TEEB Implementation in Indonesia: “Promoting biodiversity and sustainability in the agriculture and food sector project”

A background review of agriculture in Indonesia

(Draft1)

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List of Acronyms

ASEAN	Association of Southeast Asian Nations
BACP	Biodiversity and Agricultural Commodities Program
BIOFIN	Biodiversity Finance Initiative
BMP	Best Management Practices
BPN	National Land Agency
CBD	Convention on Biological Diversity
CIFOR	Center for International Forestry Research
COP	Conference of the Parties
CPO	Crude Palm Oil
ESMERALDA	Enhancing ecoSysteM sERvices mApping for poLicy and Decision mAking
EU	European Union
FAO	Food and Agriculture Organization
GAP	Good Agricultural Practices
GDP	Gross Domestic Product
GMP	Good Manufacturing Practices
GOI	Government of the Republic of Indonesia
GOLS	Governing Oil Palm Landscapes for Sustainability
GSAD	Indonesia Grand Strategy of Agricultural Development
IBSAP	Indonesian Biodiversity Strategy and Action Plan
INDC	Intended Nationally Determined Contribution
IPBES	Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services
IPOP	Indonesian Palm Oil Pledge
ISPO	Indonesian Sustainable Palm Oil
MIFEE	Merauke Integrated Food and Energy Estate
MoA	Ministry of Agriculture
MTI	The WWF Market Transformation Initiative
OECD	Organisation for Economic Co-operation and Development
PIS Agro	Partnership for Indonesia's Sustainable Agriculture
RPJMN	Rencana Pembangunan Jangka Menengah Nasional
RPJP	Rencana Pembangunan Jangka Panjang
RSPO	Roundtable on Sustainable Palm Oil
SAN	Sustainable Agriculture Network
SCP	Sustainable Consumption and Production
SNI	Indonesian National Standard
TEEB	The Economics of Ecosystems and Biodiversity
UN	United Nations
UNCTAD	United Nations Conference on Trade and Developmen
UNDP	United Nations Development Programme
UN-REDD	United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation
USAID	United States Agency for International Development
WWF	World Wildlife Fund

Executive Summary

1. BACKGROUND

Indonesia has achieved impressive economic growth since the Asian financial crisis of the late 1990s, maintaining the lead as the largest economy in Southeast Asia. This has been achieved through considerable structural change driven by large-scale industrialization and greater integration into the global economy with supportive government policy, the country's endowment of natural resources and its young and growing labour force (Elias & Noone, 2011).

Over the past four decades, the structural composition of Indonesia has shifted from a primarily agrarian to an industry and services driven economy. However, **agriculture remains the mainstay of the economy and a major source of employment to over a third of the 256 million Indonesians. In 2015, the agricultural sector accounted for 13.5% of the Gross Domestic Product (GDP) and 33.5% of the total employment.** The agricultural sector comprises large plantations (both state-owned and private) cultivating export crops (palm oil and rubber) on about 15 percent of the total agricultural area. About 68% are smallholders operating on less than one hectare, and mostly producing rice, soybeans, corn, fruits and vegetables. **Indonesia is a leading global producer and exporter of palm oil, rubber and cocoa.** It is also a top world producer of coffee, tea, cassava, rice and tropical spices (FAO, 2017; Indonesia Investments, 2017; World Growth, 2011).

2. PROBLEM DEFINITION: Challenges to sustainable agriculture and biodiversity in Indonesia

Globally, food systems are now the source of 60% of terrestrial biodiversity loss, 33% of soil degradation and 61% of the depletion of commercial fish stocks. The situation in Indonesia is almost consistent with these global statistics. Indonesia's **biodiversity is increasingly under threats from habitat degradation and fragmentation, landscape change and fire, pollution, climate change, and overexploitation of natural resources** (UNDP, 2016).

Addressing the negative impacts on biodiversity is critical, given that **Indonesia contains second greatest biodiversity on Earth**. More than 60% of Indonesian rainforest species are endemic to the region (Manurung, 2016). It contains 10% of the world's flowering plant species, of which over half are endemic; it ranks second vis-à-vis mammals, containing 12% of the planet's mammal species. Indonesia's rich biodiversity has significant economic benefits, **in 2012 the total economic contribution of biodiversity and ecosystems were estimated to be US$ 329.9 million**.

The drive to increase agri-food production is taking a major toll on the environment, leading to forest clearing, soil degradation, pollution and introduction of pests. **Indonesia ranks among countries with the highest rate of deforestation**. **It is estimated that the country's primary forest loss, totalled over 6.02 million ha from 2000 to 2012 and increased on average by 47,600 ha per year**. This loss is of great concern, especially in Indonesia's tropical lowland forest, since a single hectare of this forest harbors more than 200 species and 500 stems. **Tropical lowland forest is Indonesia's most biodiverse ecosystem and the most threatened by agricultural conversion**, particularly for palm oil plantations considered a major threat to forest ecosystems. Besides biodiversity, the loss of forest ecosystems is

considered a key driver to the loss of critical environmental services in Indonesia, including provision of water catchment areas, prevention of erosion and floods (Margono et al., 2014; UNFCCC, 2016).

On the other hand, **climate change is becoming a major threat to the sustainability of agriculture and food security in Indonesia**. A study by Yuliawana and Handokob (2016), revealed that for every 1°C of temperature rise in Indonesia, irrigated rice yield decreases by about 11.1% while rain-fed rice yield decreases by about 14.4%. In South Sumatra, evidence points towards a decrease in the production of paddy rice, corn and soybean due to temperature and rainfall variability (Ruminta et al., 2018). Land conversion, increased usage of agrochemicals and land degradation are also considered key challenges to future agriculture development in Indonesia. The situation is expected to be compounded further by population pressure leading to high demand for food, feed and fuels, and scarcity and competition for land and water resource (Manurung, 2016; Setyanto, 2015).

3. CURRENT SITUATION: Indonesia's national level strategies and policies

Indonesia has embraced sustainable agriculture, through a variety of national level strategies and policies, which has evolved over time. Indonesia's economic planning follows **a 20-year National Long-Term Development Plan (Rencana Pembangunan Jangka Panjang/RPJP) 2005–2025**. It is segmented into five-year medium-term plans called **RPJMN (Rencana Pembangunan Jangka Menengah Nasional)**, each with different development priorities.

Currently, the Ministry of Agriculture (MoA) is implementing the 2015−2019 National Medium-Term Strategic Plan for Agriculture. **The vision of the Indonesian MoA in 2015-2019 is "…. realization of sustainable agriculture bioindustry systems producing various healthy foods and high value-added products-based on local resources for food sovereignty and farmers welfare."**

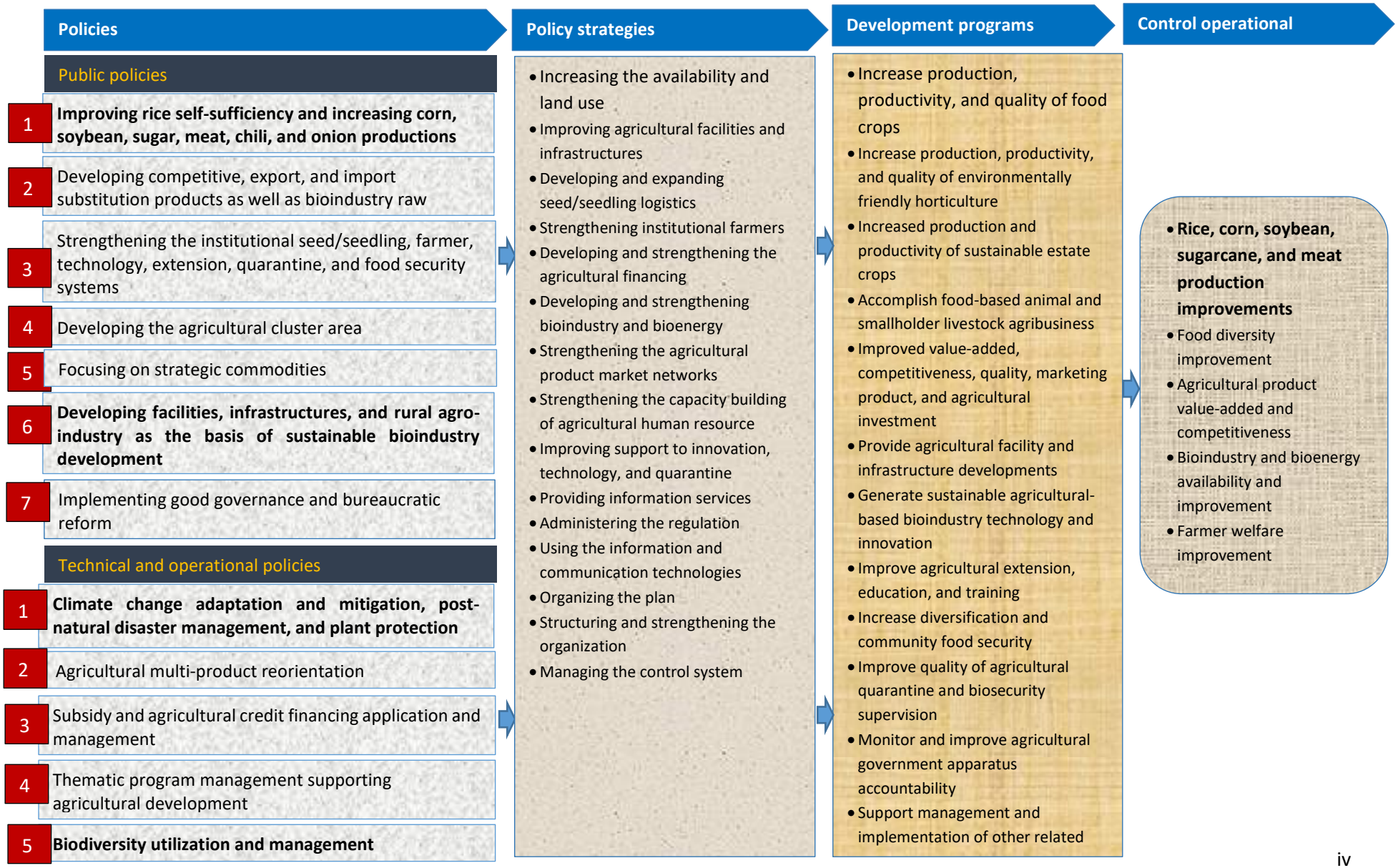
To realize the vision, **the mission of the Indonesian MoA** is to achieve:

(1) food sovereignty;
(2) sustainable agriculture-bioindustry system;
(3) farmers welfare; and
(4) bureaucracy reform.

It has three strategic goals including:
(1) achieving self-sufficiency in rice, corn, and soybean as well as increasing meat and sugar production;
(2) improving food diversification;
(3) enhancing value-added commodities, competitive in accomplishing export market and import substitution.

The policy direction and strategy (2015-2019) of the Indonesian Ministry of Agriculture is summarized in Table 4. It comprises public and technical as well as operational policies, policy strategies, agricultural development programs, and control policy measures. **Technical and operational policies emphasize biodiversity utilization and management which aligns with the objectives of the TEEB project implementation in Indonesia.**

Table 1: Policy strategy and agricultural development program plans, 2015-2019



Source: Rafani (2015, p. 3)

AS part of the long term national strategy, Indonesia has developed **the Grand Strategy of Agricultural Development (GSAD) 2015–2045**. This is Indonesia's first long-term agricultural development plan. It is formulated **as part of the constitutional mandate to achieve a dignified, independent, developed, fair, and prosperous Indonesia**. In the medium term, the GSAD 2015–2045 is in line with the Strategic Plan of the Ministry of Agriculture 2015–2019 which aims to achieve food sovereignty and enhance the welfare of farmers.

The GSAD 2015–2045 has the primary objective of promoting sustainable agroindustry and offers a new concept and approach on future agriculture development in Indonesia. **This approach is in line with emerging challenges including resource constraint, climate change, science and innovation, as well as governance issues.**

Furthermore, Indonesia has developed a suite of green agriculture approaches and instruments to support the implementation of its national policies and strategies. Within the oil palm sector, green agriculture practices are being promoted through national level and internationally accepted certification schemes. In 2011 Indonesia established its own mandatory certification scheme – the Indonesian Sustainable Palm Oil (ISPO) which governs oil palm production on plantations greater than 25 ha that prohibits the use of fire. Many large companies subscribe to the Roundtable on Sustainable Palm Oil (RSPO) – which is an internationally accepted voluntary certification scheme. In addition, the Indonesian Palm Oil Pledge (IPOP) – formed in 2014 and dissolved in July 2016 provided a platform where participating companies pledged to produce and trade only deforestation-free oil palm within their supply chains. However, the implementation of these schemes is limited by technical and regulatory constraints, particularly for smallholder farmers (Leimona et al., 2015; World Bank, 2016).

To combat biodiversity loss, Indonesia launched the first Biodiversity Strategy and Action Plan (IBSAP) in 1991 and was adopted as part of the Government of Indonesia (GOI) 25-year Development Strategy for 1991-2015. It is used a national blue print for the implementation of the objectives laid out in the Convention on Biodiversity and the Nagoya Protocol in line with national interests. Currently, the IBSAP 2015-2020 serves as an umbrella for addressing current challenges and priorities for conservation Indonesian biodiversity.

4. ACCOUNTING FOR ECOSYSTEM IMPACTS AND DEPENDENCIES

Despite well intended national policies and strategic plans, there is a long road ahead to close the gap between aspiration and application. **Mainstreaming biodiversity and ecosystem values into the agri-food value chain remains a major challenge**. Consequently, **the expansion of agricultural land and conversion of forests in Indonesia remain the key drivers to ecosystem services and biodiversity loss**.

There is increased concern on the potential environmental effects from expansion of agricultural land and conversion of forested land to crop plantations. However, there is paucity of studies assessing environmental impacts of agri-food systems across the value chain in Indonesia. A **few studies conducted mostly at farm gate points towards significant impacts on biodiversity, climate change and natural resources, leading to losses of carbon from the landscape, threats to rare and endemic species, and water and air pollution**.

Historically, fire in Indonesia has been used for land clearing and preparation; land acquisition; and as a mechanism to force inhabitants off the land. **Approximately 20% of wildfires in Indonesia can be attributed directly to oil palm plantation practices** (Goodman & Mulik, 2015). The clearing of forests and burning of peat lands is a key contributor to increases in greenhouse gas emissions, biodiversity and ecosystem services loss.

A massive forest and peat fire that took place between July and November of 2015 caused significant losses and damages to ecosystems, and ecosystem services and biodiversity

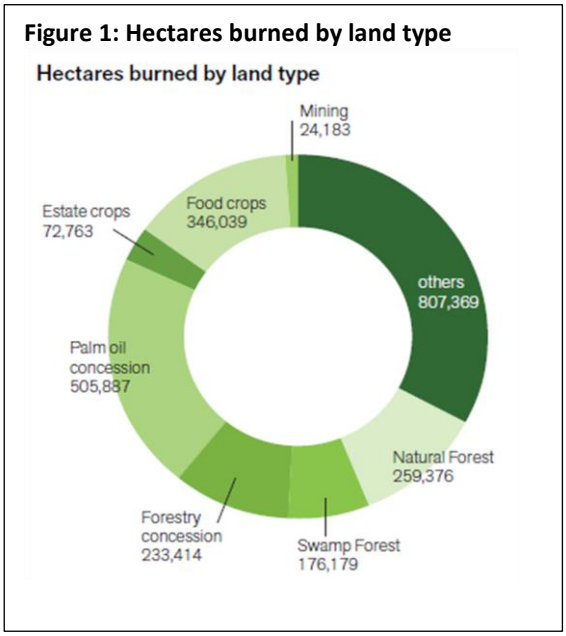
A massive forest and peat fire on plantation areas that took place between July and November of 2015 is estimated to have emitted approximately **1.75 billion metric tons of CO_2 equivalents**. According to the government, **2.6 million ha of Indonesian land burned between June and October 2015, with Sumatra and Kalimantan and the agricultural land bearing the greatest impacts,** as shown in Table 4 and Figure 9**.**

Table 2: Hectares burned by province

Province	Thousand hectares	Percent
South Sumatra	608	23
Central Kalimantan	429	16
East Kalimantan	388	15
South Kalimantan	292	11
Papua	268	10
West Kalimantan	178	7
Riau	139	5
Jambi	123	5
Other	186	7
Total	**2,611**	**100**

Source: World Bank (2016)

Figure 1: Hectares burned by land type



The World Bank estimates that the 2015 fires cost Indonesia at least US$ 16.1 billion (IDR 221 trillion), equivalent to 1.9 percent of 2015 GDP as shown in Table 8; of which the **cost of biodiversity loss totalled US$ 287 million and losses and damages to agriculture amounted to US$ 4.8 billion**. The greatest losses and damages accrued to agriculture, environment, carbon emissions and forestry.

Table 3: Estimated losses and damages from forest fires and haze, June-October 2015 (US$ millions)

	Jambi	Riau	South Sumatra	West Kalimantan	South Kalimantan	Central Kalimantan	East Kalimantan	Papua	Total
Agriculture	**210**	**181**	**1,033**	**349**	**523**	**1,242**	**1,128**	**173**	**4,839**
-Estate crops	*134*	*134*	*260*	*238*	*169*	*1,075*	*1,006*	*95*	*3,112*
-Food crops	*77*	*47*	*773*	*111*	*355*	*166*	*122*	*77*	*1,727*
Environment	226	229	1,205	376	387	776	530	523	4,253
Biodiversity loss	**17**	**24**	**72**	**23**	**27**	**33**	**33**	**58**	**287**
Carbon emission	**209**	**204**	**1,133**	**353**	**360**	**743**	**498**	**465**	**3,966**
Forestry	136	304	972	168	698	92	815	746	3,931
Manufacturing & mining	**29**	**183**	**133**	**61**	**122**	**14**	**69**	**0**	**610**
Trade	184	292	290	120	139	131	108	68	1,333
Transportation	20	31	81	17	66	111	32	13	372
Tourism	10	116	118	54	38	42	16	4	399
Health	36	22	28	12	24	17	12	1	151
Education	4	4	9	4	6	5	4	3	39
Firefighting costs	10	11	49	14	24	35	31	22	197
Total in US$ million	**866**	**1,373**	**3,919**	**1,176**	**2,028**	**2,464**	**2,746**	**1,552**	**16,124**

Source: World Bank (2016).

These costs could be higher if regional and global costs of air pollution were accounted for. Despite the magnitude of the cost to the economy, this practice continues largely driven by the lack of effective enforcement and a high return, particularly from oil palm (World Bank, 2016).

Promoting the sustainable management of agricultural landscape is considered a key solution for biodiversity and natural resources conservation. The Indonesian Government is making strides towards this direction. However, more support is needed to move beyond aspirations to practical implementation.

5. PROJECT AIMS AND OBJECTIVES: TEEB Implementation in Indonesia, "Promoting biodiversity and sustainability in the agriculture and food sector project"

1. To complement the Indonesian Government's initiatives for agriculture sustainability and biodiversity conservation, **the United Nations Environment (UN Environment), with the support of the European Union (EU), launched a four-year project for "Promoting biodiversity and sustainability in the agriculture and food sector in Indonesia**.

2. This project is in line with the Cancun Declaration adopted at the 2016 December CBD COP13 in which governments committed to mainstream biodiversity across all sectors. The project would contribute to integrating biodiversity values into national accounting and reporting systems and will encourage sectors that depend or have an impact on biodiversity to adopt integrated approaches for its conservation and sustainable use. In line with the Declaration, the project will also contribute to supporting sustainable production and consumption throughout value chains, the safe and sustainable application of technologies, and the phasing out of harmful incentives and strengthening of positive incentives.

3. **The overall objective of this project is to protect biodiversity and contribute to a more sustainable agriculture and food sector with well-functioning ecosystems**. This will be achieved by:
    - developing and applying instruments to capture the value of ecosystems services across the entire life cycle in the agri-food and the non-food agricultural raw material sectors;
    - identifying intervention options protecting biodiversity and promoting well-functioning ecosystems and by direct engagement with farmers, agri-businesses, government, and civil society (including consumers).

The example above – on the costs and damages of 2015 **massive forest and peat fire in Indonesia**– has not been funded by the UN Environment/EU project, but **demonstrates the often-invisible externalities, impacts and dependencies between the agricultural sector and ecosystems & biodiversity**. This Executive Summary is limited to this one example, but the main report provides six such examples.

The studies presented are more limited in scope that the full TEEBAgriFood assessments that would be conducted under the current UN Environment/EU project. For instance, these analyses do not cover the **entire value chain** 'from farm to fork' (and including final waste management), does not consider all impacts such as **human health**, and do not present a **Theory of Change**, i.e. what can be done to intervene to switch away from the current business-as-usual scenario to an alternative – the sustainable management of agricultural landscapes.

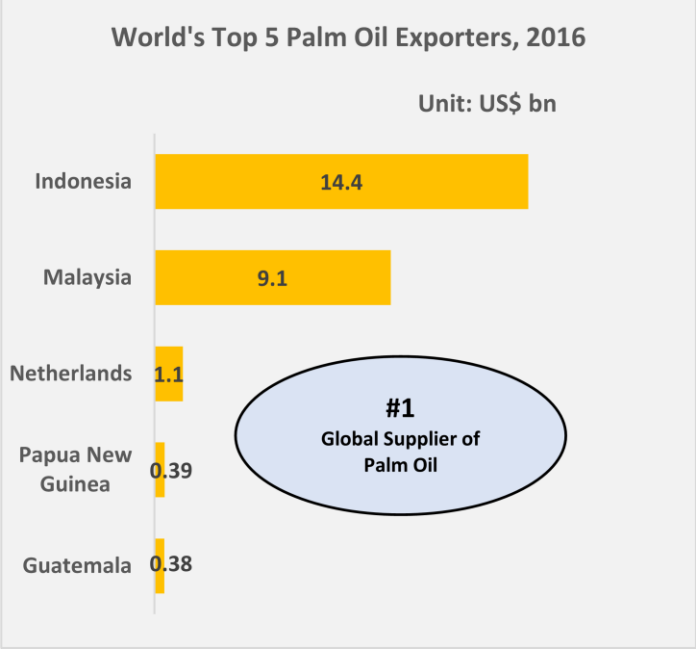
Although 'partial' vis-à-vis the TEEBAgriFood Evaluation Framework, the studies described herein reveal the potential for **complex trade-off** between social- economic and environmental objectives in the Indonesian agri-food systems. Research into this area is still evolving, with an evaluation of possible trade-offs mainly focused at farm level or partial agri-food value chains. More comprehensive analysis of potential social- economic and environmental trade-offs is generally constrained by the complexity of the agri-food value chains and data availability. However, an understanding of these trade-off is crucial for the effective implementation of the Indonesian green agricultural initiatives and biodiversity conservation, and this is the focus of the UN Environment/EU project.

1 Introduction: Snapshot of Indonesian agricultural production

Indonesia has achieved impressive economic growth since the Asian financial crisis of the late 1990s, maintaining the lead as the largest economy in Southeast Asia. This has been achieved through considerable structural change driven by large-scale industrialization and greater integration into the global economy with supportive government policy, the country's endowment of natural resources and its young and growing labour force (Elias & Noone, 2011).

Over the past four decades, the structural composition of Indonesia has shifted from a primarily agrarian to an industry and services driven economy[1]. However, **agriculture remains the mainstay of the economy and a major source of employment to over a third of the 256 million Indonesians. In 2015, the agricultural sector accounted for 13.5% of the Gross Domestic Product (GDP) and 33.5% of the total employment.** The agricultural sector comprises large plantations (both state-owned and private) cultivating export crops (palm oil and rubber) on about 15 percent of the total agricultural area. About 68% are smallholders operating on less than one hectare, and mostly producing rice, soybeans, corn, fruits and vegetables. The major agricultural products include palm oil, rubber, cocoa, coffee, tea, cassava, rice and tropical spices (FAO, 2017; Indonesia Investments, 2017; World Growth, 2011).

Indonesia is a leading global producer and exporter of palm oil



- **In 2016, Indonesia exported US$14.4 billion worth of palm oil accounting for 51.7% of global exports**
- **Indonesia is the world's largest producer of palm oil** and plantations which occupy around 7.9 million hectares of land across the country
- Indonesia produced 35 million tons of palm oil, around 55% of global production
- **To maintain its global lead, Indonesia plans to increase palm oil production to 42 million tons by 2020**.

Source: Workman (2017)

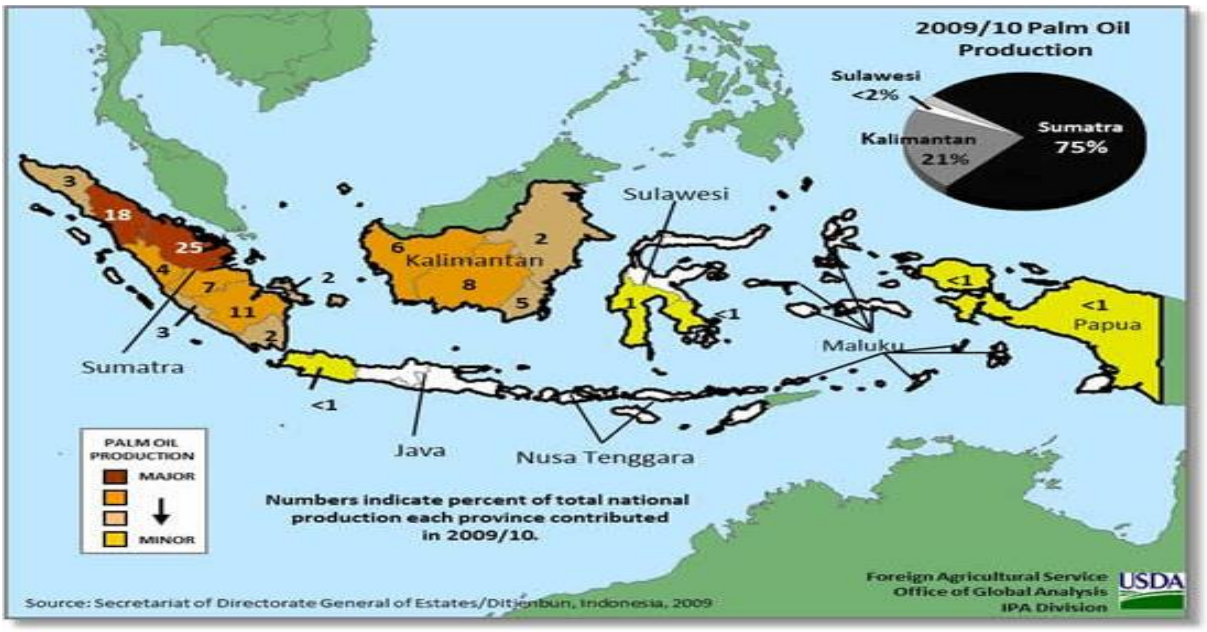
Increased palm oil production has been driven by a rise in global demand (for use in food, cosmetics and bio-fuel industries) and higher yields. Over the past decade, Indonesia has shifted its focus from the export of raw palm oil and other raw commodities to refined products. Palm oil refining capacity

[1] http://worldgrowth.org/site/wp-content/uploads/2012/06/WG_Indonesian_Palm_Oil_Benefits_Report-2_11.pdf

is reported to have more than doubled from an annual 21.3 million tons in 2012 to 45 million tons by the start of 2015 (Indonesia Investments, 2017).

In terms of regional distribution, **Sumatra hosts about 75% of palm oil production, followed by Kalimantan at 21% and to a lesser extent Sulawesi** as shown in Figure 2.

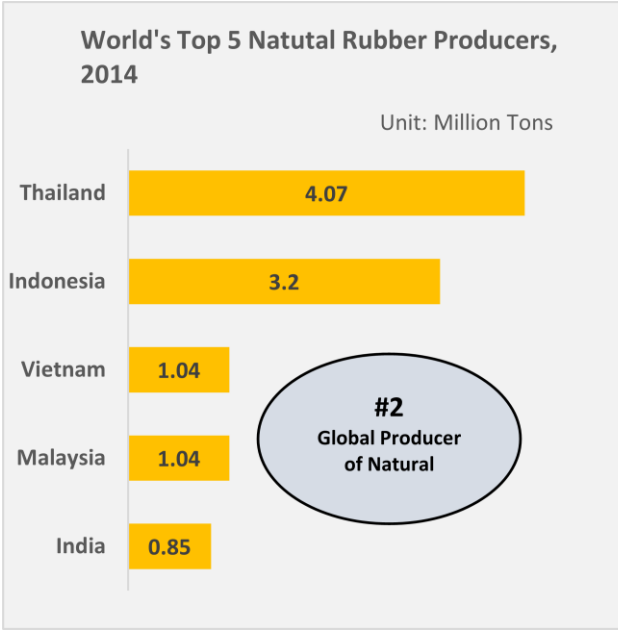
Figure 2: Distribution of regional palm oil production in Indonesia



Besides palm oil, Indonesia is a major global producer of rubber, second to Thailand (Indonesia Investments, 2017).

Indonesia is a second top world producer of natural rubber

Indonesia has experienced a steady growth in rubber production since the 1980s. In 2015, the country's rubber plantations covered a total of 3.65 million hectares. **Nearly 85% of the rubber producers in Indonesia are small holders, and they contribute 81% to the national output.** However, while smallholder rubber estates have increased, government and private rubber estates have shown a slight decrease, probably driven by higher prospects in palm oil production. **Sumatra is the key natural rubber producing area in Indonesia accounting for two-thirds of the rubber latex** harvested followed by Kalimantan, Sulawesi and Java (Indonesia Investments, 2017)



Source: Indonesia Investments (2017)

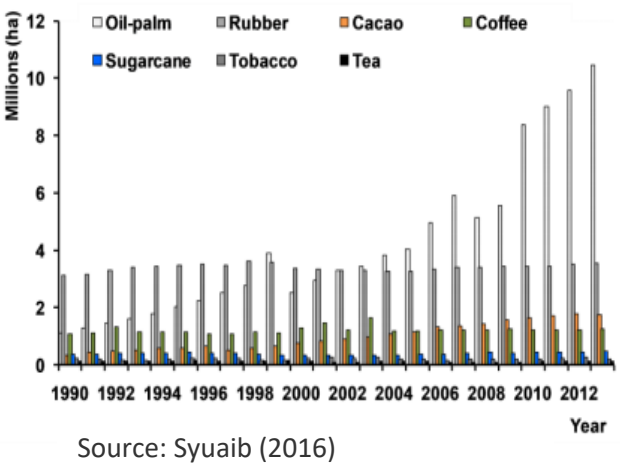
Indonesia is also the second largest producer of cacao

Indonesia is also the second largest producer of cacao, and among the five largest producers of coffee. Other major crops include tea, sugarcane and tobacco.

Driven by higher yields, there has been a shift in favour of palm oil production, particularly, from the mid 2000's.

Smallholders are the dominant producers of coffee, cacao, sugarcane and tobacco.

Trend of plantation areas of major industrial commodities in Indonesia



Source: Syuaib (2016)

Plantations crops are mostly grown in Sumatra and Sulawesi islands, with coffee and cacao grown in the highland area, oil palm in the lowland area, and rubber in the middle and lowland areas. Besides these two islands, rubber and oil palm plantations are widely grown in West and Central Kalimantan provinces, respectively (Syuaib, 2016).

Indonesia is ranked third in rice production

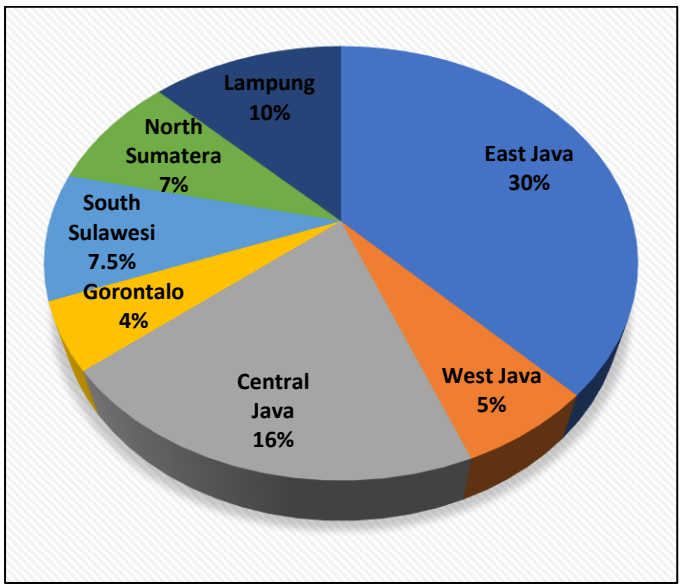
Rice is the most important cereal crop in Indonesia, accounting for 97 – 100% of household consumption level both in the cities and villages (Haryono, 2012; Nurliani & Rosada, 2016). **Indonesia is ranked third in rice production, after China and India**, with 14.3 million ha of land cultivated and 77.3 million metric tons produced in 2016 (FAOSTAT, 2018; Indonesia-Investments, 2017b). **The Indonesian government has placed self-sufficiency in certain agricultural products high on the agenda including rice**. Between independence and 1979, rice production lagged behind the increasing demand making the country a net importer of rice. However, after 1979, new measures and techniques were applied including the introduction of high-yielding varieties of rice, appropriate fertilizers, agricultural machinery and the application of integrated pest management (UNDP, 1996). By the 1980s, the country achieved rice self-sufficiency, but this was short-lived. The country's very high per capita rice consumption, currently at almost 150 Kgs/person/year, turned the country back into a net rice importer by the 1990s. Since then, the country has strived to achieve rice self-sufficiency but only succeeded between 2008 and 2009. Currently, Indonesia imports nearly 3 million metric tons of rice annually, mostly from Thailand and Vietnam, to buffer the country's rice reserves (Indonesia-Investments, 2017a).

Although **rice is grown in all provinces of the country, it is chiefly cultivated in the following regions: (1) South Sumatra, (2) West Java, (3) Central Java, (4) East Java and (5) South Sulawesi.**

Maize is Indonesia's second most important cereal crop

Maize is the second most important cereal crop after rice (Haryono, 2012; Swastika et al., 2004). Between 1970 and 2000, maize constituted nearly 19% of the total area cultivated for food crops but today the figure stands at about 32% (Swastika et al., 2004; Yudi, 2014). In 2017, approximately 3.4 million ha (ha) were used for maize production in Indonesia (GAIN Report, 2017). Although maize is grown in all provinces of the country, it is predominantly cultivated in the following regions: Java – the largest producer, Lampung, Sumatra, Sulawesi and Gorontalo as shown in Figure 3.

Figure 3: Key maize producing provinces in Indonesia



Source: Adapted from Haryono (2012)

Source: Indonesia-Investments (2015)

The demand for maize in Indonesia can be broken into three main components. **First, about 55% of the domestic maize is used for feed, of which about 83% is for poultry feed. Second, about 30% of domestic maize is for human food,** especially in rural South Sulawesi, East Nusa Tenggara and East Java**. Lastly, the remaining 15% of maize produced in Indonesia serves the needs of other industries and seeds** (Yudi, 2014). It is worth highlighting that prior to the current use trends, maize was initially predominantly cultivated for human consumption. For instance, in 1985, about 82.5% of maize produced in Indonesia was used as human food. However, by 1999, many households had switched to rice such that almost 43.2% of the domestic maize was used in the feed industry (Haryono, 2012).

Overall, Indonesia is a net importer of grains, horticulture and livestock produce.

Despite this impressive growth, there is still a long road ahead for the agri-food systems in Indonesia. **The key challenge is how to sustainably manage agricultural systems in ways that reconcile ecological and economic functions.**

1.1 Challenges to sustainable agriculture and biodiversity in Indonesia

Globally, food systems are now the source of 60% of terrestrial biodiversity loss, 33% of soil degradation and 61% of the depletion of commercial fish stocks[2]. The situation in Indonesia is almost consistent with these global statistics. Indonesia's **biodiversity is increasingly under threat from habitat degradation and fragmentation, landscape change and fire, pollution, climate change, and overexploitation of natural resources** (UNDP, 2016).

Addressing the negative impacts on biodiversity is critical, given that **Indonesia contains second greatest biodiversity on Earth**. More than 60% of Indonesian rainforest species are endemic to the region (Manurung, 2016). It contains 10% of the world's flowering plant species, of which over half are endemic; it ranks second vis-à-vis mammals, containing 12% of the planet's mammal species[3]. Indonesia's rich biodiversity has significant economic benefits, **in 2012 the total economic contribution of biodiversity and ecosystems were estimated to be US$ 329.9 million**.

The drive to increase agri-food production is taking a major toll on the environment, leading to forest clearing, soil degradation, pollution and introduction of pests. **Indonesia ranks among countries with the highest rate of deforestation**. It is estimated that the country's primary forest loss, totalled over 6.02 million ha from 2000 to 2012 and increased on average by 47,600 ha per year. This loss is of great concern, especially in Indonesia's tropical lowland forest, since a single hectare of this forest harbors more than 200 species and 500 stems. **Tropical lowland forest is Indonesia's most biodiverse ecosystem and the most threatened by agricultural conversion**, particularly for palm oil plantations considered a major threat to forest ecosystems. Besides biodiversity, the loss of forest ecosystems is regarded as key driver to the loss of critical environmental services in Indonesia, including provision of water catchment areas, prevention of erosion and floods (Margono et al., 2014; UNFCCC, 2016).

On the other hand, **climate change is becoming a major threat to the sustainability of agriculture and food security in Indonesia**. A study by Yuliawana and Handokob (2016), revealed that for every 1°C of temperature rise in Indonesia, irrigated rice yield decreases by about 11.1% while rain-fed rice yield decreases by about 14.4%. In South Sumatra, evidence points towards a decrease in the production of paddy rice, corn and soybean due to temperature and rainfall variability (Ruminta et al., 2018). Land conversion, increased usage of agrochemicals and land degradation are also considered as key challenges to future agriculture development in Indonesia. The situation is expected to be compounded further by population pressure leading to high demand for food, feed and fuels, and scarcity and competition for land and water resource (Manurung, 2016; Setyanto, 2015).

Efforts to address agriculture's environmental footprint and threats to its sustainability exist, but are constrained by technical and regulatory challenges. Within the oil palm sector, green agriculture practices are being promoted through national level and internationally accepted certification schemes. In 2011 Indonesia established its own mandatory certification scheme – the Indonesian Sustainable Palm Oil (ISPO) which governs oil palm production on plantations greater than 25 ha that

[2] TEEB. 2015. TEEB for Agriculture & Food: an interim report, United Nations Environment Programme, Geneva, Switzerland.
[3] Convention on Biological Diversity. *Country Profiles –Indonesia*. Available at, https://www.cbd.int/countries/profile/default.shtml.

prohibits the use of fire. However, this scheme is not internationally recognized. Many large companies subscribe to the Roundtable on Sustainable Palm Oil (RSPO) – which is an internationally accepted voluntary certification scheme. In addition, the Indonesian Palm Oil Pledge (IPOP) – formed in 2014 and dissolved in July 2016 provided a platform where participating companies pledged to produce and trade only deforestation-free oil palm within their supply chains. There were technical challenges to ensuring the IPOP pledge is met, particularly, for smallholders, consequently, the Government recommended smallholders to be exempted (Leimona et al., 2015; World Bank, 2016).

In May 2011, the Indonesian government signed a 2-year forest moratorium, directed to prevent deforestation of the primary forests and peatlands for oil palm expansion, timber plantation or logging. This could be applauded as an important crucial step towards improved forest governance in Indonesia[4]. However, it has been criticized for its narrow scope, lack of enforcement and monitoring, largely, due to limited institutional capacity and support to the local government (Murdiyarso et al., 2011).

Indonesia has embraced sustainable agriculture, through a variety of national level strategies and policies, which has evolved over time. These include the National Agenda 21 (1997); National Development Program (PROPENAS) and the Medium-Term Development Plan (Rencana Pembangunan Jangka Menengah/RPJM) 2004−2009; Revitalization of Agriculture, Fisheries, and Forestry (Revitalisasi Pertanian, Perikanan, dan Kehutanan/RPPK) 2005−2025; National Long-Term Development Plan (Rencana Pembangunan Jangka Panjang/RPJP) 2005−2025; Indonesia Grand Strategy of Agricultural Development (GSAD) 2015–2045 (Leimona et al., 2015; Manurung, 2016). Indonesia has also expressed interest in combating global climate change. At the 2015 United Nations Climate Change Conference, Indonesia submitted an Intended Nationally Determined Contribution (INDC) and made a commitment to reduce GHG emissions by 26% below business as usual (BAU) by 2020. In the INDC, Indonesia also commits to reducing emissions to 29% below BAU by 2030, and, with foreign assistance, an additional reduction by 41% compared with BAU (Kharina et al., 2016).

Over the years, Indonesia has also developed several policies and initiatives targeting the conservation of biodiversity including the Act on the conservation of biological resources and their ecosystems (Act No. 5 of 1990)[5]; Provisions for the Management of the Living Environment (Act No. 4 of 1982)[6]; Decree on ecosystem restoration in production forest areas[7]; Act on the conservation of biological resources and their ecosystems (Act No. 5 of 1990)[8]; Provisions for the Management of the Living Environment (Act No. 4 of 1982)[9]; Decree on ecosystem restoration in production forest areas.[10]; Government

[4] The Indonesian 2-year forest moratorium is also an important step towards meeting its voluntary commitment to reduce emissions.
[5] Can be found: https://www.informea.org/en/legislation/act-conservation-biological-resources-and-their-ecosystems-act-no-5-1990. Assessed Nov 2017
[6] Can be found: https://www.informea.org/en/legislation/act-concerning-basic-provisions-management-living-environment-act-no-4-1982. Assessed Nov 2017
[7] Can be found: https://www.informea.org/en/legislation/decree-minister-forestry-no-sk159menhut-ii2004-re-ecosystem-restoration-production. Assessed Nov 2017
[8] Can be found: https://www.informea.org/en/legislation/act-conservation-biological-resources-and-their-ecosystems-act-no-5-1990. Assessed Nov 2017
[9] Can be found: https://www.informea.org/en/legislation/act-concerning-basic-provisions-management-living-environment-act-no-4-1982. Assessed Nov 2017
[10] Can be found: https://www.informea.org/en/legislation/decree-minister-forestry-no-sk159menhut-ii2004-re-ecosystem-restoration-production. Assessed Nov 2017

Regulation on the protection of marine environment[11]; Regulation of the Agriculture Minister on Agricultural Products Certification Institution[12]; Law No. 29/2000 on Plant Varieties Protection[13]; Protection of Sustainable Food Crops Farmland in Indonesia (Law No. 41/2009) and more recently, Indonesian Biodiversity Strategy and Action Plan (IBSAP) 2015-2020[14].

1.2 TEEB Implementation in Indonesia: Promoting biodiversity and sustainability in the agriculture and food sector project

4. To complement the Indonesian Government's initiatives for agriculture sustainability and biodiversity conservation, the United Nations Environment (UN Environment), with the support of the European Union (EU), launched a four-year project for "Promoting biodiversity and sustainability in the agriculture and food sector in Indonesia.

5. This project is in line with the Cancun Declaration[15] adopted at the 2016 December CBD COP13 in which governments commit to mainstream biodiversity across all sectors. The project would contribute to integrating biodiversity values into national accounting and reporting systems and will encourage sectors that depend or have an impact on biodiversity to adopt integrated approaches for its conservation and sustainable use. In addition, and in line with the Declaration, the project will contribute to supporting sustainable production and consumption throughout value chains, the safe and sustainable application of technologies, and the phasing out of harmful incentives and strengthening of positive incentives.

6. **The overall objective of this project is to protect biodiversity and contribute to a more sustainable agriculture and food sector with well-functioning ecosystems**. This will be achieved by:
   - developing and applying instruments to capture the value of ecosystems services across the entire life cycle in the agri-food and the non-food agricultural raw material sectors;
   - identifying intervention options protecting biodiversity and promoting well-functioning ecosystems and by direct engagement with farmers, agri-businesses, government, and civil society (including consumers).

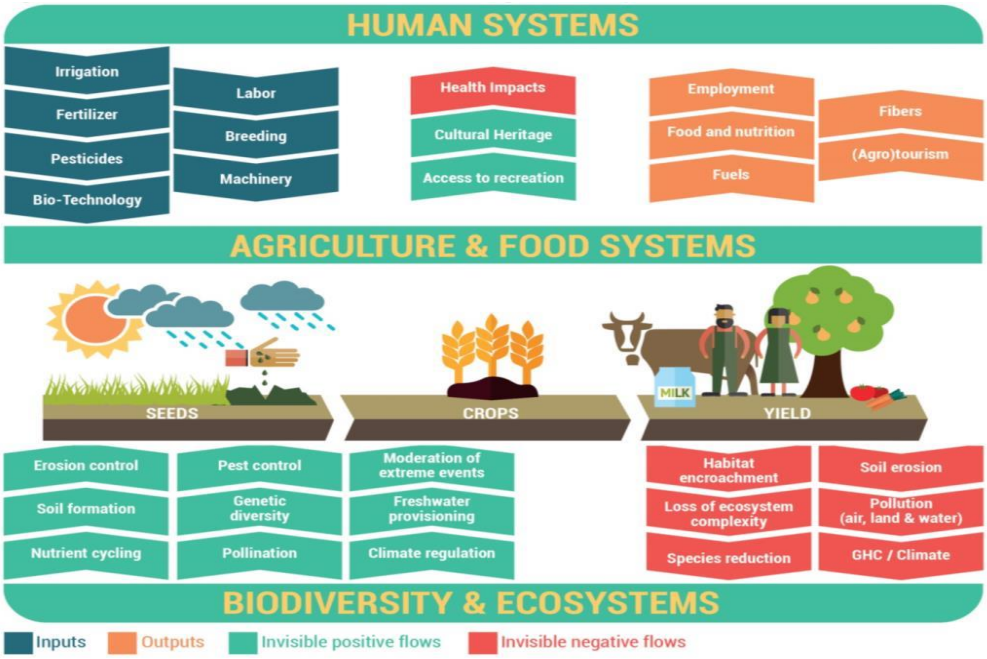
7. The TEEBAgriFood Framework[16] will be used to assess the sectors for the EU Partner countries in scope. The focus in this action is capturing the value of ecosystems services, protecting biodiversity and promoting well-functioning ecosystems of the framework. The action aims to be comprehensive, from farm to fork (i.e. across the entire value chain). The Framework allows

[11] Can be found: https://www.informea.org/en/legislation/government-regulation-no-212010-protection-marine-environment. Assessed Nov 2017
[12] Can be found: https://www.informea.org/en/legislation/regulation-agriculture-minister-no-75permentanot140112011-agricultural-products. Assessed Nov 2017
[13] Can be found: https://www.informea.org/en/legislation/law-no-292000-plant-varieties-protection. Assessed Nov 2017
[14] https://www.bappenas.go.id/files/publikasi_utama/Dokumen_IBSAP_2015-2020.pdf
[15] http://www.cbd.int/cop/cop-13/hls/Cancun%20Declaration-EN.pdf
[16] The current published version of the Evaluation Framework can be found here: http://www.teebweb.org/agriculture-and-food/#framework. The Framework that is to be published in the upcoming TEEBAgriFood 'Foundations' report is an evolution of this previous version but retains the same core components. The 'Foundations' report is due to be published in Q1 2018 and thus the Framework will be finalized before the current EC Partnership Instrument project is contracted.

decision-makers (regulators, agri-business and farmers) to see explicitly any trade-offs that arise through the application of different measures, as compared with Business-As-Usual (BAU).

8. The rationale for the development of the TEEBAgriFood Evaluation Framework, is to provide a comprehensive and universal framework that captures all the positive and negative impacts and externalities across the entire agri-food value chain. It is a frame of reference that can enable us to answer the question "what we should value, and why?" It can be used to evaluate a policy question, a business question or an accounting question[17]. The TEEBAgriFood schematic (Figure 4) below provides a visual illustration of some of the impacts and externalities that might be omitted were we not to apply a holistic and comprehensive evaluation framework.

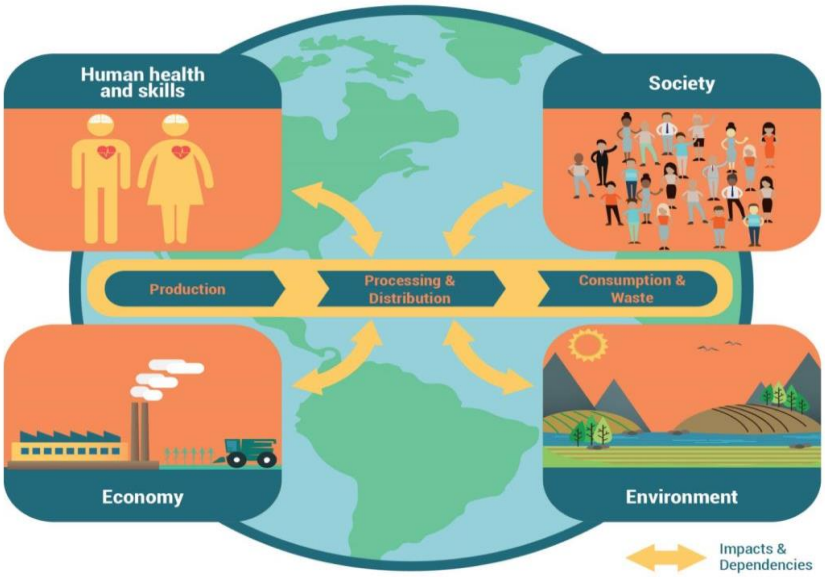
Figure 4: The visible and invisible flows of agricultural production



The schematic in Figure 4 above refers to the impacts and dependencies that occur within the farm-gate, but the Evaluation Framework looks at inter-linkages across the value chain, and trade-offs across capital stocks in the eco-agri-food systems complex. This is illustrated in the schematic below (Figure 5).

[17] For more details, see Chapter 3 in the TEEBAgriFood Interim Report: http://www.teebweb.org/publication/teebagfood-interim-report/

Figure 5: The eco-agri-food systems complex



9. The project builds on the momentum of the international TEEB initiative[18], TEEB country studies[19], TEEB for Agriculture and Food[20] and on national interest.
10. It also builds on on-going UN Environment/TEEB initiatives in Indonesia. TEEB will work closely with:
    - The UN-REDD which recently launched the Tropical Landscapes Finance Facility amidst great interest from government and the private sector. The UN-REDD is also linked with the EU REDD Facility and we will seek representation from this initiative in the Indonesia project steering committee.
    - The Natural Capital Protocol, and links will be made to ensure representation from those firms which have already committed to Protocol on the project meetings.
    - BIOFIN[21] is a global partnership developed to improve biodiversity management through sound financing and economic thinking. BIOFIN works directly with Finance and Environmental ministries in 30 countries helping them to understand how to use finance solutions to maintain ecosystems and the services they provide, and Indonesia is part of this partnership.

Beyond these specific country links, there are complementarities between this project and initiatives providing guidance and opportunities in this space including FAO-OECD Guidelines on Responsible Supply Chains; the BioTrade initiative managed by UNCTAD[22]; the Intergovernmental Science- Policy Platform on Biodiversity and Ecosystem Services (IPBES)[23]; ESMERALDA[24] (Enhancing ecoSysteM sERvices mApping for poLicy and Decision mAking); FAO assessment/Platform on mainstreaming biodiversity in agricultural sectors[25] and DG Research and Innovation initiatives such as FOOD 2030[26].

[18] http://www.teebweb.org/
[19] http://www.teebweb.org/areas-of-work/country-studies-home/
[20] http://www.teebweb.org/agriculture-and-food/
[21] Can be found: http://www.biodiversityfinance.net. Assessed Nov 2017
[22] www.biotrade.org
[23] http://www.ipbes.net/
[24] http://www.esmeralda-project.eu/
[25] http://www.fao.org/biodiversity/en/
[26] http://ec.europa.eu/research/conferences/2016/food2030/index.cfm

2 Overview of national objectives in agriculture

Indonesia's economic planning follows **a 20-year National Long-Term Development Plan (Rencana Pembangunan Jangka Panjang/RPJP) 2005–2025**. It is segmented into five-year medium-term plans called **RPJMN (Rencana Pembangunan Jangka Menengah Nasional)**, each with different development priorities.

2.1 The 2015–2019 National Medium-Term Strategic Plan for Agriculture

Developed by the Indonesian Ministry of Agriculture (MoA), **the vision of the Indonesian MoA in 2015-2019 is "…. realization of sustainable agriculture bioindustry systems producing various healthy foods and high value-added products-based on local resources for food sovereignty and farmers welfare."**

To realize the vision, **the mission of the Indonesian MoA** is to achieve:

(1) food sovereignty;
(2) sustainable agriculture-bioindustry system;
(3) farmers welfare; and
(4) bureaucracy reform.

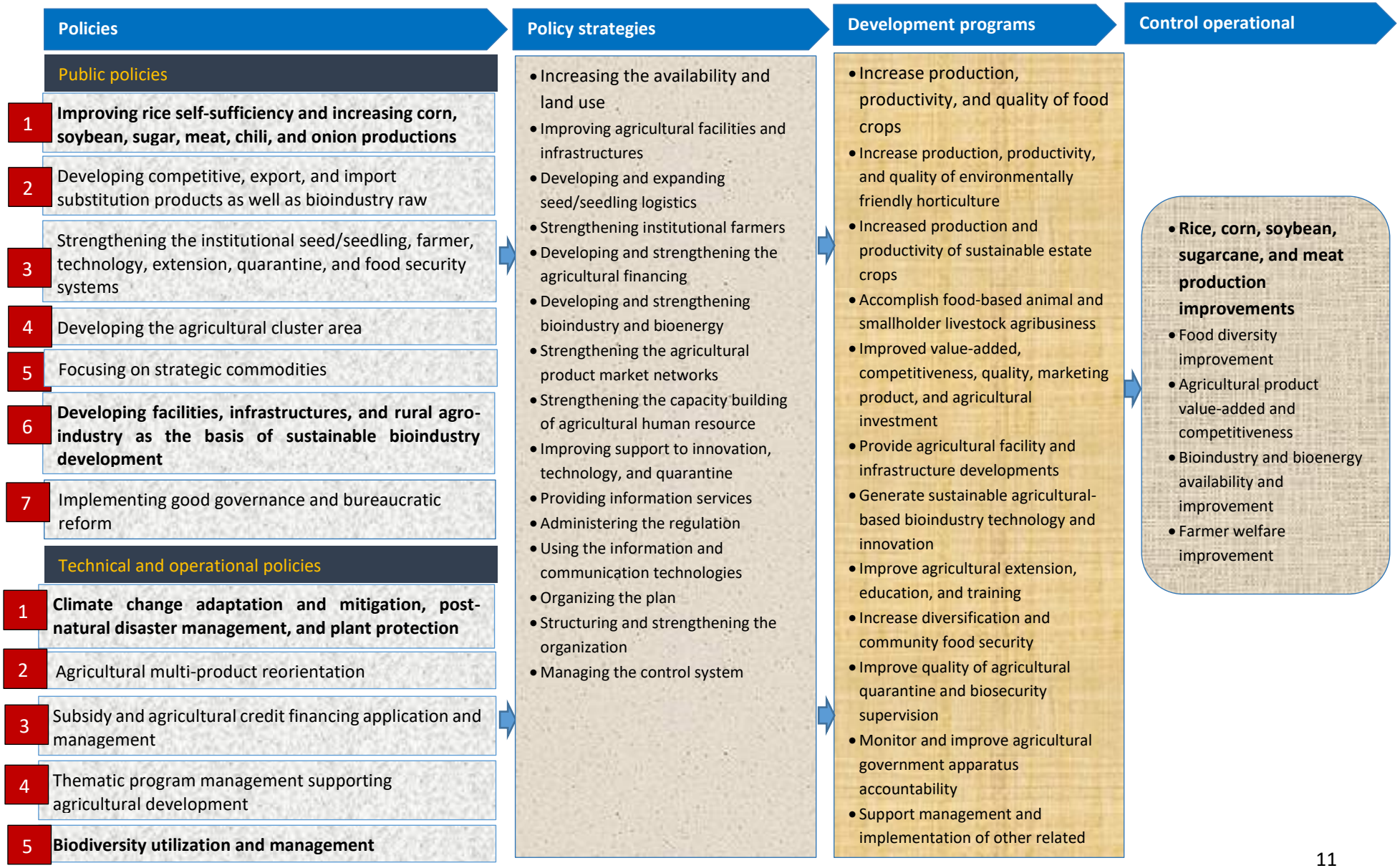
The objectives include:
(1) improving the availability and diversification of food toward food sovereignty;
(2) increasing the value added and competitiveness enhancing agricultural food products;
(3) developing raw material availabilities for bioindustry and bioenergy;
(4) improving the income and welfare of farmers and
(5) improving the performance quality of agricultural government apparatus trustworthily and professionally.

Strategic goals include:
(1) achieving self-sufficiency in rice, corn, and soybean as well as increasing meat and sugar production;
(2) improving food diversification;
(3) enhancing value-added commodities, competitive in accomplishing export market and import substitution.

Policy direction, strategy, and target

The policy direction and strategy (2015-2019) of the **Indonesian MoA** is summarized in Table 4. It comprises public and technical as well as operational policies, policy strategies, agricultural development programs, and control policy measures. **Technical and operational policies emphasize biodiversity utilization and management which aligns with the objectives of the TEEB project implementation in Indonesia.**

Table 4: Policy strategy and agricultural development program plans, 2015-2019



Source: Rafani (2015, p. 3)

To accomplish the stated policies and strategies, supporting regulatory and institutional support is needed as summarized in Table 5.

Table 5: Supporting Regulatory and Institutional Frameworks

Regulatory framework (supporting legislation)	Institutional framework (bureaucratic reform agendas)
1. Land regulation: accelerating the release of local government laws in line with the Law number 41/2009 on Protection of Sustainable Food Crops Farmland; 2. Agricultural input regulation: improved seed and fertilizer subsidies as well as seed system development; 3. Agricultural finance regulation: accelerating and simplifying the requirement accesses of farmers to credit scheme; 4. Farmer protection regulation: implementing the Law number 19/2013 on Protection and Empowerment of Farmers; 5. Food diversification and nutrition regulations; 6. Agricultural products export and import regulations and 7. agricultural investment regulation.	1. Institutional aspects: establishing the proportional, effective, and efficient (appropriate function and dimension) organizations; 2. Governance aspect: establishing the coherent system, process, procedure, effective, efficient, and measurable in accordance with good governance principles; 3. Legislation aspects: more orderly, un-overlapping, and favourably; 4. Human resource apparatus aspects: integrity, neutral, competent, capable, professional, high performance, and well-to-do; 5. Control aspects: increasing governance free from corruption, collusion, and nepotism; 6. Accountability aspects: increasing the performance capacity and capability of bureaucracy; 7. Public service aspects: realizing the excellent service in accordance with the needs and expectation of community; and (8) mindset and cultural set aspects: establishing bureaucracy-based integrity and high-performance.

2.2 Indonesia Grand Strategy of Agricultural Development (GSAD) 2015–2045

The Grand Strategy of Agricultural Development (GSAD) 2015–2045 is Indonesia's first long-term agricultural development plan. It is formulated as part of the constitutional mandate to achieve a dignified, independent, developed, fair, and prosperous Indonesia. In the medium term, the GSAD 2015–2045 is in line with the Strategic Plan of the Ministry of Agriculture 2015–2019 which aims to achieve food sovereignty and enhance the welfare of farmers.

The GSAD 2015–2045 has the primary objective of promoting sustainable agroindustry and offers a new concept and approach on future agriculture development in Indonesia. **This approach is in line with emerging challenges including resource constraint, climate change, science and innovation, as well as governance issues.**

2.3 Direction and conceptual foundation

As an integral part of national development, agricultural development is directed to achieve the objective of national development as mandated by the constitution, namely an independent,

developed, dignified, fair, and prosperous Indonesia. The GSAD **2015–2045 is formulated i**n accordance to this paradigm. The suitable conceptual framework to pursue that direction are:

1. **At the national level**, economic development is based on the paradigm of "**agriculture for national developmen**t" along with "**development for agriculture**".
2. **At the sectoral level**, "development of a sustainable agricultural-bioindustry system based on bioculture".

The paradigm of "**agriculture for development**" mentions that national economic development is designed and implemented based on stages of agricultural development and agriculture is positioned as driving force for national development. This paradigm at the same time should be balanced by the paradigm of "**development for agriculture**". **This paradigm emphasizes a need for agriculture to be supported by other sectors given its significance for food security and multi-functions for solving various environmental and social issues** (Manurung, 2016).

The vision of GSAD **2015–2045 is to** "**achieve a sustainable agricultural bioindustry system to produce diversified healthy foods and high value-added products from tropical agriculture and maritime resources".** This vision will be realized through mission and targets outlined in Table 3.

Table 6: The mission and targets of the Grand Strategy of Agricultural Development (GSAD) 2015-2045

Mission	Direction and Targets
To develop and carry out: 1. Spatial plan and agrarian reform **2. Inclusive and sustainable agriculture – bioindustrial system** 3. Economic activities for agricultural production, information, and technology 4. Agriculture processing system for post-harvest and bioindustry within rural areas 5. Domestic and global agricultural value chain management system 6. Financing system for agriculture activities 7. Agricultural research, innovation and human resources development 8. Rural and agricultural infrastructure 9. Imperative legislation, regulation and management programmes.	1. All the villagers are freed from poverty by 2030 2. Annual income per capita of farmer at $ 7,500 by 2040 3. Indonesia economic prosperity status as high-income country with annual per capita GDP of $ 20,000 by 2040 4. National food self-reliance status by 2020, national food sovereignty by 2025, and community food sovereignty by 2035 5. Self-reliance in energy through the implementation of integrated bio-energy for the total rural areas nationwide by 2035 6. Substituting of imported carbohydrates at least 50 % by 2025 and 100 % in 2030 and substitution of 75 % of national fossil-based products by 2030 7. Improved bioservices sector throughout the total rural areas by 2040 8. Sustainable integrated bioeconomy throughout rural areas by 2045 9. Reduced agriculture labor from 39 % in 2010 to 7 % by 2045, and declining share of GDP from 15.3 % in 2010 to 3 % by 2045 10. Increased bioindustry workforce sector from 6 % in 2010

Source: Sudaryanto (2016)

Development of **inclusive and sustainable agriculture – bioindustrial system is among the key priorities of** GSAD **2015–2045.** Indonesia is one of the few ASEAN member states that have developed a bioeconomy policy strategy, with priorities areas on agro-industry and energy (Manurung, 2016).

A number of strategic policies are recognized as prerequisite for the successful implementation of the GSAD 2015-2045. These include policies on science and innovation; production supplies; farm practices; agricultural processing industry; market and trade; agricultural infrastructures; human resources and development of farmers' institution. In addition, some policies are also needed in the areas of macroeconomic, agrarian and spatial management, and food, water, and energy security.

In addition, to promote its self- sufficiency program, the government has developed some crop specific policies. Those that apply to rice and corn (maize) production are outlined in Box 1.

Box 1: Government policies in rice and maize production

Government policies towards rice production in Indonesia

Input subsidies. Through the Ministry of Agriculture (MoA), Indonesia provides huge fertilizer subsidy (50 – 75% of market price) to predominantly small-scale farmers. For instance, total budget for fertilizer subsidy in 2014 was around US$ 1.51 billion (Sudaryanto, 2014). Between 2006 and 2010, expenditure on fertilizer subsidy accounted for about 37% of total budgetary support to agriculture (OECD, 2012). According to Osorio et al. (2011), Indonesia's fertilizer subsidy programme is envisaged to (a) increase agriculture productivity and preserve national food security and (b) enhance farmers' ability to optimize the use of fertilizer.

Development of specified lands. On November 29, 2016, Indonesia's MoA issued regulation 56/2016 on "The Development of Agricultural Cluster Areas". The regulations details development of specified lands in order to increase food crops, horticulture, estate crops, and animal husbandry (GAIN Report, 2017).

Strengthening the Government's capacity to achieve food security. Between 2017 and 2020, the Indonesian Government is allocating more than US$ 7 billion to strengthen its capacity to achieve food security (World Food Programme, 2017). Research and development (R&D), training and education are some of the services the Government has already embarked on (Indonesia-Investments, 2015). However, **in order to measure the impact of this investment there is a need to increase capacity to monitor progress and analyse data** to ensure that such important public resources are put to most effective use.

Government policies towards maize production in Indonesia

Seed subsidies. Indonesia provides free hybrid and composite maize seed to small-scale farmers through the Ministry of Agriculture (MoA). For instance, in 2017, farmers received 15 kg of hybrid maize seed per hectare or 25 kg of composite maize seed per hectare. In total, about 45,000 metric tons of free hybrid maize seed was provided to Indonesian farmers in 2017 (GAIN Report, 2017).

Development of specified lands. On November 29, 2016, Indonesia's MoA issued regulation 56/2016 on "The Development of Agricultural Cluster Areas". The regulations details development of specified lands in order to increase food crops (including maize), horticulture, estate crops, and animal husbandry (GAIN Report, 2017). A year earlier, the Government unveiled the purchase of additional one million hectares of maize plantations in Indonesia to the tune of about US$ 187 million (Indonesia-Investments, 2015).

Strengthening the Government's capacity to achieve food security. Between 2017 and 2020, the Indonesian Government is allocating more than US$ 7 billion to strengthen its capacity to achieve food security (World Food Programme, 2017). Research and development (R&D), training and education are some of the services the Government has already embarked on (Indonesia-Investments, 2015). However, **in order to measure the impact of this investment there is a need to increase capacity to monitor progress and analyse data** to ensure that such important public resources are put to most effective use.

2.4 Indonesian Biodiversity Strategy and Action Plan (IBSAP) 2015-2020

To combat diversity loss, Indonesia launched the first Biodiversity Strategy and Action Plan (IBSAP) in 1991 and was adopted as part of the Government of Indonesia (GOI) 25-year Development Strategy for 1991-2015. It is used a national blue print for the implementation of the objectives laid out in the Convention on Biodiversity and the Nagoya Protocol in line with national interests. Currently, the IBSAP 2015-2020 serves as an umbrella for addressing current challenges and priorities for conservation Indonesian biodiversity.

Furthermore, Indonesia has developed a suite of green agriculture approaches and instruments to support the implementation of its national policies and strategies. An outline of these instruments is provided in the following section.

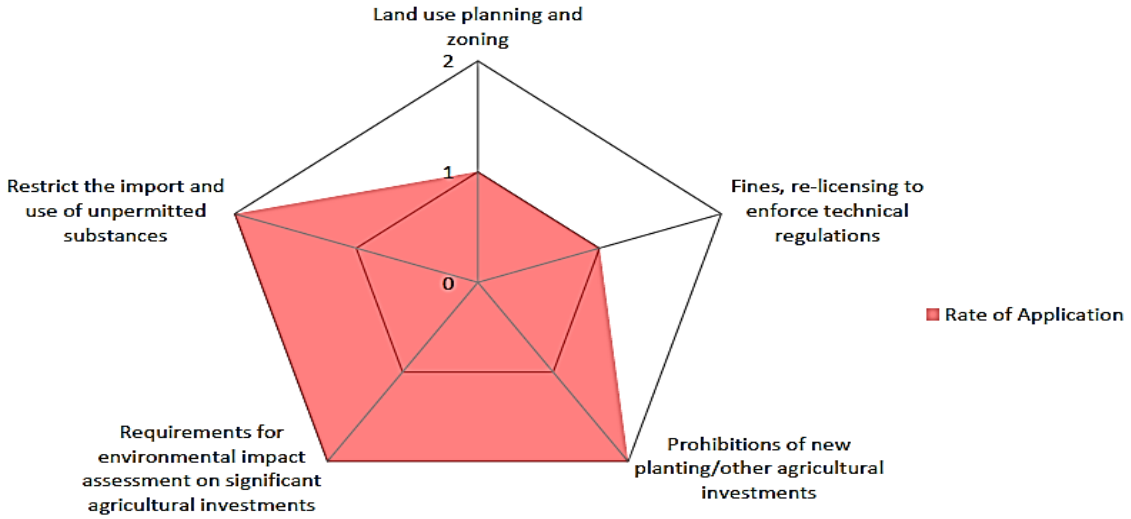
2.5 An overview of green agriculture approaches and instruments

The government and private sector in Indonesia are applying a range of green agriculture approaches and instruments at the national and subnational levels. The instruments are broadly categorized as **(1) direct regulation, (2) instruments that correct or create markets, and (3) information, advocacy and voluntary approaches.** A synthesis study by Leimona et al. (2015), summarized in section 2.5.1—2.5.3, provides a detailed outline of green agriculture initiatives in Indonesia and the extent to which market instruments and voluntary standards are being applied drawing from a focus group discussion with stakeholders from major public institutions and available literature.

2.5.1 Direct regulation

Regarding direct regulation, five instruments are perceived to be widely applied in the agricultural sector in Indonesia as indicated in Figure 6. However, land use and zoning and fines or re-licensing to enforce technical regulations are still at an early stage of application. Limited application of these instruments could be attributed to inadequate law enforcement and other issues related to the implementation of such instruments including lack of coordination between government institutions. For example, while the Ministry of Agriculture sets policy to encourage farm or land certification, the process of land certification administration is under the National Land Agency (BPN), making it difficult for farmers to follow all the procedures required to obtain certification of their land.

Figure 6: Direct regulation instruments



Note: Application rating: 0 = non-existent; 1 = incipient; 2 = widely applied.

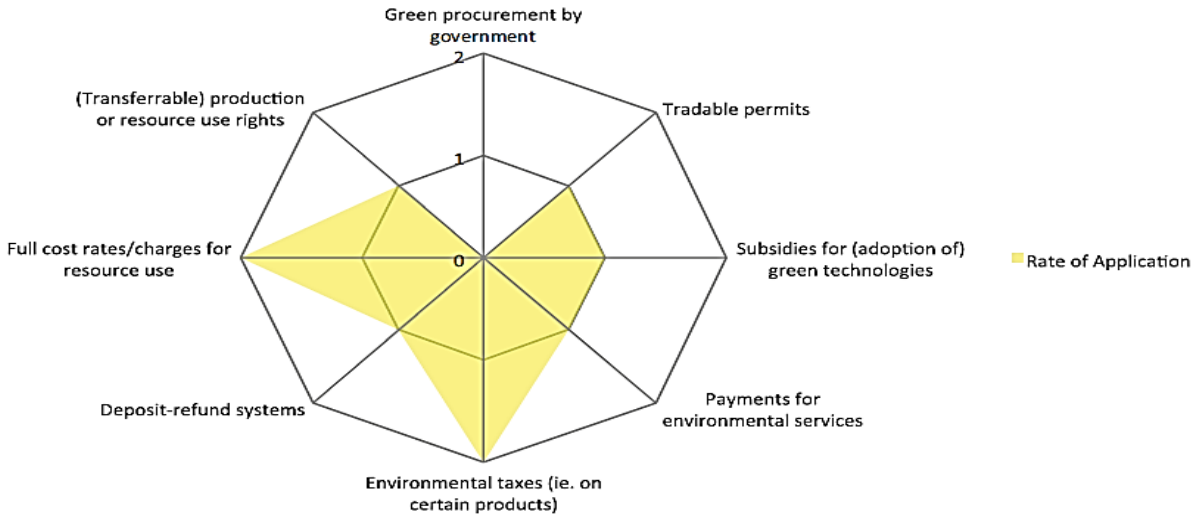
Source: Leimona et al. (2015)

2.5.2 Instruments that correct or create markets

There are about eight instruments in place including **the green procurement by the government** which is integrated into the Sustainable Consumption and Production (SCP) activities coordinated by the Ministry of Environment and has been in place since 2000[27]. **The government also provides subsidies for adoption of green technologies**. For example, **the government provides a subsidy to encourage the production of organic fertilizer, with an overall objective of reviving soil fertility degradation due to the application of synthetic fertilizer and boost food security, particularly for rice, as targeted by the food self-sufficiency program**. Despite, market instruments or incentives being in place, their application is still at its infancy. Charges for resource use and environmental tax on certain products were rated as widely applied as shown in Figure 7. **Application of these instruments have been constrained by a low level of political will to address environmental issues, inadequate law enforcement, lack of integrated environmental management policies and lack of both financial and knowledgeable human resources.**

[27] *www.menlh.go.id/indonesia-pelopor-integrasi-scp-dalam-kebijakannasionalnya/.*

Figure 7: Instruments that create/correct markets



Note: Application rating: 0 = nonexistent; 1 = incipient; 2 = widely applied.

Source: Leimona et al. (2015)

2.5.3 Information, advocacy, and voluntary approaches

There are a number of approaches in place including **promotion of Good Agricultural Practices (GAP) and Best Management Practices (BMP)**. The Indonesian law (UU No. 16/2006) makes provision for the extension system (sistem penyuluhan) to increase smallholders' capacity to apply GAP and BMP. This is also reiterated in a Regulation (Permentan) No. 48/2006 enacted by the Minister of Agriculture. It provides guidelines for farmers and local government to achieve sustainable agriculture through comprehensive GAP, from land preparation to monitoring and maintenance.

There are several environmental campaigns around the promotion of sustainable agriculture value chains including the Biodiversity and Agricultural Commodities Program (BACP)[28] and the WWF Market Transformation Initiative (MTI)[29]. **The Mars Cacao Partnership Initiative program**[30] launched in 2007, aimed at securing the cacao supply chain, share best practices, and build partnerships between farmers and traders, institutionalized through the Cocoa Sustainability Partnership (CSP). In 2011, **the Partnership for Indonesia's Sustainable Agriculture (PIS Agro)**[31] was created at the World Economic Forum on East Asia in Jakarta. It seeks to provide an innovative, multi-stakeholder model for addressing the nation's agricultural opportunities and challenges. To this end, **the PIS Agro for palm oil is designed to implement GAP on farms and Good Manufacturing Practices (GMP) in the processing industry**, as well as other relevant activities, such as the provision of a financing scheme and organizing farmers into cooperatives and marketing plans.

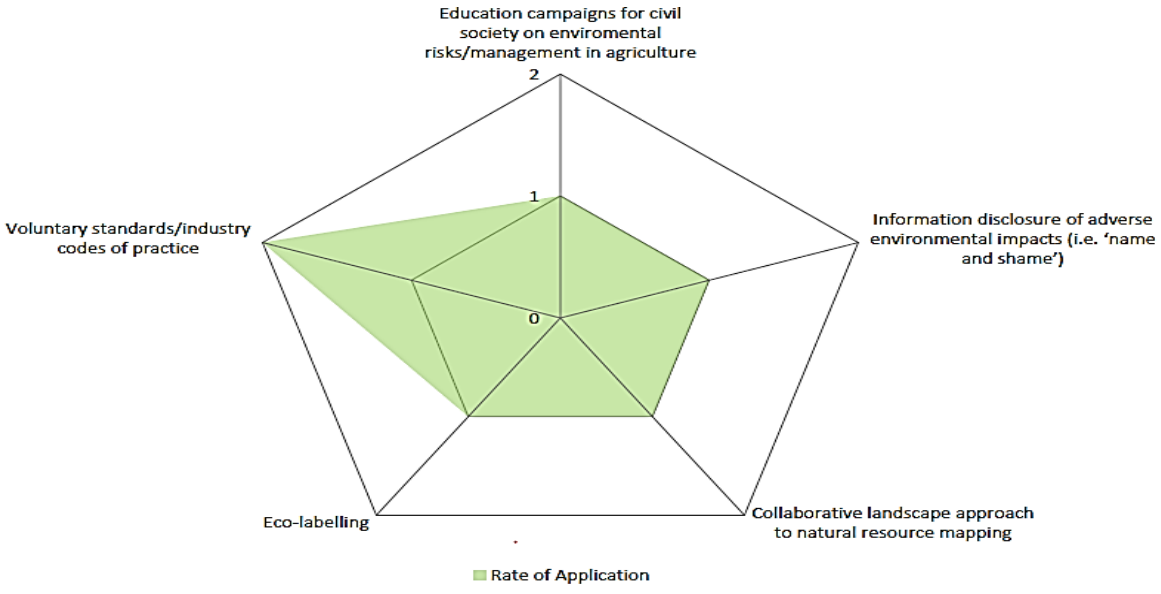
[28] http://documents.worldbank.org/curated/en/852021482149743042/Biodiversity-and-Agricultural-Commodities-Program-BACP
[29] https://www.wwf.or.id/en/about_wwf/whatwedo/pds/mti_indonesia/
[30] http://www.mars.com/global/sustainable-in-a-generation/our-approach-to-sustainability/raw-materials/cocoa
[31] http://www.pisagro.org/

In addition, **there has been some advocacy around the adoption of green technology**. Consequently, **pest management controls that are environment friendly such as natural agents are widely used to control and manage pests on agricultural land**. In the rice subsector, the government promotes the use of natural agents or predators to control pests. Farmers are also encouraged to use high-yielding and fertilizer-responsive varieties of rice to reduce the impact of excessive and inefficient use of chemical fertilizers.

Certification and voluntary standards/industry codes of practice are commonly applied, particularly in the estate crop value chains. **Eco-certification for coffee, cocoa and oil palm, is one example of a voluntary approach instrument implemented in Indonesia**. Other voluntary instruments include the **Roundtable on Sustainable Palm Oil (RSPO)[32] and Rainforest Alliance/Sustainable Agriculture Network (SAN)[33] (for coffee and cacao).** These are internationally recognized industry codes of practice driven by NGO and the private sector. A few are mandatory, including the Indonesia Sustainable Palm Oil (ISPO)[34] which was established in 2011 and is the first national-level palm oil sustainability standard in the world.

However, **except for voluntary standards, the level of application of information, advocacy, and voluntary instruments was found to be relatively incipient** as shown in Figure 8.

Figure 8: Information, advocacy and voluntary approach



Note: Application rating: 0 = nonexistent; 1 = incipient; 2 = widely applied.

Source: Leimona et al. (2015)

T**he above is largely attributed to ineffective extension system for agriculture in Indonesia**. Extension workers tend to have inadequate skills and knowledge on current environmental issues. In addition,

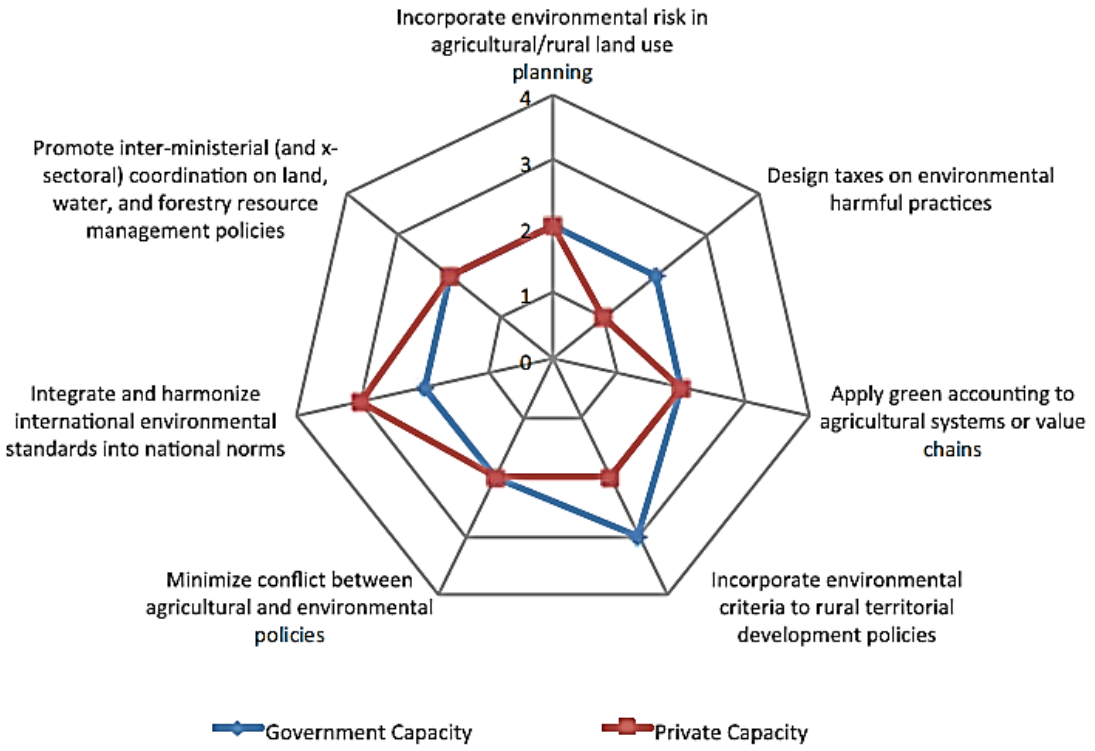
[32] https://rspo.org/about
[33] http://woodcert.com/san-certificate.html
[34] http://www.musimmas.com/sustainability/stakeholder-collaboration/indonesian-sustainable-palm-oil-ispo

extension workers and their programs tend to focus on rice and other crops, such as soybean and vegetables, rather than estate crops (rubber, coffee, cacao and palm oil).

Another approach that is been applied to promote green agriculture in Indonesia is **the promotion of organic farming**. Developed by the Ministry for Agriculture, the framework for organic agriculture has been in place since 2001. Other milestones include the issuance of the Indonesian National Standard (SNI) 6729-2002 which was revised in 2010. In 2008, the Ministry of Agriculture issued guidelines on organic crop certification. **In 2010, the Ministry of Agriculture launched the 'Go Organic 2010' program**. The Minister of Agriculture through regulation No. 64/2013 gave more detailed legal guidelines for developing organic farming. However, **organic farmers in Indonesia faces many challenges including market constraints, a lack of consumer interest, and a lack of networking with private companies** (Mayrowani, 2012).

Overall, the capacity of government and private sector to integrate agro-environment policies is relatively low as illustrated in Figure 9.

Figure 9: Government and private sector capacity to perform agro-environment policy development and integration functions.



Note: Capacity rating: 0 = N/A; 1 = non-existent; 2 = low; 3 = high; 4 = world class.

Source: Leimona et al. (2015)

The private sector is considered the key driver behind the integrating and harmonizing international environmental standards into national norms. This is evidenced by a number of green initiatives for example, the RSPO to the ISPO certification standards in the oil palm sector. The government is seen as taking a lead role in the incorporating environmental criteria into rural territory development policies.

The analysis above, highlights that despite well intended national policies and strategic plans, coupled with market and regulatory instruments being in place, there is a long road ahead to close the gap between aspiration and application. **Mainstreaming biodiversity and ecosystem values into the agri-food value chain remains a major challenge**. Consequently, **the expansion of agricultural land and conversion of forests in Indonesia remain the key drivers to ecosystem services and biodiversity loss**. A few case studies are outlined below, highlight potential costs of unsustainable agriculture as well as benefits of adopting more sustainable practices.

3 Review of agricultural impacts in Indonesia

There is increased concern on the potential environmental effects from expansion of agricultural land and conversion of forested land to crop plantations. However, there is paucity of studies assessing environmental impacts of agri-food systems across the value chain in Indonesia. A **few studies conducted mostly at farm gate points towards significant impacts on biodiversity, climate change and natural resources, leading to losses of carbon from the landscape, threats to rare and endemic species, and water and air pollution**. Six case studies are explored here in depth.

Indonesia has the highest rates of deforestation in South East Asia. **It is estimated that the country has lost over 40% of its standing tropical rainforest since 1950 to make way for agriculture and urbanization**. Over the years, agricultural expansion has been driven by economic and social benefits, population growth coupled with increase in global demand and more recently, the need for cleaner source of energy (Margono et al., 2014).

Agricultural expansion in Indonesia has led to the clearing of forests and burning of peat lands, which are considered as the key contributors to increases in greenhouse gas emissions, and biodiversity and ecosystem services loss. Historically, fire in Indonesia has been used for land clearing and preparation; land acquisition; and as a mechanism to force inhabitants off the land. **Approximately 20% of wildfires in Indonesia can be attributed directly to oil palm plantation practices** (Goodman & Mulik, 2015).

Case study 1: A massive forest and peat fire that took place between July and November of 2015 caused significant losses and damages to ecosystems, and ecosystem services and biodiversity

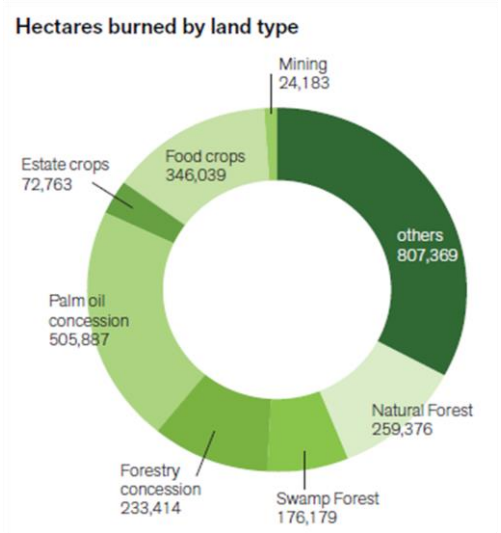
A massive forest and peat fire on plantation areas that took place between July and November of 2015 is estimated to have emitted approximately **1.75 billion metric tons of CO_2 equivalents**. According to the government, **2.6 million ha of Indonesian land burned between June and October 2015, with Sumatra and Kalimantan and the agricultural land bearing the greatest impacts,** as shown in Table 4 and Figure 9**.**

Table 7: Hectares burned by province

Province	Thousand hectares	Percent
South Sumatra	608	23
Central Kalimantan	429	16
East Kalimantan	388	15
South Kalimantan	292	11
Papua	268	10
West Kalimantan	178	7
Riau	139	5
Jambi	123	5
Other	186	7
Total	**2,611**	**100**

Source: World Bank (2016)

Figure 10: Hectares burned by land type



The World Bank estimates that the 2015 fires cost Indonesia at least US$ 16.1 billion (IDR 221 trillion), equivalent to 1.9 percent of 2015 GDP as shown in Table 8; of which the **cost of biodiversity loss totalled US$ 287 million and losses and damages to agriculture amounted to US$ 4.8 billion**. The greatest losses and damages accrued to agriculture, environment, carbon emissions and forestry.

Table 8: Estimated losses and damages from forest fires and haze, June-October 2015 (US$ millions)[35]

	Jambi	Riau	South Sumatra	West Kalimantan	South Kalimantan	Central Kalimantan	East Kalimantan	Papua	Total
Agriculture	**210**	**181**	**1,033**	**349**	**523**	**1,242**	**1,128**	**173**	**4,839**
-Estate crops	*134*	*134*	*260*	*238*	*169*	*1,075*	*1,006*	*95*	*3,112*
-Food crops	*77*	*47*	*773*	*111*	*355*	*166*	*122*	*77*	*1,727*
Environment	226	229	1,205	376	387	776	530	523	4,253
Biodiversity loss	**17**	**24**	**72**	**23**	**27**	**33**	**33**	**58**	**287**
Carbon emission	**209**	**204**	**1,133**	**353**	**360**	**743**	**498**	**465**	**3,966**
Forestry	136	304	972	168	698	92	815	746	3,931
Manufacturing & mining	**29**	**183**	**133**	**61**	**122**	**14**	**69**	**0**	**610**
Trade	184	292	290	120	139	131	108	68	1,333
Transportation	20	31	81	17	66	111	32	13	372
Tourism	10	116	118	54	38	42	16	4	399
Health	36	22	28	12	24	17	12	1	151
Education	4	4	9	4	6	5	4	3	39
Firefighting costs	10	11	49	14	24	35	31	22	197
Total in US$ million	**866**	**1,373**	**3,919**	**1,176**	**2,028**	**2,464**	**2,746**	**1,552**	**16,124**

Source: World Bank (2016).

[35] The World Bank estimates an average daily loss of productivity in the seven provinces (excluding East Kalimantan) multiplied by the number of school closures as a result of haze

These costs could be higher if regional and global costs of air pollution were accounted for. Despite the magnitude of the cost to the economy, this practice continues largely driven by the lack of effective enforcement and a high return, particularly from oil palm (World Bank, 2016).

3.1 Palm oil driving land use change and landscape resilience

Palm oil production is vital to the Indonesian economy. It is essential for Indonesia's economic development strategy, contributing to national earnings and a source of employment to millions of people, supporting their livelihoods across the production and supply chain. To leverage the economic and social benefits, palm oil production is expected to increase to 42 million tons by 2020. Additional production of palm oil is needed to support biofuel blend targets which has been promoted since 2006 mainly to reduce the country's dependence on oil imports and mitigate climate change (Sharma et al., 2017).

The 2006 Presidential Instruction on biofuel supply and utilization mandated other government agencies to advance biofuel development in all stages, from feedstock supply to commercialization of biofuel technologies and increased biofuel consumption. It issued forest utilization permits for biofuel plants in "critical or abandoned forest/land," and further promoted biofuel use with the goal of replacing fossil fuels as an alternative for transportation. To reinforce the Presidential Instruction, the government issued Indonesia's National Energy Policy under Presidential Regulation No. 5/2006. This regulation formalized the promotion of biofuels in Indonesia, for both ethanol and biodiesel, and established a 5% biofuel in national energy consumption mandate by 2025. **As part of achieving these targets, Indonesia has been providing biofuels subsidies to producers**, which has an additional benefit of promoting the domestic agricultural economy (Kharina et al., 2016).

However, the drive to increase palm oil cultivation is taking a major toll on the environment. Palm oil cultivation is leading to the clearing of forests and burning of peat lands, leading to biodiversity loss and increased greenhouse gas emissions (Goodman & Mulik, 2015).

A stocktaking assessment by Fitzherbert et al. (2008) in South East Asia including Indonesia highlight significant biodiversity loss to palm plantations compared to other crop plantations. It was found that oil palm supports fewer species than rubber, cocoa, or coffee plantations. In Malaysia, the conversion of rubber plantations to oil palm resulted in a 14% decline in bird diversity (Peh et al., 2006). Overall all plantation types decreased species richness when compared to intact forest. The severity of the impact is driven by many factors, including changes in the forest structure, use of dangerous chemicals, frequent human disturbance, and increasing habitat fragmentation. Further impacts are expected once oil palm plantations are establishment. For example, water pollution from plantations and onsite mills is likely to be a major threat to aquatic biodiversity, with potential pollutants ranging from palm oil mill effluent (POME), fertilisers, insecticides, rodenticides and herbicides. (Fitzherbert et al., 2008). However, the extent of such impacts remains to be empirically verified.

In addition, the expansion of oil palm in Indonesia is increasingly being associated with a number of social impacts which needs attention. Studies conducted **highlight unequal distribution of benefits, increased conflict over land and ambiguous and contested land tenure in local communities**. Many oil palm plantations contract local people and immigrants through different types of outgrower

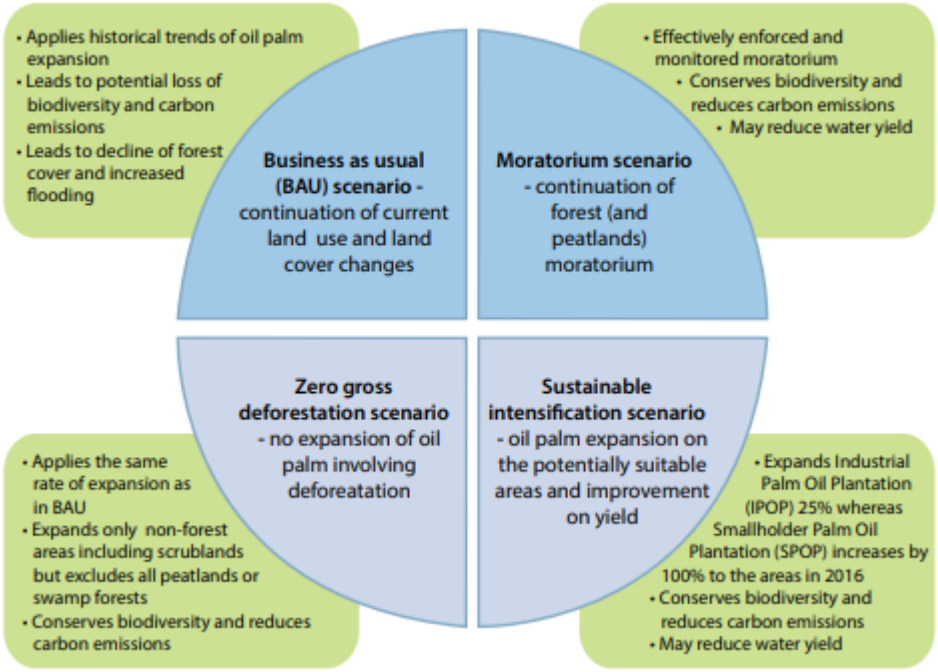
arrangements. However, **contractual terms frequently lead to unequal benefit sharing, with women most vulnerable to loss of livelihoods** (Budidarsono et al., 2012; Obidzinski et al., 2012)

Case Study 2: Future oil palm expansion in Central Kalimantan have the potential to impact on biodiversity and ecosystem services

It is projected that oil palm expansion into forests and peatlands is likely to continue driven by financial incentives from increased global demand for palm oil. This underscores the importance of assessing impacts and trade-offs of projected future growth of oil palm under plausible future land-use scenarios. This analysis is central for evidence-based decision making, policy development and management that promote sustainable development with enhanced ecosystem services.

To this end, Sharma et al. (2017), assessed the impacts of oil palm expansion on key ecosystem services and analyzed the trade-offs among ecosystem services under four plausible future land-use scenarios in Central Kalimantan: business as usual, moratorium, zero gross deforestation and sustainable intensification— a detailed description of these scenarios is presented in Figure 11 . The study is part of "the Governing Oil Palm Landscapes for Sustainability (GOLS) Project by Center for International Forestry Research(CIFOR) and the United States Agency for International Development (USAID)[36].

Figure 11: Four future LULC scenarios and associated outcomes on ecosystem services



Source: Sharma et al. (2017)

[36] https://www.cifor.org/library/5883/governing-oil-palm-landscapes-for-sustainability-gols/

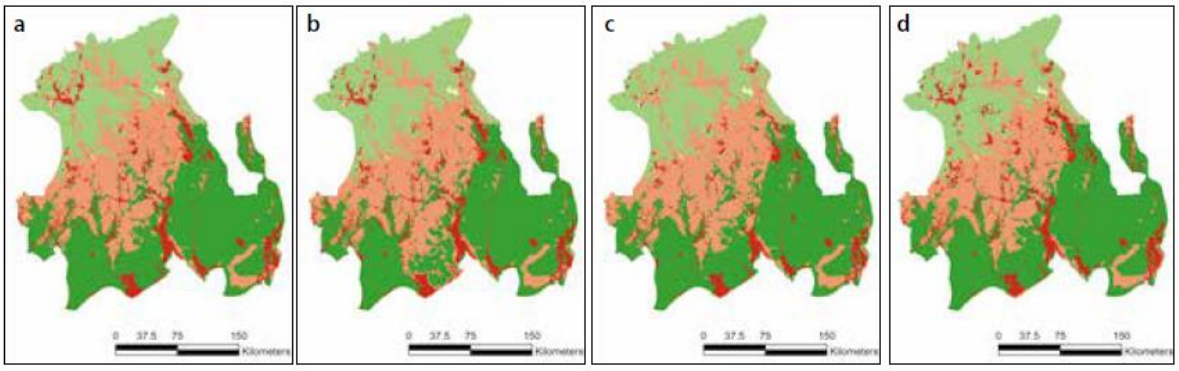
The ecosystem services for analysis were decided upon through a consultative workshop with stakeholders from the government, non-governmental organizations, companies and local communities, in Pangkalan Bun in Central Kalimantan on 22 November 2016. Four ecosystem services considered for analysis under future land use/land cover (LULC) scenarios including; **carbon storage and sequestration**, **biodiversity conservation**, **water yield**, and **palm oil production**. These ecosystem services were analyzed under different plausible LULC scenarios from present to 2030. The study results are highlighted below.

Carbon storage and sequestration: A reduction in carbon stock was predicted under all four future LULC scenarios in the order of, zero gross deforestation, sustainable intensification, business as usual and moratorium—as illustrated in Figure 12.

Biodiversity conservation: The direct measurement of biodiversity in terms of genes, species or ecosystems and their abundance and frequency was beyond the scope of the study and instead InVEST Habitat Quality model was used to assess biodiversity indirectly. The sustainable intensification scenario with 25% less expansion of industrial oil palm plantations provided the highest value of habitat quality. This was followed by zero gross deforestation, business as usual and moratorium scenarios as shown in Figure 13.

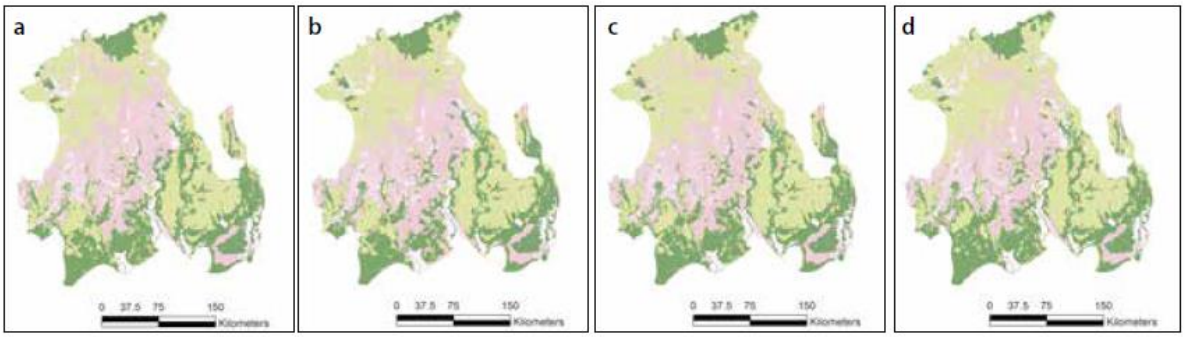
Water Yield: The InVEST Water Yield model was used to derive water yield maps and quantify water volume under the future LULC scenarios. An inverse relationship was observed between LULC scenario with high forest covers and water yields. Overall, water yield was predicted to be relatively low under zero gross deforestation and the highest under sustainable intensification—as illustrated in Figure 14.

Figure 12: Carbon stock (tC/ha) in the LULC classes under business as usual (a), moratorium (b), zero gross deforestation, (c) sustainable intensification, and (d) scenarios in Central Kalimantan study area.



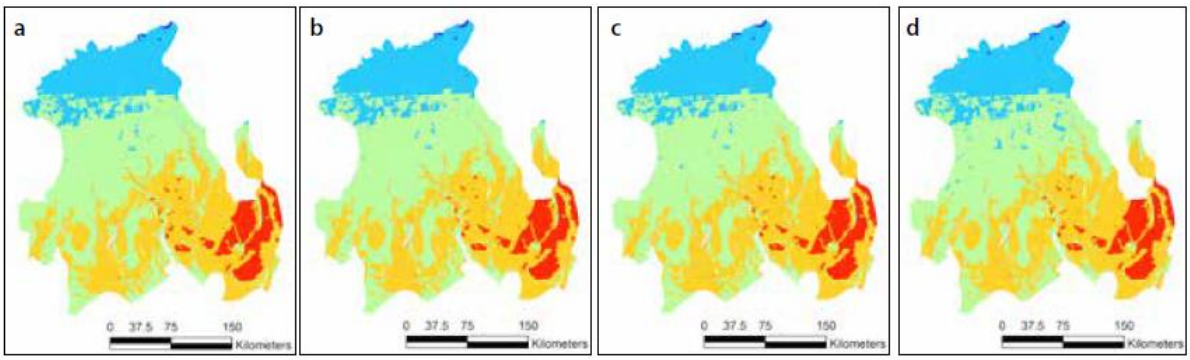
***The darker green refers to the highest carbon stock up to 2320 tC/ha and the dark red refers to the lowest carbon stock of below 70 tC/ha.**

Figure 13: Habitat quality under business as usual (a), moratorium (b), zero gross deforestation, (c) sustainable intensification, and (d) scenarios in Central Kalimantan study area.



***The darker green represents the highest habitat quality with value 1 and white represents the lowest habitat quality with value 0**.

Figure 14: Water yield map for business as usual (a), moratorium (b), zero gross deforestation, (c) sustainable intensification, and (d) scenarios in Central Kalimantan study area.



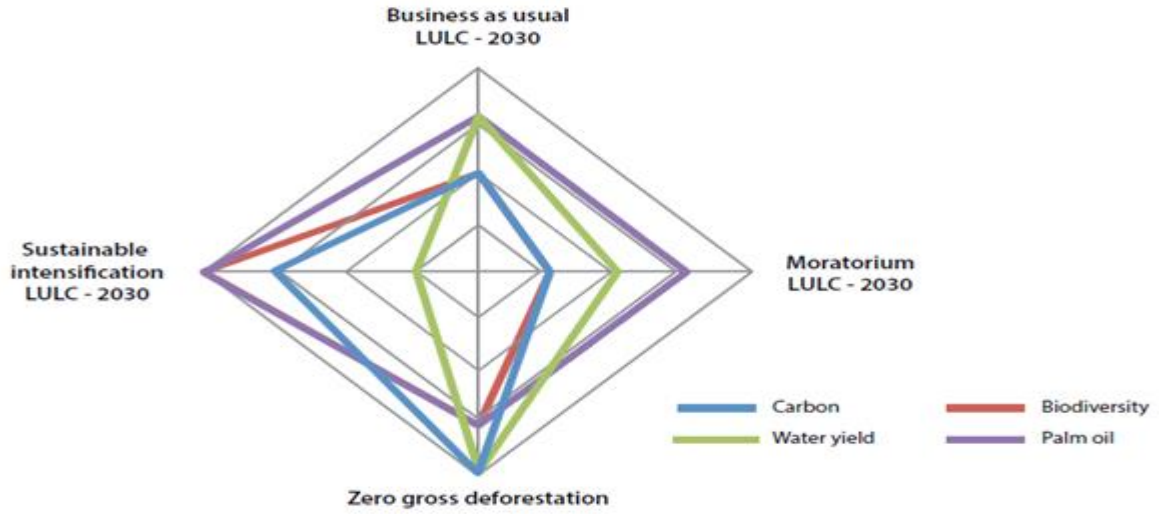
Source: Sharma et al. (2017)

***Red represents the lowest water yield per year between 601-1000 mm and dark blue represents the highest water yield per year between 2501 – 3000 mm.**

A **trade-off between carbon benefit and habitat quality** was noticed under LULC scenarios. For example, in zero gross deforestation scenario, **oil palm expansion in low carbon area with some habitat quality (such as scrubland) enhanced the carbon benefit**, whereas, **the habitat quality was negatively impacted relative to the previous land use**.

All four-ecosystem services were combined for each LULC scenario through a qualitative approach. These ecosystem services were ranked lowest to highest (1–4), with a rank of 2 and 3 representing fair and good ecosystem services, respectively. These rankings are illustrated in Figure 15 for all four LULC scenarios.

Figure 15: A diagrammatical water yield palm oil representation of four ecosystem services under future LULC scenarios



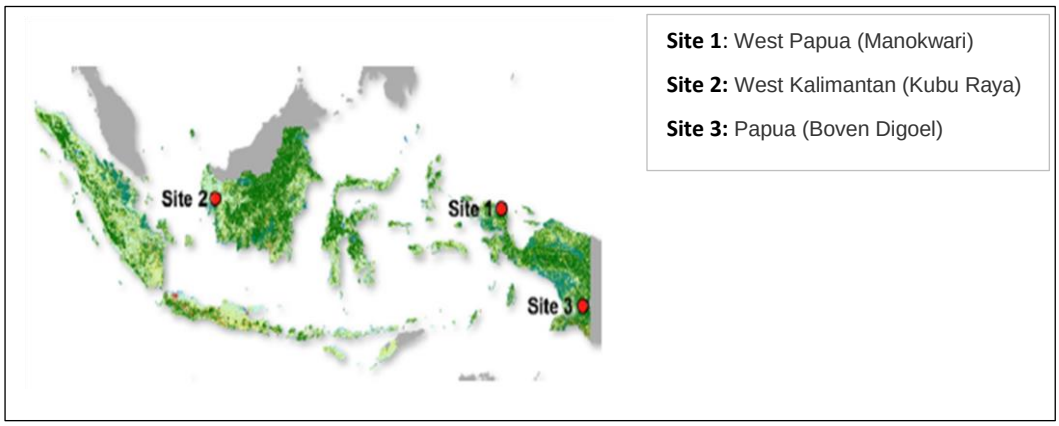
Source: Sharma et al. (2017)

Overall, **zero gross deforestation was found to be the most desirable option for the study area followed by sustainable intensification, in terms of the four ecosystem services assessed in this study**. However, zero gross deforestation has a caveat in that a successful implementation would require a review of the forest moratorium to encompass all forest types, a clear land-use policy strategy and a detailed land-use plan involving all jurisdictions and engagement of stakeholders.

Case Study 3: Oil palm expansion driving land use change in West Kalimantan, Papua and West Papua

Recently, the provinces of West Kalimantan, Papua, and West Papua have been among the most active areas in oil palm plantation development. Of the 3.5 million ha of new oil palm plantation proposals submitted to the government by 2009, 70% were in these three provinces. Obidzinski et al. (2012) analysed the environmental and social impacts of oil palm development at three plantation sites in in these provinces. One site was selected from each of the three provinces for the analysis of the impacts and trade-offs of oil palm plantations in Manokwari District, West Papua; Kubu Raya District, West Kalimantan; and Boven Digoel District, Papua. The location of the study sites is shown in Figure 16.

Figure 16: Location of research sites in Indonesia.

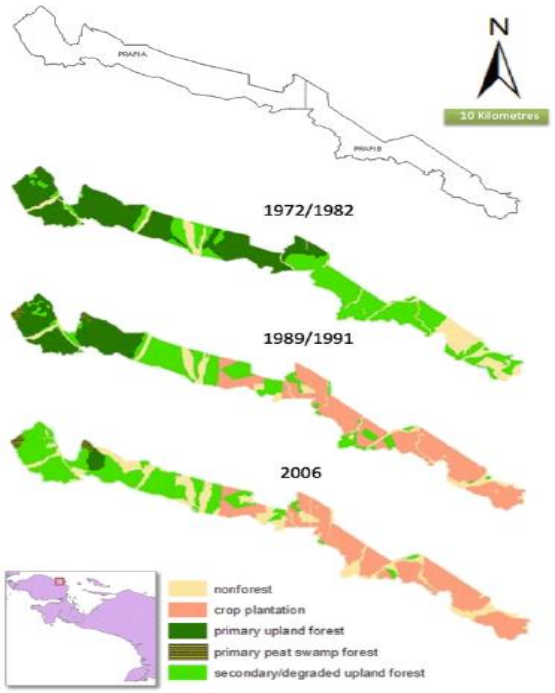


Source: Obidzinski et al. (2012)

The selected sites are associated with biofuel production, although none focus exclusively on supplying Crude Palm Oil (CPO) for biofuels. Site 2 is a subsidiary of Wilmar, one of Indonesia's largest biofuel producers. Sites 1 and 3 have shipped CPO to major biodiesel production centers in Indonesia.

An analysis of land cover change for three sites at three different points in time, show evidence of deforestation due to oil palm plantations, as shown in Figure 16-18.

Figure 18: Land cover change analysis for site 1 at three points in time: 1972/82 (prior to plantation establishment); 1989/91; and (c) 2006



Source: Obidzinski et al. (2012)

Figure 18: Land cover change analysis for site 3 in three-time periods, 1990 (prior to plantation establishment); 2002 (showing land clearing in Block A); and 2008 (showing land clearing in Block B).

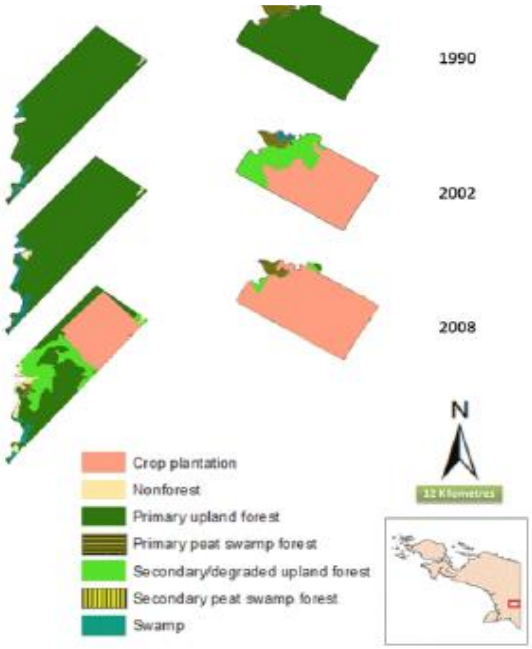
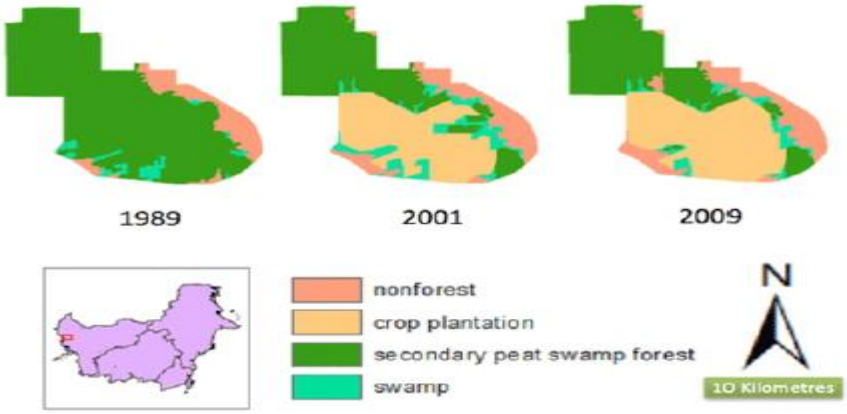


Figure 19: Land cover change analysis for site 2 shown in three different time periods: 1989 (prior to plantation establishment in 1994); 2001; and 2009



Source: Obidzinski et al. (2012)

The study results in Table 9, indicated that the **development of oil palm in all three sites has caused deforestation. Other secondary external impacts reported at the sites included water pollution, soil erosion, and air pollution**.

Table 9: Deforestation and oil palm expansion in all sites

	Site 1	Site 2	Site 3
Net deforestation	6056.11 ha	7099.63 ha	21,804.07 ha
Deforestation due to oil palm	4048.97 ha	4949.26 ha	20,794.19 ha
Total oil palm expansion	4856.90 ha	5265.66 ha	20,999.41 ha
% oil palm expansion that occurs at the expense of forests	83%	94%	99%

Source: Obidzinski et al. (2012)

In terms of social impacts, although **many stakeholder groups report significant gains, these benefits were not evenly distributed**. Other stakeholders, mainly traditional landowners, experienced **restrictions on traditional land use rights and land losses**. **Overall, it was noted that oil palm plantations contributed to land scarcity, rising land prices, and conflicts over land in all sites.** Customary land rights, remain among key unresolved issues in Indonesia's oil palm sector. The failure to recognize the traditional land use/ownerships system results in persistent conflicts. Customary landowners in all research sites are mostly native communities dependent on forests and other natural resources for their livelihoods, and therefore unaccustomed to intensive farming practices. Inability to adapt to the changing legal and economic environment renders these groups susceptible to negative impacts of oil palm development, e.g., economic marginalization and damage to resources upon which their livelihoods depend.

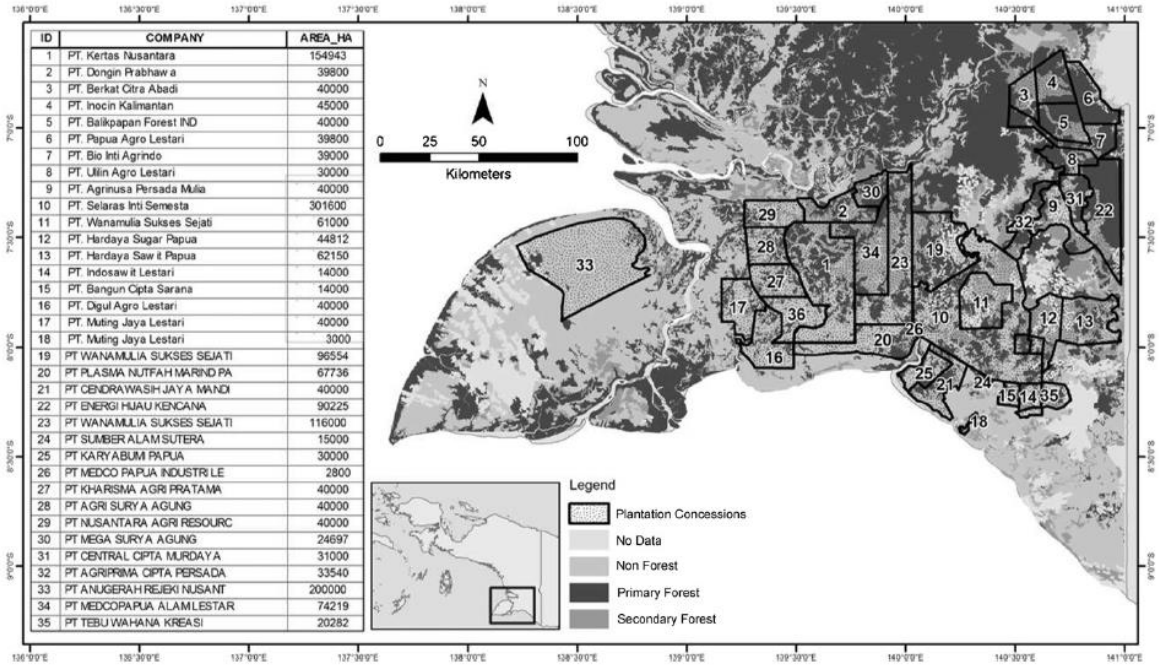
Case Study 4: Large scale land acquisition for agro-development have the potential to drive carbon emissions and biodiversity loss: Case study of the Merauke Integrated Food and Energy Estate (MIFEE) in Indonesia.

In response to uncertainty in food security, in 2010, the Indonesian government announced plans to develop at least 2 million ha of new agricultural land over the next decade. The integrated food and energy estate, or MIFEE (Merauke Integrated Food and Energy Estate) is considered a strategic step to ensure sufficient food supply for Indonesia's growing population. The MIFEE program was to utilize the frontier land in the South of Papua which is currently considered to be underutilized to boost the food production and stimulate economic growth. In addition to ensuring national food security, the MIFEE is expected to offer multiple benefits including employment opportunities, infrastructure development, increased tax revenues, stimulate the production of renewable energy resources and optimize the use of idle land in Merauke Regency.

One of the government's key assumptions is that MIFEE was envisioned to have a relatively limited environmental impact, especially on forest, as it is located in the savanna landscape of southern Papua. On the contrary, there are concerns that approximately 50% of the proposed plantation area

is forested (e.g. Obidzinski et al., 2013). Figure 20, shows the proposed MIFEE land concessions for plantations and the type of land cover.

Figure 20: MIFEE land concessions for plantations



ID	COMPANY	AREA_HA
1	PT. Kertas Nusantara	154943
2	PT. Dongin Prabhaw a	39800
3	PT. Berkat Citra Abadi	40000
4	PT. Inocin Kalimantan	45000
5	PT. Balikpapan Forest IND	40000
6	PT. Papua Agro Lestari	39800
7	PT. Bio Inti Agrindo	39000
8	PT. Ulin Agro Lestari	30000
9	PT. Agrinusa Persada Mulia	40000
10	PT. Selaras Inti Semesta	301600
11	PT. Wanamulia Sukses Sejati	61000
12	PT. Hardaya Sugar Papua	44812
13	PT. Hardaya Saw it Papua	62150
14	PT. Indosaw it Lestari	14000
15	PT. Bangun Cipta Sarana	14000
16	PT. Digul Agro Lestari	40000
17	PT. Muting Jaya Lestari	40000
18	PT. Muting Jaya Lestari	3000
19	PT WANAMULIA SUKSES SEJATI	96554
20	PT PLASMA NUTFAH MARIND PA	67736
21	PT CENDRAWASIH JAYA MANDI	40000
22	PT ENERGI HIJAU KENCANA	90225
23	PT WANAMULIA SUKSES SEJATI	116000
24	PT SUMBER ALAM SUTERA	15000
25	PT KARYABUMI PAPUA	30000
26	PT MEDCO PAPUA INDUSTRI LE	2800
27	PT KHARISMA AGRI PRATAMA	40000
28	PT AGRI SURYA AGUNG	40000
29	PT NUSANTARA AGRI RESOURC	40000
30	PT MEGA SURYA AGUNG	24697
31	PT CENTRAL CIPTA MURDAYA	31000
32	PT AGRIPRIMA CIPTA PERSADA	33540
33	PT ANUGERAH REJEKI NUSANT	200000
34	PT MEDCOPAPUA ALAM LESTAR	74219
35	PT TEBU WAHANA KREASI	20282

Source: Obidzinski et al. (2013)

The study further tested the government assumption of low environmental impact of the MIFEE plantation program in Papua's forest frontiers and points to the contrary.
The analysis was based on the following key features of the program:

1. Thirty-six companies, including foreign investors, have expressed interest in MIFEE; of those, 26 companies have been granted concession permits.
2. The proposed land uses are mainly industrial timber plantations (Hutan Tanaman Industri, HTI2) and oil palm, covering 973,058 ha and 290,107 ha, respectively.
3. The total target area for the project is 2,051,158 ha, although scaled-back versions of 1.2 million ha, 700,000 ha, and 500,000 ha have been discussed.
4. Of the entire concession area, approximately 50% is forested (much of which is primary and secondary dryland forest), 17% is scrubland/swamp scrubland and 14% is savanna.

Impact of MIFE on deforestation, carbon emissions, and loss of biodiversity

It was estimated that MIFEE would cause annual net carbon emissions of about 770 million tons (2 million ha of land with average carbon emissions of 395 tons CO_2-eq per hectare per year) as shown in Table 10. Of this total, about 524 million tons CO_2-eq, or 70% of the entire carbon emissions under MIFEE, would be the direct result of the conversion of primary and secondary forest areas. Additional emissions would come from such factors as heavy machinery and soil disturbance.

In contrast, it was estimated that the conversion of scrubland/swamp scrubland and savannah to HTI and oil palm plantations would result in a modest carbon sequestration of 19 tons CO_2-eq per hectare per year.

Table 10: Average CO_2-eq emissions and area of total CO_2-eq emissions under the MIFEE scheme

Transition	Average CO_2-eq emissions (tonne/ha/year)	Total CO_2-eq emissions per area (tonne/year)
Total	395.10	770,683,640
Primary dry forest (HTI)	543.76	359,186,313
Primary dry forest (oil palm)	63.33	41,830,124
Secondary dry forest (HTI)	163.73	108,154,128
Secondary dry forest (oil palm)	22.58	14,917,810
Nonforest (HTI/oil palm)	−19.37	−39,721,775

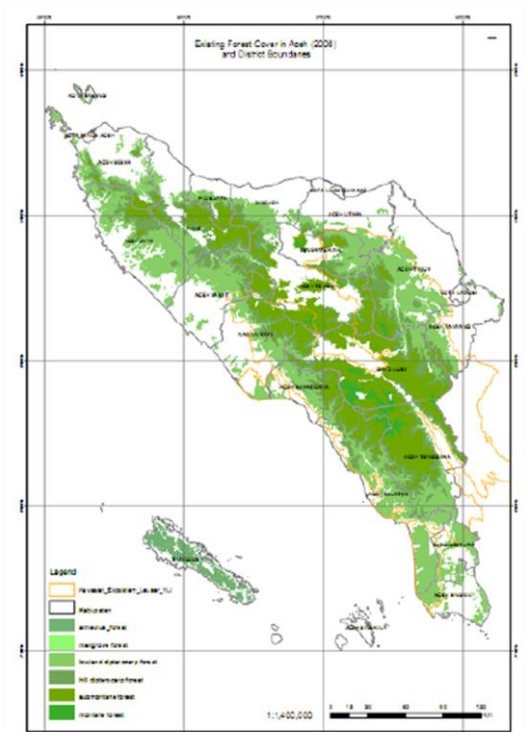
Source: Obidzinski et al. (2013)

Another important environmental impact of forest conversion for MIFEE plantations is biodiversity loss. Papua is regarded be Indonesia's most biologically diverse and highly endemic region, estimated to host 50% of Indonesia's biodiversity (Pattiselanno). Although the extent of the impact on biodiversity could not be ascertained from their study, their concerns that monoculture plantations such as palm oil have been found to have negative impacts on biodiversity levels. For instance, species richness has been shown to fall by 50% when tropical forest is converted to oil palm plantations. This decline is a direct result of habitat disruption, fragmentation, and pollution. Despite biodiversity loss being less severe when tropical forest is converted to timber plantations, the decline nonetheless could be significant (Fitzherbert et al., 2008).

Case Study 5: Conserving the Aceh forest ecosystem yields higher benefits to biodiversity and ecosystem services

The province of Aceh is one of the last areas in Indonesia with a large part of its forest ecosystem intact. The forest area in Aceh comprises of over 3.1 million ha. The major threats envisioned for the conservation of the forest resources in Aceh include logging and forest conversion to plantations. Logging is a highly attractive venture in Aceh forest given its richness in tropical hardwood species. Land conversion to production of valuable cash crops such as oil palm and coffee is another factor driving deforestation in the province.

Figure 21: Map of Aceh Province showing district divisions and forest cover



- Aceh comprises roughly 12% of the Indonesian Island of Sumatra at 5.74 million ha

  Green Acer Development
- In December 2006, the Governor Irwandi endorsed **a Green Economic Development and Investment Strategy for Aceh Province.**
- The plan is to conserve some 3.1 million ha of forest leading to the effective protection of Acer's forests ecological integrity involving the local (Kabupaten) governments.
- The plan is set to represent a major pillar of 'good governance' and set the foundations for investments in forest conservation and earn revenues from the varying ecological services/assets provided by the forests.

Source: van Beukering et al. (2009)

To justify the benefits of forest conservation, a study by van Beukering et al. (2009), demonstrated the consequence of short term gains from deforestation under two scenarios.

1. **The 'conservation' scenario**, implying that protection of the rainforest is strictly enforced and thus logging will be excluded as an economic activity and;

2. **The 'deforestation' scenario**, implying a continuation of the current trend of clearcutting (business as usual).

The economic value of ecosystem services of Aceh's forests under the two scenarios are presented in Table 11. The results demonstrate that consequence of short term gains from deforestation. **At a discount rate of 3.5% the benefits of conserving the Aceh forest ecosystem, its ecosystem services and biodiversity vastly outweigh the benefits of deforestation**. Over a 30-year time frame the **conservation scenario yields higher benefits (US$ 13.4 billion) than its deforestation counterpart (US$ 12 billion).**

Table 11: The economic value of ecosystem services of Aceh's forests over a 30-year period, 3.5% discounting (million US$)

Ecosystem Services	Deforestation scenario	Conservation scenario	Additional benefit of conservation
Water supply	1,059	2,487	1,428
Fishery	2,025	2,490	465
Flood prevention	1,622	1,860	238
Agriculture	3,512	3,991	479
Hydro-electricity	15	26	11
Tourism	25	139	114
Biodiversity	103	582	479
Carbon sequestration	0	1,217	1,217
Fire prevention	183	225	42
Non-timber forest products	161	391	230
Timber	3,308	0	-3,308
Total	12,013	13,408	1,395

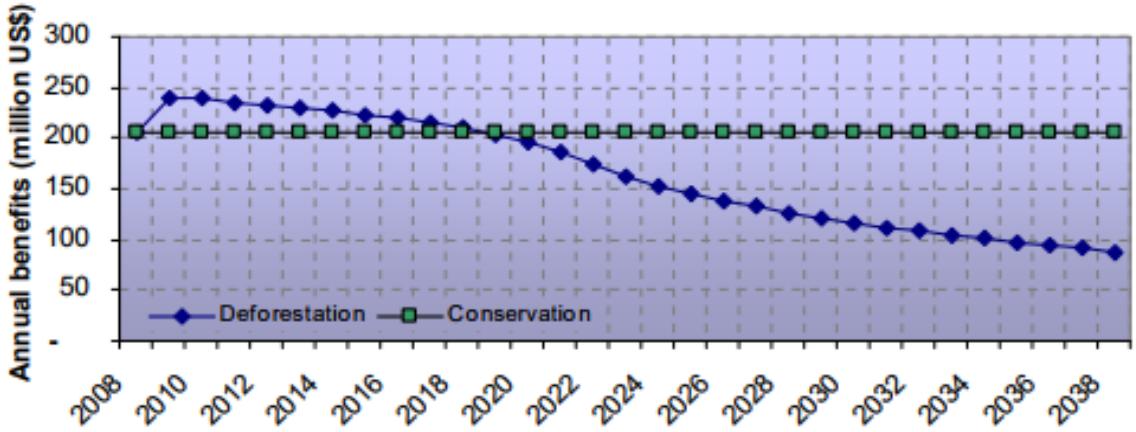
van Beukering et al. (2009)

The impacts of deforestation on each ecosystem services were estimated under varied assumptions**,** which are not outlined here for brevity, but highlight the assumptions used in the estimation of the value of Aceh's forests to agriculture.

The value of Aceh's forests to agriculture.

To estimate the value of Aceh's forests to agriculture, the threats to agriculture and plantations caused by deforestation of the Aceh forest ecosystem is assumed to be the combination of increased flooding events, reduced pest-control and pollination, erosion and droughts. To determine the economic value for the agricultural sector of the Aceh forest ecosystem, three types of crops are considered, including rice, fruit and vegetables, and palm oil and by-products. The total agriculture value of the Aceh forest ecosystem for each district is the sum of these values, to the extent that they depend on the Aceh forest ecosystem.

Figure 22: Annual benefits for agriculture



Source: van Beukering et al. (2009)

The annual benefits to agriculture in Figure 22, demonstrate differences in the time profile of the benefits of deforestation versus conservation, with conservation delivering steady and higher benefits over the long-run. The reason is that a conserved Aceh's forest ecosystem will continue to supply ecosystem services to the agriculture, whereas a fully deforested Aceh's forest ecosystem will ecologically have collapsed and can only provide very few services. In the short term, the deforestation scenario yields higher benefits from large areas of newly converted land, however in the long term, revenue from deforestation falls further as the depletion of certain ecological services including reduction in soil fertility, begins to take its toll and land becomes abandoned. **Over a 30-year time frame the conservation the value stays constant at US$ 205 million than its deforestation counterpart which yields only US$ 88 million.**

Case Study 6: Rice land conversion into plantation crops could threaten future food security in East Tanjung Jabung Regency

Land conversion from food crops into plantation crops such as palm oil and rubber are becoming an issue of great concern. The Regency of East Tanjung Jabung is one of the main rice produces in Jambi Province that has experienced high loss of rice land. A study by Daulay et al. (2016), assessed the extent of this loss and the key drivers, using Landsat Imagery and a survey of rice and palm oil farmers. The study revealed five main sources of land for oil palm development, namely forest land, shrub, dry land, rice land and idle land as shown in Table 12. A total of 56, 766 ha of new palm oil plantations were established from 2006 to 2014. Out of which 15, 616 ha (28% of the total) were converted from rice land. Two other popular crops in this Province are rubber and coconut, but the study found no evidence of land conversion from rice land for these crops.

Table 12: Land conversion to Palm oil plantations in Tanjung Jabung Timur in the period 2006-2010 and 2010-2014

No	District	Year 2006-2010				Year 2010-2014					Total land for palm oil expansion (ha)
		forest-palm oil (ha)	shrub-palm oil (ha)	dry land-palm oil (ha)	rice land - palm oil (ha)	forest-palm oil (ha)	shrub-palm oil (ha)	dry land-palm oil (ha)	rice land - palm oil (ha)	idle land-palm oil (ha)	
1	Berbak	124	126	50	1,155	-	351	-	133	-	1,939
2	Dendang	1,018	-	3,780	52	474	397	970	-	-	6,692
3	Geragai	3,061	70	5,002	391	2,869	1,790	358	96	7	13,644
4	Kuala Jambi	-	-	261	628	-	-	-	-	-	889
5	Mendahara	-	-	-	71	695	228	-	-	-	994
6	Mendahara Ulu	2,690	-	971	461	434	60	285	-	7	4,909
7	Nipah Panjang	-	-	-	737	-	487	18	24	15	1,281
8	Rantau Rasau	7	-	479	5,822	-	268	809	80	-	7,465
9	West Sabak	44	-	4,442	55	1,488	1,322	32	120	-	7,503
10	East Sabak	-	-	2,653	5,696	13	125	1,112	-	-	9,599
11	Sadu	-	143	30	54	24	1,321	39	41	199	1,853
	SUM	6,944	339	17,670	15,121	5,998	6,348	3,623	495	228	56,766

Source: Daulay et al. (2016)

Although this level of conversion is currently not considered to be a major threat, continued conversion of food crop land into plantations because of higher yields could threaten future food security.

4 Conclusion

Over the past three decades, Indonesia has transitioned from an agriculture-based economy to an industrial and service-based economy. Though the agricultural sector has declined in relative importance, it remains the mainstay of the economy. However, on the one hand Indonesia's agriculture sector has a large environmental footprint and a key threat to biodiversity loss and climate change. On the other hand, climate change is also becoming a serious threat to Indonesia agriculture sustainability.

Despite well intended national policies and strategic plans aimed at addressing agriculture's environmental footprint, coupled with market and regulatory instruments being in place, there is a long road ahead to close the gap between aspiration and application. **Mainstreaming biodiversity and ecosystem values into the agri-food value chain and other national development policy and planning remains a major challenge, largely due to technical and regulatory constraints**. Consequently, **the expansion of agricultural land and conversion of forests in Indonesia remain the key drivers to ecosystem services and biodiversity loss.**

The case studies investigated reveal the potential for complex trade-off between social- economic and environmental objectives in the Indonesia's agri-food systems. Research into this area is still evolving, with an evaluation of possible trade-offs mainly focused at farm level and mainly targeting the palm oil development. More comprehensive analysis of potential social- economic and environmental trade-offs is generally constrained by the complexity of the agri-food value chains and data availability.

However, an understanding of these trade-off is crucial for the effective implementation of the Indonesian Government sustainable agriculture initiatives.

The UN Environment TEEB project on "Promoting biodiversity and sustainability in the agriculture and food sector in Indonesia" complements the Government green growth initiatives by **highlighting several trade-offs made in land-use decisions and mainstreaming the values of biodiversity and ecosystem services values in decision-making**.

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