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THE CHANGE IN WORLD PRICE AND EXPORT TAX OF CRUDE PALM OIL AND THEIR IMPACT ON THE ECONOMY AND WELFARE IN INDONESIA: USING A COMPUTABLE GENERAL EQUILIBRIUM (CGE) MODEL

Sadik Ikhsan[1,2]*, **Ratya Anindita**[1], **Nuhfil Hanani**[1], **Djoko Koestiono**[1]
[1]Faculty of Agriculture, University of Brawijaya, Malang, Indonesia
[2]Faculty of Agriculture, University of Lambung Mangkurat, Banjarbaru, Indonesia

*E-mail: sadikikhsan@yahoo.com.sg

ABSTRACT
The research aimed to analyze the impact of change in world price and export tax of crude palm oil on the export and domestic production performance of some selected economic sectors, as well as households' welfare in Indonesia. The analyses were carried out by a Computable General Equilibrium (CGE) static model with data taken from Indonesian Social Accounting Matrix (SAM) 2008. The results showed that the increase in world price accompanied by the increase in export tax of crude palm oil and rupiah depreciation have positive impact on the export and domestic production performance of palm oil manufacture sectors and other related economic sectors. Prevailing progressive tax on crued palm oil export does not have negative impact resulted in decreasing palm oil export because export unit price received by producers remains higher than the price at baseline. Due to the increasing of export performance and domestic production, production sectors have economic ability to meet the demands of paying higher value-added upon primary production factors owned by households so that households' factor income increase and eventually, it leads households' welfare increase as well.

KEY WORDS
Social accounting matrix, computable general equilibrium, crude palm oil, export taxes, exports, domestic production, welfare.

Indonesia obtains huge economical benefits from oil palm plantations and the palm oil manufacture. The share of Indonesian exports of crude palm oil in 2010 as 46.68% which was along with Malaysian export as 42.21% (FAOStat-Agriculture, 2012) had dominated the world market. The contribution of foreign exchange from the exports in 2014 reached US$ 17,464.9 million or 13,4 percent of Indonesia export total value (Indonesian Central Beureau of Statistics, 2015). In addition, oil palm plantations are labor intensive due to land area stretching many hectares and the lack of mechanization, especially in planting, harvesting and fruit gathering, offering solutions to unemployment problems in Indonesia. Finally, the crude palm oil is a basic material for palm oil downstream manufactures which processes it into high value-added derivative products. The adequacy of supply availability determines the development of domestic palm oil downstream manufactures in Indonesia.

High demands of crude palm oil caused by population growth, raising of gross domestic income of importing countries, shifting of consumer preferences due to health concerns, economical prices, as well as the growing of various derivative products, including biofuel, lead to increase world prices of crude palm oil. High world prices provide incentives to producers offering their products to export markets.

Exports of crude palm oil should be controlled to ensure that its supply is sufficient in the country. One of the trade instruments used by Indonesia for this purpose is export tax. The amount of export tax is formulated increase progressively following world prices of crude palm oil represented by the Export Reference Price (ERP) (Table 1). ERP is set through the regulation of the Minister of Trade based on weighted average price referring to c.i.f. Rotterdam, Malaysian Derivative Exchange (MDEX), and Indonesia Stock Exchange in the

last one month before prevailing ERP. ERP is valid for one month only and then is set a new ERP for the next month.

Table 1 - The amount of export tax on crude palm oil in the range of ERP

No.	ERP range (US$/ton)	Export tax (%)
1.	ERP ≤ 700	0.0
2.	700 < ERP ≤ 750	1.5
3.	750 < ERP ≤ 800	3.0
4.	800 < ERP ≤ 850	4.5
5.	850 < ERP ≤ 900	6.0
6.	900 < ERP ≤ 950	7.5
7.	950 < ERP ≤ 1000	10.0
8.	1000 < ERP ≤ 1050	12.5
9.	1050 < ERP ≤ 1100	15.0
10.	1100 < ERP ≤ 1150	17.5

Source: The Regulation of Ministry of Finance No. 159/PMK.011/2008 at October 30th, 2008.

Changes in world price of crude palm oil led to changes in ERP, export taxes prevailed and export unit price received by producers. As a consequence of implementation of export tax, export unit price received by producers lessened form the world price as much as that tax (Anindita & Reed, 2008). The changes will impact directly on domestic production of oil palm plantations and palm oil manufacture, transformation of that product to enter either export or domestic markets, and households' welfare. Novindra's research (2011), using a partial approach, showed that the simulation of 50 percent increasing export tax of crude palm oil led to its export price received by producers, reduced by 1.106 percent and succeeded in reducing the export of crude palm oil as 0.031 percent which was diverted to meet the domestic demands for downstream manufactures using basic materials of crude palm oil. Decreasing domestic crude palm oil price was a disincentive for producers responded by reducing decreasing domestic production of crude palm oil amounted to 0.024 percent.

In a partial approach, the adjustment of supply and demand on a single commodity to achieve an equilibrium is affected only by the price of that commodity. Prices of other commodities are considered constant —or it is thought to be unrelated to commodity. However, in the real world, different results are obtained. In the general equilibrium approach referring to the Walras' Law, a framework is made to link all markets which therefore interact among industries, factor resources, and institutions. The adjustments that take place in one market due to price change to find a new equilibrium, will interact simultaneously other markets and generate market feedbacks (Vargas *et al*, 1999) until it forms a new general equilibrium covering all markets.

This study aimed to analyse the impact of world price changes and export tax of crude palm oil on the economy sectors and households' welfare in Indonesia by using Computable General Equilibrium (CGE) static approach.

THEORETICAL REVIEW

The impact of Export Tax on Production, Consumption, and Welfare. Before tax is applied, the relative price of commodities q_1 and q_2 prevailing in the country was $p = \frac{p_1}{p_2} = \frac{p_1^*}{p_2^*} = p^*$ or equal to the world price. After prevailing ad valorem tax on the export commodity, q_1 amounted te so that its price is $p_1 = p_1^*(1–te)$ and the relative prices of commodities distorted into $p^T = \frac{p_1^*(1-te)}{p_2^*} = p^*(1–te)$ that was less than the world relative prices of commodities, p*.

Graphic illustration of the impact of the export tax implementation on the equilibrium of production and consumption is shown in Figure 1. On the free trade with the world relative

prices of commodities, p*, levels of production and consumption respectively found in Q_1 and C_1 with the welfare lies in the community indifference curve, I_1. As a result of prevailed export tax, relative price of commodity in the domestic market, $p^T = p^*(1–te)$ is less than p* and, therefore, slope of production possibilities frontier (PPF) and community indifference curve become more gently sloping so that the domestic production moves from Q_1 to Q_T (= production decreased) and community consumption moves from C_1 to C_T (= consumption decreased).. The production point of Q_t and consumption point of C_t are intersected both by the line of domestic relative prices, p^T (after prevailing export taxes) and the line of world relative prices, p* indicates that both of them cannot be separated from p^T and p*.

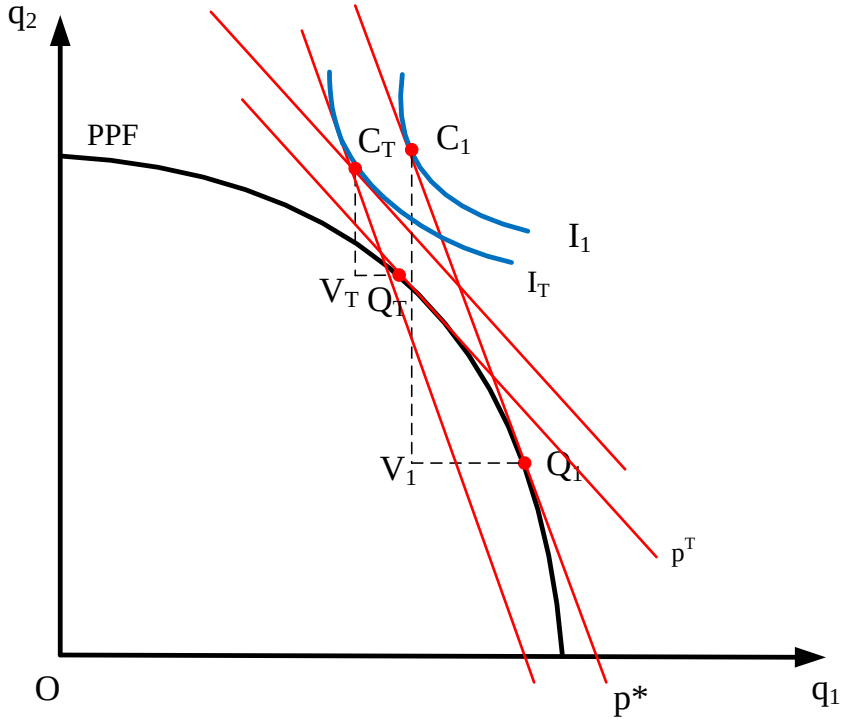

Figure 1 - Implementation export tax causes p* → pT

The shift from Q_1 to Q_T (production decreased) and from C_1 to C_T (consumption decreased) also cause excess demand, ED ($ED_1 = q_{1C} – q_{1Q}$ for commodities of q_1, and $ED_2 = q_{2C} – q_{2Q}$ for commodities of q_2) decrease. According to the trade balance condition, ED can be fulfilled through the trade i.e. exports and imports at the world relative prices of commodities, p*. Therefore, the impact of prevailed export tax is reduced trade both in volume and in value.

The equilibrium of society consumption at the point of C_T found in indifference curve of I_T which is lower than I_1 indicates that after prevailing export tax, society welfare has decreased. According to Salvatore (1995), the welfare decrease comes from two causes: (1) the economy does not produce at the point of maximizing profit on the world prices —or known as loss due to the distortion of production; and (2) the consumption which can be conducted not on the highest indifference curve that maximizes the welfare on the world prices —or known as losses due to the distortion of consumption.

Armington Assumption on Commodities. Final commodities consumed by households, firms, and government consist of domestic commodities (i.e. commodities which are produced inside the country) and import commodities. Armington (1969) assumed that in the view of the consumer, those commodities had differences based on the country of origin, although they were produced in similar production technology. Both are imperfect substitutable and to be aggregated into composite final commodities (Figure 2) by the CES (constant elasticity of substitution) production function,

$$Q_c = \gamma\left(\delta Q_m^{-\eta_i} + (1-\delta)Q_d^{-\eta_i}\right)^{-\frac{1}{\eta_i}} \qquad (1)$$

where: Q_c, Q_m, Q_d - composite commodity, import commodity, and domestic commodity (in sequence);
γ - scalling parameter;
δ - share parameter;
η - substitution parameter, $\eta = \frac{(\sigma-1)}{\sigma}$, $\eta \leq 1$;
σ - elasticity of substitution.

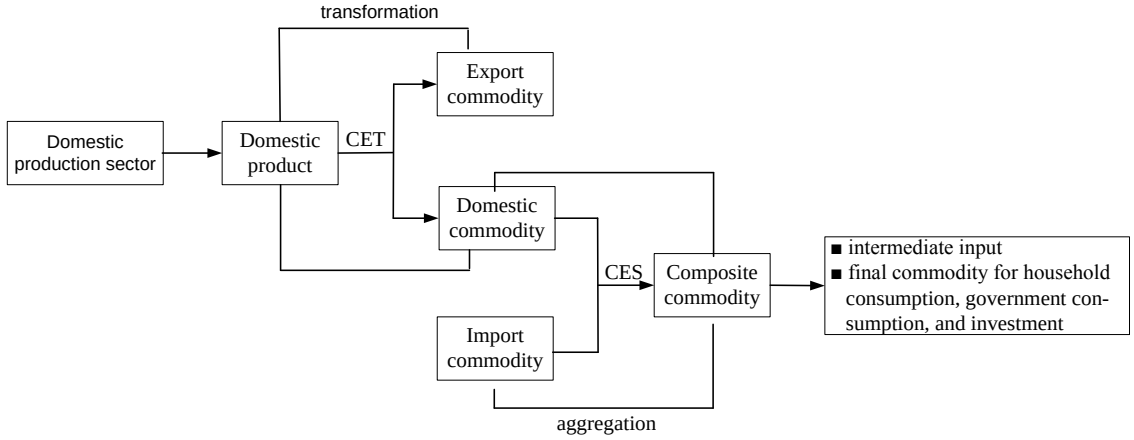

Figure 2 - The aggregation between domestic and import commodity to become composite commodity and the transformation of domestic product into domestic and export commodity

Intermediate inputs which are used in production activities also consist of domestic intermediate-inputs and import intermediate inputs. They are imperfect substitutable and are aggregated based on the Armington assumption by the CES production function to become composite intermediate inputs.
Armington assumption is a solution to cross hauling matter in trade statistics. Cross hauling refers to a kind of commodity that are simultaneously shipped in opposite directions between two countries over the same route and in a certain time duration.
By using the same Armington assumption, the final commodities produced by domestic production sectors are transformed according to its market destination to be domestic and export commodities (Figure 2) by using CET (constant elasticity of transformation) function,

$$Q_p = \theta\left(\xi Q_e^{\Phi_i} + (1-\xi) Q_d^{\Phi_i}\right)^{\frac{1}{\Phi_i}} \qquad (2)$$

where:
Q_p, Q_e, Q_d commodity produced by domestic production sector, export commodity, and domestic commodity (in sequence);
θ - scalling parameter;
ξ - share parameter;
Φ - transformation parameter, $\Phi = \frac{(\psi+1)}{\psi}$, $\Phi \geq 1$;
ψ - elasticity of transformasion.

Production Structure. Production activities in CGE model are formulated in hierarchical structure, two-nested stage, namely bottom stage production activities and top stage

production activities (Figure 3). Bottom stage production activities use primary factors of production consisting of labor and capital as inputs to produce outputs namely value-added or composite primary factors. The technology of production in this stage is specified by a CES function. Labor itself is a CES aggregation of skilled labors and unskilled labors. Moreover, top stage production activites use inputs which are value-added made by bottom stage production activity and composite intermediate inputs to produce the final products. The production technology at the top stage is specified as a Leontief function.

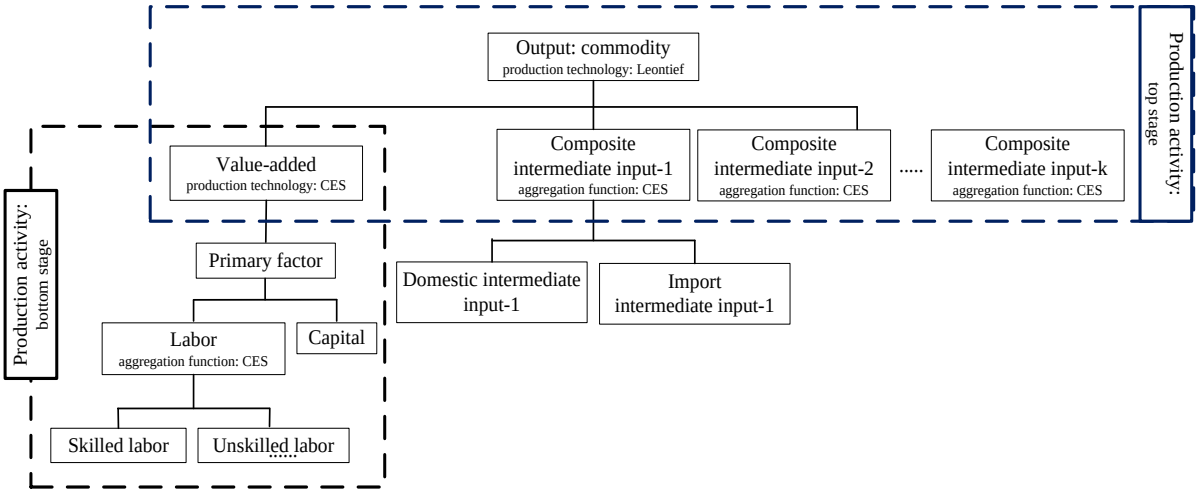

Figure 3 - Production activities structure-hierarchical or two-nested stage: bottom stage and top stage

Welfare. Prevailing policies such as crude palm oil export tax which impacts on the economy changes causes the social welfare of agencies in the economy becomes better-off or worse-off. Hicks in 1943 proposed monetary measurement which allow the consumer freedom of choice in responding to a changing economic environment, namely equivalent variation (EV) and compensasting variation (CV) to represent the welfare changes (Just *et al*, 2004). EV and CV are formulated based on indirect money metric utility function, $\mu(\underline{\mathbf{q}}; \underline{\mathbf{p}}, m)$. It refers to the income needed by consumer at a prices of $\underline{\mathbf{p}}$ to be as well off as one would be facing prices $\underline{\mathbf{q}}$ and having income m. In mathematics. Varian (1992) defines EV and CV as follows:

$$EV = \mu(\underline{\mathbf{p}}^0; \underline{\mathbf{p}}^1, m^1) - \mu(\underline{\mathbf{p}}^0; \underline{\mathbf{p}}^0, m^0) = \mu(\underline{\mathbf{p}}^0; \underline{\mathbf{p}}^1, m^1) - m^0 \quad (3a)$$

$$CV = \mu(\underline{\mathbf{p}}^1; \underline{\mathbf{p}}^1, m^1) - \mu(\underline{\mathbf{p}}^1; \underline{\mathbf{p}}^0, m^0) = m^1 - \mu(\underline{\mathbf{p}}^1; \underline{\mathbf{p}}^0, m^0) \quad (3b)$$

Where:

$\underline{\mathbf{p}}^0$ vector of prevailing prices (or old prices);
$\underline{\mathbf{p}}^1$ vector of new prices;
m^0 old income;
m^1 new income.

If a policy is a changing of prices from $\underline{\mathbf{p}}^0$ into $\underline{\mathbf{p}}^1$ which leads to the increasing of new utility of the consumer to a higher position, then EV uses the prevailed prices, $\underline{\mathbf{p}}^0$ as a base for evaluating the amount of income change needed by consumers to obtain equivalent utilities as the new utilities at ($\underline{\mathbf{p}}^1$, m^1). Meanwhile, CV uses new price, $\underline{\mathbf{p}}^1$ as a base for determining the income change to compensate the consumers for the price changes and place them to the old utilities position ($\underline{\mathbf{p}}^0$, m^0).

Practically, Just *et al* (2004) interprets CV and EV as willingness to pay (WTP) and willingness to accept (WTA). CV is amount of income taken from (or vice versa) consumers after the changes of the price and/or income to restore consumer welfare levels to its original position. In the same way, EV is amount of income given to (or vice versa) consumers as a

compensation to place the consumers into the same welfare levels as the changes due to the changes of price and/or the changes of income.

MATERIALS AND METHODS

CGE static models used in this study was constructed by referring to a general model developed by Hosoe *et al* (2015) and Lofgren *et al* (2002) with data obtained from Indonesia Social Accounting Matrix (SAM) and Input-Output Table 2008 (Indonesian Central Beureau of Statistics, 2010). Aggregation and disaggregation on SAM sectors reduced the dimensions of SAM matrix from 105 x105 to 81 x 81 with four classifications of households consisting of farm-worker households, agricultural-entrepreneur households, rural non-agricultural households, and urban non-agricultural households.

In the CGE statics model, the behavior of producers represented through the production sectors is assumed to maximize profit with respect to production technology. Each sector produces domestic product which is transformed folowing CET function into domestic commodity and export commodity. Households as comsumers that maximize utilities specified as a Geary-Stone function with respect to their budget constraint. The maximization of Stone-Geary utility function generates a demand function of Linear Expenditure System (LES). Final commodities consumed by households and intermediate commodities used by production sectors are composite commodities agregated from domestic comodities and import commodities with the CES function based on Armington assumption. Modelling and analizing CGE statics are conducted with GAMS/MPSGE program. The ~~G~~AMS/MPSGE program has some advantages. It has routines to process calibration and specification of the CES and CET function. The calibration process, including replication check to validate the ~~b~~enchmarks equilibrium is performed automatically by MPSGE.

Analysis of impact of changes in world prices and export tax of crude palm oil on the performance of domestic product and export of economy sectors as well as household welfare was conducted by before–after pairwise comparison between baseline and counterfactual. Baseline is set on ERP = US$ 925.-/ton; export tax (te) = 7.5%, and exchange rate (EXR) = IDR 9,466.-/US$, meanwhile counterfactuals are simulated as follows:

Scenario-1	: ERP = US$	700.-/ton,	te =	00.0%,	EXR = IDR	9,466.-/US$;
Scenario-2	: ERP = US$	1,025.-/ton,	te =	12.5%,	EXR = IDR	9,466.-/US$;
Scenario-3	: ERP = US$	1,125.-/ton,	te =	17.5%,	EXR = IDR	9,466.-/US$;
Scenario-1.1	: ERP = US$	700.-/ton,	te =	00.0%,	EXR = IDR	11,000.-/US$;
Scenario-1.2	: ERP = US$	700.-/ton,	te =	00.0%,	EXR = IDR	13,000.-/US$;
Scenario-2.1	: ERP = US$	1,025.-/ton,	te =	12.5%,	EXR = IDR	11,000.-/US$;
Scenario-2.2	: ERP = US$	1,025.-/ton,	te =	12.5%,	EXR = IDR	13,000.-/US$;

Where:
ERP export reference price;
IDR Indonesian rupiah;
te export tax; and
EXR rupiah exchange rate.

RESULT AND DISCUSSION

The connection of Input-Output between Oil Palm Plantation Sector and Palm Oil Manufacture Sector. The connection of input-output between oil palm plantation and palm oil manufacture is shown in Figure 4. Oil palm plantation sector produces output worth of IDR 83,010.00 billions. Most of them, i.e. IDR 67,026.33 billions (80.74%) is absorbed by palm oil manufacture sector as an intermediate input. Meanwhile, the rest used by the oil palm plantation sector itself was IDR 3,912.51 billions (4.71%) and other sectors were IDR

11,700.87 billions (14,10%) as intermediate input, and is being exported around IDR 370.28 billions (0.45%). Most of intermediate input used by oil palm plantation sector was fertilizer and pesticide amounting IDR 15, 956.1 billions (48%).

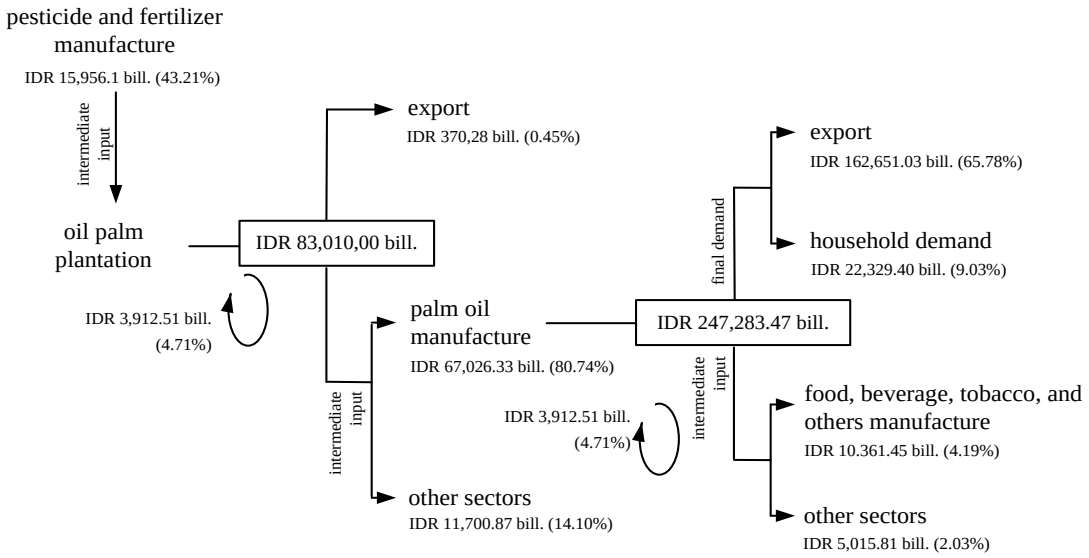

Figure 4 - The connection of input-output among sectors associated with oil palm plantation and palm oil manufacture

Palm oil industry generates products worthing IDR 247,283.47 billions. Most of products amounting IDR 162, 651.03 billions (65.78%) offered to the export market. The rest of it amounting IDR 22,329.40 billions (9.03%) to meet final demand of households and amounting IDR 3,912.51 billion (18.98%), IDR 10,361.45 billions (4.19%), and IDR 5,015.81 billions (2.03%), respectively, used by palm oil manufacture itself; food, beverages, tobacco (and others) manufacture; and other manufactures as intermediate input.

The impact of ERP Changes and Export Tax of Crude Palm Oil on the Domestic Productions and Exports. Increasing ERP of crude palm oil has direct and positive impacts on palm oil export. As shown in Tabel 2, higher export of palm oil was associated with higher ERP of crude palm oil. Progressive increase of export tax of crude palm oil along with increase of world prices of crude palm oil is suggested resulting negative impact. However, in that case, it is not causing lower export unit price (pe) received by producers due to greater percentage of increasing ERP than percentage of increase in export tax. Prevailing export tax only reduces some price received by producers but not providing disincentive to producers offering their product to export markets.

Increase in ERP of crude palm oil impacts indirectly and negatively on export of fresh fruit bunches produced by oil palm plantation sector. This fact is consistent with the idea of not exporting commodities in the form of the feedstock or raw materials. The comodities should be proccessed through manufacture to produce downstream products level I and II which provide higher value-added to the commodities (National Income Policy Center, Fiscal Policy Agency, 2011). In addition, the exports of food, beverages and tobacco also decrease. Yet, due to rising domestic production of food, beverages and tobacco, decrease in their export might indicate products are aimed mostly to fulfill domestic market demands.

The depreciation of Indonesian rupiah against US$ generally gives a positive impact on export of commodities produced by oil palm plantation, palm oil manufacture, and food, beverages, and tobacco manufacture sector (Table 3). Depreciation causes export unit price increased after being converted into Indonesia rupiah. At ERP US$ 700.-/ton (scenario 1.1 and 1.2), exports of these commodities increase, except exports of palm oil which decrease. Nevertheless, decrease in export of palm oil occurs due to its world price which is lower than its price on the baseline (US$ 925.-/ton).

Table 2 - Changes in domestic production and export of selected sectors due to the effect of ERP changes and export tax of crude palm oil

	Baseline	Scenario		
		1	2	3
ERP (US$/ton)	925	700	1,025	1,125
te (%)	7.5	0.0	12.5	17.5
EXR (IDR/US$)	9,466	9,466	9,466	9,466
pe (indeks)	0.925	0.757	0.969	1.004
Domestic productions	Actual Value (IDR bill.)	Changes percentage from baseline		
Oil palm plantation sector	83,010.00	10.714	-3.571	-7.143
Palm oil manufacture sector	247,283.47	1.802	-0.180	-0.360
Food, beverage, tobacco (and others) manufacture sector	988,275.16	-0.612	0.240	0.479
Fertilizers and pesticides manufacture sector	65,367.99	-0.926	0.000	0.000
Exports				
Oil palm plantation sector	370.28	28.828	-5.936	-10.167
Palm oil manufacture sector	162,651.03	-25.954	11.145	21.832
Food, beverage, tobacco (and others) manufacture sector	43,933.86	1.087	-0.408	-0.951

Note: ERP is export reference price; te is export tax; EXR is exchange rate; pe is export unit price (after tax) received by producers, pe = pwe.(1 – te).EXR —namely, normalizing price index.

Along with the increase of world prices and export tax of crude palm oil, as shown in Table 2, at scenario 2 domestic production of oil palm plantation sector and palm oil manufacture sector decrease. However, this negative impact, especially on the domestic production of palm oil manufacture sector, can be compensated by rupiah depreciation at IDR11,000.-/US$ and IDR 13,000.-/US$, respectively at scenario 2.1 and 2.2 (Table 3). Higher depreciates of Indonesia rupiah generate higher domestic production of oil palm plantation sector. Moreover, decrease in domestic production of oil palm plantation is not only caused by indirect negative impact of highly progressive export tax, but also by high cost of production. High cost of production of oil palm plantation sector is due to demands of paying higher value-added unit on the use of primary factors to households as factor owner.

Table 3 - Changes in domestic production and exports of selected sectors due to effect of rupiah depreciation

	Baseline	Scenario			
		1.1	1. 2	2.1	2.2
ERP (US$/ton)	925	700	700	1,025	1,025
te (%)	7.5	0.0	0.0	12.5	12.5
EXR (IDR/US$)	9,466	11,000	13,000	11,000	13,000
Domestic Production	Actual value (billions IDR)	Changes percentage from baseline			
Oil palm plantation sector	83,010.00	3.571	10.714	-3.571	-3.571
Palm oil manufacture sector	247,283.47	5.946	10.631	4.144	8.649
Food, beverage, tobacco (and others) manufacture sector	988,275.16	0.000	0.612	0.799	1.305
Fertilizers and pesticides manufacture sector	65,367.99	6.481	6.667	6.481	15.741
Export					
Oil palm plantation sector	370.28	45.724	66.999	6.979	23.721
Palm oil manufacture sector	162,651.03	-18.473	-10.229	22.290	35.267
Food, beverage, tobacco (and others) manufacture sector	43,933.86	16.168	35.734	14.402	33.967

The impact of ERP and Export Tax of Crude Palm Oil Change to Households' Welfare. Households' welfare increased following increasing ERP of crued palm oil and the rupiah depreciation (Table 4). At ERP US$ 700.-/ton, without an export tax, and the exchange rate Rp 9,466.-/US$, households' welfare decreases. Increasing ERP of crude palm oil to IDR 1,025.-/ton and rupiah depreciation at IDR11,000.-/US$ and IDR 13,000.-/US$ (scenario 2.1

and 2.2) cause producers' revenue that gain the positive impact from these changes increase after being converted into rupiah. Progressive increasing export tax along with increasing ERP of crude palm oil does not significantly give a negative effect on export value received by producers. Therefore, producers have ability to meet demands for paying higher value-added on primary factors used in production activities. The payment on value-added of the primary factors is households' factor income. Higher value-added of primary factors paid by sectors causes increasing factor income received by household and, ultimately increasing households' welfare.

Table 4 - Changes in households' welfare due to the effect of changes in ERP and export tax of crude palm oil and the depreciation of rupiah

	Baseline	Scenario					
		1	1.1	1.2	2	2.1	2.2
ERP(US$/ton)	925	700	700	700	1,025	1,025	1,025
te (%)	7.5	0.0	0.0	0.0	12.5	12.5	12.5
EXR(Rp/US$)	9,466	9,466	11,000	13,000	9,466	11,000	13,000
Welfare	Actual value (billions IDR)	Percentage changes from baseline					
Farm-worker households	176,551.43	-1.176	2.941	7.647	0.000	4.118	8.824
Agricultural-entrepreneur households	730,442.47	-0.565	3.390	7.910	0.565	4.520	8.475
Rural non-agriculture households	1,134,739.53	-0.505	3.182	7.071	0.505	4.040	7.576
Urban non-agriculture households	1,781,466.50	-0.515	3.093	6.701	0.515	4.124	7.732

CONCLUSION

The increase of the world price of crude palm oil gives a direct and positive impact on the exports of palm oil. Higher crude palm oil world price generate higher export of crude palm oil increases. The prevailing of progressive export tax does not cause the performance of palm oil exports decreases. However, the export of products from oil palm plantation sector and from food, beverages and tobacco manufature sector decrease. Domestic production from oil palm plantation and palm oil manufacture sector also decrease; while the domestic production from food, beverages and tobacco manufacture sector, as well as from fertilizer and pesticide manufacture sector increase. However, depreciation of rupiah increases domestic production of palm oil. Depreciation generally has positive effects on export performance due to rising export price received by producers after being converted into rupiah. The increasing of this export value encourages domestic production performance to increase. Therefore, the production sector has the ability to meet the demands for paying higher value-added on primary production factor. The higher value-added on primary production factor causes the factor income received by households as the factor owner increases and, ultimately, households' welfare increase.

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