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Livelihood assets analysis of vanilla farmers in Jembrana district, Bali, Indonesia

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Abstract

Vanilla (*Vanilla planifolia*) cultivation plays a significant role in supporting the local economy and livelihoods in Bali, Indonesia. Despite its high market value, farmers face economic vulnerability due to the long cultivation period and maintenance challenges. This study aims to evaluate the livelihood assets of vanilla farmers in Jembrana district and their implications for the sustainability of vanilla farming. Data were collected through a survey with structured interviews of 93 vanilla farmers in Jembrana district, from July to September 2024. Quantitative data were collected and analysed using descriptive statistical methods. The study findings revealed that while physical assets were moderately high in value, human and natural assets were low, and financial and social assets were moderate. The study underlines the need for targeted government support, particularly in the form of training programmes to improve agricultural skills, the provision of low-interest finance or subsidies for input costs, and the establishment of cooperative networks to improve market access. Such interventions are critical to address the human and natural capital gaps and to ensure the long-term sustainability of vanilla farming in the region.

Keywords: farmer resilience, sustainable agriculture, *Vanilla planifolia*

1 Introduction

The concept of sustainable livelihood was first introduced in the early 1990s with the main objective of overcoming poverty through community empowerment and holistic and participatory utilisation of existing resources. This approach emphasises the importance of understanding how rural communities survive by utilising their assets, such as human, social, and natural resources. Sustainable livelihood is not just about survival, but also how to increase resilience and long-term well-being through wise use of resources, especially in the face of major challenges such as climate change and economic uncertainty (DFID, 1999; Bhuiyan *et al*., 2012). This approach also recognises the importance of structural and relational factors in determining the success of livelihoods, which depend not only on individuals but also on social interactions and access to various resources that can strengthen or reduce community resilience following the progress of livelihood research in the 21st century (Natarajan *et al*., 2022). Based on previous research, the sustainable livelihoods approach in the agricultural sector focuses on the management of various assets owned by farmers to achieve long-term prosperity (Hellin & Fisher, 2019). It also emphasises the need for farmers in the agricultural sector, especially those facing price volatility and climate change, to manage natural resources such as land and water, technical knowledge on efficient farming practices, and social networks to obtain information and support (Xu *et al*., 2015), as well as livelihood diversification as a strategy to reduce dependence on a single source of income (Ahmadzai *et al*., 2021).

In the context of vanilla farming in Bali, the application of the sustainable livelihood approach is very relevant. Vanilla (*Vanilla planifolia*) as one of the high-value commodities, provides great opportunities for farmers to improve their welfare. However, to achieve optimal results, vanilla farmers in Bali must wisely manage their various livelihood assets, including technical knowledge, social networks, and natural resources around them. Vanilla farming in Bali relies not only on technical skills, but also on external factors such as climate change, market price fluctuations, and power dy-

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namics in access to resources (Ariyanto, 2023; Wang *et al*., 2023). The increasingly apparent impacts of climate change, such as changing weather patterns and increasing frequency of natural disasters, make vanilla farming a highly vulnerable sector. In this case, livelihood diversification strategies carried out by farmers, such as managing various types of crops or seeking additional sources of income, are important to maintain and increase the resilience of their businesses (Illu *et al*., 2021). In addition, the highly fluctuating price of vanilla is a major challenge for farmers in Bali. The vanilla market, which is largely traded as a commodity, experiences price spikes when demand increases, but also significant price drops when there is excess supply (Tothova, 2011; Wahyudi *et al*., 2023). This makes vanilla farmers vulnerable to income uncertainty, which in turn affects their production strategies. Nevertheless, Indonesia, as one of the largest vanilla producers in the world, has great potential to further develop this sector. Global demand for natural vanilla, especially from the premium food and beverage industry, continues to increase, opening up huge export opportunities. However, despite the high selling value of vanilla, many vanilla farmers in Bali still face major obstacles, such as limited access to markets, lack of technical knowledge, and price volatility that affect the sustainability of their businesses (Gallage & Møller, 2017; Frenkel & Belanger, 2018).

Bali was chosen as the research location because it is one of the main vanilla producing areas in Indonesia, although it still faces various challenges in increasing farmer productivity and resilience. In addition, Bali as one of the richest provinces in Indonesia with the promotion of the tourism sector has different socio-economic characteristics from other regions, when it comes to its agricultural sector, interestingly there are research results that show several major challenges for Balinese agriculture, such as reduced agricultural land, the imbalance between supply and demand for food commodities, limited mastery of technology, weak agricultural management and product marketing, and high rates of crop losses and food waste (Widhianthini *et al*., 2024). Based on data from the Bali Provincial Agriculture and Food Security Service, vanilla agricultural production has continued to decline over the past 10 years (BPS, 2024). This is reinforced by initial observations of farmers who explained that vanilla farming in Bali showed a sluggish trend in practice because the price of vanilla has continued to fall at the farmer level, raising questions about the resilience of their livelihoods at this time. Hence the importance of Bali as a suitable research location to reveal the resilience in their livelihoods.

This research on the livelihoods of vanilla farmers in Bali is useful for understanding the economic and social challenges they face. This research will help understand how external factors such as agricultural policies, global market dynamics, and environmental changes interact and influence the success of vanilla farming. Through a better understanding of the livelihood conditions of vanilla farmers, it is hoped that more appropriate and effective solutions can be formulated to improve their welfare, such as increasing market access, technical support, and policies that support vanilla price stability. Several previous studies have also shown that dependence on traditional methods or the inability to adapt to changes in farming systems can make farmers more vulnerable to price volatility, and other studies have revealed the importance of a comprehensive approach in increasing farmer resilience, including income diversification, access to social safety nets (Watteyn *et al*., 2022) and sustainable natural resource management (Rakoto Harison *et al*., 2024). Thus, this research is expected to make an important contribution to designing more sustainable agricultural policies and increasing farmer productivity and income, ultimately helping to reduce hunger and improve food security in Bali.

2 Materials and methods

The study was conducted in the Jembrana district of Bali, Indonesia, from July to September 2024. The research location is shown in Fig. 1.

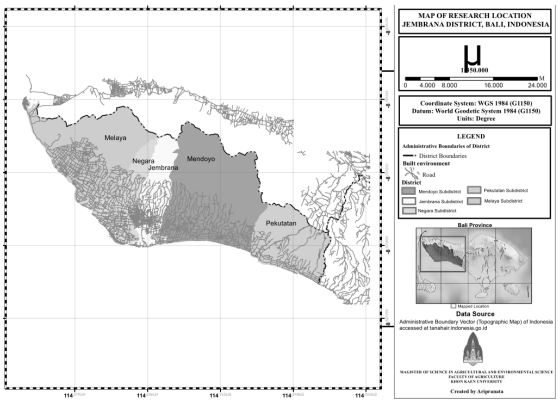

Fig. 1: *Map of research location in Jembrana District, Bali, Indonesia*

Jembrana was chosen as the research site because it is home to the largest concentration of vanilla farmers in Bali. Data collection was done through interview survey using a questionnaire as the research tool to collect information as shown in Table 1. According to the data, there were 1322 farmers in Jembrana district (Pemerintah Provinsi Bali, 2022). Simple random sampling was the technique used, and the Taro Yamane formula was used to obtain the sample size of 93 (Yamane, 1973). In this research, the authors used an

Table 1: *Assets and livelihood indicators investigated in the questionnaire.*

Livelihood assets	*Indicators*
Human capital	• Confidence and expertise in farm production • Access to health facilities • Use of new farming technologies • Farming experience • Access to agricultural news and information • Availability of training and visit programs • Benefits from training knowledge • Application of vanilla farming knowledge • Use of non-family labor
Natural capital	• Perceived soil fertility • Adequacy of water resources • Suitability of local climate • Biodiversity in farming community • Implementation of erosion control
Financial capital	• Savings from farming activities • Access to local financial services • Sufficiency of liquid assets • Availability of ready cash • Farm income's contribution to finances • Access to input credit
Physical capital	• Electricity availability • Household water sufficiency • Road access to farm • Reliability of phone signal • Internet access in the area • Availability of fertilisers for vanilla • Access to agricultural equipment
Social capital	• Participation in farmer groups • Peer support for sharing knowledge and resources • Participation in cultural farming activities • Social ties with other farmers • Contribution to community knowledge

error tolerance of 10 %, based on a list with all vanilla farmers in Jembrana district, 93 farmers were randomly selected.

A quantitative methodology was used for analysis. Descriptive statistics were used to explain the study variables and respondent characteristics. Frequency distribution and summary statistics, including mean, and standard deviation were employed. The respondent characteristics studied included gender, age, and education, as well as farmers' assessment of information on livelihood assets according to the indicators shown in Table 1. For each indicator the respondents were asked to rate their level of agreement or disagreement with a statement on a scale of one to five (one being the lowest, see Table 2). This method of scoring is used overall to measure the average of the respondents' responses to each question and to estimate the average for each livelihood asset (Best, 1977).The data collected were tabulated in Microsoft Excel and then further processed in Microsoft Excel and using SPSS application version 28.0.1.0, 2021.

Table 2: *Rating scale for livelihood assets.*

Average score	*Meaning*
4.50-5.00	Highest
3.50-4.49	High
2.50-3.49	Moderate
1.50-2.49	Low
1.00-1.49	Lowest

In the case of financial capital, responses depend on respondents' openness to share financial details, which may be influenced by social desirability bias or concerns about confidentiality. Similarly, for social capital, responses are often

subjective, reflecting individuals' perceptions of their social networks and relationships. However, when surveys or structured data collection methods are well conducted, with clear questions and assurances of confidentiality, the data can be considered quite reliable. To further strengthen reliability, triangulation of responses with other sources, such as official records or interviews, can provide more complete insights.

In this study, livelihood assets are linked to the framework presented in Fig. 2, following Natarajan (2022) with own adjustments. The livelihood asset values were depicted in a spider diagram in the form of a pentagon. The placement of each asset value within the pentagon provides a visual representation of ownership of goods used for a living, both owned and accessed in vanilla farming. The pentagon shape serves to illustrate the variation in individual access to assets (DFID, 1999). Maximum access to the asset is represented by the outer perimeter of the pentagon, while zero access is indicated by the intersection of the lines at the pentagon's centre. This diagrammatic model facilitates communication of information regarding asset distribution and access among vanilla farmers.

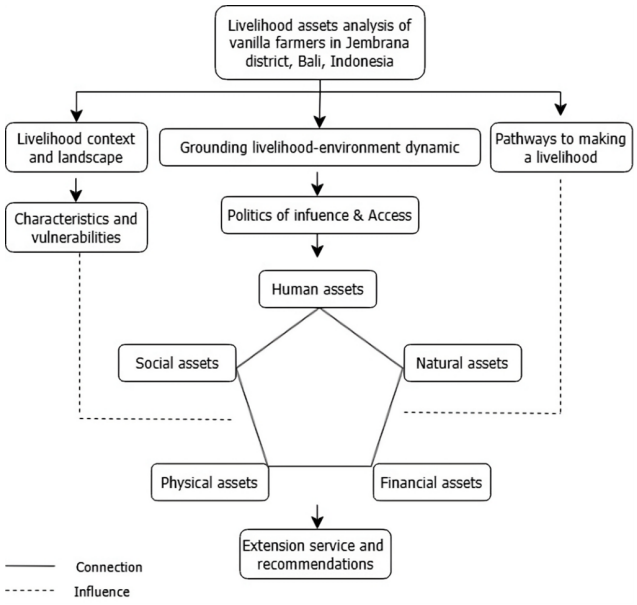

Fig. 2: *Livelihood framework used in the study (after Natarajan* et al.*, 2022).*

3 Results

3.1 Characteristics of respondents

Table 3 shows that more men are involved in vanilla production than women. We identified that 66.7 % of respondents were engaged in part-time farming practices, indicating that many farmers were seeking additional sources of income apart from their farming activities. As many as 33.3 % of farmers stated that their main crop was vanilla, this seems small but it shows that vanilla is not their only source of income. This figure does not assume that other sources of income are more important because it is proven that the remaining 66.7 % still make vanilla a commodity of choice that cannot be released, while other commodities are commodities of choice that are always changing. Many farmers combine vanilla with other activities to increase their income, such as livestock or handicrafts, which better reflects a strategy of diversifying sources of income. In addition, the analysis of the scale of vanilla farming shows that 69.9 % of farmers manage small land (≤ 0.50 ha), reflecting limitations in production capacity and access to larger resources. This indicates the need for land reform to support the efficiency and sustainability of vanilla production, as

Table 3: *Socio-economic characteristics of the respondents.*

Variable	*Percentage (%)*
Sex	
Male	97.9
Female	2.2
Age of HH (year)	
17–25	0.0
26–45	18.3
46–65	81.7
Education	
No schooling	0.0
Primary school	23.7
Junior high school	20.4
Senior high school	52.7
University/College	3.2
Other occupation*	
Civil service	17.2
Artisan	16.1
Craftsman	16.1
Entrepreneur/Business	35.5
Livestock	18.3
Other farming	80.7
Crops cultivated†	
Vanilla	60.8
Nutmeg	1.4
Banana	2.9
Clove	0.8
Cacao	10.8
Coconut	23.3

*Other occupations apart from vanilla farming, N=62, people can have more than one occupation; †N=93, people can have more than one cultivated crop.

well as ensuring better access to land and agricultural technology. Meanwhile, 18.3 % of respondents manage medium-scale land (0.51-1 ha), indicating an effort to expand agricultural business without losing control over production management, and only 11.8 % manage large-scale land (> 1 ha), indicating challenges in increasing production capacity, including limited market access and risk management. These results underline the conditions in which most vanilla farmers operate on a small scale, which can be an important indicator for the development of better market support and services for small-scale farmers. In addition to vanilla, out of the 93 farmers, 62 do have off-farm activities (67 %) such as side businesses in agriculture, handicrafts, and animal husbandry. Most respondents (81.7 %) are in the elderly age group (mean age was 53 years), which can lead to a further decline in productivity, while around 50 % of respondents only have a high school education, meaning half of the population does not have an educational background that can support better agricultural development. In addition, of the total land area, vanilla is the largest type of plant cultivated, reaching 60.8 %, followed by coconut and other cultivated plant variants.

3.2 Livelihood assets of vanilla farmers

The livelihood assets of the respondents are shown in table 4. Human and natural assets had low values, while physical, financial, and social assets showed moderate values. The data in Table 4 show that overall human assets are very low, while natural assets are mainly reflected in soil fertility, which is moderate, while other aspects remain low. Among financial assets, ownership of liquid assets was high, whileaccess to credit was the lowest. Physical assets included most of the sub-assets with high values, with electricity access being the only sub-asset rated very high. Social assets had a moderate value; participation in cultural and traditional activities was low, but participation in social groups was high. This suggests that vanilla farmers maintain strong associations that facilitate the exchange of ideas in their farming practices.

3.3 The pentagon of vanilla farmers' livelihoods

The livelihood assets depicted in Fig. 3 show that of all assets, the lowest value is found for the human assets (1.5). This indicates that the quality or availability of human resources in a community or individual is limited. This can include skills, education, experience, or even access to adequate health services. The impact of low human assets can greatly affect the ability of individuals or groups to improve their well-being in a sustainable way. The highest assets are physical assets, meaning that they have good access to or many physical resources that support their economic activities or livelihoods. These physical assets can include things like land, equipment, buildings, infrastructure and technology. The existence of high levels of physical assets can bring many benefits, but also poses a number of challenges that need to be properly managed.

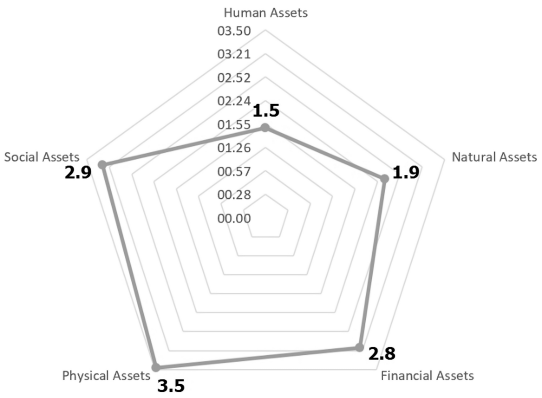

Fig. 3: *The pentagon of the vanilla farmers' livelihood.*

4 Discussion

Farmers' adaptation of agricultural practices is significantly influenced by social factors, including culture, beliefs, and values, which can affect technology adoption. An overemphasis on technical skills may hinder effective adaptation (Tangonyire & Akuriba, 2020). Policymakers must consider livelihood assets – human, social, natural, physical, and financial capital – along with farmer characteristics and socio-economic factors when developing agricultural policies (Ngaiwi *et al*., 2023). These assets play a critical role in farmers' adaptation and resilience. Responses to agricultural policies depend on location, resources, and demographic factors such as age and economic status. The unique characteristics of each farmer influence the effectiveness of policies, so micro-level analysis is needed (Louhichi *et al*., 2020). Evaluating socio-economic conditions and livelihood assets is essential for assessing agricultural sustainability (Onuwa *et al*., 2022).This study aimed to provide insights into how these factors interact to enhance the adoption of sustainable agricultural practices and improve farmers' livelihoods.

The relationship between livelihood assets in vanilla farming and the 21st century livelihood research framework (Natarajan *et al*., 2022) in this case, vanilla farmers' human assets are low, indicating limitations in terms of skills, education, and access to health services. This impacts their ability to manage and optimize other assets, such as physical

Table 4: *The livelihood assets of vanilla farmers.*

Livelihood assets	*Mean*	*Std. Deviation*	*Remark*
Human assets			
Skill and experience in production	1.55	0.80	Low
Ease of access to health for farmers	1.61	0.89	Low
Applying new technology to farm	1.40	0.64	Lowest
Experience in farm	1.68	0.89	Low
News and information accessible	1.61	0.83	Low
Visit and training program accessible	1.43	0.73	Lowest
Knowledge from visit and training program	1.42	0.73	Lowest
Application of knowledge about vanilla farming practices	1.40	0.71	Lowest
Labour resources outside family	1.34	0.60	Lowest
Pooled mean & std. deviation	1.50	0.76	Low
Natural assets			
Soil fertility	3.27	1.51	Moderate
Water resources for agriculture	1.57	0.91	Low
Climate (suitable)	1.67	0.68	Low
Biodiversity in community	1.67	0.74	Low
Erosion protection	1.54	0.67	Low
Pooled mean & std. deviation	1.94	0.90	Low
Financial assets			
Saving	2.92	1.67	Moderate
Local financial	2.70	0.87	Moderate
Liquid assets	3.67	1.40	High
Cash at hand	3.32	1.21	Moderate
Farm Income	2.66	0.71	Moderate
Agriculture inputs credit	1.34	0.68	Low
Pooled mean & std. deviation	2.77	1.09	Moderate
Physical assets			
Main electricity	4.57	0.79	Highest
Water consumption in the household	3.80	1.44	High
Road to farm	3.84	1.06	High
Telephone signal	3.86	0.99	High
Internet accessible	3.81	0.99	High
Accessibility to obtain fertilizer for fertilizing vanilla plants	2.15	1.17	Low
Accessibility to obtain agricultural equipment for vanilla farming	2.37	1.01	Low
Pooled mean & std. deviation	3.48	1.07	Moderate
Social assets			
Joining a farmer's social group	4.12	1.26	High
Collaborate to share technology, knowledge, and subsidy information for agricultural resources.	2.61	0.82	Moderate
Participating in cultural and traditional activities	2.02	1.23	Low
Social relations with other farmers	2.97	0.77	Moderate
The development of knowledge and sharing of that knowledge	2.78	0.79	Moderate
Pooled mean & std. deviation	2.90	0.97	Moderate

assets, which are relatively high. Physical resources such as land, equipment, and infrastructure provide many benefits, but if not managed with the right skills, their benefits will be limited. This is in accordance with the concept of livelihood context and landscape in the framework Figure 2 which links its characteristics and vulnerabilities to the availability of human and physical resources. In addition, social assets (access to social networks and community support) are at a moderate level, indicating that although there is potential for social support, this is not yet strong enough to fully assist farmers in facing challenges. Low natural assets, such as limited soil quality and air resources, pose a serious threat to

agricultural extinction, given the very large influence of climate and environmental contexts on agricultural output. On the other hand, financial assets which are also at a moderate level indicate that although there is access to finance, it is not enough to support long-term investment or management of other assets. This relates to the politics of influence & access in the framework figure 2, which highlights how relational power and access to financial resources can influence farmers' ability to survive and thrive. The sustainability of vanilla farmers' livelihoods is highly dependent on improving the quality of their human, social and natural assets, so that they can use their existing physical and financial assets more effectively.

4.1 Livelihood assets

Livelihood diversification allows rural families to develop various interests and social networks to improve their standard of living (Ellis, 1998). In this study, the diversification of vanilla production with other jobs is one way to survive. Previous research has shown that livelihood diversification can improve rural economies by aligning political, social, economic, and environmental goals (Miani *et al*., 2023). Furthermore, diversification is also important for adapting to climate change (Biswas & Mallick, 2021), although success often depends on wealthier landowners with sufficient assets (Alobo Loison, 2015). In addition to earning income, they also perform household chores and participate in social and cultural activities (Carloni, 2005). Some farming families in Bali are also involved in the tourism sector, either through employment in tourism services or through the use of land for homestays or nature tourism. Some families receive remittances from relatives abroad, which is a major source of income and helps them survive and reinvest in farming. This is consistent with Liu (2023), who explain that human assets enable individuals or families to adopt various livelihood strategies. One of the strategies is like that carried out by the vanilla farming household above in getting income from the tourism sector or receiving remittances and managing them. However, all assets remain low, threatening the sustainability of vanilla farming. Low natural assets can also affect future success. Although social conditions support physical assets, their value is often medium to low. If this continues, vanilla farming may struggle and shift to other crops, however, vanilla still has high economic value (Baharuddin *et al*., 2023; Dewi & Marhaeni, 2018; Soarizafy *et al*., 2024).

4.1.1 Human assets

Human assets in vanilla farming are essential to increase agricultural productivity and sustainability. Specifically, our findings highlight that the skills and experience of farmers, as well as access to health services, are key factors that limit their productivity. This is consistent with Milost (2014), who emphasizes the importance of investing in human resources to boost agricultural productivity.

The limited application of new technologies such as precision farming tools or greenhouse use in vanilla agriculture and the lack of access to training programs further exacerbate these issues. This aligns with previous research by Liu *et al*. (2023), which found that skills and health are central to the choice of livelihood and directly influence productivity. Additionally, our study shows that the low availability of labour, particularly outside of family resources, hinders farmers' ability to expand their businesses, leading to reduced yields and efficiency. This finding supports the work of Abdul-Rahaman & Abdulai (2018), who highlighted that reliance on external labour limits growth opportunities for farmers. Furthermore, the importance of extension services in improving human assets is evident, as highlighted by Dhehibi *et al*. (2022), who emphasized that improving access to extension services, technology, and training is essential for supporting agricultural sustainability.

4.1.2 Natural assets

Natural assets are very important in supporting the livelihoods of vanilla farmers. The relatively low value of natural assets indicates limited access to essential resources, such as water for agriculture and erosion protection, despite good soil fertility. This aligns with Senganimalunje *et al*. (2022), who highlighted that natural resources are vital for livelihoods and risk mitigation. Extreme weather events may worsen erosion, reducing the value of these resources, while water scarcity, as noted by Chiarelli *et al*. (2020), hampers economic activities and triggers conflicts. The impact of global climate change is expected to worsen these challenges (Habib-ur-Rahman *et al*., 2022). Although soil fertility remains relatively good, better land management practices could improve productivity. Since many farmers manage limited land, land reform—such as redistribution or access to larger plots—is essential to increase yields and competitiveness. Such reforms will help farmers overcome the challenges posed by climate change, ensuring more sustainable vanilla farming.

4.1.3 Financial assets

The lack of development and innovation in vanilla farming in Bali is partly due to the lack of information and knowledge about available loan options. This is important because the available capital can make it easier for farmers to fund everything they want to do. Access to credit is essential for making informed decisions, ensuring stable incomes, and

supporting the long-term sustainability of farming activities (Javed *et al*., 2023). Other studies have shown that in less developed countries, obtaining agricultural loans remains a significant challenge, and lack of funding limits farmers' ability to access modern technologies needed for growth (Assouto & Houngbeme, 2023). However, vanilla farmers have relatively high liquid assets, which is very important for those who are risk-averse. This is in line with previous studies that have shown that owning liquid assets can reduce financial risk (Nartea & Webster, 2008). These liquid assets are important for meeting household and food needs, and the combination of savings and income from vanilla farming helps farmers maintain their livelihoods. This is in line with Karlan *et al*. (2014), which discusses how financial conditions reflect individual money and resource management. When discussing finances, planting other varieties in one plot of land will provide additional input of income, including in vanilla farming. Such as the use of an intercropping system, namely planting other crops alongside vanilla. The intercropping method plays an important role in agricultural development and farmers' income as revealed by previous studies, especially when agricultural land is limited (Akhsan *et al*., 2022; Paudel, 2016). Importance of expanding knowledge about credit options and encouraging income diversification to improve of vanilla farming.

4.1.4 Physical assets

Vanilla farmers have relatively good access to electricity, clean water for households, roads to their fields, telephone signals, and internet. These facilities are essential in improving the quality of life and supporting agricultural activities. For example, in previous studies, access to safe drinking water is essential for human health and ecosystems (Ayanlade, 2023; Sheel *et al*., 2024), while reliable internet connectivity plays an increasingly important role in ensuring social and economic inclusion (Scholz *et al*., 2017). Vanilla farmers face significant challenges in accessing fertilizers and agricultural equipment. Many farmers rely on rudimentary equipment and have limited access to fertilizers. While proper fertilization can increase productivity, poor management can lead to negative environmental impacts and soil nutrient imbalances (Penuelas *et al*., 2023). The majority of vanilla farmers in Bali primarily use organic fertilizers, with limited use of chemical fertilizers. Controlled use of chemical fertilizers can make agricultural output more productive. On the other hand, the limited access to production resources reflects a broader problem of inadequate infrastructure. Other studies have shown that infrastructure constraints for smallholder farmers can jeopardize the sustainability of their livelihoods (Hagel *et al*., 2019). The need to increase access to efficient agricultural inputs to improve the sustainability and competitiveness of vanilla farming in Bali.

4.1.5 Social assets

Social conditions of vanilla farmers reflected in other studies that reveal the importance of farmer involvement in farmer groups to support sustainable growth and diversification of rural livelihoods (Kassegn & Abdinasir, 2023; Prasetyo & Firdauzi, 2023). Active participation in these groups can encourage the implementation of recommended agricultural practices, indicating that social factors play an important role in knowledge transfer and improving farmer welfare (Röös *et al*., 2019). Traditional knowledge in local communities is essential for socio-economic growth, especially through intercultural approaches that strengthen social ties and human relationships with nature (Krainer *et al*., 2022). This highlights the importance of strengthening social relationships to improve farmers' social and economic resilience. In addition, although there is moderate support for the dissemination of technology, knowledge, and information, access to agricultural subsidies and modern technology is still limited. This reflects the challenge that despite efforts to promote mutual support and knowledge exchange, access to these critical resources remains inadequate. Furthermore, relational forces—such as social class, gender, and ethnicity—also influence farmers' access to social, cultural, and agricultural resources. Those with stronger social positions tend to have better access to information and support, while marginalized farmers face significant barriers despite their skills (Krainer *et al*., 2022). Therefore, more inclusive policies that strengthen access to education, training, and participation in social and cultural activities will be important in supporting the economic and social resilience of vanilla farmers (Minyiwab *et al*., 2024).

5 Conclusion

The livelihood conditions of vanilla farmers in Bali present challenges to their lives and families. This livelihood can reflect the living conditions where the farmers' households are highly dependent on how they run their agricultural systems, in addition to the very dynamic social and economic conditions that can affect the livelihood conditions. Assets in livelihoods can provide a picture of the overall living conditions of households that influence each other. The importance of the ability to increase knowledge and information accompanied by an environmental approach will improve livelihood conditions. Financial management, improvement of facilities and infrastructure, and strong social

cooperation will have a real positive impact on the sustainability of households, especially vanilla farmers.

To enhance the sustainability of vanilla farming in Bali, we recommend developing an extension program. That focuses on program should provide practical training in vanilla processing (Watteyn *et al*., 2023), the use of eco-friendly pesticides, and the adoption of modern agricultural technologies (Wulandari, 2021), such as efficient irrigation and proper fertilisation (Hagel *et al*., 2019; Penuelas *et al*., 2023). Collaboration among universities, extension agencies, the private sector, and research institutions is crucial to translating the latest research into practical field applications. Future research should include more data triangulation and address the political aspects of access to social assets. It is also essential to consider local conditions and resource availability when designing policies and training programs for vanilla farmers.

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Ethical approval

The Ethics Research Committee of the State University of Malang (2.4.5/UN32.14.2.8/LT/2024) and the Research Ethics Committee of Khon Kaen University (HE673178), both authorized this work.

Conflict of interest

The authors declare that they have no conflict of interest.

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