Effect of fertiliser subsidy on fertiliser usage in rice farming in Indonesia

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Abstract. The Indonesian government has implemented a fertiliser subsidy policy to increase rice production. Most previous research utilised limited samples and focused on the overall impact of fertilisers on production. In this research, the scope is Indonesia and focuses on the impact of fertiliser on the different combinations of fertiliser usage and classified between subsidised and non-subsidised farmers. The objective of this research was to analyse the effect of fertiliser usage on the production of subsidised and non-subsidised farmers. The data utilised were secondary data from the Household Survey on Food Crops conducted in 2014 by Statistics Indonesia. A Cobb-Douglas production function was employed for several combinations of fertiliser usage and comparison between subsidised and non-subsidised farmers. BPS-Statistics Indonesia. Meanwhile, for TSP and NPK fertilisers, the increase in production was higher in subsidised farmers. Therefore, rice production can be effectively increased by increasing urea usage by non-subsidised farmers and increasing TSP and NPK fertilisers for subsidised farmers.

1 Introduction

The fertiliser subsidy has been implemented in Indonesia since 1971 to encourage farmers to use fertiliser as a complement to the new, high-yielding rice varieties that were available at that time [1]. In addition, the subsidy's objective is to increase rice production in Indonesia. In 2023, the government subsidised 7.85 million tons of fertiliser consisting of urea and NPK with the amount of 4.64 million tons and 3.21 million tons, respectively. These subsidised fertilisers are allocated to nine commodities: rice, corn, soybean, chilli, shallot, onion, coffee, sugarcane, and cocoa.

Fertiliser subsidies have several impacts on farmers, including increasing efficiency [2], productivity [3], household income [3], fertiliser use [4], and competitiveness [5]. Several studies have also analysed the effectiveness of the fertiliser subsidy, including Osorio et al. [6]. The author utilised the Agriculture Census 2003 and Rice Household Survey 2008 and concluded that farmers received benefits from fertiliser subsidies, but 40% of the large farmers received 60% of the fertiliser subsidy. Proper fertiliser usage has a positive effect on productivity, but over-use of fertiliser has a negative effect on productivity (inverted U-shaped relationship). This research was also supported by earlier research that revealed that

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farmers only receive 7% of the financial subsidy [1]. Most studies on fertiliser subsidy in Indonesia have limited scope, such as Mantau et al. [5] in several districts in Gorontalo Province and Mulyadiana et al. [7] in Karanganyar, Central Java Province.

In addition, there is limited literature analysing the relationship between fertiliser subsidy and usage; even when it is available, the scope is limited to villages or sub-districts. This research also divides fertiliser usage into four combinations based on the largest combination used by farmers, namely: urea; urea and TSP; urea and NPK; and urea, TSP, and NPK. Therefore, the objective of this research is to analyse the effect of fertiliser subsidy on fertiliser usage and the effect of fertiliser usage on production within the scope of Indonesia.

2 Methodology

This research utilised secondary data from the Rice Household Survey in 2014 which is based on information from 2013. The survey respondents were based on the Agriculture Census conducted in 2012. There were 87,330 farmers surveyed from all over the country.

The Cobb-Douglas production function was used to analyse the relationship between fertiliser usage and rice production. The model is divided according to fertiliser usage for subsidised and non-subsidised farmers. The model can be expressed as follows:

$$\mathrm{LnQ_i}=\alpha_0+\sum_{i=1}^{n}\alpha_{in}\mathrm{LnFER_{in}}+\beta_1\mathrm{LnLAND_i}+\beta_2\mathrm{LnSEED_i}+\beta_3\mathrm{LnFLAB_i}+\beta_4\mathrm{LnNFLAB_i}+\beta_5\mathrm{DIRR_i}+\varepsilon_i \quad (1)$$

where:

Q	: unhusked rice production (kg)
FER	: fertiliser usage (kg)
LAND	: harvested land (m^2)
SEED	: amount of seeds used (kg)
FLAB	: family labour (man hour)
NFLAB	: non-family labour (man hour)
DIRR	: dummy irrigation (1=irrigated, 0=non irrigated)

3 Results and discussion

Most Indonesian rice farmers used urea in their farming and combined it with other fertilisers (Fig. 1). Twenty percent of the rice farmers used urea and TSP, followed by urea+NPK (17%), and only urea (12%) (Fig. 1). Differentiating between subsidised and non-subsidised farmers, the fertiliser usage was basically similar. The top three uses were still urea+TSP, urea+NPK, and urea. Meanwhile, the difference in non-subsidised farmers was that 20% of the farmers were not using any fertiliser (Fig. 2).

The usage of urea among rice farmers was relatively high compared to the recommended dosage from the Ministry of Agriculture. The recommended usage dosage, according to the Minister of Agriculture Regulation No. 40 of 2007, was 200 kg per ha for productivity below 5 tons per ha. A similar case was observed for TSP, in which the dosage was higher than the recommendation of 50–150 kg per ha. Meanwhile, for NPK, the dosage was lower than the recommendation of 150–350 kg per ha (Table 1). The high usage of fertilisers, especially for nitrogen and phosphorous, has also been reported by Roche [9] in 1989 and Mariyono [10] using 1985–2000 data. Mariyono [10] revealed three possible reasons for fertiliser over-usage: technological change, analytical model, and government policy.

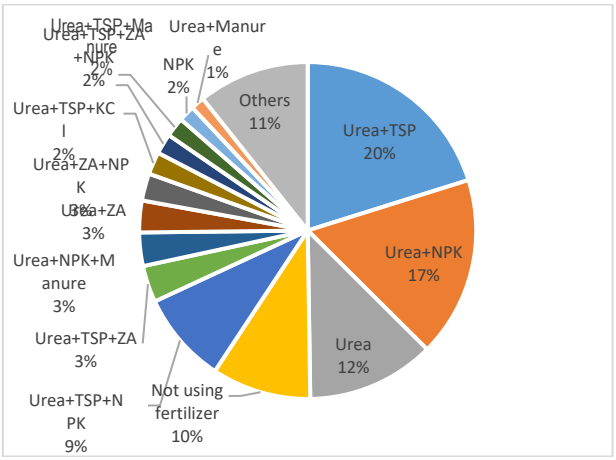

Fig. 1. Fertiliser usage among Indonesian rice farmers, 2013.
Source: [8]

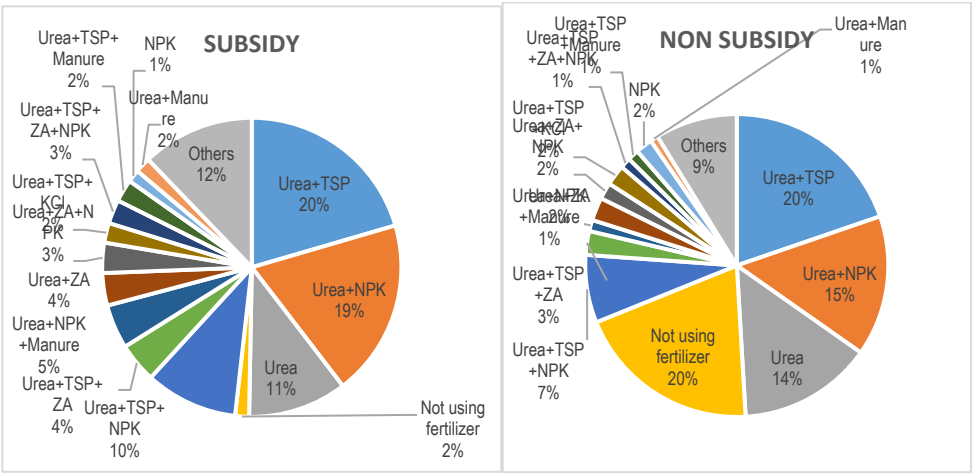

Fig. 2. Fertiliser usage among subsidised and non-subsidised Indonesian rice farmers, 2013.
Source: [8]

Table 1. Fertiliser usage for subsidised and non-subsidised rice farmers, 2013.

Fertiliser usage	Urea (kg/ha)	TSP (kg/ha)	NPK (kg/ha)
Urea	203.15		
Urea+TSP	249.51	155.62	
Urea+NPK	224.37		144.72
Urea+TSP+NPK	228.41	142.00	129.47

Comparing the usage of fertiliser between subsidised and non-subsidised farmers, subsidised farmers used more fertilisers (urea, TSP, and NPK) than non-subsidised farmers (Tables 2 and 3). This finding is also similar to the case of the three African countries [4].

The next analysis involved constructing a production function for four combinations of fertiliser usage. This combination means that farmers only use urea, urea and TSP, urea and NPK, and urea, TSP, and NPK. These combinations are differentiated between subsidised and non-subsidised farmers.

Table 2. Fertiliser usage for subsidised rice farmers, 2013.

Fertiliser usage	Urea (kg/ha)	TSP (kg/ha)	NPK (kg/ha)
Urea	232.79		
Urea+TSP	262.36	160.33	
Urea+NPK	234.91		149.71
Urea+TSP+NPK	237.14	145.41	135.79

Table 3. Fertiliser usage for non-subsidised rice farmers, 2013.

Fertiliser usage	Urea (kg/ha)	TSP (kg/ha)	NPK (kg/ha)
Urea	174.77		
Urea+TSP	232.44	149.35	
Urea+NPK	207.18		136.60
Urea+TSP+NPK	212.96	135.94	118.28

The first combination is for farmers using only urea in their rice farming. The results indicated that for subsidised farmers, an increase of 1% in the use of urea will increase unhusked rice production by 0.066%, and in the case of non-subsidised farmers, the increase is higher by 0.107%. This implies that it is more effective to increase unhusked rice production by increasing the use of urea in non-subsidised farmers, since the use of urea among non-subsidised farmers is smaller compared to subsidised farmers. This result is similar to the research by Muhardi and Effendy [11] which found that land, fertiliser, seed, and labour have positive and significant effects on lowland rice production.

Table 4. Production function of farmers using urea fertiliser.

Variable	Subsidy		Non-subsidy	
	Coefficient	Prob.	Coefficient	Prob.
Constant	0.929 ***	0.000	1.736 ***	0.000
Harvested area	0.676 ***	0.000	0.505 ***	0.000
Urea	0.066 ***	0.000	0.107 ***	0.000
Seed	-0.001	0.976	0.047 ***	0.006
Family labour	-0.025 **	0.012	0.046 ***	0.000
Non-family labour	0.096 ***	0.000	0.140 ***	0.000
Irrigation dummy	0.140 ***	0.000	0.053 **	0.011
N	3,551		3,493	
R^2	0.585		0.550	
F	808.77 ***	0.000	759.09 ***	

Note: ***, **, and *indicate significance at the 1%, 5%, and 10% levels, respectively.

The second combination is for farmers using urea and TSP fertiliser (Table 5). Similar to the first combination, it is more effective to increase unhusked rice production by increasing the use of urea by non-subsidised farmers. Meanwhile, for TSP fertiliser, the increase is

higher for subsidised farmers than for non-subsidised farmers. An increase of 1% in the use of TSP fertiliser will increase unhusked rice production by 0.16% for subsidised farmers and 0.091% for non-subsidised farmers, although the usage of TSP is higher for subsidised farmers.

Table 5. Production function of farmers using urea and TSP fertilisers.

Variable	Subsidy		Non-subsidy	
	Coefficient	Prob.	Coefficient	Prob.
Constant	0.689 ***	0.000	1.085 ***	0.000
Harvested area	0.639 ***	0.000	0.613 ***	0.000
Urea	0.114 ***	0.000	0.124 ***	0.000
TSP	0.160 ***	0.000	0.091 ***	0.000
Seed	0.015	0.193	0.011	0.451
Family labour	-0.035 ***	0.000	-0.016 *	0.055
Non-family labour	0.033 ***	0.000	0.050 ***	0.000
Irrigation dummy	0.176 ***	0.000	0.056 ***	0.000
N	7,716		5,638	
R^2	0.694		0.661	
F	2490.68 ***	0.000	1476.27 ***	0.000

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

The next combination is urea and NPK; for urea, the effect of increasing the fertiliser is higher on non-subsidised farmers (Table 6). On the contrary, a 1% increase in NPK fertiliser usage will increase unhusked rice production by 0.105% for subsidised farmers compared to 0.041% for non-subsidised farmers.

The last combination was the use of Urea, TSP and NPK fertiliser (Table 7). In this combination, the increase in unhusked rice production is higher for subsidised farmers than for non-subsidised farmers, which differs from other combinations.

From the results, it can be inferred that rice production can be effectively increased by increasing urea usage by non-subsidised farmers and increasing TSP and NPK fertilisers for subsidised farmers. In addition, the government must control the over-usage of fertiliser to decrease the value of the subsidy and minimise the effect on the environment caused by the fertiliser being over-used. Encouraging farmers to use organic fertilisers will minimise the effect on the environment, and a combination of organic and synthetic fertilisers could yield an efficiency level 9% higher than the conventional method [12].

4 Conclusions

The combination of fertiliser usage is relatively similar between subsidised and non-subsidised farmers, although it tends to be higher than the proposed usage recommended by the government regulation. The effect of fertilisers on production differs between combination usage. To increase rice production, urea usage must be increased in non-subsidised farmers, while TSP and NPK usage must be increased in non-subsidised farmers.

Table 6. Production function of farmers using urea and NPK fertilisers.

Variable	Subsidy		Non-subsidy	
	Coefficient	Prob.	Coefficient	Prob.
Constant	0.971 ***	0.000	1.458 ***	0.000
Harvested area	0.597 ***	0.000	0.533 ***	0.000
Urea	0.148 ***	0.000	0.191 ***	0.000
NPK	0.105 ***	0.000	0.041 **	0.011
Seed	0.036 **	0.016	0.047 **	0.014
Family labour	-0.020 ***	0.009	-0.012	0.231
Non-family labour	0.040 ***	0.000	0.045 ***	0.000
Irrigation dummy	0.162 ***	0.000	0.088 ***	0.000
N	6,402		3,920	
R^2	0.668		0.580	
F	1,945.92 ***	0.000	770.09 ***	0.000

Note: ***, **, and *indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 7. Production function of farmers using Urea, TSP, and NPK fertilisers.

Variable	Subsidy		Non-subsidy	
	Coefficient	Prob.	Coefficient	Prob.
Constant	0.993 ***	0.000	1.169 ***	0.000
Harvested area	0.590 ***	0.000	0.600 ***	0.000
Urea	0.161 ***	0.000	0.118 ***	0.000
TSP	0.122 ***	0.000	0.074 ***	0.002
NPK	0.081 ***	0.000	0.039 **	0.028
Seed	0.003	0.851	0.054 **	0.024
Family labour	-0.052 ***	0.000	-0.020 *	0.074
Non-family labour	0.012	0.245	0.017	0.264
Irrigation dummy	0.149 ***	0.000	0.145 ***	0.000
N	3,584		2,190	
R^2	0.732		0.664	
F	1,252.75 ***	0.000	541.09 ***	0.000

Note: ***, **, and *indicate significance at the 1%, 5%, and 10% levels, respectively.

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