

- Effect of hydropower plants to the depletion of water resources and increase flood flow in the downstream. Clarify the influence of the operating regime of the hydro-electric plants, water reservoirs in the upstream to the increase of saline intrusion;
- Research the accumulation of pollutants in the estuary ecosystem and the health risks to local communities through using of aquatic products.

4. Conclusion and Recommendation

1. With the advantage geographical conditions, Danang has many potential developments and also many risks. The greatest risks include: depletion of water resources; increase flooding and environmental degradation;
2. The city has plans to enhance capacity to minimize the risk. However, due to limitations in practical experience and finance, it is necessary to get supports and cooperate with domestic and foreign organizations in order to solve these problems together.

REFERENCE

1. Danang People’s Committee August 2008, The project for Danang environment city development;
2. Danang People’s Committee February 2012, Climate Change and Sea Level Rise Action;
3. Danang Department of Natural Resources and Environment, June 2010, Current state of environment in Danang Report (2005-2009 period);
4. Huynh Van Thang 2011, Impacts of Hydropower in Vu Gia river upstream to the downstream areas;
5. IWE 2009, Vulnerability assesement of Climate Change in Danang City;
6. Ministry of Natural Resources and Environment 2009, Climate Change and Sea Level Rise Scenerio for Vietnam;
7. Ministry of Natural Resources and Environment 2009, Environment Report of Vietnam: Environment in Vietnamese Industrial Zones;
8. Ministry of Natural Resources and Environment 2010, National Environmental Report;
9. Nguyen Van Thang and others 2010, Climate Change and Impacts in Vietnam, Science and Technology Publisher;
10. Tran Van Quang and others October 2011, Danang hydrology and Urban development Simulation Model project- Midterm report;
11. Tran Van Quang, Urban risk and Danang environtment city, Proceeding of the fourth International Conference ACT AHEAD, 23-25th February 2009, New Dehli, India.
12. TA 4713-VIE, ADB, MONRE, MOIT, Quang Nam DONRE (2008), Final SEA report: SEA of the Quang Nam province hydropower plan for the Vu Gia -Thu Bon River basin.
13. Vietnam Ministry of Natural Resources and Environment 2009, Climate Change and Sea Level Rise Scenario for Vietnam;
14. 00037314-VIE/01/014 project , Final report of project water diaster risk reduction in Ngu Hanh Son district, Danang City;

Increasing Environmental Risks and Food Security in Indonesia

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Key words: environmental risks, food security, Indonesia

Abstract

This paper examines environmental risks and food security in Indonesia, focusing on the interrelationship between global environmental change, land use practices, food production, poverty and malnutrition issues. More frequent cases of extreme weather such as droughts, floods, and landslides in food-production centers in Indonesia have had serious consequences on farming practices and crop production, and hence food security. The decrease occurred mostly in Java, where food production is very much dependent on farming practices, the quality of irrigation infrastructure, downstream water management, the stewardship performance of catchment areas, and natural resources management in general. The production decrease will have serious consequences on the food security of the country, especially among the poor and those with limited access to healthcare facilities. The 30 millions people living below the poverty line and many millions of others near the poverty line are very vulnerable to environmental risks. Moreover, the threat of malnutrition due to crop failures, especially among rural children, will be accelerated in years to come, especially if policy responses by central and local government fail to consider recent scholarship in the relationship between environmental risks and crop production. The paper calls for new knowledge, tools, policy, and wisdom in approaching the complex issues of environmental risks, heavy floods, water shortages, pests and diseases, crop production, food security, and consequent malnutrition. The future development of food security in Indonesia, for its part, must rely on more scientific and evidence-based policy formulation and implementation at the national, provincial, and local level.

1. Introduction

Environmental risks brought about by climate change have shown the impacts on food production declines, particularly in developing countries, including Indonesia. The decline in food production is mostly due increasing temperatures and soil salinity, especially along the coastal area. Food production also suffers from extreme weathers, resulting in droughts and floods, pest and disease attacks and

declining production capacity due to damages in agricultural infrastructures. Studies in tropical regions show that production of corn and rice will decline due to raising air temperature and climate change. A temperature increase of 2 degree Celsius will reduce corn production by 20 percent and rice production by 10 percent (IPCC, 2007). Similar reports by Food and Agricultural Organization (FAO) also suggests that 65 developing countries are in a high risk of losing their cereal production as high as 280 million ton because of the global climate change (see Boer, 2010).

The Southeast Asia region is likely to suffer more from climate change than the global average with the mean cost of climate change in the four countries (Philippines, Indonesia, Thailand and Vietnam) to have an equivalent of 6.7 percent of combined GDP each year by 2100 under the “business-as-usual scenario”. The four countries (Philippines, Indonesia, Vietnam and Thailand) are projected to experience rice yield potential fall of about 50 percent by 2100 relative to the 1990 level on average assuming no adaptation and no technical improvement; with a decline of 34 percent in Indonesia and 75 percent in the Philippines, and to start in 2020 in most countries (ADB, 2009).

Indonesia as the largest economy in Southeast Asia will suffer the most from the environmental risks, especially droughts and floods, as these phenomena would decrease food production and production capacity of the country. The country relies on 15 percent of its gross domestic products (GDP) coming from agriculture and 41 percent of the labor force dependent from agricultural sector. Indonesia will have serious food security episodes in the near future once the knowledge on the links between environmental risks and food security is not clearly outlined and the policy to handle the issues is not properly formulated and implemented.

This paper examines environmental risks and food security in Indonesia, focusing on the interrelationship between global environmental change, land use practices, food production, poverty and malnutrition issues. The structure of the paper is outlined as follows. Following this introduction, the sections will outline increasing environmental risks in the country. Discussion on major dimensions of food security will be presented in more detail. The concluding remarks of the paper will suggest some policy changes and calls for more integrated research on bio-physical aspects and social-economic aspects of the links between environmental risks and food security in the country.

2. Increasing Environmental Risks

Environmental risks in Indonesia are closely associated with increasing the extreme weathers, both their frequency and intensity. Studies have shown that in the last 100 years, the frequency and intensity of ENSO phenomena (El-Nino Southern Oscillation), where 10 of which occurred after the 1940s. The droughts and floods in Indonesia that have lead to crop failures in the last 10 years occurred during the extreme dry weather of El-Nino and La-Nina, respectively. The variation of rainfalls in Java, the production centers of major food crops in Indonesia, especially rice, corn, soybean and sugarcane, is highly affected by ENSO phenomena. The cumulative area of crop failures attributable to droughts (El-Nino) is about 250 thousand hectares and to floods (La-Nina) is about 90 thousand hectares (Boer, 2010).

Moreover, the pest and disease attacks on the food crops have also increased more significantly during the periods of extreme weather. Observation in the districts of Karawang, Indramayu, and Tasikmalaya in West Java shows that the frequency of floods in recent years has increased the pest

attacks of golden snail in the paddy fields. Similarly, high rainfall in during the transition between rainy season and dry season has accelerated the pest attacks of brown plant-hopper. During La Nina year of 1998, the area of rice fields attacked by brown-plant-hopper in Java reached about 100 thousand hectares; while during normal year the pest attacks are less than 10 thousand hectares (Boer, 2010).

Global warming usually shortens the rainy season so that two-time harvesting will experience a very high risk of drought. Agricultural infrastructures such as irrigation system might not help much as the majority of water resources for 7.6 million hectares of paddy fields in Indonesia are from non-dam water resources. While the water resources coming from dam irrigation system is only 11 percent of the total irrigation system. Consequently, during the rainy season, water cannot be stored for irrigating the rice fields during the dry season; while during the dry season, most rice fields will suffer from serious drought, even outside the El-Nino years. Cropping intensity for the rice fields using dam irrigation water resources could reach 2.4; while that for non-dam water irrigation water resources is only 1.6 for less than two-time harvesting. The impacts of environmental risks on cropping patterns and food production will worsen once nearly half of the irrigation infrastructures in this country have suffered from serious damage due to lacks of political commitment to maintain the infrastructures (Ministry of Environment, 2007).

Studies using historical data on droughts and food production in Indonesia suggest the decline about 4 percent on production during four periods of El-Nino and 6 percent during non-El-Nino periods (Yokoyama, 2003 and Ratag, 2006). The drought impacts on corn production were more severe, causing a 13.5 percent decrease mostly due to a significant decline in harvested area. Studies by Naylor et al. (2007) also show that the food production decline in Java/Bali due to droughts could reach 18 percent in the period of January – April. Econometric studies by Handoko et al. (2008) on the impacts of climate change on food production in Indonesia using the last 100 years climate data combined with the forecast for 2050 show a very significant decline in food production. Based on the climate data, environmental risks brought about by climate change will raise the air temperature in the Provinces of Central Java, Yogyakarta, West Java and other regions outside Java, but will decrease the air temperature in the Provinces of East Java and Banten.

The temperature raise will increase the use of water by food crops through evapo-transpiration so that the amount of rice field being irrigated will decline. Consequently, the harvested area will decline as the water supply for irrigation decreases and cannot fulfill the water demand from the paddy fields. In the provinces experiencing increasing air temperature the food production decline is higher than those experiencing a decrease in air temperature. Under the concept of thermal unit that determines the collection of biomass and food harvest, the climate change will decrease the production of all major food crops. If there are no policy actions on mitigation and adaptation of climate change, lowland rice production is expected to decline at 20.3 percent, upland rice at 27.1 percent, corn at 13.6 percent, soybean on 12.4 percent, and sugarcane at 7.6 percent.

Studies by Boer (2010) also show that the climate change, environmental risks and persistent land conversion will affect the ability of Java land resources in producing rice will decrease by 5 percent of the present production capacity in 2025, and further decrease by 10 percent in 2050. This decreasing food production capacity simply does not adequate if the compensation and mitigation procedures

rely on increasing the cropping intensity only. Indonesia needs more land expansion for food production, especially in the islands outside Java to offset the decreasing trend of production capacity in Java. A delay in the agricultural infrastructure development and rehabilitation will have more serious consequences on crop failures and production declines, hence the food security status of the country.

Historical data on food production show a significant decline in the early 1990s, mostly due to droughts in 1987/88 and 1992/1993 and pest incidents in major production centers (Arifin, 2009). More importantly, deterioration of important infrastructures such as irrigation, roads, bridges, ports, etc, in several places of the country has contributed to the decline in agricultural growth. The slowdown in growth or leveling-off in agricultural production has continued until the 1998 Asian Economic Crisis and the fall of President Soeharto, marking more complex settings of transitional period of economic and political reforms. During that difficult time, food security was really a focus of attention because Indonesia experienced a very serious production decline due to long drought as a result of El-Nino season.

Consequently, Indonesia has to depend on a very large amount of rice import just to fulfill the domestic consumption. The price of rice skyrocketed to a level which was not affordable by the poor, let alone the impact of declining purchasing power due to imported inflation. Even though Indonesia imported a record high of 5.8 million ton in 1998, the price of rice remained very high, which also contributing to inflation rate in the following year. The wet season of La-Nina year in 1999 contributed further to bad performance of rice production, resulting in another import surge of 4.2 million ton. Within two years of 1998 and 1999, rice import reached to 85 and 78 percent above the 3 years moving average, the record high in the modern history of rice industry in Indonesia.

A similar story of rice import surge occurred again during extreme weather condition of El-Nino drought and La-Nina wet season in 2002 and 2003, where Indonesia has to import respectively 3.1 and 2 million ton. The magnitude of how strong the political dimension of the economy of rice industry in Indonesia could be seen from a very high attention of every level of society on the performance of rice production, price stability, and stock management. A common belief is that the import surge of rice in Indonesia is closely related with a significant decline in domestic price of non-husked rice at farm level and decrease in the flows and volumes of inter-regional and inter-island trade of rice in Indonesia. It had also affected the seed, fertilizer, pesticides and agriculture machinery and equipment industries (Sawit and Lokollo, 2007).

Over a decade after the Asian Economic Crisis, or when the global economy experienced financial crisis in 2008, the issues of environmental risks also amplifies as the climate change impacts on the food production is more real. The current government administration under President Yudhoyono issued a well-known policy strategy on “revitalizing agriculture” in 2005, although there has been no significant indication at the field level that could lead to radical changes. Rice production system which is highly dependent on small-scale rice farmers implies serious complexities related to increasing economies of scale and efficiency level. In the upstream sector, rice industry has to rely on 9.5 million farm households with 0.5 hectare of land or 53.6 percent out of total 17.8 million farm households (BPS, 2009). In the downstream sector, rice milling and processing industries also rely on 132 small-scale millers affiliated with Perum Bulog, a state-owned enterprise having responsible for

rice price stabilization rice subsidy for the poor, and some large scale private sector millers. These farmers cultivate rice fields in the most fertile lands and in the regions with the best water-control and access to large domestic and global markets. Once these very land resources are disturbed by climate change, the threat to food security is also increasing.

3. Food Security Consequences

Food security here refers to a situation in which all households have both physical and economic access to adequate food for all members, and where households are not at risk of losing such access. Food security can be viewed at different levels: for nations, regions or households. Food security actually has at least four main dimensions, namely: food availability, accessibility, price stability, and utilization. If one of them missing, a country could face serious food insecurity episodes. Adequate food availability means that, on average, sufficient food supplies should be available to meet consumption needs. However, a very high price of food causes the majority of population cannot afford to buy the food, the food security could be a serious problem, even though the food is plenty and available in the country. Stability refers to minimizing the probability that, in difficult years or seasons, food consumption might fall below requirements. Accessibility draws attention to the fact that, even with bountiful supplies many people still go hungry because they do not have the resources to produce or purchase the food they need. Food security concerns the individual or family unit, and its principal determinant is purchasing power at the income adjusted for the cost of living. Similarly, purchasing power, income adjusted for the cost of living. Purchasing power at the national level, i.e., the amount of foreign exchange available to pay for necessary food imports, is a key determinant of national food security. Therefore, food security is not only a question of poverty, but also the proportion of income households to devote to food.

The current rate of food production in Indonesia is threatened in meeting the growing demand of food consumption. In the last five years, rice production grows at below 3 percent per year, while the demand for food is estimated to grow at 4.88 percent per year (according to simple food-demand equation of Johnston-Mellor based on population growth rate at 1.5 percent, economic growth rate at 6.5 percent and income elasticity on food is 0.52). When food production domestically is inadequate, food import is necessary and economically justified even though politically it seems not correct. However, when food-import dependency is very high, food security may face a very serious threat because the world market is not stable and food availability in the domestic market is very much affected by domestic food production. Large fluctuations in prices would have meant large fluctuations in the purchasing power of both consumers and farmers, and it would have been difficult for many to adapt to these frequent changes. Moreover, the world rice market was thin and unstable, much more so than other world grain markets, especially after the sharp increase of world rice price since 2008.

More frequent cases of extreme weather such as droughts, floods, and landslides in food-production centers in Indonesia have had serious consequences on farming practices and crop production, hence food security in the country. Environmental changes are believed to be an important determinant of the major decrease in food production in 2011, where rice production decreased by 1.6 percent, maize by 6 percent, and soybean by 4 percent (Table 1). The decrease occurred mostly in Java, where food production is very much dependent on farming practices, the quality of irrigation infrastructure,

downstream water management, the stewardship performance of catchment areas, and natural resources management in general. An increase in sugar production in 2011 was simply not adequate to fulfill increasing demand of sugar, both from food industry and direct household consumption. Indonesia has to rely on import of refined sugar from the international market, which complicates the incentive system of domestic sugar production.

It might be not easy to show the empirical evidence about the most significant determining factors of declining food production in 2011, as the observation data are available only in a short period of time. Especially, whether or not the decline is attributable only to environmental risks, such as flood and drought, remains unclear. But, the actual data from the field confirmed that the production decline is due to the decrease in harvested area of rice, corn, and soybean. The decrease was so significant occurred in Java (the Provinces of East Java, Central Java, Yogyakarta, West Java and Banten), where the flood and drought in 2011 occurred mostly in these provinces, as the food production centers of the country. These provinces also experience a serious problem of agricultural infrastructures, especially damages of irrigation networks, from the physical infrastructures to software or human resources. The water-user organizations that have contributed significantly to increased food production and productivity in the old days have not shown their roles in maintaining the level of agricultural practices, water and resource uses in the fields for the last decade or so. If there is no significant progress in technological change and land expansion for food production Outside Java, then Indonesia would face serious challenges in meeting the growing food demand in the future. During El-Nino years as in 1997/1998 and 2002/2003 food production usually declined, because the drought has reduced both cropping intensity and the productivity.

Table 1. Production of Major Food Crops in Indonesia, 2002-2011

Food Crops	2007	2008	2009	2010	2011*)
Rice					
Harvested Area (ha)	12,147,637	12,327,425	12,883,576	13,244,184	13,224,379
Productivity (ton/ha)	4.71	4.89	5.00	5.01	4.94
Production (ton non-husked)	57,157,435	60,325,925	64,389,890	66,411,469	65,385,183
Corn					
Harvested Area (ha)	3,630,324	4,001,724	4,160,659	4,131,676	3,869,855
Productivity (ton/ha)	3.66	4.08	4,23	4,43	4,45
Production (ton dry grain)	13,287,527	16,317,252	17,629,748	18,327,636	17,230,172
Soybean					
Harvested Area (ha)	459116	590.956	722,791	660,823	631,425
Productivity (ton/ha)	1.29	1.31	1.25	1.24	1.29
Production (ton dry bean)	592,534	775,710	974,512	907,031	870,068
Sugar					
Harvested Area (ha)	427,799	436,505	441,040	435,000	440,000
Productivity (ton/ha)	6.13	6.11	5.70	5.11	5.22
Production (ton sugar)	2,623,786	2,668,428	2,517,374	2,200,000	2,300,000

Notes: *) The third forecast, November 2011
Source: Central Agency of Statistics (BPS), various issues

Moreover, food crop production system has also face the structural problems of uneven land-use structure and land distribution, both within the province and between provinces or particularly between Java and Off-Java. The number of agricultural households in Java increased from around 11.7 million in 1993 to 13.6 million in 2003. The figure for the whole Indonesia during the same time period increased from 20.8 million to 24.9 million, suggesting the addition of more than four million households entering the agricultural sector during a decade—an average of around 400 thousand new entrants per year. These figures have serious consequences on the farmers’ welfare and rural people in general as rice remains a staple food for the country so that any cases of production decline would have poverty implication. The majority (76 percent) of Indonesia households is net consumer of rice and the rest 24 percent is net producer. In urban areas, 96 percent of households is net consumer and only 4 percent of them is net producer of rice; while in rural areas, the net consumer of rice accounts about 60 percent of rural households, and 40 percent of them is net producer of rice.

By the time of this writing, the level of rice consumption in Indonesia is very high, nearly 140 kilogram per capita per year, consisting of direct consumption, rice being used for seed, and rice consumption by the industry. Although, the government is presently in the process of recalculating the rice consumption, such figure of consumption is obviously the highest in the world, far above the average 80 kg per capita per year of Asian rice consumers. Given that the production performance is somewhat dependent on environmental risks, natural and economic volatility, high consumption level in rice would imply to the amount of rice traded in the world market. Problems usually arise when the world rice trade and distribution activities are not operated properly due to mismanagement in the bureaucratic level of rice price stabilization and consumption subsidies. This very high level of rice consumption could trigger more problems for the Indonesian economy unless the diversification movement since the last decade is not only operational on paper. This rhetoric movement should probably combine with the development of food technology, a simple know-how but modern in nature, that complements and compatible with the Indonesia’s food production system.

4. Consequences on Poverty and Food Insecurity

The food production decrease will have serious consequences on the food security of the country, especially among the poor and those with limited access to healthcare facilities. The following Table 2 presents that the current poverty line of Rp 233 thousand (US\$ 26) per month have included about 30 millions of people (12.5 percent) in the poverty basket, consisting of 11 millions (9.2 percent) living in urban area and 19 millions (15.7 percent) living in rural area. Except in 2006, the poverty incidence in Indonesia has declined consistently during the last decade as the Indonesia economy grows significantly, after hard hit by the Asian Economic Crisis. A significant 5 percent increase of poverty incidence occurred in 2006 after the Government removes the fuel subsidy, and the purchasing power suffered from a sudden increase in food prices, housing, transportation, education costs, etc.

The wide disparity of poverty incidence in rural area and urban area has also proven that agricultural development that is not supported by rural development will not bring positive welfare impacts to the economy. Moreover, breaking down this national average to provincial figures, the disparity of poverty incidence in the country is very high. In the Capital Province of Jakarta, only 3.7 percent of population lives below the poverty line, but in the provinces of Papua and West Papua the poverty

figures are 32 and 31.9 percent, respectively. Ironically, the poverty figures in the provinces in Java as the food production centers of Indonesia are quite high, i.e.: 10.7 percent in West Java, 14.2 percent in East Java, 15.8 percent in West Java, and 16.1 percent in Yogyakarta (not shown in the table).

Table 2. Poverty Line, Percentage and Total of Poverty in Indonesia, 1999-2011

Year	Poverty Line (Rp/cap/month)			Percentage of Poverty (%)			Total Poverty (million)		
	Urban	Rural	National	Urban	Rural	National	Urban	Rural	National
1999	89,845	69,420	79,633	15.09	20.22	18.17	12.40	25.10	37.50
2000	91,632	73,648	82,640	14.58	22.38	19.14	12.30	26.40	38.70
2001	100,011	80,382	90,197	9.76	24.95	18.40	8.60	29.30	37.90
2002	130,499	96,512	113,506	14.46	21.10	18.20	13.30	25.10	38.40
2003	138,803	105,888	122,346	13.57	20.23	17.42	12.20	25.10	37.30
2004	143,455	108,725	126,090	12.13	20.11	16.66	11.40	24.80	36.10
2005	150,799	117,259	134,029	11.37	19.51	15.97	12.40	22.70	35.10
2006	175,324	131,256	153,290	13.36	21.90	17.75	14.29	24.76	39.05
2007	187,942	146,837	167,390	12.52	20.37	16.58	13.56	23.61	37.17
2008	204,896	161,831	183,364	11.65	18.93	15.42	12.77	22.19	34.96
2009	222,123	179,835	200,979	10.72	17.35	14.15	11.91	20.62	32.53
2010	232,989	192,354	212,672	9.87	16.56	13.33	11.10	19.93	31.02
2011	253,016	213,395	233,206	9.23	15.72	12.49	11.05	18.97	30.02

Source: Central Agency of Statistics (BPS), various issues

The dominance of smallholders in food crop farming systems in Indonesia has made government policies to alleviate poverty in rural area more complicated, especially if the development of rural-non-farm labor is very slow. In rural Java, households with agricultural land of less than 0.5 ha increased from 69 percent in 1993 to 72 percent in 2003. This brings about an increase in the number of households with agricultural land of less than 0.5 ha through out Indonesia to 53 percent in 2003. In addition, throughout Indonesia, around 75 percent of agricultural households own and operate their farm of the size less than a hectare. That with the size of 1.0-2.0 ha consists of approximately 15 percent, and above that is around 10 percent. With most of the agricultural land ownership below 1.0 ha (and around 53 percent is below 0.5 ha), it is quite difficult for farmers to attain economic scale, unless the farming activities are functionally consolidated (see Siregar, 2007).

Table 3. The Vulnerability of Poor People in Indonesia, 2008-2009 (in percent)

		2009			Row Total
		Poor	Near Poor	Not Poor	
2008	Poor	46.71 50.98	20.28 26.77	33.01 6.51	100.00
	Near Poor	22.32 20.19	21.53 23.58	56.15 9.18	100.00
	Not Poor	5.37 28.83	7.65 49.65	86.98 84.31	100.00
	Column Total	100.00	100.00	100.00	

Source: Central Agency of Statistics (BPS), 2011

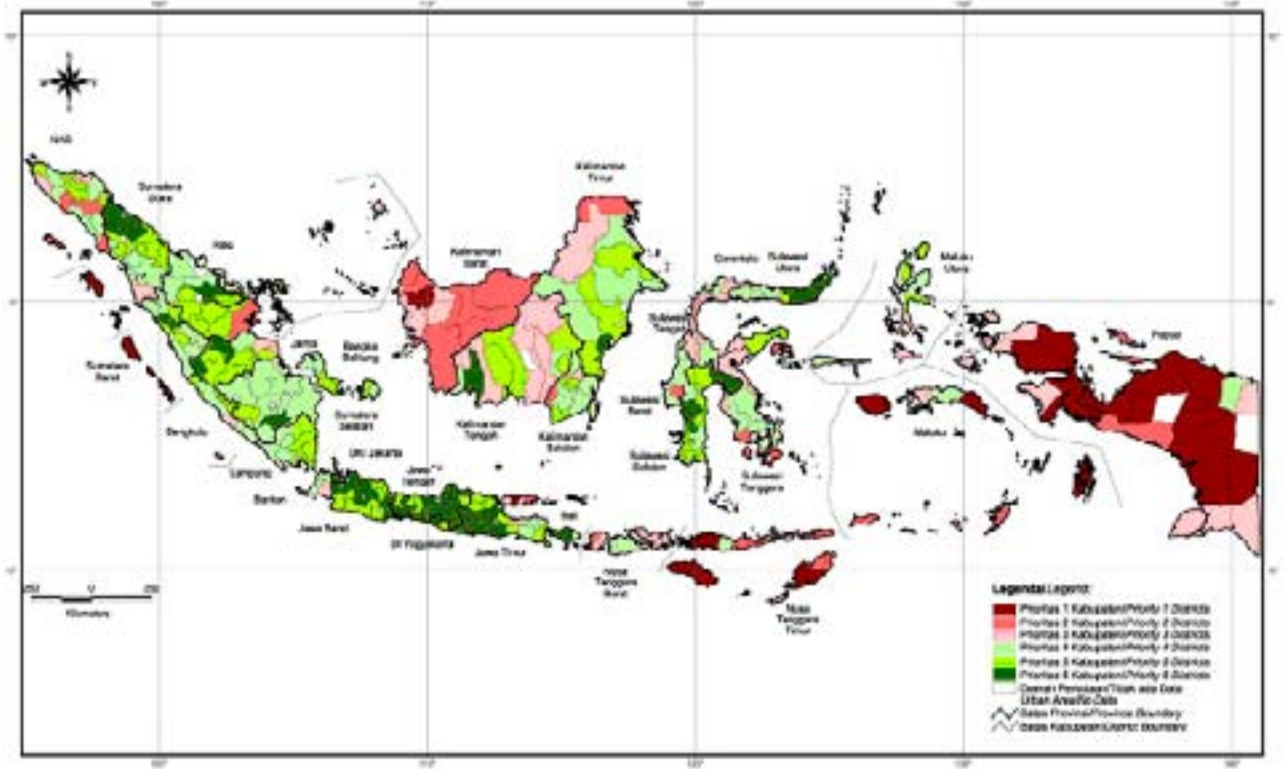
These people are really vulnerable of food price increases, as the share of food price to the poverty line is 74 percent, while the remaining 26 percent is split into housing, electricity, education, and transportation expenses. In rural area, the price of rice has contributed to 32.8 percent of the poverty

line, while in urban area the rice has contributed to 25.4 percent of the poverty line. Because of inelastic demand of rice, these poor households generally suffer the most when the rice price-increase. This implies, however, that cheap rice policy such as give-away rice subsidy to poor household cannot be simply assumed as proper policy to alleviate poverty, hence to maintain food security status in Indonesia.

The literature has solid evidence that the incidence of malnutrition and food insecurity is directly associated with poverty (Martianto, 2010, Hartoyo and Riadi, 2010, and Arifin, 2011). Environmental risks such as flood, drought, and natural disasters such as land slides and earthquake could cause additional number of new poverty very significantly, as much as 10 percent additional. The cases of malnutrition in region-prone environmental risks such as southern coastal area of East Java, Yogyakarta, West Nusa Tenggara and East Nusa Tenggara are directly related to this group of near-poor. Moreover, the threat of malnutrition due to crop failures, especially among rural children, will be accelerated in years to come, especially if policy responses by central and local government fail to consider recent scholarship in the relationship between environmental risks and crop production.

A high correlation between the level of poverty and food insecurity is presented in Figure 1. The map is drawn based on the composite index of food insecurity based on 14 indicators representing the elements of food availability, food Access, food utilization, and the nutritional situation in the district. The green and light green colors represent districts with good or high food security, while the red and dark-red colors represent districts with high vulnerability and food insecurity. Regions of higher vulnerability require higher priority of policy actions of food security, and vice versa for regions of lower security require lower priority. Regions with high poverty level usually suffer from food insecurity and vulnerability such as in Papua, Maluku, West and East Nusa Tenggara, etc primarily because the resilience of society living in the regions is usually low.

Figure 1. Food Security and Vulnerability Atlas of Indonesia



Source: Agency for Food Security and World Food Program, 2010

Similar to the poverty incidence, the figures of food insecurity vary greatly across regions in Indonesia as well as across income groups of the people. Low-income group suffers from inadequate energy intake and very poor food quality, as indicated by a low desirable dietary pattern (DDP) score. Similarly, the diets of people living in poor regions and remote areas are inadequate and unbalanced. Scientists have been in agreement on the use of 70 percent cut-off point to estimate the prevalence of food insecurity in the country. The prevalence of Indonesians who consume food or energy equivalent of 70 percent or less than the recommended dietary allowance (RDA) is about 25.3 million people or approximately 11.1 percent of the total population. The cut-off points for malnutrition to be considered as a public health problem are 10, 5 and 20 percent for underweight, wasted and stunted children, respectively. The current prevalence of underweight children of 18 percent is quite high and obviously a public health problem (see Martianto, 2010).

Environmental risks resulting in sudden shocks in crop failures, hence decreasing food production will have serious impacts on food security status, especially among the rural poor and those living in remote and isolated areas. Floods, droughts, and natural disasters that hit the poor both in rural and in urban will deteriorate the situation because of the vulnerability status of poor people and near-poor category. People under the category of near-poor and even of not-poor could fall into poverty category after the sudden shocks of environmental risks. Moreover, if the floods, droughts and natural disasters occur in poor rural and even urban areas, then the rational consequences will be the new food security, malnutrition, and public health problems. This would serve as a significant call for policy changes that maintain food price stability or at least preventing high fluctuation of food price, especially among the poor.

5. Food Price Stability: Reforms Required

Food price stability has actually been one of policy priorities for food security in Indonesia in the last four decades, although recently its effectiveness has been questioned. Since the establishment of parastatal agency of Bulog in 1967, the price policy was aimed at keeping the food price, especially rice as the staple food, stable at the farm level and the consumer level. The price stabilization policy was praised to be credible, transparent, and effectively enforced by any levels of government, from central to regions. Two major policies were implemented: First, a floor price kept the farm-gate price of rice well above the production costs. Bulog bought rice production not absorbed by the market, especially during harvest season. The procured rice was used to build a national buffer stock. The economic rationales behind maintaining the floor price above the market-clearing level were to protect against market failure, to ensure profitability of the farmers and to procure enough rice for Bulog's operation. Second, a ceiling price made rice affordable to low-income households, especially in the urban areas. Whenever prices went above the ceiling due to drought and other natural calamities, Bulog would sell cheap rice to targeted consumers. The argument in support of such market operations was to avoid price spikes, which could trigger social unrest similar to the ones experienced by the previous regime. This approach in price policy is sometimes known as "price band", where fluctuation is allowed to occur within the band of floor price and ceiling price.

This pricing policy was successful in the first 30 years of Soeharto administration, in large part because the economic policy strategy was smoothly translated into organizational and implementation

policies down to local level. Bulog was highly credited as a successful government institution in achieving price stability and effectively contributing to achieving and sustaining self-sufficiency in rice. The success of Bulog was characterized by a centralized management that had strong leadership and effective organizational command to implement the policy. However, as the Indonesian economic policy shifted towards more openness, adopting de-regulation policies in international trade, banking, and finance, the closed and centralized management system within Bulog started losing its effectiveness and acceptability. From the early 1990s, Bulog performance has attracted criticism from economists and other social scientists as well (Arifin, 2008).

The pressures on openness and democracy at post-Soeharto regimes raised concern for reforms in the bureaucratic structure of the public administration. The stabilization policy became very expensive, given its declining impact on food price stability as not immediate as it used to be. Since 2003 the status of Bulog has changed from a government agency into state owned enterprises, leaving the stabilization policy has no single government authority that has a direct responsibility to implement the policy. The most recent food stabilization policy was stipulated in Presidential Decree No. 3/2012, regulating the government price procurement for non-husked rice at Rp 3300/kg and for rice at Rp 6600/kg under some technical quality criteria. However, because the farm gate price and the retail price are far above the procurement price, Bulog is not able to procure the food stocks such as required for stabilization policy.

Meanwhile, the rice-for-the-poor policies aimed at providing price subsidy for the needy, might not be very effective as an immediate tool for poverty alleviation, hence for food security objectives in the country. The program is designed to reduce the impact of severe economic crisis by providing 15 kilograms of medium-grade rice every month to the targeted poor households. Even though the program was designed as an emergency-relief measure during the Asian Economic Crisis, presently it offers an alternative to rice price stabilization, especially outside the harvest seasons. The main challenge today is to sharpen the cost-effectiveness of the program: to concentrate more of the assistance in urban areas, tighten eligibility criteria, increase public awareness, improve beneficiary reporting, and ensure that the program is extended and placed on a financially sound mechanism. A better public-private partnership in relief distribution could extend the outreach of rice-for-the-poor program as long as standards of program accountability are well maintained.

The fact of increasing environmental risks in the last decades or so has drawn attention to the fact that assuring food security is largely an income problem, that income levels can change rapidly, and that even some of the most prosperous parts of the country have large numbers of households without food security. The experience in the program should improve food security policies in the field by providing a better design for medium-term measures for providing assistance to vulnerable households in the country. These might include some combination of targeted food subsidies, ration shops, village granaries, food stamps, and subsidized food stalls.

Other policy changes which are required to improve the performance of price stabilization policy include: removing local regulations that hinder regional food distribution, improving the infrastructures and controlling food smuggling; strengthening local-level institutions, such as agency for food security; and supporting policy instruments which are operational at local level. Finally, local government should be more active in maintaining food stocks, and providing price guarantee for

farmers. These could be important pre-requisites to develop food diversifications policy for the future.

6. Concluding Remarks: Future Agenda

This paper has examined environmental risks such as floods, droughts, and other natural disasters could result in sudden shocks in crop failures, decreasing food production, hence affecting food security status of the country. Environmental risks that hit the rural and urban poor and vulnerable group of population will worsen the impacts because of sensitivity of these groups due to external shocks. Empirical evidence in the last decades or so that people under the category of near-poor and not-poor could fall into poverty category after the sudden shocks of environmental risks. Further consequences of these phenomena include lack of access to adequate and good quality food, malnutrition, especially among children and those living in remote areas. Acute problems of food access and prevalence on recommended dietary allowance (RDA) will become serious public health problems, which might be more complicated.

Policy changes to improve food security for the country could be formulated as follows: (1) increasing productivity and efficiency in food production, capacity building in research and development (and research for development), and integration with rural development and employment creation; (2) reducing poverty by subsidizing the needy and empowering the active poor, promoting economic diversification in rural areas; (3) removing local regulations that hinder regional food distribution, improving infrastructures, and developing food stocks at local level; and (4) strengthening institutions, improving social capital and governance improvement at all levels, and decentralized investment decisions.

The paper calls for new knowledge, tools, policy, and wisdom in approaching the complex issues of environmental risks, heavy floods, water shortages, pests and diseases, crop production, food security, and consequent malnutrition. The future research agenda in the field of environmental risks and food security should cover the biophysical, socioeconomic, and health dimensions of global environmental change. The future development of food security in Indonesia, for its part, must rely on more scientific and evidence-based policy formulation and implementation at the national, provincial, and local level.

References

- Arifin, B. 2008. "From Remarkable Success to Troubling Present: The Case of Bulog in Indonesia". in S. Rashid, A. Gulati, and R. Cummings, Jr. (eds.). *From Parastatals to Private Trade: Lessons from Asian Agriculture*. Washington, D.C.: International Food Policy Research Institute (IFPRI) and Johns Hopkins University Press, pp: 137-164.
- Arifin, B. 2009. "Pemanasan Global dan Ketahanan Pangan Nasional" (Global Warming and National Food Security). *Majalah Pangan*, Vol. 55 (18), pp: 1-16.
- Arifin, B. 2011. "Pembangunan Pertanian untuk Penanggulangan Kemiskinan (Agricultural Development for Poverty Alleviation)" in R. Wibowo, H. Siregar, and A. Daryanto (eds). *Format Baru Strategi dan Kebijakan Pembangunan Pertanian Indonesia 2010-2014*. Bogor: IPB Press. pp: 51-70.
- Asian Development Bank (ADB). 1999. "The Economics of Climate Change in Southeast Asia: A

Regional". Manila: ADB.

Boer, R. 2010. "Ancaman Perubahan Iklim Global terhadap Ketahanan Pangan Indonesia" (The Threats of Global Climate Change on Food Security in Indonesia). *Jurnal Agrimedia*, Vol. 15(2), pp: 16-21

Central Agency of Statistics (BPS). (Various Issues). *Statistical Yearbook of Indonesia* Jakarta: BPS.

Handoko I, Y. Sugiarto, dan Y. Syaikat. 2008. *Kajian Keterkaitan Perubahan Iklim dan Produksi Pangan Strategis (The Relationship between Climate Change and Strategic Food Crop Production)*. Final Report, 21 October 2008. Jakarta: Partnership for Governance Reform.

Hartoyo and H. Riadi. 2010. "Nutrition Security and Food Security in Seven Districts in NTT Province, Indonesia: Status, Causes and Recommendations for Response". Final Report, February 2010. Jakarta and Rome: Food and Agricultural Organization (FAO) and World Food Programme (WFP).

Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate Change 2007: Synthesis Report*. Geneva, Switzerland: IPCC

Martianto, D. 2010. "Food and Nutrition Security Situation in Indonesia and Its Implication for the Development of Food, Agriculture, and Nutrition Education and Research at Bogor Agricultural University". *Journal of Development in Sustainable Agriculture* Vol. 3, pp: 64-81.

Ministry of the Environment. 2007. "Climate Variability, Climate Change and their Implications". Jakarta: Ministry of the Environment.

Naylor, R., D.S. Battisti, W. P. Falcon, M. Burke, and D. Vimont. 2007. "Assessing risks of climate variability and climate change for Indonesian rice agriculture", *PNAS (Proceeding of the National Academy of Science)* Vol. 104 (19), May 8, 2007. pp: 7752-7757.

Ratag, M.A. 2006. "Climate change and climate variability projections and their application in Indonesia: Range of uncertainty and variability in future climate". Paper presented in the Regional Meeting of TroFCCA Southeast Asia, 29-30 May, 2006, held in CIFOR, Bogor, Indonesia

Sawit, M. H. and E. M. Lokollo. 2007. "Rice Import Surge in Indonesia". Bogor: The Indonesian Center for Socio-Economic and Policy Studies (ICASEPS) and Action Aid International (AAI).

Siregar, H. 2007. "Agricultural Development in Indonesia: Current Problems, Issues, and Policies". Paper presented at FAO-SEARCA Policy Workshop, "Asian Economic Renaissance: Challenges and Consequences on Agriculture, Food Security, and Poverty", in Chiang Mai – Thailand, 19-20 March 2007

World Bank. 2006. *Repositioning Nutrition as Center to Development*. Washington, D.C.: The World Bank.

Yokoyama, S. 2003. "ENSO Impacts on Food Crop Production in Indonesia". *Indonesian Quarterly*, Vol 31 (1), 2003. pp: 88-96