THE ROLE OF WOMEN FARMERS IN ADVANCING SUSTAINABLE DEVELOPMENT GOALS (SDGS) TO PROMOTE WELFARE IN LABUHAN BATU REGENCY

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Abstract

This study investigates the role of women farmers in advancing Sustainable Development Goals (SDGs) to improve household welfare in Labuhan Batu Regency. Women farmers are central contributors to agricultural production, yet their involvement is often constrained by limited access to resources, health challenges, and institutional barriers. This study employs a quantitative approach using Structural Equation Modeling–Partial Least Squares (SEM-PLS) with 100 respondents selected through the Slovin formula. The findings show that women farmers' role and health have a positive and significant effect on welfare, while access to resources does not directly influence welfare. However, an SDG-based economy significantly improves welfare and acts as an effective mediator for the roles, health, and resource access of women farmers. The mediating effect indicates that sustainable economic mechanisms strengthen the contribution of women farmers toward welfare improvement. The study concludes that enhancing women's participation, improving health access, and optimizing resource utilization within an SDG-aligned economic framework are essential strategies for increasing household welfare. These results provide empirical support for integrating gender-responsive and sustainability-based approaches into regional agricultural development policies.

Keywords: access to resources; health; SDG-based economy; welfare; women farmers.

INTRODUCTION

Gender equality has become a global priority in sustainable development, particularly since the adoption of the Sustainable Development Goals (SDGs) by the United Nations. The SDGs emphasize the crucial role of women's empowerment in achieving several key targets, especially SDG 5 (Gender Equality), SDG 1 (No Poverty), and SDG 2 (Zero Hunger). In the agricultural sector, women serve as essential contributors—acting as food producers, household managers, and guardians of environmental sustainability. However, despite their central roles, women farmers worldwide continue to face disparities in access to land, technology, information, and participation in decision-making processes. The Food and Agriculture Organization's report on The Status of Women in Agrifood Systems reveals that in nearly 80 percent of countries with available data, fewer than half of women have ownership or secure rights to agricultural land (FAO, 2023). These challenges often place women in vulnerable socio-economic positions, even though they hold substantial potential in strengthening food security and household welfare.

At the national level, Indonesia—being an agrarian country—reflects a similar situation. Agriculture remains a cornerstone of the national economy, particularly in rural regions where women actively participate in various stages of agricultural production, including land preparation, planting, maintenance, harvesting, and post-harvest activities. According to the World Bank (2022), approximately 10 percent of agricultural households in Indonesia are female-headed, and women represent 24 percent of farmers; however, women usually own smaller landholding sizes compared to men. The FAO Country Gender Assessment of Agriculture and the Rural Sector in Indonesia found that women often have no control over valuable resources and assets such as land, labor, and new technologies (FAO, 2019). Structural barriers such as limited access to farmer groups, capital, training, and strategic decision-making positions persist and hinder their empowerment (Wijers, 2019). As a result, the full economic value of women's labor in agriculture is frequently overlooked and does not translate into adequate policy support.

Research demonstrates that empowering women farmers can significantly improve production efficiency and household welfare. Diiro et al. (2018) found that increased female participation in production decision-making is associated with a 32 percent increase in crop productivity among smallholder farmers. The World Bank Gender Strategy 2024-2030 further emphasizes that gender gaps in agricultural productivity can reach up to 66 percent, primarily because women farmers face gender-specific constraints such as unequal access to inputs, lower literacy, and reduced participation in farmers' groups (World Bank, 2024). Closing the gender gap in farm productivity would increase global GDP by approximately 1 percent—nearly USD 1 trillion—and reduce food insecurity by about 45 million people (FAO, 2023). Thus, strengthening women's capacity in agriculture is not only a social necessity but also an economically strategic approach for national development.

Regionally, North Sumatra Province is known for its strong agricultural base, and Labuhan Batu Regency stands out as one of its prominent agrarian areas. Rice farming is a major livelihood source for rural communities in the region. However, agricultural production in Labuhan Batu has experienced considerable fluctuations over the past five years. Data show that Panai Hilir District recorded a sharp decline in production from 67,986.8 tons in 2019 to 48,084.8 tons in 2023. Rantau Selatan District, the focus of this study, also illustrates unstable production trends. These fluctuations indicate vulnerabilities in local agricultural management related to socio-economic dynamics—including the underutilization of women's roles.

In Labuhan Batu's agrarian context, women play multifaceted roles extending beyond technical agricultural work. Research by Qanti, Wardhana, and Ihle (2022) on Indonesian women's participation in agricultural decision-making found that deeply ingrained social norms portray men as primary decision-makers for agricultural production, while women show higher participation only in decisions related to land transactions and credit requests. Furthermore, women farmers frequently encounter institutional and cultural constraints. Limited access to farmer groups, agricultural technology, and training programs continue to pose significant barriers. Social norms that prioritize domestic roles for women often restrict their participation in formal agricultural settings (Jost et al., 2016). Recent research on gender roles in Indonesia's agricultural transformation emphasizes that patriarchal norms marginalize women and limit their access to critical resources like financial capital, land, and assets (Wulandari et al., 2025). These structural inequalities hinder productivity improvements and slow progress toward inclusive welfare for farming households.

The Labuhan Batu Regency Government has shown commitment to SDG implementation through the Regional Medium-Term Development Plan (RPJMD). However, gender mainstreaming within agricultural policy remains limited, as most interventions continue to adopt technical approaches dominated by male actors. Empowering women farmers is essential not only from a social inclusion standpoint but also as an economic strategy capable of generating systemic impacts on rural development. When women have equitable access to resources, training, and economic institutions, they can become key drivers in poverty reduction and improved household welfare. Based on these considerations, this study aims to analyze the role of women farmers in advancing SDG-based economic development and contributing to community welfare in Rantau Selatan District, Labuhan Batu Regency. The study also explores how health conditions and access to resources influence women's contributions to the agricultural sector. The findings are expected to provide a scientific foundation for formulating inclusive village development policies that support the empowerment of women farmers as essential actors in sustainable agriculture.

LITERATURE REVIEW
Women Farmers' Role

Women farmers play a critical role in agricultural production systems, particularly in rural and agrarian regions. Their involvement extends across multiple stages of agricultural activities, including land preparation, planting, harvesting, post-harvest processing, and household-based decision-making (FAO, 2023; Doss, 2018). Beyond their technical contributions, women farmers function as key economic actors who influence resource allocation, production efficiency, and income utilization within farming households. The Food and Agriculture Organization reports that globally, 36 percent of working women work in agrifood systems, making agriculture a significant source of livelihood for women worldwide (FAO, 2023). Empirical studies demonstrate that women's participation in agricultural decision-making enhances productivity and strengthens household coping mechanisms against economic shocks (Diiro et al., 2018; Quisumbing et al., 2021). Despite their extensive involvement, women farmers often experience limited recognition and restricted participation in formal agricultural institutions. Structural barriers—such as gender-biased norms, limited access to farmer organizations, and weak bargaining power—constrain their ability to fully optimize their economic roles (Doss, 2018; Anderson et al., 2021). Research

indicates that women are frequently overrepresented in unpaid, seasonal, and part-time agricultural work, and available evidence suggests that women are often paid less than men for the same work (FAO, 2011). Nonetheless, when women farmers are actively engaged and supported, their contributions generate positive spillover effects in terms of food security, income stability, and household welfare (WFP et al., 2021). Therefore, women farmers' roles should be understood not merely as labor inputs but as strategic drivers of rural economic development.

Women Farmers' Health

Health is a fundamental form of human capital that directly influences productivity and economic participation (Grossman, 1972; Schultz, 2002). For women farmers, physical and mental health conditions are especially critical due to their dual responsibilities in agricultural labor and household management. Adequate health enables women farmers to sustain long working hours, maintain productivity, and engage consistently in agricultural activities. Research demonstrates that healthcare coverage leads to higher utilization of healthcare services, resulting in healthier workers who have lower probability of leaving work due to illness and higher rates of production (Rutledge, 2025; Gubler et al., 2018). Conversely, poor health conditions reduce labor capacity, increase vulnerability, and limit their long-term economic potential.

Women farmers often face heightened health risks arising from physically demanding work, nutritional deficiencies, limited access to healthcare services, and psychosocial stress (Price & Evans, 2024). These challenges are frequently exacerbated by inequality in healthcare access in rural areas. The United Nations notes that rural women encounter numerous constraints in accessing affordable, adequate health services, including affordability issues, mobility restrictions, and lack of transportation (UN Women, 2012). Studies show that excessive physical labor, low socioeconomic status, and poor sanitation environments contribute to deteriorating physical and mental function among farmers (Kim et al., 2015). Prior research highlights that improvements in women's health are associated with higher work efficiency, better income outcomes, and enhanced household welfare (Wang et al., 2019). Thus, women farmers' health is a key determinant of both individual well-being and broader economic sustainability in agricultural communities.

Access to Resources

Access to productive resources represents a central determinant of agricultural performance and welfare outcomes. For women farmers, access includes land ownership or control, agricultural inputs, extension services, market information, technology, and membership in farmer groups or cooperatives (FAO, 2023; Kosec et al., 2024). Unequal access to these resources often constrains women's productivity and limits their participation in value-added agricultural activities. The World Bank Gender Strategy 2024-2030 notes that women farmers have lower yields and productivity due to limited access to inputs, labor, and extension advice, as well as less secure land tenure and limited access to financial services (World Bank, 2024).

Studies consistently show that women farmers who have better access to resources are more likely to adopt improved farming practices, engage with markets, and generate higher income levels (Alkire et al., 2013; J-PAL, 2023). A systematic review found that women are rarely specifically targeted by agricultural information and extension services, and to get new knowledge they rely more heavily on their own social networks than men. Resource accessibility also strengthens women's negotiating positions within households and communities, contributing to more balanced decision-making processes (Meinzen-Dick et al., 2019). Consequently, access to resources functions not only as an enabling factor for agricultural productivity but also as a pathway toward women's economic empowerment and improved household welfare.

SDG-Based Economic Development

SDG-based economic development refers to economic activities that align with the principles of sustainability, inclusivity, and social equity as outlined in the Sustainable Development Goals (United Nations, 2015). In rural and agricultural contexts, this approach emphasizes poverty reduction (SDG 1), food security (SDG 2), gender equality (SDG 5), and inclusive economic growth (SDG 8). The UN recognizes that SDG 2 explicitly focuses on supporting sustainable agriculture, empowering small farmers, promoting gender equality, and ending rural poverty, highlighting the interlinkages among these objectives (United Nations, 2023). Integrating SDG principles into local economic systems ensures that growth benefits are widely shared and environmentally sustainable. Women farmers are recognized as essential agents within SDG-oriented economic systems due to their contributions to food production, household resilience, and community development (UN Women, 2021; Atapattu et al., 2024). Target 2.3 of the SDGs specifically aims to double agricultural productivity and incomes of small-

scale food producers, particularly women, indigenous peoples, and family farmers, through secure and equal access to land and productive resources (United Nations, 2015). When women gain equal access to resources and economic opportunities, SDG-based economic activities become more effective in reducing poverty and strengthening welfare outcomes. In this study, SDG-based economic development is positioned as a mediating mechanism that links women farmers' roles, health, and access to resources with community welfare.

Community Welfare

Community welfare is a multidimensional concept encompassing economic security, quality of life, social stability, and long-term resilience (Stiglitz et al., 2009; UNDP, 2022). In agricultural communities, welfare is closely tied to income stability, food availability, health conditions, and access to socio-economic opportunities. Strong welfare outcomes indicate the ability of households to meet basic needs, manage risks, and invest in future livelihoods (Sen, 1999). The welfare effects in rural areas encompass both economic aspects—such as income support and livelihood expansion—and non-economic aspects including institutional security, infrastructure, and overall well-being (Liu et al., 2023).

Previous research emphasizes that improvements in women's economic participation contribute substantially to community welfare. Evaluation of the 'Accelerating Progress towards Rural Women's Economic Empowerment' programme found that women participating in the programme benefited from enhanced agricultural practices, resulting in increased productivity, more sustainable income, and better diets for their families (WFP et al., 2021). Women's involvement in income-generating activities, combined with better health and resource access, increases household resilience and enhances overall living standards (IFAD, 2021; Bryan et al., 2023). Evidence indicates that women's participation in community groups enhances resilience, increases access to important resources, builds social networks, and increases their influence in community-level decision-making (Kumar et al., 2018; Diiro et al., 2018). Within this framework, community welfare represents the final outcome variable that reflects the cumulative effects of women farmers' empowerment and SDG-based economic development.

The Effect of Women Farmers' Role on Household Welfare in Labuhanbatu Regency

Women farmers contribute significantly to agricultural production, post-harvest management, and household decision-making. Research demonstrates that increased female participation in agricultural decision-making is associated with a 32% increase in productivity (Diiro et al., 2018). The FAO (2023) reports that women's active involvement strengthens household resilience against economic shocks and generates positive spillover effects on food security and income stability.

H1: Women farmers' role has a positive effect on household welfare in Labuhanbatu Regency.

The Effect of Women Farmers' Health on Household Welfare in Labuhanbatu Regency

Health constitutes essential human capital that directly influences agricultural productivity. Women farmers face heightened health risks from physically demanding work and dual responsibilities of farm work and domestic duties (Price & Evans, 2024). Poor physical and mental health reduces labor capacity and limits economic potential, while healthy women farmers demonstrate higher work efficiency and enhanced household welfare.

H2: Women farmers' health has a positive effect on household welfare in Labuhanbatu Regency.

The Effect of Women Farmers' Access to Resources on Household Welfare in Labuhanbatu Regency

Access to productive resources including land, credit, technology, and extension services determines agricultural performance and welfare outcomes. Doss (2018) demonstrates that the gender productivity gap largely stems from differences in input access rather than inherent ability. Women farmers with better resource access are more likely to adopt improved farming practices and generate higher income levels.

H3: Women farmers' access to resources has a positive effect on household welfare in Labuhanbatu Regency.

The Effect of SDG-Based Economy on Household Welfare in Labuhanbatu Regency

SDG-based economic development emphasizes inclusive, equitable, and sustainable growth aligned with poverty reduction (SDG 1), food security (SDG 2), gender equality (SDG 5), and decent work (SDG 8). The World Bank (2024) emphasizes that closing gender gaps can significantly increase household income and reduce poverty. Integrating SDG principles into local economic systems contributes to improved household welfare.

H4: SDG-based economy has a positive effect on household welfare in Labuhanbatu Regency.

The Effect of Women Farmers' Role on SDG-Based Economy in Labuhanbatu Regency

Women farmers serve as key agents in achieving sustainable development goals through contributions to food production and community development. Fertő & Bojnec (2024) found that women farmers actively adopt agri-environment-climate schemes and contribute to green agricultural transitions. SDG Target 2.3 explicitly aims to double productivity of small-scale food producers, particularly women (UN Women, 2021).

H5: Women farmers' role has a positive effect on SDG-based economy in Labuhanbatu Regency.

The Effect of Women Farmers' Health on SDG-Based Economy in Labuhanbatu Regency

Health enables women's active participation in sustainable economic activities. Quisumbing et al. (2023) demonstrate that women's empowerment—including health-related domains—positively impacts agricultural production and food security. When women farmers maintain good physical and mental health, they contribute more substantially to sustainable economic development aligned with SDG principles.

H6: Women farmers' health has a positive effect on SDG-based economy in Labuhanbatu Regency.

The Effect of Women Farmers' Access to Resources on SDG-Based Economy in Labuhanbatu Regency

Access to productive resources constitutes a prerequisite for achieving sustainable development goals. Alkire et al. (2013) developed the Women's Empowerment in Agriculture Index (WEAI), measuring women's access to resources as a key empowerment indicator. When women farmers have control over land, capital, and training, they strengthen inclusive and sustainable local economies.

H7: Women farmers' access to resources has a positive effect on SDG-based economy in Labuhanbatu Regency.

The Effect of Women Farmers' Role on Household Welfare through SDG-Based Economy in Labuhanbatu Regency

Women farmers' roles influence household welfare through sustainable economic development pathways. Anderson et al. (2021) confirm that empowering women in agriculture generates economic benefits for households and communities. WFP et al. (2021) found that women in economic empowerment programs experienced increased productivity and improved family welfare through SDG-aligned activities.

H8: Women farmers' role has a positive effect on household welfare through SDG-based economy as a mediating variable in Labuhanbatu Regency.

The Effect of Women Farmers' Health on Household Welfare through SDG-Based Economy in Labuhanbatu Regency

Women farmers' health enables participation in sustainable economic activities that impact household welfare. Myers et al. (2023) found that women's empowerment domains—including health and workload balance—positively correlate with food security and household welfare outcomes. Healthy women farmers contribute to SDG-aligned development, which ultimately improves household welfare.

H9: Women farmers' health has a positive effect on household welfare through SDG-based economy as a mediating variable in Labuhanbatu Regency.

The Effect of Women Farmers' Access to Resources on Household Welfare through SDG-Based Economy in Labuhanbatu Regency

Access to resources mediates the relationship between women farmers and household welfare through sustainable economic channels. Bryan et al. (2023) demonstrate that women's access to agricultural resources strengthens climate resilience and household economic outcomes. When women gain access to productive resources, they contribute to SDG-based economic activities that improve household welfare.

H10: Women farmers' access to resources has a positive effect on household welfare through SDG-based economy as a mediating variable in Labuhanbatu Regency.

Based on the theoretical foundation and hypothesis development described above, the conceptual framework of this study is illustrated in Figure 1.
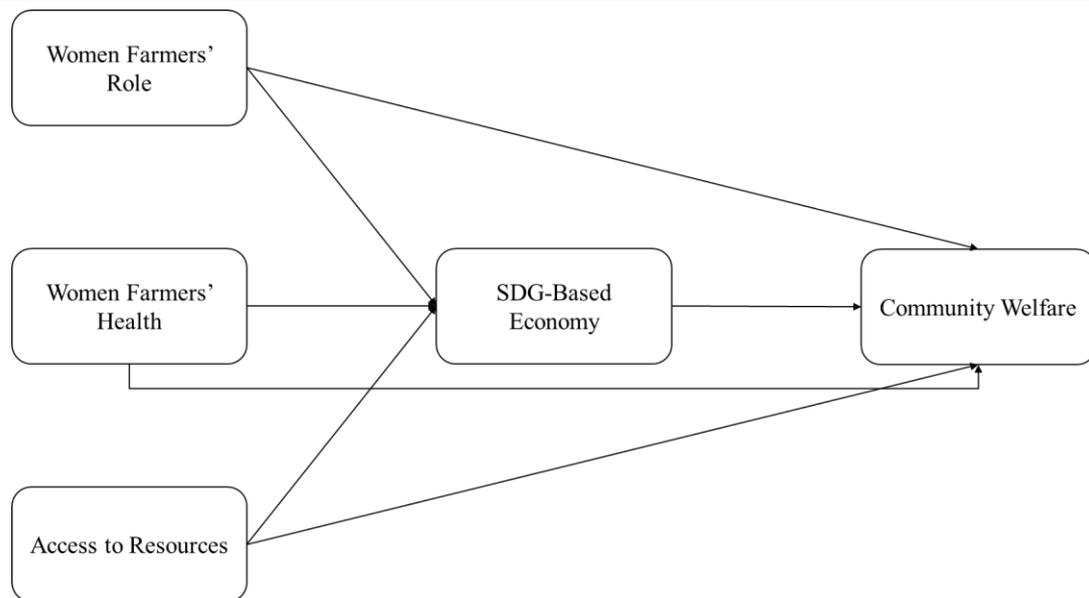
Figure 1. Conceptual Framework

METHOD

Research Scope

This study employs a causal research design. According to Umar (2008), causal design is useful for analyzing how one variable affects another variable. This research aims to determine the degree of relationship and the pattern of influence between two or more variables, thereby building a theory that explains a phenomenon.

Research Location and Timeline

This research was conducted in Labuhanbatu Regency, North Sumatra Province, Indonesia, specifically focusing on four sub-districts: Bilah Hilir, Panai Hulu, Rantau Selatan, and Rantau Utara. The research timeline spans from September 2024 to November 2025, covering activities from title submission, proposal writing, data processing, thesis writing, to thesis defense.

Population and Sample

Population refers to all individuals, objects, or events that become the focus of attention in a study (Kuncoro, 2013). Labuhanbatu Regency consists of nine sub-districts: Bilah Hulu, Pangkatan, Bilah Barat, Bilah Hilir, Panai Hulu, Panai Tengah, Panai Hilir, Rantau Selatan, and Rantau Utara. Conceptually, the target population in this study comprises all women farmers who are members of farmer groups in Labuhanbatu Regency. However, this research purposively focused on four sub-districts with relatively higher numbers of women farmers: Bilah Hilir, Panai Hulu, Rantau Selatan, and Rantau Utara. These four sub-districts were selected as they are considered more representative in describing the role of women farmers in agricultural activities. The total population of women farmers in these four sub-districts is 134 individuals. According to Sugiyono (2018), a sample is a portion of the number and characteristics possessed by a particular population. Based on the population above, the researcher used the Slovin formula to calculate the sample size with a 5% margin of error tolerance. The calculation resulted in 100.37, which was rounded to 100 respondents. Thus, the number of women farmer samples to be studied in Labuhanbatu Regency is 100 individuals.

Operational Definition of Variables

The variables examined in this study include Women Farmers' Role (X1) with three dimensions: planting decision, harvest management, and community participation. Health (X2) consists of five dimensions: body mass index awareness, menstrual health concern, mental health stress level, diet and nutrition adherence, and physical activity frequency. Access to Resources (X3) includes three dimensions: activeness in farmer groups, ease of access to subsidy assistance, and ease of market access. SDG-Based Economy (Z) as the mediating variable comprises four dimensions: additional income from agricultural products, effectiveness in land management, concern for waste management, and long-term business sustainability. Welfare (Y) as the dependent variable includes three dimensions: job satisfaction, economic security perception, and social relations harmony.

Variable Measurement Scale

This study uses a five-point Likert scale to measure all variables. The scale ranges from 1 (Strongly Disagree), 2 (Disagree), 3 (Somewhat Disagree), 4 (Agree), to 5 (Strongly Agree). The Likert scale has nominal and ordinal units and captures information about quantitative differences in a concept from one observation to the next.

Data Collection Techniques

Data collection in this study uses two methods. First, questionnaire technique by providing a list of statements to be submitted to respondents, specifically for women farmers in Labuhanbatu Regency. Second, documentation method to complement data related to the researcher's data collection from respondents.

Data Analysis Techniques

The data analysis begins with descriptive statistics to provide an overview of the data, including tables, graphs, mean, standard deviation, and percentage calculations. The main analysis method used is Structural Equation Modeling (SEM) using Partial Least Square (PLS) with SmartPLS software. SEM is a set of statistical techniques that allows testing of a series of relatively complex relationships that cannot be solved by linear regression equations. In SEM using PLS, there are three simultaneous activities: examining the validity and reliability of instruments through confirmatory factor analysis, testing the model of relationships between variables through path analysis, and obtaining a suitable model for prediction through structural model and regression analysis.

The measurement model (outer model) specifies the relationship between latent variables and their indicators to test validity and reliability. Convergent validity is measured using Factor Loading greater than 0.6 and Average Variance Extracted greater than 0.5 (Indrawati, 2019). Discriminant validity is fulfilled if the cross-loading value meets the criteria, Fornell-Larcker criterion is satisfied, and HTMT value is less than 0.9 (Ghozali, 2019). Reliability testing uses Cronbach's Alpha and Composite Reliability, both of which must exceed 0.6 to be considered reliable (Abdillah, 2018). Multicollinearity is tested using Variance Inflation Factor (VIF), where a value less than 10 indicates the model is free from multicollinearity assumptions. The structural model (inner model) in PLS is evaluated using R-square for dependent constructs and path coefficient values or t-values for significance testing between constructs. The path coefficient value shown by the t-statistic must exceed 2.25 for a two-tailed hypothesis with alpha 5%. R-square values of 0.67, 0.33, and 0.19 indicate good, moderate, and weak models respectively. Q-square is used to test predictive relevance, where values greater than 0 indicate the model has relevant predictive value (Ghozali, 2019).

Hypothesis Testing

Hypothesis testing consists of direct effect and indirect effect analysis. Direct effect analysis tests the hypothesis of direct influence of an exogenous variable on an endogenous variable. If the path coefficient is positive, the influence is in the same direction; if negative, the influence is in the opposite direction. A P-value less than 0.05 indicates significance. Indirect effect analysis tests the hypothesis of indirect influence mediated by an intervening variable. If P-value is less than 0.05, the mediator variable significantly mediates the influence of an exogenous variable on an endogenous variable, indicating an indirect effect exists. Conversely, if P-value exceeds 0.05, the mediator variable does not mediate the influence, indicating a direct effect only.

RESULTS AND DISCUSSION
Respondent Profile

The research respondents consist of 100 women farmers from four sub-districts in Labuhanbatu Regency. The majority of respondents are in productive age, with 31-40 years (30%) and 41-50 years (28%) being the dominant groups. Education levels are dominated by senior high school graduates (40%) and junior high school graduates (35%). Most respondents have extensive farming experience of more than 5 years (50%), followed by 3-4 years (32%). Respondents are distributed across Rantau Selatan (30%), Bilah Hilir (25%), Rantau Utara (25%), and Panai Hulu (20%). This profile indicates that the majority of women farmers possess adequate experience and basic education to support productive agricultural activities.

Measurement Model

Table 1. Validity and Reliability Test Results

Variable	Indicator	Loadings	AVE	CR
Access to Resources	ASD1	0.869	0.845	0.942
	ASD2	0.928		
	ASD3	0.957		
Health	K1	0.812	0.710	0.924
	K2	0.862		
	K3	0.838		
	K4	0.872		
	K5	0.827		
Women Farmers' Role	PPP1	0.876	0.820	0.932
	PPP2	0.893		
	PPP3	0.946		
SDG Economy	SGDS1	0.870	0.745	0.921
	SGDS2	0.861		
	SGDS3	0.868		
	SGDS4	0.854		
Welfare	KN1	0.880	0.764	0.907
	KN2	0.874		
	KN3	0.869		

Source: Primary Data Processing, 2025

Table 1 presents the convergent validity test results measured through loading factor values, Average Variance Extracted (AVE), and Composite Reliability (CR). Based on Hair et al. (2019), indicators are valid if loading values exceed 0.70, AVE exceeds 0.50, and CR exceeds 0.70. All indicators demonstrate loading values above 0.80, ranging from 0.812 (K1) to 0.957 (ASD3). The Access to Resources construct shows the highest AVE (0.845) and CR (0.942), indicating that 84.5% of indicator variance is explained by the construct. Health construct has AVE of 0.710 and CR of 0.924, Women Farmers' Role has AVE of 0.820 and CR of 0.932, SDG Economy has AVE of 0.745 and CR of 0.921, and Welfare has AVE of 0.764 and CR of 0.907. These results confirm that all constructs meet convergent validity and reliability criteria.

Discriminant Validity

Table 2. Discriminant Validity Test Results

HTMT	AR	SGDE	Health	Walfare	WFR	Fornell-Larcker	AR	SGDE	Health	Walfare	WFR
AR	-					AR	0.919				
SGDE	0.408					SGDE	0.369	0.863			
Health	0.098	0.419				Health	-0.083	0.374	0.843		
Walfare	0.124	0.629	0.483			Walfare	0.092	0.553	0.427	0.874	
WFR	0.115	0.435	0.058	0.434	-	WFR	-0.099	0.391	0.007	0.383	0.905

Note. AR = Access to Resources; SGDE = SDG-Based Economy; WFR = Women Farmers' Role
Source: Primary Data Processing, 2025

Table 2 presents both HTMT and Fornell-Larcker criterion results for discriminant validity assessment. According to Henseler et al. (2015), discriminant validity is established when HTMT values are below 0.90. All HTMT values in this study range from 0.058 to 0.629, well below the threshold. The lowest HTMT value is between Health and Women Farmers' Role (0.058), indicating these constructs are highly distinct. The highest HTMT value is between SDG-Based Economy and Welfare (0.629), which remains acceptable despite their theoretical relationship.

For Fornell-Larcker criterion, diagonal values (bold) represent the square root of AVE for each construct. Discriminant validity is confirmed when diagonal values exceed all inter-construct correlations in the corresponding row and column. Access to Resources (0.919) exceeds its highest correlation of 0.369 with SDG-Based Economy. SDG-Based Economy (0.863) exceeds its highest correlation of 0.553 with Welfare. Health (0.843) exceeds its highest correlation of 0.427 with Welfare. Welfare (0.874) exceeds its highest correlation of 0.553 with SDG-Based Economy. Women Farmers' Role (0.905) exceeds its highest correlation of 0.391 with SDG-Based Economy. All constructs satisfy both criteria, confirming discriminant validity.

Structural Model

Table 3. Discriminant Validity Test Results

Variable	R^2	R^2 Adjusted	Q^2
SDG Economy	0.486	0.470	0.562
Welfare	0.412	0.387	0.501

Source: Primary Data Processing, 2025

The R^2 value for SDG Economy (0.486) indicates that 48.6% of its variance is explained by Access to Resources, Health, and Women Farmers' Role, classified as moderate explanatory power. The R^2 for Welfare (0.412) shows that 41.2% of variance is explained by the model. Q^2 values of 0.562 and 0.501 exceed 0.35 threshold, confirming strong predictive relevance (Hair et al., 2019).

Hypothesis	Relationship	β	T-Statistics	P-Values	Result
H1	WFR → Welfare	0.396	5.462	0.000	Accepted
H2	Health → Welfare	0.438	5.508	0.000	Accepted
H3	AR → Welfare	0.167	0.198	0.843	Rejected
H4	SGDE → Welfare	0.335	2.733	0.006	Accepted
H5	WFR → SGDE	0.432	6.287	0.000	Accepted
H6	Health → SGDE	0.408	6.203	0.000	Accepted
H7	AR → SGDE	0.446	5.962	0.000	Accepted
H8	WFR → SGDE → Welfare	0.145	2.482	0.013	Accepted
H9	Health → SGDE → Welfare	0.137	2.614	0.009	Accepted
H10	AR → SGDE → Welfare	0.149	2.349	0.019	Accepted

Note. AR = Access to Resources; SGDE = SDG-Based Economy; WFR = Women Farmers' Role
Source: Primary Data Processing, 2025

The results indicate that the role of women farmers (WFR) and health both have strong, positive, and significant effects on welfare, demonstrating that active participation and better health conditions directly enhance well-being. Meanwhile, access to resources (AR) does not significantly influence welfare on its own, suggesting that resource availability alone is not enough to improve well-being without a supporting economic mechanism. The SDG-Based Economy (SGDE) significantly improves welfare, and WFR, health, and AR each positively contribute to the development of an SDG-aligned economy. This shows that women's involvement, good health, and adequate resource access collectively support a sustainable economic structure. All mediation pathways through SGDE are significant, meaning that WFR, health, and AR improve welfare more effectively when their influence operates through an SDG-Based Economy. Notably, AR—although insignificant in its direct effect—becomes impactful when mediated by SGDE. Overall, the findings highlight that sustainable economic transformation is a key pathway that strengthens the positive effects of women's roles, health, and resource access on welfare.

The Effect of Women Farmers' Role on Welfare

Women farmers' role has a positive and significant effect on household welfare (β=0.396, p=0.000). The higher the level of women's involvement in agricultural activities—from planting, harvesting, to household decision-making—the higher the welfare achieved. This finding aligns with Machio and Meemken (2023) who found that women's involvement in agricultural activities contributes to improving household living standards. Rangga et al. (2023) also confirmed that women's participation in agriculture provides direct impact on family welfare improvement. Women's active role in agriculture not only provides economic contribution but also becomes an important foundation for village socio-economic development.

The Effect of Health on Welfare

Health has a positive and significant effect on welfare (β=0.438, p=0.000), showing the strongest direct effect among all variables. This result is consistent with Human Capital Theory, where health directly improves work ability and productivity. Witt et al. (2020) showed that farmers' mental and physical health improves motivation and work efficiency. Becot et al. (2024) found that women's dual role burden can reduce productivity if not supported by good health conditions. Health is not only an individual factor but an important component in rural economic sustainability aligned with SDG 3, SDG 5, and SDG 8.

The Effect of Resource Access on Welfare

Resource access does not have a significant direct effect on welfare (β=0.167, p=0.843). This indicates that resource availability—such as land, capital, and production facilities—has not automatically improved welfare without optimal utilization. This finding aligns with Ambler et al. (2021) showing that resource transfer only impacts welfare when accompanied by utilization ability and economic empowerment strategies. Awuah-Frimpong et al. (2024) confirmed that resource access improves income only when utilized to increase productivity and market connectivity.

The Effect of SDG-Based Economy on Welfare

SDG-based economy has a positive and significant effect on welfare (β=0.335, p=0.006). Implementation of inclusion, sustainability, and equity principles in rural economic development provides real impact on welfare improvement. Gulo et al. (2025) confirmed that SDG-based economic strategies at village level improve community welfare. Joan et al. (2022) showed that financial inclusion as part of SDGs implementation provides significant impact on household income improvement.

The Effect of Women Farmers' Role on SDG-Based Economy

Women farmers' role has a positive and significant effect on SDG economy (β=0.432, p=0.000). The more active women are in agricultural activities, the greater their contribution to sustainable village economy. Lestari and Yuwana (2023) showed that women farmer empowerment through sustainable agricultural training improves productivity and supports environmentally friendly practices. Solomon et al. (2024) confirmed that women's active involvement in sustainable agriculture contributes directly to food security and SDGs achievement.

The Effect of Health on SDG-Based Economy

Health has a positive and significant effect on SDG economy (β=0.408, p=0.000). Good health enables women to work more productively and adopt sustainable agricultural practices. Bhujel and Joshi (2023) confirmed that women farmers with good health are more able to adopt climate-friendly agricultural technology and support sustainable economic growth in agrarian communities.

The Effect of Resource Access on SDG-Based Economy

Resource access has a positive and significant effect on SDG economy (β=0.446, p=0.000), representing the strongest effect on SDG economy. Abidin and Prasetyani (2021) stated that improved resource access drives significant contribution to sustainable economic development. Valencia et al. (2021) confirmed that women's access to agricultural resources increases their contribution to poverty eradication (SDG 1), food security (SDG 2), and gender equality (SDG 5).

Mediation Effects of SDG-Based Economy

SDG economy significantly mediates the relationships between independent variables and welfare. Women farmers' role affects welfare through SDG economy (β=0.145, p=0.013), consistent with Rosyadi et al. (2024) who confirmed that women's participation in sustainable agriculture drives family income improvement. Health affects welfare through SDG economy (β=0.137, p=0.009), supported by Cetrone et al. (2020) showing that health improvement through agroecology programs impacts welfare. Resource access affects welfare through SDG economy (β=0.149, p=0.019), confirming Kumar et al. (2024) who found that resource access improves welfare through capacity strengthening and integration into local economy. Notably, while resource access has no direct effect on welfare, it significantly affects welfare through SDG economy mediation. This indicates full mediation, where resources must be optimally utilized within sustainable economic frameworks to generate welfare

improvements. The full mediation role of SDG economy for resource access underscores the importance of integrating sustainability principles in agricultural development programs.

CONCLUSION

This study was designed to examine how women farmers' roles, health conditions, and access to agricultural resources influence household welfare, both directly and through an SDG-based economic system. As outlined in the Introduction, the research aimed to identify the key factors that support sustainable welfare improvement among women farmers and to understand whether a sustainability-oriented economic framework strengthens these relationships. The results confirm that the role of women farmers and their health conditions significantly improve welfare, while access to resources alone does not yield a direct impact. However, an SDG-based economy plays a crucial role by directly enhancing welfare and serving as an effective mediating pathway for all three predictors. These findings emphasize that sustainable economic mechanisms are essential to maximize the benefits of women's participation, good health, and resource availability.

Overall, the study concludes that welfare improvements among women farmer households depend not only on individual and resource-related factors but also on the strength of the sustainable economic system that connects them. This reinforces the importance of integrating SDG principles into agricultural and community development programs. In terms of future implementation, the findings suggest that service programs should focus on strengthening women's empowerment, improving health access, expanding productive resource utilization, and embedding SDG-based economic practices into village development plans. Continuous mentoring and evaluation should also be incorporated to ensure long-term sustainability and measurable welfare growth.

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