

Determinants of Income and Asset Dynamics among Smallholder Sakub Sheep Farmers in Indonesia

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Abstract

Sakub sheep, a new breed originating from the Sakub Highland in Brebes Regency, holds significant potential to enhance farmers' welfare. This study aims to evaluate the income and asset growth of Sakub sheep farmers and to determine the factors influencing these outcomes. Using a survey method, the research was conducted in the main Sakub sheep development areas, specifically in the Paguyangan and Sirampog sub-districts, with 125 farmers sampled through G*Power-3.1. The independent variables used to estimate income (Y1) and asset growth (Y2) included age, education, location, experience, farm distance, number of animals, animal source, number of children, family labor contribution, motivation, interest, and perception. Data were collected through interviews and exploration and analyzed descriptively and robust multiple linear regression. The results indicate that farmers have an average age of 43.46 years and 7.74 years of education, with the majority residing in Paguyangan. They possess an average of 14.55 years of experience, and the majority maintain barns located < 100 meters of their homes. Farmers typically keep an average of 8.98 animals, primarily sourced from breeding. On average, they have 2.02 children, while household members contribute 253.08 labor hours annually. Overall, farmers exhibit relatively low income and slow asset growth, averaging IDR 16,596,808 and IDR 13,328,800 per year. Income is positively affected by education, experience, the number of animals, and interest, but is negatively influenced by family labor contribution. In contrast, asset growth is positively influenced by the number of animals and perception and negatively affected by experience and family labor contribution.

1 INTRODUCTION

Indonesia is a tropical nation situated in the Ring of Fire, surrounded by mountains and fertile highlands. The highlands possess significant potential for natural resources, especially indigenous cattle germplasm. Indigenous Indonesian sheep have been bred to meet the needs of local farmers. Indigenous Indonesian sheep, specifically the Javanese and Sumatran Thin-tailed breeds, provided the foundation for the development of local sheep breeds. The government then introduced sheep from temperate regions [1], leading to the development and recognition of numerous local sheep breeds [2]. Moreover, the improvement of superior indigenous sheep continues to meet the meat demand of the Indonesian population.

A location suitable for local sheep development is located on the slopes of the Slamet Mountains in Brebes Regency, characterized by its high-quality natural resources. The local sheep are named after the region's highest hill, Sakub hill. Sakub sheep were formally recognized by Decree No. 882/KPTS/PK.010/M/12/2022[3] as a local breed, originating from the crossbreeding of indigenous Indonesian sheep with several imported breeds, including Merino, Texel, and Suffolk. Sakub sheep are well-developed in the Paguyangan and Sirampog sub-districts, positively influencing local farmers' economic conditions due to their superior traits and growth [4–6].

Sakub sheep, a relatively novel breed, are anticipated to improve farmers' welfare. Previous studies concerning Sakub sheep have predominantly focused on the production and morphometric characteristics. Research addressing the socio-economic conditions of Sakub sheep farmers remains limited. Data on farmers' socio-economic status is essential, as it serves as a metric for assessing the effectiveness of Sakub sheep in improving farmers' welfare. Prior research by [7] examined the impact of age, education, experience, and livestock quantity on business efficiency. This information remains available to further development, as the success of a livestock business is determined not solely by these factors but also by income and asset growth. This study addresses the socio-economic aspects of Sakub sheep farmers that require exploration.

This study analyzes the influence of independent variables, including farmer characteristics and perception factors, on farmers' income and asset growth. Perceptual variables were used in this study as they serve as significant predictors of farmer behavior that enhances productivity [8, 9]. This study's novelty lies in its comprehensive analysis of the factors influencing income and asset growth among Sakub sheep farmers in Brebes, using multiple linear regression. This study assesses both demographic and operational variables, as well as psychological factors, including motivation, interest, and perception, which have previously been overlooked in research on Sakub sheep. The results of this study are expected to provide novel insights for developing strategies to enhance the welfare of Sakub sheep farmers and to serve as a significant reference for sheep farm management in Indonesia.

2 MATERIALS AND METHODS

The research was carried out in April to June 2025, focusing on Sakub sheep farmers affiliated with farmer groups in Brebes Regency. The research sites were intentionally chosen in the Paguyangan and Sirampog subdistricts, which are development areas with a significant population of Sakub sheep. The required minimum number of farmer respondents was determined using G*Power 3.1, based on the input parameters outlined in Table 1. The analysis of these input characteristics indicated that the minimal number of responders required was 121 farmers. A total of 125 farmers were selected proportionally from the two subdistricts. A total of 82 farmers from Panguyangan and 43 from Sirampog subdistricts were randomly selected as study respondents.

This research employed a survey methodology focusing on Sakub sheep farmers. Data collection methods comprised observation and interviews. The researchers conducted visits to farmer groups, farmers' residences, and livestock enclosures. One hundred twenty-five respondents were interviewed in person after completing the questionnaire. The questionnaire comprised farmers' profiles, the number of cattle owned, their motivations, interests, and perceptions regarding Sakub sheep farming.

Table 1
G*Power Input Parameters and
Value

Input Parameters	Value
Effect size f^2	0.2
Alpha error probability	0.05
Power	0.9
Number of predictors	12
Output	Value
Total sample size	121

All research variables are displayed in Table 2. The operational definitions of motivation, interest, and perception shown in Table 2 were referred to and developed from (Cahyo et al., 2025; Muatip et al., 2022). Data were collected from farmers through the following methods. Initially, interviews were conducted to collect data on farmers' names, ages, educational backgrounds, primary and secondary occupations, duration of farming experience, animal categories, residential addresses, distances from residences to cages, origins of livestock, and numbers of family members. Secondly, farmers were asked to provide the quantity of livestock and the price of Sakub sheep in their ownership. The motivation, perceptions, and interest in continuing the Sakub sheep farming business were assessed using a 4-point Likert scale.

Table 2
Dependent and Independent Research Variables, Units and Operational Definition

Code	Variables	Units/Operational Definition
Y1	Income	IDR/Year
Y2	Asset growth	IDR value of Sakub Sheep/Years
X1	Age	Years
X2	Education	Years
X3	Location	(1 = Paguyangan and 2 = Sirampog).
X4	Experience	Years
X5	Farm distance	Distance from house to cage (0 < 100 m and 1 > 100 m).
X6	Number of Animal	Small Livestock Unit (SLU)
X7	Source of Animal	0 = purchased and 1 = self-produced.
X8	Number of Children	The number of farmer's children
X9	Family Contribution on Farm	Children's and spouse's contribution in managing the Sakub sheep farming in hours.
X10	Motivation	The motive force of a farmer in working. Farmer motivation is measured using a questionnaire with a 1–4 Likert scale. Data was categorised into three groups: low (≤ 20), medium (20–30), and high (≥ 30).
X11	Interest	The tendency or interest of Sakub sheep farmers in Sakub sheep farming. Farmers' interest is measured using a questionnaire with a 1–4 Likert scale. The data was categorised into three groups: low (≤ 49), medium (49–64), and high (≥ 64).
X12	Perception	Views or attitudes towards something that can motivate or encourage someone to do or not do something. Farmers' motivation is measured using a questionnaire with a 1–4 Likert scale. The data was categorised into three groups: low (≤ 30), medium (30–45), and high (≥ 45).

The collected data was analyzed both descriptively and quantitatively using multiple linear regression. The descriptive analysis aimed to concisely explain the data on farmers' profiles, motivations, interests, and perceptions. Multiple linear regression analysis was employed to identify the determinants affecting farmers' income and the growth of sheep assets. This study employed robust regression analysis to address the classical assumptions within the research model. The research location, located on the mountainside of Slamet Mountain, and the regression model are shown in Fig. 1. The photograph of the research site was obtained during fieldwork, while the regression model was developed by the authors. Before data collection, all respondents were informed about the objectives of the study, and their

participation was voluntary. Informed consent was obtained from all participants before the interviews were conducted. A written consent statement was also provided in the questionnaire, explaining the purpose of the study, the voluntary nature of participation, and the confidentiality of the data. The confidentiality and anonymity of the respondents were ensured, and all data were used solely for research purposes. The results of the regression analysis involved the coefficient of determination (R^2), the simultaneous test (F-test), the partial test (T-test), and the interpretation of the regression coefficients. Data analysis was conducted using Microsoft Excel and SPSS 25.

3 RESULTS

The Sakub sheep profile in Table 3 showed farmers in this research had an average age of 43.46 years and an average education level of 7.74 years, equivalent to the first year of junior secondary school. The majority of sampled farmers were located in Paguyangan District (65.60%), while the remaining 34.40% resided in Sirampog District, Brebes Regency. The farmers had an average experience of 14.55 years in livestock raising. Most farmers kept their barns in proximity to their homes (< 100 m), accounting for 78 respondents (62.40%). The average number of Sakub sheep owned per farmer was 8.98 head, with 84 farmers (71.2%) raising animals from their own breeding and 36 farmers (28.8%) raising animals purchased. On average, farmers had two children, and the total family labor contribution to the farming enterprise amounted to 253.08 hours per year.

Table 3
The Sakub Farmers' Characteristics

Criteria	Categories	Results	
		N	Percentage
Age	Years	43.46 ± 12.50	
Education	Years	7.74 ± 2.78	
Location	Paguyangan	82	65.60%
	Sirampog	43	34.40%
Experience	Years	14.55 ± 11.88	
Farm distance	< 100 m	78	62.40%
	> 100 m	47	37.60%
Number of Animal Held	Head	8.98 ± 4.17	
Source of Animal	Purchase	36	28,80%
	Self Breeding	89	71,20%
Number of Children	Person	2.02 ± 1.11	
Family Contribution on Farm	Hours	253.08 ± 133.51	

Sakub sheep farmers in Brebes Regency had a motivation level in the medium (51.2%) and high (48.8%) categories, with no farmers falling into the low category. The majority of Sakub sheep farmers in Brebes Regency showed a low level of interest at 66.40%. Farmers' perceptions were reasonably high, with most (82.3%) falling into the medium perception category (Table 4).

Table 4
Sakub Farmers' Motivation, Interest, and Perception

Variables	Category (%)		
	Low	Medium	High
Motivation	0.00	51.20	48.80
Interest	66.40	25.60	8.00
Perception	3.20	83.20	13.60

Table 5
Sakub Farmers' Income and Asset Growth

Variables	Category (%)			Average $\pm$ SD (IDR/years)
	Low	Medium	High	
Income	64.30	31.30	4.30	Rp 16,596,808 $\pm$ 9,212,745.271
Asset Growth	56.00	34.40	9.60	Rp13,328,800 $\pm$ 7,766,816.469

The average income (Table 5) obtained by farmers within 1 year was IDR 16,596,808, with the majority of farmers (64.30%) having an income of less than or equal to IDR 17,950,000, which falls within the low category. The majority of farmers (56%) had an increase in livestock assets in the low category (less than IDR 12,670,000), with an average increase in IDR 13,328,800 over 1 year.

Table 6
Multiple Linear Regression R^2 and T-test

Model	R^2	F-Statistic	Prob. (F statistic)
Model 1 Farmers' Income	0,901	6.992	0.000
Model 2 Asset Growth	0,583	3.674	0.000

The results of the regression analysis in Table 6 showed that Model 1, which measures the influence of independent variables on farmers' income, had a determination coefficient (R^2) of 0.901. This value indicates that as much as 90.1% of the variation in farmers' income can be explained by this model. The F-test yielded an F-statistic value of 6.992 with a significance level (Prob. F-statistic) of 0.000, indicating that this model is statistically significant at a 95% confidence level. Meanwhile, Model 2, which analyzes asset growth, shows a determination coefficient (R^2) of 0.583. This means that 58.3% of the variation in

asset growth can be explained by this model. The model also shows strong statistical significance, with an F-statistic of 3.674 and a p-value of 0.000. These results show that the model is statistically significant and relevant in explaining asset growth.

Table 7
Multiple Linear Regression Coeffisien and t-test

Variables	Model 1		Model 2	
	Coeff.	Prob. (t stat.)	Coeff.	Prob. (t stat.)
Constant	14.976	0.000*	0.070	0.933
X1 Age	-0.038	0.210	-0.139	0.158
X2 Education	0.076	0.002*	-0.040	0.177
X3 Location	0.063	0.570	0.064	0.771
X4 Experience	0.198	0.000*	-0.091	0.007*
X5 Farm distance	-0.016	0.803	-0.098	0.137
X6 Number of Animal Held	0.219	0.000*	0.244	0.000*
X7 Source of Animal	0.024	0.505	-0.019	0.781
X8 Number of Children	0.032	0.134	-0.017	0.669
X9 Family Contribution on Farm	-0.012	0.026*	-0.017	0.008*
X10 Motivation	-0.003	0.941	0.002	0.983
X11 Interest	0.073	0.029*	0.057	0.159
X12 Perception	0.063	0.203	0.183	0.000*

Model 1 in Table 7, with farmers' income as the dependent variable, shows that these variables are significantly influenced by constant, education, experience, number of livestock reared, family contribution to farming, and interest. These results shows that increases in the variables education, experience, number of livestock reared, and interest are positively correlated with the dependent variables. In contrast, family contribution to farming shows a significant negative relationship.

Furthermore, in Model 2, which uses farmers' asset growth as the dependent variable, the independent variables with significant effects include experience, number of livestock reared, family contribution to farming, and perception. Interestingly, the experience, which was previously positively correlated in Model 1, showed a significant negative association in Model 2. The variables of number of livestock raised and perception remained to show a significant positive relationship.

Other variables, such as age, location, distance to farming, livestock source, number of children, and motivation, did not show a significant influence in either model ($p > 0.05$). This suggests that these

variables may be less relevant in the dependent variables in this study.

4 DISCUSSION

Sakub sheep farmers had an average age within the productive range, ranging from 17 to 77 years. Generally, the optimal age for agricultural production is between 35 and 44 years, with a notable decrease in productivity at age 65 [12]. Productive-age farmers possess many benefits, including physical capability, technological competence, creativity, flexibility, and access to Business Credit (KUR) [13]. Being in a productive age, farmers have significant potential for developing their farming [14].

The results of this study indicated that farmers have an average level of education of Junior High School (SMP). This average level of education aligns with findings from [15] and [16], which indicate that farmers' educational level in that year was primarily at the elementary and junior high school levels. The education levels of farmers in various areas of Brebes Regency were reported [17] to be predominantly those who did not complete elementary school, which is lower than the results of our study. [18] stated that formal education significantly enhances knowledge, collective decision-making, and the sustainability of family farming businesses.

The farmers, primarily from the Paguyangan subdistrict, had substantial experience. The farmers' expertise positively impacted livestock farming due to their superior adaptability [19]. However, it also negatively affected the sector, as farmers often continue to employ traditional business strategies [20]. Consequently, farmers would establish cages near their residences to improve time and labor efficiency, response time, and security [21].

Sakub sheep farms continued to operate using traditional methods, with an average herd size of 8.98 sheep; the majority (71.20%) breed their own sheep. This research affirms that most sheep farmers in Indonesia are smallholders with limited sheep populations, who significantly contribute to the rural economy [22]. Highland areas highly favorable for small-scale animal production due to their abundant natural resources [23], including agricultural waste [24]. This significant potential positively influences feed cost efficiency, the primary output in sheep farming [25, 26], allowing farmers to engage in high-risk breeding businesses for livestock production. This strategy is used by farmers instead of purchasing young stock from the market to fatten.

Familial factors additionally contribute to the adoption of traditional livestock farming methods in Indonesia. Livestock farming is typically conducted as a secondary job or additional income source [27]. Familial aspects significantly contribute to the farming practices in rural Indonesia [28]. The spouses and children of Sakub sheep farmers spend 4.87 hours weekly on agricultural labor. Working hours differ among systems. The spouses and children of dairy farmers spend over 3.1 hours of labor weekly to aid in farming production [29]. A supplementary report on Balinese cattle farms in Konawe Regency indicates that working hours may reach 3.4 hours/week, but remain lower than those in rice farming [30]. Nurtini et al. [31] reported that family members account for up to 25.11% of the total labor.

Motivation is essential to the growth of livestock businesses. The motivation level of Sakub sheep farmers ranges from moderate to high. Motivation is essential for enhancing farmer welfare. Farmer motivation influences productivity and performance [32]. [33] stated that motivation can encourage farmers to stay engaged in innovation despite difficulties. Motivation can be enhanced and sustained through various methods, including incentives and encouragement of farmers [34]. Besides motivation, farmers' interest significantly influences their productivity. Sakub sheep farmers exhibit less interest. This state poses a threat to the sustainability of Sakub sheep farming and requires improvement. The low interest is attributed to the fact that most farmers are already old. This condition aligns with the conclusion of [35], who indicated that beginner farmers exhibit greater interest. Significant interest in research [36] was observed among middle-aged farmers who lacked employment stability and sought to increase their income. The predominance of Sakub sheep farming as an additional business is believed to contribute to the low interest among farmers.

The perception of Sakub sheep farmers is within the moderate category, signifying a fairly positive view of livestock farming. A positive perception maintains farmers' commitment to continuing and improving their livestock farming (Muatip et al., 2022). A positive perception can be established and maintained to ensure that farmers demonstrate a strong dedication to their farming. [37] argue that positive perception among rural farmers can be developed through strong socio-cultural practices, community support, and sustainable empowerment initiatives.

The average monthly income of Sakub sheep farmers is IDR 1,383,067, which remains below the regional minimum wage in Brebes Regency. The low revenue is attributed to the Sakub sheep farming technique being non-intensive and functioning as a secondary occupation. This low income aligns with the argument made by [38] that animal farming is significant, although it remains subordinate to crop production. This side work tends to result in low earning levels. The existing intermediary-dominated sales system results in inadequate income maximization. [39] state that middlemen facilitate access to farm product marketing; nevertheless, they may also lower farmers' selling prices, resulting in reduced farmer revenue. Income is correlated with an increase in farmers' assets. An increase in farmers' income will foster a more favorable perception, motivating them to sustain and enhance their livestock assets.

-- Independent variables significantly influence the income and asset growth of Sakub sheep farmers. These findings correlate with other research indicating that farmer characteristics significantly influence farm productivity [40] [41]. Education and experience significantly increase the income of Sakub sheep farmers. Education and experience equip farmers with the knowledge and skills to manage their farms, thereby positively influencing their income. Qui et al [8] reported similar findings, indicating that education and experience greatly enhance the productivity of pig farming in Vietnam by promoting improved farm management. Haruna et al [42] stated that farmers' education and experience can impact income growth due to their correlation with improvements in farmers' knowledge, perceptions, and attitudes.

This study's results demonstrate that an increase in livestock population correlates with an increase in farmers' income. The scale of farming is a significant determinant influencing livestock earnings. The findings of this study align with prior research [43–45]. The quantity of animals farmed correlates with the sustainability of the farmer's household [46], indicating that increasing livestock is necessary for the farmer's income to match the regional wage in Brebes District. Income can be increased by effective utilization of labor inputs, namely by involving family members in animal farming. Nonetheless, the findings of this study contradict earlier research [47, 48] that stated that family participation in livestock farming negatively affects farmers' income. This situation is believed to arise from the fact that Sakub sheep farming is not the main occupation, leading in expenses for family members involved in the Sakub sheep.

The ordinal statement-based variable that significantly impacts farmers' income is interest. Farmers' interest in this study positively affects their income. Increased interest can positively influence farmers' income in multiple ways. Farmers who invest in their businesses will seek more knowledge about techniques to enhance productivity, thereby increasing their knowledge and facilitating the adoption of innovations [49]. The participation of farmers in livestock farming will enhance the adoption of innovations and technology that positively influence farming production [50]. Interest significantly influences farmers' adoption of technology, potentially increasing their future income.

The findings from the analysis in Model 2 (Table 7) indicate that the income-enhancing experience of farmers (Model 1), conversely, reduces the growth of farmers' assets. Experienced farmers possess superior marketing skills for their livestock, as demonstrated by research conducted after they had previously sold their cattle, with no new births or purchases occurring. This condition is believed to be associated with the research variables, particularly livestock assets and the research date. Experienced farmers possess superior marketing skills for their livestock, as demonstrated by research conducted after they had previously sold their cattle, with no new births or purchases occurring. This hypothesis can be supported by the observation that experience improves income while negatively affecting asset growth. Experienced farmers typically establish close relationships with consumers, allowing them to optimize product sales [51]. Collaboration between farmers and business organizations, such as cooperatives, may improve market access [52], allowing farmers to sell products internationally and thereby shortening the sales cycle [53]. Experienced farmers also have access to online sales channels to expand their marketing reach [54].

The number of livestock farmed positively affects increases in farmers' assets. The number of animals farmed is considered a living asset owned by farmers; thus, an increase in livestock ownership corresponds to an increase in their assets. The increase in production scale positively influences farm output by enhancing cost efficiency [55, 56]. Large-scale farms can allocate more assets to technology [57], hence enhancing the efficiency of large-scale animal enterprises [58]. Model 2 additionally demonstrates the impact of familial contributions on asset growth, alongside the effect of population size. The family contribution in farms negatively affects asset growth. This outcome is likely due to Sakub sheep farming not yet becoming a primary occupation.

Results from Model 2 indicate that farmers' perceptions positively influence asset growth among Sakub sheep farmers. Farmers' perceptions are influenced by economic conditions, knowledge, education, social norms, and farming culture [59]. Farmers with positive perceptions will exhibit a strong commitment to sustaining their farms [10], which correlates with an increase in the quantity of livestock assets owned. Ashfaq et al.[60] found that farmers with positive perceptions tend to increase their livestock assets due to their confidence in management and health competencies. A positive perception will also motivate farmers to seek information to enhance their livestock farms, such as through focus group discussions (FGD) and key informant interviews (KII) [61]. Muatip et al.[62] stated that access to information enhances feed management, reproduction, and marketing, thereby increasing profitability and livestock populations.

5 CONCLUSION

This study evaluated the income and asset growth of Sakub sheep farmers in Brebes Regency, Indonesia, and identified the factors influencing these outcomes. The findings reveal that farmers generally experience low income and slow asset growth, with average annual figures of IDR 16,596,808 and IDR 13,328,800, respectively. Key factors positively influencing income include education, farming experience, the number of animals reared, and interest in sheep farming. Conversely, family labor contributions negatively affect income. Regarding asset growth, the number of animals owned and farmers' perceptions positively contribute, whereas farming experience and family labor contributions negatively affect it. The study highlights that enhancing education, fostering interest in sheep farming, and increasing herd sizes can significantly improve both income and asset growth. Moreover, reducing over-reliance on family labor and addressing challenges related to traditional farming practices may lead to better economic outcomes for farmers. These insights can inform targeted interventions and policy strategies to support the sustainability and prosperity of Sakub sheep farming in Brebes Regency.

Declarations

Ethics Statement: This study involving human participants was reviewed and approved by Research and Community Service Institutions Universitas Jenderal Soedirman. All participants provided informed consent before participation in this study.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the conduct of this research, the preparation of the manuscript, or the publication of this article. The research was carried out independently, and there are no financial, commercial, or personal relationships that could influence the objectivity of the findings or interpretations presented herein.

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Author Contribution

The author's names is presented in initial form. The authors' contributions are mention below. KM: Conceptualization, Methodology, Field Survey, Validation, Softfile-Analysis, Writing-Review-Editing. DNC: Methodology, Field Survey, Softfile-Analysis, Visualization, Writing-Review-Editing. LS: Validation, Visualization, Writing-Review-Editing. IS: Methodology, Validation, Softfile-Analysis, Writing-Review-Editing. MS: Conceptualization, Supervision, Writing-Review-Editing. NNH: Conceptualization, Methodology, Visualization, Writing-Review-Editing. SADH: Field Survey, Supervision, Writing-Review-Editing. KY: Methodology, Field Survey, Visualization, Writing-Review-Editing. NKF: Methodology, Field Survey, Visualization, Writing-Review-Editing. PRS: Methodology, Field Survey, Validation, Writing-Review-Editing. FHA: Methodology, Field Survey, Visualization, Writing-Review-Editing. All of the authors read and approved the final manuscript.

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Data Availability

The datasets of the current study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy and confidentiality considerations of the respondents.

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Figures

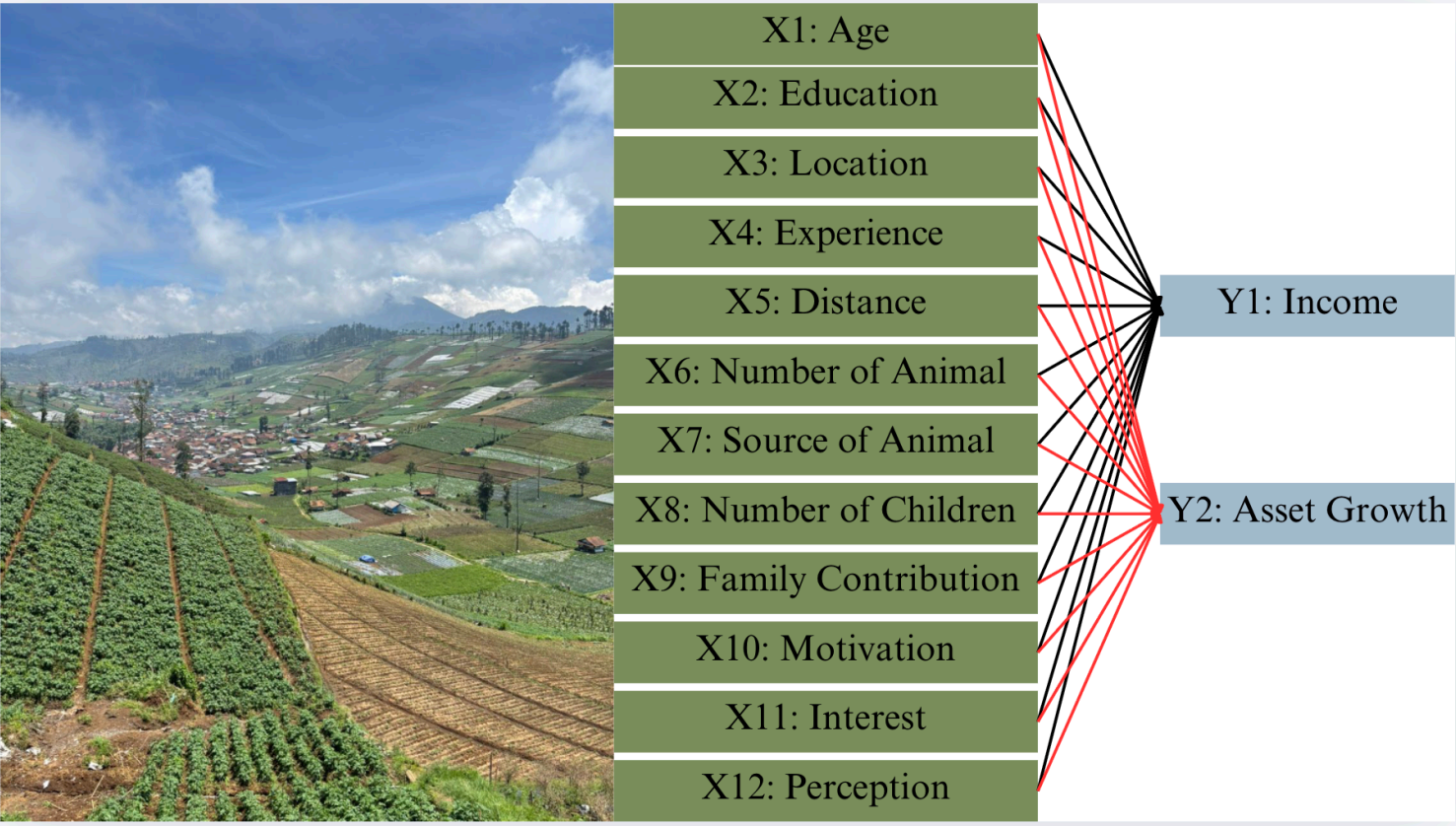


Figure 1

Research location on the mountainside of Mount Slamet and the regression model used in this study.
Source: Author’s documentation and own elaboration (2025).