The Impact of Biofuels on the Indonesian Economy and Regional Performance

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Abstract

The paper examines he impacts of biofuel development on the Indonesian economy, sectoral and regional performance, using a computable general equilibrium of INDIE, an Indonesian version of GTAP. The results show that the biofuel impact on the Indoensian economy is negative, albeit very small, or deterioriating the GDP. Increasing demand for sugarcane, maize, cassava and CPO as biofuel feedstock, has caused a negative impact on household consumption. Strong incentives to increase demands for maize, cassava, soybean, sugarcane and palm oil to enhance the energy diversification would increase the output because of the profitability performance of these crops. Finally, the impact of biofuel on regional development is also negative due to higher food prices, except for oil-rich provinces such as Nanggroe Aceh Darussalam (NAD), South Sumatra (Sumsel), East Kalimantan (Kaltim) and Papua. Major challenges faced by biofuels development in Indonesia is on furhter research and development on the trade-offs between food, fuels, forest and feeds. The paper suggests that biofuel development also requires improvement of social capital, governance principles and enforcement structures at all level to contribute to the policy implementation of revitalizing agriculture.

Keywords: Biofuel, computable general equilibrium, the Indonesian economy

1. Introduction

Biofuel is a promising renewable energy for Indonesia, a country rich in fossil-fuel resources and renewable potentials. Attention on biofuels has grown rapidly during the last two years, especially after the world price of oil increased sharply. In the modern history of Indonesia's development, the share of non-renewable energy sources is extremely high, where oil is very dominant (51.7 percent), followed by natural gas (28,6 percent) and coal (15.3 percent). The share of renewable energy sources is less than 5 percent, where hydropower contributes about 3.1 percent and geothermal about 1.3 percent to the total energy source (Ministry of Energy, 2008). Indonesia has also developed other sources of renewable energy, although in a very slow pace, such as mini/micro-hydro, biomass, solar and wind energy.

Indonesia can no longer depend heavily on fossil fuels, which have been used lavishly, but depleting very badly fast. The production level of Indonesian oil has declined significantly in the last decade or so, while the consumption level increased steadily as the economy grows. In 2009, the estimated daily lifting of oil is 960 thousand barrels, a very significant decline from 1.41 million barrels in 2000, while the consumption level is nearly 1.5 million barrels per day. As a result, Indonesia is also an oil importing country as there has not been major increase in investment and production capacity of the sector. Consequently, the high price of oil in the international market has caused Indonesia some difficulties in adjusting the state budget and development policies. For example, in order to maintain domestic price stability of oil, the government has to allocate oil subsidy about Rp 102.5 trillion in 2009 (above 10 percent of the total state budget). The share of fuel import is estimated about 43 percent of domestic fossil fuel consumption. This is taking a tremendous share of the state budget. Assuming the consumption of fossil fuel reduction is up to 10 percent, the biofuels development program could contribute to foreign-reserve savings up to US $ 10 billion. Renewable energy and biofuels can help reduce the dependency on imported oil, hence contributing the reduction on budget subsidy (Arifin, 2008).

While the development of renewable energy is in progress, recent attention has been given to the development of biofuels, as Indonesia has the production potentials, primarily from palm oil and soybean for biodiesel; and maize, sugarcane and cassava for bioethanol. Private sector and farmers in general have played important roles in such development, inducing an increase on the demand of some food crops such as maize, cassava and sugarcane and palm oil as a source of intermediate good for bio-fuel. The derived demand of these commodities is an increase the demand for land. This may have led the country to face a new challenge in the form of competition in the land uses between bio-fuel development and food security. On the other hand, an increase of demand for these food crops increases its international price. The policy option is needed for adjusting this competition, especially for Indonesia as a producer and high demand for food and fuel.

The current government administration of Indonesia has launched biofuels development policies in response to a growing scarcity of fossil fuels, increasing price and contributing to agricultural development and poverty alleviation. In 2006 President Susilo Bambang Yudhoyono (SBY) announced his Presidential Instruction No 1/2006 on the Provision and Utilization of Biofuel. The instruction was addressed to 14 different ministers plus all of Indonesia’s governors and regents/mayors. In the directive the presidents urged officials in all of these agencies “to take any steps necessary to accelerate provision and utilization of biofuel as alternative fuel.” A follow up policy for biofuels is the Presidential Decree No 5/2006 on Biofuel Development that urges a more consultative effort to develop biofuels as a part of energy diversification strategy. However, at the time of the issuance of the decree, there was no Indonesian-wide study on the effects of biofuels on the country’s economy, sectoral development, and regional performance of the country.

This paper examines the impact of biofuels on the Indonesian economy and regional performance, by applying a computable general equilibrium (CGE) model for the country. Impacts on food security and rural development are also addressed as the issues of fuels vs. food enter the public debates. Finally, the paper concludes with challenges faced by biofuels development in Indonesia.

2. The model

The model used in the study is called INDIE or an Indonesian CGE model developed by the Department of Economics at Bogor Agricultural Univesity (IPB), which is a modified version of WAYANG model (Witwerr, 1999). The development of the INDIE from WAYANG model is the new model capturing the land shifter and intermediate demand change as a result of an increase the demand of some crops that related to the bio-fuel. The change of demand for land and the intermediate good of one commodity in INDIE model are not caused by the change of the relative price of the commodity but because of the change on demand of the commodity (in this case the demand of some crops that related with the bio-fuel). The model simulation then try to captures the abilities of the necessary policy options on reducing adverse effects of competition between bio-energy development and food security can be assessed objectively through the simulation analysis.

The INDIE model identifies ten different types of households, representing ten socio-economic groups as defined in the 2005 Social Accounting Matrix (SAM) published by the Indonesian Central Bureau of Statistics (BPS). In addition to disaggregating households, the model has also employed a disaggregated industry and commodity structure. The microeconomic behaviour assumed within it is competitive profit maximisation on the part of all firms and competitive utility maximisation on the part of consumers. In the simulations reported in this paper, the markets for final outputs, intermediate goods and factors of production are all assumed to clear at prices that are determined endogenously within the model. The nominal exchange rate between the rupiah and the US dollar can be thought of as being fixed exogenously. The role within the model of the exogenous nominal exchange rate is to determine, along with international prices, the nominal domestic price level. The additional aggregation in this research is regional aggregation (30 provinces).

The descriptions of the database structure of the model are summarized below:

Industries and Commodities

The national model contains 74 goods and services produced by 74 corresponding industries. In this case each industry produces a single output, so the set of commodities coincides with the set of industries.

Factors of Production

Four types of labor are identified: farmer, operator, administrator and manager. All types of labor are assumed to be fully mobile across all sectors. These assumptions imply that wages in each type must be equal in all sectors, though each type of labor wage can differ and need not move together.

There are two kinds of mobile capital - one that is mobile among agricultural sectors, and another that is mobile among non-agricultural industries. However, in the long run simulation, the capital can be mobile across sector.

In every sector, it is assumed that there is constant elasticity of substitution (CES) production technology with diminishing returns to scale to variable factors alone. The assumption of constant returns means that all factor demand functions are homogeneous of degree one in output. In each sector, there is a zero profit condition, which equates the price of output to the minimum unit cost of production. This condition can be thought of determining the price of the fixed factor in that sector.

Households

The model contains ten major household categories - seven rural and three urban - differentiated by socio-economic group. The sources of income of each of these household types depend on their ownership of factors of production. The household categories are described as follows.

1. Rural 1: Agricultural employees- Agricultural workers who do not own land
2. Rural 2: Small farmers - Agricultural workers with land < 0.5 ha
3. Rural 3: Medium farmers - Agricultural workers with land 0.5 ~ 1 ha

4. Rural 4: Large farmers - Agricultural workers with land >1 ha
5. Rural 5: Rural low income - non-agricultural households, consisting of small retail store owners, small entrepreneurs, small personal service providers, and clerical and manual workers in rural areas
6. Rural 6: Rural non-labor households, consisting of non-labor force and unclassified households in rural areas
7. Rural 7: Rural high income - non-agricultural households consisting of managers technicians, professionals, military officers, teachers, large entrepreneurs, large retail store owners, large personal service providers, and skilled clerical workers in rural areas
8. Urban 1: Urban low income households, consisting of small retail store owners, small entrepreneurs, small personal service providers, and clerical and manual workers in urban areas
9. Urban 2: Urban non-labor households, consisting of non-labor force and unclassified households in urban areas
10. Urban 3: Urban high income households, consisting of managers, technicians, professionals, military officers, teachers, large entrepreneurs, large personal service providers, and skilled clerical workers in urban areas

3. The Model Simulations

There are five different scenarios that emerged, namely: First, the existing condition of escalating price for food commodities, crude palm oil (CPO), and crude oil as various external shocks through Indonesian economy. Each magnitude of the simulations is based on average growth per year of international price, as it well represented in Table 1. The second simulation related with the increasing demand for sugarcane, maize, soybean, cassava, and CPO as intermediate inputs for bio-fuel with 20 per cent shock. Nowadays, the bio-energy development is handling two critical issues/problems, which are food security in opposition to the necessity of energy supply diversification in the longer term.

Third simulation is accomplished in subject to increasing productivity of rice, maize, cassava, soybeans, sugarcane and palm oil with equivalent 10 per cent increase as a policy option to increase the output supply responding an increase of demand of these commodities. Fourth simulation is basically engaging the 10 per cent increasing land area for rice, maize, cassava, soybeans, sugarcane and CPO, which also the policy response of an increase of the demand of these commodities. Lastly, the fifth simulation was a combined simulation arrangement of the early mentioned increasing land area and productivity with the assumption an increase of productivity of food crops (rice, maize, soybean and cassava) and an increase of land supply for sugar cane and palm oil. Argument the last policy option is it is easier to increase supply of land for palm oil and sugar cane in outside Java Island and increase food crops productivity in Java Island (as most food crops area in Java).

Table 1. The Shock's Magnitude of INDIE Model (average growth per year of the international price of some commodities)

Commodities	**The period of time**	**The average growth per year of the international price (%)**
Sugarcane	2005-2007	11.52
Rice	2005-2008	18.91
Maize	2005-2008	30.74
Palm Oil	2005-2008	41.51
Soybeans	2005-2008	29.12
Petroleum	2005-2008	48.25

Analytical scheme for every simulation impact to Indonesian economy is alienated into long run (policy options) and short run (increasing price and demand) impact. The short run simulation indicates that the investment cannot adjust the shock change of the economy. In the long run simulation investment can be changed adjusting the exogenous shock. The impact it self is decomposed to measure the macroeconomic performance, sectoral economic performance, and regional performance to enhance the comprehensive circumstance of the Indonesian economy. The following sections portray the essence impacts of the policy simulations.

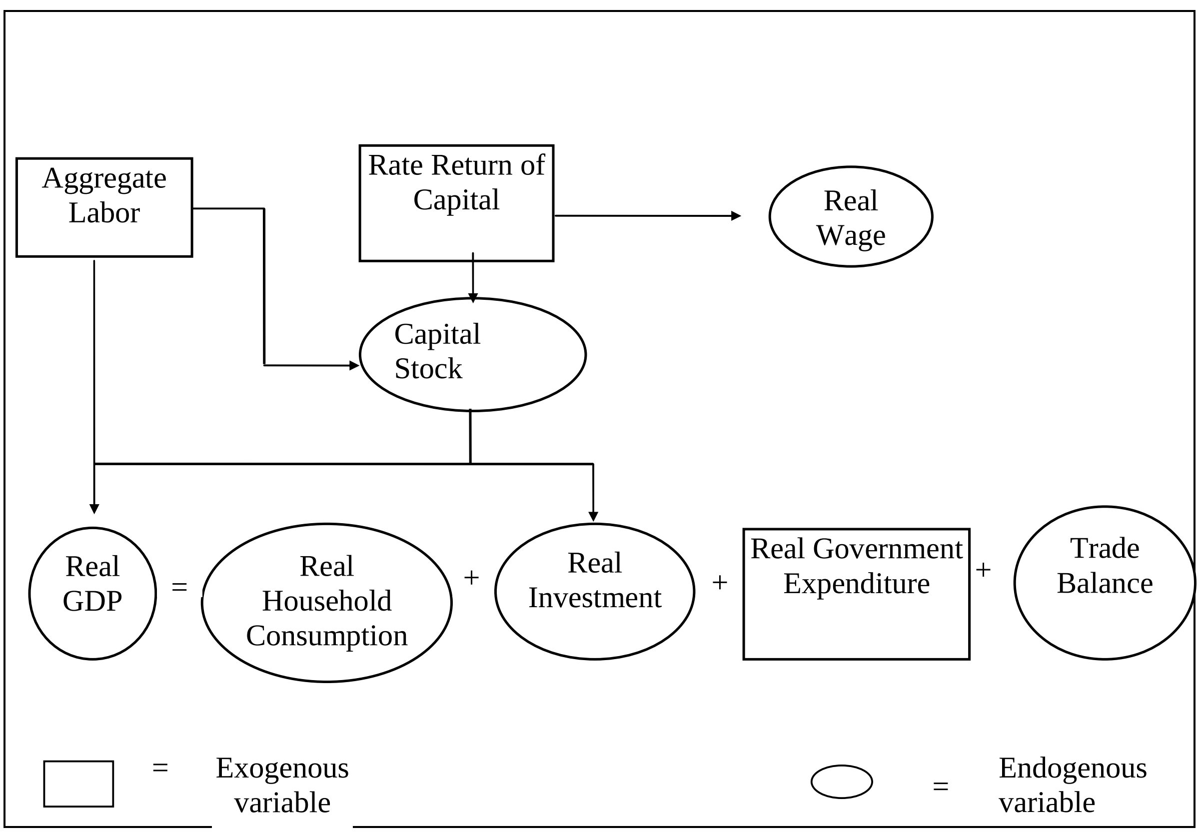

Figure 1. The INDIE Macroeconomic Closure (Horridge, *et al*. (1993), modified)

5. The Biofuel Impact on the Indonesian Macroeconomy

On this sequence, the impact of the international price change as well as the policy option are represented with macroeconomic variable change on five simulation scenarios. The impact through macroeconomic performance can be detected from the standard GDP formation variables. Theoretically, GDP can be measured from expenditure and income approach. From expenditure side, set of the macroeconomic data including: household consumption, government expenditure, investment, and net export. Meanwhile, income side of the GDP requires return to land , return to capital and return to labor (wage)

Figure 1 illustrates the appropriate macroeconomic closure. Government expenditure is considered as exogenous variable, while household consumption, investment, and trade balance is asumed as endogenous variables. Additionally, Indonesia is postulated as small country with the more elastic capital's supply elasticity compared to the intenational capital in the market. On the other hand nominal wage is endogenous variable that stimulated by rate of return, while real wage is explicitly engaged with inflation rate.

The undertaken response for simulation 1 to macroeconomic performance shows that simultaneous increasing price of food, CPO, accelerated with crude oil will deteriorate the real GDP with – 0.442 percent. As the dominantly consumption driven economic on macro perspective, increasing price of food, CPO, and crude oil will influence a decelerate performance through expenditure approach. With the strong dependency and large portion on food and crude oil consumption characterization, the rational expectation of household consumers will lead into lower utilization, given the deteriorate implication of household consumption (- 1.67 percent).

Based on simulation 2, increasing demand of sugarcane, maize, cassava and CPO as bio fuel crops causing a similar negative impact on household consumption with lesser level change (-0.275 percent). The compensation of bio fuel's emerging trend is a decrease allocation of the mention commodities as "food" particularly for CPO and sugarcane. Vegetable oil and sugar are the widely consumed products for Indonesian people. Therefore, supply limitation condition consequences a decrease of household consumption that leads into GDP decline (- 0.273 percent).

Homogenous predicted impacts of policy actions occurred for simulation 3 and 5 with minor difference change in real GDP (0.603 percent and 0.536 percent). In the long run, intensive agricultural strategy by enhancing 10 per cent productivity of selected commodities (rice, maize, cassava, soybeans, sugarcane and palm oil) is caused a slight positive effect of real GDP. Actualization of bio fuel supporting program through increase land area of the same commodities above caused the most inconsequential impact (0.142 percent) for real GDP. Meanwhile, the arrangement of increasing food commodities productivity with extensive land area of CPO and sugarcane will not as good as increasing the productivity is simulation 3 for Indonesian real GDP performance.

The external shocks of international price of food, CPO and crude oil will cause an upward derived tension on inflation (simulation 1). As the source of imported inflation, the measurement on consumer price index term experience increasing change (0.827 percent). Additionally, the twofold function as intermediate goods (food, CPO, and crude oil) for manufacturing industry stimulates the high cost problem and non competitiveness industries, given the single way out to increase the final goods price.

Inflation (consumer price index) highlight in the long run describes a fine presentation. Simulation 3, 4, and 5 analogously caused decrease inflation. Internal strength of food sovereignty through productivity (especially rice) will minimize the imported inflation of volatile foods in Indonesia (-1.463 percent). The importance of increasing land supply of food crops, sugarcane and CPO to fulfill the bio fuel demand only contributes for inflation downward for -0.746 percent. Increase land area could not automatically generate large boost of bio fuel crops. Simulation 5 that represent the accumulation impact of escalating food productivity of food crops and land area for sugarcane and palm oil stood as not the best policy option for achieving low and stable inflation (- 1.46 percent).

Table 2. The Biofuel Impact on the Indonesian Macroeconomic Performance

Macroeconomic Variables	**Percentage Change (%)**				
	Short run		**Long Run**		
	Sim 1	**Sim 2**	**Sim 3**	**Sim 4**	**Sim 5**
Trade Balance (delb))*	-13702.4	-3191.51	4522.287	3003.012	4640.83
Rent of Capital (p1cap_I)	-0.013	-0.296	0.026	0.161	-0.087
Labor Wage (p1labA_iw)	-3.865	-0.358	0.541	0.172	0.399
Labor Wage (p1labF_iw)	-2.973	3.487	-3.683	-0.882	-2.698
Labor Wage (p1labO_iw)	1.651	-1.378	0.816	0.386	0.485
Labor Wage (p1labP_iw)	-2.789	-0.345	0.461	0.147	0.345
Consumer Price Index (p3tot)	0.827	0.305	-1.463	-0.746	-1.46
Real Devaluation (p0realdev)	5.754	-0.142	0.826	0.439	0.851
Real Wage (realwageA)	-4.692	-0.663	2.004	0.918	1.859
Real Wage (realwageF)	-3.8	3.182	-2.219	-0.135	-1.238
Real Wage (realwageO)	0.824	-1.683	2.279	1.133	1.945
Real Wage (realwageP)	-3.617	-0.65	1.925	0.893	1.806
Real GDP (x0gdpexp)	-0.435	-0.273	0.603	0.142	0.536
Import (x0imp_c)	-2.416	0.34	-0.462	-0.336	-0.444
Real Aggregate Investment Expenditure (x2tot_i)	0	0	-0.327	0.274	-0.41
Household Consumption (x3tot)	-1.605	-0.275	0.89	-0.034	0.794
Export (x4tot)	-0.203	-0.086	0.123	0.052	0.155

Even though Indonesia has resource endowment to produce the agricultural product (food and CPO), the high international price on agriculture could not give the positive impact on the Indonesian net export. Increasing crude oil price has implies a superior negative impact, since increasing food and crude oil price caused an opposite impact for trade balance. Indonesia is positioned as the crude oil and soybean net importer, consequencing a massive deficit on Indonesian trade balance achieving -13702.4 million US$.

Trade balance performance related to the increasing demand of bio fuel consequencing depreciate effect on trade balance (-3191.51 million US$). Deficit condition is stipulated by increasing domestic import demand of (0.34 percent) particularly for CPO. As expected, three choices of policy simulations improve the trade balance in the long run. These policy simulations increase the output supply of the crops that increse its productivity and supply of land. The policy simulation in scenario 3, 4 and 5 also reduce the price of the commodies that are increase its productivity and land. It will also increase the product competitiveness in the world market. Orderly, simulation 5 create the most significant effect than others.

From the income side of GDP, most of the labor classification (administration, professional, and farmer) will received significant dercease the based on simulation 1. The worse case of circumstance happened for the farmer real wage when the mixed international commodities and crude oil price rise. It's because in most agricultural activities, the applicable technology and machinery of on and off farm requires high amount of petroleum. Astonishingly, greater impact of rural development is conducted by simulation 2 (increasing demand for sugarcane, maize, cassava, and CPO as bio fuel source) with 3.182 per cent change on farmer real wage. Abundant of the mentioned commodities in Indonesia accelereted with the recent trend of bio fuel making the non bio fuel crops farmer relocate the activity into the bio fuel crops, to gain the high demand incentive.

On the contrary, the policy respon to increase the productivity and supply of land will reduce the farmer's real wage. As a common knowledge, under an inelastic demand function, an increase of agricultural commodities productivity and supply of land will shift the supply of the commodity, increase the output with the percentage change lesser than a decrease of price. As a result, it will decrease the total revenue of the coomodity for the farmer. Therefore the real wage of the farmer in simulation 3, 4 and 5 will have a negative percentage change. However, the policy respon (simulation 3, 4 and 5) is a better option to increase an output that have a high demand for bio fuel. There is only a small negative percentage change of real wage in simulation 3,4 and 5 (-2.219, -0.135 and -1.238, respectively) compare to the high positive percentage change of farmer real wage (3.182 percent) with an increase of the demand of the commodity for biofuel (simulation 2). As a result, the positive percentage change of farmer real wage occure with an increase of productivity and supply of land of those commodities.

Table 3. The Impact on Indonesian Sectoral Output Price

Commodities	Percentage Change (%)				
	Short run		Long Run		
	Sim 1	Sim 2	Sim 3	Sim 4	Sim 5
Rice	-1.608	1.424	-12.175	-16.856	-11.913
Maize	0.205	10.19	-18.602	-8.43	-18.334
Cassava	-2.627	5.963	-20.384	-10.199	-20.037
Soybeans	14.22	-1.61	-10.499	-4.508	-10.309
Sugarcane	-2.183	9.065	-15.714	-6.175	-7.233
Oil-Palm	-0.281	12.206	-17.34	-6.666	-7.954
Petroleum	25.826	-0.3	0.427	0.212	0.365

The impact of high commodities at the sectoral level can be seen from commodity prices, domestic and imported output (following Table 3, 4 and 5). As a whole, the high commodity prices of many sectors should be a non fundamental factor to pushes inflation. But as we can see in Table 3, not all sectors experience the rise of output price because of simulation 1. The highest increase of output price happens on the sectors which are related to the price shocked in the simulations, for instance soybeans (14.22 percent), maize (0.205 percent), and petroleum (25.826 percent). Rice, cassava, sugarcane, and palm oil result the adverse impacts. The price transmission from international to the domestic market for rice, cassava and sugar cane is not tight. The government intervention to keep the price of rice and sugar low still occurs in Indonesia. Cassava is not importing goods, so the influence of world price is not significant to the domestic price. In case of palm oil, the domestic price is not automatically rise an increase of world price because the government still applies the export tax of palm oil export.

Meanwhile, general outcomes for simulation 2 reflect the increasing price of agricultural commodities with petroleum and soybean as an exemption. The petroleum price is not influenced by an increase of food crops, sugar cane and palm oil demand. Soybean, as an imported good also will not increase its domestic price because the high demand of soybean could not fulfill by the domestic product but the imported good.

An increase of productivity, land supply or combination of those policies for rice, maize, cassava, soybean, sugarcane and palm oil in simulation 3,4 and 5 will decrease the price of those commodities. It is happened because the shift of supply curve of those commodities because of the policies will decrease the price and increase the output with given demand schedule.

Table 4. The Impact on Indonesian Sectoral Output

Commodities	**Percentage Change (%)**				
	Short run		**Long Run**		
	Sim 1	**Sim 2**	**Sim 3**	**Sim 4**	**Sim 5**
Rice	0.089	-0.438	6.281	3.127	6.182
Maize	1.883	6.407	5.8	2.582	5.585
Cassava	-0.575	1.771	5.494	2.613	5.343
Soybeans	16.523	-6.061	14.284	6.213	13.917
Sugarcane	-0.708	6.133	7.897	3.263	4.272
Oil-Palm	1.465	14.118	3.51	1.384	1.786
Petroleum	20.305	0.386	-0.419	-0.272	-0.331

The impact on sectoral output can be seen in Table 4, which shows that the impacts on outputs vary among sectors. However, soybean is the sector that would increase sharply more than 16 percent in simulation 1. Other sectors which face the high international price (rice, maize, palm oil and petroleum) also respond to the price with positive percentage change in output. However, for other sectors such as cassava and sugarcane, which compete with the sector that has a high international price such as soybean, reduce its output. This occurs since the farmers have responded reasonably well to the high price and have moved the more high return sectors

Forceful demands for maize, cassava, soybean, sugarcane and palm oil to enhance the energy diversification automatically increase the output because of the profitability. The largest output change occurred for oil palm (14.098 percent) and the less output change stands for cassava (1.771 percent). In contrast, the decelerating output phase of rice (-0.438 pe cent) and soybeans (-6.061 percent) could be an obstacle to Indonesian food security in the short term. Again, the economic motivation set as background to shift the former rice and soybean's farmer lucid action to develop bio fuel crops. For soybean case, an increase of soybean demand is more efficient to fulfill through the import. Petroleum as the substitute commodity for bio fuel is not having a decrease output (even though it was only increase slightly), since the domestic structural linkage of petroleum and manufacturing industry remain strong (0.387 percent).

A 10 percent increase in productivity of rice, soybeans, maize, cassava, sugarcane and palm oil (simulation 3) has resulted in the output increase in these commodities. Purposively, land area is one of the important things to increase the agricultural yield, therefore it has proven that increasing land area for those commodities (simulation 4) will increase the output with soybean is the highest one. It shows that soybean is the most sensitive commodities in responding the productivity and land supply growth. The joined policy options (simulation 5) caused an improved performance on every sectoral output compared, but not as big as the productivity increase (simulation 3).

Table 5. The Impact Indonesian Sectoral Labor Absorption

Commodities	**Percentage Change (%)**				
	Short run		**Long Run**		
	Sim 1	**Sim 2**	**Sim 3**	**Sim 4**	**Sim 5**
Rice	0.291	-0.784	-5.704	-0.602	-5.932
Maize	3.42	9.893	-6.812	-1.76	-7.349
Cassava	-0.574	2.801	-7.891	-2.432	-8.331
Soybeans	26.028	-9.594	6.428	4.091	5.694
Sugarcane	-0.733	8.975	-3.314	-0.033	1.167
OilPalm	2.572	20.984	-9.874	-2.928	-2.608
Petroleum	33.656	0.844	-0.841	-0.466	-0.646

Mostly, the impact of increasing food and petroleum will deepen into employment creation as it represented with the positive growth in labor absorption for several sectors, namely: rice, maize, soybeans, palm oil, and petroleum. Petroleum ruled as the main contributor of labor absorption (33.656 per cent) in high commodity prices era, since the sector requires a small number of labor, and typically related with high capitalization. In the meantime, the expanded activity on commodity based production regarding the price shocks is not followed by cassava and sugarcane (negative responses), which is inline with the negative impact of its output (Table 3). Conversely, cassava and sugarcane experienced an increase of labor absorption a line with maize and palm oil from the simulation 2 result. However, the high demand is not good enough for rice and soybean, because it can not fulfilled by the domestic production. Import of those goods will increase, it needs the policy of increasing productivity and land supply.

The long run policy simulation for increasing productivity (simulation 3), land supply (simulation 4) and the combination of those policies give the interesting result for policy simulation. An increase the productivity of food crops, sugarcane and palm oil will increase the labor productivity. As a result, the labor absorption will decrease in the production activity. Reducing labor absorption even could not be recovered by an increase the demand of these commodities for some commodities such as rice and cassava. Meanwhile, reducing labor absorption because of increasing the land supply can be recovered by an increased of demand for those commodities. It shows that, if the government try to increase labor absorption to anticipate an increase of demand of commodities for bio-fuel, an increase of land supply is more effective.

Table 6. The Biofuel Impact on the Regional Economic Performance

	Percentage Change (%)				
	Short run		**Long Run**		
Province	**Sim 1**	**Sim 2**	**Sim 3**	**Sim 4**	**Sim 5**
NAD	4.47	0.022	0.198	0.126	0.157
Sumut	-2.892	0.111	0.556	0.176	0.513
Sumbar	-2.529	-0.379	0.583	0.35	0.442
Riau	-0.402	0.054	0.411	0.112	0.349
Jambi	-0.697	0.035	0.451	0.29	0.345
Sumsel	1.656	0.097	0.189	0.085	0.161
Babel	-2.324	0.317	0.105	-0.071	0.135
Bengkulu	-2.058	-0.216	0.813	0.502	0.662
Lampung	-2.133	0.283	0.598	0.486	0.489
DKI	-3.204	0.09	0.053	0.106	0.06
Jabar	-1.794	0.03	0.137	0.075	0.129
Banten	-3.204	0.041	0.101	0.006	0.099
Jateng	3.195	-0.323	0.492	0.289	0.365
DIY	-5.276	-0.423	0.858	0.087	0.689
Jatim	-2.666	-0.483	0.873	0.344	0.705
Kalbar	-1.818	-0.14	0.662	0.383	0.538
Kalteng	-1.62	0.343	0.746	0.352	0.66
Kalsel	-1.333	-0.143	0.301	0.342	0.209
Kaltim	6.205	0.115	-0.055	-0.11	-0.035
Sulut	-1.806	-0.072	0.738	0.192	0.652
Gorontalo	-1.322	1.168	1.007	0.665	0.891
Sulteng	-1.853	-0.173	0.837	0.464	0.695
Sulsel	-1.389	0.087	0.389	0.43	0.296
Sultra	-1.242	-0.056	0.671	0.368	0.534
Bali	-2.697	-0.188	0.426	0.244	0.376
NTB	-1.185	-0.186	0.386	0.273	0.332
NTB	-0.987	0.011	1.003	0.536	0.846
Maluku	-1.032	-0.374	0.877	0.173	0.747
Malut	-1.253	0.183	0.885	0.325	0.802
Papua	0.682	-0.088	0.83	0.256	0.747

The high commodity prices will influence the Indonesian regional economy. As shown Table 6, when simulation 1 is applied, the decrease of GRDP in the most of regions occurs exchange the impact of international agricultural prices, except for Nangroe Aceh Darussalam (NAD), South Sumatra (Sumsel), East Kalimantan (Kaltim) and Papua. This reveals that the use of oil as input in production is still crucial, so it will decrease the GDP provinces, except for the region that produce crude oil. The most significant GRDP decrease for DI Yogyakarta, Banten, and DKI Jakarta as the manufacturing and trade backbone of economies. Petroleum has an extent fraction on those sectors expenditure. On the opposite side, East Kalimantan as the main petroleum producers will obtain the highest positive impact followed by Nangroe Aceh Darussalam (NAD).

Increasing the demand of food crops, sugar cane and palm oil as intermediate good for bio-fuel has increased the regional GDP for the provinces that produce these biofuel feedstocks. The highest increase is found in the Province of Gorontalo, which has become an important production center of maize in Eastern Indonesia. Surprisingly, an increase the productivity and land supply or both of those commodities will increase the regional GDP of most region, except the Province of East Kalimantan for all policy simulation and the Province of Bangka Belitung for simulation 4 (increase land supply) because these provinces are not the food crops producer region, so it is not beneficial from these policies.

5. Concluding Remarks: The Way Forward

The paper has examined the impacts of biofuel development on the Indonesian economy, sectoral and regional performance, using a computable general equilibrium of INDIE, an Indonesian version of GTAP. Generally, the biofuel impact on the Indoensian economy is negative, albeit very small, or deterioriating the GDP. Because the structure of the Indonesian economy is dominated by consumption, increasing price of food, CPO, and crude oil will influence a decelerate performance through expenditure approach. Similarly, increasing demand of sugarcane, maize, cassava and CPO as biofuel feed stock, has caused a negative impact on household consumption. These feedstocks have so far been widely consumed by the Indonesian people, so that the limitated supply of these foodcrops has lead to a decrease in household consumption, which results in the GDP decline. The external shocks of international price of food, CPO and crude oil would cause an upward derived tension on inflation ,The twofold function as intermediate goods (food, CPO, and crude oil) for manufacturing industry stimulates the high cost problem and non competitiveness industries, given the single way out to increase the final goods price.

The impact of biofuel development varies among among sectors. Soybean is the sector that would increase sharply more than 16 percent in simulation 1. Other sectors which face the high international price (rice, maize, palm oil and petroleum) also respond to the price with positive percentage change in output. However, for other sectors such as cassava and sugarcane, which compete with the sector that has a high international price such as soybean, reduce its output. Strong incentives to increase demands for maize, cassava, soybean, sugarcane and palm oil to enhance the energy diversification would increase the output because of the profitability performance of these crops. The largest output change occurred for oil palm (14 8 percent) and the less output change stands for cassava (1.8 percent). In contrast, the decelerating output phase of rice (-0.44 pe cent) and soybeans (-6.1 percent) could be an obstacle to Indonesian food security in the short term. Petroleum as the substitute commodity for bio fuel is not having a decrease output (even though it was only increase slightly), since the domestic structural linkage of petroleum and manufacturing industry remain strong (0.39 percent).

Finally, the impact of biofuel development on the Indonesian regional economy varies significantly depending on the initial economic peformance of the province. Similar to that on the macroeconomy, the simulations show that most regions would experience a decline in their GDP due to higher food prices at the globla level, except for oil-rich provinces such as Nanggroe Aceh Darussalam (NAD), South Sumatra (Sumsel), East Kalimantan (Kaltim) and Papua. The highes GRDP decline would occur in the Provinces of DI Yogyakarta, Banten, and DKI Jakarta, because these provinces are the economic backbone of manufacturing and trade sectors. Inversely, two major petroleum provinces of East Kalimantan and Nanggroe Aceh Darussalam (NAD) would enjoy a positive impacts of biofuel development because their regional economy is very much dependent on the oil economy.

Major challenges faced by biofuels development is on furhter research and development on the trade-offs between food, fuels, forest and feeds. Capacity building for policy makers, researchers and academic community, private sectors and government agencies, is really required to sharpen the policy formulation, organization, and implementation of biofuels development. This should include modelling in inter-linkages in resource allocation and product use, as well as broader perspectives on international trades and dynamic modeling in the biofuels industry. Finally, biofuels development – such as any other development policies – also requires improvement of social capital, governance principles and enforcement structures at all level. Policy makers and government administration have to develop the property rights systems in order to improve the predictability of economic decision-making procedures by biofuels stakeholders.

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