer-to-farmer learning (29.7%), remains vital, underscoring the need for extension strategies that build on indigenous knowledge. Horned melon production is traditional, low-input and sustainable, with universal organic manure use and 85.6% intercropping, though yields remain limited. Chemical fertilizer use (16.9%) and postharvest activities like grading (26.3%) and packing (56.3%) are low, constraining value addition. Most farms are small (<0.5 ha) and 94.1% target cash crops. Policy and extension should integrate local knowledge with improved techniques; genetic resource management needs seed banks and participatory breeding and market/value chain development can boost incomes *via* postharvest training, infrastructure and cooperatives.

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Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

All data collection procedures for this research were approved by the research ethics committee for Midlands State University.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

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