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THE IMPACT OF RURAL ROAD REHABILITATION ON RICE PRODUCTIVITY AND FARMERS INCOME IN KEMANG VILLAGE, CIANJUR, WEST JAVA, INDONESIA

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ABSTRACT

This paper sought to evaluate the impact of road rehabilitation on rice production and farm income in Kemang Village, Cianjur West Java. The study used survey data collected from 1998 until 2005. Cobb Douglas production function was used to analyze the effect of production factors and road rehabilitation on rice production and farmers' incomes. Road rehabilitation decreases the input-output price ratio and raises the use of input. Higher use of inputs increased production cost, however it lead to higher rice production in all land ownership strata. Road rehabilitation had significant impact on rice productivity. Additional revenue after road rehabilitation was much higher than the additional cost of production, as a result, the rice farming income in all strata increased. Furthermore, road rehabilitation also increases the non-rice farm income and off-farm income in all land ownership strata.

Key words : input-output price ratio, production cost, rice productivity, rice income, non-rice on-farm income, off-farm income.

INTRODUCTION

Road infrastructure is very important to maintain the distribution of goods, both consumer and production goods, and factors of production from one region to another. Mosher (1968) stated that road is the first infrastructure to be built to support agricultural development. Good roads will lower transportation cost that lead to reduce input prices paid by the farmers. Research with data from developing countries conducted by Antle (1983) demonstrated the importance of transportation infrastructure in increasing aggregate agricultural productivity. Queiros and Gautam (1992) also showed a significant and positive correlation between roads and economic development using cross section data analysis covering 98 countries in the United States between 1950 and 1988. Similar finding in Java, Indonesia also concluded the importance of the road in improving agricultural production. If the length of roads could be increased by 10%, it will increase the demands of fertilizers: urea by 4.92% and and TSP 5.30%. These increasing demands for fertilizers have resulted in increasing production of rice, maize, groundnuts and cassava by 2.23%, 8.90%, 9.82%, 9.34% and 2.99%, respectively (Hartoyo, 1994).

Rehabilitation of roads will reduce transportation costs (Rietveld and Nijkamp, 1992; Badatya and Gopakumaran, 2004). This reduction in transport costs will lower the prices of external inputs paid by farmers, such as fertilizers and pesticide. Ahmed and Hossain (1990) also showed a negative correlation between the prices of fertilizers and the index of underdeveloped transportation

roads. Fertilizer prices in a region with better road infrastructure are lower compared to the poor one. Rehabilitation of roads also could increase output prices received by farmers. Minten (1999) showed that the improved quality of road infrastructure will cause the output price increased significantly. In addition, the rehabilitation of roads also leads to an increase in the frequency of extension workers to visiting their working villages, which in turn increases productivity (Badatya and Gopakumaran, 2004). Another study conducted by Inoni and Omotor (2009) revealed that quality of road could have statistically significant effects on agricultural output and rural household income. Improvement of rural road quality by 10% will increase of agricultural output by 12% and income by 2.2%, respectively.

This study focuses on the impact of a 5 km road rehabilitation between Pangawaren hamlet, Sukaratu village and Kemang Village in the District of Cianjur, West Java that was conducted in 2002. This is the only road to Kemang Village. Before the rehabilitation, road condition was very poor. The roads were narrow and winding with sharp turn, which cause only trucks and motorcycles could pass this road. As a result, cost of transportation in Kemang Village was expensive. After the road improvement, all vehicles can easily pass in and out of the village. This research is designed to asses the impact of road rehabilitation on rice production and farmers' incomes in Kemang Village.

THEORETICAL FRAMEWORK

Theoretically, the impact of road rehabilitation on the production and farmers' income could be described by Figure 1. As stated before, the rehabilitation of the road could decline prices of inputs paid by the farmers and increase prices of outputs received by the farmers. These conditions resulted in a decline in the ratio of input prices to output prices, as shown by a movement from v_1 to v_2 in Figure 1. In addition, the rehabilitation of roads also leads to increase frequency of agricultural extension workers to visits the farmers, which could improve the knowledge and technology application of the farmers. Improvement of technology application can be represented by an upward shift in the production function (total production, TP) curve, from TP_1 to TP_2, and shift the marginal physical product (MPP) curve, from MPP_1 to MPP_2. Assuming that farmers maximize the profits, then the optimal input use is achieved when MPP equals to the input-output price ratio (v).

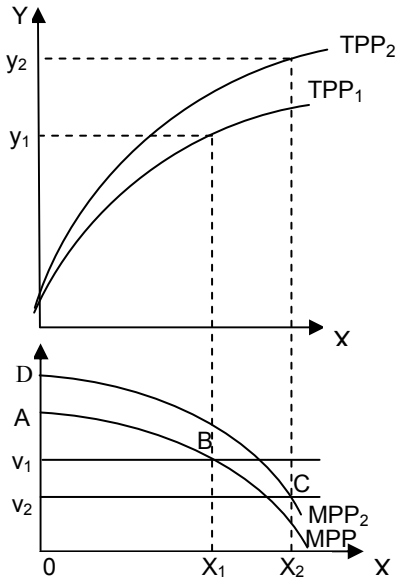

Fig. 1. Impact of road rehabilitation on rice production and income

Optimal input X use before road rehabilitation is achieved when the input-output price ratio v_1 equals MPP1 i.e., at X_1. After the rehabilitation of the roads, the optimal input use occurs when the input-output price ratio v_2 equals MPP_2 i.e., at X_2. The increased of inputs will lead to increased productivity, from y_1 to y_2, which in turn led to increasing farmers' income. In Figure 1, increase of farmers' income is shown by an increase in the area from ABv_1 to be DCv_2.

DATA AND SOURCES OF DATA

The research was funded by Japan Society for the Promotion of Science (JSPS) and Directorate General of Higher Education Indonesia (DGHE) under the theme of "Toward Harmonization between Development and Environmental Conservation in Biological Production". Institutions involved in the study were the University of Tokyo and the Bogor Agricultural University within the framework of Japan-Indonesia cooperation.

The study in Kemang Village, Cianjur district was conducted in the period of 1998-2006. Most of the farmlands in Kemang Village are dry land, which covers 84.7 percent of the total village land areas, while the rest (15.3 percent) is wetland areas (Mugniesjah and Mizuno, 2007). Although the wetland area is much smaller than the dry land, the average household income of rice farm was higher than that of dry land. In 1998, the average household income from rice farming was Rp 1.39 million, while the average income from dry land was Rp 0.86 million (Mugniesjah and Mizuno, 2003).

Data collected through household survey includes characteristics of farm household, farm and household income during the year. The survey was conducted in 1998, 1999, 2000, 2003 and 2005, subsequently. The study period captured the conditions of households of Kemang Village before and after the rehabilitation of roads, which was implemented in 2002. The numbers of respondents surveyed in this paper were 56 households - in each survey. In the wet land area with good irrigation, rice can be planted twice a year, in the rainy season and dry season. Totally, there were 364 observations that can be used for the analysis of the impact of road rehabilitation on rice production and farm income.

METHOD OF ANALYSIS

Cobb Douglas production function is used to analyze the impact of road rehabilitation on farm productivity and income. The function is expressed as follows:

$$\hat{Y} = \prod_{i=1}^{6} A X_1^{b_i} e^{b_7 + b_8}$$

where Y is rice production per season (in quintal), X1 is the area of arable land (in hectares), X2 is rice seeds used (in kg), X3 is urea fertilizer used (in kg), X4 is the other fertilizers used (in kg), X5 is total value of pesticides used (in Rupiah), X6 is labor is used (in man-days), e is natural number (e = 2.7283 ...), D is a dummy variable with value 1 for after road rehabilitation and the value 0 for before rehabilitation of roads, and b_i is the notion of parameters and T is trend. Trend variables included in the model Cobb Douglass production function to determine the effect of environmental change on rice production during the study period (1988-2005). By entering a trend variable in the model, it is expected that the dummy variables reflect only on the impact of road rehabilitation.

RESULTS AND DISCUSSION

Kemang Village is one of the village in Bojongpicung subdistrict, Cianjur District, West Java. This village is an upland area that is surrounded by national forest land managed by Perhutani.

Total village area is approximately 2529 hectares which consists of 1040 ha of forest land (43.5%), 87.8 ha of wet land, 878.6 ha of dry land and others by 20 ha. The population of this village in 1998 was 4346 people; with the number of households was 1398. The main occupation of population this village is farmers, farm laborers, traders, and transportation services ((Mugniesjah and Mizuno, 2007). In addition to farming in their own land, some people also cultivate at National Forest Land (NFL). Based on farmers' land ownership sample, the average size of land cultivated is presented in Table 1.

Table 1. Average land cultivation before and after road rehabilitation.

Strata Land Ownership (Hectare)	**Average Land Cultivation (Hectare)**		
	Wet Land	**Dry Land**	**Total**
Before Rehabilitation			
I (<0.50)	0.096	0.160	0.256
II (0.50 - <1.00)	0.113	0.584	0.697
III (≥ 1.00)	0.325	1.739	2.060
Total	0.192	0.896	1.087
After Rehabilitation			
I (<0.50)	0.102	0.525	0.627
II (0.50 - <1.00)	0.118	0.854	0.972
III (≥ 1.00)	0.342	1.759	2.101
Total	0.209	1.192	1.401
Change			
I (<0.50)	0.006	0.365	0.371
II (0.50 - <1.00)	0.005	0.270	0.275
III (≥ 1.00)	0.017	0.020	0.041
Total	0.017	0.296	0.314
	8.9	33.0	28.9

Before road rehabilitation, the average size of wet land cultivated was 0.192 ha, and after rehabilitation it increased to 0.209 ha, or on average increased only by 0.017 ha (Table 1). In other words there are no significant changes in size of wet land. This situation is occurs in every strata of land ownership. One main reason is there is no irrigation improvements during time observation. Most of the wet land in Kemang village was cultivated by paddy.

Meanwhile, the size of dry land increased significantly. Before rehabilitation, the average size of dry land was 0.896 ha, but after rehabilitation, it increased to 1,192 ha, or increased by 0.296 ha (33%). The significant increase was especially occurring in small farmer, namely in strata I and II, since they have access to cultivate in NFL. Perhutani gave permission to farmers to cultivate in NFL with the agreement that besides to cultivating food or estate commodities, farmers also have an obligation to maintain forest conservation. After 2002, on dry land, besides food crops and tree crops, also many bananas are cultivated for its leaf. Income from banana leaves was relatively high because it can be harvested every 10 days. In Kemang village there are some traders who buy banana leaves from farmers and then sell it to some markets in Jakarta every two days. The high demand of banana leaves from urban market influence farmer’s income.

Impact of Road Rehabilitation on Factor Prices

As previously explained, roads rehabilitation will lead to decreased of transportation costs, which then decrease factor prices and an increase output prices (Rietveld and Nijkamp, 1992; Badatya and Gopakumaran, 2004). The prices of inputs before and after road rehabilitation were presented in Table 2. Output and input prices changed from year to year, in part, due to inflation. Therefore, to reduce the impact of inflation, the prices of inputs – before and after rehabilitation – were divided by the price of husked-rice (*gabah*) at harvest time. The average price of rice seed before the rehabilitation of the road was equivalent to 1.35 kg of husked-rice before the rehabilitation, and decline to 1.21 after the rehabilitation (Table 2). The decline of seed price was due to the decrease of transportation costs from the Bojongpicung subdistrict, where farmers used to buy inputs, to Kemang village. This means that the rehabilitation of roads could reduce seed price by an average of 10.2 percent.

Table 2. Changes of input-output price ratios: Before and after road rehabilitation

Input Production	Before Rehabilitation (equivalent of kg husked-rice)	After Rehabilitation (equivalent of kg husked-rice)	Change	
			(equivalent of kg husked-rice)	Percent (%)
Seed	1.35	1.21	-0.14	-10.2
N Fertilizer	0.98	0.94	-0.04	-3.9
Other Fertilizers	1.35	1.14	-0.21	-15.8
Wage Rate	1.36	1.55	0.19	13.6

The price of nitrogen fertilizer also declined (Table 2). Before rehabilitation of the road, the average price of nitrogen fertilizer equivalent to 0.98 kg of husked rice, but after rehabilitation, it decreased to 0.95 kg of husked rice. Therefore, the rehabilitation of roads could reduce price of nitrogen fertilizer by 3.9 percent. The same trend was also seen for other fertilizers (P and KCl fertilizers). The prices of other fertilizers decline by an average of 15.8 percent after road rehabilitation.

Change in wage rate as a result of the road rehabilitation showed a different trend. Before road rehabilitation, average wage rate per day was 1.36 kg of husked-rice equivalent. It increased to 1.55 kg of husked-rice equivalent after road rehabilitation, or an increase of 13.6 percent. However, transportation became cheaper after the rehabilitation. Therefore, agricultural workers could have more job opportunities, both in agricultural and non-agricultural sectors, in other villages or even in the other cities. As a result, wage rate of agricultural labor increased. This result was in line with the previous research conducted by Ahmed and Hossain (1990).

Impact of Road Rehabilitation on Production Inputs

Farmers of Kemang Village usually purchased their factors of production (inputs) to agricultural kiosks in Bojongpicung Sub–district. There were actually 3 agricultural kiosks in Kemang Village. However, with lower transportation costs, the farmers prefer to purchase their required inputs directly to Bojongpicung Sub-district, though 3 kiosks in their village could supply all the farmers' needs.

Changes in input-output prices ratio affected the use of inputs of the farmers. The average uses of inputs before and after road rehabilitation were presented in Table 3. Before the road rehabilitation, the average use of seed was 77.9 kg per hectare, and after road rehabilitation the

average use of seeds increased to 88.3 kg per hectare (increased by 13.3 percent). The average use of seeds in strata I and II was higher than in strata III. Farmers in strata I and II, mostly used lower quality seed from the previous harvest. The use of paddy seeds was much higher than recommendation, which was about 25-30 kg per hectare, since they used seeds from their previous harvest which had poor quality (Hartoyo, Mizuno and Mugniesjah, 2003). Due to this condition, it was reasonable for farmers to use more seeds than its recommended rate.

Table 3. Average inputs used before and after road rehabilitation

	Inputs				
Strata	**Seed (kg/ha)**	**N Fertilizer (kg/ha)**	**Other Fertilizer (kg/ha)**	**Family Labor (MH/ha)**	**Hired Labor (MH/ha)**
Before Rehabilitation					
I	93.3	254.9	162.6	689	717
II	102.9	258.2	166.8	717	709
III	65.6	266.9	165.0	424	727
Total	77.9	263.3	164.9	520	722
After Rehabilitation					
I	117.2	296.2	228.0	706	663
II	90.6	329.4	230.9	800	644
III	73.9	347.0	246.8	547	816
Total	88.3	330.4	236.8	635	744
Change					
I	23.9	41.3	65.4	17	-54
II	-12.3	71.2	64.1	83	-65
III	8.3	80.1	81.8	123	89
Total	10.4	67.1	71.9	115	22
%	13.3	25.5	43.9	22.7	3.0

The use of fertilizer N increased from 263.3 kg to 330.4 kg per hectare after the road rehabilitation. Similar trend occurred in the use of other fertilizers. The use of other fertilizers increased from 164.9 kg to 236.8 kg after road rehabilitation. Based on the size of land ownership, it can be shown that land ownership have positive correlation with use of fertilizer. Farmers with higher land ownership have higher increased use of fertilizers, both fertilizer N and other fertilizers. The increase in the use of fertilizer N as a result of road rehabilitation on strata I, II and III were 41.3 kg, 71.2 kg and 80 kg per hectare, respectively, and other fertilizers is 65.4 kg, 64.1 kg and 81.8 kg per hectare, respectively. It appears that the rich farmers can take more advantage of the road rehabilitation for rice production enhancement through increased use of fertilizer. The increase in fertilizers uses were not only due to decrease in the price ratio of fertilizer to the price of husked rice, but also due to the rehabilitation of roads. Improved road conditions caused the distribution of inputs more smoothly from the city to the village, so that farmers can optimize the use of fertilizers.

The use of labor, both family and hired labor, increased after the rehabilitation of roads. Use of family labor increased from 520 man-hours to 722 man-hours per hectare, while the use of hired labor increased from 635 man-hours to 744 man-hours per hectare. Based on the size of land ownership, it can be shown that the greater the size of land ownership, the greater the increase in the use of family labor. Increased use of family labor for farmer's strata I, II and III were 17 man-hours,

83 man-hours and 123 man-hours per hectare, respectively. This occurs because the use of family labor in strata III was relatively smaller than the strata I and II. Meanwhile, the use of hired labor on strata I and II decline, on the contraty the use of hired labor in the third strata increased. Decline in the use of hired labor in strata I and II because wage of farm laborers increased by 13.6 % after road rehabilitation (Table 3). Increased use of family labor was much higher than the increased use of hired labor. After the rehabilitation of roads, the use of fertilizers intensively increased. The use of more fertilizers not only resulted in higher rice growth and production, but also faster growth of weeds. Therefore, farmers had to increase the use of labor, especially family labor, for weeding. This phenomenon occurred if only the additional revenue as a result of additional labor was higher than the additional labor costs.

Impact of Rehabilitation of Road on Production

Rice production is not only determined by the amount of production factors used in the production process, but also indirectly affected by the quality of road infrastructure. Impact of road rehabilitation on production could be assessed from the estimated of production function parameters which are presented in Table 4. Variance of Inflation Factors (VIF) for all variables is smaller than 3, indicating that there is no multicollinearity. Under these conditions, the results of the production function estimation can be used for further analysis.

Table 4. The estimated rice production function

Variable	Coefficient	t-value	P value > 0
Constant	2.692	10.38	< 0.001
Size of land holding	0.625	12.29	< 0.001
Seeds	0.184	3.34	< 0.001
N Fertilizer	0.090	1.58	0.057
Other Fertilizers	0.024	1.90	0.029
Pesticides	-0.003	-0.58	0.282
Labor	0.192	3.20	< 0.001
Trend	0.021	0.48	0.314
Road Rehabilitation	0.262	1.96	< 0.023
F ratio	82.04		< 0.001
R^2	0.6490		

Table 4 showed that the coefficient of determination (R^2) of the model is 0.649 which meant that about 65 percent of the variation in production can be explained by variations in the independent variables: land size, seed, N fertilizer, other fertilizers, labor, chemicals and road rehabilitation. In addition, it also showed that the value of F ratio is 82.04, which is significant at the level of less than 0.1 percent, indicating that at least one variable included in the model have a significant effect on rice production.

Variables of land size, seed and labor have positive signs and statistically significant at the level of less than 0.1 percent. N fertilizer and other fertilizers have positive sign and significant at the level of less than 6 percent. Coefficients of production function for land size, seed, N fertilizer, other fertilizers, and labor are 0.625, 0.184, 0.090, 0.024 and 0.192, respectively, indicating that the elasticity of production for each input. If the land size, seed, N fertilizer, other fertilizers and labor each increase by 10 percent, assuming other factors are constant, then rice production will increase by 6.25, 1.84, 0.90, 0.24 and 1.92 percent, respectively.

Coefficient variable of pesticides has a negative sign, but not significant at the level of 10 percent, meaning that the pesticide does not have a significant effect on rice production in Kemang Village. The negative sign of pesticides coefficient does not indicate the excessiveness of pesticide applications. In general, farmers in the village of Kemang use pesticides only if there has been a pest-disease symptom. This could be interpreted that the use of pesticides is applied only for eradicating pests and diseases, and not for preventive purposes. Therefore, it is reasonable for pesticides to have no-significant effect on rice production in Kemang (Hartoyo, Mizuno and Mugniesjah, 2003).

Coefficient of the trend variable has a value of 0.021 which is not significant at the 10% level, indicating that the changes in rice production environments during the study period had no significant effect on rice production. In addition, it can also be inferred that during the study period (1998-2005) there was no improvement of irrigation infrastructure. So it is reasonable if the trend variable had no effect on rice production.

A dummy variable coefficient for road improvement is 0.262 and significant at the level of less than 2.5 percent. In addition to have an influence on input-output prices ratio and input use, rehabilitation of roads also has a significant positive impact on production. This means that, after the rehabilitation of the roads, the productivity of rice per unit of input is higher than before. This finding is inline with those of Inoni and Omotor (2009), Ajiboye and Afolayan (2009) and Tunde and Adeniyi (2012) in Nigeria, where quality of transportation will increase agricultural production.

Impact of Road Rehabilitation on Rice Incomes

Estimated rice incomes before and after road rehabilitation are presented in Table 5. In this analysis, to reduce the effects of inflation, the revenue, costs of production and income are expressed in units of output prices, or the equivalent price of husked rice.

As explained before, rice production increased with road rehabilitation. Increased rice production will increase revenues of rice farming. Before road rehabilitation, farm revenue is equivalent to 4,293 kg of husked rice and increase to 4,908 kg after the rehabilitation (increase by 14.3 percent). Increased production also occurs in every stratum. Table 5 shows that the greater of the land ownership, the higher the increase in rice production. Increased in rice production in strata I, II and III respectively were 457.1 kg, 476 kg and 768.5 kg of husked rice equivalent per hectare. This is consistent with the increased use of inputs, especially fertilizer urea, other fertilizers and labor. The use of these inputs is positively correlated with the size of land ownership (Table 6). At the same time, rehabilitation of roads also increases the use of inputs, which lead to increase costs of production. Before the rehabilitation of roads, the average costs of seed, N fertilizer, other fertilizers, and hired labor are equivalent to 105.2, 258.1, 222.6 and 981.8 kg of husked rice, respectively.

After the rehabilitation, the average costs of seed, N fertilizer, other fertilizers, and hired labor are equivalent 106.8, 52.5, 47.4 and 171.3 kg of husked rice, respectively. Indicating that there increased in the costs of production ranges from 1.5 to 21.3 percent (Table 5). Based on the size of land ownership, it can be seen that the higher the level, the higher the increase in production costs. Increased production costs in strata I, II, and III, respectively for 136.7 kg, 187.7 kg and 375.3 kg of husked rice equivalent. In general, rehabilitation of road has increased total costs of production from 1,567.8 kg to 1,840 kg of husked rice equivalent (increased by 17.4 percent). However, this increase in cost of production is still lower than its increase of farm revenues. This indicates that the rehabilitation of roads could increase the income of rice farming, from 2,725.2 kg to 3,067.4 kg of husked rice equivalent (increased by 12.6 percent). The Increased rice farming income was occur in all strata. However, increase of farmers 'income of strata III is higher than others. This means that the rehabilitation of the road has a positive impact on the productivity and income of rice. This impact

can be perceived by all strata, however farmer's strata III gained a greater positive impact than others. These are in line with Inoni and Omotor (2009), Ajiboye and Afolayan (2009) findings, which showed that an improvement in transportation facilities will increase households' income in Nigeria.

Table 5. Effects of road rehabilitation on rice income

Strata	Revenue (equivalent kg of husked-rice)	Cost (equivalent of kg husked-rice)					Income (equivalent of kg husked-rice)
		Seed	N Fertilizer	Other Fertilizer	Hired Labor	Total	
Before Rehabilitation							
I	4149.7	118.5	247.0	208.3	942.2	1516.1	2633.6
II	4229.7	131.3	254.5	227.6	959.2	1572.7	2657.0
III	4348.4	94.9	262.1	225.2	998.4	1580.6	2767.9
Total	4293.1	105.2	258.1	222.6	981.8	1567.8	2725.2
After Rehabilitation							
I	4606.8	125.6	281.9	235.8	1009.5	1652.8	2954.1
II	4705.7	112.4	310.1	268.7	1069.3	1760.4	2945.3
III	5116.9	96.0	324.3	286.7	1248.8	1955.9	3161.0
Total	4908.0	106.8	310.6	270.0	1153.2	1840.0	3067.4
Change							
I	457.1	7.0	34.9	27.5	67.3	136.7	320.5
II	476.0	-19.0	55.6	41.0	110.0	187.7	288.3
III	768.5	1.2	62.2	61.5	250.4	375.3	393.2
Total	614.9	1.6	52.5	47.4	171.4	272.8	342.0
%	14.3	1.5	20.3	21.3	17.4	17.4	12.6

Impact of Road Rehabilitation on Household Incomes

Data on household income in Kemang village is relatively limited, so not all of their income can be presented in this paper. In this paper, household incomes are derived from rice, non-rice crops such as grains, bananas, other crops and non-agricultural income, such as non-agricultural labor, carpentry, transportation services (motorcyle taxi) and trade. The comparison of household income before and after the rehabilitation of the road is presented in Table 6.

The household income derived from rice has increased 11.3 % from 792.9 kg to 882.3 kg of husked rice equivalent (Table 6). Increase in household income from rice is smaller than the increase in income per hectare of rice (12.3%) whereas paddy land size increased (8.9%). This situation occurs since not all wet land can be cultivated with paddy during the dry season. In addition, with the increase in revenue from banana leaves, some farmers cultivate bananas in the wet land. The increase in revenue derived from rice also occurred in all strata land ownership. Farmers with strata III gained the highest increase in revenue.

The income of non-paddy likewise increased (Table 6). Before the road rehabilitation, income from non-rice equivalent is 1997.3 kg of grain, and after the rehabilitation of roads, non-rice income has increased to 3013 kg grain equivalent, or an average increase of 50.8%. Increased size of dry land cultivated (33%) which led to the increase in non-rice income is very high. Based on the

strata, it can be shown that the increase in non-rice income on strata I and II are higher than on strata III. After the rehabilitation of roads, non-rice income on strata I, II and III has increased respectively to 1113.8 kg, 1237.5 kg and 818.1 kg of grain equivalent. It was as a result of the increased size of arable dry land on strata I and II was higher than that of on strata III.

Household incomes from non-agriculture are positively related to the size of land ownership. The higher size of land ownership correlates with the higher non agricultural income. This situation occurs, both before and after rehabilitation of road. Rehabilitation of the road has a positive impact on non-agriculture income. Before the rehabilitation of roads, non-agriculture income was 2866.3 kg grain equivalent, but after road rehabilitation these income has increased to 4090.6 kg grain equivalent, or an average increase of 42.7%. The highest increase in non-agricultural income occurred in strata II since many family members works as non-agricultural laborers, both within and outside the village. Better road condition lead to increase in non-agriculture employment activities outside the village and district. The increase in income was not only caused by higher activity of non-agriculture jobs outside the village, but also due to lower transportation costs.

Table 6. Impact of road rehabilitation on household income

Strata	Source of Household Income (equivalent of kg husked rice)			Total (equivalent of kg husked rice)
	Rice	Non-Rice	Non –Agriculture	
Before Rehabilitation				
I	485.9	1709.8	1682.8	3878.4
II	529.1	1726.1	790.2	3045.4
III	1229.3	2421.3	5218.3	8868.8
Total	792.9	1997.3	2866.3	5656.5
After Rehabilitation				
I	576.9	2823.6	2584.5	5985.0
II	606.4	2963.6	4047.7	7617.7
III	1394.6	3239.4	5628.7	10262.7
Total	882.3	3013.0	4090.6	7985.8
Change				
I	91.0	1113.8	901.7	2106.5
II	77.3	1237.5	3257.5	4572.3
III	165.4	818.1	410.5	1393.9
Total	89.4	1015.6	1224.3	2329.3
%	11.3	50.8	42.7	41.2

CONCLUSION

This study discusses the impact of road rehabilitation on rice production and farm income in Kemang Village. The findings show that the road rehabilitation has an influence on the prices of inputs purchased by farmers, such as seed and fertilizers. Rehabilitation of roads declined the ratios of the input prices (seed and fertilizers) relative to husked rice price. However, the ratio of wage rate to the price of husked rice is increasing because there is higher opportunity for farm labor to work both in agricultural and non-agricultural sectors in the city or outside the village.

The decline in input-output price ratio led to increase in the use of production factors, which in turn led to increased production costs as well as farm revenues. The increased revenue is much higher than its associated costs, which results in higher farm income. Increased productivity, revenues and income of rice farming, not only occur for large farmers, but also for small farmers. The increase is related to the size of land ownership. The large size of land ownership, the higher the increase productivity, revenue and income per-hectares. Therefore, rehabilitation of roads can increase rice production and incomes of the farmers in rural areas.

Overall, rehabilitation of the road also has a positive effect on household income from non-rice farming and non-agricultural activities. However, for the larger size of land owned, the increase of non-rice farming and non-agricultural income was smaller. Road rehabilitation can therefore improve the welfare of farmers.

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