











Farmer Regeneration and Labor Requirements in Rice Farming: A Case Study of West Denpasar District, Denpasar City, Bali, Indonesia



Dwi Putra Darmawan^{1*}, Gede Mekse Korri Arisena¹, Ni Made Classia Sukendar¹,
Ni Luh Made Indah Murdyani Dewi¹, Anak Agung Keswari Krisnandika²,
Putu Perdana Kusuma Wiguna³, Dina Lare Dunensa¹,
Anak Agung Istri Agung Peradnya Dewi¹, Desak Dwi Asthri Cahyani¹

¹ Study Program of Agribusiness, Faculty of Agriculture, Bukit Jimbaran Campus, Udayana University, 80361 Denpasar, Bali, Indonesia

² Study Program of Landscape Architecture, Faculty of Agriculture, Bukit Jimbaran Campus, Udayana University, 80361 Denpasar, Bali, Indonesia

³ Study Program of Agroecotechnology, Faculty of Agriculture, Bukit Jimbaran Campus, Udayana University, 80361 Denpasar, Bali, Indonesia

* Correspondence: Dwi Putra Darmawan (putradarmawan@unud.ac.id)

Received: 07-19-2024

Revised: 09-14-2024

Accepted: 09-22-2024

Citation: Darmawan, P. P., Arisena, G. M. K., Sukendar, N. M. C., Dewi, N. L. M. I. M., Krisnandika, A. A. K., Wiguna, P. P. K., Dunensa, D. L., Dewi, A. A. I. A. P., & Cahyani, D. D. A. (2024). Farmer regeneration and labor requirements in rice farming: A case study of West Denpasar District, Denpasar City, Bali, Indonesia. *Org. Farming*, 10(3), 185-201. <https://doi.org/10.56578/of100303>.



© 2024 by the author(s). Published by Acadlore Publishing Services Limited, Hong Kong. This article is available for free download and can be reused and cited, provided that the original published version is credited, under the CC BY 4.0 license.

Abstract: Farmer regeneration has been recognized as a critical factor in ensuring sustainable agricultural development and preserving ecological and cultural heritage. This study aims to: (i) examine the socio-demographic characteristics of rice farmers, (ii) assess the state of farmer regeneration, and (iii) analyze the labor requirements within the rice farming sector in West Denpasar District, Denpasar City, Bali, Indonesia. A mixed-method approach was employed, combining structured and in-depth interviews with 187 farmers, selected using the Slovin formula with a 5% margin of error and a 95% confidence level from a population of 352 farmers. Quantitative and qualitative data were collected through interviews and surveys to evaluate the agricultural system and workforce dynamics. The findings indicated that 59.36% of respondents identified farming as their primary occupation. However, a significant majority of their children pursued non-agricultural professions, citing the preference for stable income and professional careers. While most farmers endeavored to instill ecological values and emphasized the cultural significance of rice farming, 74.86% reported that their children had no engagement in agricultural activities. The labor force in rice farming primarily comprised family members supplemented by hired workers, particularly during labor-intensive periods. The employment of external workers was necessitated by extensive landholdings and the operational demands of mechanized and manual farming practices. These findings underscore the importance of addressing generational shifts in farming participation to ensure the sustainability of agricultural productivity and cultural heritage. Farmer regeneration was identified as pivotal to enhancing agricultural output, fostering ecological conservation, and improving community food security, while simultaneously addressing broader socio-economic challenges.

Keywords: Farmer regeneration; Labor; Rice farming; Subak; Sustainable agriculture

1. Introduction

Well-managed urban agriculture through a sustainable urban agricultural development approach could yield numerous rewards for urban living, including improving food security, generating higher incomes for local farmers, offering job opportunities, alleviating poverty, providing sufficient resources for nutritious food, promoting green open urban spaces, concretizing urban environmental conservation, making aesthetic urban areas more attractive, and being utilized as an environmental service for reducing erosion, increasing soil fertility, and conservation

planning (Fauzi et al., 2016; Kosca, 2014; Specht et al., 2014; Trigunasih & Wiguna, 2020; Trigunasih & Wiguna, 2022; Suardi et al., 2023).

The high conversion rate of agricultural land is also influenced by the human capital availability. Challenges offered by urban agriculture demanded farmers' high level of independence in running their crop production (Darmawan et al., 2023a). Today, the younger generation appears reluctant to immerse themselves in the agricultural world, putting the farmer regeneration in a dim situation (Coulibaly & Li, 2020). A good mixture of the primary elements of land, finance, and human capital is required to manifest sustainable agricultural business (Stringer et al., 2020; Suardi et al., 2023).

The limited interest among the younger generation in agricultural careers has been largely influenced by the perception of the sector as lacking prestige, being high-risk, and failing to provide stable and sufficient income. Furthermore, various structural and socio-economic factors have exacerbated this trend. These include limited average land ownership, the diversification of income sources through non-agricultural businesses and industries in underdeveloped rural areas, the predominance of conventional agricultural management practices, the absence of targeted incentive policies for young or novice farmers, and shifts in societal perspectives influenced by postmodern values (Prasetyaningrum et al., 2022; Suriani et al., 2023).

Farmer regeneration is one of the most critical factors in ensuring agricultural sustainability. The agricultural sector requires production personnel who are skilled, professional, and able to utilize the technological development (Dudek & Rosa, 2023; Muhie, 2022). The low availability of agricultural resources is one of the factors for the slow renewal of Indonesian farmers. This condition is caused by not only agricultural knowledge that has yet to be passed on to the younger generation by parents or the community but also other factors, such as changes in family, school, farming, and non-agriculture, which alienate the younger generation from their environment.

Workers in the agricultural sector are paid daily. There is no difference in wages between female and male labor, and the difference only lies in the type of work (Sabar et al., 2023). The labor expenditure includes tillage, seedling nursery, planting, weeding, fertilizing, eradicating pests and diseases, harvesting, transporting, and drying (Nurhayati et al., 2024). Meanwhile, rice farming activities in the *jajar legowo* planting system in Sumber Sari Village, Sebulu District, Kutai Kartanegara Regency require at least one male labor and two female labors. Farming rice paddy with *jajar legowo* planting system in Sumber Sari Village can be done using family labor (Ngastini et al., 2017).

Labor, the human capital, is an indispensable production factor in agribusiness. For instance, agricultural workers in a maize farming business in Kendari City, Indonesia and Buukumba Regency, South Sulawesi, Indonesia, play a prominent role in land preparation, corn seed planting, weeding, fertilizer administration, and harvesting period (Ihdhinashita et al., 2023; Ilsan et al., 2022). Additionally, the landowner of soya bean farming in Kulon Progo Regency, Yogyakarta, Indonesia, has to forfeit the highest expenditures on the human worker capital who are primarily involved in the entire farming process: land preparation, sowing, adding manure and fertilizers, weeding, pest control, harvesting, drying, threshing, bean-sorting/grading, and postharvest handling (Purnamasari et al., 2017).

Similarly, rice farming also spends a considerable amount of money on worker's wages since it profoundly relies on their work on the land preparation, sowing, seed removal, cultivation landline making, cultivation, seed replacement, drying, irrigation, adding manure and fertilizers, pest control, harvesting, and postharvest handling (Pawitri et al., 2021). It is well established that the quality of human capital, that includes their assets like educational background, skills, and intelligence, would be very influential for the rice farming business growth. Another game changer in this field is the farmer regeneration (Maulidiah et al., 2021; Siregar et al., 2021).

Farmer regeneration in Denpasar City, especially West Denpasar District, Bali Province, Indonesia, has become an important issue because the sustainability of the agricultural sector is highly dependent on the involvement of the younger generation. As a tourism area, of course, the income from the tourism sector is more promising than agriculture. Rice paddy fields in West Denpasar District commonly fuse under a traditional irrigation system organization of Subak. Based on data from Agricultural Agency of Denpasar City and field surveys, the area of rice fields in West Denpasar District is only 208 ha. Farmer regeneration would ensure the existence of Subak in that area. Farmer regeneration is a very intricate matter that would yield an impactful situation not only for the farmer family but also for the local agricultural sector in a broader scale. Farmer regeneration underpins the cultivation of a sustainable future of agriculture in Denpasar City, especially in the West Denpasar District.

This study analyzes the regeneration of rice farmers and the labor needs of rice farming businesses in the West Denpasar District. The novelty of this study is the extensive empirical work regarding farmer regeneration and labor requirements in the rice farming business. The demography characteristics of the farmer, their regeneration, and labor requirements were discussed comprehensively to portray the farmer regeneration in the West Denpasar District.

2. Methodology

2.1 Research location

This study was conducted in the West Denpasar District, which is a sub-district in Denpasar City, the capital city of Bali Province, Indonesia. The West Denpasar District covers an area of 23.76 km² and account for 18.83% of the area of Denpasar City. In terms of land use, the West Denpasar District has around 208 ha of rice fields. The geographical location of the area is between 08°36'24" and 08°41'59" south latitude, and 115°10'23" and 115°14'14" east longitude. The West Denpasar District is divided into 11 villages and 119 hamlets (Central Statistics Agency of Denpasar City, 2023). All villages in the area do not border the sea. The district is bordered by the East Denpasar District to the east, the South Denpasar District to the south, the North Denpasar District to the north, and the North Kuta District in Badung Regency to the west. Figure 1 shows the research location.

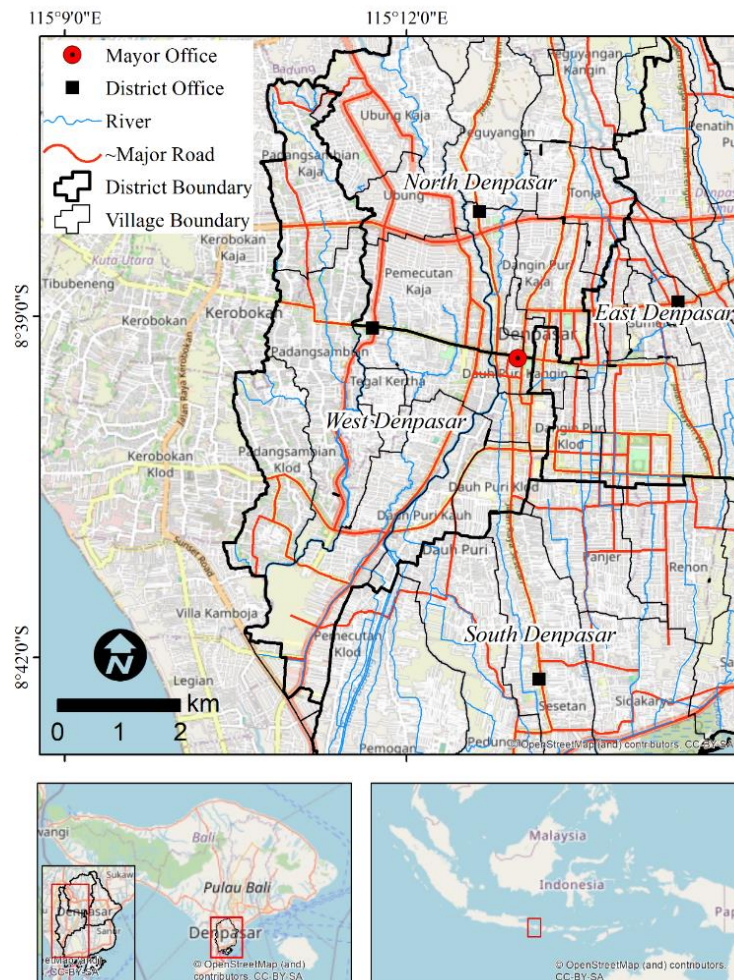


Figure 1. Research location

2.2 Methodology

The research is divided into several stages, namely data collection, sampling, interviews, data analysis and publication.

2.2.1 Samples and population

The population of this study was all the 352 farmers in the West Denpasar District. The research sample was determined using the Slovin formula (Lehmann et al., 2013) in Eq. (1).

$$n = \frac{N}{1 + N \cdot [Moe]^2} \quad (1)$$

where, n is the number of samples; N is the number of populations; and Moe is the maximum margin of error.

If the population of 352 people was entered with a maximum margin of error of 5% and a confidence level of 95%, the respondents in this study were 187 people. The sampling technique employed was random sampling, ensuring that the sample was representative of farmers who cultivate rice in the West Denpasar District.

2.2.2 Data collection methods

The data collection methods used in this study are as follows:

a) Interview: A communication or interaction process was conducted to collect information by means of direct verbal questions and answers to the Subak administrators and sample farmers. In this study, two interview methods were carried out:

- Structured interviews: This kind of interviews involves the use of research instruments prepared in advance.

In this study, structured interviews were conducted using a prepared questionnaire, enabling respondents to answer written questions or statements for data collection. The questionnaire is shown in Appendix 1.

- In-depth interviews: Information was obtained by asking farmers to answer research objectives face to face.

b) Survey: This means an investigation to be conducted to obtain facts from existing symptoms and seek factual information. In this study, a survey was conducted based on a questionnaire to obtain data on the farming system in Denpasar City.

c) Documentation method: This involves searching for data on things or variables in the form of notes, transcripts, books, newspapers, magazines, inscriptions, meeting minutes, agendas, and so on related to rice farming in the West Denpasar District.

d) Document review: Data on the general condition of the research location was obtained using previous studies to add information.

2.2.3 Research variables

This study included three research variables: a) demography characteristics of the rice farmers, b) rice farmer regeneration, and c) labor requirements, with a total of 18 indicators. The research variables and their indicators are presented in Table 1.

Table 1. Research variables and indicators

No.	Research Variable	Research Indicator
1	Demography characteristics of the rice farmers	1. Age
		2. Rice farming experience
		3. Farmer as the primary occupation
		4. Having the “second job”
		5. Farming rice to fulfill the household’s needs
		6. Physically capable of executing rice farming activities with optimal performances
2	Rice farmer regeneration	1. Number of children
		2. The presence of children taking up farming as an occupation
		3. Children’s occupation
		4. Interest to continue rice farming among children (their experience in engaging in rice farming activities)
		5. The desire to take over farming
		6. Encouraging their children to preserve the environmental ecology (the farmland preservation)
3	Rice farming labor requirements	1. Labor requirements at each stage of rice farming
		2. The farming workforce comes from the family members
		3. The farming workforce employed are non-family members/hired workers
		4. The farming workforce employed are the family and non-family members/hired workers
		5. Farming worker resources
		6. Payroll system

2.2.4 Data analysis

Simple tabulation tables were subsequently used to present the study findings for each study objective. The descriptive analysis was conducted through interviews based on the farmer’s perspectives and stance points as the study subjects. The study subjects were scrutinized earnestly as they were. Quantitative data were also gathered to support the qualitative analysis. Before the analysis, all data were carefully examined to avoid misconstrue by neatly following several steps: a) editing: detecting and correcting errors in the data, b) coding: classifying excerpts into codes to acquire themes and patterns, and c) tabulation: organizing data into tabular forms. Figure 2 shows the research diagram.

The interview guided by a questionnaire was directed to collect the study data. Participants were requested to respond to several written questions or statements prepared in the questionnaire. Furthermore, in accordance with

the questionnaire, a survey was also conducted to acquire information related to farmer regeneration and labor requirements in the West Denpasar District. To support the study findings and obtain sufficient data about the study location's general profile, a review of the literature was also conducted using several previous studies and related documents. All literature was screened and included to extract crucial information about farming land areas in the West Denpasar District.

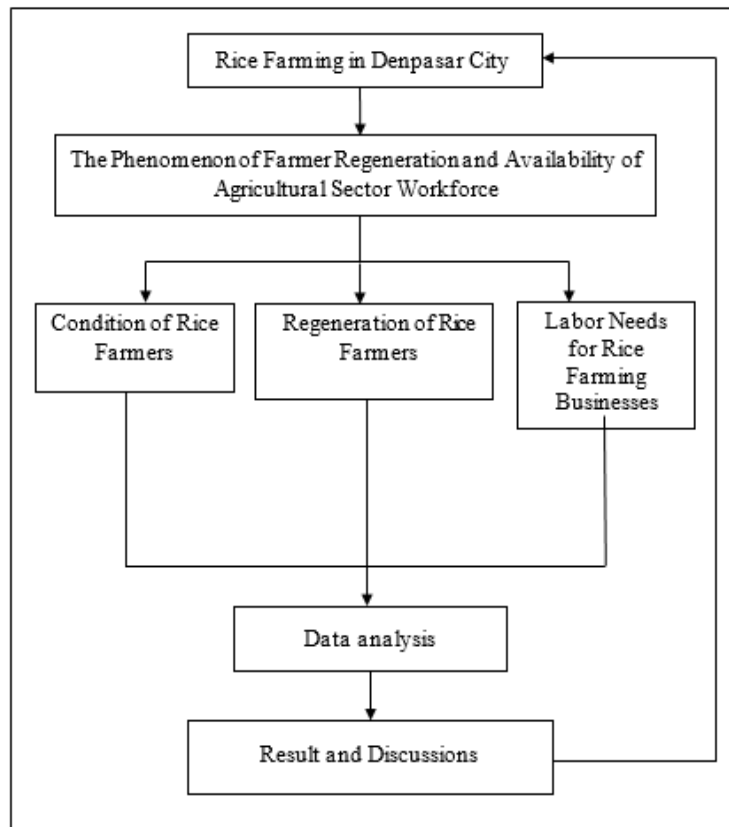


Figure 2. Research diagram

3. Results and Discussion

3.1 Social and Demographic Characteristics

Age is a critical element for a farmer because it affects the agricultural process and farming productivity (Gusti et al., 2022). Farming activities are closely associated with field-based work that greatly relies on physical strength. Table 2 presents the characteristics of the farmers in the West Denpasar District according to the age category.

Table 2. Participants' age characteristics

No.	Age	Number of Participants	Percentage (%)
1	≤ 14	0	0.00
2	14 – 25	0	0.00
3	26 – 35	4	2.14
4	36 – 45	20	10.70
5	46 – 55	55	29.41
6	56 – 65	64	34.22
7	≥ 65	44	23.53
Total		187	100.00

Most farmers (34.22%) in the West Denpasar District are in the age range of 56 to 65 years, with 46-55 years accounting for 29.41%, 65 years and above for 23.53%, 36-45 years for 10.70%, and 26-35 years for only 2.14%. This shows that the majority of farmers in the West Denpasar District are still in the productive age category. According to Toshkov (2021), age is one of the things that affects the amount of income. In general, the older a

person is, the higher the wages they receive because the workforce is still in the productive age. Conversely, if the workforce is outside the productive age category, their productivity decreases, which in turn lead to decreasing wages. Wong & Tetrick (2017) stated that the level of productivity of an individual in working is also influenced by age factors. Work productivity increases with age. However, work productivity also decreases at a certain age in line with the strength and physical abilities of the individual which are decreasing. Age has a significant impact, especially on jobs that require physical abilities and strength of the workforce. Liu et al. (2023) stated that in general, the age of farmers can affect farming activities and farming business processing which, in this case, is related to physical condition and thinking ability. Younger farmers are usually stronger and more physically active in managing farming businesses so that they are able to work harder than older farmers. While older farmers have farming experience which can be transmitted to younger farmers.

Farming experience is described as the length of time spent by the farmer to work and manage the farmland. Farmers with a longer duration of experience commonly demonstrate a deeper understanding and greater knowledge regarding farming activities in comparison to those with a shorter farming duration (Gusti et al., 2022). Table 3 shows the participants' farming experience.

Table 3. Farming experience

No.	Farming Experience (year)	Number of Participants	Percentage (%)
1	≤ 5	14	7.49
2	6 – 10	14	7.49
3	11 – 15	10	5.35
4	16 – 20	18	9.63
5	21 – 25	12	6.42
6	26 – 30	28	14.97
7	≥ 30	91	48.66
Total		187	100.00

The majority (48.66%) of respondents have farming experience of 30 years and more, with 26-30 years accounting for 14.97%, 16-20 years for 9.63%, 6-10 years for 7.49%, 5 years or less for 7.49%, and 11-15 years for 5.35%. With the majority of farmers with farming experience of more than 30 years, farmers have more appropriate choices and are more careful in making decisions related to their business. However, if the farmer's experience in his business is still lacking, the decision-making process can be carried out faster so that it is riskier.

Ilham et al. (2024) stated that farmers' productivity is influenced by their experience in running a farming business. With longer work experience, farmers have the ability to carry out production stages and develop the agricultural sector compared to those with less experience. Expertise in farming is in line with the length of farming experience. Davidescu et al. (2020) argued that work experience is a basis for an individual's ability to work. Work experience describes an individual's capacity to do a job, minimize errors while working and make working time more efficient. The profession of farmers for respondents in this study was categorized into three aspects: farmers with farming as their only job, farmers with side jobs, and farmers not considering farming as their main job. With farming as a second job to supplement the primary source of income, it moderately motivates farmers in sustaining their agricultural business. Furthermore, the demand to farm with no side occupation was discovered to be a great drive to engage constantly in farming activities (Darmawan et al., 2023b). The categories can be seen in Table 4.

Table 4. Occupation as a farmer

No.	Occupation as a Farmer	Number of Participants	Percentage (%)
1	Farmer as the primary occupation (no side hustling job)	111	59.36
2	Farmer as the primary occupation (with side-hustling/off-farm job)	55	29.41
3	Farmer as the side-hustling job	21	11.23
Total		187	100

The majority (59.36%) of farmers in the West Denpasar District pursued the profession of farmers as their main job and did not have other jobs. Meanwhile, 29.41% of farmers had side jobs. The remaining 11.23% of respondents pursued the profession of farmers only as a side job. This shows that the profession of farmers is still the dominant profession for the community to meet the household needs. One of the most widely pursued livelihoods in Indonesia is farming. Agriculture in Indonesia has become a priority aspect. According to the New Order, one of the goals is to develop agriculture. In fact, until now agriculture is still the main concern of the Indonesian government. Marlianti et al. (2017) also argued that agriculture is one of the important sectors because it produces clothing, housing, and housing needed by the community. In addition, the agricultural sector also supports other economic activities so that it plays a role in improving the economy of the Indonesian people.

Lestari et al. (2023) stated that some farmers have rice fields inherited from their parents and must manage them because good harvests can generate high incomes, which is why they continue to work as farmers. In addition to pursuing their main job as farmers, respondents also pursued side jobs to meet their household needs or make farming a side job. Farmers with more than one job are able to minimize dependence on just one job. This is because the profession of a farmer faces various problems, one of which is the low income. Thus, if farmers want to earn additional income, they can use their time to work in other areas.

The agricultural activities clearly aim to meet the needs of the farmer and their families. These needs could be fulfilled directly using the harvested crop from the farmland or revenue acquired from the crop's sale. Specifically, the motive of rice farming among farmers in the West Denpasar District is shown in Table 5.

Table 5. Rice farming motive

No.	Rice Farming Motive	Number of Participants	Percentage (%)
1	All crops are used to meet the need of farmers and their families.	8	4.28
2	Most of the crops are personally consumed, leaving the rest for sale.	111	59.36
3	All crops are intended for commercial purposes.	68	36.36
Total		187	100

Most farmers (59.36%) used their harvest for consumption and the rest was traded. Meanwhile, 36.36% of farmers sold their entire harvest and only 4.28% of them used their entire rice harvest for consumption. This shows that most farmers are very effective in utilizing the harvest obtained by selling to the market to meet other needs and utilizing the rice harvest for consumption needs. In addition, farmers also need capital to run farming activities in the next period. In order to meet the needs for survival, there are several strategies carried out by farmers, one of which is to carry out cost-of-living efficiency, namely combining food and non-food consumption arrangements by consuming part of the rice harvest. With high rice planting costs, farmers must manage income from farming to finance subsequent farming production. Farmers choose not to sell their crops because the prices are very cheap during the harvest season and prefer to use their crops as supplies until the next harvest season. Meanwhile, the decision of farmers to sell all their crops is their position as sharecroppers, who carry out economic activities only to meet daily needs.

The decision to sell or consume the crops is partly determined by the physical ability to carry out their farming activities. Each farmer would have a different level of physical ability in executing the farming activities or operations. Physical ability portrays an individual's capability to perform a physical task daily (Orhan et al., 2023). The physical ability of the farmer in West Denpasar District is presented in Table 6.

Table 6. Physical ability of farmers

No.	Physical Ability in Executing Farming Activities	Number of Participants	Percentage (%)
1	All steps of rice cultivation conducted by the farmer him/herself	2	1.06
2	All steps of rice cultivation assisted by family members	3	1.6
3	All steps of rice cultivation assisted by family members and hired workers	152	80.85
4	All steps of rice cultivation conducted by hired workers	0	0.00
5	All steps of rice cultivation assisted by hired workers	30	15.96
Total		187	100

Most farmers (80.85%) stated that the stages of work for farming were assisted by their family members and hired workers, followed by 15.96% (farmers and assisted farm laborers doing farming), 1.6% (only assisted family members doing farming), and 1.06% (only farmers themselves doing farming). In the results of this study, there were no farmers who only deployed farm laborers to work on the stages of their farming. The results of this study indicate that in South Sulawesi, all stages of farming activities are carried out cooperatively by members of the farmer's family. However, most stages of agricultural land processing are carried out by men because they require a lot of manpower. However, this does not rule out the possibility of female family members participating. According to a 2018 study, members of the farmer's family are an asset for farmers. This is because there is a lot of labor that can be used to run a farm. The more family members a farmer has, the more labor can be used. Farmers who carry out farming activities that require farm laborers were also found in a 2019 study because farmers felt it was quite difficult to work on their own land without the help of farm laborers. The decision to use farm laborers aims to reduce the burden of labor required, even though this decision is a waste of costs.

The number of farmers has an impact on agricultural productivity which affects food availability in Indonesia. The increasing age of farmers affects physical abilities and the ability to adapt to developments in agricultural technology. The increasing age of farmers is not balanced by the emergence of new young farmers. The decrease

in the number of young farmers is caused by their decreasing desire to work in the agricultural sector. In addition, most parents in rural areas do not want their children to work as farmers. The existence of farmers can guarantee food availability. Farmer regeneration is a requirement for the realization of sustainable agriculture.

3.2 Farmer Regeneration in the West Denpasar District

Farmer regeneration essentially correlates to family matters. Young people's participation in the agricultural field is commonly the outcome of family farm succession. Parents pass down the agribusiness to their children (Anwarudin et al., 2020). Table 7 presents the distribution of the number of children among farmers in the West Denpasar District.

Table 7. Number of children

No.	Number of Children	Number of Participants	Percentage (%)
1	0	4	2.16
2	1	12	6.49
3	2	92	49.73
4	3	52	28.11
5	4	20	10.81
6	5	4	2.16
7	≥ 6	3	1.62
Total		187	100

Based on Table 7, the majority of farmers (49.73%) in the West Denpasar District have two children, followed by three children (28.11%), four children (10.81%), and six children or more (1.62%). Only 6.49% of farms have one child. About 2.16% of respondent farmers do not have children or have five children. Based on the results, with more children, more family members can participate in helping with the farming activities. However, with the increasing number of family members, the number of dependents for farmers also increases. Farmer regeneration is also a dilemma for farmers. The size of the family farmland does not support the quantity of labor. In fact, the land inherited from the family encourages farmer regeneration and the emergence of young farmers. The cost of living increases along with the increasing number of family members living together. However, these family members are an asset for farmers because a lot of labor can be used to run the farm. The more family members a farmer has, the more labor can be used and more possibility of regeneration.

The term "regeneration" of farming has the same meaning as "succession" or "inheritance" of farming. Farming regeneration is the process of bringing new farmers into the farming business. Farmer regeneration can occur in a family environment, where the management of the farming business is inherited from parents to their children. While non-family regeneration occurs when the inheritance of the farming business is transferred to newcomers who do not have family ties. Regeneration can occur with external plans or without plans from the community itself.

Farmer regeneration or succession is a series of efforts established to transfer the farm business to the next generation of new farmers. Farmer regeneration is vital and could be a key to future farming sustainability (Anwarudin et al., 2020). Not to mention that on a broader scale, it would affect national food security. Farmer regeneration has evolved into a critical concern for the future of farming today. Many family farm business owners will be too old soon for agricultural work. But on the other hand, the younger generation seems disinterested in agricultural operations. A successful farmer regeneration is marked by the willingness of the potential successors to effectively take over the farm. Bertolozzi-Caredio et al. (2020) further mentioned the influence of individual, familial, institutional, and contextual dimensions on the family farm succession.

The individual dimension covers the degree of willingness of an individual to take over the farm. The influence of family on farm succession is explained by their role in equipping successors with attributes, such as skill and knowledge, facilitating their development, shaping their agricultural mastery, and providing initial farming capital. Institutional dimensions have pronounced impacts on farming regeneration, particularly through the issuance of policies or programs that support the development and effectiveness of agriculture operations. The sufficient regulation scheme may captivate the younger generation to take over the farm business. The contextual dimension, particularly economic risk, becomes the major consideration in taking over the farmland (Leonard et al., 2020). There are four main factors in the effective farming succession: personal, the farm and family, the agricultural resources (labor policy framework, availability of access to finances and land), and society (land attractiveness, appreciation for farming, and lifestyle) (Coopmans et al., 2021).

Similarly, a study conducted in Yogyakarta, Indonesia, on a young farmer population, confirmed that the better off-farm work opportunities, high economic risk-bearing of farmland cultivation and crop distribution, the insufficient authority supports, and land ownership challenges have been hampering their decision to jump into agricultural field (Maulida et al., 2022). The need to motivate young farmers to participate in agricultural works

could be delivered by driving farming modernization, providing easier land access, and making a positive difference to their income. However, the most important is the willingness of young generation (Borda et al., 2023).

Table 8 and Figure 3 show the willingness of the farmer family in the West Denpasar District in preparing the future successor for their farming business. The total respondents were 183 farmers because four people did not have children.

Table 8. Farmer regeneration

No.	Farmer Regeneration	Number of Persons		Total	Percentage (%)		Total
		Yes	No		Yes	No	
1	Having children working as farmers	22	161	183	12.02	87.98	100
2	Willingness to inherit the farmland to their children	91	92	183	49.73	50.27	100
3	Encouraging their children to preserve the environmental ecology (the farmland preservation)	158	25	183	86.34	13.66	100

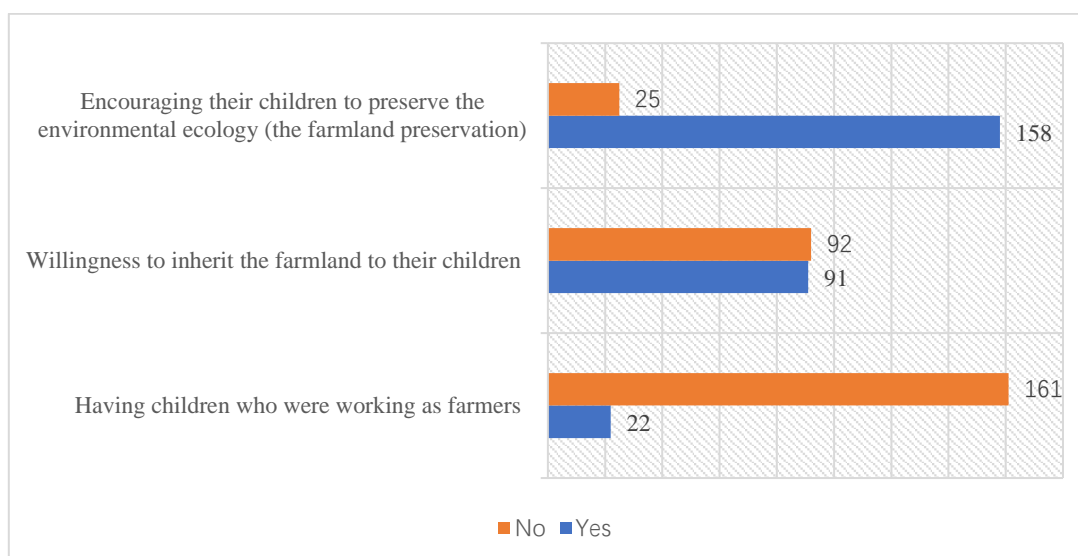


Figure 3. Graphic of farmer regeneration

Of the total 183 respondents, the children of 87.98% of farmers were not farmers. Meanwhile, 12.02% of farmers with children being farmers to cultivate rice and shallots. Children of farmers chose to work in this field as a continuation of the activities carried out by their parents. Meanwhile, children of farmers not working as farmers were engaged in various other types of jobs, including teachers, entrepreneurs, laborers, civil servants, soldiers, make-up artists, the tourism sector and students. They did not work in farming because they already had other jobs with more promising incomes. In addition, the demands for education and lack of interest are also the reasons. A total of 86.34% of farmer respondents stated that they advised their children to maintain the environmental ecology by maintaining their rice fields. The remaining 13.66% of farmers did not advise their children regarding this matter. It is very important to maintain environmental ecology. Therefore, farmers suggested that land owned by themselves would still be used as agricultural land. Table 8 and Figure 3 show farmer regeneration in the West Denpasar District.

There are two stereotypes in society that complicate the regeneration of farmers. First, the assumption that agriculture is related to men and is closely linked to the patriarchal system. Second, the view that considers farmers as a job that is close to poverty because it is often associated with the living conditions of rural communities and agriculture is considered a job that is far from stability and welfare. 50.27% of farmers stated that they did not want to pass on land to their children because the land was rent/shared or their children already had other jobs. Meanwhile, 49.73% of farmer respondents wanted to pass on land to their children because the land was previously inherited from their parents or they believed that this could guarantee the availability of food, especially rice, and increase household income.

According to Widiyanti et al. (2019), farming families do not pass on the profession of farmer to their children because they see that being a farmer is not promising for the future. Instead, they encourage their children to work in fields outside of agriculture. According to Prasetyaningrum et al. (2022), one of the factors that causes a decline in the workforce in the agricultural sector is a bad perception of agriculture, which makes it difficult to achieve sustainable agriculture.

With the conversion of land, the rice production area will decrease, leading to the decline in the availability of food. According to Faoziyah et al. (2024), there are many agricultural lands that have been converted into housing, oil palm plantations, or industry, leading to the decline in the availability of food. Conversion has been carried out in line with the increase in population and global flows that accelerate technology and information. Generally, participants demonstrated a poor willingness to recommend farm work or inherit their farmland to their children. A study by Brandth & Overrein (2013) also mentioned that rather than introducing agricultural work to their children, today's generation of fathers perceive the greater importance of familiarizing their children with skills that are markedly demanded by modern society.

The individual dimension of personal interest to be involved in farming operations links to willingness to take over the farm as a farmer. Children would hold an important share in deciding the future of their parents' farm business. The total respondents were 183 farmers because four people did not have children. The interest in rice farming among the farmer's children is presented in Table 9.

Table 9. Interest to rice farming among the children

No.	Interest to Rice Farming Among the Children	Number of Participants	Percentage (%)
1	All children are ever involved in farming activities	3	1.64
2	The majority of children are involved in farming activities	43	23.50
3	All children are never involved in farming activities	137	74.86
	Total	183	100

The majority of farmer's children were never involved in farming (74.86%), which may explain their unappealing assumption toward farming work. Henning et al. (2022) suggested the provision of sufficient exposure to agriculture that could be manifested through first-hand experience, construction of adequate support system, and institutionalization of proper education or socialization to positively influence youth participation in South Africa's agriculture. The poor interest in this field also could derive from the image and situation of the agricultural sector, which is less prestigious and cannot provide the social comfort that current young people crave. Aligned with this finding, the stereotypes related to farmer's images and agricultural works did exist.

The negative stereotypes, lifestyle expectations, and the insufficient income from the agriculture reduce young people's willingness to work in the agriculture field (Girdziute et al., 2022). Insufficient income, inadequate working conditions, severely limited land access, poor market bargaining power for the younger generation, administrative burden, climate change effects, and pest attacks discourage young people from taking over farming as their primary occupation (Borda et al., 2023). The future world needs to confront the challenges of deskilling of rural youth, downgrading of farming and rural life, government's chronic neglect on the small-scale agriculture and rural infrastructure, and limited land access for younger generations to manifest effective farming succession (White, 2012).

Farmer regeneration ensures that there are successors in the agricultural sector, which means that there is new labor involved. Without regeneration, the number of agricultural labors can decrease because many farmers are aging and there is a lack of interest from the younger generation to enter the agricultural sector. Young farmers involved in regeneration are generally more open to modern agricultural technologies and practices, which can increase the productivity and efficiency of the agricultural workforce. Regeneration brings new ideas that can improve the quality of the workforce in the agricultural sector, such as the use of modern agricultural tools and data-based methods.

Without regeneration, the agricultural sector can experience a shortage of workers because older farmers retire or die, while the younger generation prefers to work in non-agricultural sectors. This can reduce the overall agricultural productivity and affect a country's food security. Farmer regeneration can open up job opportunities for many people, especially those who want to enter the world of agriculture. Programs that support regeneration can create opportunities for new workers to work in the agricultural sector either as farmers or farming labor. Agricultural regeneration ensures that more labors can be absorbed.

3.3 Labor Requirements for the Rice Farming in the West Denpasar District

Land is considered as a primary factor that would affect the quantity and quality of the crop production. Larger and higher quality of rice farmland go hand in hand with higher quality of rice crops. Land ownership could enhance the rice yield and income of the small and midsize farm households (Pochanasomboon et al., 2020). The farmland size cultivated by farmers in the West Denpasar District is shown in Table 10.

Table 10. Farm land size

No.	Farm Land Size (100 m ²)	Number of Participants	Percentage (%)
1	1 – 10	3	1.60
2	11 – 20	38	20.32
3	21 – 30	49	26.20
4	31 – 40	28	14.97
5	41 – 50	25	13.37
6	51 – 60	16	8.56
7	61 – 80	13	6.95
8	81 – 100	5	2.67
9	> 100	10	5.35
Total		187	100

Based on Table 10, most farmers (26.20%) in the West Denpasar District have agricultural areas of 21 to 30 acres, with 11-20 acres accounting for 20.32%, 31-40 acres for 14.97%, 41-50 acres for 13.37%, 51-60 acres for 8.56%, 61-80 acres for 6.95%, more than 100 acres for 5.35%, 81-100 acres for 2.67%, and 1-10 acres for only 1.60%. From the wide range of the area, most farmers in the West Denpasar District are still in the category of small farmers because they own or rent land for farming with an area of 10 to 50 acres and have limited resources (Anseuw et al., 2016). With a narrow agricultural area, farmers are expected to save production costs in the form of labor costs. The amount of expenditure can be influenced by the estimated area of rice fields because if the area of rice fields is small, the costs incurred by farmers are also small. Meanwhile, if the area of rice fields is large, the costs incurred by farmers are also greater (Fil'izza & Sishadiyati, 2023).

Table 11. Labor requirements for each rice farming stage

Stages	Labor Requirements (person/acre)									
	1 – 10	11-20	21-30	31-40	41-50	51-60	61-80	81-100	> 100	
Land preparation	1	2	2	2	2	4	2	4	2	
Seedling	1	1	2	1	1	2	1	2	2	
Sowing and transplanting	2	3	3	3	4	6	3	6	4	
Care and management	1	1	2	2	2	2	2	3	2	
Pest and disease control	1	1	1	1	1	2	1	2	1	
Harvesting	2	3	3	4	4	6	5	5	4	
Total	8	11	13	13	14	22	14	22	15	

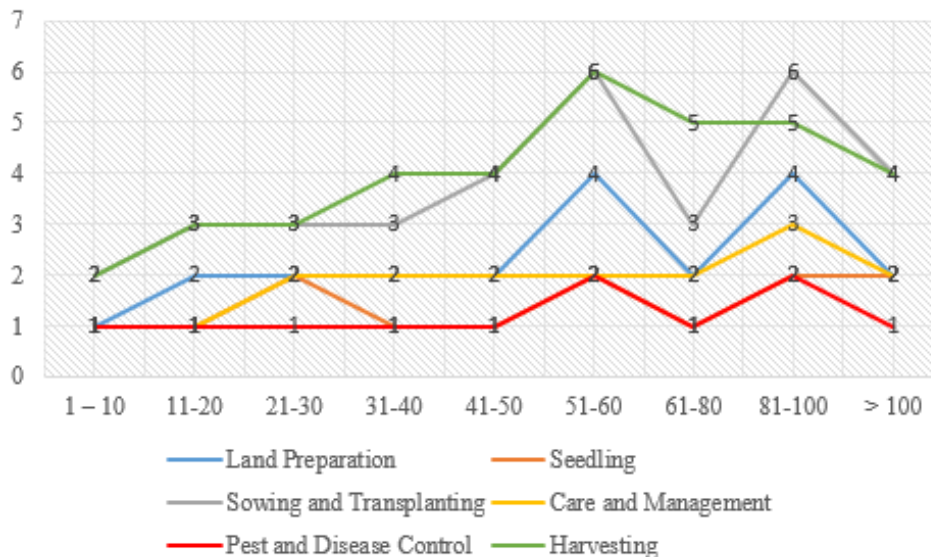


Figure 4. Graphic of labor requirements for each rice farming stage

The household-scale farmers in Indonesia are dominated by small-scale farmers, those who only have a maximum of 0.50 ha of land. The positive roles of small-scale farming businesses for sustainable rural development are unlocking more working opportunities for rural unemployment and pronouncedly contributing to food security (Szumelda, 2019). The domination of very small farms has also been reported in Southeast Asia,

India, and Africa region. However, in Africa, small-scale farms unfortunately limit the farmers' ability to rise out of poverty and become food secure (Giller et al., 2021). In Indonesia, the minimum land size to achieve the break event point is 0.51 ha. A larger farming size would realize higher profit rates (Relawati et al., 2022). The number of workers required in the investigated farming business for each stage involved in rice farming in the West Denpasar District is elaborated in Table 11 and Figure 4.

Based on the farm land size and labor requirements, the larger the area used for farming, the greater the need for labor from the land preparation process to harvesting. This can be seen in the agricultural area of 1-10 acres which requires 8 workers, with 11 workers required for 11-20 acres, 13 workers required for 21-30 and 31-40 acres, respectively, 14 workers required for 41-50 acres, 22 workers required for 51-60 acres, 14 workers required for 61-80 acres, 22 workers for 81-100 acres, and 15 people for more than 100 acres. In this study, it was found that only 10 farmers had agricultural areas with an area of >100 acres. The need for labor above 100 is relatively small because there is no contract system with work time and payment per day/acre. The stages of agricultural activities carried out can be completed in several days and have different schedules. Meanwhile, smaller agricultural areas require more labor because the payment system is carried out by contract and the completion time is quite short. This can have an impact on the efficiency of input costs used by farmers in farming, especially labor costs.

The basic contract work system applies targets to certain units and these targets must be arranged in such a way that workers can complete the work within a certain period of time. In agricultural activities that require more labor, the source of labor can also vary. The source of agricultural labor can come from within or outside the farmer's family. The family referred to in this case is the nuclear family, namely wife, children, in-laws, grandchildren, father and mother. In certain agricultural operations that necessitate more workforce, the farmer holders could employ multiple sources to obtain more workers. The workers could originate from their own family members or non-family members. The types of agricultural workforce resources employed in this study is showed in Table 12.

Table 12. Farming workforce resources

No.	Farming Workforce Resources	Number of Participants	Percentage (%)
1	The farming workforce comes from the family members	6	3.21
2	The farming laborers employed are non-family members/hired workers	39	20.86
3	The farming labor employed are family and non-family members	142	75.94
Total		187	100

The majority (75.94%) of labor came from within and outside the family. Then 20.86% of other farmers stated that the labor used came from outside the family. Only 3.21% of farmers stated that the labor they used came from family. Labor from outside the family is needed because labor from underprivileged families is lacking for farming, the land being cultivated is also large and farmers need supporting agricultural machinery. In addition, each family member has other activities and jobs for priority. Labor from outside the family is farm laborers in the same Subak or from other areas, such as Buwit, Tabanan, Badung and even from outside the island. Farmers who utilize labor from within and outside the family argued that by utilizing labor from both sources, farming work could be completed faster and easier, making farming time and costs more efficient. The difference in the amount of salary received by workers from outside the family depends on the agreement of each party. Some farmers involve their families to work on their agricultural land in order to reduce the cost of workers' wages (Sabar et al., 2023).

Small family farming has several characteristics. For example, these farms mainly or entirely employ their own family members and completely rely on agricultural works at least for the food needs. Additionally, such farms often engage in other activities, either local or migrant in nature, and frequently manage limited resources such as small-scale fisheries or rare assets like land (Mozumder et al., 2018). Small-scale family farms are generally favorable. However, many young agricultural workers still decide to work as salaried employees, which drives non-family farms as providers of employment opportunities (Yagi & Hayashi, 2021). Sen et al. (2021) found that the total incomes from the pure agricultural sector and non-agricultural sector are the lowest and highest, respectively. This finding propels the implementation of income diversification as a survival strategy, including rural areas. However, opposing discoveries were reported by Darmawan et al. (2023b). In their study, most farmers in Denpasar City choose to settle on their farming business due to the constructive working situation and they earn higher amount of income compared to their children working in the non-agricultural sector.

4. Conclusions

The majority of farmers did subsistence farming, i.e., nearly all crops raised were used to provide the needs of

the farmers and their families, leaving the rest for trade. Further, most of them did the farm work with their family members and several hired workers. Findings also yielded that most rice farmers encouraged their posterities to preserve the environmental ecology. Farmer regeneration represents a concept of the indispensable role of the younger generation in agriculture and the call to embrace it. The shift in farmer demography characteristics, psychological challenges, technology development, and limited access to resources are those factors contributing to agricultural landscape transformations. Effective farmer regeneration sheds light as a promising alternative to vanquish these challenges and ensure future farming business and national food security. Its implication would be powerful and abiding because it can maintain global food security, guarantee ecological sustainability, improve the local economic situation, and enhance the well-being of farmers and the community. By fusing both past wisdom and modern science, youth could concretize climate change mitigation efforts, amplify agricultural productivity, and achieve a state of ecological balance. Constant and serious community and authority engagement is key to manifesting a conducive environment for young people's meaningful participation in agriculture. Sufficient emotional support, adequate mentorship, proper education, and effective policies would establish appeals for the young and drive their eagerness to throw themselves into farming. Along with it, sufficient agricultural skills need to be developed to pave the way toward flourishing agricultural businesses. Conclusively, farmer regeneration is an investment worth making for future sustainable agriculture and global food security cultivation.

To solve the problem of farmer regeneration, several strategies could be carried out, such as increasing the attractiveness of the farming profession by promoting and campaigning for a positive image of farmers in the eyes of the younger generation, increasing access to agricultural technology, farming capital and partnerships, increasing access and quality of education in rural areas, and forming cooperatives or farmer institutions that accommodate agricultural products at reasonable prices.

Author Contributions

Conceptualization, D.P.D. and G.M.K.A.; methodology, D.P.D. and G.M.K.A.; spatial analysis, P.P.K.W.; validation, N.M.C.S. and N.L.M.I.M.D.; field surveys, D.L.D, A.A.I.A.P.D and D.D.A.C.; data analysis, N.M.C.S. and N.L.M.I.M.D.; writing—original draft preparation, A.A.K.K.; writing—review and editing, N.M.C.S. and N.L.M.I.M.D.; visualization, P.P.K.W.; supervision, D.P.D.; project administration, N.L.M.I.M.D.; funding acquisition, D.P.D. All authors have read and agreed to the published version of the manuscript.

Funding

This study was funded by the National List of Budget of Executors (DIPA) of Non-Tax State Revenue of the University of Udayana for the fiscal year of 2023, as declared in the Research Implementation Assignment Agreement Letter No.: B/1.320/UN14.4.A/PT.01.03/2023, issued on 2 May 2023.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Acknowledgements

We would like to extend our gratitude to Kelian Subak (a leader figure, those who served as Head of Subak) in West Denpasar District for the golden opportunity to conduct this project. Not to mention, their precious and profound assistance in the data collection process. We also thank all Krama Subak (Subak's member) for their valuable contribution and voluntary consent to participate in this study.

Conflicts of Interest

The authors declare no conflict of interest.

References

- Anseeuw, W., Jayne, T., Kachule, R., & Kotsopoulos, J. (2016). The quiet rise of medium-scale farms in Malawi. *Land*, 5(3), 1-22. <https://doi.org/10.3390/land5030019>
- Anwarudin, O., Sumardjo, S., Satria, A., & Fatchiya, A. (2020). Process and approach to farmer regeneration through multi-strategy in Indonesia. *J. Penelit. Pengemb. Pertan.*, 39(2), 73-85.
- Bertolozzi-Caredio, D., Bardaji, I., Coopmans, I., Soriano, B., & Garrido, A. (2020). Key steps and dynamics of family farm succession in marginal extensive livestock farming. *J. Rural Stud.*, 76, 131-141.

- <https://doi.org/10.1016/j.jrurstud.2020.04.030>.
- Borda, Á. J., Sárvári, B., & Balogh, J. M. (2023). Generation change in agriculture: A systematic review of the literature. *Economies*, *11*(5), 129. <https://doi.org/10.3390/economies11050129>.
- Brandth, B. & Overrein, G. (2013). Resourcing children in a changing rural context: Fathering and farm succession in two generations of farmers. *Sociol. Ruralis*, *53*(1), 95-111. <https://doi.org/10.1111/soru.12003>.
- Central Statistics Agency of Denpasar City. (2023). *Denpasar City in 2023 Figures*. Central Statistics Agency of Denpasar City. <https://denpasarkota.bps.go.id/id/publication/2023/02/28/de0a5ca2638a5f89a861cfb3/kota-denpasar-dalam-angka-2023.html>
- Coopmans, I., Dessein, J., Accatino, F., Antonioli, F., Bertolozzi-Caredio, D., Gavrilesco, C., Gradziuk, P., Manevska-Tasevska, G., Meuwissen, M., Peneva, M., Pettit, A., Urquhart, J., & Wauters, E. (2021). Understanding farm generational renewal and its influencing factors in Europe. *J. Rural Stud.*, *86*, 398-409. <https://doi.org/10.1016/j.jrurstud.2021.06.023>.
- Coulibaly, B. & Li, S. (2020). Impact of agricultural land loss on rural livelihoods in peri-urban areas: Empirical evidence from Sebougou, Mali. *Land*, *9*(12), 470. <https://doi.org/10.3390/land9120470>.
- Darmawan, D. P., Arisena, G. M. K., Djelantik, A. A. A. W. S., Krisnandika, A. A. K., Dewi, N. L. M. I. M., Korri, N. T. L., & Sukendar, N. M. C. (2023b). Farmers' motivation and obstacles in the smallest available agricultural region. *Global J. Environ. Sci. Manage.*, *9*(4), 967-982. <https://doi.org/10.22034/gjesm.2023.04.20>.
- Darmawan, D. P., Arisena, G. M. K., Djelantik, A. A. A. W. S., Krisnandika, A. A. K., Utari, N. K. S., & Korri, N. T. L. (2023a). Farmers' independence level in the urban area of Subak Sembung Denpasar City, Bali Province, Indonesia. *J. Agric. Sci. Sri Lanka.*, *18*(1), 40-54. <http://doi.org/10.4038/jas.v18i1.10097>.
- Davidescu, A. A., Apostu, S. A., Paul, A., & Casuneanu, I. (2020). Work flexibility, job satisfaction, and job performance among Romanian employees—Implications for sustainable human resource management. *Sustainability*, *12*(15), 6086. <https://doi.org/10.3390/su12156086>.
- Dudek, M. & Rosa, A. (2023). Regenerative agriculture as a sustainable system of food production: Concepts, conditions, perceptions and initial implementations in Poland, Czechia and Slovakia. *Sustainability*, *15*(22), 15721. <https://doi.org/10.3390/su152215721>.
- Faoziyah, U., Rosyaridho, M. F., & Panggabean, R. (2024). Unearthing agricultural land use dynamics in Indonesia: Between food security and policy interventions. *Land*, *13*(12), 2030. <https://doi.org/10.3390/land13122030>.
- Fauzi, A. R., Ichniarsyah, A. N., & Agustin, H. (2016). Urban agriculture: Urgency, role, and best practice. *J. Agroteknol.*, *10*(1), 49-62.
- Fil'izza, A. U. & Sishadiyati. (2023). The influence of rice field area, agricultural labor, and government expenditure in the agricultural sector on economic growth in East Java Province. *J. Econ. Finance Manag. Stud.*, *6*(12), 5975-5979. <https://doi.org/10.47191/jefms/v6-i12-24>.
- Giller, K. E., Delaune, T., Silva, J. V., Descheemaeker, K., van de Ven, G., Schut, A. G. T., van Wijk, M., Hammond, J., Hochman, Z., Taulya, G., Chikowo, R., Narayanan, S., Kishore, A., Bresciani, F., Teixeira, H. M., Andersson, J. A., & van Ittersum, M. K. (2021). The future of farming: Who will produce our food? *Food Sec.*, *13*(5), 1073-1099. <https://doi.org/10.1007/s12571-021-01184-6>.
- Girdziute, L., Besuspariene, E., Nausediene, A., Novikova, A., Leppala, J., & Jakob, M. (2022). Youth's (Un) willingness to work in agriculture sector. *Front. Public Health*, *10*, 937657. <https://doi.org/10.3389/fpubh.2022.937657>.
- Gusti, I. M., Gayatri, S., & Prasetyo, A. S. (2022). The affecting of farmer ages, level of education and farm experience of the farming knowledge about Kartu Tani beneficial and method of use in Parakan Distric, Temanggung Regency. *J. Litbang Prov. Jawa Tengah*, *19*(2), 209-221. <https://doi.org/10.36762/jurnaljateng.v19i2.926>.
- Henning, J. I. F., Matthews, N., August, M., & Madende, P. (2022). Youths' perceptions and aspiration towards participating in the agricultural sector: A South African case study. *Soc. Sci.*, *11*(5), 215. <https://doi.org/10.3390/socsci11050215>.
- Ihdhinashita, I., Yunus, L., & Zani, M. (2023). The productivity and income analysis of corn farming in Lalodati Sub-District Puuwatu District Kendari City. *Bult. Penelit. Sos. Ekonomi Pertan. Fak. Pertan. Univ. Haluoleo*, *25*(1), 19-25. <https://doi.org/10.37149/bpsosek.v25i1.154>.
- Ilham, M., Karno, E., Halim, M., Abdullah, B.D., Hasniah, H., & Murniati, M. (2024). Analysis of farmers' entrepreneurial behavior, and its effect on farm productivity. *J. Economia*, *20*(3), 433-452.
- Ilsan, M., Hasan, I., & Nuraeni. (2022). Potential and realized of farmer household labor to support optimal performance of corn and rice farming in South Sulawesi Indonesia. *Pak. J. Life Soc. Sci.*, *20*(1), 8-14.
- Koscica, M. (2014). The role of urban agriculture in addressing food insecurity in developing cities. *J. Int. Aff.*, *67*(2), 177-186.
- Lehmann, N., Finger, R., Klein, T., & Calanca, P. (2013). Sample size requirements for assessing statistical moments of simulated crop yield distributions. *Agric.*, *3*(2), 210-220.

- <https://doi.org/10.3390/agriculture3020210>.
- Leonard, B., Farrell, M., Mahon, M., Kinsella, A., & O'Donoghue, C. (2020). Risky (farm) business: Perceptions of economic risk in farm succession and inheritance. *J. Rural Stud.*, *75*, 57-69. <https://doi.org/10.1016/j.jrurstud.2019.12.007>
- Lestari, R., Yamin, M., & Sari, D. W. (2023). Factors affecting farmers' decision in selling rice farmland in Pemulutan Subdistrict, Ogan Ilir Regency, South Sumatra Province, Indonesia. *World J. Adv. Res. Rev.*, *18*(3), 1576-1583. <https://doi.org/10.30574/wjarr.2023.18.3.1212>.
- Liu, J., Fang, Y., Wang, K., Liu, B., & Wang, R. (2023). The aging of farmers and its challenges for labor-intensive agriculture in China: A perspective on farmland transfer plans for farmers' retirement. *J. Rural Stud.*, *100*, 103013. <https://doi.org/10.1016/j.jrurstud.2023.103013>.
- Marlianti, N., Wahyunadi, W., & Harsono, I. (2017). The role of agricultural sector on the economy of West Nusa Tenggara (Input-output analysis approach). *J. Ekonom. Stud. Pembangunan*, *9*(2), 176-189. <https://doi.org/10.17977/um002v9i22017p176>.
- Maulida, Y. F., Wati, R. I., & Subejo. (2022). The succession patterns of agricultural lands in the special region of Yogyakarta Province, Indonesia. *J. Popul. Soc. Stud.*, *30*, 625-639. <https://doi.org/10.25133/JPSSv302022.035>
- Maulidiah, I. A., Prayitno, G., & Subagiyo, A. (2021). The role of agricultural extension on the development of farmers group (Case study: Pare sub-district, Blitar Regency, East Java). *SOCA: Jurnal Sosial Ekonomi Pertanian*, *15*(3), 482-494. <https://doi.org/10.24843/SOCA.2021.v15.i03.p06>.
- Mozumder, M. M. H., Shamsuzzaman, M. M., Rashed-Un-Nabi, & Harun-Al-Rashid, A. (2018). Socio-economic characteristics and fishing operation activities of the artisanal fishers in the Sundarbans Mangrove Forest, Bangladesh. *Turk. J. Fish. Aquat. Sci.*, *18*(6), 789-799. https://doi.org/10.4194/1303-2712-v18_6_05.
- Muhie, S. H. (2022). Novel approaches and practices to sustainable agriculture. *J. Agric. Food Res.*, *10*, 100446. <https://doi.org/10.1016/j.jafr.2022.100446>.
- Ngastini, Yulianto, E. H., & Mursidah. (2017). Efisiensi alokatif penggunaan tenaga kerja pada usahatani padi (*Oryza Sativa* L.) sistem tanam jajar legowo di desa sumber sari. *J. Ekonom. Pertan. Pembangunan*, *14*(2), 51-63.
- Nurhayati, N., Fahri, A., Yusuf, R., Sinaga, P. H., Widyanto, H., Zuhdi, F., Masganti, M., Lenin, I., Meilin, A., Yuliani, N., Cahyaningrum, H., & Edi, S. (2024). Feasibility analysis of inpari ir nutri zinc rice seed farming in irrigated paddy fields in Riau Province. *KnE Soc. Sci.*, *9*(25), 302-316. <https://doi.org/10.18502/kss.v9i25.16978>.
- Orhan, B., Karaçam, A., & Cetin, A. (2023). The effect of adapted physical activities on an individual with special need's turn-taking skills. *Avrasya Spor Bilim. Eğit. Derg.*, *5*(2), 381-396. <https://doi.org/10.47778/ejsse.1343423>.
- Pawitri, G., Budiraharjo, K., & Setiawan, B. M. (2021). The production efficiency in organic rice farming. *SOCA: J. Sosial Ekonomi Pertanian*, *15*(3), 450-457. <https://doi.org/10.24843/SOCA.2021.v15.i03.p03>
- Pochanasomboon, A., Attavanich, W., & Kidsom, A. (2020). Impacts of land ownership on the economic performance and viability of rice farming in Thailand. *Land*, *9*(3), 71. <https://doi.org/10.3390/land9030071>.
- Prasetyaningrum, D., Ruminar, H., & Irwandi, P. (2022). The perception and interest of career choices in agriculture: Case of agroecotechnology and agribusiness students. *HABITAT*, *33*(2), 186-200. <https://doi.org/10.21776/ub.habitat.2022.033.2.19>.
- Purnamasari, F., Waluyati, L., & Masyhuri. (2017). The effect of good agriculture practices (GAP) on soybean productivity with cobb-douglas production function analysis in Kulon Progo Regency. *Agro Ekonomi*, *28*(2), 220-223. <https://doi.org/10.22146/jae.26823>.
- Relawati, R., Iriany, A., Prihartini, I., & Ramli, M. F. (2022). Farmers' willingness to pay bio-activators to maintain soil fertility. *SOCA: J. Sosial Ekonomi Pertanian*, *16*(3), 234-245.
- Sabar, W., Rahim, A., & Bato, A. R. (2023). The role of women's agricultural workers and household economic resilience. *J. Ilmu Sos. Humaniora*, *12*(1), 52-59. <https://doi.org/10.23887/jish.v12i1.51701>.
- Sen, B., Dorosh, P., & Ahmed, M. (2021). Moving out of agriculture in Bangladesh: The role of farm, non-farm and mixed households. *World Dev.*, *144*, 105479. <https://doi.org/10.1016/j.worlddev.2021.105479>.
- Siregar, A. P., Tarsilohadi, E. R., & Oktaviana, N. (2021). The transformation of agriculture, forestry and fisheries sectors in the Indonesian economy. *SOCA: J. Sosial Ekonomi Pertanian*, *15*(3), 518-530.
- Specht, K., Siebert, R., Hartmann, I., Freisinger, U. B., Sawicka, M., Werner, A., Thomaier, S., Henckel, D., Walk, H., & Dierich, A. (2014). Urban agriculture of the future: An overview of sustainability aspects of food production in and on buildings. *Agric. Hum. Values*, *31*(1), 33-51. <https://doi.org/10.1007/s10460-013-9448-4>.
- Stringer, L. C., Fraser, E. D. G., Harris, D., Lyon, C., Pereira, L., Ward, C. F. M., & Simelton, E. (2020). Adaptation and development pathways for different types of farmers. *Environ. Sci. Policy*, *104*, 174-189. <https://doi.org/10.1016/j.envsci.2019.10.007>.
- Suardi, I., Widhianthini, Arisena, G. M. K., Sukewijaya, I. M., & Krisnandika, A. A. K. (2023). Status of

- agriculture resources sustainability and agricultural policy in Denpasar City, Province of Bali, Indonesia. *Afr. J. Food Agric. Nutr. Dev.*, 23(3), 22694-22710. <https://doi.org/10.18697/ajfand.118.21875>.
- Suriani, N., Sari, Y. P., Handayani, F., & Noviar, H. (2023). The younger generation and the future of agriculture. *JURNAL TRITON*, 14(2), 384-392. <https://doi.org/10.47687/jt.v14i2.468>.
- Szumelda, A. U. (2019). Agriculture and everyday realities on small farms – An entrepreneurial challenge to farmers between the desire for autonomy and a secure existence. Two examples from east and south-east Poland. *J. Rural Stud.*, 67, 57-68. <https://doi.org/10.1016/j.jrurstud.2019.02.008>
- Toshkov, D. (2021). The relationship between age and happiness varies by income. *J. Happiness Stud.*, 23(9), 1169-1188. <https://doi.org/10.1007/s10902-021-00445-7>.
- Trigunasih, N. M. & Wiguna, P. P. K. (2020). Land suitability for rice field and conservation planning in Ho Watershed, Tabanan Regency, Bali Province, Indonesia. *Geographia Technica*, 15(1), 124-131. https://doi.org/10.21163/GT_2020.151.11.
- Trigunasih, N. M. & Wiguna, P. P. K. (2022). Identification of soil fertility status of Subak rice fields based on soil chemical properties in Denpasar city, Bali, Indonesia. *Afr. J. Food Agric. Nutr. Dev.*, 22(115), 21807-21824. <https://doi.org/10.18697/ajfand.115.20880>.
- White, B. (2012). Agriculture and the generation problem: Rural youth, employment and the future of farming. *Agric. Gener. Problem*, 43(6), 9-19. <https://doi.org/10.1111/j.1759-5436.2012.00375.x>.
- Widiyanti, E., Karsidi, R., Wijaya, M., & Utari, P. (2019). Farming occupation in the views of farmer families in rural area. *IOP Conf. Ser.: Mater. Sci. Eng.*, 633, 012060. <https://doi.org/10.1088/1757-899X/633/1/012060>.
- Wong, C. M. & Tetrick, T. E. (2017). Job crafting: Older workers' mechanism for maintaining person-job fit. *Front. Psychol.*, 8, 1-12. <https://doi.org/10.3389/fpsyg.2017.01548>.
- Yagi, H. & Hayashi, T. (2021). Working conditions and labor flexibility in non-family farms: Weather-based labor management by Japanese paddy rice corporations. *Int. Food Agribusiness Manag. Rev.*, 24(2), 249-266. <https://doi.org/10.22434/IFAMR2020.0013>.

Appendix

Appendix 1. Questionnaire

Rice farmer condition

1. Name:
2. Sex: (M / F)
3. Age:
4. Worked as a farmer for: _____ Years
5. Is the farmer the main job (choose one of the options below)
 - a. Farming as the main job (do not have another job)
 - b. Farmer as the main job (have a side job)
 - c. Farmer as a side job
6. What is the side job _____
7. Do you plant rice to meet the family's rice needs (choose one of the options below)
 - a. All the harvest is consumed
 - b. The harvest is consumed and the rest is sold
 - c. All the harvest is sold
8. Are you still physically able to farm (yes / no) (choose one of the options below)
 - a. All stages of work are done by yourself
 - b. Stages of work are assisted by family members
 - c. Stages of work are assisted by family members and farm laborers
 - d. No physical work, all stages of work use farm laborers

Rice farmer regeneration

1. Number of children _____
2. Are there any children as farmers (yes / no)
 - a. If yes What kind of farming?
 - b. If no Whats children's jobs?
 - c. If no why don't children work as farmers?
3. Are children interested in agriculture? Why?

Choose one:

 - a. All children have helped in the rice fields in rice farming activities
 - b. Some children have helped in the rice fields in rice farming activities

c. Children have never helped in the rice fields in rice farming activities

4. Desire to inherit land to be cultivated by children (yes / no)

Why:

5. Advise children to maintain the ecology of the environment (land owned remains as agricultural land) (yes / no)

Why:

Labor needs for rice farming

1. Labor needs at each stage of rice farming

a. How big is the area (tick one)

- 1 – 10 acres
- 11 – 20 acres
- 21 – 30 acres
- 31 – 40 acres
- 41 – 50 acres
- 51 – 60 acres
- 61 – 80 acres
- 81 – 100 acres
- >100 acres

2. Labor requirements at each stage of rice farming

No.	Farming Stage	Labor Requirements (Number of Labor)
1	Land preparation (early season)	
2	Nursery	
3	Planting	
4	Care	
5	Pest and disease control	
6	Harvesting	

3. Origin of labor (choose one)

a. The labor comes from family members (wife, children, in-laws, grandchildren, father and mother)

Why?

b. The labor comes from outside the family

Why?

Who are the workers outside the family?

c. The labor comes from within the family and outside the family

Why?

4. Where does the workforce come from (respondents may choose more than one option)

- a. Farmers in one Subak
- b. Farmers outside the Subak
- c. Farm laborers in the village
- d. Farm laborers outside the village
- e. Farm laborers outside the sub-district
- f. Farm laborers outside the province
- g. Others:

5. Labor payroll system (respondents may choose more than one option)

a. Labor in the family

What is the system like:

- Paid
- Unpaid
- Others:

b. Labor outside the family

What is the system like:

- Daily? How much per day?
- Contract? What is the counting event like?
- Others?