Research Article

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Understanding farmers' behavior toward risk management practices and financial access: Evidence from chili farms in West Java, Indonesia

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Abstract: Farmers have different characteristics in facing agricultural risks and decision-making. Access to finance is important for farmers to cope with the risks, including chili production. This research aimed to identify farmers' behavior in facing the risks of chili production and analyze the financial and other factors that influence the behavior. The research was performed applying a survey of 300 chili farmers in West Java, Indonesia. The risk was analyzed using the coefficient of variation and risk aversion, while factors related to the farmers' behavior in facing the risks were investigated using logistic regression analysis. The results show that chili farmers face high chili production risk. The farmers' behavior is significantly influenced by their access to finance and farm size. This study provides insights to policymakers and financial sources, indicating the need to provide farmers with wider access to finance to help farmers cope with the risk.

Keywords: chili, production risk, farmers' behavior, Indonesia

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1 Introduction

The agricultural sector is important for Indonesia, and the economy is also dependent on this sector [1]. Agriculture contributes to Indonesian income by 12.98% [2]. In addition, agriculture has been engaged by many Indonesians, where chili is one of the agricultural products that have a high economic value, and contributes to Indonesian agricultural export by 6% [3]. Chili production is vulnerable to risks such as natural disasters, price fluctuations, crop disease, climate change, and capitalization. Risks of harvest failure can be due to lack of maintenance such as pest attacks and diseases that may decrease crop productivity. In addition, high humidity can lead to increased disease attacks [4]. Agricultural risks may include harvest failure to agricultural production that may decrease agricultural productivity. Farmers need to know the level of risk of their farms and manage the risks to make the decisions efficiently [5].

Agricultural risks affect the production and investment decisions of farmers, who tend to avoid high risks and prefer ease in decision-making, although each farmer has different characteristics in dealing with agricultural risks. The study of Duong et al. [6] highlighted the tendency of farmers to avoid high risks through the comprehensive review of farmers' perceptions of agricultural risks. The presence of risk in agriculture has a significant influence on farmers' production and investment decisions [7]. The behavior of farmers in the face of risk is influenced by socio-economic factors, such as land size, farmers' age, number of households, farmer's education, farming experience, and land ownership status [8]. Furthermore, several socio-psychological factors such as age and household size

can influence farmers' attitudes toward risk [9]. The agricultural risks are an unfavorable thing that can arise during the production where the probability of such risks and their impact, in fact, can be calculated and predicted. Understanding farmers' attitudes toward risk is essential for designing effective agricultural policies and programs [10,11].

Access to agricultural financing can boost farmers' income and is a significant factor in agricultural production risk [7]. Having access to financing is essential for raising farmers' incomes and enhancing their standard of living. Farmers can purchase agricultural inputs such as seeds, fertilizer, and equipment by increasing their access to financing [12–14]. Additionally, having access to financing can help farmers invest in infrastructure and technology [15], such as transportation, storage facilities, and irrigation systems, which can help them become more competitive over the long run [16].

Understanding the farmers' behavior in facing risks and its relation to access to finance has not studied yet, especially in financing from different financial providers. Therefore, this research is important to help farmers' decision-making in coping agricultural risk, in particular chili production. This study aimed to analyze the farmers' risk behavior on chili production, and determine access to finance and other factors that influence the behavior to such risks. This study is crucial in contributing to the development of the agricultural sector especially in chili production. Furthermore, the findings of this study provide insights to agricultural policymakers and providers of finance by considering the role of access to finance to help farmers coping with the risk.

2 Methods

This research was performed in West Java, particularly in the districts of Bandung, Garut, and Ciamis, considering that these areas are production centers and potential areas in chili production in West Java, Indonesia. The sample area was determined based on the distance of the farmer's area to the city center as a representation of the financial service center, i.e., near, medium, and far from the city center. The closer the distance to the city is represented as the group who can easily access various financial services.

The survey was performed by conducting interviews with 300 chili farmers who were randomly selected in the study areas. This study used supporting letters from Universitas Padjadjaran, Indonesia to support the farmers' survey. The agricultural office of each study area gave a study permission before conducting the survey. Prior to the interviews, the farmers were explained about the objectives and contents of this study. To ensure the farmers' voluntary participation and to guarantee their anonymity, the farmers were first asked if they would be interested in being interviewed.

Agriculture risks may arise from several factors that are unpredictable and uncontrollable by the farmers. Risk is the probability of an event resulting in a loss when the event occurs during a certain period. Coefficient of variation (CV) was used to measure the risk:

$$\mathrm{CV} = \frac{\sigma}{X} \times 100\%,$$

where CV is the coefficient variation, σ is the standard deviation, and $\bar{X}$ is the average.

The criteria for measuring the value of the CV are when the CV is more than 0.5 then the risk on the business that the farmer bears is greater. The farmer's behavior was analyzed with the $K(s)$ or risk aversion value to calculate the value of reluctance in risk [17]:

$$K(s) = \frac{1}{0}\left(1 - \frac{P_{xi} \cdot X_i}{P_{yfi} \cdot \mu_y}\right),$$

where $K(s)$ is the level of reluctance in facing risk, θ is the coefficient variation production, P_{xi} is the most significant input price (IDR), X_i is the quantity most significant user input, P_y is the output price (IDR), f_i is the elasticity of the most significant production input (%), and μ_y is the average production.

Farmers' behavior in relation to risk includes risk averse, which means that they are not prepared to take the risk or the loss. The second type of risk is neutral, i.e., a farmer who is unaware of the level of risk faced. The third is a risk taker, who is willing to take risk even though the results obtained may be low. The $K(s)$ value is categorized into three behavioral criteria, i.e., risk taker ($K(s)$ is lower than 0.4 indicating farmer faces risk), risk neutral ($0.4 \leq K(s) \leq 1.2$ means farmer's behavior between risk taker and risk averter), and risk averter ($1.2 < K(s) < 2.0$ means farmer avoids risk) [18]. In the formula $K(s)$, the regression analysis of the production function of chili is used in obtaining the most significant production input using the value of the standardized coefficient of the largest independent variable [17]. The beta coefficient (standardized coefficient) value is obtained using the following formula:

Standardized coefficient = beta coefficient

$a_n X_n$ = coefficient regression variable independent to $-n$

σX_n = standard deviation variable independent to $-n$

σY = standard deviation variable dependent

Coefficient value of the independent variable in beta coefficient (standardized coefficient) is obtained through

the regression analysis of chili production function with an equation model regression as follows:

$$\text{Ln}Y = \text{In}\ a_0 + a_1\ \text{In}\ \text{LL} + a_2\ \text{In}\ \text{BBT} + a_3\ \text{In}\ \text{PPK} + a_4\ \text{In}\ \text{PS} + a_5\ \text{In}\ \text{TK} + €,$$

where Y is the amount of production of chili (ton), A is the estimated parameters in function production, LL is the land area (ha), BBT is the amount of seed (stem), PPK is the total fertilizer (kg), PS is the total pesticide (liter), TK is the man-days (HKSP), and € is the error term.

Factors related to the farmers' behavior in risk were investigated using logistic regression analysis. The logistic equations used are as follows:

$$\text{Logit}\,(Y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6,$$

where Y is the farmers' risk behavior ($Y = 1$ if a farmer is a risk taker; $Y = 0$ otherwise), β_0 is a constant, β is the coefficient, X_1 is the financial access (1: have experience in obtaining finance from at least one financial source; 0: otherwise), X_2 is the age (years), X_3 is the education (years), X_4 is the farming experience (years), X_5 is the number of family members (numbers), and X_6 is the farm size (hectare).

The variables related to farmers' access to finance and their characteristics such as age, education, farm experience, family size, and farm inputs such as amount of seed, fertilizer, pesticide, labor, and land area. Farmers' access to finance refers to the farmers' experience in obtaining finance from any financial source, measured in whether the farmers obtained finance from at least one source of finance. In general, farmers can obtain finance from many sources of finance such as from banks, micro-finance institution, government through farmers, association, trader, agricultural input kiosk, and other sources of finance such as from family, friends, and relatives [19]. Access to finance is important for farmers to help in their decisions about investment that are significantly affected by the existence of risk in agriculture [7].

Farmer's characteristics such as age, farming experience, land area, and resource ownership can also influence farmers' risk [20]. Age is a characteristic of a farmer that refers to the amount of time since a person's birth measured in years. Age of farmers can influence farmers' behavior [21,22]. Furthermore, the behavior of farmers is influenced by age, in which farming activities can be carried out by productive farmers by participating in farmer groups' activity, such as rice farming training and interacting with other farmers about planning their farm operations [23].

The level of education refers to the length of formal education measured in years. New technologies and best management practices are more likely to be adopted by farmers who have received formal agricultural education, which is attributed to less risk aversion, higher skills, and improved decision-making abilities [24].

Farm experience refers to the knowledge and skills acquired by a farmer through practice and direct interaction with farm activities, such as farm management, crop maintenance, or other farm-related activities over a certain period of time and are measured in years. Farmers who have more farming experience are more likely to take less risk [25] which potentially have acquired the information and abilities necessary to assess risks, thus have a better ability to weigh potential gains against potential losses.

Land area refers to the size of farms operated by the farmers, measured in hectare. Larger farms often have diversified farm systems, which can serve as a buffer against changes in prices and other disturbances, and potentially are able to implement more creative and yield-maximizing techniques [26]. Family size refers to the number of persons who live in the farmers' house, measured by number. The large number of family members encourages a brave attitude toward the risk of fluctuations in chili prices [27].

The farmers were also asked about the agricultural inputs applied in their farms. Farmers who are more risk-taking are more likely to invest in adopting high-yielding varieties and fertilizers, although in the face of risks associated with climate change and volatile markets [28]. Seeds have an influence on farmers' behavior [29,30]. Furthermore, a pesticide is a chemical substance or formulation used to control pests, weeds, and plant diseases and is measured in liter per hectare (L/ha). Pesticides can affect farmers' behavior [31], in which farmers who are more willing to take risks often apply more pesticides to increase crop yields [32].

The sum of the labor force is all those who are willing to work, and is measured by the unit of man-days. Labor consumption influences farmers' behavior [33]. Higher risk-tolerant farmers are more likely to adjust to labor investments to adapt to the climate change and increase agricultural production [34].

Consent: Farmers' consent was obtained for this study prior to the interviews, by adopting a methodology from a study by Wulandari et al. [19].

Ethical approval: The research related to human use has been complied with all the relevant national regulations, institutional policies and in accordance the tenets of the Helsinki Declaration, and has been approved by the authors' institutional review board or equivalent committee.

3 Results and discussion

3.1 Characteristics of farmers

The farmers are between the ages of 24 and 82, with an average age of 48. This broad age distribution points to a multigenerational group of people engaged in farming. With an average age of 48, many farmers are probably in the middle of their productive years, incorporating a healthy dose of youth with an extensive amount of experience. The wide range also suggests that farming is a lifetime occupation, with younger farmers contributing innovation and older farmers possibly holding priceless wisdom. Younger farmers are more likely to take chances of risks because they are eager to try new techniques and potentially contribute to more profits [35].

The farmers' educational backgrounds range from having no formal schooling to attending a university. The majority of the farmers have primary school background. The existence of farmers without a formal schooling highlights possible obstacles to education in rural areas and raises the possibility that their farming methods heavily rely on traditional knowledge and practical experience. Education is important in contributing to young farmers in managing stress and applying creative farming techniques [36].

The farmers typically have three family members. This comparatively small family size may be a reflection of larger demographic trends, like declining birth rates or the prevalence of nuclear families in rural areas. A smaller household may affect decisions about the size of operations and investment in labor-saving technologies, as well as the availability of family labor for farming activities.

Farmers typically have 17 years of experience in farming, which shows that they are highly knowledgeable and accustomed to agricultural methods. This wealth of experience is probably an immense benefit, helping to manage the farm effectively and withstand setbacks like shifting market conditions and weather patterns. Yet it also implies that a large number of farmers began working early in life, which might have limited their access to formal education and other non-farming possibilities.

With an average farm size of 0.31 hectares, these farmers' operations vary greatly in size. According to this average farm size, a large number of farmers work on a small scale, which can restrict economies of scale and make them more susceptible to environmental and economic shocks. Diversification of revenue streams and creative methods to optimize productivity are frequently required for small farm sizes. Larger farms are better equipped to handle economic and climate-related shocks because they have more financial, physical, and human capital which can maximize yield [37]. Regarding access to finance, almost half the percentage of the farmers have experience in obtaining finance from at least one source of finance.

Farmers living in different geographical areas in terms of the distance of the farmer's area to the city center were categorized into three groups, i.e., near, medium, and far from the city center. The percentage of farmers participated in this study who lived in near, medium, and far from the city center includes 32, 36, and 32%, respectively.

3.2 Risk level of chili production

Farmer often faces a variety of production risks, thus farmer needs to understand the risks because the farmer is vulnerable to the various risks. The risk level of chili production was assessed using CV analysis by comparing the standard deviation value with the average production. A low value of the CV indicates lower risks. The risk analysis represented by the CV value is presented in Figure 1.

From Figure 1, in general the production risk encountered by chili farmers regarding the distance to the city is relatively high because the CV value is greater than 0.5. The results also show that the CV of the chili farmer whose location is not far from city has a risk level of 1.456 which is higher than the other two locations. This means the level of risk that the farmer who is located not too close or not too far from the city is larger than the two other areas. This may be due to the farming centers being carried out in medium-far areas, thus many chili farmers are in this area. A study by Flaten et al. [38] revealed that farmers living in central areas tended to pay more attention to production risks which may be associated with the occurrence of disease outbreaks, and more densely populated area may also contribute to the greater disease matter.

3.3 Risk behavior of farmers

The risk behavior was analyzed by calculating risk aversion or $K(s)$ values [16]. Prior conducting the resistance test, it is necessary to analyze any of the factors that have the greatest and most significant contribution to the chili production indicated as in Table 1.

The results of the factor analysis show that the most influential input is different regarding the distance, in which the most significant input contribution for the nearest and medium area is labor, while for the far area is the seedling.

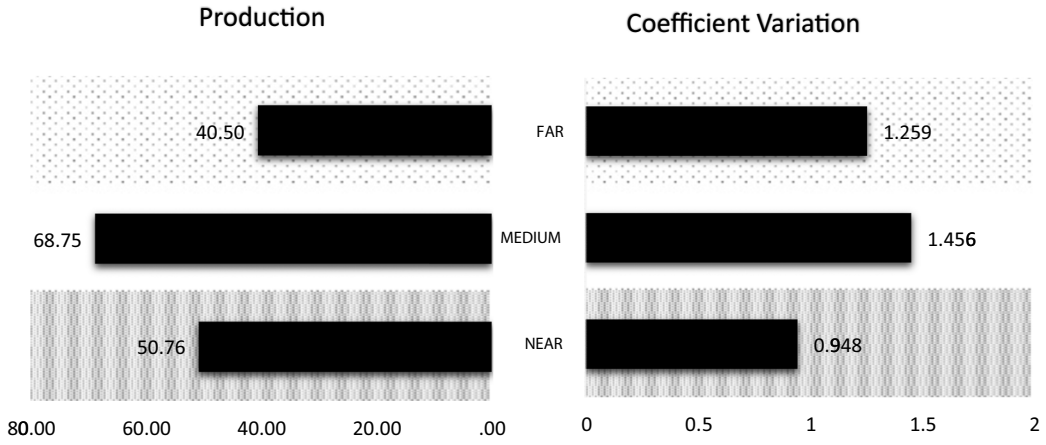

Figure 1: Risk analysis of chili production.

Table 1: Factors that influence the production of chili regarding the distance from city

Variable	Near			Medium			Far		
	Coefficient regression	Standardized Coef	Sig.	Coefficient regression	Standardized Coef	Sig.	Coefficient regression	Standardized Coef	Sig.
Seedlings	0.439	0.176	0.014	0.377	0.147	0.012	0.466	0.138	0.001
Fertilizer	0.111	0.247	0.653	−0.100	0.123	0.417	−0.058	0.119	0.627
Pesticide	−0.328	0.278	0.242	0.185	0.129	0.154	0.151	0.137	0.270
Labor	0.896	0.217	0,000	0.612	0.143	0,000	0.495	0.158	0.002

Table 2: Factor value used to determine the parameter $K(s)$

Location	θ	P_{xi}	X_i	P_y	f_i	μ_y
Near	0.948	Wages for each respondent	Number of labors for each respondent	Average chili sell price	0.044	5076.47
Medium	1.456	Wages for each respondent	Number of labors for each respondent	Average chili sell price	0.522	6875.77
Far	1.259	Wages for each respondent	Amount of seeds for each respondent	Average chili sell price	0.023	4050.62

The further procedure is by determining the parameter of $K(s)$ using the factor value presented in Table 2.

The risk aversion or $K(s)$ values [18] indicate the behavior of farmers in which $0 < K(s) < 0.4$ means the farmer behaves boldly to face the risk (risk taker), $0.4 \leq K(s) \leq 1.2$ means the farmers behave between the risk taker and the risk averter (risk neutral), and $1.2 < K/s < 2.0$ means the farmer behave avoiding the risk (risk averter). Farmers' behavior toward the risks of chili production is presented in Figure 2.

Overall, farmers' behavior is dominated by farmers who are risk taker at 51%. Risks may include natural disasters, crop diseases, price fluctuations [39], and capitalization [40]. All the farmers who live in the nearest areas to the city are risk takers. These farmers are risk takers because areas near the center are vulnerable to water scarcity, high humidity, temporary conditions of the soil in the process of production, the need for water, moisture, and soil fertility that is a very important part in boosting the production process. Another reason that farmers' tendency to be risk takers may be related to economic pressures, such as low income or high debt levels, which lead to coerce farmers to engage in riskier agricultural practices to maintain their livelihoods [40]. Areas that are medium distance from the city is dominated by farmers who behave risk neutral where the farmer is eager to accept risk but is less willing to take high risks. Farmers who are in the most remote areas of the district, mostly behave at a risk neutral level at 53%, which means that farmers expect additional profits when the risks they face increase.

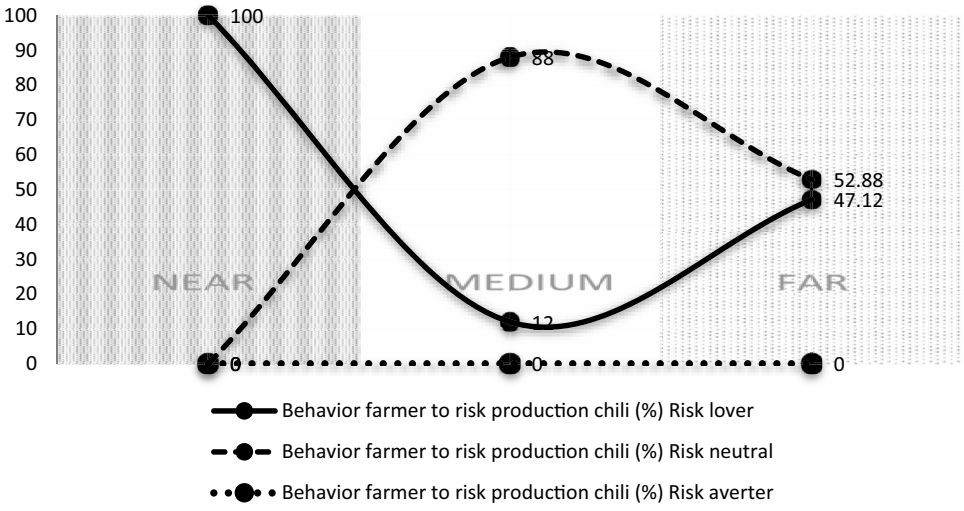

Figure 2: Farmers' behavior toward the risks of chili production.

3.4 Factors affecting the behavior of farmers

The result of the factors that influence the behavior of farmers facing the risk of chili production is presented in Table 3.

The results show that financial access and farm size have significant influence on the farmer's behavior in facing the risk. The findings indicate the farmers take the risk when they have obtained financing, as the finance can be useful to buy good agricultural inputs and investment that can help the farmers to minimize production risk [7]. Furthermore, it is important for applying a sustainable finance model in assisting smallholder farmers with the adoption of agricultural innovations and risk management related to financial constraints and climate vulnerability [41].

The results also show the influence of farm size on farmers' behavior of risk, which indicate that farmers who have larger farms are potentially risk-taking in coping with the risk. In addition to potentially being able to employ more innovative and yield-maximizing strategies, larger farms frequently have diversified farm systems that can act as a buffer against price fluctuations and other obstacles [26]. Farmers' decisions about production are influenced by risk aversion, in which regarding the scale of farms, compared to smaller farms, larger farms are better able to deal with and manage production risks because of their farms' scale [42]. The farmers' risk behavior can vary and some farmers continue to take risks even when conditions are relatively safer, may be due to farmers' understanding of their situation in an uncertain economic environment [43]. Another reason may be related to keep the farmers on the safer side, as an alternative strategy to manage the risk of uncontrollable adversity to a certain degree [44].

Table 3: Factors of farmers' behavior in chili risk production

Variable	Coefficient	SE	Sig.
Constant	−0.360	0.962	0.708
Financial access	0.672	0.262	0.010
Age	−0.011	0.015	0.449
Farming experience	0.016	0.013	0.224
Educational background	−0.044	0.149	0.767
Number of family size	−0.076	0.100	0.444
Farm size	2.255	0.618	0.000
Constant	−0.360	0.962	0.708

4 Conclusion and recommendations

Chili farmers in Indonesia face high production risks due to a number of factors including climate change, land conditions, pest disease plants, and price fluctuations. In general, farmers behave dominantly as risk-taker. Factors of financial access and farm size have significant influence on the farmer's risk behavior. To cope with the risk, the role of the government, the technical team, and the accompaniment are needed in monitoring, motivating, and supervising the farmers. In this case, training and discernment are important to improve farmers' competency in facing the production risks. Moreover, support for farmers in the form of broader and more affordable access to finance is important to help farmers in facing production risks.

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Data availability statement: The authors confirm that the data supporting the findings of this study are available upon request from the corresponding author and the supplementary materials.

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