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Rice farming to brick production: What are major drivers of livelihood shift?

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The study aimed to find out the significant drivers of livelihood shift from rice farming to brick making. The study was conducted in a brick producing village, which was previously a rice producing area. Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) methods were used to collect data and information. Data were analyzed using pairwise comparison of the Analytical Hierarchy Process (AHP). The push factors were a high risk of failure, rice price fluctuation, declining returns to farming, lack of irrigation water, labor shortage, and pest and disease occurrence. The pull factors that have driven the livelihood shift were low risk of failure, short cash flow period, high returns, low barriers to entry, high demand, and availability of raw clay. The push factors were more dominant than the pull factors, and the five most important factors in order of priority were a high risk of failure, inadequate water supply, uncertainty in price and demand, higher returns from brick production, and declining returns to farming. Brick making offers more benefits in terms of employment generation, income distribution, and economic growth, but a shift from rice farming to brick production has grave implications for agriculture, food security, and environmental quality. There should be integrated efforts to maintain multi-functionality and comparative benefits of rice farming and to ensure a more sustainable brick production.

Keywords: Bricks, drivers, livelihood, rice farming, Sulawesi

INTRODUCTION

Rice is an essential food crop and staple food for 97% of the population of Indonesia (BPS, 2018). Rice farming is the primary source of livelihood and income for 21 million farming households in Indonesia, including in Southeast Sulawesi where rice is the most strategic crop (Saediman, 2015). For this reason, the government of Indonesia has taken much effort to increase rice production and productivity (Saediman et al., 2016; Saediman et al., 2019a). As a result of various policies and programs covering up-stream to downstream subsector, infrastructure, financing, price, and supporting institutions, rice self-sufficiency was attained in 1984. Following that attainment, however, production has been less than consumption, and Indonesia has continuously imported rice to meet domestic demand (Widyanti et al., 2015).The volume of imported rice fluctuates depending on domestic production in a particular year. Population growth pressure, climate change (Naylor et al., 2007), and accelerating rate of conversion of paddy fields to non-agricultural uses (Harini et al., 2012; Nurliani and Rosada, 2016) are three significant threats to attain rice self-sufficiency. Another threat is the lack of interest of the young generation to work in agriculture, as can be seen from the decreasing trend of the economically active population in agriculture (Agus and Irawan, 2006).

Conversion of paddy fields to non-agricultural

uses is driven by a high need for land for physical development that accompanies population and rapid economic growth (Chofyan, 2016.). Paddy field conversion takes place as the land is directly cleared for the establishment of industry, infrastructure, facilities, and residential use. Paddy field conversion also takes place indirectly, such as for the establishment of clamp kilns to produce bricks, which are highly demanded by the construction sector. For the production of bricks, the land was required for establishing the clamp, obtaining clay for bricks, and forming and drying the bricks. Land requirement is an essential issue as brick-fields are established on land that would otherwise be used for the cultivation of rice or secondary food crops (Gomes and Hossain, 2003). Then, after some period of brick production, the land can no longer be used for agricultural purposes as it becomes a fully degraded, unleveled, and un-reclaimed land. So, either it is abandoned to become a wasteland or used for non-agricultural purposes (Singh and Asgher, 2005).

In Southeast Sulawesi, in recent years, an increasing number of farmers have shifted from rice farming to other crops or other types of livelihoods (Fausayana et al., 2019; Sari et al., 2019; Wulandari et al., 2019). For example, Abenggi village in South Konawe District, which has been known as a rice producing village for many years (Saediman et al., 2019b), no longer had rice farming in 2018. Rice farmers shift to brick production or other crops such as melon, watermelon, and chili. Economic returns from brick production are significantly higher than that of rice farming. Therefore, higher returns is one of the drivers of livelihood shifting (Saediman et al., 2019b). The factors that motivate the shift may be termed as push factors and pull factors (David, 2006; Kainth, 2010). Push factors are compelling conditions that push farmers out of the original livelihood, while pull factors are attractive conditions that lure them into entering the new livelihood. In this regard, there is a need to ascertain other drivers of livelihood shifting and the importance of the level of returns among those other drivers.

This study aimed to find out the major drivers of livelihood shift from rice farming to brick production. Specifically, this study is intended to (1) find out push and pull factors that are responsible for the livelihood shift, and (2) analyze the importance of each factor in each group of push and pull factors. Information concerning the factors is essential to provide recommendations for anticipating and addressing the issue of livelihood shift.

MATERIALS AND METHODS

This study was conducted in November 2018 and was a follow-up from the previous study which had been reported in Saediman et al. (2019b). Similar to the previous study, the present study was conducted in Abenggi village, Landono sub-district, South Konawe district. During the survey carried out for the present study, it was found that there was no longer rice farming in the village. Rice farmers had shifted to brick production or other crops such as melon, watermelon, and chili.

The study aimed to identify and discuss the major drivers of livelihood shift. Focus Group Discussions (FGDs) and Key Informant Interviews (KII) methods were used to collect data and information. Two FGDs were held; once with a group of brick producers who have operated brick making enterprise at least five years and another one with brick producers who just recently left rice farming and joined brick making. KIIs were held with the head of the village, the head of farmers group, and an experienced brick producer. Information from FGDs and KIIs were described qualitatively.

Data and information were analyzed using the AHP approach. AHP is an analytical method based on pairwise comparison to determine factors or variables with the highest priority (Kurttila et al., 2000). Pairwise comparison is done through a questionnaire with a 9-point scale. The value of 1 means equal importance between the factors being compared, while the value of 9 indicates extreme or absolute importance. The AHP approach used in this study was modified from the SWOT-AHP method (Kahraman et al., 2007; Geo and Saediman, 2019). In this regard, four steps being taken were as follows:

(1) Identification of the push and pull factors

Relevant factors in the push and pull factor were identified through FGDs, KIIs, and review of the literature. The results of the previous study (Saediman et al., 2019b) were also used. The generated factors were then reviewed and put in each push and pull group.

Step 2: Pairwise comparison between factors in each push and pull group.

AHP questionnaires were developed for pairwise comparisons between factors within each push and pull group. The researcher team discussed the questionnaire and had a consensus in assigning a relative weight. The pairwise

comparison resulted in the local priorities of the factors within the group. Priority values reflected the researcher team's perception of the relative importance of the concerned factors.

Step 3: Pairwise comparison between the push and pull factors

The factor with the largest local priority value was selected from each group of the push and pull factors. Similar with Step 2, a pairwise comparison was performed for these two factors to obtain the group priority value. The group priority value reflected the relative importance of a group compared to the other.

Step 4: Calculation of the global priority value.

The group priority value was then multiplied by the priority value to obtain the global priority value. The global priority value reflected the relative importance of a factor relative to all factors in the two groups.

RESULTS

Identification of the push and pull factors

Table 1 presents the significant drivers of livelihood shift from rice farming to brick production. Factors that compel farmers to leave rice farming (push factors) are a higher risk of failure (PS1), uncertainty in demand and price (PS2), declining returns to farming (PS3), lack of irrigation water (PS4), labor shortages (PS5), and lack of collective action (PS6). On the other hand, factors that attract farmers to start brick making business (pull factors) are lower risk (PL1), short cash flow period and year-round availability (PL2), high returns (PL3), low barriers to entry (PL4), high demand (PL5), and availability of raw clay (PL6).

Table 1; Result of pairwise comparison of the push group

Push Factors	GP	Rank
(PS1) Higher risk to failure	0.362	1
(PS2) Uncertainty in demand and price	0.173	3
(PS3) Declining returns to farming	0.113	4
(PS4) Lack of irrigation water	0.245	2
(PS5) Labor shortages	0.065	5
(PS6) Lack of collective action	0.042	6
CR = 0.071		

Pairwise comparison between factors

Tables 1-2 present the results of the pair-wise comparison between factors in each group. Under the push factors, "higher risk to failure" is the highest-rated factor, and "the lack of collective action" is the lowest rated factor. Under the pull factors, "higher returns" is the most rated factor, and "the availability of raw clay" is the least rated factor.

Table 2; Result of pairwise comparison of the pull group

Pull Factors	GP	Rank
(PL1) Lower risk	0.112	5
(PL2) Short cash flow & availability	0.206	2
(PL3) Higher Returns	0.293	1
(PL4) Low barriers to entry	0.178	3
(PL5) High demand for bricks	0.151	4
(PL6) Availability of raw clay	0.059	6
CR = 0.075		

Based on the group priority values in Table 3, push factor has a higher priority value (0.667) than the pull factor (0.333). This means that push factors are more dominant in the process of livelihood shift from rice farming to brick production.

Table 3 and Fig. 1 present the global priority value of each factor. The global priority value indicates the level of the relative importance of each factor on the livelihood shift.

Table 3; Global priority value of all factors in the two groups

Push and Pull Factors	Local priority	Global priority
Push Factors (group priority 0.667)		
(PS1) Higher risk of failure	0.362	0.241
(PS2) Uncertainty in demand and price	0.173	0.116
(PS3) Declining returns to farming	0.113	0.075
(PS4) Inadequate water supply	0.245	0.164
(PS5) Labor shortages	0.065	0.043
(PS6) Issues with farmer organization	0.042	0.028
Pull Factors (group priority 0.333)		
(PL1) Lower risk	0.112	0.037
(PL2) Short cash flow and availability	0.206	0.069
(PL3) Higher returns	0.293	0.098
(PL4) Low barriers to entry	0.178	0.059
(PL5) High demand for bricks	0.151	0.050
(PL6) Availability of raw clay	0.059	0.020

A factor that gets the highest priority value is “a higher risk of failure” (PS1). After this factor, eleven factors in order of priority are “lack of irrigation water” (PS4), “uncertainty in demand and price” (PS2), “higher return” (PL3), “declining returns to farming” (PS3), “short cash flow period and year-round availability” (PL2), “low barriers to entry” (PL4), “high demand for bricks” (PL5), “labor shortages” (PS5), “lower risks” (PL1), “lack of collection action” (PS6), and “availability of raw clay”(PL6).

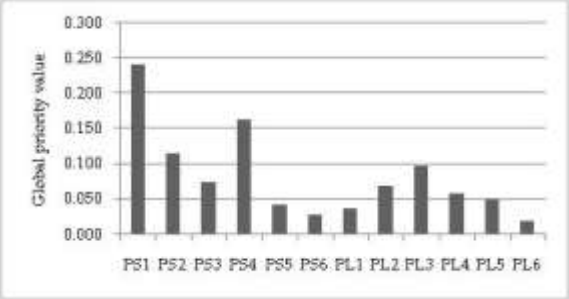

Figure 1; Global priority values of all factors

DISCUSSION

Under the push group, “higher risk of failure” was rated as the most influential factor. Risks consisted of production risk, market risk, and man-made risk (Pasaribu, 2010). Production risk is related to climate change and changes in biotic and abiotic factors. Concerning climate change, respondents discussed erratic rainfall which led to disruptions in cropping schedule, inadequate water supply, and flooding. Biotic and abiotic factors include pest and disease occurrence and soil fertility. Market risk arises due to price fluctuation and imbalance in demand and supply. During harvest, supply is higher than demand so the price of unhusked and milled rice usually decreases. Man-made risk includes non-availability of seeds, fertilizers, and chemicals when needed as well as the quality of production inputs. All of these risks negatively affect yield and farm income and hence lead to farmers’ decisions to leave rice farming.

Water shortage and lack of collection action are the other two factors in the push category. Water shortage is not only related to erratic rainfall, but also to less functioning of irrigation system and water management. Irrigation in the study village still depends on rain and farmers said there had been damage in irrigation outlet leading to the non-properly functioning of irrigation system. Water management is needed to govern the water usage allocation among farmers, and it is usually done by the Water Users’ Association (WUAs) and Farmer Groups. However, the WUAs and Farmer Groups are not so active when many of their members quit farming. Active farmer organizations are needed to solve many issues in rice farming. Since rice is both labor and water-intensive crop, good collaboration among farmers is needed to resolve any issues in rice farming (Ruan et al., 2015). For example, farmers need to collaborate to do concerted planting, build an irrigation system, coordinate water usage, coordinate pest and disease control, and share costs of irrigation facilities construction and maintenance. According to respondents, the rodent attack was getting more severe and challenging to address. Less-functioning of farmers organization will make collective action difficult to implement. In such a condition, there had been frequent harvest failure due to water shortage and pest and disease occurrence.

The labor shortage is rated as one of the factors under the push category. The labor shortage is directly caused by the shift of farmers from rice farming to brick production. Different from other types of jobs where workers can return to work in rice farming during peak cropping season, brick production is a labor-intensive enterprise that does not enable the workers to do so. The labor shortage will generate constraints in rice farming operations as some activities need collaboration among farmers and need much labor during peak season (such as planting and harvesting). The shortage of farm labor leads to an increase in the real wages of farm laborers, both of which encourage rice farmers to leave farming. This result is consistent with the finding of Gurung et al., (2016) that labor shortage coupled with increased labor cost are principal reasons for rice farmers in Bangladesh to shift to aquaculture. Rajalakshmy (2006) reported that the increased cost of farm laborers was one of the factors that drove the shifting from rice farming.

Less profit from rice farming is one of the factors under the push category. The profitability of brick production is significantly higher than that of rice farming (Saediman et al., 2019b). Increased labor wages, relatively low prices of rice, and low productivity are three factors that lead to such low profitability of rice farming. Some of the factors that lead to low productivity might include the use of non-certified seeds, lack of fertilizer use, poor soil quality, unsuitable pest and disease management practices, and inadequate water supply. Among these, respondent farmers

mentioned pest and disease outbreak, especially rodent attack, as the major problem that was difficult to address. Difficulty in resolving rodent attack was not only related to lack of collective action, but also to the fact that many rice fields being fallowed or cultivated with other crops facilitated the conducive habitat for rat to grow and thrive.

Uncertainty of price and demand is one of the factors identified under the push factors. During harvest, the bulk supply of rice usually leads to a reduced price. The lack of storage facilities and the immediate need for farmers to repay their debts force them to sell their produce soon after harvest. Most of the farmers sold their produce to the buyers in the village, usually the owner of the rice mill. There is also the quality issue of the rice, especially when the harvest season was on the excessive rain period. The result of these conditions is the low price received by farmers. Therefore, the majority of farmers sold their produce at a price level lower than they expect to receive. All of these problems led to low rice yield and declining farm returns.

Under the pull factors, higher returns are the most rated factor. Previous study results revealed that the net income in brick making is higher than in rice farming, and the difference is statistically significant. This finding indicated that the level of economic returns was one of the primary factors for farmers to leave rice farming. This agrees to findings reported in David (2006) and Buyinza et al., (2009) that the level of income is an essential reason for villagers to involve in non-agricultural activities.

Study results also indicated that revenues from brick making were much higher than that of rice farming. Higher revenues meant higher total turnover, which was distributed to all of those involved in the business. In fact, in addition to the brick owner-operators, many villagers were getting benefits from employment in the brick kiln, transportation of bricks to the consumers' sites, and sale of fuelwood. In addition to two family workers, each brick clamp employed at least two hired workers who got daily wages. More certain, quicker and higher wages attracted village labor to work in the brick-making than in rice farming. The village administration could get benefits from the collection of cash contributions from brick-making enterprises. Local businesses also got indirect benefits. Indeed, the high turnover in the brick making had multiplier effects in other related economic activities in the village. Brick making can have many positive effects on employment generation, not only in the brick sector itself but also in other sectors as a result of its multiplier effect.

The FGDs revealed that respondents considered the level of income from both rice farming and brick making as low. For many brick producers, however, having shed or uncooked bricks helped them a lot to take a loan from brick intermediaries or to buy daily necessities on credit in the nearby kiosks. In this regard, in addition to the level of returns, respondents indicated the short period of cash flows and more stable income in the brick making as the factors that led to their decision to enter the business. Shorter production cycle means that brick producers and workers can get cash much quicker than in rice farming.

Low barriers to entry, raw material availability, high market demand, and lower risk are other pull factors that attract villagers to shift to brick production. Brick making has some characteristics that make everyone able to enter the business quickly. They include the use of traditional technology, ease of operation, and low start-up capital (Saediman et al., 2014; Saediman, 2016).This result corroborates the findings of Kumbhar et al., (2014) that traditional brick making has advantages of lower capital cost, use of traditional knowledge, and availability of raw material. The use of traditional technology enables anyone to learn and practice the brick making. The notable investment cost is only for the establishment of the shed, whereas tools and equipment needed consist of hoe, wooden mold, and bucket, which can be bought and repaired within the local community (Saediman et al., 2014; Saediman, 2016). A clamp is made under the shed close to the house, and soil quarrying is done near the clamp to obtain at no cost the clay as the primary raw material. Fuelwood is still widely available in the village; a forest near the village was recently cleared for oil palm plantation, so wood waste and forest residues for fuelwood are abundant. High demand for bricks by the construction industry is spurred by the economic growth and preference of people to houses made of stone instead of wood. Weather condition is the only difficult constraint in brick making, so overall it is regarded as less risky compared to rice farming.

As a result, rice farming was regarded as a higher risky livelihood and had gradually lost its comparative benefits compared to brick making and other crops. This result is in line with a study by Reardon et al., (2000) that pull factors will be at work when economic returns are relatively higher

to non-farm employment than to farming, and returns to farming are relatively riskier.

Pair-wise comparison between the push and the pull factors indicated that the push factors are more dominant drivers in the livelihood shift. This can be seen from the global priority values, in which the first three most influential factors are from the push group. These results imply the challenges facing rice sector in the study village and in other areas in the province. While brick making provides more benefits in terms of employment generation, income distribution, and economic growth, in the long-term a livelihood shift from rice farming to brick production will have serious implication for agriculture (Islam et al., 2015; Kathuria and Balasubramanian, 2013) and environmental quality (Alam and Starr, 2009). Therefore, there should be integrated efforts to maintain competitiveness and comparative benefits of rice farming, and at the same time ensure more sustainable practices in brick production.

CONCLUSION

The factors that have driven the livelihood shift from rice faming to brick production consist of the push and pull factors. The push factors that compelled farmers to quit rice farming, in order of priority, are a higher risk of failure, inadequate water supply, the uncertainty in price and demand, declining returns to farming, labor shortage, and less functioning farmers' organization. The pull factors that attracted farmers to enter brick making business, in order of priority, are higher returns from brick production, short cash-flow period and year-round availability, low barriers to entry, high demand for brick, lower risk, and availability of raw clay. The push factors were more dominant than the pull factors, meaning that the push factors were more responsible for the livelihood shift than the pull factors. Brick making offers more benefits in terms of employment generation, income distribution, and economic growth, but a shift from rice farming to brick production has serious implication for agriculture, food security, and environmental quality. Therefore, there should be integrated policies and programs to ensure competitiveness and comparative benefits of rice farming, and at the same time ensure more sustainable practices in brick production.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

All authors contributed equally in this research, from the design, data collection, data input and processing, data analysis, manuscript writing, and manuscript finalization. All authors had reviewed and approved the final manuscript.

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