

The Role of Gender Inclusion in Promoting Sustainable Horticultural Practices in Southwest Nigeria

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ABSTRACT

The study investigates the role of gender inclusion in fostering sustainable horticultural practices for smallholder farmers in Southwest Nigeria. Through the application of Structural Equation Modeling (SEM) to the cross-sectional survey of 422 horticulture farmers in six states, the study explores the link between gender diversity and key features of inclusive business models (IBMs), such as capacity building, technical assistance, access to credit, quality assurance, and access to agricultural inputs, and gauges them in terms of impact on sustainability outcomes including profitability, efficiency, climate resilience, quality of products, and sales growth. The research shows that the integration of gender is an independent catalyst for sustainability by promoting participation, stirring innovation, and improving balanced access to resources in the value chains of horticultural production. The study also found that access to agricultural inputs and tailored capacity building measures are the best indicators of long-term success for both male and female farmers. On the other hand, general technical competence and limited access to financial credit had mixed or negative effects more often, especially for women. It is, therefore, crucial to include gender-sensitive approaches in policy design and implementation, with specific actions taken to help women in the horticulture value chains overcome the challenges they face. The study also gives policy-makers, researchers, and others who want to help create equitable and sustainable horticultural systems in Nigeria useful empirical evidence.

Keywords: *Inclusive Business Model, Sustainable Horticulture, Gender Inclusion, Access to Credit, Technical Assistance, Capacity Building*



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INTRODUCTION

Food security and sustainable agriculture have been central issues for policy-makers and scientists the world over, more so because the population of the world is projected to increase to 10 billion by 2050 (Food and Agriculture Organization of the United Nations, 2018). The rapid impacts from climate change, resource depletion, and rapid urbanization loom over the sustainability of the food system, more severely in the developing world (Saleem et al., 2024). Notably, the world's food insecurity has risen alarmingly from 22.6% in 2014 to 30.4% in 2020, the trend being exacerbated by the COVID-19 pandemic and the recurring economic disruptions (FAO, 2023). Small-scale farmers in Sub-Saharan Africa, who produce over 80% of the foods in the region, rank high among the poor and the food insecure (Chiaka et al., 2022).

Nigeria, the most populous country in Africa, serves as an example of these issues. While 70% of Nigeria's rural population lives in rural areas and agriculture contributes roughly 23% of the country's GDP (Ukwe, 2025), the sector faces numerous obstacles due to outdated farming methods, limited access to resources, and the adverse effects of climate change. The production of fruits and vegetables through horticulture is the key to both economic growth and food security. Nigeria used to lead the subregion in the production of crops like pineapple, cocoa, and palm oil, but the subsector has already seen a sharp drop in output, with its horticultural output lagging behind the subregion (Adeniyi et al., 2024).

Gender inclusion is crucial in determining sustainable horticultural practices and, consequently, food security (Tamunomiegbam and Arinze, 2024). The adoption of sustainable farming practices is aided by the distinct viewpoints and priorities that women, who make up a sizable portion of the agricultural workforce, bring, such as resource conservation and household nutrition. However, their capacity to fully participate in and profit from the horticultural value chain is constrained by structural gender differences in access to land, credit, and extension services (Homann-Kee Tui et al., 2024).

Although Nigeria used to lead the subregion in the production of crops like pineapple, cocoa, and palm oil, the subsector has already seen a sharp drop in output, with its horticultural output lagging behind (NBS, 2024; FAO, 2023). Since horticulture is a major source of income and a means of subsistence for many households, the situation is especially volatile in Southwest Nigeria. Lack of access to better seeds and agricultural supplies, inadequate extension services, inadequate infrastructure, and volatile markets are some of the persistent issues that the region's farmers must deal with (Bjornlund et al., 2020).

According to recent reports, less than 5% of Nigerian credit lines are directed to the horticultural industry, and over 70% of the country's rural farmers do not have access to formal credit facilities, which severely hinders their capacity to implement sustainable farming practices (Adesiyani & Kehinde, 2024). An estimated 26.5 million

Nigerians are expected to experience severe food insecurity by 2024, with horticultural and rural households bearing the brunt of the ensuing crisis (World Food Programme, 2024).

Crop rotation, organic manuring, integrated pest management, and water-saving irrigation are examples of sustainable horticultural practices that are acknowledged for their capacity to lessen environmental effects and increase resilience. Adopting these strategies could improve soil health and promote biological diversity while reducing water use by 30% and pesticide use by up to 50% (FAO, 2023; Ojo et al., 2024). Adoption is still low, though, and is frequently attributed to a lack of funding, technical assistance, and awareness (Adebayo et al., 2023).

About 43% of agricultural workers are women, and in Nigeria, (Figure 1) their participation is particularly noticeable in horticultural supply chains (FAO, 2023; UN Women, 2024).

Nevertheless, despite their enormous contributions, women still face systemic discrimination, which manifests as limited access to decision-making, credit, land, and extension services (Olaitan et al., 2020).

Compared to 24% of their male counterparts, only 13% of Nigerian women own land and less than 10% have access to credit (NBS, 2024). These disparities not only maintain existing gender disparities but also reduces the viability and productivity of the horticultural systems (Meinzen-Dick et al., 2022). According to recent international research, bridging the gender gap in agriculture can increase the productivity of women-run farms by 20–30% and reduce the number of food deprived people, who make up roughly 17% of the population (FAO, 2023).

It has been established that gender-inclusive business models that include women and impoverished individuals in the supply chains of agriculture can increase household income, encourage innovation, and make communities stronger (Timu et al., 2024).

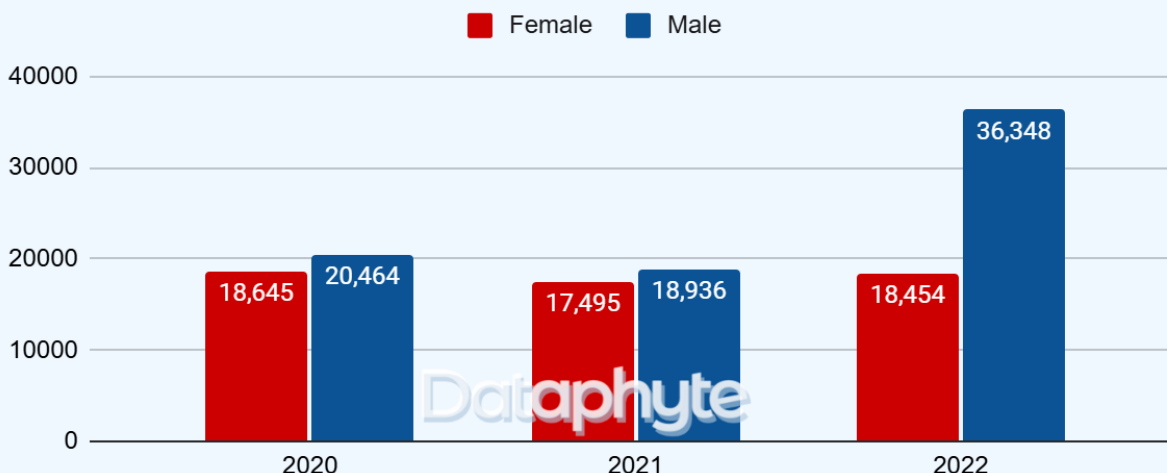
For example, the 2Scale program in Nigeria has been very important in closing these gaps by connecting private sector players, agricultural associations, NGOs, and governments. The goal is to give women and young people more access to technology, services, capital, and marketing opportunities (van Dijk et al., 2021).

Even with these efforts, however, long-lasting cultural and institutional problems are still a major barrier to achieving gender equality and making Nigerian horticulture sustainable (Pyburn et al., 2023). For instance, women farmers are more likely to be impacted by transaction costs, inadequate access to market information, and exclusion from cooperative networks, which limits their capacity to engage in inclusive business practices (Ojo et al., 2024).

The Toward Sustainable Clusters in Agribusiness through Learning in Entrepreneurship (2SCALE) programme enables various groups to collaborate and promote inclusivity within agribusiness in sub-Saharan

Nigeria's agriculture sector has historically had a higher proportion of men than women, but in 2022, the gap is more pronounced, with only 21% of women actively participating in the sector

Number of Male and Females in the Nigerian Agricultural Sector



Source: 2023 Social Statistics Report | Analysis: Dataphyte Research

Figure 1: Statistics of gender participation in the Nigerian agricultural sector

Africa. It was initiated in 2012 and sponsored by the Dutch Ministry of Foreign Affairs. 2SCALE develops and implements public-private value chains that involve small farmers, micro-enterprises, and poor consumers. 2SCALE enables these groups to participate and prosper within value chains that are sustainable and cost-effective (2Scale, 2020). Gender equity and justice are among the core objectives that 2SCALE aims to achieve, and it does this by enabling women and youth to participate, eliminating participation barriers, and acknowledging their roles within farming, processing, and marketing. 2SCALE also enhances food and nutrition security by providing training programs, access to funds, and market links.

In view of this, the current study aims to examine the value of gender inclusivity in promoting sustainable horticultural practices in Southwest Nigeria. This research will offer practical policy recommendations for policymakers, development practitioners, and stakeholders dedicated to creating resilient, inclusive, and sustainable food systems by revealing the relationship between gender diversity, inclusive business models, their fundamental drivers, and the resulting sustainability benefits.

MATERIALS AND METHODS

The study was conducted in Southwest Nigeria, covering the states of Lagos, Ogun, Oyo, Osun, Ondo, and Ekiti, which jointly form one of the important hubs of horticulture and innovation in agricultural practices in the country. The

The study area was selected intentionally due to the high population of smallholder farmers involved in horticulture, their involvement in inclusive business model (IBM) approaches, and the presence of both traditional and modern agricultural practices.

Cross-sectional survey research design was used in order to achieve in-depth understanding of the status of gender inclusion and the practice of sustainable horticulture production at the household level by the smallholder farmers. The research design aided in obtaining measurable information from different respondents at once over the stipulated period, hence enabling the estimation of variation and uniformity in the respondents.

The study population was the registered agricultural horticultural producers operating in value chains managed by IBM, mainly those from the 2Scale initiative and associated value chain activities. In order to increase the representativeness of the study and to limit sampling bias, multi-stage sampling was used. Three states were first randomly sampled from the six southwestern states in Nigeria. Two local government areas were thereafter randomly sampled from identified states to ensure the sampling reflected the various rural and peri-urban communities of the horticultural farmers adequately. At the local government area level, the identified local horticultural producers and cooperatives were sampled. Using Cochran's sample size determination formula, 422 respondents were selected from the value chains in the region, at a 95% confidence level.

Data was collected by the administration of structured questionnaires. The questionnaire was organized into various discrete sections; the first one recorded socio-demographics, including age, gender, educational backgrounds, experience in farming, and farm size; the second one assessed the adoption of inclusive business practices, touching on points concerning participation in capacity-building activities, technical expertise, access to credit lines, quality management practices, and availability of farm-produced goods. The third one focused on the adoption of sustainable horticultural practices, including the use of organic manures, integrated pest management practices, crop rotational practices, and water-saving irrigation practices. The fourth one measured sustainability outcomes in five vital dimensions: profitability, operating efficiency, climate resilience, quality of products, and sales growth. The last one included the questionnaire items concerning gender diversity and inclusion, including female participation levels, presence of women in management, and access to resources and opportunities for participation in decision-making processes.

The scales of measurement were adapted from proven instruments used in prior empirical research and tailored for the local setting by pre-testing in the field. The majority of the items were measured by five-point Likert scales from 1 ("Strongly Disagree") to 5 ("Strongly Agree"), enabling strong measurement of perception. Internal consistency reliability was evaluated using Cronbach's alpha, with all major scales exceeding the recommended threshold of 0.7, indicating satisfactory reliability.

The researchers carried out direct interviews in English and local languages according to the preference shown by the respondents. Through this approach, non-response bias was effectively minimized, hence encouraging high participation by farmers with different literacy levels. Descriptive in the form of frequencies, means, and standard deviations were used to determine the key variables.

For inferential analysis, the Structural Equation Model was implemented using SmartPLS software package. The SEM enabled the simultaneous estimation of interrelations between the constituents of IBM, gender diversity, and the different sustainability outcomes, handling measurement errors effectively and complex interdependencies. The moderation analysis was used to identify whether gender diversity exerted a statistically significant impact on the direction or the strength of the relationship between sustainability outcomes and participation in the IBM. Conventional indices were used to assess the model fit adequacy, and extensive checks were carried out to validate the conclusions.

Ethical approval for the study was obtained from the relevant institutional review committee. All participants provided informed consent after being presented with a summary of the study's objectives, methodologies, and rights entitled to them, including confidentiality, voluntariness, and the prerogative to drop out at any time with no consequences. Data were anonymised to ensure

the confidentiality of respondents. This rigorous methodological approach ensured that the findings of the study are reliable, providing a solid foundation for evidence-based recommendations on gender inclusion and sustainable horticultural development in Southwest Nigeria.

$$Y = f(X \cdot Z)$$

$$Y = \beta_0 + \beta_1 X + \beta_2 Z + \beta_3 X \cdot Z + e_i$$

$$Y = \beta_0 + \beta_1 IBM + \beta_2 GDI + \beta_3 IBM \cdot GDI + e_i \quad (1)$$

Where:

β_0 = the intercept expected value of y when x is equal to zero.

β = the Coefficient of the independent variable (it is the rate of change in y with respect to x).

e = the error term to accommodate the effect of other variables that can influence sustainable horticulture farming but which were not included in the model.

RESULTS AND DISCUSSION

This study identifies the central role that gender diversity and inclusion can play in ensuring the adoption of sustainable horticulture practices among Southwest Nigeria smallholder farmers. A survey of 422 horticulture farmers found that 60.3% were men and 39.7% were women, confirming the predominance of men while still representing a considerable number of women contributing to the sector (Tables 1-5). Interestingly, initiatives such as 2Scale and similar inclusive business models (IBMs) have significantly improved women's opportunities. More than 89% of the respondents indicated that 2Scale had helped ensure equal footing for both genders and had gone a step further to ensure gender diversity was encouraged in the initiatives involved. However, women are still much disadvantaged. Among the respondents, 54.5% were 40 years and above, with a mean farming experience of 12.7 years, but women are highly misrepresented in leadership, with a mere 14.7% occupying positions of cooperative as well as farmer group leadership. Additionally, a wide gender gap exists when it comes to resource access, while only 28.7% of all the respondents used formal credit facilities. National data indicate that fewer than 5% of agricultural credits of banks target the horticulture subsector, and a mere 13% of women own land compared to 24% of the men. All these disadvantages are intensified by societal expectations and limited decision rights, which continue to hamper women's full participation in the sector.

Studies have shown that gender diversity is not only an ethical need, but also as a prime driver of sustainability. Farm enterprises with higher representation by women showed a stronger tendency to adopt sustainable practices, such as the use of organic manure, integrated

Table 1: Distribution of sample frame.

S/N	Name	Numbers Per State	Agricultural Zones
1	Ogun State	72.0	Abeokuta, Ijebu Ode, Ikenne Ilaro
2	Lagos State	70.0	Badagry, Igbogbo Imota Epe
3	Oyo State	70.0	Ibadan/Ibarapa, Oyo, Saki/Iseyin Ogbomoso
4	Osun State	70.0	Iwo and Ikire zone; Ikirun and Osogbo zone; Ife and Ilesa zone
5	Ondo State	70.0	Akure, Owo, Ondo, Akoko North, Ikare; Okitipupa
6	Ekiti State	70.0	Aramoko, Ikere; Isan-Ekiti
	Total	422	

Source: Author's Compilation 2023

Table 2: Tabular Representation of Research Instrument.

S/N	Constructs	Source	No of Items
1	Capacity Building	7	4
2	Technical Assistance	8	4
3	Access to Credit	9	4
4	Quality Control	10	4
5	Access to Farm Input	12	4
6	Profitability	11	4
7	Efficiency	11	4
8	Climate Resilience	8	4
9	Quality of produce	10	4
10	Gender Diversity	13	4
11	Sales Growth	11	4
	Total Items		42

Source: Researcher's Compilations 2024

Table 3: Summary of Pilot Test Incorporating Construct Validity Test

Variable	No. of items	Pilot	AVE	Remark
Inclusive Business Model	20		0.723	Reliable
Sustainable Horticulture Farming	20		0.592	Reliable
Gender Diversity	4		0.684	Reliable

Source: Computed from Pilot study, 2024

pest management, and crop rotation (Rahmania et al., 2025). Findings are also consistent with evidence suggesting that women tend to priorities environmentally sustainable and resource-conservin gpractices, encouraged by the desire to provide adequate household

nutrition as well as their farm management duties.It was observed that gender diversity has a significant positive correlation with improved sustainability outcomes ($\beta = 0.22$, $p < 0.01$), including better product quality and as well as higher financial resilience and a better ability to recover

Table 4: Demographic Characteristics of Respondents.

Characteristics	Classification	Frequency	Percentage (%)
Gender	Male	213	60.3
	Female	140	39.7
	Total	353	100.0
Age	Under 25 years	17	4.8
	25-30 years	10	2.8
	31-35 years	16	4.5
	36-40 years	100	28.3
	Above 40 years	210	59.5
	Total	353	100.0
Highest Educational Qualification	First leaving Certification/SSCE	17	4.8
	OND/NCE	40	11.3
	Professional Qualification related to agribusiness	62	17.6
	Professional qualification not related to agribusiness	80	22.7
	Degree(BSC/HND/B.Ed)	114	32.3
	Post Graduate Qualifications	40	11.3
	Total	353	100.0
Marital Status	Single	51	14.5
	Married	173	49.0
	Divorced	42	11.9
	Widow/Widower	87	24.6
	Total	353	100.0
Years of Work Experience	Below 10 years	100	28.3
	10-20 years	110	31.2
	Above 20 years	143	40.5
	Total	353	100.0

Source: Author's Computation, 2025

following climatic shocks. On the other hand, the effect of gender diversity on IBM factors produced a negative and statistically significant coefficient ($\beta = -0.17$, $p < 0.05$). This suggests that while, by itself, gender inclusion enhances sustainability, the substantive benefit directly provided by the IBMs is reduced when gender diversity increases, almost certainly a reflection of continuing structural challenges faced by women, such as limited access to credit, land, and extension services (Dharamshi et al., 2023; Homann-Kee Tui et al., 2024).

Access to agricultural inputs was the strongest predictor of the desired sustainability outcomes for both male and female farmers, with 84.6% of respondents indicating input support program availability, almost entirely through improved seeds and organic manure. Effects were much stronger in the male group, indicating the input distribution mechanisms might still tip disproportionately towards the men. Technical expertise and capacity-building opportunities were taken up widely, by 79.4% and 65.1%, respectively, though their impact seemed reduced for the women, probably through the generic nature of the training, which made them ineffective, coupled with attendance logistics difficulties. Interestingly, credit access was related to undesirable sustainability, specifically among the women, as they are required to offer higher collateral and are subjected to higher interest rates.

Women expressed major adoption constraints, with reduced access to credit (62.8%), higher input prices (56.3%), and inadequate technical services (48.5%) listed as the main constraining factors (Table 4). In spite of these challenges, women overwhelmingly named improved yield quality, better marketing access, and improved household

nutrition as the main benefits of sustainable horticulture, which are all factors directly related to improving the well-being of their households. Current understanding of gender-responsive programs and policies continues to be seriously deficient, as revealed by the observation that only 34.2% of respondents were familiar with projects initiated by governmental institutions or international donor organizations focused on strengthening the contribution of women to agriculture. That lack highlights the need for intensified outreach activities, effective communication techniques, and incorporation of gender-responsive approaches through all phases of program initiation and program implementation. These findings are consistent with current literature, which highlights the fact that smallholder farmers, often among the poorest segments of a population, remain crucial for the achievement of food security all over Sub-Saharan Africa, while simultaneously facing own food insecurity themselves. Data from the current study supports the argument that inclusive business models, designed with a clear concentration on gender sensitivity, are catalysts for building stronger chains, enhancing farmers' livelihoods, and ensuring sustainability. Regardless, the negative effect of gender diversity found for the influence of inclusive business models further reveals that current initiatives are perhaps not sufficiently personalized to address the various challenges faced by women. This finding supports other studies which have shown that access to credit, extension services, and quality assurance systems are a guarantee for sustainability, while such facilities are often fewer for women due to system and cultural barriers.

The results clearly show a strong bent towards gender

Table 5: Gender Diversity.

Statements	SD Freq (%)	D Freq (%)	N Freq (%)	A Freq (%)	SA Freq (%)	Mean	Std Deviation
There are equal opportunities for men and women in 2Scale programmes regarding horticulture farming	11 (3.1%)	12 (3.4%)	14 (4.0%)	144 (40.8)	172 (48.7)	4.2861	.92948
2Scale programmes have provided opportunity for more women in horticulture farming	10 (2.8%)	11(3.1%)	15 (4.2%)	145 (41.1)	172 (48.7)	4.2975	.90731
Gender challenges in horticulture farming are relatively reduced through 2Scale programmes	10 (2.8%)	11 (3.1%)	15 (4.2%)	145 (41.1)	172 (48.7)	4.2975	.90731
2Scale programmes support gender diversity	13 (3.7%)	10 (2.8%)	12(3.4%)	140 (39.7)	178 (50.4)	4.3031	.94533
OVERALL MEAN						4.2960	.91847

Source: Researcher's Computation, 2025

sensitivity among the 2SCALE horticulture activities. The overall value on all statements, computed at 4.2960 (SD = .91847), shows that respondents clearly view the programme favourably, enabling them to promote gender diversity, enhance the prospects for women, and address gender-specific issues related to horticulture.

This finding aligns with current literature, where developmental efforts are considered essential to changing gender dynamics within agricultural groups (Kumari et al., 2025; Tourtelier et al., 2023). The statement asserting that "2SCALE programmes support gender diversity" (M = 4.3031) may mean that gender mainstreaming efforts are gaining enhanced visibility, or else, perceived visibility within applied settings. Similarly, respondents showed agreement that the programme created new possibilities open to women (M = 4.2975) and helped address gender-linked difficulties (M = 4.2975). These findings align with the perspective presented by the FAO (2010), which confirms that institutional transformations and specific interventions aim to enhance women's productive capacities within agricultural settings. The standard deviations, which are between 0.90 and 0.95, and the 6–7% representative rates of disagreement or neutrality, highlights that, despite overall positive perceptions, achieving full gender equity remains an objective desirable to achieve. The rates of dissent or neutrality so identified might signal localized exclusion, socio-cultural resistance, or an unequal distribution of the benefits from programs to different regions, ethnic groups, or social classes. The result parallels conclusions by Pattnaik & Lahiri-Dutt (2020), who noted that socio-economic variables like caste, religion, and household income have major impacts on women's experience from agriculture within India.

The information depicted within the (Tables 1-5) show that there exists an optimistic outlook on participation, yet researchers like Rao (2012) advice that visibility by women within the agriculture does not automatically translate to empowerment. While access to resources might prove essential, overall empowerment requires that individuals exert control over said resources, take participatory decision-making, and receive institutional recognition. Dharamshi et al. (2023) claim that women's engagement within agriculture takes place within the broader framework of the "feminization of agrarian distress," whereby women

take on agricultural work without a relative increase in rights, leadership, and recognition.

As per Installation Theory (Dharamshi et al., 2023), the comparatively higher average scores suggest a certain level of change within the physical forms of agricultural inclusion. Findings show that women are becoming more involved in the schemes and trainings given by the program, which most likely provides them with an enhanced skill set. However, difficulties are bound to persist on the social level, considering that customary patriarchal values still tend to govern ownership of land, access to credits, participation within the market, and achieving social status (Bryan et al., 2013). Feyertag et al. (2021) maintains that without de facto ownership over land, women's capacity to access institutional assistance and monetary resources continues to stay limited, despite knowledge or contributions on their part.

Also, the assumption that problems related to gender have been adequately dealt with should receive careful scrutiny. While program structures might include gender-inclusive terminology and approaches, the nuances of gender relationships within agricultural settings include not only formal arrangements for access but informal relationships of power, household negotiations, and cultural recognitions. As explained by Chayal and Dhaka (2016), despite the meaningful contributions that women make through their work on farms, they are often understood and identified as "helpers" and not farmers, a distinction that has considerable effects on their social status and right to resources.

Overall, 2SCALE appears to actively enhance notable improvements in gender diversity within the horticulture industry, matching the account by Dharamshi et al. (2023) of an extended and dynamic trajectory of established arrangements. However, the ongoing survival of resistance, despite extensive theoretical debates on systematic gender-based discrimination, further suggests that such improvements need refinement through ongoing interaction on both institutional and normative sites. Future actions need to aim at transforming participation into meaningful empowerment by tackling problems concerning land rights, decision-making structures, and the integration of women into policy and information arrangements before ensuring that inclusion goes beyond symbolism to build transformative arrangements.

Conclusion

This study emphasizes how gender inclusion is a key factor in smallholder farmers' adoption of sustainable horticultural practices in Southwest Nigeria. Improving sustainability outcomes for both men and women requires access to agricultural inputs and customized capacity building. In order for sustainable horticulture to reach its full potential, stakeholders must place a high priority on removing these obstacles by implementing integrated strategies that give women farmers access to credit, land, and technical assistance. Such effort is required for improving gender parity as well as for increasing the stability and results of horticultural value chains that are vital to Nigeria's rural development and food security.

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