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Towards Low GHG Emission in New Oil Palm Development – Results of RSPO's Approach

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Responsible low emission in new oil palm development is becoming a necessity for the industry. The results of projected greenhouse gas (GHG) emission associated with new oil palm development by Roundtable on Sustainable Palm Oil (RSPO) members in Malaysia, Indonesia, Papua New Guinea, South America and Africa are presented. These results were obtained from GHG Assessment Report submissions (through RSPO New Planting Procedure) from the year 2015 to 2017, demonstrated the use of RSPO GHG Assessment Procedure for New Development in land use planning to ensure that new plantation developments are designed to minimise net GHG emission. These new oil palm developments are planned on 193 857.24 ha of which 127 620 ha (66%) is proposed to be developed and the balance in set-aside areas resulting in a projected net emission reduction of about 2 million tCO_2eq or 1.54 $tCO_2eq/tCPO$. The emission reduction comes from avoiding planting on peat and establishing conservation areas which accounted for about 34 per cent of the areas as well as adopting other emission reduction strategies. It also demonstrated the commitment to public reporting. The results also showed that the RSPO GHG Assessment Procedure for New Development is a useful tool to assist growers in achieving low carbon new oil palm development. Identification and estimation of the potential sources of emission and sinks of carbon from plantations enables designing of new oil palm development, including mitigation plan in minimising net GHG emissions.

Keywords*: Oil palm, RSPO, criterion 7.8, GHG emission, PalmGHG, emission hotspots, LCA.*

Environmental non-governmental organisations are concerned that new expansion of oil palm agriculture in Southeast Asia and elsewhere will destroy huge tracts of tropical forests and peatlands. Koh and Wilcove (2008) have reported that the rapid expansion of oil palm has led to major land use change throughout Southeast Asia causing degradation of habitats for biodiversity and ecological services. Agus *et al*. (2013) reported that oil palm expansion was responsible for 16 per cent of the total emissions from land use change and peat oxidation in Indonesia between 1990 and 2010.

Concerned stakeholders are pushing hard to reduce climate change and deforestation impact from oil palm development which they believe are largely ignored with the clearance of peat and high carbon stock areas seldom being addressed in "sustainable palm oil" (Reza, 2014; Poynton, 2014).

Aggressive media campaigns that lobby for the boycott of global brands which use palm oil are continuing. Campaigns were also levied against oil palm growers to promote commitment to "no deforestation and no peatland planting". "No palm oil" labelling has

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also unfairly branded palm oil products in retail outlets in Europe ("Malaysia to fight", 2016).

The expansion of oil palm planting in low carbon stock areas has become a general expectation for companies to demonstrate their commitment to sustainable land development. Accounting for greenhouse gas (GHG) emission from land use change in plantation development has become one of the key components in demonstrating low carbon development.

In the last decade a small portion of the global palm oil industry has committed to the global voluntary sustainability standards, of which the most prominent is the Roundtable on Sustainable Palm Oil (RSPO).

THE ROUNDTABLE ON SUSTAINABLE PALM OIL

The RSPO is an international multi-stakeholder forum to promote the production, procurement, finance and use of sustainable palm oil products. Formed in 2004, the RSPO's mission is to develop, implement, verify, assure and periodically review credible global standards for the entire supply chain of sustainable palm oil. The vision is to make production and use of sustainable palm oil a norm (www.rspo.org).

RSPO as the foremost palm oil certification system has the largest reach of all certification systems. It is important to recognise the diversity in palm oil industry. There are large multinationals with hundreds of thousands of hectares of land on one end of the spectrum and smallholders each with 2 ha of land on the other end of the spectrum and the small and medium size plantations in between. As of March 2018, the RSPO has more than 3 787 members, from 91 countries, representing the seven key sectors of the industry: oil palm producers, processors or traders, consumer goods manufacturers, retailers, banks/investors, and environmental and social non-governmental organisations. As of March 2018, the RSPO certification covers 2.55 million hectares of oil palm and 315 Certified Palm Oil Mills; producing 11.86 million tonnes of certified sustainable palm oil (CSPO) which is approximately 19 per cent of the world's total palm oil production. RSPO has and is continuing its sustainability agenda efforts for smallholders' inclusivity, with a total of 96 645 individual smallholders registered covering 291 883 ha of certified areas (RSPO, 2017).

The first RSPO Principles and Criteria (P&C) for the production of sustainable palm oil was released in 2007 to define sustainable palm oil in practical and implementable terms that allows for palm oil to be certified as sustainable. There are eight Principles in total, of which Principles 1-6 are applicable to existing plantation, Principle 7 is on responsible development of new plantings and Principle 8 on continuous improvement.

The release of the 2007 RSPO P&C has encouraged many oil palm plantations to manage their plantation operations in accordance with the global sustainability standards enshrined in the RSPO P&C. They in turn are certified accordingly as sustainable production system (Gan, 2009, 2012; Siburat, 2014; Tang, 2014; Ibrahim, 2014).

The 2007 P&C was reviewed, revised and an updated version accepted by the General Assembly on April 25, 2013. In the revised 2013 RSPO Principles & Criteria, the importance of GHG emissions accounting and mitigation have been incorporated as two new criteria: calculation of GHG emission from existing plantation as criterion 5.6 and minimising net GHG emissions from new planting developments as criterion 7.8 (RSPO, 2013).

Criterion 5.6 requires that all RSPO certified operations calculate and report their GHG emission while criterion 7.8 requires that all new developments in RSPO certified operations or operations seeking RSPO certification to identify and estimate potential sources of emission and sequestration of carbon to enable new developments to minimise net GHG emissions.

A custom made GHG calculator called PalmGHG and Carbon Assessment Tool, Version 1 were developed for compliance to the new GHG related Criteria 5.6 and Criteria 7.8 respectively. Both PalmGHG and Carbon Assessment Tool were updated and improved by the RSPO Emission Reduction Working Group (ERWG) over the two years implementation periods stipulated within RSPO (2013). (*Note*: ERWG was established in November 2013 and officially disbanded by December 2017). The latest version of the two tools was known as PalmGHG Version 3 and GHG Assessment Procedure for New Development Version 3 respectively. Both PalmGHG and GHG Assessment Procedure for New Development, Version 3 were launched in December 2016 and took effect in January 2017, along with mandatory requirement for public reporting of both Criteria (RSPO, 2016a). Companies were also required to submit GHG emission from existing plantings and new development plans to ERWG for review. This requirement went into effect in 2015 before the public reporting requirement.

The submissions of GHG emission from existing plantings and new development plans provide a good opportunity for ERWG to study the dynamics of GHG emission in existing and new plantings. The key findings on GHG emission from existing oil palm areas (C5.6) have been presented in the cluster session of the RT14 Conference held in Bangkok from 8-12 November, 2016 (Gan, 2016). The preliminary emission data from the submissions for new development/new plantings of the members' concession from 2015 to 2017 were reported in RT 15 Conference held in Bali from 28-30 November, 2017 (Parish & Gan, 2017). These actual GHG data complemented the findings of Gan and Cai (2017) which used hypothetical data to make detailed comparisons of GHG emissions from different scenarios of land use and operation using PalmGHG. The studies found that plantation on peatland and land use change are the main contributors to the GHG emission in palm oil production process.

This paper focuses on understanding the effectiveness of RSPO GHG Assessment Procedure for New Development in guiding RSPO growers and millers to plan development in such a way that minimise net GHG emissions towards the goal of low carbon development. This is done through analysing data obtained from GHG assessment reports submitted for approved New Planting areas based on RSPO New Planting Procedure (NPP), version November 2015. An update of the GHG emissions from existing planting (C5.6) is reported in a separate paper.

RSPO GHG ASSESSMENT PROCEDURE FOR NEW DEVELOPMENT

The RSPO GHG Assessment Procedure for New Development (Oct 2016 version) provides a step-wise approach in identifying and estimating carbon stocks prior to and after new developments as well as major sources of emissions that may result directly from the development (RSPO, 2016a). The aim is that new developments must be designed to minimise GHG emissions which takes into

account avoidance of land areas with high carbon stocks and consideration of sequestration options. This procedure is to be integrated with high conservation value (HCV) and social and environmental impact assessment (SEIA) studies as part of New Planting Procedure submission (RSPO, 2015). The procedure is summarised as below.

Land cover analysis and mapping

The first step of the assessment process is to prepare an above-ground land cover map from the satellite imagery of the proposed development area. Several remote sensing methods are available to stratify the proposed development area into land cover classes. Readily available satellite imagery is the Landsat satellite imagery data (http://www.usgs.glovis.gov). Other options e.g. LiDAR can also be used.

The RSPO procedure allows flexibility in determining the land cover classes. Three options are allowed:

- Option 1: To use RSPO's default 6 land cover classes (*Table 1*),
- Option 2: Use existing National or Regional land cover classes, and
- Option 3: Use new local specific land cover classes.

The land cover map of the proposed area for new oil palm development is then prepared.

The satellite based land cover classification is then validated through ground-truthing conducted by the field assessment team. The result of ground truthing is then compared to the result of satellite stratification and an accuracy assessment based on Cohen's Kappa is conducted. Cohen's Kappa value ≥60 per cent is required by the RSPO procedure. The RSPO procedure also provides the option that ground verification may not be required if existing field survey data is sufficiently accurate for verification; for example, a verified land cover map developed for a HCV or high carbon stock (HCS) assessment is available and accurate enough for verification. This can also be supplemented by cross-checking the land cover classification with other high resolution satellite images.

Soil mapping

The soil map of the new development area is then developed with the purpose to identify the presence and extent of peat or other organic soils. Soil carbon in mineral soils is not considered. The soil mapping may utilise the results of existing soil surveys or involve additional fieldwork.

Carbon stock estimation

Once the land cover types and soil types are identified and validated, the next step is the determination of the carbon stock values of each land cover type. The carbon stock is expressed in tonnes carbon per hectare (tC/ha). In the RSPO procedure, the carbon stock assessment only takes into account: (i) above-ground biomass, (ii) below-ground biomass and (iii) soil organic matter, where peat is present. The carbon stock default values for the default RSPO six land cover classes as defined in the procedures (RSPO, 2016a) are presented in *Table 1* [*Note*: The default values are set at a conservative (high) level to encourage companies to undertake their own assessments].

These default values are, but one option in determining the carbon stocks of the land covers. Regional/national specific values or local values through field assessment can also

TABLE 1
RSPO DEFAULT ABOVE GROUND BIOMASS (AGB) AND BELOW GROUND BIOMASS (BGB) VALUES (TC/HA) FOR 6 LAND COVER CLASSES

No.	*Land cover classes*	*Default value (tC/ha[1])*
1	Undisturbed forest	268.0
2	Disturbed forest	128.0
3	Tree crop	75.0
4	Shrub land	46.0
5	Annual/ food crop	8.5
6	Grassland	5.0

Source: RSPO (2016a)
Note: [1] = The default values are set at a conservative (high) level to encourage companies to undertake their own assessments

be used. The guideline for field measurement is available in the RSPO Procedure (RSPO, 2016a). This guideline only covers above-ground biomass measurements. Below-ground biomass is estimated using root to shoot ratio.

Additionally, growers may choose to use high carbon stock approach (HCSA) (RSPO, 2016b) to comply with parts of the RSPO Procedure. However, a portion of the Procedure that are not in HCSA will still need to be applied.

Carbon stock map

A map showing the different land cover strata and estimated carbon stock (above, below and soil carbon) is then prepared.

Development of integrated map

An integrated map is then prepared by overlaying the carbon stock map with HCV areas and/or any other environmentally and/or socially sensitive or important areas as identified through SEIA and peat areas, if present. This map indicates the areas to be avoided or conserved and potential areas for new plantings.

Scenario setting

Based on this integrated map, several new development scenarios with hypothetical land use options and mill design are set. These take into consideration the different combination of land covers, soil types and operational options. Scenarios are projections of hypothetical land use options, operational decisions and mill design that enable projected GHG emissions to be estimated. New developments avoiding high carbon areas with operational practices that minimise GHG emissions are ideal.

GHG emission calculation

The respective GHG emission from each scenario is calculated by using the RSPO New Development GHG Calculator.

Selection of optimum scenario

The pros and cons of the various scenarios are taken into account. These include: i) Avoidance of land areas with high carbon stock and/or potential high GHG emissions (if developed); ii) Options to increase the

sequestration of carbon (conservation areas, river buffer zones, etc.); iii) alternate mill design e.g. methane capture; and iv) Practical management issues such as access and connectivity, socio-economic concerns, etc. All scenarios must avoid conversion of HCV areas as determined in HCV assessment and no-development areas determined through Free Prior and Informed Consent (FPIC) process.

The most optimal development option is then selected and justification for the selection decision reported. The development option chosen may not be the one with the least GHG emissions. Areas to be avoided or conserved and potential areas for new plantings are then finalised and a final development map prepared.

Management and mitigation plan

Management and mitigation plan was developed to provide a master plan to implement the chosen scenario. Mitigation options are also developed to further reduce the GHG emission from the operations. The plan inculdes: i) Increasing sequestration (i.e. conservation areas, river buffer zones, etc.); ii) Management of the peat soils to minimise subsidence and oxidation [if peat area development (max 100 ha per plantation as per RSPO P&C 2013) are chosen]; iii) Adoption of low GHG emissions management practices such as efficient use of fossil fuels, fertiliser regimes, etc. and iv) Alternative mill technologies such as POME management, biogas, etc. Monitoring the implementation of the plan and periodic review and refinement is also developed. The RSPO procedure provides a template for reporting this land use planning.

ANALYSIS OF SUBMISSIONS DATA (JAN 2015 TO OCT 2017)

The submissions of GHG assessment report for new development from RSPO members through the RSPO Procedures for New Plantings, provide the ERWG with an opportunity to study the impacts and effectiveness of the Procedures in guiding RSPO growers and millers in planning development that minimise net GHG emissions.

GHG assessment report submissions and reporting during the two years' implementation period (January 2015 to December 2016) were provided to the RSPO ERWG, with voluntary public reporting option. Starting on 1 January 2017, the summary of GHG assessment for new oil palm development is reported publicly, along with New Planting Procedures (NPP) notification.

Data has been extracted from GHG assessment submissions of all approved NPP, for the whole year of 2015 and 2016, as well as January to October of 2017. The collated information are presented in *Figure 1*.

A total area proposed for development of 193 857.24 ha from thirty-one approved submissions, were recorded for the period starting January 2015 to October 2017 (refer to *Figure 1*). The total thirty-one approved submissions, comprised of nine submissions in 2015 covering 54 899.65 ha, eighteen submissions in 2016 covering 103 944.38 ha and four submissions in 2017 (January to October) covering 35 013.21 ha. Geographically, most of the submissions were from Asia (22 submissions covering 73 651.72 ha). Africa had six submission covering 117 892.15 ha while Latin America had three submissions covering 2 313.37 ha.

The submissions assessed a total area of 193 857.24 ha of which 127 620 ha (66%) was planned to be developed. The rest of the land area covering 66 237.24 ha (34%) was earmarked for conservation as HCV area, HCS area, social set-asides, and other

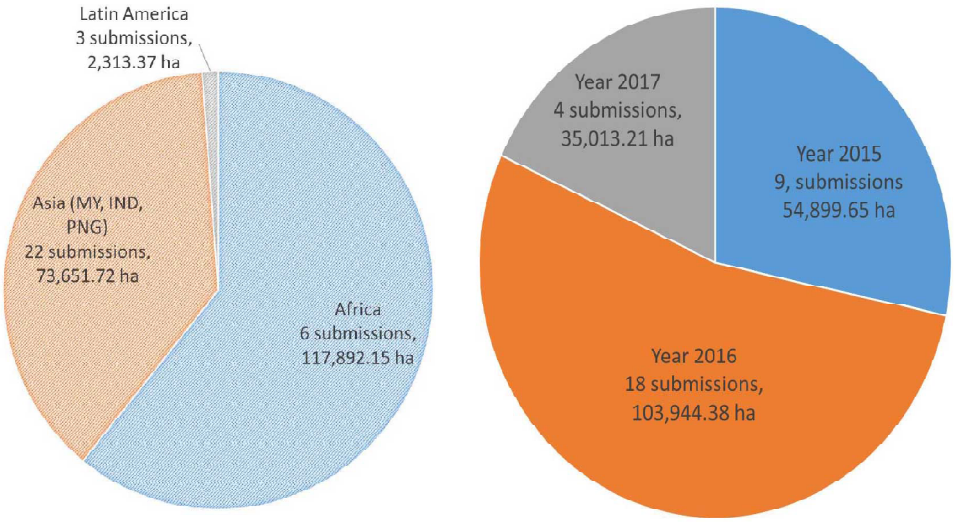

Figure 1 Number of GHG assessment submissions and associated total assessment areas
Note:(Left) Number of GHG assessment submissions and associated total assessment areas (in hectares) for oil palm new development by region of Africa, Latin America, and Asia (Malaysia, Indonesia, Papua New Guinea); and (Right) Total GHG assessment submissions and associated total assessment areas (in hectares) for oil palm new development for years 2015, 2016 and 2017 (January to October)

TABLE 2
PROPOSED DEVELOPMENT AND CONSERVATION AREAS SET-ASIDE EXTRACTED FROM THE GHG ASSESSMENT SUBMISSIONS FOR PERIOD 2015, 2016 AND 2017 (JAN-OCT) FOR THREE REGIONS

Regions	*Area (Ha)*				
	Assessment area	*Planting area*	*Infrastructure development*	*Conservation set aside*(non-peat soil area)*	*Conservation set aside (peat soil area)*
Africa	117892.15	72609.25	2027.50	43255.40	0.00
Asia	73651.72	52755.07	274.14	14980.82	5641.69
Latin America	2313.37	2255.68	0.00	57.69	0.00
Total	193857.24	127620.00	2301.64	58293.91	5641.69

* includes 5 424 ha set aside for social activity i.e. non forest area

conservation area or infrastructure. There were 5 641.69 ha of peat in the assessment areas all of which are earmarked for conservation. See *Table 2* for the detailed breakdown.

The land covers of the total development area and the planned planted area are tabulated in *Tables 3* and *4* respectively. The land covers of the conservation or set aside area are not fully elaborated in the submissions. However, from several submissions that did elaborate on the land cover of the set aside area, the land cover in the environmental conservation area

TABLE 3
LAND-USE COVER OF THE TOTAL DEVELOPMENT AREA

Region	*Area (Ha)*							
	Disturbed forest		*Shrubland*	*Tree crop*	*Food crop*	*Grassland*	*Open land*	*Total*
	Non- peat	*Peat*						
Indonesia	10 579.03	5 641.69	31 161.66	14 177.95	14.00	1 088.42	5 740.75	68 403.50
Malaysia	147.60	0.00	0.00	38.49	0.00	374.15	0.00	560.24
Africa	44 548.86	0.00	9 492.13	112.00	3 627.54	58 927.00	1 184.60	117 892.13
Latin America	57.69	0.00	0.00	332.94	0.00	1 922.74	0.00	2 313.37
Papua New Guinea	742.30	0.00	876.00	124.20	0.00	972.00	1 973.50	4 688.00
Total	56 075.48	5 641.69	41 529.79	14 785.58	3 641.54	63 284.31	8 898.85	193 857.24

TABLE 4
LAND-USE COVER OF THE AREA TO BE PLANTED

Region	*Area (Ha)*							
	Disturbed forest		*Shrubland*	*Tree crop*	*Food crop*	*Grassland*	*Open land*	*Total*
	Non- peat	*Peat*						
Indonesia	1 575.42	0.00	30 887.52	8 865.42	14.00	1 088.42	5 740.75	48 171.53
Malaysia	83.92	0.00	0.00	38.49	0.00	374.15	0.00	496.56
Africa	1 404.68	0.00	7 464.63	0.00	3 627.54	58 927.80	1 184.60	72 609.25
Latin America	0.00	0.00	0.00	332.94	0.00	1 922.74	0.00	2 255.68
Papua New Guinea	141.30	0.00	876.00	124.20	0.00	972.00	1 973.50	4 087.00
Total	3 205.32	0.00	39 228.15	9 361.05	3 641.54	63 285.11	8 898.85	127 620.02

(HCV, HCS, peat and other conservation) is generally disturbed forest while the land cover of social set aside area is generally tree crop.

PROJECTED GHG EMISSIONS OF NEW DEVELOPMENT AREAS

The GHG emission calculated using the land cover categories in *Tables 3* and *4*, with the RSPO default carbon stock value, and projected operational parameters with no methane capture (*Table 5*) are tabulated in *Tables 6* and *7*. GHG emissions from new development, if the entire assessment area was planted (No RSPO, business as usual scenario) is seen in *Tables 6* and *7* for GHG emissions from new development if only the planned area is planted (compliant to RSPO 7.8 scenario).

IMPACT OF RSPO CRITERION 7.8 ON LAND USE PLANNING AND GHG EMISSION FROM THE PALM OIL INDUSTRY

RSPO has developed simple and user friendly tool to assist grower members in ensuring that new oil palm development is carried out in a responsible manner. Since its implementation,

TABLE 5
PROJECTED OPERATIONAL PARAMETERS

General info		
Fresh fruit bunch (FFB) yield	25	tonnes/ha/yr
Oil extraction rate (OER)	25	%
Kernel extraction rate (KER)	5	%
Estate fuel		
Diesel consumption	21.5	l/ha
Gasoline consumption	8	l/ha
Estate fertiliser		
Urea consumption	400	kg/ha
MOP consumption	500	kg/ha
RP consumption	200	kg/ha
Kieserite consumption	160	kg/ha
Dolomite consumption	40	kg/ha
Sea transport distance	6000	Km
Land transport distance	200	Km
Mill fuel		
Diesel consumption	0.1	l/tFFB processed

*The projected operational parameters are taken from the average of available data

criterion 7.8 (along with criterion 7.3 on HCV) of RSPO has impacted how RSPO certified growers plan their new development. Growers are now setting aside more land for conservation.

- Thirty-one new development submissions over the last three years (from 2015 to 2017) showed that growers are setting aside one third of their new development area for conservation (*Table 2*). This proportion is larger for Africa with 40 per cent of the new development area reserved for conservation (*Table 2*).
- The land covers of the set aside land are mostly disturbed forest with some tree crops (See the difference between *Tables 3* and *4*). Ninety-five percent of the land identified as disturbed forest are earmarked for conservation (See the difference between *Tables 3* and *4*) with many of the remaining 5 per cent coming from submissions following HCS Approach where small patches of forest are allowed to be converted after going through patch analysis (HCSA, 2015 and 2017).
- All peatland identified in the assessment area in the submissions were marked for conservation (*Table 2*). This is going beyond RSPO standard which still allow for small areas of peat to be developed (maximum 100 ha/ development) (RSPO, 2013).

In terms of GHG emission, new developments following criterion 7.8 of RSPO P&C 2013 result in much lower emission than non RSPO developments (business as usual). This is apparent from the comparison between "compliant to RSPO criterion 7.8" scenario and

TABLE 6
PROJECTED GHG EMISSION (tCO_2EQ) FOR NEW DEVELOPMENT FOR BUSINESS AS USUAL SCENARIO (NO RSPO REQUIREMENTS) IN SEVERAL COUNTRIES AND REGIONS

	Emission (tCO_2eq)					
	Africa	*Indonesia*	*Malaysia*	*Papua New Guinea*	*Latin America*	*Total*
Land clearing	1 003 797.61	650 263.31	2 486.62	21 924.41	6 155.12	1 684 627.06
Crop sequestration	-1 060 365.82	-595 380.51	-4 507.21	-41 599.82	-20 528.11	-1 722 381.46
Fertilisers	146 436.97	82 222.30	622.45	5 744.95	2 834.94	237 861.61
N_2O	134 909.14	117 981.93	573.45	5 292.70	2 611.77	261 368.98
Field fuel	10 089.73	5 665.24	42.89	395.84	195.33	16 389.03
Peat	0.00	308 036.27	0.00	0.00	0.00	0.00
Conservation credit	0.00	0.00	0.00	0.00	0.00	0.00
POME	555 051.22	311 653.46	2 359.31	21 775.53	10 745.49	901 585.01
Mill fuel	8 834.75	4 960.59	37.55	346.60	171.04	14 350.52
Purchased electricity	0.00	0.00	0.00	0.00	0.00	0.00
Credit (excess electricity export)	0.00	0.00	0.00	0.00	0.00	0.00
Credit (sale of biomass for power)	0.00	0.00	0.00	0.00	0.00	0.00
Total	798 753.60	885 402.59	1 615.05	13 880.22	2 185.58	1 701 837.04
Emission per tonne CPO (tCO_2eq/tCPO)	0.94	1.86	0.45	0.42	0.13	1.23

"no RSPO (business as usual)" scenario above.

- "Compliant to RSPO criterion 7.8" scenario resulted in net sequestration of -303,773 tCO_2eq in absolute terms or -0.31 tCO_2eq/tCPO in per tonne CPO term (*Table 7*).
  - The sequestration per tonne CPO is higher in Africa (-0.74 tCO_2e/tCPO - *Table 7*) where a larger portion of the assessment area is conserved due to presence of high forest cover landscape.
  - Net sequestration means that conversion to oil palm resulted in net carbon gain even after accounting for operational emissions.
- "The No RSPO (business as usual)" scenario resulted in net emission of 1 701 837.04 tCO_2eq in absolute terms or 1.23 tCO_2eq/tCPO in per tonne CPO term (*Table 6*).
- Hence, the GHG emission saving from the 31 submissions from 2015 to 2017 developed in accordance with the "Compliant to RSPO criterion 7.8" scenario is equivalent to 2 million tonnes CO_2eq in absolute term when compared to "No RSPO (business as usual)" scenario.
  - Out of the 2 million tCO_2eq GHG emission, 1.4 million tCO_2eq are genuine GHG emission savings coming from land use change (about 600,000 tonnes CO_2eq), peat avoidance (about 300,000

TABLE 7
GHG EMISSION (tCO_2EQ) COMPLIANT TO RSPO CRITERION 7.8 SCENARIO IN SEVERAL COUNTRIES AND REGIONS

	Emission (tCO_2eq)					
	Africa	*Indonesia*	*Malaysia*	*Papua New Guinea*	*Latin America*	*Total*
Land clearing	124461.38	336302.70	2273.16	10641.72	5072.09	478751.06
Crop sequestration	-644311.31	-427458.78	-4406.31	-36266.73	-20016.18	-1132459.33
Fertilisers	88979.66	59032.24	608.51	5008.45	2764.24	156393.11
N_2O	81975.00	54385.10	560.61	4614.18	2546.64	144081.52
Field fuel	6130.84	4067.41	41.93	345.09	190.46	10775.73
Peat	0.00	0.00	0.00	0.00	0.00	0.00
Conservation credit	-380966.58	-176190.13	-560.59	-5505.16	-317.06	-563539.52
POME	337266.42	223754.40	2306.50	18983.92	10477.52	592788.76
Mill fuel	5368.27	3561.50	36.71	302.17	166.77	9435.41
Purchased electricity	0.00	0.00	0.00	0.00	0.00	0.00
Credit (excess electricity export)	0.00	0.00	0.00	0.00	0.00	0.00
Credit (sale of biomass for power)	0.00	0.00	0.00	0.00	0.00	0.00
Total	-381096.32	77454.44	860.52	-1876.37	884.48	-303773.26
Emission per tonne CPO (tCO_2eq/tCPO)	-0.74	0.23	0.24	-0.06	0.06	-0.31

tonnes CO_2eq) and conservation area sequestration (about 500,000 tonnes CO_2e). 1.4 million tonnes CO_2e is equivalent to 300 000 cars removed from the road.

- The other 0.6 million tCO_2eq emission reduction was due to the smaller area planted with the other areas set-aside for conservation. Less area planted means less operational emission from fertiliser, fuel, POME etc.

Nothwithstanding the positive effect of RSPO P&C criterion 7.8, its impact on overall GHG emission of oil palm industry is still limited. This is because only 19 per cent of global CPO production has been RSPO certified (RSPO, 2017). The impact is illustrated in the following graph in *Figure 2*.

- The red line in *Figure 2* is the "no RSPO (business as usual)" scenario where the total GHG emission of the palm oil industry is estimated by multiplying the oil palm hectarage (FAOSTAT, 2017) and projected future hectarage with the GHG emission per tonne CPO of "no RSPO business as usual" scenario taken from *Table 6* (1.23 tCO_2eq/tCPO).
- The green line in *Figure 2* is the "compliant to RSPO criterion 7.8" scenario where the total GHG emission of the palm oil industry is estimated by multiplying the oil palm hectarage (FAOSTAT, 2017) and projected future hectarage with GHG emission per

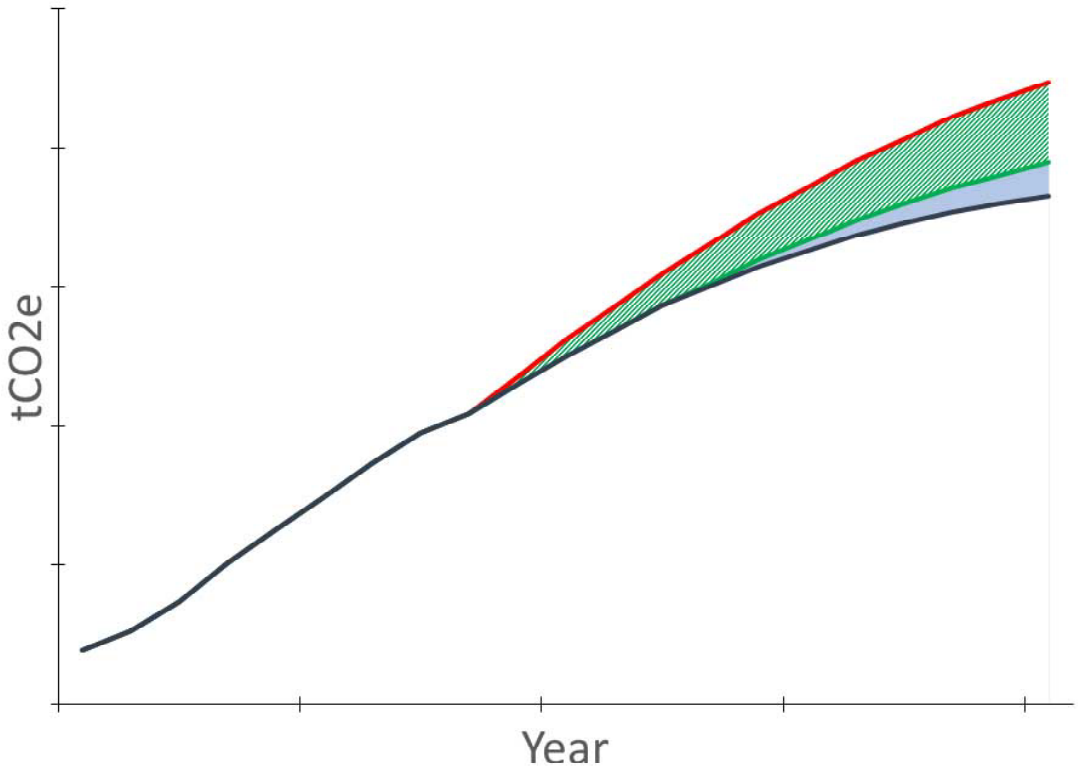

Figure 2 Projected trend of GHG emission reduction on business as usual and compliance with RSPO P&C criterion 7.8

tonne CPO of "no RSPO business as usual" scenario taken from *Table 6* (1.23 tCO_2eq/tCPO) as well as GHG emission per tonne CPO of "compliant to RSPO criterion 7.8" scenario taken from *Table 7* (-0.31 tCO_2e/tCPO). Since only 19 per cent of the world palm oil production is RSPO certified with the rest (81%) non RSPO certified production expected to follow the business as usual GHG emission trajectory, only 19 per cent of the projected future planting is multiplied with "compliant to RSPO criterion 7.8" GHG value while the rest (81%) is still multiplied with "no RSPO business as usual" GHG value. The green shaded area is the total GHG emission that is avoided in the future due to RSPO criterion 7.8.

- The blue line in *Figure 2* is the projected total GHG emission of palm oil industry if further emission reduction is achieved through commensurate efforts. Commensurate efforts come in many forms.
  - o Consumer group manufacturers or traders and refiners can contribute by raising the uptake of CSPO (which currently stands at 50%) which will hopefully lead to more growers joining RSPO.
  - o Consumer group manufacturers or traders and refiners or other

members can also contribute by promoting emission reduction efforts such as methane capture, composting etc.

- Contribution can also come in the form of support to the smallholder certification programme. Smallholders accounted for 40 per cent of all palm oil production and are the least certified sector.
- Several downstream players as well as other institutions have engaged with the palm oil sector to reduce GHG emission. Neste Oil supported a research to find a cheaper alternative to methane capture in reducing emission from POME (Enstrom, 2017). International Finance Corporation is running a collaborative programme to enroll thousands of Indonesian smallholders in sustainable certification (Fitriyardi, 2014). Those two examples have demonstrated what other stakeholders can do to help the palm oil sector reduce emission.

RSPO has made a big impact on an individual company basis - however on the global industry-wide basis RSPO impact is still limited. Commensurate efforts from all categories of membership can help RSPO achieve more in meeting its vision of making production and use of sustainable palm oil a norm.

CONCLUSION

The results of GHG emission from new oil palm development in Malaysia, Indonesia, Papua New Guinea, South America and Africa obtained from 2015 to 2017 new oil palm development have shown a positive impact. The first impact was peatland has been totally excluded from future planting and significant forest areas will be set aside which has resulted in significant avoidance in GHG emission. The results also show that the RSPO GHG Assessment Procedure is a useful tool to assist growers in achieving low carbon new oil palm development. Identification and estimation of the potential sources of emission and sinks of carbon from new plantation enables designing of new oil palm development in minimising net GHG emissions. Simplified tools and incentives for GHG emission reduction by the smallholder sector should be developed. The impact on the overall GHG emission of palm oil sector is still limited. Commensurate efforts from other stakeholders can help in increasing the emission reduction.

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