

# Understanding Livelihood Assets of Potato Farmer Household in Probolinggo Regency, East Java Province, Indonesia

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**Abstract.** Potato farming is critical in the local community of the mountainous terrain in Probolinggo Regency, East Java province. Despite the region's vulnerability to landslides and volcanic activity, its fertile land provides an optimal environment for agriculture, significantly contributing to potato production in Indonesia. However, farmers continue encountering challenges such as limited resources, market instability, and highland farming conditions. Understanding potato farmers' livelihood assets is crucial for supporting agricultural sustainability in the challenging terrain of Probolinggo Regency, East Java. This study used descriptive analysis, scoring, a Livelihood Index, and pentagon assets to characterize potato farmers' human, financial, physical, natural, and social assets. Results demonstrate the relative strength of financial assets, followed by natural, physical, human, and social assets, suggesting that farmers possess a moderate level of livelihood security.

**Keywords:** agriculture; livelihood assets; livelihood index; pentagon asset; potato

## INTRODUCTION

Regional economic development relies on local potential to drive productive activity. Despite being at medium to high risk of landslides and volcanic activity, the region's fertile land provides an ideal environment for agricultural activities ([Nurbudiati & Wulandari, 2020](#)). As a result, a substantial portion of the land in Probolinggo Regency is dedicated to extensive plantations, highlighting the region's agricultural importance. Situated in the mountainous terrain, Probolinggo Regency in East Java province is a prominent center for potato cultivation. Potato farming is an essential and economically significant occupation for the local community, providing a vital source of income and contributing significantly to the overall welfare of the highland population. According to the Center for Data and Agricultural Information Systems of the Ministry of Agriculture, potato production in Indonesia reached 1.5 million tons in 2022, an increase of 0.14 million tons from the previous year ([Badan Pusat Statistik, 2022](#)). In the past five years, East Java, Central Java, and West Java have been recognized as the primary potato producers, with total production showing fluctuations but a general

trend of increase in recent years. The potato production figures for East Java stand at 385,124 tons, for Central Java at 278,717 tons, and for West Java at 272,074 tons. Despite the rise in production, farmers continue to face various risks that could impact their livelihoods, including limited access to resources, market instability, and challenges associated with highland farming in Indonesia ([Santoso et al., 2023](#); [Miani et al., 2023](#)). These challenges may be attributed to the demanding conditions of upland farming, restricted access to resources, and insufficient support for farmer livelihoods. To mitigate this risk, farmers need livelihood assets, which are resources used by the community for their livelihoods.

Farm-based livelihoods play a crucial role in the planning of rural development, especially in developing countries with agrarian-based economies ([Paul et al., 2020](#)). The assets essential to farmers' livelihoods, including human capital, natural resources, physical infrastructure, financial resources, and social support, play a pivotal role in enhancing farmers' income, reducing their susceptibility to risks, and ultimately improving their overall well-being ([Afifah et al., 2021](#)). These assets are instrumental in showcasing the farmers' capacity to



effectively manage risks and fulfill their basic needs. Farmers who have access to a diverse range of livelihood assets are better positioned to maximize their crop production through the optimal use of available resources. They achieve this by employing a wider array of production inputs compared to those who do not have access to such assets. Consequently, the ownership of livelihood assets significantly influences the progression and sustainability of farming ventures. A livelihood includes resources and activities needed for living and is sustainable when it can cope with challenges and maintain or enhance its assets without depleting natural resources ([Erenstein et al., 2007](#)).

Farmers' capacity to manage risks and secure basic necessities depends heavily on their livelihood assets. This research evaluates livelihood assets among potato farmers in Probolinggo Regency using a selection of factors deemed more appropriate for this specific context than those used in prior investigations.

## METHODS

The research was intentionally conducted in the Sumber District, Probolinggo Regency, from August 2023 to April 2024. Probolinggo Regency was selected as the research location because it is a leading potato producer in East Java Province. Sumber District was selected for its substantial potato farming, with 692 hectares yielding 1,455 tons ([Central Statistics Agency and the Ministry of Agriculture, 2023](#)). This data underscores the district's importance to potato production. This research employed a mixed-methods approach, combining primary data collection (surveys and interviews with closed questionnaires) with secondary data analysis. Secondary sources included the Central Statistics Agency, the Department of Agriculture, and relevant archives, enriching the primary data and offering a more complete understanding of the research area.

Simple random sampling was utilized to select a representative sample of potato farmers in Sumber District, Probolinggo Regency. This probability-based approach guaranteed equal selection probability for all farmers. The respondents chosen for this research were farmers who had cultivated potatoes in the most recent planting season in the Sumber District, Probolinggo Regency. The determination of the sample size in this research followed the calculation formula of the Slovin method. Consequently, with a population of 626 potato farmers and a margin of error of 12%, a total of 63 potato farmers were included as the sample. Below is the formula for calculating the required sample for research using the Slovin method ([Riandi et al., 2016](#)):

$$n = \frac{N}{1 + N(e)^2}$$

From the [formula above](#), it is known that:  $n$  is sample size,  $N$  is population size, and  $e$  is maximum tolerated error (standard error) of 12%.

The Sustainable Livelihoods (SL) approach serves as an essential analytical framework for comprehending the multifaceted factors impacting an individual's livelihood and their interconnectedness ([Fauzia Putra & Suprianto, 2020](#)). This approach aids in the comprehension of how individuals, particularly farmers, build and sustain their livelihoods. The SL approach acknowledges the diverse assets within people's livelihoods crucial for ensuring their existence. This study uses the pentagon assets consisting of human assets, financial assets, physical assets, natural assets, and social assets. The measurement of livelihood assets is done by determining relevant indicators for each asset and calculating the livelihood asset index. Understanding the resources available to potato farmers is crucial for assessing their overall well-being and optimizing their farming practices. This breakdown delves into the key categories of livelihood assets and the specific indicators used to measure them. The following are the indicators used for livelihood assets in this study:

1. Human assets: This category includes formal education and farming experience.
2. Financial assets: This category encompasses the total income obtained by farmers from the recent potato harvest (in Rp) and total savings amount (in Rp).
3. Physical assets: This category comprises the number of private vehicles owned by farmers (bikes, motorbikes, cars) and the quantity of conventional agricultural tools owned (e.g., hoes, sickles).
4. Natural assets: This category includes the land area used for farming and potato farming productivity.
5. Social assets: This category covers the participation of farmers in various groups/activities (e.g., farmer groups, cooperatives, BUMDES, religious groups, agricultural extension, mutual cooperation, and partnerships) and the number of information sources used by farmers to obtain agricultural information.

The factors used to analyze livelihood assets were carefully selected and adjusted to reflect the particular circumstances of the research area. This process involved utilizing the [DFID \(1999\)](#) framework as a foundation and validating the chosen factors against relevant previous research. By analyzing these livelihood assets and their indicators, we gain a comprehensive picture of the resources available to potato farmers. This understanding allows us to assess their strengths, weaknesses, and potential areas for improvement, ultimately contributing to more sustainable and successful potato farming practices.

This study assessed livelihood assets using ordinal data, providing a holistic view of contributing factors such as education, income, land ownership, and access to information. Data gathered through farmer interviews in Sumber District were converted into numerical scores and grouped into five categories for each asset factor. This data

transformation was necessary because the original data for each livelihood asset factor were measured on different scales, making direct comparison and analysis challenging. Data standardization through scoring and categorization facilitated pentagon asset analysis. This scored data was used to calculate an index and create the pentagon for comprehensive analysis. The equation based on [Ansyah et al., \(2019\)](#):

$$\text{Livelihood Index} = \frac{\text{Actual Score}}{\text{highest score} \times \text{number of respondents}} \times 100$$

Following the calculation of individual factor indices, overall livelihood asset indices were determined using the following example:

$$\text{Average Asset Score Index} = \frac{AA1+AA2}{n}$$

In this formula, AA represents one of the five livelihood assets, AA1 is the index for its first factor, and n is the total number of factors for that asset. Adopting [Gai et al. \(2020\)](#) approach, livelihood asset scores were categorized into five classifications (very weak, weak, moderate, strong, and very strong). Average index values for each asset were then visualized in a pentagon asset graph.

## RESULTS AND DISCUSSION

The Probolinggo Regency is distinguished by its extensive agricultural land covering 373.13 km<sup>2</sup>, surpassing the region's residential areas which encompass approximately 147.74 km<sup>2</sup>. The fertile land in this region is well-suited for cultivating a diverse range of horticultural commodities, including potatoes, onions, carrots, and corn, which are highly regarded as superior crops ([Haryanti, 2021](#)). Notably, many farmers engage in the cultivation of potatoes alongside leeks and cabbage, showcasing the multifaceted nature of agricultural practices in the region. It is evident that farm-based livelihoods play a pivotal role in shaping the framework for rural development, particularly in nations with agrarian-based economies ([Paul et al., 2020](#)). Therefore, it is

important to analyze the characteristics of farmers and their livelihood assets further.

### **Characteristics of potato farmers**

The respondent profile, also known as sample characteristics, offers an overview based on demographic and research-related traits. The average age of the farmers in Sumber District is 45 years. Most of them are between 25 and 50 years old, indicating that many farmers have valuable knowledge and skills. Age can affect a farmer's ability to work and think. According to [Ayu et al. \(2022\)](#), productivity levels based on age are: unproductive (<15 years), productive (15 - 55 years), and unproductive (>55 years). On average, farmers fall within the productive age range.

Farmers, on average, have completed 8 years of formal education, mostly finishing elementary school but not junior high school. Many farmers believe that long-term education does not significantly impact their farming careers, as it is often passed down through generations. Although a few farmers have higher education, most of them are migrants from urban areas. Education plays a critical role in empowering individuals from underprivileged backgrounds to break free from poverty and enhance their economic prospects ([Wang et al., 2019](#)). Socialization programs related to improving education in rural areas are necessary to address the varying levels of education and provide opportunities for ongoing learning and skill development.

The majority of farmers have accumulated 25 years of experience in agriculture, with some having dedicated as many as 57 years to the profession, while others are relatively new with just 4 years under their belts. Their collective expertise, particularly in horticultural commodities, positions them as invaluable resources for the wider farming community. The newer generation of farmers, with less than 25 years of experience, stands poised to benefit from the wisdom of their predecessors while

introducing fresh perspectives to meet the demands of modern agriculture. Additionally, it is important to recognize the pivotal role that the newer generation of farmers plays in shaping the future of agriculture ([Hikmawati et al., 2021](#)). With less than 25 years of experience, these individuals represent the next wave of agricultural leaders who have the opportunity to build upon the foundational knowledge of their predecessors while also introducing innovative practices and technologies to adapt to the evolving climate.

Nearly half (49.21%) of the surveyed farmers rely solely on their primary farming activities. While side jobs can be a key diversification strategy ([Mulyasari et al., 2023](#)), only about half of the respondents reported having additional income sources. Among those with side jobs, off-farm employment was most common (30.16%), suggesting a search for income stability outside of agriculture. Other side hustles, like livestock rearing or trade, were less prevalent (9.52% each). This suggests limited diversification, with most farmers primarily dependent on agriculture. Notably, only one respondent was retired, indicating a predominantly active farming population.

The average farm size owned by farmers is 0.99 hectares, indicating that many operate relatively small-scale farming operations. About 76.2% of the farmers have farms of 1 hectare or less, showing a focus on intensive farming practices. The remaining farmers own between 1.1 and 2 hectares of land, indicating slightly larger scale farming activities. Farmland ownership is mostly hereditary. The main crops grown by farmers in Sumber District are potatoes, cabbage, and leeks.

### **Livelihood Asset Analysis of Potato Farmers**

The comprehensive examination of livelihood assets provides insight into the foundational resources held by farmers to facilitate their effective participation in

agricultural activities. These livelihood assets encompass human (such as skills and knowledge), financial, physical (including agricultural tools and infrastructure), natural (land productivity and biodiversity), and social resources. Different socio-economic characteristics and asset endowments influence people's involvement in various livelihood activities, leading to different

outcomes (Walelign et al., 2015). Each asset's indicators have been tailored based on the guidelines provided by the Department for International Development (DFID) in 1999 and the specific contextual factors at the research location. The livelihood index serves as a measure of overall livelihood well-being. Detailed outcomes derived from the analysis of livelihood assets (Table 1).

**Table 1.** Livelihood Index Calculation results

No.	Aset	Indicator	Description				Classification
			Frequency	Total Score	Index (%)	Total Index (%)	
1.	Human assets	Education					
		Score 1	5	5	1.59		
		Score 2	38	76	24.13		
		Score 3	9	27	8.57		
		Score 4	9	36	11.43		
		Score 5	2	10	3.17	52.86	Moderate
		Experience					
		Score 1	6	6	1.90		
		Score 2	16	32	10.16		
		Score 3	27	81	25.71		
Score 4	10	40	12.70				
Score 5	4	20	6.35				
2.	Financial assets	Potato farming income					
		Score 1	0	0	0.00		
		Score 2	19	38	12.06		
		Score 3	32	96	30.48		
		Score 4	10	40	12.70		
		Score 5	2	10	3.17	60.48	Strong
		Total savings					
		Score 1	0	0	0.00		
		Score 2	0	0	0.00		
		Score 3	55	165	52.38		
Score 4	8	32	10.16				
Score 5	0	0	0.00				
3.	Physical assets	Vehicle					
		Score 1	3	3	0.95		
		Score 2	21	42	13.33	55.24	Moderate
		Score 3	30	90	28.57		
		Score 4	6	24	7.62		
		Score 5	3	15	4.76		

		.....(Continued).....				
		Agricultural tools				
		Score 1	0	0	0.00	
		Score 2	29	58	18.41	
		Score 3	26	78	24.76	
		Score 4	2	8	2.54	
		Score 5	6	30	9.52	
4.	Natural assets	Agricultural land				
		Score 1	0	0	0.00	
		Score 2	22	44	13.97	
		Score 3	28	84	26.67	
		Score 4	10	40	12.70	
		Score 5	3	15	4.76	
						58.26 Moderate
		Land productivity				
		Score 1	0	0	0.00	
		Score 2	15	30	9.52	
		Score 3	42	126	40.00	
		Score 4	2	8	2.54	
		Score 5	4	20	6.35	
5.	Social assets	Group/activity participation				
		Score 1	4	4	1.27	
		Score 2	17	34	10.79	
		Score 3	37	111	35.24	
		Score 4	3	12	3.81	
		Score 5	2	10	3.17	
						52.07 Moderate
		Information access				
		Score 1	12	12	3.81	
		Score 2	22	44	13.97	
		Score 3	18	54	17.14	
		Score 4	8	32	10.16	
		Score 5	3	15	4.76	

Source: Primary data (processed), 2024

Human capital, encompassing education and experience, plays a vital role in determining farmers' income, adaptability, and well-being (Keshavarz et al., 2017). The human capital of the surveyed farmers, assessed at 52.83%, suggests a moderate level of knowledge and experience sufficient to sustain their primary occupation. Data of human capital presented in Table 1, focusing on education and experience, revealed that educational levels were generally low, with

the majority of respondents completing only elementary school (averaging 8 years of formal education). Access to higher education was limited. In contrast, experience scores were more evenly distributed, suggesting a moderate level of practical knowledge and skills gained through farming. Both education and experience are key to farmers' livelihoods, highlighting the need for improved access to education and ongoing skills development

through training and extension programs ([Li et al., 2020](#); [Gai et al., 2020](#); [Tjoe 2016](#)).

Financial resources are fundamental to farmers' chosen livelihood strategies ([Pour et al., 2018](#)). Financial assets, encompassing savings and access to various capital sources, play a critical role in enabling farmers to invest in new technologies, scale up their production, and effectively manage the financial risks inherent in agriculture ([Sihombing et al., 2021](#)). Access to savings and liquid assets provides a crucial financial buffer against potential crop failures, fluctuations in commodity prices, and other unexpected events. The ability to convert fixed assets into financial assets allows farmers to better manage risks ([Zhou et al., 2021](#)), highlighting the importance of agricultural activities for financial well-being. A total index value of 60.48% reflects the positive state of farmers' financial assets. Income levels among surveyed farmers were moderate (majority scored 3), with a low percentage reaching the highest score. Most families use multiple earners, with no gender-based wage gap for farm labor. Savings habits were better, with over half scoring 3, though no one achieved the highest score. This suggests that farmers generate enough income to cover household expenses and also have access to savings mechanisms. Both income and savings show room for improvement.

Physical assets, including vehicles and farm equipment, are crucial for farmers' livelihoods ([Yurike & Syafruddin, 2022](#); [Ibrahim et al., 2018](#)). With a total index of 55.35%, farmers' physical asset holdings, including transportation and agricultural equipment, is reasonably good. Vehicle ownership among surveyed farmers was moderate, the majority of respondents (28.57%) are concentrated at a score of 3, with limited access to vehicles likely due to Probolinggo's terrain. Similarly, farm equipment ownership was also moderate, the majority of respondents (24.76%) have a score of 3, with few farmers having access to modern technology leading to continued

reliance on traditional tools. Improved infrastructure and access to better technology are needed to enhance farmers' physical assets and production efficiency.

Natural assets, including land and water, are vital for livelihoods ([Rahma et al., 2022](#); [Sibarani & Somboonsuke, 2024](#)). The ownership of agricultural land and land productivity serve as key indicators in assessing natural assets. With a total index of 57.86%, farmers' natural assets are considered moderately good, reflecting access to productive farmland that supports their agricultural activities and general well-being. In terms of agricultural land area, the majority of respondents (26.67%) are concentrated at a score of 3, indicating relatively limited land ownership. Land use activities have a direct impact on various aspects, including land performance, maintenance quality, resource utilization, landscape patterns, and farm sustainability ([Yang et al., 2019](#)). Productivity showed a similar pattern. The productivity of agricultural land for potato farming is notably good enough, enabling farmers to yield favorable harvests from their land. The majority of respondents (40.00%) have a score of 3, indicating a moderate level of productivity. However, because farmers are very dependent on rainfall for irrigation, potato farming is only carried out during the rainy season. The findings of this study align with [Dendir & Simane \(2019\)](#), indicating that while the agricultural sector significantly contributes to the overall economy, it is predominantly rain-fed and thus susceptible to the impacts of climate change and extreme events. Furthermore, current land management practices, particularly on sloping land without adequate conservation measures, pose a threat to long-term sustainability ([Medina & Sunarti, 2022](#)).

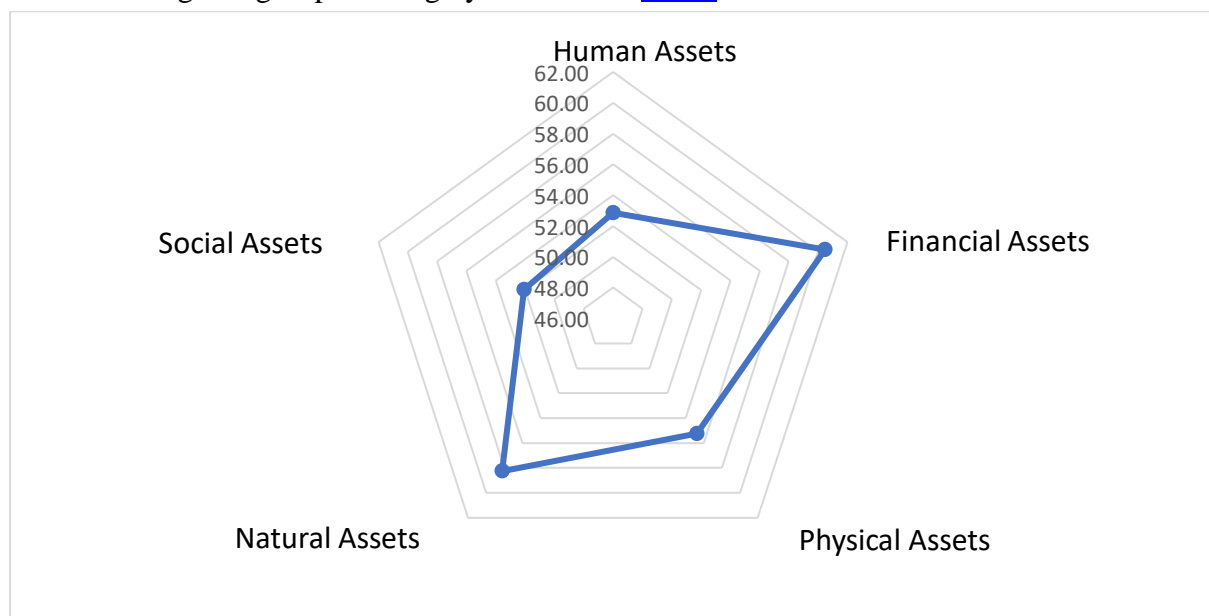
Social assets, including group participation and information access, are crucial for sustainable livelihoods ([Augustina et al., 2024](#)). With a total index of 52.20%, farmers' social assets are considered moderately good, reflecting their

involvement in social groups and availability of information. In Sumber District, community ties are strong, particularly through traditions like mutual cooperation. However, participation in formal farmer groups, while moderate could be further encouraged. Strong farmer participation in social groups and activities indicates their involvement in community networks, access to social support, and opportunities for knowledge exchange (Yusoff et al., 2016). Despite the impact of globalization, the majority of farmers in Sumber District, who are Tengger tribes, maintain strong social relations due to shared traditions.

The community engages in various social activities, including farmer groups, cooperatives, BUMDES, religious groups, agricultural extension, cooperation, and partnerships. *Gotong-royong*, a communal activity, is deeply rooted in the community and strengthens social relations among farmers. Religious groups are highly favored

by the community, and culture and tradition serve as important social assets for farmers to achieve livelihood sustainability (Sidayat & Fatmawati, 2021).

Additionally, farmers show great interest in participating in agricultural extension groups to gain the latest knowledge related to agriculture, which ultimately leads to increased production. Farmers' cooperative organizations can enhance support and publicity, integrate village social networks, and strengthen the community's ability to resist risks (Ao et al., 2022). Meanwhile, access to reliable and relevant information is a key weakness, hindering farmers' ability to make informed decisions regarding their farming practices and livelihoods. Strengthening farmers' social networks and improving access to credible information sources are vital steps in enhancing their social capital and building resilience against risks (Medina & Sunarti, 2022).



**Figure 1.** Livelihood Asset Profile of Potato Farmers (Source: Primary data processed, 2024)

Figure 1 shows the results of a livelihood asset analysis carried out in Sumber District, Probolinggo Regency. It effectively illustrates the varying strengths of assets held by farmers in Sumber District. A comprehensive assessment of farmers'

livelihood assets reveals a generally positive picture (overall index 0.89, corresponding to 55.78%), signifying a relatively robust level of livelihood assets and foundational support for sustaining livelihoods among the farmers. Financial assets performed best (0.96),



followed by natural assets (0.92), physical assets (0.88), human assets (0.89), and social assets (0.83). While human capital is reasonably good, improvements through training and community programs are possible. Financial resilience can be further strengthened through income diversification and better access to financial services. Physical assets, though moderately good, can be optimized through technology and skill development. Natural assets, while good, require sustainable management practices. Social assets, while showing participation in community groups, need better access to information. Continued optimization across all asset categories is crucial for long-term farmer well-being. The strengthening of each livelihood asset is pivotal for ameliorating the welfare of the farmers and fortifying their resilience in the face of challenges and

## CONCLUSION

Despite limitations in sampling, this study revealed that farmers in the region have reasonably good access to livelihood assets, financial assets were strongest (65.92%), followed by natural (56.97%), physical (55.78%), human (52.53%), and social assets (49.02%), averaging 56.04% overall, indicating reasonably good access to livelihood assets. This suggests that targeted interventions by the government can effectively address vulnerabilities and strengthen farmers' resilience against risks. Extension services can also play a role by providing guidance on adaptation strategies tailored to farmers' specific asset profiles. To further enhance resilience, a multi-pronged approach is recommended: For human capital, increased training and outreach are needed. Financial resilience can be strengthened through expanded access to financial services. Physical asset improvement involves better technology and infrastructure. Natural assets require sustainable management. Finally, social assets can be bolstered by strengthening networks and improving information access. To further refine our understanding, future

opportunities. Agriculture serves as the primary source of livelihood for rural residents in developing countries and is highly susceptible to climate variability and change (Keshavarz et al., 2017). Farmers encounter risks such as natural disasters, market fluctuations, and disease outbreaks, which can result in prolonged poverty. Livelihood assets play a crucial role in guiding farmers' decisions and assisting families in mitigating these risks. The sustainable livelihood framework focuses on capital assets and helps farmers improve their livelihoods by leveraging specific assets (Kuang et al., 2020). Understanding the different types of assets that farmers possess can greatly assist organizations and policymakers in designing effective interventions aimed at improving the overall well-being of the farming community.

research should incorporate a more comprehensive set of relevant factors in livelihood asset analyses, recognizing the unique characteristics of each region and their influence on farmers' resources. This will allow for a more nuanced and representative picture of farmers' livelihood assets.

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