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Sustainable Livelihood Strategy for Red Onion (*Allium Ascalonicum* L.) Farmers in Pajeng Village, Gondang District Bojonegoro Regency

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Abstract: The main commodity that is favored by the people of Pajeng Village, Bojonegoro Regency is shallots, because apart from being able to be cultivated in both the rainy and dry seasons. There are sustainability obstacles which has an impact on the sustainability of shallot farming. Therefore, an appropriate livelihood strategy is needed for adaptation to improve livelihoods for sustainable survival. Livelihood Vulnerability Index and descriptive analysis were used to answer the research objectives. Meanwhile, SEM-PLS analysis to answer the next research objective is to analyze livelihood assets, livelihood risks, livelihood strategies and welfare of red onion farmers. The level of mastery of livelihood assets is in the medium category with an index value of 2.08. The highest asset control is physical capital at 2.34 and human capital at 2.22. The level of vulnerability of the livelihood assets of shallot farmers is in the medium category with an LVI vulnerability index value of 0.49. The highest vulnerability value for financial capital is 0.71, while the livelihood asset with the lowest vulnerability for physical capital is 0.37. Livelihood risks have a significant effect on livelihood assets, livelihood strategies and welfare.

Keywords: Farmer; Livelihood assets; Red onion; Sustainable

Introduction

The agricultural sector is the backbone of many developing economies, providing livelihoods for a substantial portion of the population (World Bank, 2023). However, the agricultural sector is also highly vulnerable to climate change impacts, such as extreme weather events and changes in rainfall patterns (Intergovernmental Panel on Climate Change, 2022). The livelihoods of farmers are particularly susceptible to these vulnerabilities, requiring strategies to adapt to the changing environment and ensure sustainable livelihoods (Food and Agriculture Organization of the United Nations, 2023). Understanding the specific challenges faced by farmers in different contexts is crucial for developing effective adaptation strategies and promoting resilience in the face of climate change (Adger et al., 2007). Agricultural businesses include businesses in the subsectors of food crops, horticulture, plantations, animal husbandry, fisheries and forestry (Central Statistics Agency, 2023). Horticulture as an agricultural subsector consists of various types of plants, including fruit plants, vegetable plants, biopharmaceutical plants and ornamental plants. The shallot plant (*Allium ascalonicum* L.) is a type of horticultural plant that is widely cultivated in Indonesia. This tuber-shaped plant is a strategic commodity that is widely consumed by the public and has high economic value. According to data from the Central Statistics Agency (2022), based on the results of the September 2021 Socio-Economic Survey (Susenas), the average range of per capita consumption of shallot commodities among Indonesians reached 2.49 kilograms per month, while regarding shallot production in Indonesia it is known that in 2021 there will be 6 Provinces cumulatively contributes 91.90% to the National Gross

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Domestic Product (GDP) from the proportion of overall domestic production. The 6 provinces include Central Java, East Java, West Nusa Tenggara, South Sulawesi and West Java.

Bojonegoro Regency is one of 9 districts as the largest shallot producing center in East Java Province. Meanwhile, according to publications from the Official Satu Data Bojonegoro Website, Gondang District in 2023 will be the largest shallot producing center in Bojonegoro Regency with production reaching 5,112 tons. The main commodity that is favored by the people of Pajeng Village, Bojonegoro Regency is shallots, because apart from being able to be cultivated in both the rainy and dry seasons, shallots have a relatively short planting and harvest time, and have high economic value, making them profitable for farmers. Apart from that, the availability of adequate land, both own land and conversion of forestry land into agricultural land, provides opportunities for farmers to cultivate shallot crops widely.

Constraints: Natural conditions, the impact of conversion of forestry land into agricultural land and large-scale illegal logging, indirectly affect the climate conditions in the Pajeng Village area. When the rainy season arrives, the lack of protective plants around the watershed often causes rivers to overflow, while during the dry season the high heat causes agricultural land to tend to dry out quickly, causing cracks and water resource deficits. This obstacle is exacerbated by the topographic conditions of Pajeng Village, namely uneven agricultural land, hills and rice fields, and a tendency to rise and fall, causing the irrigation function to be unable to reach all agricultural areas. The next obstacle faced by farmers is the market aspect in the form of uncertain price fluctuations, both the price of ready-to-plant seeds and the price of shallot harvest. Besides that, there is price competition between the prices of imported shallots and domestic shallots, causing shallot prices to fluctuate (Pranata et al., 2015). The availability of ready-to-plant seeds and the sale of harvested crops using a slash system on land still depends on the area of Nganjuk Regency. Because the downstream capabilities of the Pajeng Village community have not yet been developed by innovating in the form of processed shallot products that are able to provide added value, so that when harvest prices experience an extreme decline, farmers tend to experience large losses. Besides that, shallot farming families have not implemented good financial management so that the profits and losses experienced by farmers cannot be known with certainty. Furthermore, the risks most often experienced by farmers in general are pests and diseases that attack both the rainy season and the dry season, thus affecting the survival and sustainability of shallot farming in the Pajeng Village area. Survival strategies or livelihood strategies are farmers' efforts to meet daily needs through management and combination of livelihood assets through five resource capitals, namely human capital, social capital, physical capital, financial capital and natural capital.

There are sustainability obstacles in the form of risks due to lack of irrigation, price fluctuations, lack of downstream capabilities, financial management of farmer households that has not been implemented properly, and pests and diseases affecting the welfare of farmers which has an impact on the sustainability of shallot farming in Pajeng Village. Therefore, an appropriate livelihood strategy is needed for adaptation to improve livelihoods for sustainable survival, reducing vulnerability and increasing welfare. The aim of this research is to analyze the level of control and level of vulnerability of shallot farmers' livelihood assets; analyze the influence of livelihood risks, livelihood assets, and livelihood strategies on the welfare of shallot farmers in Pajeng Village, Gondang District, Bojonegoro Regency.

The concept of sustainable livelihoods has gained prominence in recent decades, particularly in the context of rural development and poverty alleviation (Chambers et al., 1992; Gong et al., 2020; Scoones, 19978). A sustainable livelihood is defined as one that can cope with and recover from shocks and stresses, while maintaining or enhancing its capabilities and assets, both now and in the future, without undermining the natural resource base (DFID, 1999). This approach emphasizes the importance of understanding the complex and dynamic interactions between people, their environment, and the various factors that influence their ability to secure a living.

Livelihood strategies are the ways in which people combine their capabilities and assets to achieve their livelihood goals (Morse et al., 2009). These strategies are shaped by a variety of factors, including the social, economic, and environmental context in which people live. In rural areas, livelihoods are often closely linked to natural resources, such as land, water, and forests (Ellis et al., 2004). However, access to these resources is often unequal, and many people face significant challenges in securing a sustainable livelihood.

To achieve sustainable livelihoods, it is essential to address the underlying causes of vulnerability and poverty (Ashley et al., 1999). This requires a holistic approach that considers the various factors that influence people's livelihoods, including their access to resources, their capabilities and skills, and the policies and institutions that shape their opportunities. By understanding these factors, it is possible to develop strategies that support sustainable livelihoods and promote rural development. This study focuses on

shallot farmers in Pajeng Village, Bojonegoro Regency, Indonesia. The novelty of this research lies in its comprehensive analysis of the interplay between livelihood risks, livelihood assets, livelihood strategies, and the well-being of shallot farmers in this specific context. This study is important for several reasons: Firstly, shallot farming is a major contributor to the local economy in Pajeng Village. Understanding the factors that influence the sustainability and well-being of shallot farmers is crucial for promoting economic development and poverty alleviation in the region. Secondly, this study employs a rigorous quantitative approach, using the Livelihood Vulnerability Index (LVI) and Structural Equation Modeling (SEM-PLS) to analyze the complex relationships between the variables. This approach provides a more robust and nuanced understanding of the challenges and opportunities faced by shallot farmers. Thirdly, the findings of this study have important implications for policymakers and stakeholders in developing targeted interventions to enhance the resilience and livelihoods of shallot farmers. By identifying the key factors that influence well-being and vulnerability, this research can inform the design of effective strategies to support sustainable shallot farming in Pajeng Village.

The study contributes to the growing body of literature on sustainable livelihoods and climate change adaptation in the agricultural sector. It provides valuable insights into the specific challenges and opportunities faced by shallot farmers in a vulnerable environment, contributing to the development of more effective strategies for promoting resilience and well-being in the face of climate change.

Method

The research approach uses a quantitative approach supported by qualitative data in the form of interviews, observations and document searches. Quantitative data processing was carried out to determine the influence of sustainable livelihood assets on market aspects, technology, financial management of farmer households, and onion farming institutions. The sampling technique in this research was carried out using a simple random sampling technique, namely sampling where each element that makes up the population is given the same opportunity to be selected as a sample (Sugiyono, 2019).

Livelihood Vulnerability Index and descriptive analysis were used to answer the research objectives, namely identifying the extent of farmers' control over livelihood assets and analyzing the level of vulnerability of shallot farmers' livelihood assets. Meanwhile, SEM-PLS analysis to answer the next research objective is to analyze livelihood assets, livelihood risks, livelihood strategies and welfare of shallot farmers in Pajeng Village, Gondang District, Bojonegoro Regency.

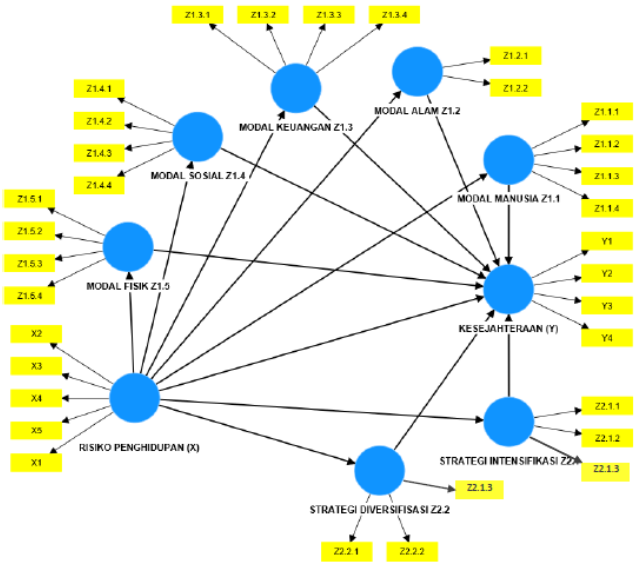

Figure 1. PLS-SEM research model

The PLS-SEM model depicted in Figure 1 is a statistical method used to analyze the relationships between observed and latent variables. This approach is widely employed in various disciplines, including the social sciences, to examine complex relationships between multiple variables and assess the mediating effects of specific variables within the model (Barroso et al., 2010; Hair et al., 2011; Richter et al., 2016). In the context of this study, the PLS-SEM model is employed to investigate the impact of livelihood risks on the well-being of shallot farmers, considering the mediating roles of livelihood assets and strategies.

The model includes five latent variables representing livelihood assets: human capital, natural capital, financial capital, social capital, and physical capital. Each latent variable is measured by several indicators, as detailed in Table 1. The model also incorporates two latent variables for livelihood strategies: intensification strategy and diversification strategy, each measured by corresponding indicators. The exogenous variable, livelihood risk, is hypothesized to influence both livelihood assets and strategies, which in turn are expected to affect the endogenous variable, well-being.

By utilizing the PLS-SEM approach, this study aims to provide a comprehensive understanding of the complex interplay between livelihood risks, assets, strategies, and well-being among shallot farmers. The findings of this analysis will contribute valuable insights for policymakers and stakeholders in developing targeted interventions to enhance the resilience and

livelihoods of shallot farmers in the face of various challenges.

Table 1. SEM-PLS Measurement Variables and Indicators Table

Exogenous variables	
X	Livelihood risk
X1	Irrigation
X2	Price fluctuations
X3	Downstreaming
X4	Financial management
X5	Pests and diseases
Mediation variables	
Z1	Livelihood assets
Z1.1	Human capital
Z1.1.1	Skills
Z1.1.2	Family members
Z1.1.3	Health
Z1.1.4	Education
Z1.2	Natural capital
Z1.2.1	Land area
Z1.2.2	Water access
Z1.3	Financial capital
Z1.3.1	Savings
Z1.3.2	Credit
Z1.3.3	Insurance
Z1.3.4	Debt ownership
Z1.4	Social capital
Z1.4.1	Social relationships
Z1.4.2	Mutual cooperation
Z1.4.3	Beliefs and traditions
Z1.4.4	Active in the organization
Z1.5	Physical capital
Z1.5.1	Machine access
Z1.5.2	Residence
Z1.5.3	Property
Z1.5.4	Business access
Z2	Livelihood strategy
Z2.1	Intensification strategy
Z2.1.1	Methods and technology
Z2.1.2	Fertilizers and pesticides
Z2.1.3	Knowledge and skills
Z2.2	Diversification strategy
Z2.2.1	On-farm business
Z2.2.2	Off-farm business
Z2.2.3	Non-farm business
Endogenous variables	
Y	Well-being
Y1	Income/capita
Y2	Net income
Y3	Food consumption
Y4	Access to education and health

Livelihood strategies are the activities that individuals or households undertake to secure the resources they need to survive and improve their well-being (UNDP, 2023). These strategies can be diverse, ranging from farming and other forms of livelihood activities, to wage labor, petty trading, and migration. Livelihood strategies are influenced by a variety of factors, including the availability of natural resources, access to markets, and the policy environment (Ellis, 2000; Schiller et al., 2012). Understanding livelihood strategies is essential for designing effective development interventions that support sustainable livelihoods and reduce poverty.

Livelihood assets are the resources that individuals or households can use to implement their livelihood strategies (DFID, 1999). These assets can be categorized into five types of capital: human capital (skills, knowledge, health), social capital (networks, relationships), natural capital (land, water, forests), physical capital (infrastructure, tools), and financial capital (savings, credit) (Ellis, 2000). The combination and use of these assets determine the resilience of individuals and households to shocks and stresses, and their ability to improve their well-being. Livelihood assets are therefore a key focus for development interventions that aim to build resilience and promote sustainable livelihoods.

In the context of sustainable livelihoods, well-being refers to the quality of life of individuals or households, encompassing both material and non-material dimensions (Alkire, 2002). Material well-being includes aspects such as income, food security, and access to basic services like education and healthcare. Non-material well-being encompasses aspects such as social inclusion, empowerment, and cultural identity. Sustainable livelihoods frameworks emphasize the importance of both material and non-material dimensions of well-being, recognizing that they are interconnected and mutually reinforcing. Development interventions that promote sustainable livelihoods seek to enhance both material and non-material well-being, leading to improved quality of life and reduced poverty.

Results and Discussion

Level Farmers' Control of Livelihood Assets

Control of assets can determine the survival of farmers and is a supporter of livelihood sustainability. The quantity of asset control can determine the type of strategy that can be implemented to support sustainable livelihoods.

Capital or human assets are the main resource that supports sustainable livelihoods, useful for alleviating poverty (Bajwa et al., 2016; Kamaruddin et al., 2015). Meanwhile, according to Parmawati et al. (2018), control of human assets is able to increase and support food consumption in the household. Control of human assets is expected to empower households and help improve welfare (Sulemana et al., 2018). The indicators contained in human assets are knowledge, skills, experience, health and workforce (Ellis, 2000). Meanwhile, the

human capital indicators in this research can be as follows:

Table 2. Human Capital Index Value

Indikator	Average Score	Category
Skills	2.29	Currently
Family members	2.06	Currently
Health	2.83	Good
Education	1.71	Currently
Total Average	2.22	Currently

Source: Processed Primary Data, 2023

The results of research on human capital have an average score of 2.22, which means that human assets are in the medium category, with the lowest indicator being education, namely having a score of 1.71. The education indicator is in the medium category but ranks lowest because most of the respondents in this study only received education at elementary school level. The indicator of family members who support shallot farming activities has the second lowest score, namely 2.06 in the medium category. The reason is that the average number of farming family members is around 1-3 people in one family so that the number of workers is insufficient to support agricultural activities. Experience passed down from generation to generation can be a guide in honing the skills of shallot farmers, so that the score range of 2.29 in the medium category tends to be good.

The shallot production process tends to be complicated and long and requires optimal care, hard work, physical exercise, and the habit of waking up early is a good habit that supports the health of shallot farmers in Pajeng Village, so that farmers' health levels tend to be in excellent physical condition and are rarely cared for. in the hospital. These components support human assets, as research by Kuang et al. (2020) shows that farmers with the characteristics of old age, low education, and qualified skills due to high farming experience reflect the actual state of human assets in general.

Health has an important role in shallot farming activities. Efforts to produce good quality shallots go through several stages including land processing, planting, quite complicated maintenance, and timely harvesting. This series of activities requires a strong physique and good endurance. Therefore, healthy farmers will be able to carry out production activities more optimally.

Table 3 describes the health history of the families of shallot farmers in Pajeng Village who were respondents in this study. As many as 84% of farming families in the last six months have never been hospitalized. This condition is supported by the existence of adequate health facilities in Pajeng Village, including orderlies and midwives, as well as supporting community health centers in the local village. In general, when farmers and their families experience mild illness, they choose to seek treatment at the nearest health facility so they can reduce medical expenses. Ownership of a Healthy Indonesia Card (KIS) from the government is quite helpful in reducing medical costs for farmers and families who experience serious illnesses and require treatment in hospital.

Table 3. Number of Respondents based on Health History

Medical history	Number of people)	Percentage (%)
Treated > 2 times	1	1%
Treated 1-2 times	15	15%
Never treated	84	84%
Amount	100	100%

Source: Processed Primary Data, 2023

Education is an indicator that reflects human assets. As according to Anwar (2022), analyzing the quality of education can reflect the quality of a region's human assets. The increase in the application of innovation and the level of knowledge is reflected in the level of formal education undertaken (Mandang et al., 2020). Quality human resources can be achieved by investing in education. Because the higher the education obtained, the more skilled the workforce will be in operating agricultural mechanisms (FAO, 2006).

Table 4. Number of Respondents based on Educational Skills

Business Access	Number of people	%
Completed/did not complete elementary school	42	42%
Junior high school	33	33%
High school/Diploma/Under Graduate	25	25%
Amount	100	100%

The table shows that the highest level of education of respondents is at elementary school level at 42% and then at junior high school level at 33%. The rest are farmers with high school, DI, S1 education levels.

The elements that form natural capital in this research are the area of land managed by farmers for farming activities and farmers' access to the reach of water sources to irrigate agricultural land. As in the following table 5.

In table 5, land area has an average score of 2.00 and access to water sources is 1.97, which means access to natural capital is in the medium category. As according to Ruhila et al. (2021), the level of income obtained by farmers through production levels depends on the area of land cultivated in a farming activity. The larger the area of farming land that is managed, the greater the

opportunity to obtain high production, which can increase farming income provided that allocating production factors must be based on the principles of technical efficiency and price efficiency (Shinta, 2011).

Table 5. Natural Capital Index Value

Indicator	Average Score	Category
Land area	2.00	Currently
Water Access	1.97	Currently
Total Average	1.99	Currently

Source: Processed Primary Data, 2023

Control of financial capital can improve welfare (You et al. 2019). The financial capital component consists of savings, access to loans, government assistance, and debt ownership. As in the following table:

Table 6. Financial Asset Index Value

Indicator	Average Score	Category
Savings	1.58	Not good
Loan Access	2.65	Good
Government Assistance	2.11	Currently
Debt ownership	1.18	Not good
Total Average	1.88	Currently

Mastery of financial capital is in the medium category, but the savings and debt ownership indicators show the bad category. The highest asset control is easy access to loans from banks, savings and loan institutions, shops and neighbors. The low habit of saving cash is influenced by high debt ownership.

Mastery of social capital livelihood assets can increase trust and reduce labor costs because work is done together (Rohmah, 2019). The research results show that the level of mastery of social capital is 1.99, so it is in the medium category. Social capital consists of indicators of social relationships, mutual cooperation, trust and tradition, and organizational participation. More details in the following table:

Table 7. Social Capital Index Value

Indicator	Average Score	Category
Social Relations	2.28	Currently
Mutual cooperation	2.26	Currently
Beliefs and traditions	1.89	Currently
Organizational participation	1.53	Not good
Total Average	1.99	Currently

Mastery of social capital is highest in the indicators of social relations and mutual cooperation. Good social relations, closeness between relatives and neighbors, and mutual cooperation can strengthen bonds and provide a sense of security. This interaction will certainly have a good impact on the sustainability of livelihoods. Mutual support between each other will make it easier to achieve goals and interests. The culture of mutual cooperation in taking turns during the planting and harvesting of shallots will reduce the amount of costs incurred to pay labor wages which has an impact on increasing farmers' income.

Physical capital livelihood assets refer to the form of infrastructure and facilities used to support farming activities. Control of large physical assets provides farmers with greater opportunities to continue farming (Liu et al., 2018). The physical capital condition of shallot farmers in Pajeng Village is in the medium category, two indicators, namely residence and property, are at a high level of sustainability. The lowest access is business access, although access to land tends to be difficult, but with the support of property in the form of motorized vehicles modified into trills/bangkel motorbikes, they are still able to reach land quite easily. Farmers can afford the high prices of fertilizers and chemical medicines with a post-harvest debt payment system. Overall control of physical capital in the category continues.

Table 8. Physical Capital Index Value

Indicator	Average	Category
Access Machinery	2.29	Currently
Residence	2.63	Good
Property	2.67	Good
Business access	1.77	Currently
Total Average	2.34	Currently

Level of Vulnerability of Shallot Farmers' Livelihood Assets

Livelihood Vulnerability Index (LVI) is a tool used to assess community vulnerability to hazards and risks that threaten the sustainability of their livelihoods. Vulnerability is used in poverty and food security analysis as well as environmental disaster/hazard studies in each region with different focuses (Bryan et al., 2009; Suryanto et al., 2019; Toufique et al., 2014).

Table 9. LVI Index

Component (C)	Sub Component (SC)	SC Value	C Value	LVI
Human Capital	Skills	0.35	0.40	0.49
	Family members	0.48		
	Health	0.11		
	Education	0.67		
Natural Capital	Land area	0.48	0.50	
	Water Access	0.52		
Financial Capital	Savings	0.70	0.71	
	Access loans/credit	0.35		
	Government assistance	0.89		
	Debt ownership	0.91		
Social Capital	Social relationships	0.34	0.49	
	Mutual cooperation	0.35		
	Beliefs and traditions	0.49		

Component (C)	Sub Component (SC)	SC Value	C Value	LVI
Physical Capital	Organizational participation	0.76	0.37	
	Access Machinery	0.35		
	Residence	0.20		
	Property	0.33		
	Business access	0.61		

Table 9 shows the five values of livelihood assets, namely human capital of 0.40, natural capital of 0.50, financial capital of 0.71, social capital of 0.49 and physical capital of 0.37. The highest value in the highest vulnerability category is human capital, while the rest are in the medium vulnerability category. In terms of physical capital, vulnerability in the medium category tends to be low.

Pentagon Assets

The further the value of asset control moves away from 0, the higher the level of asset control (Saleh, 2015; Anisa, 2021). Furthermore, the pentagons and lines in the asset pentagon also describe the level of vulnerability to asset control. The LVI value approaches the center of the pentagon, the lower the level of vulnerability (Saragih et al., 2007).

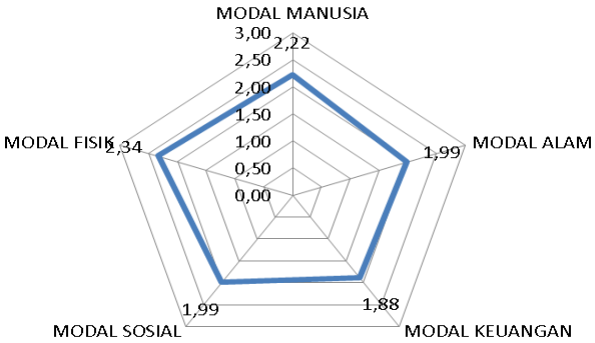

Figure 2. Pentagon assets level of control over livelihood assets (Source: Processed Primary Data, 2023)

The results of the asset pentagon analysis in Figure 2 show that the more vulnerable the livelihood assets are, the farther the asset point value is from the center of the pentagon.

The outermost point of the asset pentagon is financial capital which shows the highest level of vulnerability, namely 0.71. The pentagon chart in Figure 3 illustrates the Livelihood Vulnerability Index (LVI) of shallot farmers in Pajeng Village, Gondang District, Bojonegoro Regency. The LVI is a composite index that measures the vulnerability of households to various shocks and stresses. The higher the LVI score, the more vulnerable the household is. The LVI is a valuable tool for policymakers and practitioners as it can assist in identifying vulnerable households and developing targeted interventions to reduce their vulnerability and strengthen their resilience to economic shocks (Béné, 2009; Davoudi et al., 2013).

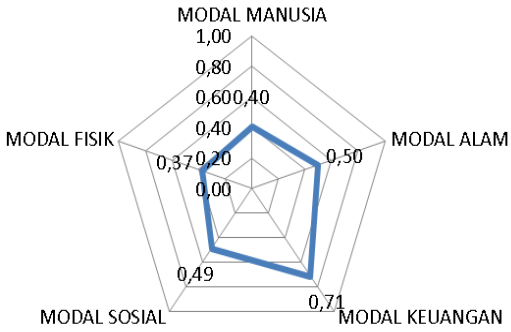

Figure 3. Pentagon asset livelihood vulnerability index (Source: Processed Primary Data, 2023)

The LVI is based on the concept of livelihood assets, which are the resources that households use to maintain their livelihoods. These assets include human capital (skills, knowledge, and health), social capital (networks and relationships), natural capital (land and water resources), physical capital (infrastructure and technology), and financial capital (savings and access to credit) (Ellis, 2000). The LVI considers the vulnerability of each of these assets to shocks and stresses. Shocks are sudden events that can disrupt livelihoods, such as natural disasters or economic crises. Stresses are chronic or ongoing problems that can undermine livelihoods, such as poverty or lack of access to resources (Cutter et al., 2010; Willison et al., 2022).

The LVI is calculated by assigning a score to each asset based on its vulnerability. The scores are then added together to create an overall LVI score. The LVI can be used to compare the vulnerability of different households or communities. It can also be used to track changes in vulnerability over time (Deressa et al., 2008). Understanding the specific challenges faced by farmers in different contexts is crucial for developing effective adaptation strategies and promoting resilience in the face of climate change (Adger et al., 2007). The findings of the study by Puspitasari et al. (2024) suggest that policymakers and practitioners should focus on strengthening the livelihood assets of shallot farmers in Pajeng Village. This can be done by providing farmers with access to training and education, improving their access to credit and insurance, and promoting sustainable agricultural practices. By strengthening the livelihood assets of farmers.

Level of Risk to Livelihood of Shallot Farmers

Producing shallots is faced with various risks. Some of the livelihood risks faced by shallot farmers in Pajeng Village include irrigation risks, price fluctuations,

downstreaming, financial management, pests and disease. The risk level index values are presented in the following table:

Table 10. Livelihood Risk Index Value of Shallot Farmers

Livelihood Risk	Index value	Category
Irrigation	1.58	Not good
Price fluctuations	1.19	Not good
Downstreaming	1.09	Not good
Financial management	1.31	Not good
Pests and diseases	1.28	Not good
Amount	1.29	Not good

Based on table 5, the farmer's risk level is in the not good category. The highest risk of impact is downstreaming. Farmers are reluctant to carry out downstreaming for various reasons, including farmers preferring to sell using a slash system on the land to speed up the process of circulating funds so that they can be immediately used for replanting capital, there is no adequate marketing network, stock and prices of shallots fluctuate.

The irrigation risk index value is 1.58. The index value is 1.19, the index value is 1.09, the Farmer Household Financial Management Index value is 1.31. This financial risk occurs because most farmers do not keep financial records. The reason they are reluctant to keep financial records is because the harvest results and the amount of income are uncertain. The absence of adequate financial management results in unclear budgets, income and expenses for farming activities. So there is no clarity regarding profits or losses. A total of 69 respondents felt affected by not doing so.

The pest and disease risk index value is 1.28. Respondents said that pests and diseases are increasingly resistant to chemical drugs. They assume that pests are becoming more resistant because of the use of drugs that exceed the recommended dosage.

Table 11. Respondents Affected by Livelihood Risks (Source: Processed Primary Data, 2023)

Livelihood Risk	Respondents affected	Sometimes exposed to risk	Not affected by risk
Irrigation	49	44	7
Price fluctuations	81	19	0
Downstreaming	91	9	0
Financial management	69	31	0
Pests and diseases	72	28	0

Table 11, shows the number of respondents affected by livelihood risks. Respondents affected or who did not carry out downstreaming were 91 out of a total of 100 respondents. Downstreaming is not implemented because farmers in Pajeng Village prefer to sell using the slash system on the land. When prices fall, generally farmers who have enough capital for the next planting season and have enough family members to support agricultural activities will usually make slight modifications to their shallot plants. They will dry their harvest in the sun while waiting for prices to stabilize, then they will sell their harvest in dry leaf condition, either directly or through the cutting process (prithil) or in the form of brambang trailer.

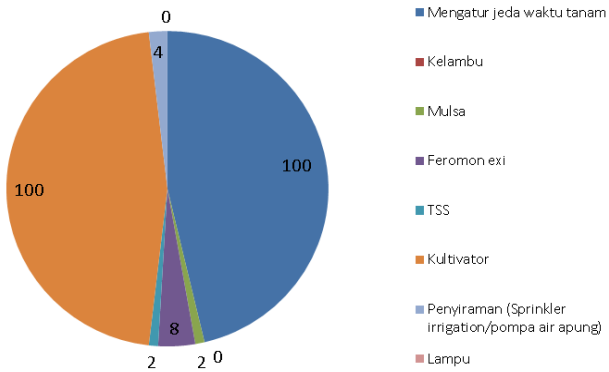

Figure 4. Method and technology intensification strategy diagram (Source: Processed Primary Data, 2023)

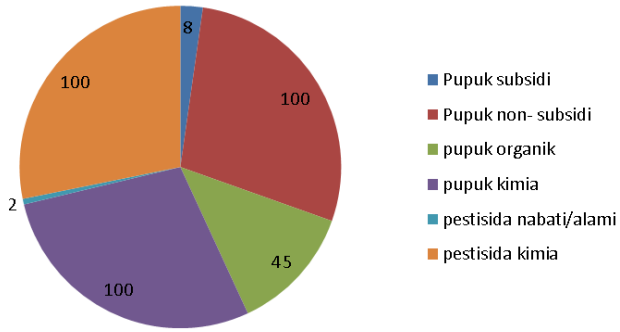

Figure 5. Fertilizer and pesticide intensification strategy diagram (Source: Processed Primary Data, 2023)

Farmer Livelihood Strategy

Strategy is a farmer's effort to overcome risks that may occur in the future. Maintaining sustainable livelihoods to be able to achieve prosperity. According to observations in the field, the strategy implemented by many farmers in Pajeng Village is the Intensification and Diversification Strategy. According to field observations, shallot farmers in Pajeng Village generally adopt an intensification strategy. These include applying several methods and technologies, using fertilizers and medicines, as well as increasing knowledge and skills.

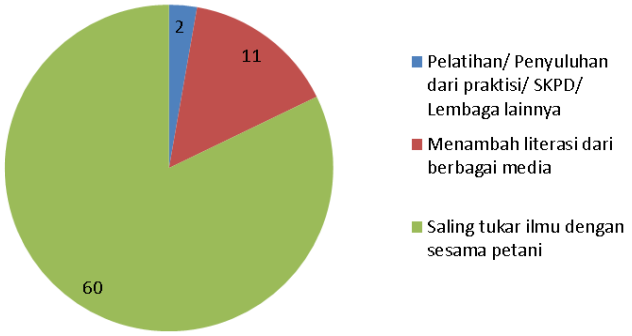

Figure 6. Knowledge and skills intensification strategy diagram (Source: Processed Primary Data, 2023)

The methods and technology applied by shallot farmers in Pajeng Village are presented in figure 4. The use of fertilizers and pesticides applied by shallot farmers in Pajeng Village is presented in figure 5. Increasing the knowledge and skills of shallot farmers in Pajeng Village is presented in figure 6.

According to researchers' observations in the Pajeng Village area, the diversification strategies implemented by shallot farmers include on-farm businesses, off-farm businesses and non-farm businesses.

Type of business on-farm implemented by farmers in Pajeng Village include diversifying plant types, raising livestock, agroforestry, intercropping and rotation. As presented in figure 7.

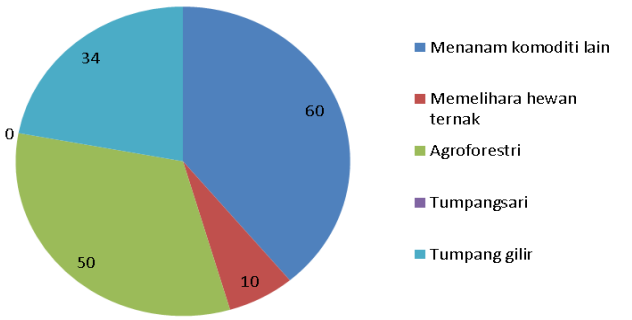

Figure 7. On-farm business diversification strategy diagram (Source: Processed Primary Data, 2023)

Agroforestry in Pajeng Village is implemented using a random mixture pattern, namely a random and irregular planting pattern between wood trees and agricultural plants. The agroforestry system in Pajeng Village is applied to corn plants adjacent to teak, cassava and banana trees. In the random mixture system, agricultural crops are generally more dominantly planted than forestry crops due to economic pressures and daily needs (Naharuddin, 2018).

Farmers carry out off-farm businesses to obtain other income outside of onion farming. Off-farm businesses include becoming a farm laborer and selling shallots.

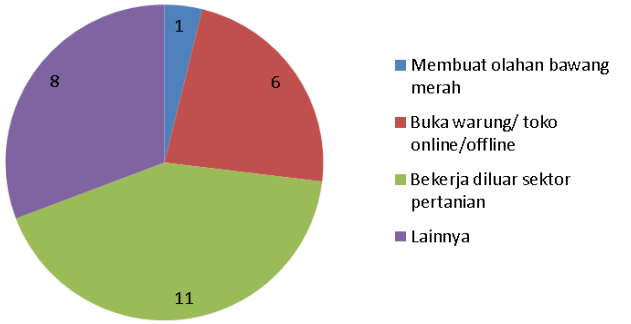

Figure 8. Off-farm business diversification strategy diagram (Source: Processed Primary Data, 2023)

Around 26% of the total respondents carry out non-farm business activities. Most respondents have jobs outside the agricultural sector, including village officials, teachers and entrepreneurs. This work is carried out in conjunction with shallot farming.

SEM-PLS Analysis

The second research objective is to analyze the influence of livelihood risks, livelihood assets and livelihood strategies on welfare, while the third research objective is to analyze the role of livelihood assets and livelihood strategies in mediating livelihood risks on welfare.

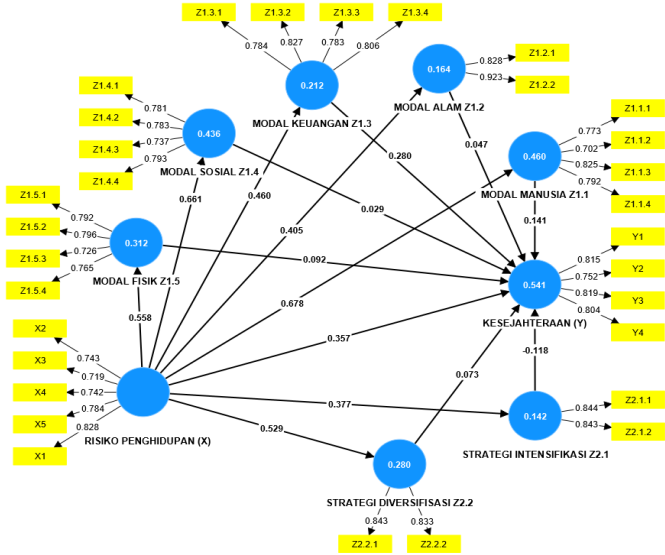

Figure 9. Results of outer model calculation of research path analysis (Source: research data processed using SmartPLS 4.0.9.5 software in 2024)

Validity indicators can be measured using the outer loading score, if the outer loading value is more than 0.70 (>0.70) then this indicator can be used. The Average Variance Extracted (AVE) value that meets the minimum criteria is greater than 0.50 (>0.50). If in the test there is an outer loading value below 0.70, the indicator can still be used provided that the minimum loading value is greater than 0.40 (Loading > 40) and the

AVE value is more than 0.50 (AVE > 0.5) so that the variable can be said to be valid. If it is less than 0.40 then it must be removed (Hair et al., 2022).

Table 12. Outer Loadings and Convergent Validity (AVE)

Variable	Sub variables	Loading (>0.70)	AVE (>0.5)
Livelihood Risk (X)	X1	0.828	0.584
	X2	0.743	
	X3	0.719	
	X4	0.742	
	X5	0.784	
Welfare (Y)	Y1	0.815	0.637
	Y2	0.752	
	Y3	0.819	
	Y4	0.804	
Human Capital Z1.1	Z1.1.1	0.773	0.599
	Z1.1.2	0.702	
	Z1.1.3	0.825	
	Z1.1.4	0.792	
Natural Capital Z1.2	Z1.2.1	0.828	0.769
	Z1.2.2	0.923	
Financial Capital Z1.3	Z1.3.1	0.784	0.641
	Z1.3.2	0.827	
	Z1.3.3	0.783	
	Z1.3.4	0.806	
Social Capital Z1.4	Z1.4.1	0.781	0.599
	Z1.4.2	0.783	
	Z1.4.3	0.737	
	Z1.4.4	0.793	
Physical Capital Z1.5	Z1.5.1	0.792	0.593
	Z1.5.2	0.796	
	Z1.5.3	0.726	
	Z1.5.4	0.765	
Z2.1 Intensification Strategy	Z2.1.1	0.844	0.711
	Z2.1.2	0.843	
	Z.2.1.3	0.064	
Diversification Strategy Z2.2	Z2.2.1	0.843	0.703
	Z2.2.2	0.833	
	Z2.2.3	0.357	

Source: Data processed using SmartPLS 4.0.9.5 software in 2024

Based on the table above, the following information can be seen that: All construct loading values are above 0.70 except Z1.2.3 (Knowledge and skills) and Z2.2.3 (Non-farm business) have loading values <0.5 so they must be removed from the research model (Amam et al., 2019). Average Variance Extracted (AVE) values are all above 0.50 Based on the calculation results, the factor loading values have met the criteria (except Z2.1.3 and Z2.2.3) and the Average Variance Extracted (AVE), all variables and indicators have met the validity criteria and can be used for further testing.

Reliability Construct (Cronbach's Alpha and Composite Reliability)

Construct reliability test as measured by composite reliability and Cronbach's alpha. A variable construct is declared reliable if it has a composite reliability value above 0.70 and Cronbach's alpha above 0.70 (Hair et al., 2022).

Table 13. Reliability Construct (Cronbach's Alpha and Composite Reliability)

Latent variables	Cronbach's alpha	Composite reliability (rho_c)
Welfare (Y)	0.810	0.875
Natural Capital Z1.2	0.709	0.869
Physical Capital Z1.5	0.771	0.853
Financial Capital Z1.3	0.814	0.877
Human Capital Z1.1	0.777	0.856
Social Capital Z1.4	0.777	0.857
Livelihood Risk (X)	0.821	0.875
Diversification Strategy Z2.2	0.577	0.825
Z2.1 Intensification Strategy	0.593	0.831

Source: Data processed using SmartPLS 4.0.9.5 software in 2024

Based on the table above, the following information can be seen that there is a variable Cronbach's Alpha value smaller than 0.70 which is marked with a red marker. The Composite Reliability value for all variables is greater than 0.70 Based on the results of the Construct Reliability calculation (Cronbach's Alpha and Composite Reliability), in the Cronbach's Alpha calculation there are variables that do not meet the criteria, the results of the Outer loading, AVE and Composite Reliability calculations all meet the criteria. Based on these considerations, the research model can be used for further testing. As according to Jogiyanto et al. (2016), it is more advisable to use Composite reliability because Composite reliability measures the actual value of reliability in a construct, while Cronbach's alpha measures the lower limit of the reliability value in a construct.

Evaluation of the Measurement Model (Inner Model)
Collinearity Assessment

Collinearity assessment in the structural model has the same concept as the formative measurement model, namely by considering the VIF value. The VIF value must be less than 5.0. This indicates that the model is free from symptoms of multicollinearity in all predictors for all responses, so that testing can be carried out to the next stage (Hair et al., 2022).

Table 14. Collinearity Assessment VIF

Latent variables	Y	Z1.2	Z1.5	Z1.3	Z1.1	Z1.4	Z2.2	Z2.1
Natural Z1.2	1.37							
Physical Z1.5	1.83							
Financial Z1.3	1.55							
Human Z1.1	2.18							
Social Z1.4	2.22							
Livelihood Risk (X)	2.70	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Diversification Strategy Z2.2	1.66							
Intensification Strategy Z2.1	1.46							

Source: Research data processed using SmartPLS 4.0.9.5 software in 2024

Based on the table above, the following information can be seen that: The VIF value for each construct variable is smaller than 5.0 (<5.0). Based on the results of calculating the VIF value, all variables do not have symptoms of multicollinearity and can be used in further analysis.

Coefficient of Determination (R2)

The coefficient of determination is used to measure the accuracy of predictions (estimates). In general, an R2 value of 0.75 is considered to have high estimation accuracy, an R2 of 0.50 has moderate estimation accuracy, and an R2 value of 0.25 has low estimation accuracy (Hair et al., 2022). The results of the coefficient of determination values can be seen in the following table.

Table 15. Coefficient of Determination (R2)

Latent variables	R-square	R-square adjusted
Welfare (Y)	0.541	0.501
Natural Capital Z1.2	0.164	0.156
Physical Capital Z1.5	0.312	0.305
Financial Capital Z1.3	0.212	0.204
Human Capital Z1.1	0.460	0.455
Social Capital Z1.4	0.436	0.431
Diversification Strategy Z2.2	0.280	0.273
Z2.1 Intensification Strategy	0.142	0.133

Source: Research data processed using SmartPLS 4.0.9.5 software in 2024

Based on the table above, the following information can be seen that: Accuracy of estimating the R2 Welfare (Y) model is 0.745. Based on this value, it has a large accuracy estimate. In other words, Natural Capital Z1.2, Physical Capital Z1.5, Financial Capital Z1.3, Human Capital Z1.1, Social Capital Z1.4, Livelihood Risk (X), Diversification Strategy Z2.2, Intensification Strategy Z2. 1, influenced 54.1% while the remaining 45.9% was influenced by other factors outside the research model. Accuracy of estimating the R2 model for Natural Capital Z1.2 0.164. Based on this value, the accuracy estimate is small. In other words, Livelihood Risk (X) influences 16.4% while the remaining 83.6% is influenced by other factors outside the research model. Accuracy of estimating the R2 Physical Capital model Z1.5 0.312. Based on this value, it has a moderate accuracy estimate. In other words, Livelihood Risk (X) influences 31.2% while the remaining 68.8% is influenced by other factors outside the research model. Accuracy of estimating the R2 model of Financial Capital Z1.3 0.212. Based on this value, the estimation accuracy is low. In other words, Livelihood Risk (X) influences 21.2% while the remaining 78.8% is influenced by other factors outside the research model. Accuracy of estimating the R2 Human Capital model Z1.1 0.460. Based on this value, it has a moderate accuracy estimate. In other words, Livelihood Risk (X) influences 46.0% while the remaining 54.0% is influenced by other factors outside the research model. Accuracy of estimating the R2 model of Social Capital Z1.4 0.436. Based on this value, it has a moderate accuracy estimate. In other words, Livelihood Risk (X) influences 43.6% while the remaining 56.4% is influenced by other factors outside the research model. Accuracy of estimating the R2 Diversification Strategy Z2.2 model 0.280. Based on this value, it has a moderate accuracy estimate. In other words, Livelihood Risk (X) influences 28.0% while the remaining 72.0% is influenced by other factors outside the research model. Accuracy of estimating the R2 Intensification Strategy Z2.1 model 0.142. Based on this value, the estimation accuracy is low. In other words, Livelihood Risk (X) influences 14.2% while the remaining 85.8% is influenced by other factors outside the research model.

Predictive Relevance (Q2)

In addition to evaluating the magnitude of the R2 value as a criterion for prediction accuracy, researchers can use the Stone-Geisser Q2 value. The Q2 value is obtained using the blindfolding procedure. As a relative measure of predictive relevance, a value of 0.02 is considered to have little predictive relevance, 0.15 to have moderate predictive relevance, and 0.35 to have large predictive relevance (Hair et al., 2022).

Table 16. Predictive Relevance (Q2)

Latent Variables	SSO	SSE	Q^2 (=1-SSE/SSO)
Welfare (Y)	400	277.72	0.306
Natural Capital Z1.2	200	177.12	0.114
Physical Capital Z1.5	400	328,87	0.178
Financial Capital Z1.3	400	352.36	0.119
Human Capital Z1.1	400	294.54	0.264
Social Capital Z1.4	400	298.70	0.253
Livelihood Risk (X)	500	500	0
Diversification Strategy Z2.2	200	161.93	0.19
Z2.1 Intensification Strategy	200	183.019	0.085

Source: Research data processed using SmartPLS 4.0.9.5 software in 2024

Table 16 presents the predictive relevance (Q2) values for the model, indicating the accuracy of the model in predicting the relationships between livelihood risks, livelihood assets, livelihood strategies, and well-being. The Q2 value is a crucial measure of the model's predictive validity, indicating its ability to forecast outcomes based on the identified factors (Hair et al., 2022). A higher Q2 value signifies greater predictive accuracy and relevance of the model.

In the context of this study, the moderate predictive relevance of the overall model suggests that while the identified factors (livelihood risks, assets, and strategies) significantly influence well-being, other external factors also play a considerable role. This aligns with the complex nature of well-being, which is often shaped by a multitude of interconnected elements beyond just economic factors (Jogiyanto & Abdillah, 2016). These external factors might include social support networks, community infrastructure, and broader economic and political conditions (Raung, 2024; Shen et al., 2022).

Furthermore, the varying predictive relevance values for different constructs highlight the nuanced relationships within the model. For instance, the moderate predictive relevance of livelihood risks on human capital and social capital underscores the critical role these assets play in mitigating risks and enhancing well-being (Paulangan et al., 2020; Zou et al., 2022). Similarly, the moderate predictive relevance of livelihood risks on diversification strategies emphasizes the importance of diverse income sources in navigating uncertainties and promoting resilience (Manggala et al., 2021; Sudjatmoko et al., 2023). These findings offer valuable insights for policymakers and development practitioners in designing targeted interventions to enhance farmers' resilience and well-being.

Effect Size (f2)

As to evaluate value R2 of all endogenous variables using f2. The difference between f2 and R2 is that f2 is more specific to each exogenous variable. In general, a value of 0.02 is considered to have a small affect size, 0.15 has a medium affect size and 0.35 has a large affect size. The following is a table of f2 values (Hair et al., 2022).

Table 17 presents the effect size (f^2) values, which measure the magnitude of the impact of one variable on another. As Hair et al. (2022) explain, f^2 values are useful for assessing the practical significance of relationships between variables in a structural equation model. In this study, several relationships exhibit large effect sizes. Specifically, livelihood risk has a substantial impact on human capital (f^2 = 0.853), social capital (f^2 = 0.774), physical capital (f^2 = 0.453), and the diversification strategy (f^2 = 0.389). These findings underscore the vulnerability of farmers' livelihoods to various risks, including irrigation challenges, price fluctuations, and lack of downstream capabilities. The results are consistent with previous research highlighting the significant influence of livelihood risks on farmers' assets and strategies (Le et al., 2019; Nhemachena et al., 2014; Steenbergen et al., 2017). For instance, Nhemachena et al. (2014) found that drought risk significantly affected farmers' human capital, particularly health, due to decreased income and food insecurity.

Table 17. Effect Size f2 Value

Latent Variables	f-square	Info
Natural Capital Z1.2 -> Well-being (Y)	0.003	Small
Physical Capital Z1.5 -> Well-being (Y)	0.010	Small
Financial Capital Z1.3 -> Welfare (Y)	0.110	Small
Human Capital Z1.1 -> Well-being (Y)	0.020	Small
Social Capital Z1.4 -> Well-being (Y)	0.001	Small
Livelihood Risk (X) -> Welfare (Y)	0.103	Small
Livelihood Risk (X) -> Natural Capital Z1.2	0.196	Currently
Livelihood Risk (X) -> Physical Capital Z1.5	0.453	Big
Livelihood Risk (X) -> Financial Capital Z1.3	0.269	Currently
Livelihood Risk (X) -> Human Capital Z1.1	0.853	Big
Livelihood Risk (X) -> Social Capital Z1.4	0.774	Big
Livelihood Risk (X) -> Diversification Strategy Z2.2	0.389	Big
Livelihood Risk (X) -> Intensification Strategy Z2.1	0.166	Currently
Diversification Strategy Z2.2 -> Prosperity (Y)	0.007	Small
Z2.1 Intensification Strategy -> Prosperity (Y)	0.021	Small

Source: Research data processed using SmartPLS 4.0.9.5 software in 2024

The large effect size of livelihood risk on human capital is particularly concerning because human capital is essential for farmers' ability to adapt to challenges and develop sustainable solutions (Moser, 1998). This finding suggests that livelihood risks can undermine farmers' health, skills, and knowledge, thereby hindering their capacity to cope with and recover from shocks. The substantial impact of livelihood risk on social capital is also noteworthy because social networks and relationships play a vital role in providing farmers with access to information, resources, and support (Flora et al., 2013; Pretty et al., 2001). The disruption of social capital due to livelihood risks can isolate farmers and limit their ability to collectively address challenges. Therefore, interventions aimed at enhancing farmers' resilience should prioritize strengthening both human and social capital.

Furthermore, the significant effect of livelihood risk on physical capital and diversification strategy emphasizes the need for interventions that support farmers in acquiring and maintaining productive assets and diversifying their income sources. Physical capital, such as land, machinery, and infrastructure, is crucial for agricultural productivity and efficiency (World Bank, 2007). Diversification strategies, including off-farm employment and non-farm activities, can provide farmers with additional income streams and reduce their reliance on agriculture, thereby mitigating the impact of livelihood risks (Barrett et al., 2001; Ellis, 2000).

Research Hypothesis Testing

Structural model coefficient analysis is used to test the hypothesis by finding out which relationships have a significant influence. If the p-value < a (0.05) then the relationship is significant, conversely if the p-value > a (0.05) then the relationship is not significant (Hair et al., 2022).

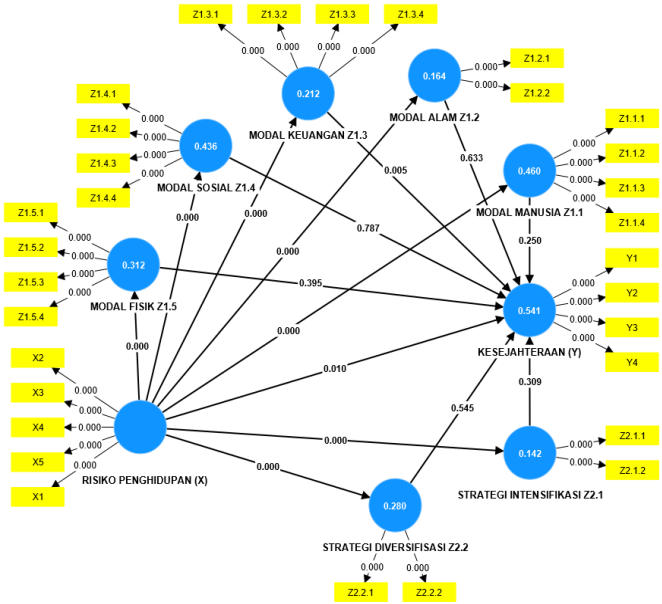

Figure 10. Results of research hypothesis test path diagram (Source: research data processed using SmartPLS 4.0.9.5 software in 2024)

Table 18. Test the Hypothesis of the Direct Influence of the Research Model

Hypothesis	Path Coefficient	Original Sample (O)	T Statistics (|O/STDEV|)	P Values
H1	Livelihood Risk (X) -> Human Capital Z1.1	0.67	10,409	0.000
H2	Livelihood Risk (X) -> Natural Capital Z1.2	0.40	4,176	0.000
H3	Livelihood Risk (X) -> Financial Capital Z1.3	0.46	4,984	0.000
H4	Livelihood Risk (X) -> Social Capital Z1.4	0.66	9,939	0.000
H5	Livelihood Risk (X) -> Physical Capital Z1.5	0.558	7,230	0.000
H6	Livelihood Risk (X) -> Diversification Strategy Z2.2	0.529	7,732	0.000
H7	Livelihood Risk (X) -> Intensification Strategy Z2.1	0.377	3,943	0.000
H8	Livelihood Risk (X) -> Welfare (Y)	0.357	2,590	0.010
H9	Human Capital Z1.1 -> Well-being (Y)	0.141	1,150	0.250
H10	Natural Capital Z1.2 -> Well-being (Y)	0.047	0.478	0.633
H11	Financial Capital Z1.3 -> Welfare (Y)	0.280	2,825	0.005
H12	Social Capital Z1.4 -> Well-being (Y)	0.029	0.270	0.787
H13	Physical Capital Z1.5 -> Well-being (Y)	0.092	0.851	0.395
H14	Diversification Strategy Z2.2 -> Prosperity (Y)	0.073	0.605	0.545
H15	Z2.1 Intensification Strategy -> Prosperity (Y)	-0.118	1,017	0.309

Source: Research data processed using SmartPLS 4.0.9.5 software in 2024

Table 18 presents the results of the hypothesis testing for the direct effects of livelihood risks, livelihood assets, and livelihood strategies on the well-being of shallot farmers. The findings indicate that livelihood risks significantly influence livelihood assets, strategies, and well-being, supporting the notion that higher risks can negatively impact farmers' well-being (Berman et al., 2012; Tacconi et al., 2023). This underscores the importance of effective risk management strategies in enhancing the livelihoods of farmers. Interestingly, only financial capital has a significant direct effect on well-being. This suggests that factors such as access to credit, debt levels, savings habits, and government assistance play a crucial role in the welfare of shallot farmers. High levels of debt and low savings can hinder farmers' ability to invest in their farms and improve their livelihoods (Barrett et al., 2013; Boltana et al., 2023). Therefore, interventions aimed at improving financial literacy and access to financial services are essential in enhancing farmers' well-being.

Conversely, human capital, natural capital, social capital, and physical capital do not significantly affect well-being directly. This implies that while these assets are essential for sustaining livelihoods, their mere possession does not guarantee improved well-being. The effectiveness of these assets in contributing to well-being may depend on various factors, such as the quality of assets, the context in which they are used, and the presence of complementary assets (Barrett et al., 2001; Moser, 1998). Further research is needed to explore these

complex relationships and identify factors that can enhance the impact of livelihood assets on the well-being of shallot farmers.

The results of hypothesis testing as per the second research objective show that livelihood risk has a significant effect on livelihood assets, livelihood strategies and welfare. Only financial capital has a significant effect on welfare. High access to loans, large amounts of debt, low savings habits and government assistance affect the welfare of shallot farmers in Pajeng Village. Meanwhile, shallot farmers' control of human capital, natural capital, social capital and physical capital does not have a significant effect on welfare. The strategies implemented by farmers do not have a significant effect on welfare. In detail, the dominant indicators in reflecting exogenous variables are as follows.

The most dominant indicator in reflecting the exogenous variable of livelihood risk (X) is irrigation at 0.828, the role of irrigation is very large in supporting the growth and development of shallots as conditions in the field mean that shallot plants require an adequate and constant water supply, and cannot tolerate inundation (Pujiati, 2018). The topography of the Pajeng Village area makes access to water quite difficult in several areas on hilly slopes even though rainfall is quite high. Pests and diseases are the next dominant indicator with a value of 0.784, generally shallots experience reduced production yields and crop failures caused by pest and disease attacks (Rosyidah, 2019). High price fluctuations often harm farmers, poor financial management due to the habit of not budgeting or recording money going in and out causes uncontrolled financial cycles within the household, and the lack of knowledge and experience in downstreaming is still a livelihood risk that continues to this day.

The most dominant indicator in reflecting the endogenous variable of welfare (Y) is income per capita. In the period January – June 2023, several respondents in the Pajeng Village area received high prices at harvest time. This fluctuation was considered positive because it was able to increase the per capita income range of shallot farmers. On the other hand, the indicator that reflects the lowest value among other indicators is net income. The high per capita income is gross income which does not reflect actual income, because in reality after deducting various expenses the net income level of shallot farmers is actually low. High debt ownership also influences the amount of net income earned by farmers. Farmers' debts to agricultural shops must be paid off when harvest time arrives, as well as debts to banks with a seasonal payment system.

The most dominant livelihood asset is the natural capital variable, land availability and water access in the rainy season (research period January-June 2023) to support shallot farming activities in Pajeng Village.

The overall farmer livelihood strategy has a fairly high factor loading value. As in the Scooness theory, farmers apply intensification and diversification strategies to increase income.

Table 19. Hypothesis Testing of the Indirect Influence of the Research Model

Hypothesis	Path Coefficient	Original Sample (O)	T Statistics (|O/STDEV|)	P Values
H16	Livelihood Risk (X) -> Human Capital Z1.1 -> Welfare (Y)	0.096	1,109	0.268
H17	Livelihood Risk (X) -> Natural Capital Z1.2 -> Welfare (Y)	0.019	0.457	0.648
H18	Livelihood Risk (X) -> Financial Capital Z1.3 -> Welfare (Y)	0.129	2,467	0.014
H19	Livelihood Risk (X) -> Social Capital Z1.4 -> Well-being (Y)	0.019	0.263	0.793
H20	Livelihood Risk (X) -> Physical Capital Z1.5 -> Welfare (Y)	0.051	0.814	0.416
H21	Livelihood Risk (X) -> Diversification Strategy Z2.2 -> Welfare (Y)	0.039	0.589	0.556
H22	Livelihood Risk (X) -> Intensification Strategy Z2.1 -> Welfare (Y)	-0.044	0.922	0.357

Source: Research data processed using SmartPLS 4.0.9.5 software in 2024

The results of hypothesis testing as per the third research objective show that livelihood assets (human capital, natural capital, physical capital and social capital) and livelihood strategies (intensification and diversification strategies) are not able to mediate livelihood risks on well-being, control of livelihood assets is not sufficient to create Shallot farmers have achieved a level of prosperity, while the implementation of the strategy has not been fully implemented optimally. Financial capital livelihood assets are able to mediate livelihood risks to welfare, inadequate irrigation limits planting frequency, pest and disease attacks and high prices of fertilizers and pesticides, minimal government participation in providing subsidy

assistance, increasing the amount of debt farmers owe to agricultural shops, price fluctuations that are not balanced with good financial management, as well as minimal levels of downstream savings, the low level of savings that they have forces farmers to access loans from both savings and loan institutions and banks. Easier access to loans actually makes farmers' welfare lower, net income becomes lower because the harvest is used to pay debts, as according to Novita (2021) that increasing debt will affect the size of the profit in the case of shallot farmers, net income which is an indicator of well-being.

Conclusion

The level of mastery of livelihood assets is in the medium category with an index value of 2.08. The highest asset control is physical capital at 2.34 and human capital at 2.22. The level of vulnerability of the livelihood assets of shallot farmers in Pajeng Village is in the medium category with an LVI vulnerability index value of 0.49. The highest vulnerability value for financial capital is 0.71, while the livelihood asset with the lowest vulnerability for physical capital is 0.37. Ease of accessing loans is a trigger for high levels of debt ownership. The risk of pests and diseases faced by farmers, as well as the high average price of pesticides, forces farmers to access debt from agricultural shops. Livelihood risks have a significant effect on livelihood assets, livelihood strategies and welfare. Asset control and implementation of strategies are able to overcome the risks that occur, and increasing risks have an impact on decreasing welfare. However, livelihood assets and livelihood strategies do not have a significant effect on welfare, which means that the indicators of livelihood assets and strategies implemented by farmers are only able to bring farmers to a level of sustainability and are not sufficient to achieve a level of prosperity. Farmers' intensification strategies are limited to a few methods and technologies so they are less than optimal in overcoming risks. The diversification strategy is carried out with on-farm, off-farm and non-farm businesses.

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Author Contributions
Conceptualization, I. P and S; methodology, S and F. D. R.; software, I. P.; validation, S and F. D. R; formal analysis, I. P.; investigation, I. P; resources, I. P; data curation, I. P and S; writing—original draft preparation, I. P; writing—review and editing, I. P.; visualization, I. P; supervision, S and F. D. R; project administration, I. P.; funding acquisition, I. P.

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The authors declare no conflict of interest.

References

Adger, W. N., Agrawala, S., Mirza, M. M. Q., Conde, C., O'Brien, K., Pulhin, J., & Takahashi, K. (2007). Assessment of adaptation practices, options, constraints and capacity. In *Climate change 2007: impacts, adaptation and vulnerability. Contribution of Working Group II to the fourth assessment report of the Intergovernmental Panel on Climate Change* (pp. 717–743). Cambridge University Press.

Alkire, S. (2002). Dimensions of human development. *World Development*, *30*(2), 181–205. https://doi.org/10.1016/S0305-750X(01)00109-7

Amam, Fanani, Z., Hartono, B., & Nugroho, B. A. (2019). The Power of Resources in Independent Livestock Farming Business in Malang District, Indonesia. *IOP Conference Series: Earth and Environmental Science*, *372*(1), 012055. https://doi.org/10.1088/1755-1315/372/1/012055

Anwar, M. (2022). Green Economy Sebagai Strategi Dalam Menangani Masalah Ekonomi Dan Multilateral. *Jurnal Pajak Dan Keuangan Negara (PKN)*, *4*(1S), 343–356. https://doi.org/10.31092/jpkn.v4i1S.1905

Ashley, C., & Carney, D. (1999). *Sustainable livelihoods: Lessons from early experience*. Department for International Development.

Bajwa, A. A., Sadia, S., Ali, H. H., Jabran, K., Peerzada, A. M., & Chauhan, B. S. (2016). Biology and management of two important Conyza weeds: a global review. *Environmental Science and Pollution Research*, *23*(24), 24694–24710. https://doi.org/10.1007/s11356-016-7794-7

Barrett, C. B., & Carter, M. R. (2013). The Economics of Poverty Traps and Persistent Poverty: Empirical and Policy Implications. *Journal of Development Studies*, *49*(7), 976–990. https://doi.org/10.1080/00220388.2013.785527

Barrett, C. B., Reardon, T., & Webb, P. (2001). Nonfarm income diversification and household livelihood strategies in rural Africa: Concepts, dynamics, and policy implications. *Food Policy*, *26*(4), 315–331. https://doi.org/10.1016/S0306-9192(01)00014-8

Barroso, C., Cepeda Carrión, G., & Roldán, J. L. (2010). Applying maximum likelihood and PLS on different sample sizes: Studies on Servqual model and employee behavior model. In *Handbook of Partial Least Squares* (pp. 427–447). Springer.

Béné, C. (2009). Small-scale fisheries: assessing their vulnerability and promoting their resilience. In *Handbook of marine fisheries conservation and management* (pp. 629–652). Oxford University Press.

Berman, R., Quinn, C., & Paavola, J. (2012). The role of institutions in the transformation of coping capacity to sustainable adaptive capacity. *Environmental Development*, *2*(1), 86–100. https://doi.org/10.1016/j.envdev.2012.03.017

Boltana, A., Tafesse, A., Belay, A., Recha, J. W., & M.Osano, P. (2023). Impact of credit on household food security: The case of Omo microfinance institution in southern Ethiopia. *Journal of Agriculture and Food Research*, *14*, 100903. https://doi.org/10.1016/j.jafr.2023.100903

Bryan, E., Deressa, T. T., Gbetibouo, G. A., & Ringler, C. (2009). Adaptation to climate change in Ethiopia and South Africa: options and constraints. *Environmental Science & Policy*, *12*(4), 413–426. https://doi.org/10.1016/j.envsci.2008.11.002

Chambers, R., & Conway, G. (1992). *Sustainable rural livelihoods: Practical concepts for the 21st century*. Institute of Development Studies.

Cutter, S. L., Burton, C. G., & Emrich, C. T. (2010). Disaster Resilience Indicators for Benchmarking Baseline Conditions. *Journal of Homeland Security and Emergency Management*, *7*(1), 1–22. https://doi.org/10.2202/1547-7355.1732

Davoudi, S., Shaw, K., Haider, L. J., Quinlan, A. E., Peterson, G. D., Wilkinson, C., & Davoudi, N. (2013). Resilience: a bridging concept or a dead end? In *Resilience and the city* (pp. 299–333). Routledge.

Deressa, T., Hassan, R. M., & Ringler, C. (2008). Measuring Ethiopian farmers' vulnerability to climate change across regional states. In *IFPRI Discussion Paper* (Vol. 806, p. 32). Retrieved from https://shorturl.at/4mCem

Ellis, F. (2000). *Rural livelihoods and diversity in developing countries*. Oxford University Press.

Ellis, F., & Allison, E. (2004). Livelihood diversification and natural resource access. In *LSP Working Paper 14*. Overseas Development Institute.

Flora, C. B., & Flora, J. L. (2013). *Rural communities: Legacy and change*. Westview Press.

Gong, Y., Zhang, R., Yao, K., Liu, B., & Wang, F. (2020). A Livelihood Resilience Measurement Framework for Dam-Induced Displacement and Resettlement. *Water*, *12*(11), 3191. https://doi.org/10.3390/w12113191

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). Partial Least Squares Structural Equation Modeling (Pls-Sem). In *Angewandte Chemie International Edition* (Third Edit, Vol. 6, Issue 11, pp. 951–952). SAGE Publications, Inc.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, *19*(2), 139–152. https://doi.org/10.2753/MTP1069-6679190202

Jogiyanto, H. M., & Abdillah, W. (2016). *Konsep dan aplikasi PLS (Partial Least Square) untuk penelitian empiris*. Yogyakarta: BPFE.

Kamaruddin, R., & Baharuddin, A. H. (2015). The importance of good aquaculture practices in improving fish farmer's income A case of Malaysia. *International Journal of Social Economics*, *42*(12), 1090–1105. https://doi.org/10.1108/IJSE-02-2014-0028

Kuang, F., Jin, J., He, R., Ning, J., & Wan, X. (2020). Farmers' livelihood risks, livelihood assets and adaptation strategies in Rugao City, China. *Journal of Environmental Management*, *264*. https://doi.org/10.1016/j.jenvman.2020.110463

Le, Q. B., Nuberg, I., & Bruwer, J. (2019). The influence of livelihood assets on the adoption of adaptation measures to climate change by smallholder farmers in Vietnam. *Climate Risk Management*, *24*, 100183. https://doi.org/10.1108/JADEE-09-2019-0139

Liu, M., Yang, L., Bai, Y., & Min, Q. (2018). The impacts of farmers' livelihood endowments on their participation in eco-compensation policies: Globally important agricultural heritage systems case studies from China. *Land Use Policy*, *77*, 231–239. https://doi.org/10.1016/j.landusepol.2018.05.054

Mandang, M., Sondakh, M. F. L., & Laoh, O. E. H. (2020). Karakteristik Petani Berlahan Sempit di Desa Tolok Kecamatan Tompaso. *Agri-Sosioekonomi*, *16*(1), 105. https://doi.org/10.35791/agrsosek.16.1.2020.27131

Manggala, M. T. W. S., Maulana, R., Saputra, D. T., Rachmawati, I., Sumantry, D., & Trisnaningsih, M. (2021). The Role of Social Media in Promotion of Micro, Small and Medium Enterprises (MSMEs) and Its Implications Law Number 11 of 2008 Concerning Information and Electronic Transactions (UUITE). *International Journal of Latin Notary*, *2*(1), 31–39. https://doi.org/10.61968/journal.v2i1.16

Morse, S., McNamara, N., & Acholo, M. (2009). *Sustainable livelihoods in northern Kenya: The role of livestock in key resource-limited districts*. Research Brief USAID.

Moser, C. O. N. (1998). The asset vulnerability framework: Reassessing urban poverty reduction strategies. *World Development*, *26*(1), 1–19. https://doi.org/10.1016/S0305-750X(97)10015-8

Naharuddin, N. (2018). Sistem Pertanian Konservasi Pola Agroforestri dan Hubungannya dengan Tingkat Erosi di Wilayah Sub-DAS Wuno, Das Palu, Sulawesi Tengah. *Jurnal Wilayah Dan Lingkungan*, *6*(3), 183. https://doi.org/10.14710/jwl.6.3.183-192

Nhemachena, C., Hassan, R., & Kurukulasuriya, P. (2014). Measuring livelihood vulnerability to climate variability and change using a sustainable livelihoods framework. In *Climate vulnerability* (pp. 291–319). Routledge.

Parmawati, R., Kurnianto, A. S., Kontrayana, A., Cholis, A. F., Hidayat, H., & Aluf, W. Al. (2018). Analysis Of Ecotourism Development Of Sembilangan Beach: Characters, Factors, And Challenges. *International Journal of Applied Sciences in Tourism and Events*, *2*(1), 59. https://doi.org/10.31940/ijaste.v2i1.903

Paulangan, Y. P., Amin, M. A. Al, Barapadang, B., Wahyudin, Y., & Taryono. (2020). Analisis Kerentanan Mata Pencaharian Masyarakat Pesisir Teluk Depapre, Jayapura, Papua. *ACROPORA: Jurnal Ilmu Kelautan Dan Perikanan Papua*, *3*(2), 36–42. https://doi.org/10.31957/acr.v3i2.1516

Pranata, A., & Umam, A. T. (2015). Pengaruh Harga Bawang Merah Terhadap Produksi Bawang Merah Di Jawa Tengah. *JEJAK*, *8*(1), 36–44. https://doi.org/10.15294/jejak.v8i1.3852

Pretty, J., & Ward, H. (2001). Social capital and the environment. *World Development*, *29*(2), 209–227. https://doi.org/10.1016/S0305-750X(00)00098-X

Puspitasari, I., Sujarwo, & Riana, F. D. (2024). Sustainable Livelihood Strategy for Red Onion (Allium Ascalonicum L.) Farmers in Pajeng Village, Gondang District Bojonegoro Regency. *Jurnal Penelitian Pendidikan IPA*, *10*(12), xxxx–xxxx. https://doi.org/10.29303/jppipa.v10i12.7584

Raung, S. A. (2024). Exploring the Livelihood Assets Utilisation and the Business Sustainability Among Garment Businesses at Tingkir Lor District, Salatiga. *KRITIS*, *33*(1), 1–16. https://doi.org/10.24246/kritis.v33i1p1-16

Richter, N. F., Cepeda, G., Roldán, J. L., & Ringle, C. M. (2016). European management research using partial least squares structural equation modeling (PLS-SEM). *European Management Journal*, *34*(6), 589–597. https://doi.org/10.1016/j.emj.2016.08.001

Ruhila, A., Srivastava, A., Yadav, P., & Galib, R. (2021). Preliminary GC-MS profiling of Bhallataka Oil. *Asian J.Research Chem*, *14*(2). https://doi.org/10.5958/0974-4150.2021.00019.5

Saragih, S., Lassa, J., & Ramli, A. (2007). *Sustainable Livelihoods Framework*. Retrieved from https://www.zef.de/uploads/tx_zefportal/Publications/2390_SL-Chapter1.pdf

Schiller, A., & Pulsipher, A. (2012). The vulnerability of global cities to climate hazards. *Adapting Cities to Climate Change: Understanding and Addressing the Development Challenges*, *19*(1), 129–157. https://doi.org/10.4324/9781849770361

Scoones, I. (19978). *Sustainable rural livelihoods: A framework for analysis. IDS Working Paper 72*. Institute of Development Studies.

Shen, J., Duan, W., Wang, Y., & Zhang, Y. (2022). Household Livelihood Vulnerability to Climate Change in West China. *International Journal of Environmental Research and Public Health*, *19*(1), 551. https://doi.org/10.3390/ijerph19010551

Shinta, A. (2011). *Manajemen pemasaran*. Universitas Brawijaya Press.

Steenbergen, D. J., Marlessy, C., & Holle, E. (2017). Effects of rapid livelihood transitions: Examining local co-developed change following a seaweed farming boom. *Marine Policy*, *82*, 216–223. https://doi.org/10.1016/j.marpol.2017.03.026

Sudjatmoko, A., Ichsan, M., Astriani, M., Mariani, & Clairine, A. (2023). The Impact of COVID-19 Pandemic on the Performance of Indonesian MSME with Innovation as Mediation. *Cogent Business & Management*, *10*(1), 187–197. https://doi.org/10.1080/23311975.2023.2179962

Sugiyono. (2019). *Metode Penelitian Kuantitatif*. Bandung: Alfabeta.

Sulemana, A., Donkor, E. A., Forkuo, E. K., & Oduro-Kwarteng, S. (2018). Optimal Routing of Solid Waste Collection Trucks: A Review of Methods. *Journal of Engineering*, *2018*, 1–12. https://doi.org/10.1155/2018/4586376

Suryanto, S., & Rahman, A. (2019). Application of livelihood vulnerability index to assess risks for farmers in the Sukoharjo regency and Klaten regency, Indonesia. *Jamba: Journal of Disaster Risk Studies*, *11*(1). https://doi.org/10.4102/jamba.v11i1.739

Tacconi, F., Waha, K., Ojeda, J. J., Leith, P., Mohammed, C., Venables, W. N., Rana, J. C., Bhardwaj, R., Yadav, R., Ahlawat, S. P., Hammond, J., & van Wijk, M. (2023). Farm diversification strategies, dietary diversity and farm size: Results from a cross-country sample in South and Southeast Asia. *Global Food Security*, *38*(6), 100706. https://doi.org/10.1016/j.gfs.2023.100706

Toufique, K. A., & Islam, A. (2014). Assessing risks from climate variability and change for disaster-prone zones in Bangladesh. *International Journal of Disaster Risk Reduction*, *10*, 236–249. https://doi.org/10.1016/j.ijdrr.2014.08.008

Willison, Z. D., de la Cruz, L. B., & Luneta, M. D. (2022). Community-based disaster risk reduction and

climate change adaptation. In *Handbook on Climate Change and Disasters* (pp. 330–352). https://doi.org/10.4337/9781800371613.00036

World Bank. (2023). *World Development Report 2023: Migrants, Refugees, and Societies*. World Bank.

Zou, H., Li, S., Zou, H., Sun, W., Niu, Y., & Yu, C. (2022). Livelihood Sustainability of Herder Households in North Tibet, China. *Sustainability*, *14*(9), 5166. https://doi.org/10.3390/su14095166