

CLIMATE CHANGING IMPACT ON RICE PRODUCTION

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ABSTRACT

Rice is the staple food of Indonesian society. The national rice production capability depends not only on the technical and economic aspects of production but also on the environmental carrying capacity, especially the availability of adequate rainfall and climate. The cyclical changes of extreme climate that occur affect the performance of national rice production. This study aims to determine the impact of extreme climate on national rice production. The research method used linear regression with El Nino (D1) and La Nina (D2) as extreme dummy extreme free variable and national rice production as its bound factor. The data used are based on BPS Indonesia with the duration of 1980-2011. The analysis shows that the presence of cyclically extreme climate has a significant effect on national rice production. Climate change has a negative and positive impact on rice production. El-Nino has a negative impact, while La Nina is the opposite. The difference in the size of the impact of climate change can be seen from the slope difference in the variable coefficient.

Key words: climate changing, El-Nino, La-Nina, production, rice

Introduction

Food sufficiency is important need for every nation. Independency on food production and distribution will establish self-determination of nation. As an autonomous nation, independency on food production, availability and distribution are very important. The lack of food resources is usually regarded as a weakness and, thus, puts the nation as dependent to other countries. Limited outcome of food production threatens the nation's stability and its people's welfare as well. The staple food becomes political and strategic commodity. Then, every single government sets up strategic policy to regulate primary food to ensure everyone has an access to food as standard needs.

Most Indonesians consume rice as their staple food to meet their needs. Rice becomes strategic commodity. The community will be focused on anything including production, availability, distribution, and consumption of rice. Rice production is related with paddy farming condition. Indonesia paddy production reached the peak in 1984, caused by the green revolution on adoption of input production technology. But, after three decades, paddy productivity tended to decrease in line with the deminishing return of production. Even though the yield area and production increased, the return decreased.

In average, Indonesia paddy production in 1993 until 2015 increased to 57 million tons from 48 million. The paddy productivity in average was 4,66 tons/are, even though, in the last three years the productivity increased (BPS, 2016). Compared with paddy productivities in Japan which was 6,65 ton/are and in Cina which was 6,35 ton/are (FAO, 1993) paddy's productivity in Indonesia could be increasing in future. The conditions reflect that the actual paddy productivity in Indonesia appears to be close to the potential production. In other condition, the size of irrigated land area tend to continuously decrease significantly in the last decade from 10,7 million are in 2000 to be 7,8 million are in 2011.

The fragmented land area for growing paddy, limited access to capital for input production, inadequate maintenance of irrigation infrastructure and also farming institution to renew technology development restrict the paddy productivity at upstream. Development of the new technology on input production such as hybrid seed, organic fertilizer for minimizing land degradation, and minimum water management for paddy farming are also important to improve productivity. In other condition, paddy farming depends on climate circumstance.

The climate changes will influence directly to the productivity. The climate changes are so dynamic with new phenomenon in the different time and duration. At the last three decades, Indonesia could either not avoid the climate phenomenon change called El Nino (6 times) at dry season and La Nina (4 times) at rainy season (Irawan, 2006). The extreme climate will lay pressures to the paddy production system. It is necessary to make certain that the paddy production will be able to fulfill food sovereignty. Government has rules to ensure the paddy production needs and regulate the system to support paddy farming, especially facing the climate changing.

The main purpose of this paper is to focus on the impact of extreme climate to rice production. It is also concerned with government regulation supporting paddy farming system, what action needs to take to increase the availability, and fulfill food sovereignty especially at the climate change circumstance. The study also pays attention to how important it is to establish farmer institutions as the primary participants for paddy production system.

The Method

The data observation involved secondary data of rice production during 1980—2011, extreme climate occurrence on that duration (Table 1), and also the government policy related with support to food sovereignty. Analysis method to achieve the main purpose is descriptive statistic with depth analysis. The impact of extreme climate to rice production was arranged with OLS (ordinary Least Squares) approach. The model runs El Nino (D1) and La Nina (D2) as dummy independent variables with the rice production as dependent variable. The model is formulated as follows:

$$Y = a - b_1 D_1 + b_2 D_2$$

with:

a = constanta

b1, b2 = coefficient

D1, D2 = El Nino, La Nina

Result and Discussion

The impact of climate extreme to rice production

Agriculture activities cannot be separated from environment condition. Nature phenomenon has more important role lately, mostly climate anomaly called El Nino and La Nina. According to Australian Bureau of Meteorology (2012) El Nino and La Nina events are a natural part of the global climate system. They occur when the Pacific Ocean and the atmosphere above it change from their natural (normal) state for several seasons. El Nino events are associated with a warming of the central and eastern tropical Pacific, while La Nina events are the reverse, with a sustained cooling of these same areas. On tropical countries like Indonesia, both of those anomalies usually disclose the rainy pattern budge, temperature, and also the duration on dry session or rainy session. Then they could impact on fire of forest in sensitive area, flood, and enhance the attack of plant agitate organism and plant diseases.

El Nino phenomenon is characterized by decreasing of rainfall for long duration, meanwhile La Nina is characterized contrary by the rainfall increasing. El Nino causes the damage in food production. El Nino and La Nina could pose negative or positive impact on food production with different level depending on geographical position or province. In general, the variation level of impact is caused by (a) the impact of anomaly climate change

toward local climate situation or local rainfall, (b) farmers' ability to maximize production declines because of anomaly climate in each area (IPCC, 2006). Table 1 showed the rice production and climate extreme in Indonesia during 1980-2011.

Table 1. Rice production and climate extreme in Indonesia during 1980-2011

No	Year	Rice Production (000 ton)	Climate *)	
			El nino	La nina
1	1980	20,574	0	0
2	1981	22,287	0	0
3	1982	23,191	1	0
4	1983	25,932	1	0
5	1984	24,006	0	0
6	1985	26,542	0	0
7	1986	27,014	1	0
8	1987	27,253	1	0
9	1988	28,340	0	1
10	1989	29,072	0	1
11	1990	28,453	0	0
12	1991	28,187	1	0
13	1992	30,358	1	0
14	1993	30,320	1	0
15	1994	29,417	1	0
16	1995	31,349	0	0
17	1996	32,215	0	0
18	1997	31,093	1	0
19	1998	31,040	1	1
20	1999	32,031	0	1
21	2000	32,693	0	1
22	2001	31,806	0	0
23	2002	32,444	0	0
24	2003	32,861	0	0
25	2004	34,102	0	0
26	2005	34,028	0	0
27	2006	34,600	0	0
28	2007	36,970	0	0
29	2008	38,078	0	0
30	2009	40,656	0	0
31	2010	42,436	0	1
32	2011	41,326	0	1

Source: Indonesia Statistic Centre Bureau, 2011

*) Indonesia Meteorology, Klimatology, and Geofisika Bureau, 2012

The analysis model of the rice production associated with El Nino or La Nina events occurred in Indonesia was arranged with OLS (ordinary Least Squares) approach. The model runs El Nino (D1) and La Nina (D2) as dummy independent variables with the rice production

as dependent variable. Statistically, this model is qualified as good fit model and also appropriate with the natural theory (Table 2).

Table 2. The OLS approach impact of climate extreme toward rice production

Multiple R	0.41
R Square	0.17
Adjusted R Square	0.11
Standard Error	4963.45
Observations	32

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	2	1.44E+08	71976297	2.92	0.06
Residual	29	7.14E+08	24635838		
Total	31	8.58E+08			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	31313.05	1211.58	25.84	1.43E-21
D1	-3232.25	1929.51	-1.67	0.10
D2	2996.98	2163.41	1.385	0.17

The result formulated as follows:

$$Y = 31.313 - 3.232 D1 + 2.996 D2$$

The result showed that climate extreme have negative and positive impact. The dummy coefficient means the different condition of rice production with or without El Nino or La Nina events. El Nino has negative impact to rice production, opposite with La Nina events. El Nino occurrences would be declining the rice production, meanwhile La Nina could enhance rice production. The different size of El Nino and La Nina impact is explained from the coefficient. This result is also supported by Irawan research in 2006. The failure of harvesting caused by El Nino drives food production down to 3,06%, and 2,43% for wet paddy. Contrary with La Nina phenomenon, because the volume of rainfall could increase the food production up to 1,08%, and 0,61% on wet paddy. Only La Nina in 1975 and 1998 caused the decreasing food production (Irawan, 2006).

Refer to Arifin (2010a), anomaly of extreme rainfall will bother agriculture activity, especially for paddy and grain. Higher rainfall boosts the flood possibility at wet land nearly 3% and the harvest failure reaches almost 14%. In the meantime, the dry season will increase land drying at wet land for almost 8% and harvest failure for about 2%. In general, Irsal Las, et al (2009) in Arifin (2010) revealed that extreme climate possibly declined food production until 10% if the nation didn't take any measure. Based on the analysis, it is important to develop the awareness toward extreme climate, especially for everyone who was involved as stakeholders in agriculture activities.

Government policy facing extreme climate

Indonesian government is also concerned with food production and distribution, especially with rice availability. Government issued food policy during 2009-2011 consisting of at least three main points. Firstly, it issued Presidential Instruction No. 7 in 2009 about rice policy. Secondly, it issued Presidential Instruction No. 5 in 2011 about rice production safety ahead of extreme climate changes. And then the third was issuing Presidential Instruction No. 8 at 2011 about government arrangement on buffer stock of rice. All those policies were arranged to maintain the goal of rice sufficiency with 10 million ton production in 2014.

Government set up the policy facing the climate extreme events to strengthen the effort supporting rice production safety. Presidential Instruction No. 5 was published on March 2, 2011. Instruction is directed to take necessary measures in a coordinated and integrated way in accordance with duties, functions, and their respective authorities to secure the production of paddy/rice and anticipated national and quick response to face extreme climate conditions. In particular, the Ministry of Agriculture in addition to focusing on risk analysis of extreme climate impacts on production and distribution of paddy/rice is also working to improve rice production systems by farmers through improved provision of production inputs (seeds, fertilizers, and pesticides), improved post-harvest activities, increased land area and irrigation management, field officers performance improvement, as well as strengthening the reserves of grain/rice at the level of government and society.

Other ministerial departments that play an important role in supporting the condition of infrastructure and facilitation of farming and the distribution of grain/rice are the Ministry of Public Works and the Ministry of Commerce. Ministry of Public Works must improve and develop the infrastructure function in supporting the development of rice farming and also providing support in improving the management of irrigation water for rice farming. Meanwhile, the Commerce Ministry is in charge of improving the supply and distribution of grain reserves and rice distribution system, including transporting grain/rice surplus areas to deficit areas. This task is certainly not meant as an instrument of justification means to import rice.

Implementing the policy

Presidential Instruction No. 5 2011 prevails for almost a year. Government awareness to anticipate the damage or failure on food production toward climate extreme is quite good. But, the effectiveness could not be evaluated soon. The damage and paddy harvest failure by the climate extreme reportedly caused the production to decrease for almost 4,95%. The Coordinator Ministry of Economic report (2011) revealed that paddy production in 2011 reached 65,39 million tons. It means the production decreased 1,63% compared with that of 2010. The production was 4,95% lower than Ministry of Agriculture target in 2011 which was almost 68,80 million tons. The decline of production was primarily caused by: a) extreme climate at plant season Juni-Agustus 2011, b) the size of yield harvest area attacked by plant rouse organism (620.807 are) and dry season (38.067 are), and c) the size of dried land amounting to 169.904 was higher than 2010 which was only 94.480 are. Dry season gave more disadvantage compared with rainy season on the same period, and also the budge of plant season in several paddy production centre from October to November 2011. Government is preparing the recovery budget for the failure of paddy production with fund of almost Rp 2 triliun.

Specifically, Presidential Instruction No. 5, 2011 was concerned with minimizing the negative impact of extreme climate by focusing on curative and spatial approach as non price policy. This policy as complement to other policies (No. 7, 2009 and No. 8, 2011) cannot stand by itself. The complexity of paddy production system needs comprehensive and integrated policy, primary to reach the target production in 2014. It raises question as to whether the target in 2014 was realistic. Only less than 2 years. The successful of implementation of all those policies in field must be synergic with participation of every single stakeholders in paddy farming system. Sawit (2007) revealed that paddy/rice holds very strategic key in agricultural development especially in rural area. It is important to pay full and careful attention on paddy/rice agribusiness system, also avoid the bias on short term.

So, the next important step is to establish the farmer institution. The key of success in implementing the policy is really concerned with the farmers institution. The effort for strengthening the paddy farming system cannot be separated from farmers empowerment. Improvement of farmers capacity on input management, adoption of production technology, capital access, and also establishment of the rule of agriculture institution are important to improve the paddy productivity and escape from the classical poverty problem.

Development means process involving social, economic, and institutional, including all effort to get the better life and welfare (Todaro, 2000). So, developing the paddy farming to improve the productivity is important to synergize all those aspects. Agriculture development is also defined as a process of social change. The implementation is not only for welfare but also for developing human resources in economic, social, political, culture, and neighborhoods by improvement, growth, and change.

Government needs to arrange the policy on long term and sustainable solution. Roadmap of farmer empowerment and capacity strengthening by adoption of new innovation and technology could possibly improve the paddy productivity significantly and reach the target of 10 million surplus in 2014. Farmer strengthening programs includes technology, capital access, and also assistances on all of the farming process. Arifin (2010b) also declared that adoption process and agriculture innovation adapted must be accompanied by institution innovation, value system change, efficiency level, income enhancement, and also significant improvement of farmer welfare will be able to solve the main problem at the upstream of paddy farming system.

Conclusion and Suggestion

Conclusion

The extreme climate have negative and positive impact. El Nino usually has negative impact to rice production, opposite with La Nina events. The different size of El Nino and La Nina impact could be explained from the coefficient.

The key of success in implementing the policy is really concerned with the farmers institution. The effort should integrate action on improvement of farmers capacity on input management, adoption of production technology, capital access, and also establishment of the rule of agriculture institution.

Suggestion

Government needs integrated action on implementing the policies and actively involving every stakeholder in paddy/rice agribusiness system. To minimize the negative impact of extreme climate, not only government but also the farmers need to be adaptable to every change. It needs support through farming technology based on durable seed on dry land or minimum water. Farmer institution strengthening will improve the ability and awareness to maximum level and avoid the damage and disadvantage caused by extreme climate.

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