Paying Attention to Environmental, Social and Economic Sustainability; Indonesian Food and Fuel Case Study[1]

By

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A. Introduction

Agricultural commodity prices worldwide rose sharply in 2006 and continued to rise even more sharply in 2007. The FAO (2008) noted that food price index rose by 9 percent on the average in 2006 compared with the previous year meanwhile it increased by 23 percent in 2007 compared to those in 2006. In fact, comparing December 2006 to December 2007, the increase in the value of the index was 37 percent. The surge in prices has been led by dairy products, which on average increased by nearly 80 percent, then by oils with nearly 50 percent and grains with 42 percent. The only exception was the price of sugar, which declined by 32 percent, after having increased by over 20 percent over the period of 2005-2006.

The price rise is caused by some reasons, which come from supply and demand side. From the supply side, weather-related production shortfalls, stock levels and increasing fuel costs involved as factors underlying the current state of the markets. Moreover, on the demand side, some factors which engaged are changing structure of food demand, increasing demand of crops to produce bio-fuels and diversifying diets that are moving away from starchy foods towards more meat and dairy products.

Agriculture products do not only depend on input factors and technology, but also on climate change, so the production risk is relatively high. Consequently, from 2004 to 2007 the production of basic food commodities universaly fluctuated (Table 1). Although global cereal output reached record levels in 2004, it declined by 1 and 2 percent respectively in 2005 and 2006. But more importantly, from the perspective of the international markets, the output in eight major exporting countries, which constitutes nearly half of global production, dropped by 4 and 7 percent during the same period. However, there was a significant increase in cereal output in 2007, responding to the higher prices. The production of major exporters of all the other major food commodity groups, on the other hand, was not affected in a similar way during the same period. The quick supply response for cereals in 2007 came at the expense of reducing productive resources to, and hence output of, oilseeds, especially soybeans.

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Another factor on the supply side that has had a significant impact on the markets recently is the gradual reduction in the level of stocks, mainly of cereals, since the mid-1990s. Indeed, since the previous high-price event in 1995, global stock levels have on average declined by 3.4 percent per year (FAO, 2008). There have been a number of changes in the policy environment after the Uruguay Round Agreements that have been instrumental in reducing stock levels in major exporting countries: the size of reserves held by public institutions; the high cost of storing perishable products; the development of other less costly instruments of risk management; increases in the number of countries able to export; and improvements in information and transportation technologies. When production shortages occur in consecutive years in major exporting countries under such circumstances, as happened in 2005 and 2006 for cereals, international markets tend to become tighter and price volatility and the magnitude of price changes become magnified when unexpected events occur. This is one of the important reasons why the international prices of cereal prices spiked so sharply in 2005. And it is expected to continue to remain at these high levels, at least until next season. By the close of the seasons ending in 2008, world cereal stocks are expected decline a further 5 percent from their already reduced level at the start of the season, reaching the lowest level since 1982, when the level of utilization was much less than it is today.

Table 1 Production in major exporters of basic food commodities

Commodities		2004	2005	2006	2007
Cereals[1)]	000 tonnes	1,038,325	1,001,221	932,527	1,041,992
	% change		-3.57	-6.86	11.74
Oilseeds[2)]	000 tonnes	281,589	293,097	306,387	288,762
	% change		4.09	4.53	-5.75
Meat[3)]	000 tonnes	196,050	203,317	208,057	209,601
	% change		3.71	2.33	0.74
Dairy[4)]	000 tonnes	370,986	378,730	383,840	394,459
	% change		2.09	1.35	2.77
Sugar[5)]	000 tonnes	76,882	93,451	103,101	102,139
	% change		21.55	10.33	-0.93

Note:
1 Includes Argentina, Australia, Canada, EU, India, Pakistan, Thailand and USA. Rice is in milled equivalents.
2 Includes Argentina, Australia, Bangladesh, Canada, China, EU, India, Pakistan, Russian Federation, South Africa, Turkey and USA. The total includes only soybeans, rape seed and sun flower seed production.
3 Includes Argentina, Australia, Canada, China, EU, India, New Zealand, Uruguay and USA.
4 Includes Argentina, Australia, Canada, EU, India, New Zealand, Ukraine, and USA. The production is expressed in milk equivalents.
5 Includes Australia, Brazil, Colombia, Cuba, EU, Guatemala, India, South Africa, Thailand
Source: FAO, 2008.

The increases in fuel prices have also raised the costs not only of producing agricultural commodities, but also of transporting them. The increase in energy prices have been very rapid and steep, with the Reuters-CRB energy price iindex more than doubling over a period of three years since the middle of 2004.

From demand perspective, it is widely accepted that economic development and income growth in important emerging countries have been gradually changing the structure of demand for food commodities (especially in China and India). Diversifying diets are moving away from starchy foods towards more meat and dairy products, which is intensifying demand for feed grains and strengthening the linkages between different food commodities (FAO, 2008). It takes seven to nearly eight-and-a-half kilos of grain to produce one kilogram of beef, and five to seven kilogram of grain to produce one kilogram of pork.

The emerging bio-fuels market is a new and significant source of demand for some agricultural commodities such as sugar, maize, cassava, oilseeds and palm oil. These commodities, which have predominantly been used as food, are now being grown as feedstock for producing bio-fuels. Significant increases in the price of crude oil allow them to become viable substitutes in certain important countries that have the capacity to use them. This possibility is increasingly leading to the implementation of public policies to support the bio-fuels sector, which further encourages the demand for these feed stocks.

Finally, the ooperations on financial markets influences significantly for the rise of agriculture and food price. Market-oriented policies are gradually making agricultural markets more transparent. Derivatives markets based agricultural markets offer an expanding range of financial instruments to increase portfolio diversification and reduce risk exposures. The abundance of liquidity in certain parts of the world that reflect favourable economic performances - notably among emerging economies, matched with low interest rates and high petroleum prices - make such derivatives markets a magnet for speculators for spreading their risk and pursuing of more lucrative returns. This influx of liquidity is likely to influence the underlying spot markets to the extent that they affect the decisions of farmers, traders, and processors of agricultural commodities. It seems more likely, though, that speculators contribute more to raising spot price volatility rather contributing to price levels.

The soar of agriculture prices can be a moment to concern on agriculture in developing countries, especially Indonesia which has wealth natural resources. Therefore, this encourages the huge agriculture production and productivity. Consequently, it causes environmental disequilibrium just as the decrease of water and land qualities.

This paper has two objectives:

1. Overview agriculture economic related on environmental sustainability and poverty reduction in Indonesia.
2. The impact of the rise of food production versus fuel price on Indonesian economy and welfare.
3. The economic impact of implementation of environmental sustainability

A. Indonesia Economic Situation

1. Agriculture performance

The contribution of agriculture sector in Indonesia, including livestock and forestry, to GDP tends to fall in the period of 2002-2007. In 2002, the contribution was 15.5 per cent and decreased in 2007 to 13.8 per cent. The sector that contributed most to Indonesia's GDP was manufacture. In 2002, the contribution of this sector was 27.8 per cent and the number increased to 28.1 per cent in 2005. However, it's share decreased slightly in 2007 (27.4 per cent) (Graph 1). This reveals that the contribution of the sectors that rely on the resource endowment tends to decrease. The time lag of agricultural production is one of the reason why the increase of agriculture prices did not automatically increase Indonesia's agriculture production.

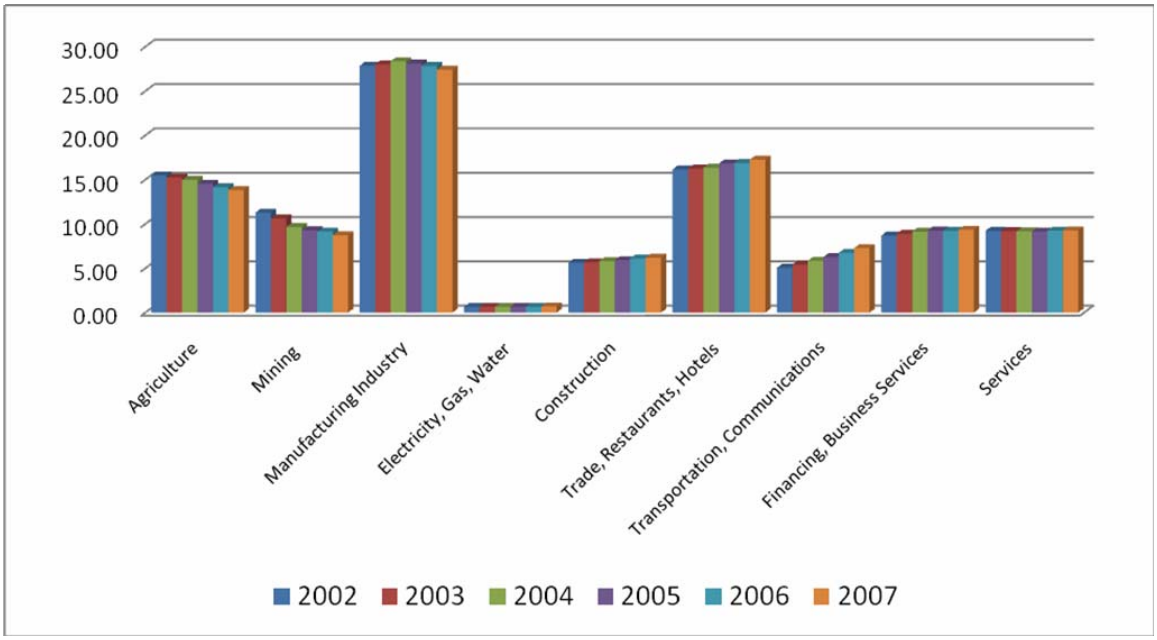


Figure 1. The contribution of agriculture sector to Indonesia's Gross Domestic Products from 2002 to 2007 (per cent)
Source: CBS, 2008

The agriculture sector consists of five sub sectors, namely fishery, forestry, livestock and products, non-food crops and food crops. Among the agricultural sector, the contribution of the forestry sector is the lowest one and it's contribution to the national GDP decreased from 2003 (1.1 per cent) to 2007 (0.8 per cent). Meanwhile, the highest sub sector contribution to the GDP is food crops, which contributed 7.6 per cent to GDP in 2007.

Forestry contribution to the national GDP decreased because of two reosons, firstly, the high lost on forest area in main forestry island in Indonesia; secondly, the rise of illegal logging. The highest area with forest loss is Kalimantan, which contributes 48 per cent of the total forest loss in Indonesia during the period 1985 to 1997 (CSIRO,

2006). Meanwhile, East Kalimantan is the province that had the highest forest loss in Indonesia during the period, contributing 24 per cent of the total forest loss in Indonesia.

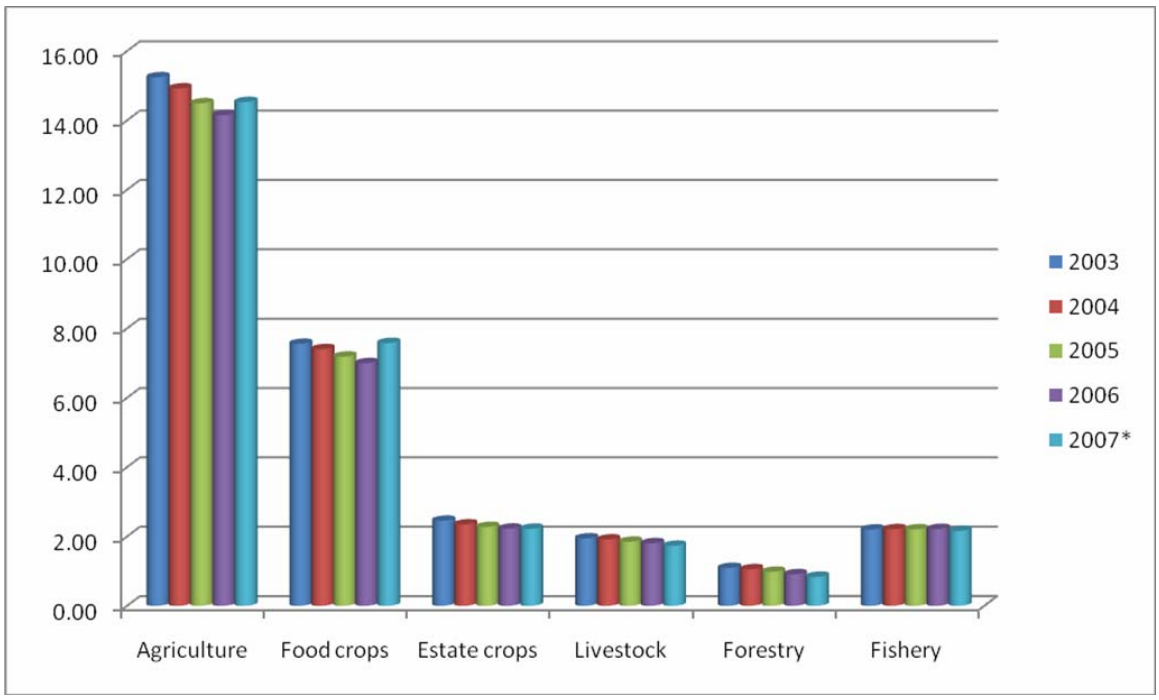
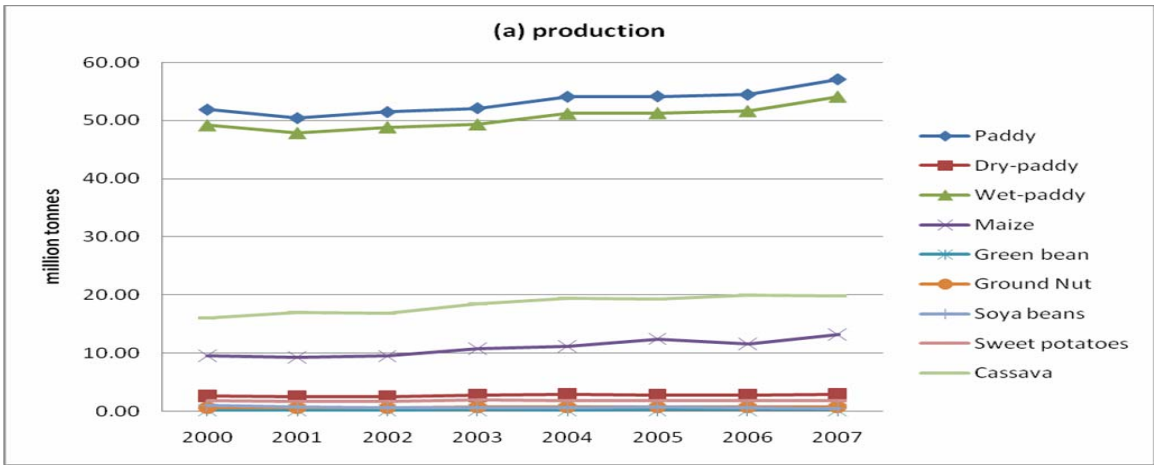
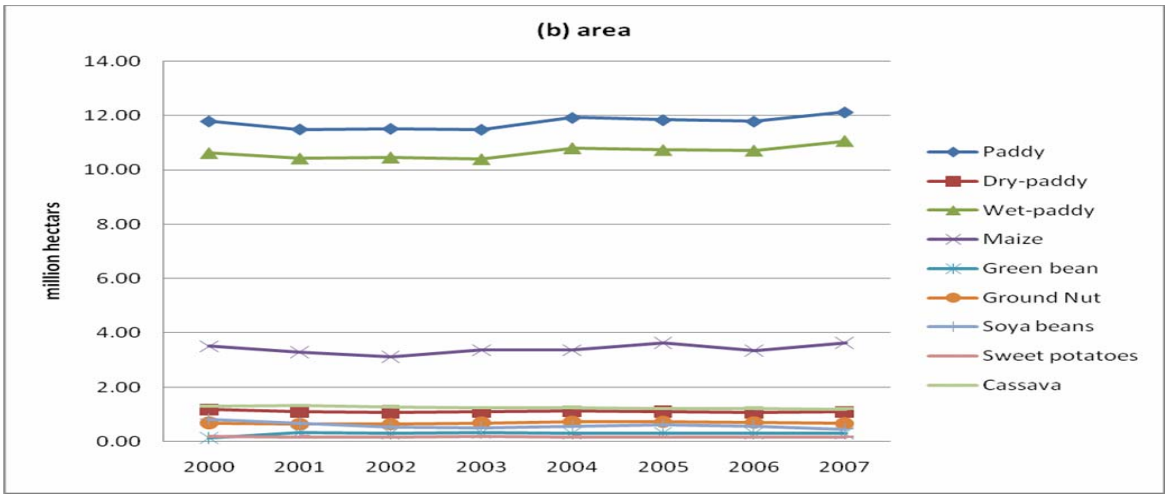


Figure 2. The contribution of food crops, estate crops, livestock, forestry and fishery to Indonesia's Gross Domestic Products from 2002 until 2007 (per cent)
Source: CBS, 2008

The FAO (2006) reported that the largest crop production in Indonesia is paddy. As shown at graph 3, paddy production tends to increase gradually with an average annual growth rate of 1.39 per cent during 2000 and 2007. In addition, paddy had the highest total farm area and expected to soar slightly since rice price worldwide increases. However, paddy's productivity was low with average productivity 45.3 quintal per hectare.

Among the nine major food crops in Indonesia, maize production had the highest growth rate in 2007 with 14.4 per cent. This is influenced by the rise of bio energy demand in the world. Maize, cassava, soya beans and oil palm are natural sources to generate alternative energy. Cassava has a big potential to expand as its productivity achieved average 147.4 quintal per hectare from 2000 until 2007.





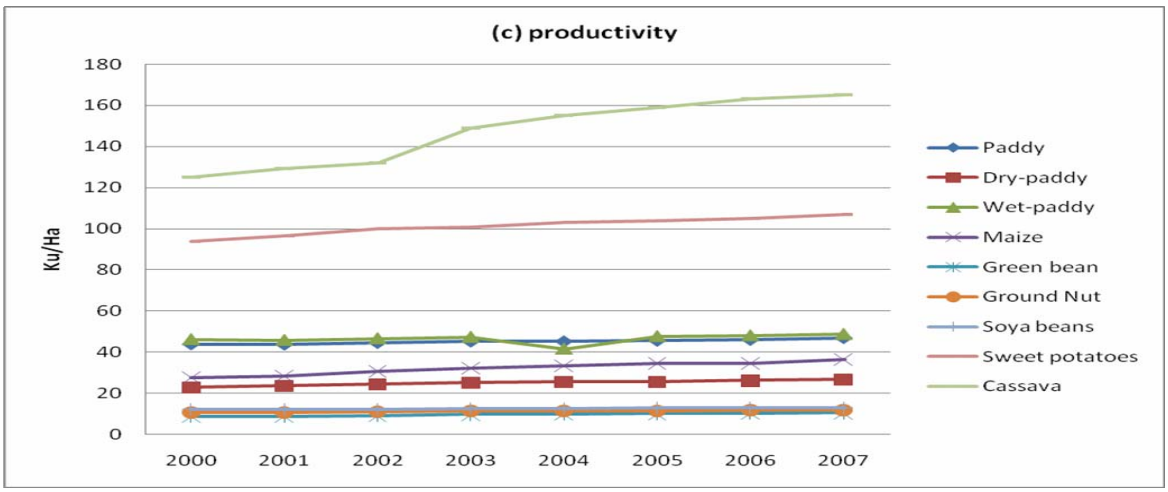


Figure 3. Production, area and productivity of farm food crops from 2000 to 2007
Sources: CBS - Statistics Indonesia and Directorate General of Food crops, 2008

One of the most essential inputs in agriculture is fertilizer. Fertilizer consumption in Indonesia tended to fluctuate during the period 1980 to 2002 (Graph 4). In 2002 it almost tripled from the consumption in the 1980s. Fertilizer consumption grew on average by 4.9 per cent annually with the highest annual growth recorded in the 1980s with 8.3 per cent. Fertilizer production tended to increase gradually throughout the period of 1980-2002. On average it grew by 4.8 per cent with the highest average growth recorded during the 1980s with 11 per cent annually (Graph 4). From 1981 to 1984, fertilizer consumption was higher than production and in the later years, there was a surplus in fertilizer production. The largest fertilizer surplus occurred in 1997 with a surplus of 1.05 million metric tons.

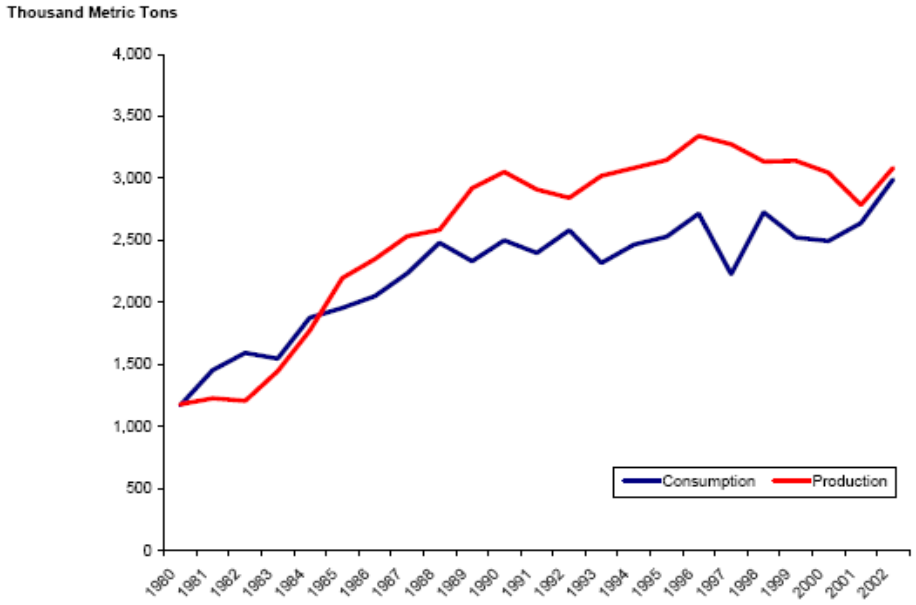


Figure 4. Fertilizer Production and Consumption (Thousand Metric Ton)
Source: FAO, 2006

In the case Indonesia, the fertilizer policy had the most impact on the yields of rice. The high increase of average rice yields in the period of 1975-1985 was achieved by a special governmental intensification program which involved the dissemination of technology, including the subsidy on pesticides and fertilizers, the provision of capital and a guaranteed floor price for rice. The low increase of rice yields during the period between 1985 and 2000 was due to decreased government support, involving a reduction in advisory services, reduction in the subsidy on pesticides and fertilizers and uncertainty concerning the floor price of rice. As a result, imports of rice have increased.

In the fact, the re-implementation of subsidies has been inconsistent, largely due to the government's limited financial capacities. In April 1998 a subsidy for AS and SP-36 fertilizer for the agriculture sector was reinstated was due to prolonged severe drought and the economic crisis sweeping the whole country. This decision was soon followed by an announcement by the Ministry of Agriculture on 1 December 1998 that the government would no longer be involved in the marketing of fertilizers and that subsidies

on fertilizers were to be terminated. In March 2001 the marketing of urea for the agricultural sector reverted to government control. In February 2003, the government applied regulations allocating the areas for the distribution of fertilizers to the different companies. The government has reinstated fertilizer subsidies for urea, SP-36, AS and NPK fertilizers in 2003-2005, but only for food crops and smallholder plantations. To maintain a relatively constant fertilizer to paddy price ratio, the floor purchase price of paddy was also increased annually. The ratio fluctuated around 0.78 in 1970/71, 1.75 in 1985/86 and 1.14 in 1992/93. These policies sometimes create conflicting decisions in recognition of the importance of food security for stabilizing the country's economy.

After two years experience, however, it is apparent that the dual pricing system leads to inefficiency and a distortion of marketing systems. Subsidized fertilizers are frequently not reaching the intended beneficiaries; they can easily be used for the unsubsidized non-food crop subsector and some subsidized fertilizers have been exported. Besides, controlling fertilizer and rice prices at low levels caused market deterioration: will not improve the purchasing power of the farmers and will not be healthy for fertilizer industry. Furthermore, the difference between fertilizer (urea) prices for food crop (subsidized) and for estate set by the government, creates instability of supply and increases price in the domestic market for food crop. As a measure, the government seemingly will liberalize the system some time before mid 1999, among others, decontrol fertilizer prices and increase gas price. Efforts are also being made to bring price of rice to international market price levels.

2. Employment Situation

The majority of the labour force in Indonesia works in the agricultural sector. In 2004 the percentage was 43.33 percent. The average annual growth rate of the labour force working in the agriculture sector was 1.04 percent in the period of time between 2004 and 2007. In the 1980s, the number of works in the agriculture sector increased by 1.80 per cent on average. However, employment dropped by 0.53 per cent on average in the 1990s (CSIRO, 2006). This shows that some of the agricultural labour force migrated to the urban areas and started working for the informal sector.

Employment in the manufacturing sector during the period of 2004-2007 increased slightly with the average annual growth was 1.82 per cent. The largest increase in this sector occured during the 1980s, with 6.29 per cent (CSIRO, 2006). Meanwhile, the mining sector’s contribution to employment in Indonesia was relative small. However, this sector has a huge potential as the mining product prices rise, such as gold, coal and tin, and Indonesia has abundance natural resource in mining and quarrying.

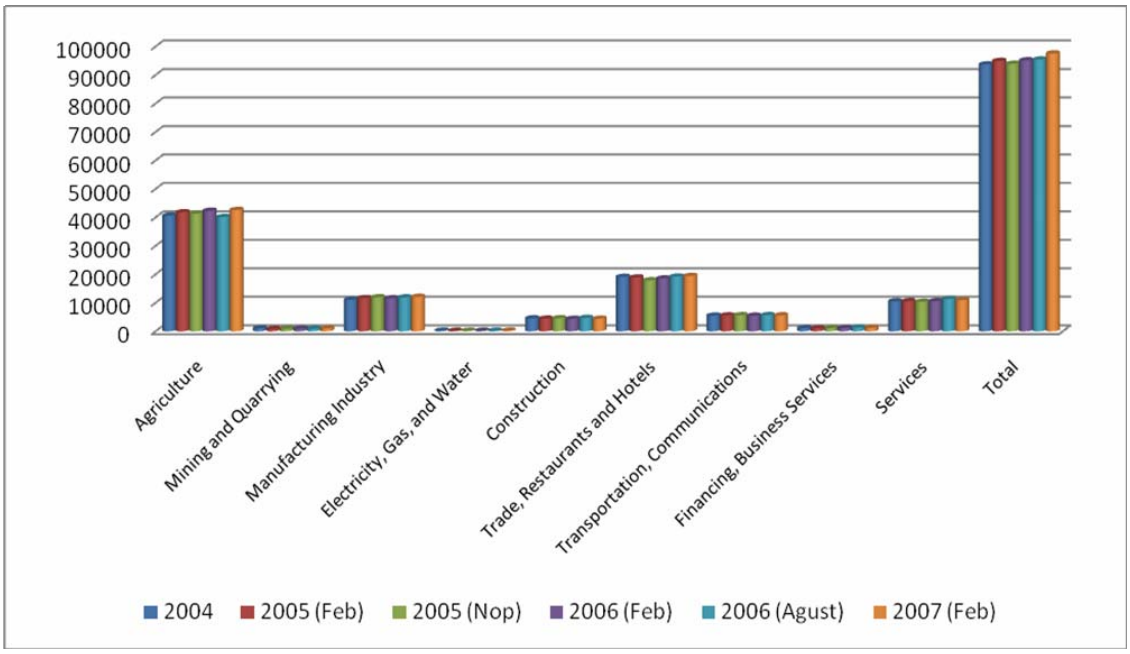


Figure 5. Population 15 Years of Age and Over Who Worked by Main Industry between 2004 and 2007 (thousand persons)
Source: CBS, 2008

3. Indonesian Poverty

Indonesia was widely recognised as one of the "East Asian Miracle" economies during the 1970s and 1980s. The country achieved the rapid economic growth along with the dramatic reduction of poverty from the 1970s until the crisis in 1997 (Oktaviani *et al.*, 2005). The percentage of population below the poverty line in urban and rural areas continued to decrease from 40 per cent in 1976 to 11 per cent in 1996. Because most people leave in rural area and depend on agricultural sector, the government's policy of promoting agriculture and rural development contributes in reducing the poverty level in Indonesia. However, beside the change in definition of poverty line, the economic or financial crisis, which was started in the middle of 1997, increased the number of poor people in Indonesia. The highest level of percentage of population below the poverty line in urban and rural areas was happened in 1998 (24 per cent), with the share of poor people in rural area higher than that in urban area.

Indonesia still faces the poverty problems. As shown in Table 2, even though the percentage of population below the poverty line in urban and rural areas decreased slightly in 1999, it were still reasonably high and tends to go up in 2006.

Table 2. Poverty line, percentage and number of population below the poverty line

Year	Poverty Line (Currency/capita/month)				Population below the Poverty Line					
					Number (million)			Percentage (%)		
	Urban		Rural							
	Rp	US$	Rp	US$	Urban	Rural	Total	Urban	Rural	Total
1996/a	42,032	17.6	31,366	13.2	9.6	24.9	34.5	13.6	19.9	17.7
1998/b	96,959	12.1	72,780	9.1	17.6	31.9	49.5	21.9	25.7	24.2
1999/c	92,409	13.0	74,272	10.5	15.7	32.7	48.4	19.5	26.1	23.5
2000/c	91,632	9.5	73,648	7.7	12.3	26.4	38.7	14.6	22.4	19.1
2001/c	100,011	9.7	80,382	7.8	8.6	29.3	37.9	9.8	24.8	18.4
2002/c	130,499	14.1	96,512	10.4	13.3	25.1	38.4	14.5	21.1	18.2
2003/c	138,803	16.2	105,888	12.4	12.2	25.1	37.3	13.6	20.2	17.4
2004/c	143,455	15.9	108,725	12.0	11.4	24.8	36.1	12.1	20.1	16.7
2005/c	t.d	-	t.d	-	12.4	22.7	35.1	11.4	19.5	16
2006/d	175,324	19.2	131,256	14.4	14.3	24.8	39.1	13.4	21.9	17.8

Note:
a/ Based on poverty line CBS version 1998
b/ Based on the December 1998 Susenas
c/ Based on the regular Susenas
d/ Based on August 2006 calculation
Source: Central Bureau of Statistics, various years

The recovery of the Indonesian economy with more stable inflation and exchange rate in the year 2000 is suspected to reduce the number of poor people in recent years and the near future. However, many Indonesian households who are not currently poor are vulnerable to falling below the poverty line. World Bank (2005) indicates that 7.4 per cent of Indonesians fall under the dollar-a-day poverty line. Meanwhile, 53.4 per cent fall under the two dollars-a-day poverty line. This indicates that most people leave just above the poverty line, and are vulnerable to become poor. This vulnerability renders that economic policies have to concern with the poverty incidents and reduction in the poverty gap and severity.

The figure of poor people in rural area may also be reflected from the ownerships of agricultural land. Oktaviani *et al*., 2005 stated that numbers of agricultural households have increased from 1995 to 1999. The agricultural households possessing more than 1 hectare were reasonably few and the land owned by farmers has decreased every year. CBS reported (Table 4) that in 1983, 44.9 per cent of agricultural land for farming is owned by small holders with land owned between 0.5 – 1.99 hectare. In 1993, however, the average land owned by farmers decrease and 48.5 per cent of farmers owned land less than 0.5 hectare. The agricultural land owned by farmers has continued to decrease. In 2003, the farmers owned land less than 0.5 hectare achieved 55 per cent.

This suggests that the distribution on land could be central to any assessment of income inequality and poverty. Without any policy to support the un-fragmentation of the

land, this condition is predicted to occur continuously in the following years. As a consequence, the agricultural production per labour, as well as the household income, will decrease without any improvement in production technology.

Table 3. On farm land distribution in Indonesia in 1983, 1993 and 2003

Type of Land (ha)	Land Distribution					
	1983		1993		2003	
	On farm (%)	Average Area (ha)	On farm (%)	Average Area (ha)	On farm (%)	Type of Land (ha)
< 0.5	40.8	0.26	48.5	0.17	55.11	< 0.5
0.5 – 1.99	44.9	0.94	39.6	0.9	33.29	0.5 – 1.99
2.0 – 4.99	11.9	2.72	10.6	3.23	6.4	2.0 – 2.99
=5	2.4	8.11	1.3	11.9	5.06	=3

Source: Central Bureau of Statistics, various years

The pattern of land ownership will influence the production and productivity of agricultural product, especially for rice as a staple food of Indonesian people. In fact, the requirement of rice in Indonesia for the future is much depend on the degree of poor and near-poor groups participate in economic growth and development. If there is a modest participation by the poor in the growth process and limited structural change, Indonesia would require another 21 million metric tons by the year 2020. However, if the economic growth is pro-poor, per capita rice consumption will decline and it tends to offset an increase in demand because of the population growth (Tabor, 2001).

B. The impact of the rise of food production, fuel price and implementation of environmental sustainability on Indonesian economy and welfare

This chapter explains how current economy issues, such as the rise of food production as caused by the soaring agriculture prices, the increase of fuel price and the implementation of environmental sustainability, can affect to the community's welfare. All the research applied the computable general equilibrium model to analyse the impacts on the poverty, income distribution and welfare.

The impact of rising food production is enlightened by the research result from Warr and Oktaviani (2008). This research used the rate and factor bias of technical change influencing food production in Indonesia. Moreover the effects of fuel price executed the approach of reducing fiscal subsidy in Indonesia is explicated by Oktaviani *et al*. (2008). Finally, the implementation of environmental sustainability which will emerge consequences on the community's welfare is explained by Resosudarmo's research (2002) which analysed the expected impact of the clean air program on national economic performance and household incomes for various socio-economic groups.

1. The impact of the rise of food production

Warr and Oktaviani (2008) assessed the econometric estimates of the rate and factor bias of technical change in Indonesian agriculture are combined with a 65 sector general equilibrium model of the Indonesian economy to generate estimates of the effect of this technical change on income distribution and poverty. The econometric estimates are based on data for Indonesian agriculture from 1975 to 2000. The general equilibrium model has a multi-household structure which facilitates analysis of the consequences that exogenous shocks have for poverty incidence and inequality.

This study is based on a hypothesis that income distribution emphasizes the factor biases of the technical change as a determinant of the distributional consequences of the productivity growth (Ferguson, 1975 in Warr and Oktaviani, 2008). If the technical change is labour-augmenting, for example, real wages may rise or fall, depending on the elasticity of factor substitution in production. If this elasticity is small enough, labour augmenting technical change will raise the return to land and other fixed assets and lower the return to labour. It is common to summarize this type of outcome on the *functional* distribution of income as meaning that 'land-owners' gain and 'workers' lose. But the *household* distribution of income must reflect the fact that households typically own combinations of factors. Thus, when agricultural productivity improves, some households clearly benefit, but there may be losers as well.

To explore this hypothesis, 4 simulations are conducted;

1. Simulation 1, labour augmenting technical change increases by 10 per cent.
2. Simulation 2, capital augmenting technical change goes up by 10 per cent.
3. Simulation 3, land augmenting technical change rises by 10 per cent.
4. Simulation 4, each primary factor's productivity increases by the amounts estimated for the period 1975 to 2000: labour by 1.97 per cent, calpital by 1.24 per cent and land by 0.25 per cent.

The result of this research reveals that the increases in primary factor productivity raise national income and aggregate consumption. But their effects on factor prices – the functional distribution of income – are not uniform. Labour-augmenting technical change (Simulation 1) effectively increases the supply of unskilled labour. This reduces the average real wage of unskilled labour. The return to capital and land rise considerably. Poverty incidence declines in both rural and urban areas. The poor households have sufficiently diversified factor ownership that they benefit from the rise in returns to factors other than unskilled labour sufficiently to compensate for the loss in the return to unskilled labour. Similarly, capital-augmentng technical change (Simulation 2) raises real consumption for every socio-economic category and reduces poverty incidence.

The most poverty-reducing form of technical change is land-augmenting (Simulation 3). It raises unskilled wages by raising the marginal product of unskilled labour used in agriculture. It also raises skilled wages. This increase in wages causes a decline in the return to capital. All socio-economic groups gain except the richest urban households. These groups derive much of their income from capital ownership.

Finally, technical change at the econometrically estimated rates (Simulation 4) raises real consumption for every one of the 1,000 socio-economic sub-categories and reduces poverty incidence at the rate of 0.18 per cent per year. Rural poverty declines at 0.16 per cent per year and urban poverty incidence at 0.13 per cent per year. Warr (2006) calculates that over the period 1976 to 2002 total poverty incidence in Indonesia declined at the annual rate of 1.41 per cent per year. This means that 13 per cent of the annual reduction in poverty was due to technical progress in agriculture alone. In rural areas the corresponding percentage is 28 per cent. This occurs even though technical change in Indonesian agriculture was labour-augmenting and the real return to unskilled labour *declines* as a result of the technical change.

2. The impact of the rise of fuel price

Oktaviani et al (2007) based on the background that budget deficit, exchange rate fluctuation and high fuel world price provides a pressure on budget capacity to stimulate the Indonesian economy. The government has designed several fiscal policies, including reducing the fuel subsidy to face the rise of fuel world price.

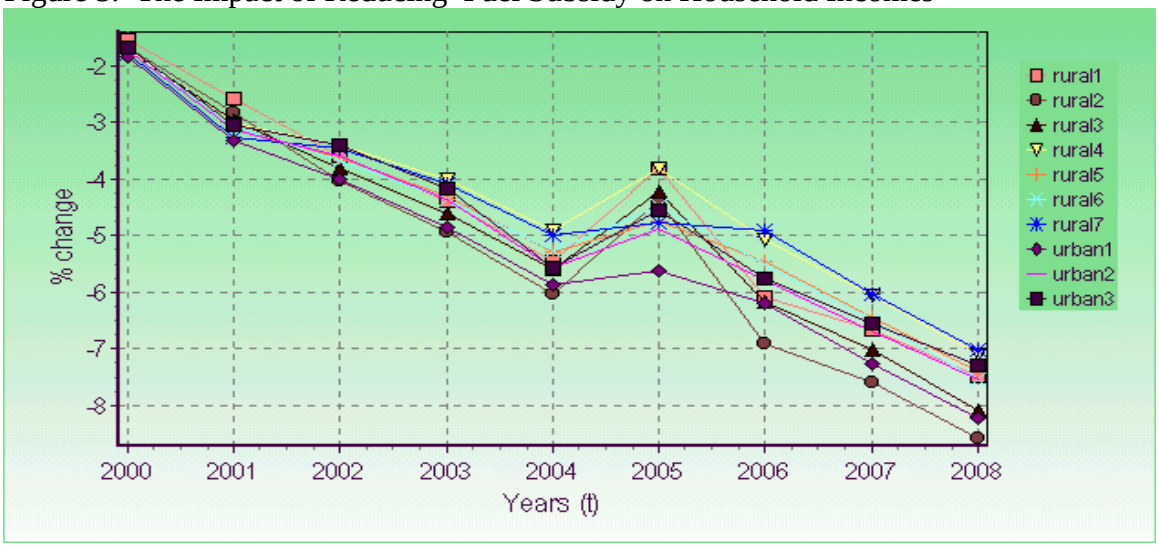
The modification on the basic model, which is a recursive-dynamic model is made in this study. The data used in the model is of the Indonesian I-O Table 2000, the Indonesian Social Accounting Matrix 2000, National Household Survey data and parameter from some other sources.

One of the objectives of this study is to investigate the impact of the reduction of fuel subsidy on poverty incidence. To examine such impact, one can look at factor income development facing households. The model assumes households are endowed with labor, capital and land. Land is sector-specific. In other words, agricultural households own land. Therefore land rent, wages and capital rents accrue to the households. In the model, labor is mobile across sector. Hence, the nation faces only one wage. The model also assumes full employment. This implies labor is paid according to their value of marginal product. In contrast, land and capital rents differ across sectors. As a sector expands, capital rent or land rent is expected to go up, conversely.

The impact of the policy changes on factor incomes is exhibited in general wage of skilled labor declines steadily. It will further even sharply decline in 2006. The decline in wages has an important implication to the household's income. The income will continue to further deteriorate, as other factor incomes for example: capital and land rent in paddy sector decrease. In 2002 the unskilled labor wage goes up compared to the 2001. However this rise is offset by the decline in capital rent. The decline in the wages

is partly associated with the increased labor supply. As the sector declines, the demand for primary factors will also follow. It hence reduces the labor wages. Letting more labor enter the labor market, as reflected by the increase in the labor supply by around 1.95 percent annually, it will further put a pressure to the labor wages. Therefore it can be concluded that households will lose their income following the reduction of fuel subsidy. The welfare of households will be reduced because the households also face the increasing prices of several commodities that they must buy.

Figure 5. The Impact of Reducing Fuel Subsidy on Household Incomes



Source: Oktaviani, et al (2007)

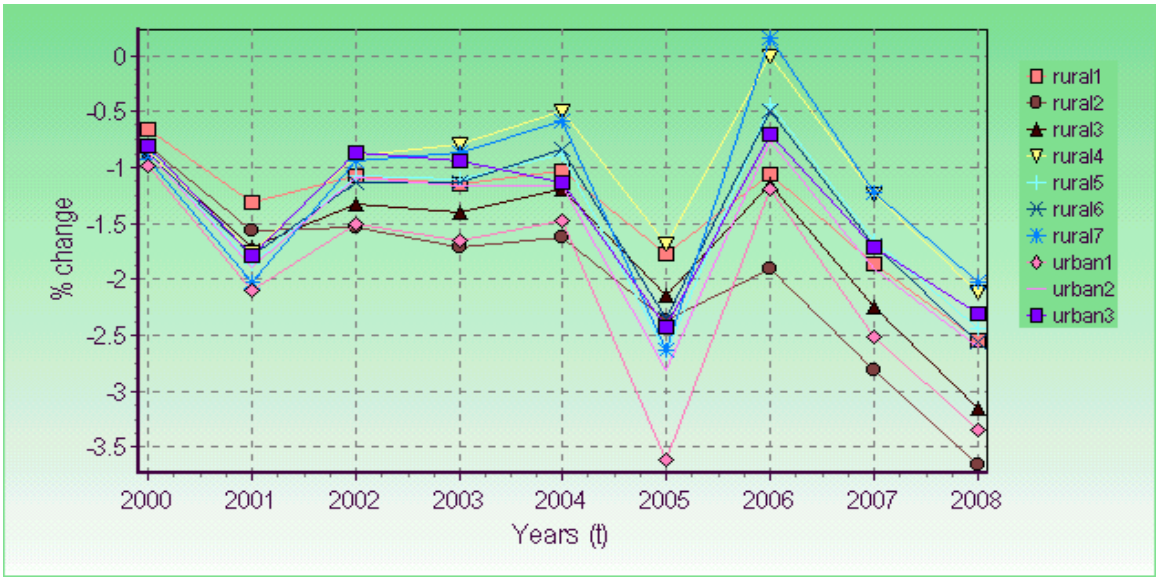
For rural households, the impact of the reduction of fuel subsidy on their income is very obvious. In 2005 it is estimated that return to land declines very sharply (8.44 percent) compared to 2004 (3.91 percent). The decline in the return to land is associated with the production of the agricultural sector. In other words, the agricultural sectors benefit from the decline in the return to land in term of cost of production.

Having described the impact of the policy change on factor income, it turns to discuss its implication to the household income. This is quite important due to the fact that households reside in different regions (rural and urban areas) and are endowed with different resources (land and landless). In general, all households experience constantly declining incomes. In 2002 there is a slight income rise, relative to the income in 2001. In the long run, rural household incomes will drop faster than of urban households (Figure 5). The declines in capital and land rents cause decreases in their income. This result suggests that incomes are evenly distributed within the society.

Figure 6. shows the impact on the number of each of household type, which tends to decrease in the type of household that we can defined as a poor household, such as the type rural 1 (landless farmer). However, it does not necessary mean that the exact number of the poor people decreases because of reducing fuel subsidy. In the model, the number of household is related with the utility. In this case, if utility is put as an exogenous variable, the number of household is the endogenous variable. In the simulation, the

utility is exogenous 0 changes. It means that in order to maintain utility, the number of household must be reduced. In this case, because the household income decline dramatically for rural 1, 2, and 3 to maintain the utility, the number of household of that types declines faster than that of other types of households.

Figure 6. The Impact of Reducing Fuel Subsidy on the Number of Household



Source: Oktaviani, et al (2007)

Focusing on the 2005 case, all types of households are estimated to drop very sharply in response to the policy. Urban household type 1 or urban low income households (Non agricultural urban household, entrepreneur low class, administration labour, sales, labour transportation, services and others) experiences the largest changes in their number of household (3.62 percent). Their depence on fuel for their household actvities such as cooking and lighting is badly influenced with the increase in the fuel prices. In the short run, the substitutability between fuel and other sources is very limited. Unlike households in rural area, they tend to substitute their use of fuel with other sources that are available around their residence. As evindenced in the Figure 6.7 a number of households for rural households type 1 is projected to decline only by 1.77 percent. Therefore the policy of compensating for the reduction of subsidy such as rice for poor people and scholarships for poor people should be directed to the urban low income households rather than to rural households.

The next step to investigate the likely impact of the fuel subsidy reduction on the poverty incidence is to calculate the poverty index. The commonly used poverty index is the FGT index. Before using this index, all household members are then scaled to represent adult equivalent measures. Adult equivalence scale is calculated by converting all members into particular scales.

How a fiscal policy such as the reduction of fuel subsidy would affect the welfare of Indonesian population as indicated by indices of headcounts, poverty gap and poverty

severity. In general, Indonesian households living under the poverty line increase quite significantly. Before the government reduces the fuel subsidy, the population under the poverty line is around 8.9 percent. The number would increase to 12.9 percent as a result of such a policy. It seems that as Indonesian population resides predominantly in rural areas, poor people are expected to rise in rural areas rather than in urban areas. Two possibilities can explain how rural population is largely affected by this policy. In the expenditure side, fuel price rises resulting from this policy change. In the Indonesian economy, fuel plays an important role as intermediate inputs for industries and transportation means. Rural households now encounter an increase in prices of products. Given a constant income, they will have a reduction in their real income. As a matter of fact, kerosene is used by majority of Indonesian population for cooking process and lighting. However their contribution to household expenditure is not significant. In the income side, most of rural household incomes are generated from labor wages and land rent. It seems that some agricultural sectors contract following the increase in the fuel price. This in turn results in a decrease in the demand for rural labor, which ultimately leads to a decline in rural household incomes. The number of people below the poverty line can be predicted to increase and the household income can be predicted to decrease if the government will reduce fuel subsidy as in case in 2005.

3. The economic impact of implementation of environmental sustainability

The implementation of environmental sustainability which will have impacts on the community's welfare is executed by Resosudarmo's (2002). Using a Computable General Equilibrium (CGE), the model studied links between air pollution and the economy.

The model focuses on the relationships among urban production activities, urban air quality, and health problems in urban areas. The use of oil-based fuels in production activities contributes to air pollution in urban areas. A high level of ambient air pollutants in these areas causes a correspondingly high number of air pollutant related illnesses. These illnesses cause urban households to spend money on medical care, and also reduce the productivity of labour in urban production activities. It is assumed that urban production activities are non-agricultural.

The objective of research is to analyse the expected impact of the clean air program on national economic performance and household incomes for various socio-economic groups. Moreover, the research limits itself to estimating the health problems associated with SPM, NO2 and lead, for which relevant data are available; data for other air pollutants are inadequate.

This research has some results. **First**, the introduction of the unleaded gasoline policy, with or without catalytic converters, will effectively reduce the ambient concentration of lead in urban air to approximately zero, thus more than fulfilling the WHO air quality standard for lead. The unleaded gasoline policy with catalytic converters is also the most effective single policy for countering the increasing trend of SPM and NO2 air pollution, although it is not able to reduce these pollutants to below

their 2000 levels, for the following reasons. First, the transport sector only contributes about 30% of SPM pollution in urban areas. Hence, although catalytic converters reduce SPM emitted by cars by up to 90% (Nurrohim, Boedoyo and Malik, 1994), this policy is only able to reduce total SPM such that in 2020 it is still 2.05 times its level in 2000. Second, the transport sector contributes only about 60% of NO2 pollution in urban areas, and catalytic converters are only able to reduce NO2 emitted from cars by approximately 40%. Therefore, this policy fails to reduce the 2020 level of NO2 in urban air below its level in 2000.

Indeed, even after implementing all four pollution abatement policies together, concentrations of SPM and NO2 in 2020 remain significantly higher than those in 2000. Recall that the 2000 ambient levels of SPM and NO2 in many parts of Jakarta, Bandung and Surabaya were higher than the WHO air quality standard. One can conclude, then, that implementing air pollution abatement policies in the transport sector (i.e. focusing on mobile sources) can reduce lead concentration in urban areas to meet the WHO air quality standard for lead, but it cannot reduce SPM and NO2 concentrations sufficiently to meet the WHO standards for these pollutants. To do this, air pollution abatement policies will also need to focus on tationary sources such as manufacturing, burning of waste, and construction activities.

Second, the most effective single policy in reducing health problems and costs associated with air pollution is the shift to unleaded gasoline with catalytic converters. Clearly this policy is important to air pollution abatement.

It is interesting to observe the simulated results of the gasoline and HSDO pricing policy. Table 3 shows that its impact on air pollution health costs is quite different under the pessimistic and optimistic assumptions. Under the pessimistic assumption, this policy is only able to reduce the total present value of health costs by about Rp 12 billion. With the optimistic outcome, however, the reduction is Rp 287 billion-almost 24 times higher-making it the second most effective pollution abatement policy for reducing total air pollution health costs. In implementing this policy it is thus crucial to ensure that the optimistic outcome will obtain.

To bring about this outcome, the government needs to socialise the pricing policy, conducting an effective educational campaign about how to improve the efficiency of fuel consumption by, for example, more regular and effective tuning, better planning of vehicle use, and more careful and effective driving. Another strategy that the government needs to consider is a gradual approach to increasing prices, so that vehicle owners have enough time to keep improving the efficiency of their fuel consumption.

The result shows that urban air quality in 2020 will be approximately three times worse than in 2000, while the number of air pollution health problems in 2020 will be more than six times higher than in 2000. The reason the increase in health problems is much more rapid than the worsening of urban air quality is that more and more people each year will be living in urban areas. Thus the number of people who contract air pollutant related illnesses will grow faster than the level of air pollutants in urban areas.

Hence, in order to avoid more air pollutant related illnesses in urban areas, the implementation of air pollution abatement policies should begin as soon as possible.

The impact of each pollution abatement policy on household income for each socio-economic group is small. Even so, it is important to ensure that the implementation of such policies does not negatively affect the incomes of households, particularly poor households. These are typically found in the agricultural employee, small and medium farmer, rural low income, rural non-labour and urban low income household categories. Agricultural employee households are, on average, the poorest in the country (Thorbecke 1992; Resosudarmo 1996).

Two policies need to be observed carefully. The first is the unleaded gasoline policy without catalytic converters. Under this policy most households, other than those in the rural nonlabour, urban low income and urban non-labour household groups, experience reductions in the total present value of their income relative to the base case. On the other hand, under the unleaded gasoline policy with catalytic converters, only rural high income households suffer such a reduction. The second policy needing careful observation is the gasoline and HSDO pricing policy under the pessimistic assumption, under which all households other than rural non-labour and rural high income households experience a decline in the present value of income. By contrast, if the optimistic outcome obtains, only urban non-labour households are negatively affected.

Some conclusion and policy implications recommended from this research. Bearing in mind the relatively small size of changes in many of the variables discussed above, these results need to be qualified. Since data are limited, the CGE model in this paper cannot capture perfectly all relationships within the economy, within the environment, and between the economy and the environment. The underlying assumptions and structure of the CGE model and the simulation scenarios should also be carefully examined, and be borne in mind when interpreting the results (Resosudarmo and Thorbecke, 1996).

Given these caveats, several important conclusions can be drawn from the simulations described above. First, to be able to reduce all air pollution levels in urban areas to below WHO standards, abatement policies should be applied not only to mobile sources, but also to stationary sources of air pollution.

Second, to reduce the occurrence of air pollution illnesses, abatement policies should be implemented as soon as possible. From the simulation one learns that, even if the concentration of air pollutants in urban areas is relatively constant, more air pollutant related health problems will occur over time because the rate of urbanisation is relatively rapid. The sooner the concentration of air pollutants can be lowered, the more health problems that might otherwise occur can be avoided.

Third, the decision to produce unleaded gasoline should be accompanied by a requirement that catalytic converters be installed on new cars. The results of the simulation show that introducing unleaded gasoline alone lowers total GDP and incomes

of poor households compared with the base case during the 20-year simulation period. On the other hand, if unleaded gasoline is accompanied by catalytic converters, total GDP and incomes of all households other than rural high income households can be increased.

Fourth, phasing out two-stroke engines and implementing vehicle emission standards are good for the economy and for household incomes, although their impacts on the economy and on air pollution are small. Implementation of these policies, whose costs are relatively small, brings about higher GDP and household incomes for all groups than would obtain under the base case.

Fifth, when adjusting gasoline and HSDO price upwards, it will be important for policy makers to find ways to ensure that the actual outcome is closer to the assumed optimistic outcome than to the pessimistic one. If the optimistic outcome is achieved, total present value of GDP and incomes of most household groups will be higher than those under the base case during the 20-year simulation period. If the pessimistic outcome occurs, the total present value of GDP during the simulation period will still be higher than under the base case, but not that of the income of most household groups. In particular, poor households will have lower total incomes under this outcome.

C. Conclusion and Policy Implication

An increase of food and fuel price in the international market in 2006 and continued to rise even more sharply in 2007 will creates the economic, social and environmental problem in most countries, including Indonesia. The price rise is caused by some reasons, which come from supply and demand side. An increase of food production and productivity is needed to avoid these problems.

The most poverty-reducing form of technical change is land-augmenting technocal change. It raises unskilled wages by raising the marginal product of unskilled labour used in agriculture. It also raises skilled wages. This increase in wages causes a decline in the return to capital. All socio-economic groups gain except the richest urban households. These groups derive much of their income from capital ownership. Based on the simulation, 13 per cent of the annual reduction in poverty was due to technical progress in agriculture alone. This occurs even though technical change in Indonesian agriculture was labour-augmenting and the real return to unskilled labour *declines* as a result of the technical change. The implication of Increasing the land augmenting technical change needs reaserch and development in high quality of input factors such as seeds and fertilizer. However, the more intensive land use will create land degradation.

The impact of the reduction of fuel subsidy in 2005 it is estimated that return to land declines very sharply (8.44 percent) compared to 2004 (3.91 percent). The decline in the return to land is associated with the production of the agricultural sector. In other words, the agricultural sectors benefit from the decline in the return to land.

In general, all households experience constantly declining incomes. In 2002 there is a slight income rise, relative to the income in 2001. In the long run, rural household

incomes will drop faster than of urban households. The declines in capital and land rents cause decreases in their income. Indonesian households living under the poverty line also increase quite significantly because of decreasing fuel subsidy. This economic performance is predicted to occur if the government continue to reduce fuel subsidy in 2008. The government should consider compensating the effects of reduced fuel subsidy. This may be in terms of education and health funding or direct transfer, especially in rural areas. The compensation can also be given indirectly to the poor by developing transportation and market access in rural and urban areas. However, the critical issue here is how to distribute the compensation fund efficiently. There ought to be an effective monitoring and evaluation system for the program to be successful.

Reducing oil subsidy can also reduce the fuel consumption. The use of oil-based fuels in production activities contributes to air pollution in urban areas. A high level of ambient air pollutants in these areas causes a correspondingly high number of air pollutant related illnesses. These illnesses cause urban households to spend money on medical care, and also reduce the productivity of labour in urban production activities. It is assumed that urban production activities are non-agricultural. The government is suggested to consider producing only unleaded gasoline, requiring cars to have catalytic converters installed, phasing out two-stroke engines from urban areas, and imposing vehicle emission standards, as soon as possible. Gasoline and HSDO prices should be allowed to increase gradually but in significant steps, and public education activities should be stepped up to promote more efficient fuel consumption. By implementing these policies, the government can expect to achieve an improvement in urban air quality, as well as higher GDP and higher incomes for poor households.

D. References

Central Burreau of Statistics. 2008. *Statistics Indonesia*. CBS, Jakarta.

CSIRO. 2006. Government Policies, Natural Resources and the Environment: Analyzing Paths to Sustainability in Indonesia. Discussion Paper: Trends, drivers and research work. World Bank / AusAID / CSIRO Collaboration

FAO. 2005. Fertilizer use by crop in Indonesia. FAO, Rome.

Nurrohim, A., M.S. Boedoyo and C. Malik. 1994. Technological Options of Air Pollution Abatement, Cost, and Benefits, Agency for the Assessment and Application of Technology (BPPT) Internal Report. Jakarta.

Oktaviani, R, Hakim, D.B, Siregar, Sahara. 2007. Impact of a Lower Subsidy on Indonesian Macroeconomic Performance, Agricultural Sector and Poverty Incidences: A Recursive Dynamic Computable General Equilibrium Analysis. MPIA Working Paper 2007-2008.

Resosudarmo, B.P., and E. Thorbecke. 1996). The Impact of Environmental Policies on Household Incomes for Different Socio-Economic Classes: The Case of Air Pollutants in Indonesia, *Ecological Economics.*17: 83–94.

Resosudarmo, B.P. 2002. Indonesia's Clean Air Program. *Bulletin of Indonesian Economic Studies, Vol. 38, No. 3, 2002: 343–65. Cartax Publishing.*

Tabor, S.R. and M. H. Sawit. Social Protection Via Rice: The OPK Rice Subsidy Program In Indonesia. *The Developing Economies*. XXXIX-3 (September 2001): 267–94.

Thorbecke, E. 1992. *Adjustment and Equity in Indonesia*, OECD Publications, Paris.

Warr, P and R. Oktaviani. 2008. Technical change and income distribution in Indonesia: A general equilibrium analysis. Contributed paper presented to the Australian Agricultural and Resource Economics Society annual conference, Canberra, February, 2008.

World Bank. 2005. *Indonesia: New Directions*. The World Bank, Jakarta.