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Targeted Scenario Analysis (TSA): Sustainable Palm Oil Concessions in Liberia

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ACRONYMS AND ABBREVIATIONS

APOI	Africa Palm Oil Initiative
BAU	Business as Usual
CI	Conservation International
COVID 19	Coronavirus Disease 2019
CPO	Crude Palm Oil
ESIA	Environmental and Social Impact Assessment
EMPL	Environmental Management & Protection Law
EPA	Environmental Protection Agency
EPO	Equatorial Palm Oil
FDI	Foreign Direct Investment
FDA	Forestry Development Authority
FOB	Free on Board
FPIC	Free, Prior and Informed Consent
FFB	Fresh Fruit Bunch
GIS	Geographic Information System
GEF	Global Environment Facility
GVL	Golden Veroleum Liberia
GGP	Good Growth Partnership
GOL	Government of Liberia
ha	Hectares
ha/yr	Hectares per year
HCS	High Carbon Stock
HCV	High Conservation Value
IAP	Integrated Approach Pilot
IMCC	Inter-Ministerial Commission on Concessions
IUCN	International Union for the Conservation of Nature
LRA	Land Rights Act
LEITI	Liberia Extractive Industries Transparency Initiative
LLA	Liberia Land Authority
LPMC	Liberia Produce Marketing Company
LRA	Liberia Revenue Act
LACRA	Liberian Agricultural Commodities Regulation Authority
MPOI	Manco Palm Oil Industries
MOPP	Maryland Oil Palm Plantation
MT	Metric tonnes
MOA	Ministry of Agriculture
MoCI	Ministry of Commerce and Industry
MFDP	Ministry of Finance and Development Planning
NBC	National Bureau of Concessions
NI	National Interpretation

NIC	National Investment Commission
NPV	Net Present Value
NGO	Non-governmental Organization
PLUP	Participatory Land Use Planning
PRS	Poverty Reduction Strategy
PAPD	Pro-Poor Agenda for Development and Prosperity
REDD+	Reducing emissions from deforestation and forest degradation (and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks)
RDCP	Reducing Deforestation from Commodity Production Project UNDP-GEF
RFF	Resources for the Future
RSPO	Roundtable on Sustainable Palm Oil
SDPL	Sime Darby Plantation Liberia
SCNL	Society for the Conservation of Nature in Liberia
SEM	Sustainable Ecosystem Management
SPO	Sustainable Palm Oil
IDH	Sustainable Trade Initiative
TSA	Targeted Scenario Analysis
TFA	Tropical Forest Alliance
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
US$	United States Dollar
WWF	World Wildlife Fund

FOREWORD

In the Pro Poor Agenda for Prosperity and Development (PAPD), President Weah emphasized the importance of "inclusion, more equitable distribution of our national wealth, and a rights-based approach to national development." This speaks directly to issues at the heart of the palm oil sector in Liberia, which is a critical sector for attracting Foreign Direct Investment, generating employment for thousands of Liberians, and leading agriculture and agroforestry as an engine of economic growth. Moreover, in addition to the importance of making sure that local communities benefit from use of Liberia's natural resources, the Government of Liberia has insisted that palm oil development proceed in a way that maintains the extraordinary biodiversity wealth housed in Liberia's natural forests. These two priorities – pro-poor equitable rural development and commitments to the environment and critical ecosystem services – have guided the Government of Liberia's efforts to promote and facilitate the palm oil sector, and will continue to do so.

Working with partners including the United Nations Development Programme, Liberia's civil society organizations, and international organizations, the Government of Liberia will continue to make every effort to catalyze growth of the palm oil sector. This will require effective and efficient sustainable models for development of concessions and smallholders. To formulate and deploy such models we need sound technical analysis to guide consideration of alternatives and trade-offs, inform planning, and make the case for investment in environmentally sustainable and socially equitable palm oil development. The UNDP Targeted Scenario Analysis conducted in this study is a valuable contribution to this body of technical analysis. Importantly, incorporation of input from a wide range of Government agencies, civil society, and the private sector in the study has ensured its broad-based relevance and will help the Government of Liberia and her partners make strides toward realizing the vision of the PAPD.

_____

Signature
Title

Executive Summary

The Government of Liberia has prioritized the development of agroforestry concessions, and interest from global companies confirms palm oil as a significant economic opportunity for the country; they have already invested on the order of US$500 million since 2008. Communities and smallholder producers in and around allocated concessions are eager for concessions to proceed, as employers and purchasers as well as funding sources for socioeconomic benefits such as improved roads and schools. Nevertheless, development of the oil palm sector has stalled.

This study compares economic gains and losses from different possible oil palm development paths in Liberia using Targeted Scenario Analysis (TSA). The UNDP developed the TSA methodology to help decision makers incorporate the value of ecosystem services into public policy.[1] This methodology involves five principal steps:

- **Step 1—Define purpose and scope of the analysis:** In the first step, a broad set of stakeholders help identify key decision makers and their objectives to ensure policy relevance of the TSA. In this step stakeholders refine the focus of the TSA objective and the scope of the analysis.
- **Step 2—Define Business as Usual (BAU) and Sustainable Ecosystem Management (SEM) Scenarios:** The TSA compares outcomes under two scenarios shaped by possible policy decisions. The second step involves achieving consensus among stakeholders to clearly define the relevant scenarios for comparison.
- **Step 3—Select criteria and indicators:** To ensure utility of the TSA to key decision makers, in the third step the analysts work with stakeholders to select policy-relevant criteria by which scenarios will be compared, and the indicators for these criteria.
- **Step 4—Construct BAU and SEM scenarios:** The fourth step involves modeling the links between policies, scenarios and indicator values. The TSA results (different indicator values under the BAU and SEM scenarios) are presented in a draft report.
- **Step 5—Make informed policy/management recommendation(s):** Based on stakeholder feedback, TSA results and recommendations are finalized and summarized in a policy brief and a final technical report.

The TSA of oil palm development scenarios in Liberia considered twelve indicators of interest to decision makers. For financial criteria, the analysis examined concessionaire net revenue, smallholder net revenue and wages, and the cost of shifting from BAU to SPO.[2] Indicators for economic criteria were government revenue and social investments by the concessionaire. Employment indicators included direct employment (concession jobs and smallholder participation in the sector), indirect employment, and low- versus high-paid jobs, as well as women's employment to capture equity and fairness

[1] Alpízar, F. & A. Bovarnick. 2013. *Targeted Scenario Analysis: A new approach to capturing and presenting ecosystem service values for decision making*. United Nations Development Programme (UNDP).
[2] In this study, the SEM scenario is called the Sustainable Palm Oil, or SPO, scenario.

considerations. Finally, the analysis examined forest cover and carbon value indicators as proxies for ecosystem service impacts, and also considered implications for access to social services.

The study focusses on the Manco Palm Oil Industries (MPOI) concession formerly held by Sime Darby. The analysis compares conventional plantation development (the BAU scenario) to smallholder-centered development that complies with Roundtable on Sustainable Palm Oil (RSPO) standards (the Sustainable Palm Oil, or SPO scenario). The findings highlight that:

- Including sustainable palm oil in the Government of Liberia's Pro-poor Agenda for Prosperity and Development, with an emphasis on smallholder producers and RSPO standards, is sound economic policy. The SPO scenario offers substantially greater total value than the BAU scenario (US$333 million over 20 years, versus US$188 million).[3]

- Environmental indicators also show the superiority of SPO over BAU; the SPO scenario maintains 107,000 hectares more under forest than the BAU scenario, and avoids the loss of at least US$75 million through carbon emissions from forest conversion.

Differences in results for the two scenarios are driven by two main factors. First, the SPO scenario includes affordable credit for smallholder oil palm development. Second, the SPO scenario maintains all primary forest and at least 60% of secondary forest, to reflect compliance with RSPO standards. These factors correspond to current commitments of the Government of Liberia, as reflected in concession agreements and national development policy. Recommendations that follow from the analysis are:

- To maximize total value generated by oil palm development, the Government of Liberia should maintain its commitment to requiring that concessionaires abide by RSPO principles and criteria. At present, this commitment is reflected mainly in the concession agreements; issuing an explicit policy through the Ministry of Agriculture would lend this commitment additional force. The IMCC could reinforce this policy by facilitating a supporting Executive Order from the Office of the President, further strengthening the Government's position with respect to concessionaires as well as potential sources of financing for sustainable oil palm development.

- The national interpretation process for RSPO principles and criteria needs to be concluded as soon as possible, and must specifically address secondary forest in a way that is appropriate for a high forest, low deforestation, least developed country context. As an example, the model results show outcomes of a requirement that 60% of secondary forest be maintained, after protecting all primary forest as well as High Carbon Stock forest and High Conservation Value forest. Once the national interpretation has been validated and approved, including reconciliation with Liberia's National Forest Definition framework, it should be explicitly

[3] Results are reported as Net Present Values (NPV). NPV takes the total of the annual values over the 20-year model period, applying a discount rate to capture the fact that a given amount in the future is worth less than that same amount is worth today.

incorporated in the Ministry of Agriculture policy decree recommended in the previous point, and ideally reinforced by Executive Order. Subsequently, the Ministry, working with the NBC, LLA and FDA should require that oil palm development plans of both concessionaires and smallholder communities explicitly demonstrate how the national interpretation will be applied. Agency review of these plans would benefit from a land suitability map, which the GOL should require as part of the concession review package while national land-use suitability mapping efforts progress.

- The Government of Liberia, NGO partners, concessionaires and communities should redouble their efforts to develop a workable model for smallholder oil palm development, with an emphasis on securing affordable credit to finance start-up costs. The advantages of the SPO scenario versus the BAU hinge on this commitment. Joint work by IDH and CI on a smallholder investment and production model with Sime Darby represents a well-advanced effort to design a mutually beneficial arrangement for communities and the concessionaire. The Government, MPOI, IDH and CI should build on this effort by using the model developed for this TSA to formulate a concrete investment prospectus for presentation to potential investors, particularly in the impact investment sector. At the same time, the model can inform how conventional development funding sources (e.g. ODA, philanthropy) may direct support to enabling conditions such as building capacity to facilitate participatory land use planning within County Administrations.

- Given the enormous benefits that accrue to the concessionaire under the SPO scenario relative to BAU, it is in the interest of MPOI to provide further support for smallholder development. In addition to working with Government and civil society to approach potential financing sources such as impact investors, MPOI should examine how it can best provide technical extension support to smallholder palm oil producers, and work with the smallholder sector to identify cost-effective arrangements for sourcing inputs.

- The Government of Liberia and NGO partners should redouble their efforts to advance REDD+ frameworks, and consider particular attention to including compensation for avoided emissions from deforestation through sustainable plantation development. To date, the evolving national REDD+ framework leaves unclear whether avoided deforestation and forest degradation within agroforestry concessions can generate revenue from carbon credits. The Ministry of Agriculture and the FDA should convene a joint session of the national REDD+ Technical Working Group and the National Oil Palm Platform of Liberia to explore how the SPO scenario can be positioned to generate carbon revenue. One use of eventual carbon revenue that should be considered is the creation of conservation-based jobs to help ensure avoided emissions from deforestation and forest degradation, and to offset the lower amount of employment generated under SPO compared to the BAU scenario.

1. INTRODUCTION

The UNDP-GEF project entitled Reducing Deforestation from Commodity Production (RDCP), also known as the Good Growth Partnership (GGP), is a child project under the UNDP-GEF 6 Commodities Integrated Approach Pilot (IAP). Launched in September 2017, the project seeks to address the underlying root causes of deforestation from agricultural commodities, and in Liberia is focused on commercial oil palm plantations as a driver of deforestation. The intended outcome of the Liberia component is inclusive and sustainable economic transformation, informed by evidence-based macro-economic policy to promote access to livelihoods, an innovative and competitive private sector, and efficient natural resource management. Specifically, the project focuses on palm oil production in northwest Liberia (Grand Cape Mount, Bomi, Gbarpolu and Bong Counties).

The RDCP Project includes a Targeted Scenario Analysis (TSA) to generate data on economic gains and losses resulting from different approaches to ecosystems management and production. The TSA methodology was developed by the UNDP to incorporate the value of ecosystem services into public policy, in a way that is relevant to choices faced by decision makers. To this end, the TSA compares two possible scenarios: one where action continues as usual (the business as usual, or BAU, scenario) and another where measures are adopted that promote sustainable management of ecosystems (the sustainable ecosystem management, or SEM, scenario). By examining the pros and cons of these two situations the TSA permits more informed public policy decisions to further sustainable development (Alpízar and Bovarnik 2013). Given the focus in this study on sustainable development of an oil palm concession, we will refer to the SEM as the Sustainable Palm Oil (SPO) scenario.

1.1 Context

The commercial palm oil sector in Liberia stands at an impasse. The Government of Liberia (GOL) has prioritized the development of large commercial concessions, and interest from global companies confirms palm oil as a significant economic opportunity for the country; indeed, they have already invested on the order of US$500 million since 2008. Communities and smallholder producers in and around allocated concessions are eager for concessions to proceed, as employers and purchasers as well as funding sources for socioeconomic benefits such as improved roads and schools. Nevertheless, development of the oil palm sector has stalled.[4]

This study examines obstacles to oil palm development in Liberia using Targeted Scenario Analysis (TSA). Per the Terms of Reference for the study, “This TSA for Liberia seeks to support the identification of oil palm production scenarios that maximize commercial viability, social equity, and environmental responsibility. It will do so through a focus on the 220,000-hectare palm oil concession currently held by the Sime Darby Plantation Liberia (SDPL) company in northwest Liberia…” In December of 2019 SDPL

[4] Oil palm development also has encountered resistance in Liberia, due to both environmental and especially social concerns.

transferred its concession rights to Manco Palm Oil Industries (MPOI), another investor group, but the parameters of the concession and the challenges faced in its development remain unchanged. Therefore this study is highly relevant and timely as the new concession holders, the GOL and other stakeholders contemplate their options. Moreover, the principal challenges that faced SDPL are common to other concessions in Liberia, so the study results will be relevant to the palm oil sector as a whole.

Box 1: COVID 19 and the Palm Oil Sector

In response to the COVID-19 crisis, President George Weah on April 8 declared a national State of Emergency, including curfews and a ban on travel between Counties. Activities relating to the production, marketing and distribution of food were exempted from these restrictions, as were leading private sector operations (such as the Arcelor Mittal Liberia iron ore mine and the Golden Veroleum Liberia oil palm operation), but they have nevertheless disrupted agricultural supply chains. For example, border closures and travel restrictions have impacted availability of agricultural inputs, with the price of fertilizer increasing by on the order of 70% (Grow Liberia 2020).

Disruption in transportation systems present challenges to getting perishable products to market. Transportation issues include gasoline shortages, reduced availability as operators choose to suspend services, and longer transport times due to the proliferation of checkpoints; combined with capacity limits to enforce social distancing, transport prices for some routes have doubled and tripled. During the Ebola crisis in 2014-15, the spike in transportation costs from comparable restrictions on movements shut made trade in some agricultural products financially unviable. For smallholder palm oil producers, these are particularly pertinent challenges given the importance of getting fresh fruit bunches (FFB) to a mill before spoilage.

The wider anticipated economic consequences of COVID-19 in Liberia are still being analyzed. For reference, annual GDP growth during the Ebola crisis fell to 0.7% in 2014, down from a projected 5.9% (Beevers 2020). However, the economy already was in a more precarious state prior to the pandemic with an estimated contraction of 2.3% in 2019. Taking into account the impact of COVID-19, the World Bank projects continued contraction in 2020 at a rate of 2.2% (World Bank 2020); given the intensification of pandemic impacts in Liberia since these projections were made (April of 2020), the ultimate contraction may be even more severe.

1.2 TSA Objective, Clients, and Policy Targets

Objective

The objective of this TSA is to explore the key obstacles to the SPO scenario, and how the GOL, MPOI, and partners can overcome them. In particular, the TSA provides an opportunity to reinforce political will as well as private sector commitment to embrace Roundtable on Sustainable Palm Oil (RSPO) principles by demonstrating viability of SPO.

Clients

The clients (decision makers) for the analysis are:

i. The Government of Liberia, in particular the Inter-Ministerial Commission on Concessions (IMCC) and key IMCC members: Environmental Protection Agency (EPA), Forestry Development Authority (FDA), Liberia Land Authority (LLA), Ministry of Agriculture (MOA), Ministry of Commerce and Industry (MoCI), Ministry of Finance and Development Planning (MFDP), National Bureau of Concessions (NBC), and National Investment Commission (NIC);

ii. Manco Palm Oil Industries (MPOI) as it prepares to develop its concession, and by extension other oil palm concessionaires in Liberia who face the same challenges (Equatorial Palm Oil (EPO), Golden Veroleum Liberia (GVL), Maryland Oil Palm Plantation (MOPP));

iii. Civil society partners who have a role in facilitating the deployment of outgrower programs, and by extension the potential sources of financing for such deployment. These include Conservation International (CI) and the Sustainable Trade Initiative (IDH).

Collectively, this audience is seeking viable ways to apply RSPO criteria and principles in Liberia and deploy outgrower programs for smallholders such that palm oil delivers broad-based growth and development. This TSA seeks to provide input of relevance on both of these fronts. With respect to the private concessionaires, the modeling approach presumes that if a scenario is not commercially viable, then it is not plausible. Moreover, commercial viability hinges on strong institutional and legal arrangements, and in particular on GOL upholding its commitments. At the same time, the GOL depends on NGO partners for the capacity to uphold these commitments. Therefore this TSA seeks to address the combined interests and perspectives of these three sets of actors – government, the private sector, and civil society.

Policy questions

To focus the analysis, the concerns surrounding palm oil development have been distilled into three policy questions that respond to the principal preoccupations of the clients listed above. In formulating the policy questions to be explored in the TSA, the intent is to ensure direct relevance to deliberations of the GOL, particularly the IMCC. While these deliberations are complex and involve many factors and concerns, at their core is the challenge of enabling commercial palm oil development while upholding the Government's environmental, labor and community rights commitments. Accepting this challenge as the primary motivation for the TSA, and recognizing that the GOL and other stakeholders including the private sector favor the SPO scenario, the study attempts to respond to the following policy-related questions:

1. From a corporate perspective, what are the financial benefits of adhering to RSPO sustainability requirements, particularly those relating to avoided deforestation?

2. From a public policy perspective, what are the economic gains or losses, in terms of employment and government revenue, of requiring adherence to RSPO standards with respect to avoided deforestation?

3. What are the net benefits of investing in forest conservation within the oil palm concession to protect ecosystems services such as carbon sequestration and biodiversity maintenance?

1.3 Policy Analysis[5]

Agriculture has been central to GOL development policy through successive administrations, as set out in the 2008 Poverty Reduction Strategy (PRS) and the current Pro-Poor Agenda for Development and Prosperity (PAPD). Palm oil in particular features prominently in GOL policy as a driver of economic growth and development, and a prime area for attracting Foreign Direct Investment (FDI). The National Export Strategy identified oil palm as a priority sector; estimates suggest that 500,000 ha under oil palm could provide an estimated 90,000 direct and indirect jobs and support 30,000 out-grower or small-holder families, with significant multiplier effects (Fricke 2010). In peak production years, a single hectare could generate net revenue on the order of US$750-1,125 per year.

Liberia's oil palm sector is constrained by ill-defined requirements for community involvement and benefit-sharing, ambiguity of environmental requirements, and limited budgets for government support, oversight and monitoring complicated by overlapping institutional mandates. Historically, the sector fell under the aegis of the Liberia Produce Marketing Company (LPMC), which was responsible for oversight, facilitation of investment, and promotion of smallholder participation. To date, the Liberian Agricultural Commodities Regulation Authority (LACRA), which replaced the LPMC, has yet to develop the capacity needed to fulfill this role (Government of Liberia 2014). The onus now rests on an Inter-Ministerial Concession Commission (IMCC) to steer decision-making and coordinate roles and activities pertaining to oil palm development by the Ministry of Agriculture (MOA), National Bureau of Concessions (NBC), National Investment Commission (NIC), Ministry of Commerce and Industry (MoCI), Forestry Development Authority (FDA), Liberia Land Authority (LLA), and the Environmental Protection Agency (EPA).

A key policy instrument is the now-lapsed National Oil Palm Export Strategy (2014-2018), which positioned oil palm as a leading contributor to the national economic transformation agenda. Two priorities emphasized the smallholder segment of the palm oil sector, and the importance of working towards sector certification with respect to sustainability standards. The first of these policy priorities is

[5] This brief analysis draws heavily from Thompson, S. 2019. *Situational Analysis of the Oil Palm Sector*. Prepared for UNDP.

reinforced by terms stipulated in the concession agreements between the GOL and oil palm companies that currently are in place. Key terms relate to outgrower programs intended to ensure that oil palm sector development yields widespread benefits. Notably, the concession agreements include government commitments to provide land, technical extension services and funding to support outgrowers; to date, the lack of financial resources and technical capacity have precluded GOL from meeting this obligation, but with the requisite political will these obstacles can be overcome.

A related policy instrument is the National REDD+ Strategy, approved by the National Legislature through the National Climate Change Committee to guide Liberia on how to reduce carbon emissions from deforestation and forest degradation (REDD+). The intent is to position Liberia for participation in the global market for REDD+ carbon credits, and raises questions about the balance between avoided deforestation and conversion of forest lands for agroforestry development. This issue is especially pertinent as carbon prices are unlikely to compete with the economic returns from palm oil for the foreseeable future (Semroc *et al.* 2015).

The principal legal instrument governing land use is the 2018 Land Rights Act (LRA), passed in 2018. The LRA assigns land ownership rights to rural communities, including the right to determine how their land will be used by investors or by any would-be users in terms of area, time of occupation, and benefits accruing to them for the use of their land. The LRA is intended to prevent land conflicts by clearly defining roles and relationships between inhabitants of rural communities and users of their land, including agricultural sector investors. Success in this regard hinges on ongoing efforts to pass new enabling regulations that specify how the LRA is to be implemented, and building the capacity of the newly established Liberia Land Authority (LLA). Moreover, the GOL granted the four existing commercial concessions between 2008 and 2011, prior to passage of the LRA, so these concessions were not subject to its requirements. As a consequence, dissatisfaction and disputes about land rights, compensation and benefit-sharing persist.

The Africa Palm Oil Initiative (APOI) under the Tropical Forest Alliance (TFA) 2020 is working with GOL to align Liberia's domestic legislation and regulations with national and international commitments relevant to sustainable palm oil production.[6] Liberia was the first country to join the APOI in 2014 and in 2015 the country developed the following nine (9) National Principles to guide sustainable oil palm industry development (Zinnah 2017):

1) Liberia should achieve zero net deforestation by 2025 through the adoption of High Carbon Stock (HCS) and High Conservation Value (HCV) designations[7]

[6] TFA 2020 is a regional public-private partnership involving USAID and West African states.

[7] 'Zero net deforestation' is distinct from 'zero deforestation'; the latter means no deforestation anywhere, while 'Zero net deforestation' accepts that some forest loss could be offset by forest restoration and therefore does not mean a total prohibition on forest clearing. Zero net deforestation allows changes in land-use as long as the overall quantity, quality and carbon density of forests is maintained. Therefore, conversion of primary or natural forests into plantations does not qualify as zero net deforestation.

2) Concessionaires should support local livelihoods through a Free Prior Informed Consent (FPIC) Agreement
3) Entities commercially producing oil palm in Liberia should be RSPO members aiming to produce RSPO oil palm
4) All palm oil companies in Liberia, both local and international, should conduct a thorough FPIC-compliant process as defined by RSPO before any agreement with communities is signed
5) Promote food security for communities as an integral part of oil palm development, especially access to current and future farmlands
6) Develop sustainable smallholder components as part of the oil palm sector through access to finance, markets and extension services
7) Develop an outgrower framework that is transparent and fairly administered
8) Develop a single, integrated national land use plan with appropriate implementation policies and associated mapping resources
9) Develop governance systems at all levels with rules and regulations that are effective and enforceable

A study commissioned by the APOI to benchmark various Liberian laws and regulations against these National Principles found that for seven out of the nine, no provisions in Liberian laws explicitly obligate private sector companies to implement or adhere to them (Heritage Partners 2017). The remaining two principles are not explicitly stated in law, but are reflected in the legal mandates of various GOL entities (Proforest 2018). These include community rights to FPIC and GOL responsibility to protect biodiversity. The benchmarking study identified the following laws as relevant:

1) Legislation on species protection:
    a) Environmental Management & Protection Law (EMPL)
    b) National Wildlife Conservation and Protected Area Management Law
    c) National Forestry Reform Law

2) Ecosystem & Habitat Protection
    a) Section 8.1(a) of National Forestry Reform Law
    b) National Wildlife Conservation and Protected Area Management Law
    c) Section 35(a) of EMPL
    d) Section 6.6 of Community Rights Law[8]
    e) Forest Management Guidelines

3) Preparation of Environmental and Social Impact Assessment (ESIA) prior to Forestry and Agriculture projects
    a) Section 11 of Environmental Management & Protection Law

4) Community/Stakeholder Consultation and FPIC prior to forestry and agricultural projects

[8] Note that Community Rights Law provisions have been incorporated into the Land Rights Act.

a) Section 16(3)(b) of the EMPL
b) Section 2.2 (c) of Community Rights Law

5) Protection of archaeological or cultural sites & resources
   a) Section 3.1.6 of the Code of Forest Harvesting Practices
   b) Section 2.2(g) of Community Rights Law
   c) Section 5.3.3 of the National Wildlife Conservation and Protected Area Management Law of Liberia

Liberia and RSPO

GOL policy includes an emphasis on RSPO standards, as reflected in oil palm concession agreements between GOL and palm oil companies. The RSPO Principles and Criteria for Sustainable Palm Oil Production set out seven major principles and forty specific criteria to guide sustainable production of palm oil.[9] These are accompanied by performance indicators and guidance to support compliance and compliance assessment for RSPO certification. The seven RSPO Principles are as follows:

- Principle 1: Behave ethically and transparently
- Principle 2: Operate legally and respect rights
- Principle 3: Optimise productivity, efficiency, positive impacts and resilience
- Principle 4: Respect community and human rights and deliver benefits
- Principle 5: Support smallholder inclusion
- Principle 6: Respect workers' rights and conditions
- Principle 7: Protect, conserve and enhance ecosystems and the environment

To ensure compatibility between international RSPO standards and national norms, laws and values, each producer country must undertake a National Interpretation (NI) of RSPO indicators and guidance through a multi-stakeholder participatory process (Liberia National Interpretation 2013). The GOL has worked on the NI since 2013, but the process has not been concluded.[10] This delay has affected production and profitability in the commercial palm oil sector because the absence of clear standards severely constricts the ability to expand plantations in a manner that complies with certification requirements.

A key point of ambiguity relates to the RSPO Principle 7, which precludes clearing of primary forest for new plantings and furthermore prohibits clearing of High Conservation Value (HCV) and High Carbon Stock (HCS) forest. However, large swathes of the land granted by GOL to the four oil palm concessions are in densely forested land, much of which features more than 80% forest cover. Although the thresholds for defining HCV and HCS forest in Liberia have not yet been defined, if one were to assume

[9] The 2018 RSPO Principles and Criteria can be accessed here: https://rspo.org/principles-and-criteria-review.
[10] A draft NI document was submitted to the RSPO Secretariat late in 2019; once reactions have been provided following a 60 day consultation period, the draft NI will go through a validation and finalization process.

an 80% forest cover benchmark around 43% of the SDPL concession and 40% of the Golden Veroleum Liberia (GVL) concession would be off limits to development. Such determinations clearly are sensitive to definitions and thresholds, so persistent ambiguity surrounding policy with respect to interpretation and application of RSPO standards may be the single-most debilitating factor for the commercial oil palm sector (LTS international 2016).[11]

Policy on Outgrower Programs

There is a clear policy commitment to stimulating the smallholder sector and promoting participation of rural community members in palm oil development through outgrower programs. Principle 7 of the TFA 2020 Action Plan is that there should be an outgrower framework that supports constructive working relationships between outgrowers and concessionaires. However, the GOL has not settled on a clear policy position on the form that such programs should take, which contributes to the impasse currently blocking development of the sector. As described in Thomson (2019), there are a variety of outgrower models that can be considered.

Since 2016, the NBC, Grow Liberia, IDH, CI, GVL and SDPL worked to develop an inclusive outgrower model. Needs assessments in rural communities in the Sime Darby and GVL landscapes revealed a strong local preference for a model centered around individual farm families; however, GOL and its partners are more inclined towards a communal plantation model. Other design features in an outgrower program relate to the role and rights of the company, financing arrangements, purchasing commitments, and the ratio of company to outgrower production within the overall concession plan. The GOL cabinet approved a plan to pilot an outgrower program but requested examination of different design options, thus deferring the articulation of a clear policy that signals requirements and expectations.

The financing needed to expand smallholder participation in oil palm cultivation presents a significant challenge for outgrower programs. As noted in the IFAD Country Strategy for Liberia, the overwhelming majority of rural Liberians lack access to financial services and agricultural credit. Programs such USAID's Development Credit Authority and Investing for Business Expansion are improving access to credit for entrepreneurs and small businesses, including in the agricultural sector, but farmers themselves remain severely credit constrained. The Project Appraisal Document for the US$25 million World Bank Smallholder Agriculture Transformation and Agribusiness Revitalization Project (STAR-P) currently being implemented states the following (World Bank 2018):

> Total credit extended to agriculture is estimated at US$23.0 million, comprising 5.4 percent of total lending in the economy … This is partly due to the limited use of agricultural inputs, low use of improved

[11] Added to this is the complication that when major concessions were awarded in 2008-2010, HCV was broadly defined as "significant", and HCS was not developed until 2013 based on tons of carbon equivalent per hectare while Liberia's forest definition is based on percent canopy cover. Moreover, the National REDD+ Strategy has yet to be translated into operational guidance. These shifting targets and requirements present an ongoing challenge for concessionaires (M. Lartey 2020, pers. comm. June 15).

> technology and equipment, limited knowledge of climate change and its impacts on sector productivity, and weak infrastructure in the agricultural sector beyond plantations, which are largely funded by foreign investments. … The high up-front cost of setting up or upgrading for developing competitive businesses pushes the financing needs of agribusinesses beyond what is available from financial institutions. In addition, the generation of cash flow is insufficient, and many agribusinesses or farmers do not have the collateral that the financial sector requires. Informal financing for agriculture is also low because of scant use of purchased inputs, and the level of smallholder commercial agriculture is low. The cost of financing in Liberia is high considering that most lending is provided in U.S. dollars. Agricultural loans from banks attract a lending rate of 14.5 percent per year and up to 25 percent or more per year on SME and microfinance loans by microfinance institutions. The low levels of productivity, high logistical costs, and import competition combined with the financing costs and use of hard currency translate into very low levels of agricultural lending. … Only five financial institutions are providing limited financing to the agricultural sector through short-term credit and mobile banking facilities. The few microfinance institutions are located mainly in urban and peri-urban areas. … There is a strong need to facilitate smallholders' and FBOs' access to adapted formal financial services, particularly for tree crop value chains.

In summary, the policy context in Liberia strongly prioritizes the oil palm sector, with a considerable emphasis on outgrower programs to stimulate wider rural development. GOL policy also affirms that oil palm development must proceed subject to sustainability principles, as reflected in RSPO principles and criteria and National Principles formulated under the APOI. In addition, GOL has articulated policies that embrace REDD+ and avoided deforestation, particularly in primary forests. However, the broader policy context leaves undetermined key questions that shape the scope for concession development, such as HCV and HCS thresholds to be applied through National Interpretation of RSPO principles and criteria, or the model for outgrower programs. Moreover, these policy positions are not fully reflected in the legal and regulatory framework. The strongest legal requirements relate to land rights of rural communities, though the regulatory enabling framework for perfection of these rights has yet to be fully developed and deployed. The Land Rights Act was passed in 2018 after the granting of the major oil palm concessions in Liberia, but is not retroactive resulting in tension with community expectations.

SDPL and two of the other original large palm oil companies in Liberia (GVL and EPO) are members of the RSPO and strive for compliance with the principles and criteria of FPIC, ESIAs and HCV/HCS forest protection in order to maintain access to international markets. The fourth original palm oil investor, Maryland Oil Palm Plantation (MOPP), is not an RSPO member. The company that took over the SDPL concession, Manco Palm Oil Industries (MPOI), is not an RSPO member but has signaled commitment to adhere to the RSPO standards. Thus, at a policy level MPOI is aligned with the GOL.

1.4 Challenges Facing Sustainable Palm Oil Development

Despite economic promise and a supportive policy environment, palm oil concession development has stalled in terms of both commercially planted area and outgrower programs. The principal obstacles to concession development in Liberia are:

1. Complexities surrounding FPIC processes and land rights, which have resulted in conflicts between palm oil companies and local communities.

2. A lack of financing for development of outgrower programs, which is stipulated as a responsibility of the Government of Liberia in concession agreements.

3. Ambiguity around environmental restrictions on land conversion, which together with social and labor requirements determine compliance with RSPO principles and criteria that enables access to key markets.

1.5 The Evolution of the Sime Darby Concession (2009-2020)

1. In 2009 Sime Darby Plantation Liberia (SDPL) was granted a concession of 220,000 ha by the Government of Liberia; stakeholders at the first TSA workshop in Monrovia (September 2019) explained that the process by which the concession was granted left much to be desired, including:
    a. A limited, *pro forma* ESIA to satisfy regulatory requirements
    b. Inadequate representation of local community needs/rights/priorities in the concession negotiation/allocation process
    c. Little clarity on the plantation development plan and implications for ecosystems and biodiversity

2. SDPL developed 10,508 ha of oil palm on former rubber plantation lands.

3. Subsequent pressure from civil society and international scrutiny with respect to social conflict and environmental performance led to a good-faith SDPL effort to abide by RSPO principles, in particular:
    a. FPIC and benefit sharing with communities, and compliance with subsequent changes in legislative context (Community Rights Law; Land Rights Act)
    b. No clearing of primary forest (emphasis on HCS and HCV areas, noting lack of National Interpretation of RSPO standards, and issues surrounding National Forest Definition)

4. This effectively halted further plantation development. As a consequence SDPL was unable to generate sufficient volume of input (Fresh Fruit Bunches – FFB) to make its processing mill financially viable.

5. Late in 2019 SDPL decided to exit, and sold the concession to Manco Palm Oil Industries (MPOI), a Liberian family-owned business that had been one of the principal domestic purchasers of SDPL's palm oil.[12] Reportedly, MPOI intends to:

    a. adhere to RSPO standards and global best practices (including zero deforestation)

[12] Annex 4 offers some brief additional reflection on the reasons for SDPL's departure.

b. keep SDPL's management team in place, as the company itself does not have experience running oil palm concessions or palm oil mills
c. keep the 10,000 hectares developed to date as commercial concession area (as opposed to some kind of co-management with or transfer to communities)
d. develop an outgrower/community oil palm program, aiming to reach 25,000 hectares as soon as possible

1.6 BAU and SPO Scenarios

BAU Scenario

The BAU scenario was defined through discussions with stakeholders; in particular, stakeholders representing civil society and the environmental NGO sectors expressed concern that Sime Darby would be replaced by a concessionaire that does not hold itself to RSPO standards. Such a concessionaire would convert forest areas to oil palm plantation irrespective of biodiversity value or carbon storage considerations. This would result in habitat loss, reduced forest connectivity, and carbon emissions from deforestation and forest degradation. Over time, anticipated negative impacts of forest loss on hydrology and local rainfall patterns (exacerbated by climate change) could undermine plantation productivity, requiring substantial investment in irrigation to maintain output levels.

In the BAU scenario, the concessionaire proceeds with commercial plantation development that ignores RSPO standards relating to maintenance of forest cover, and limits the role of smallholders. One of the main drivers of this scenario is the fact that RSPO standards place significant constraints on where planting may occur in the concession to avoid HCS and HCV areas. The concession agreement stipulates a gross concession area of 311,187 ha (*Government of Liberia* 2009). Of this gross area, about 296,380 ha are available for potential planting, but while the concession agreement includes development of 220,000 ha, RSPO restrictions leave only about 130,000 ha available for development (Kuepper *et al.* 2016). Although RSPO members are not likely to go down this path, under the BAU scenario a concessionaire could seek to maximize returns on its investment by ignoring RSPO standards and GOL requirements.[13] Doing so would reflect a belief that market access and price premiums linked to RSPO certification do not outweigh the returns to be made from greater production volumes, and that the GOL is not able or inclined to enforce relevant sustainability policies.

With respect to smallholders, under the BAU the concessionaire minimizes the degree to which smallholder supplies of palm oil fruit help sustain the commercial mill. This reflects a view that smallholders are not capable of reliably producing oil palm fruit of sufficient quality or quantity; that the cost of supporting smallholders (i.e. with training, supervision and technical inputs) outweighs the benefits of outsourced production; and/or that there is a high risk that smallholders will divert their

[13] Current GOL requirements as well as corporate policies of private concessionaires largely are aligned with a sustainable scenario; the BAU scenario as described here amounts to a failure to abide by these requirements and policies, while the SPO scenario described below reflects enforcement and application of these requirements and policies.

output to other buyers rather than deliver to the mill. The first two of these concerns are linked to the challenge of determining who will finance investment in smallholder production capacity; the third relates to the question of the appropriate price to be paid by the mill for supply from smallholders.

The BAU involves a difficult to quantify but significant set of costs associated with stakeholder conflict. First, as the concessionaire develops its plantation, it inevitably will encounter areas claimed as local community lands. Second, communities have high expectations with respect to employment opportunities (e.g. through outgrower programs) and socioeconomic benefits. Third, civil society organizations have a history of vigorous response to socially and environmentally unsustainable oil palm concession development. Based on historical experience, such conflicts can be expected to lead to production delays, destruction of plant and equipment, and legal action.

SPO Scenario

The SPO scenario involves a mix of commercial and smallholder oil palm development in the concession, adhering to RSPO standards. The outgrower model would provide the foundation for an equitable and symbiotic relationship between the concessionaire and smallholders, as communities are supported with local land use planning to balance oil palm, food crops/other activities, and habitat maintenance. Therefore a central consideration under SPO will be the transaction costs and net benefits of appropriately including communities in the overall concession development plan. Under this scenario, the concessionaire is expected to pursue at least 20,000 ha of commercial plantation development to generate the minimum volume required for financial viability of the mill.

Adherence to RSPO standards implies a National Interpretation of RSPO criteria and principles calibrated to permit development while maintaining healthy ecosystems and respecting social and labor rights. A key aspect of the SPO scenario is the geospatial implications of this National Interpretation: which parts of the concession are available for oil palm planting once HCS and HCV forests are excluded. Although definition and identification of such areas still is ongoing, the study assumes that all primary forest will be barred from conversion. The question then hinges on how secondary forests will be treated. In a high forest, low deforestation country with pressing rural development needs, one may argue that definitions and standards need to accommodate some level of conversion by smallholder farmers; the study's SPO scenario assumes that communities can convert up to 40% of secondary forest on their land.

Table 1 below summarizes the main distinctions between the BAU and SPO scenarios used in the modeling exercise.

Table 1: Key Differences in Model Parameters between BAU and SPO Scenarios

	BAU		SPO	
Factor/Variable	***Value***	***Justification***	***Value***	***Justification***
Ultimate area under Commercial Oil Palm *(hectares)*	220,000 ha	Stated intention under original concession agreement	20,000 ha	Minimum requirement for mill viability
Commercial planting rate *(hectares per year)*	12,000 ha/yr	Average implied by terms of original concession agreement	5,000 ha/yr	Assumption (noting that 10,000 already developed)
Ultimate area under Smallholder Oil Palm *(hectares)*	0 ha	BAU continues the current stalemate, where there is no financing for further smallholder startup costs; initial area of 1,000 ha under smallholder oil palm declines to 0 as trees age out of productivity	120,000 ha	Area available for development after excluding likely HCS/HCV forest area
Smallholder planting rate *(hectares per year)*	N/A	Without further support, smallholders work existing 1,000 ha until 20-year tree age	12,000 ha/yr	Assumed equal to intended commercial planting rate as indication of feasibility
Crude Palm Oil (CPO) price *(US$/MT)*	$700 / MT	Approximation based on recent year export prices calculated from LEITI reports and world market trends	$750 / MT	Increase BAU by US$50/ton for documented RSPO compliance, per WWF (2012)
Revenue loss due to social conflict *(%)*	10%	Conservation assumption, parallels Chain Action Research analysis; consistent with Blundell et al. (2018)	0%	Assume that large smallholder program and social benefits prevent conflicts that disrupt the concession
Women as % of commercial plantation employees *(%)*	15%	Historical track record to date	34%	Observed on other plantations in Liberia; assume under SPO this becomes a deliberate goal of hiring practices
Voluntary company social expenditures[14] *(US$/year)*	0	Community development contribution of $5/yr per hectare of developed land, stipulated in concession agreement, assumed to suffice	$450,000	Minimum contribution to community development, per practice to date

1.7 Relevant Indicators

Table 2 below lists several criteria by which to assess the differences between the BAU and SPO scenarios, and multiple indicators for each criterion, for a total of twelve indicators. These factors can

[14] These are funds programmed by the company for community projects in addition to mandatory contributions stipulated by law and the concession agreement. Projects are determined through community engagement processes, and typically include education, sanitation and livelihood initiatives.

inform government policy with respect to social and sustainability requirements for agroforestry development.

Table 2: Indicators Considered in the TSA

Criteria	Indicators	Comments
Financial	1. Concessionaire net revenue 2. Smallholder net revenue and wages 3. Cost of shifting from BAU to SPO	These indicators are direct results to emerge from the economic models of palm oil production.
Economic	4. Government revenue 5. Social investments by concessionaire	These indicators result from formulas for concessionaire obligations, based on regulations and the concession agreement.
Employment	6. Direct employment (concession jobs and smallholder participation) 7. Indirect employment 8. Ratio of low and high-paid jobs	These indicators result from parameters derived from literature, applied to the economic production models.
Equity and Fairness	9. Women's employment	
Other	10. Access to education, health services and housing 11. Forest cover 12. Carbon value	Access to services depends on decisions by GOL and the concessionaire that fall outside the modeling exercise. Forest cover is based on GIS modeling. Carbon value is a conservative proxy for full value of ecosystem services (see Box 2).

Box 2: Ecosystem Services, Palm Oil Production, and Externalities

As an agroforestry product, palm oil depends on several ecosystem services. Critical services to sustain production systems include those linked to soil quality, water supply and pollination. Palm oil production in West Africa particularly is influenced by seasonal rainfall patterns and corresponding availability of water and sunshine.

Literature on the impacts of forest conversion to oil palm identifies a range of environmental externalities in addition to carbon emissions. Worldwide around half of oil palm expansion since the early 1970s has involved forest clearing. The remainder replaced cropland, pasture, and other land uses, some of which indirectly led to forest clearing to accommodate these displaced activities (IUCN 2018). Moreover, freshwater systems in and around plantations are polluted by fertilizer and pesticide runoff. IUCN (2018) presents the considerable body of global research on negative biodiversity impacts of expanding oil palm plantations. Converting complex forest ecosystems to simple monocultures reduces tree diversity by 99%, thereby eliminating habitat for a wide range of animal species. Biodiversity loss is exacerbated by hunting and trapping of wildlife in plantations; habitat loss can also intensify human-wildlife conflict in the wider landscape and lead to further killing. IUCN (2018) notes: "Over the last four decades, species have slid towards extinction twice as fast in Indonesia as in any other country … at least in part as a result of forest conversion for oil palm production," and warns that half of the world's

threatened mammal species and almost two-thirds of all threatened bird species are found in areas around the world suitable for future oil palm development.

Interdependencies between production and these externalities raise complex modeling questions; while production requires conversion of forest to oil palm, negative impacts from externalities relating to watershed services, soil maintenance and microclimatic stability may in turn undermine long-term plantation productivity. These impacts also affect the wider food and agriculture system including non-timber forest products, cultivation of local food crops, and bushmeat supplies. Additional ecosystem service values include the potential for future nature-based tourism, which is particularly relevant as the plantation sits in the heart of a landscape featuring extraordinary natural assets and a set of existing and planned protected areas. Finally, impoverishment of the ecosystem also has negative implications for spiritual and cultural ecosystem service values that have been integral to local forest communities. The effect of these impacts on total ecosystem service value is beyond the scope of the present analysis, but the focus on carbon emissions clearly represents a conservative approach as the calculations do not include these other factors.

1.8 Time Horizon

The time horizon for the modeling exercise that informs this TSA is 20 years (2021-2041). The rationale for this time horizon is that it equals the productive lifespan of the oil palm tree; productivity decline after 20 years requires that areas under cultivation be cleared and replanted. Thus, beyond 20 years the basic model repeats itself, such that analysis of a 20-year period can be interpreted as applicable to the overall lifespan of the concession (see Annex 1). Moreover, all forest conversion takes place within the initial 20-year period, such that this window captures the difference in deforestation impacts of the two scenarios.

2. Results

The following sections describe results obtained from the analysis which combined several modeling elements: GIS analysis of land suitability for oil palm development in the concession area, and cost models for commercial and smallholder palm oil production. Detailed description of methods and steps used in the analysis are deferred to Annexes 2 and 3. Additional discussions of estimates and results are presented in Annex 2 to facilitate consideration of assumptions and replication of procedures.

2.1 Key Model Factors

As previously indicated, the principal differences with respect to development of oil palm between the BAU and SPO scenarios are that, under SPO:

- Commercial oil palm expands to a total of 20,000 ha (versus 220,000 ha under BAU)

- Smallholder oil palm expands to a total of 120,000 ha (versus declining to 0 from 1,000 ha under BAU)
- Oil palm development is barred from areas under primary forest

The key implication of the SPO versus BAU scenarios is that under SPO the palm oil produced from the concession area earns a price premium of US$ 50 per ton, assuming continued RSPO certification. Further aspects of the SPO scenario include community benefits that reduce social conflict and thereby avoid costs of interruptions to production, and an emphasis on gender equity in employment opportunities. Finally, the SPO scenario maintains all primary forest and a majority of secondary forest.

Production modeling factors

Published literature, corporate technical documents, and analyses prepared by NGOs operating in the palm oil sector inform the set of model parameters, particularly with respect to cost structures and employment multipliers. Government documents such as concession agreements, the Revenue Code of Liberia (LRC), and annual reports under the Extractive Industries Transparency Initiative (LEITI) guide government revenue implications in the model. The two factors that are the fundamental drivers of model results are yield (both Fresh Fruit Bunch – FFB – production per hectare of oil palm, and milling conversion of FFB to Crude Palm Oil – CPO), and the price paid to smallholders for FFB.

Yield: the yield in FFB per hectare depends on land suitability and cultivation and management practices, as well as the age of the trees. Palm oil production models treat a large proportion of production costs as fixed per hectare, such that differences in yield have significant implications for net revenue; costs that vary with production volume (e.g. transport) are a relatively minor portion of total cost. Figure 1 shows a typical age-yield profile, as used in the TSA model:

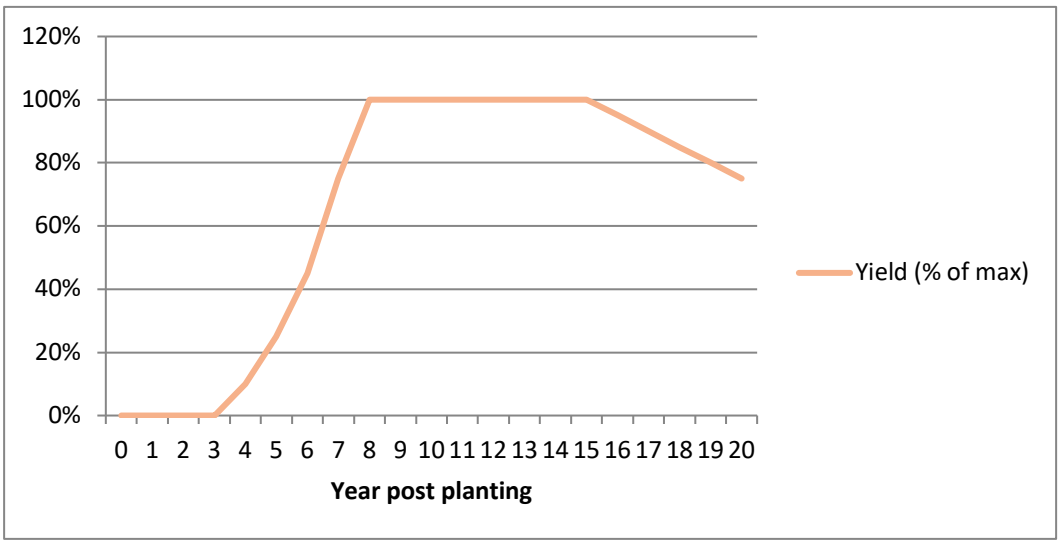

Fig 1: Annual Yield (% of Maximum) as a Function of Tree Age

A key modeling decision then is the maximum yield achieved. The TSA model applies a maximum yield of 18 tons of FFB per hectare for commercial oil palm, and 15 tons per hectare for smallholder oil palm, reflecting production achieved under optimal conditions in Ghana. The conversion ratio achieved in the milling stage –tons of CPO per ton of FFB– is also a key parameter. Although highly efficient operations in Southeast Asia achieve rates on the order of 24-25%, the TSA model employs a more conservative rate of 22%.

FFB price: The price paid to smallholders by the palm oil concessionaire for FFB supplied to the mill is a second critical factor, determining the distribution of benefits between the company and communities, and the viability of smallholder production more generally. Small producers voiced dissatisfaction with FFB prices paid by Sime Darby in the past, manifested by illegal sales of concession FFB to small informal milling operations instead of the concession mill. In its Southeast Asia operations, Sime Darby uses a formula that results in an FFB price equivalent to about 15.5% of the CPO price. Prices paid by other concessionaires reach 18% and as high as nearly 21%. Based on Sime Darby data reflected in LEITI reports and its own modeling of smallholder participation in the Liberia concession, the TSA model applies a FFB price equivalent to 18% of the CPO price (FOB Monrovia).

Cost model factors in moving to the SPO scenario

Achieving the SPO scenario requires two areas of investment that need to be considered as costs of moving from BAU to SPO. These are financing arrangements for smallholder establishment of oil palm plots, and the costs of land-use planning and certifying RSPO compliance.

Financing for smallholder oil palm development: the cost of entering into palm oil production (land clearing, seedling procurement, and maintaining plots until commercial production begins, but excluding financing costs) is somewhere in the range of US$4,500 to US$8,000 per hectare over three years, which is beyond the means of smallholders. Under concession agreements, the Government of Liberia is responsible for securing this financing for oil palm concession outgrowers. Difficulty in doing so to date is a leading reason for limited smallholder oil palm development. The SPO scenario assumes that current efforts of partners (i.e. IDH and CI) to secure upfront concessionary financing succeeds, with repayment coming from smallholder revenue in later years. This financing cost is part of the cost of the transition to the SPO scenario.

How credit is structured has a large impact on model results. The model assumes that smallholder oil palm development is made possible by US$8,000/ha in credit at a concessionary rate of 4%, repaid over 11 years commencing as of the 5th year of planting a given plot (see Table A2.2 in Annex 2). These parameters reflect an amalgamation of credit structures reflected in Sime Darby and IDH concept materials and Grow Liberia (2013).

Costs of land-use planning and certification: incorporating smallholders into a sustainable palm oil value chain will require investment in local participatory land-use planning (PLUP), and RSPO certification that confirms that land-use planning and management protects primary forest and other HCS/HCV forest.

PLUP processes involve collaboration between communities, NGO partners, and government agencies to balance commercial agroforestry, local food security and forest conservation (including HCS/HCV forest identification); this entails intensive stakeholder engagement as well as technical expertise (mapping, needs assessment, land-use scenario analysis, etc.). The PLUP process also informs ESIA required for initial RSPO baseline assessment, followed by improvement planning and periodic verification. Thus, planning and certification entail both upfront and recurring costs of moving from the BAU to the SPO scenario.

The model assumes US$19/ha in upfront costs for PLUP, ESIA and initial RSPO certification, followed by annual costs of US$7/ha. These parameters are based on figures in NGO budgets and analyses (see Grow Liberia 2013).

2.2 Comparing BAU and SPO Scenarios by Indicator

To compare the BAU and SPO scenarios, we run the model with the two sets of parameters, differing as per Table 1 above, to produce estimated 20-year trends of the indicators of interest described in Section 2.3. These trends are then graphed for a visual representation of the difference between the scenarios, supplemented by summary statistics where relevant. Using GIS techniques, we also compare the two scenarios with respect to forest cover and connectivity, as indications of habitat quality for biodiversity.

The model results reflect the evolution of anticipated trends assuming that establishment of newly planted oil palm areas begins in the first year (2021 in the charts below). Delay of initial planting would shift the trends further into the future, but would not affect the comparison between BAU and SPO scenarios. To facilitate the comparison between the two scenarios, streams of annual dollar amounts are converted into Net Present Value (NPV). NPV takes the total of the annual values over the 20-year model period, adjusting values in later periods to capture the fact that a given amount in the future is worth less than that same amount is worth today. How much less depends on the discount rate; the higher the discount rate, the lower the present value of future amounts. The results below assume a discount rate of 5%, which is relatively conservative as project analysis in developing country settings typically employs rates of at least 15% (see Annex 1 for an illustration of the impact of discounting on the concessionaire's net revenue under BAU). The consequence of using a relatively low discount rate is that future pay-offs from current investments become more attractive.

2.2.1 Concessionaire net revenue

From the perspective of the concessionaire, the outcome of interest is corporate profit. Under the BAU scenario, the concessionaire absorbs considerable investment costs to convert forest to plantation, such that annual net revenue is negative until 2031 (see Figure 2 below). Thereafter it rises rapidly, approaching US$120 million per annum by 2041. Under SPO, the concessionaire avoids the burden of investment cost and generates profit as of the first year, rising steadily as increasing smallholder FFB supplies become available. However, total volume is more constrained under SPO by the limit to total area available for planting due to a proscription against converting primary forest, and thus eventually

annual net revenue under BAU outpaces that achieved under SPO, but not until after 2035. However, as a consequence of discounting future annual net revenue, the net present value of the total revenue stream over the entire period is actually negative under BAU, making conventional (unsustainable) plantation development a losing proposition for the concessionaire.

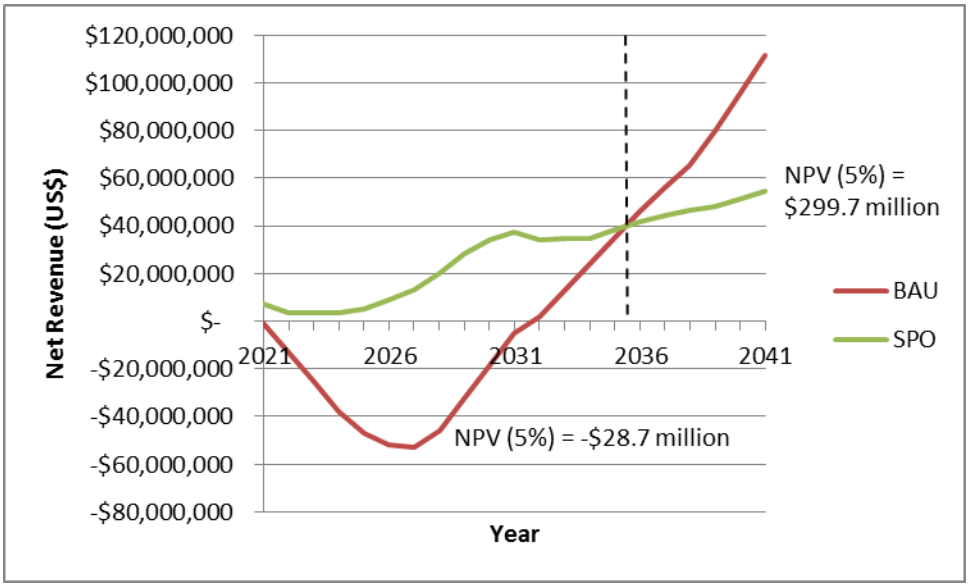

Fig. 2: Concessionaire Net Revenue (US$ per year)

Converting the annual net revenue streams in Figure 2 to net present values under the BAU and SPO scenarios yields –US$28.7 million and US$299.7 million respectively, indicating that the concessionaire benefits substantially by operating under the SPO scenario.[15] Although the trend lines have BAU outperforming SPO in later years, the SPO is far more attractive due to discounting as well as the need for substantial concessionaire investment in replanting after 2041 under BAU as trees age beyond their productive lifespan of 20 years.[16]

2.2.2 Smallholder net revenue and wages

Smallholders earn revenue from sales of FFB to the mill, and incur production costs that include debt service and wages for their own labor. Given that SPO emphasizes smallholder production, it is no surprise that annual smallholder net revenue ultimately is much greater under this scenario than the negligible amount under BAU (Figure 3). However, annual net revenue in the smallholder segment does not become positive until 2036 due to the cost of debt service (see section 3.1.2 above). Positive revenue in the early years is in fact sustained by credit; after that there is a long period in which planting

[15] Unless otherwise stated, all NPV calculations use a discount rate of 5%.

[16] See Annex 1 for illustration of how the production model repeats itself after 20 years; the 20-year time horizon was selected for the TSA analysis for this reason, as extending the calculations beyond this point will not affect the conclusions. One might hypothesize that in the long term, the BAU scenario is further disadvantaged by decreases in productivity, principally due to deteriorating hydrological conditions. This would further reinforce the relative superiority of the SPO scenario, but is beyond the scope of this modeling exercise.

costs and debt service outpace revenues from trees maturing and entering into production. (For an individual plot, annual net revenue becomes positive 9 years after initial planting, and cumulative revenue is positive after 19 years; see Table A2.4 in Annex 2.).

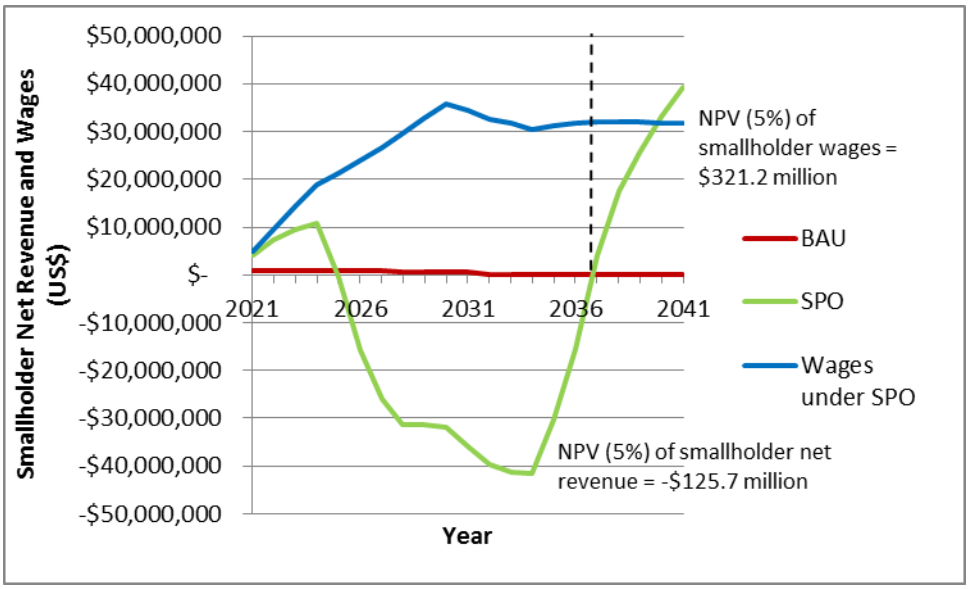

Fig. 3: Annual Smallholder Net Revenue and Wages (US$ per year)

As noted, the long period of negative net revenue for the smallholder segment under SPO is driven by investment costs and debt service. Net revenue includes a cost component in the form of wages for smallholder labor; in the model a portion of credit is used to cover smallholder wages. The total annual smallholder wages shown in the 'Wages under SPO' curve average more than US$27 million per year, resulting in a NPV of US$321 million. Thus, even during the investment phase when smallholder operations generate negative revenue, the wages earned by smallholders represent a substantial contribution to household income.

2.2.3 Cost of Shifting from BAU to SPO

The costs of moving from the BAU scenario to the SPO scenario relate to working with smallholders to initiate certified sustainable oil palm cultivation and FFB production. By far the largest cost is the upfront investment in establishing smallholder oil palm plots, modeled as $8,000 per ha; the difference between the BAU and SPO scenarios in terms of this investment requirement is the interest paid for the credit required to cover upfront costs (4%, repaid over 11 years starting in year 5 after planting; see Annex 2). To this must be added the costs of Participatory Land Use Planning (PLUP), Environmental and Social Impact Assessment (ESIA), and initial RSPO certification, followed by regular RSPO monitoring and verification.

The costs of PLUP, ESIA and RSPO certification and verification are relatively minor, never exceeding US$1 million per year in total. In contrast, the annual cost of credit to support smallholder investment

increases steadily to peak at nearly US$110 million in 2035 and 2036, and then declines as loans are closed. This cost of credit already is captured in the revenue trends described in Figure 3 above, considered an integral part of the smallholder model. Implicit in this modeling approach is that the cost of credit must be covered by smallholder revenue.

2.2.4 Government Revenue

Oil palm development generates revenue for the Government of Liberia principally through land rental fees, corporate income tax, and personal income tax. Other revenues are derived from various licensing, processing and administrative fees, which account for just over a quarter of the total.[17] Annual land rental fees are US$5 per hectare for developed land and US$2.50 for undeveloped land in the concession area.[18] Corporate and personal income tax rates are defined in the LRC, with the former set at 25%, and the latter on a sliding scale based on income level to a maximum rate of 25%.

The BAU scenario results in significantly greater total annual government revenue (land rental fees, tax on corporate and personal income, and other fees) than SPO as of 2032 (Figure 4). As we have already seen, the much larger area under production generates greater corporate revenue in later years, and therefore a larger corporate tax base. Likewise, the greater employment generated under BAU through cultivation of a larger area leads to greater personal income tax revenue.

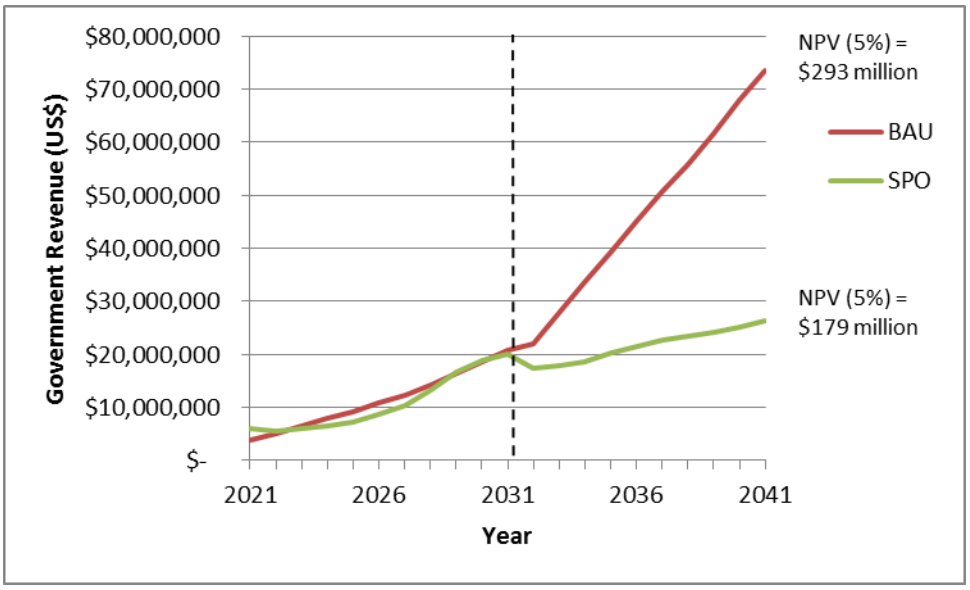

Fig. 4: Total Annual Government Revenue (US$ per year)

Figure 5 shows the portion of total government revenue that is accounted for by the tax on corporate income. Though ultimately greater under BAU, it does not exceed revenue collected under SPO until after 2035; the NPV of annual corporate income tax paid over the 20-year period is much larger under

[17] Future work may consider whether the current fee levels are appropriate; this exercise takes them as fixed.
[18] Community land that is not available for development is not subject to the rental fee.

SPO, approaching US$100 million, compared to US$72.5 million under BAU. This results from the fact that for the first 11 years under BAU, corporate net revenue is negative due to investment in new plantings, thus generating no government revenue. Moreover, these figures overstate government revenue under BAU as they do not reflect carry-over loss deductions, which would delay initial corporate income tax revenues even further. Any tax holidays or additional tax incentives provided by Government to stimulate commercial investment result in even lower revenues under BAU.

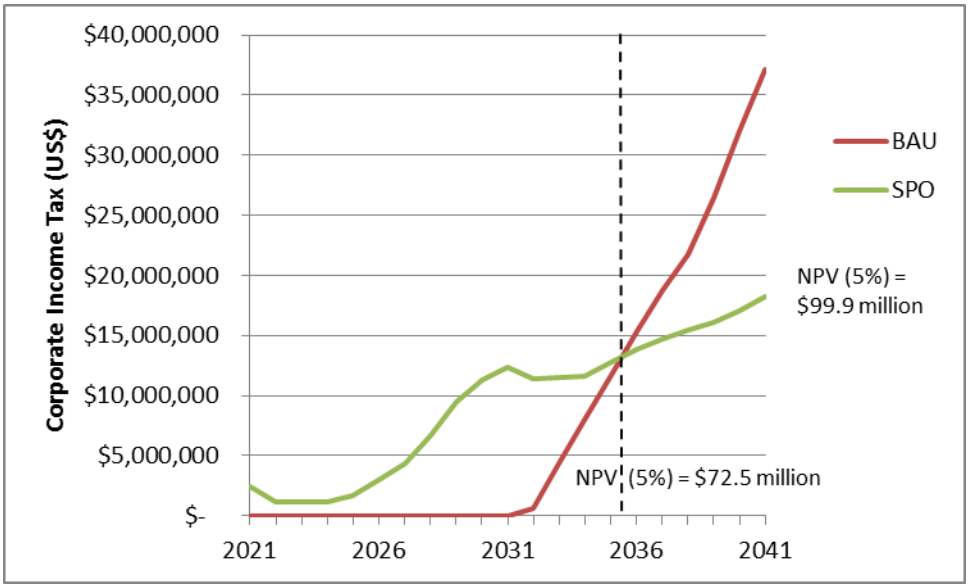

Fig. 5: Annual Government Revenue from Corporate Income Tax (US$ per year)

2.2.5 Social Investments by Concessionaire

For communities, in addition to employment and smallholder revenue, oil palm development is of interest due to additional social benefit payments from the concessionaire. A portion of these payments are mandated under the concession agreement, which specifies obligations of US$5 per year per hectare of developed concession area to a community development fund.[19] Historically Sime Darby has made available considerably greater amounts than its obligations for community engagement and development, on the order of US$450,000 per year when it had developed only 10,000 hectares. Therefore the model takes this figure as a minimum amount, reflecting an investment in community goodwill, to be exceeded when the developed area expands to sufficient size under the BAU scenario.[20] The concession agreement also stipulates a contribution of 1% of gross sales to an Oil Palm Development Fund; the model assumes that these funds flow to communities as support for the smallholder palm oil segment.

[19] What is not clear is whether smallholder oil palm areas count as developed areas for the purposes of this obligation; the model assumes not, as the concessionaire can plausibly argue that these areas are not developed as commercial plantation area for which it is responsible.

[20] Note that this is a conservative assumption, as the company could be assumed to devote greater amounts to voluntary payments as more communities become involved over time, in order to maintain positive relationships.

Annual contributions are proportional to area under cultivation. Therefore annual community benefit expenditures ultimately are greater under BAU than under SPO, since a larger area ends up converted to oil palm under BAU. By 2041, annual expenditures on community benefits are a little more than 60% greater under the BAU than under SPO (Figure 5).

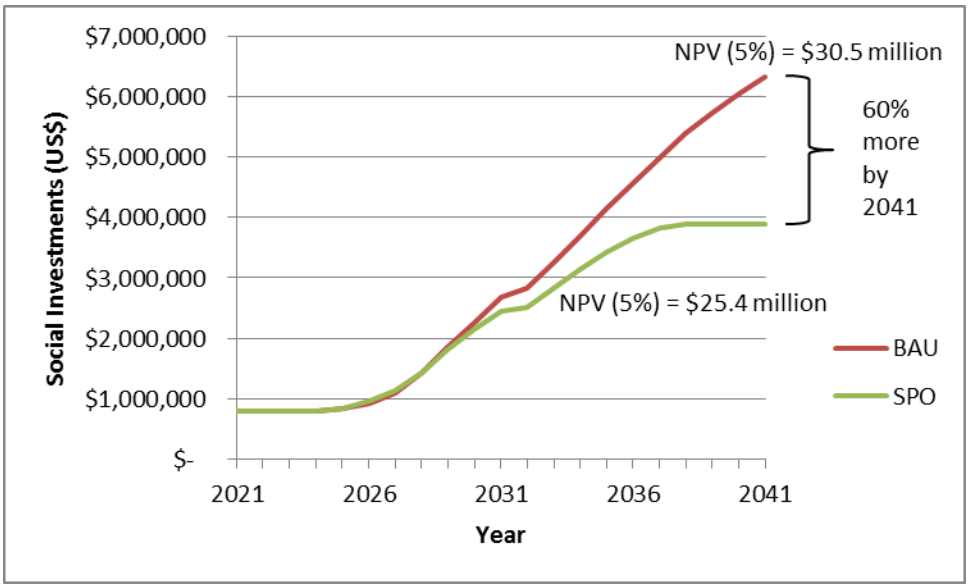

Fig. 5: Social Investments by Concessionaire
(Contributions to Community Development Fund and Oil Palm Development Fund, US$ per year)

2.2.6 Employment (Direct, Indirect and Ratio of Low to High-paid Jobs)

Under BAU, employment principally takes the form of plantation labor, while under SPO the more modest number of plantation jobs is supplemented by growing numbers of smallholder producers. The lines in Figure 6 result from a fixed number of laborers per hectare multiplied by constant planting rates per year, therefore they level off once the maximum planted area under each scenario is reached. Since the maximum planted area is substantially higher under BAU, there is correspondingly greater employment (42,803 jobs compared to 27,891 under SPO by year 2041). Assuming that planted area reaches a steady state under the two scenarios, the employment levels may be expected to persist into the future.

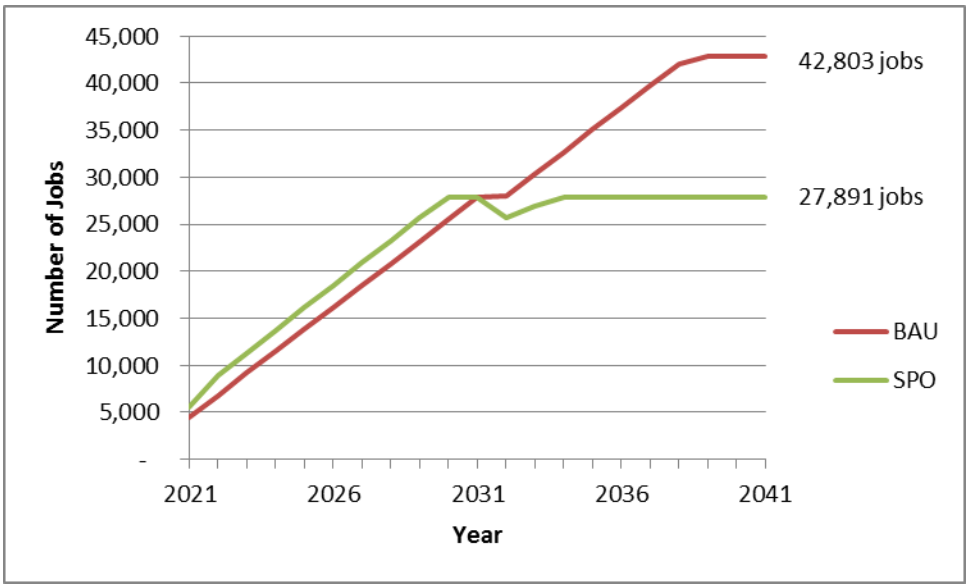

Fig. 6: Employment
(low-skilled plantation jobs and smallholder jobs per year)

Figure 6 shows estimated numbers of low-skilled jobs. The more extensive commercial plantation development under BAU would also include more skilled, higher-paying managerial and oversight jobs. This cadre of skilled labor would be smaller under the SPO scenario as smallholder production would not feature the same management hierarchy, but skilled labor in the employ of the concessionaire would also be involved in some extension, outreach and oversight roles to support smallholders. Using parameters based on workforce composition figures for Malaysia, Indonesia and Cote d'Ivoire, skilled labor employment is estimated to reach nearly 2,500 positions under BAU, but only 225 under SPO. However, based on experience in the Sime Darby concession, only a small number of these positions might be filled by Liberians; to date the majority of high-skilled roles have been filled by expatriates.

The employment results described above relate to direct employment on the plantation or as smallholder producers. In both scenarios oil palm development also offers indirect employment gains through supporting activities, equipment and input suppliers, service providers, etc. Literature suggests a range of about 2.79 to more than 3 indirectly generated jobs per on-plantation job. In this model we use the lower end of this range for a conservative estimate, resulting in nearly 80,000 jobs under the SPO scenario by 2041 versus more than 125,000 jobs under the BAU scenario (the nature of these indirect jobs can be presumed to be the same under each scenario). Again, the larger number of hectares under production in the BAU scenario results in greater employment.[21]

[21] The government revenue estimates from taxes on personal income do not include consideration of this indirect employment.

2.2.7 Women's Employment

The gender breakdown of employment opportunities created under the two scenarios is not an analytical result of the model, but can be considered on the basis of other data. LEITI reports indicate that women accounted for about 15% of workers in Sime Darby operations. However, on other oil palm plantations in Liberia, women account for about 34% of workers. The SPO scenario involves NGO and civil society partner support for smallholder oil palm development, and these organizations (e.g. IDH, CI and SCNL, as well other actors in the sector such UNDP and USAID) are committed to pursuing gender equity in their programming. Therefore moving from 15% to 34% share of employment for women under SPO is a plausible minimum goal, and consistent with gender mainstreaming strategies of the Ministry of Agriculture (*Gender Analysis Report* 2018). Consequently, direct employment of 6,400 women under BAU by year 20 increases to 9,400 women under SPO (Figure 8). Within the overall economy, World Bank data suggests a general women's employment participation rate of 46%; this implies indirect employment for 58,000 and 36,000 women under BAU and SPO respectively by 2041.

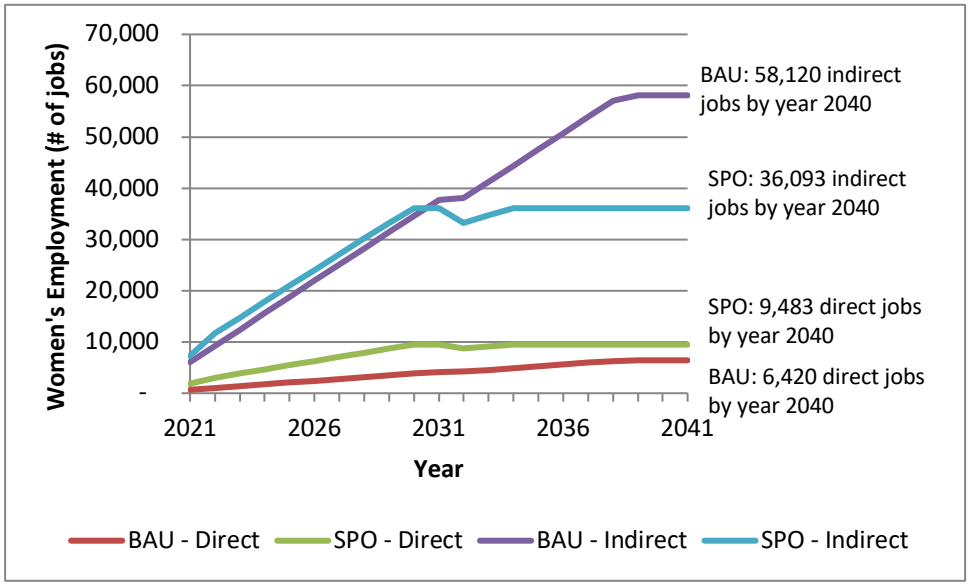

Fig. 8: Women's Employment (jobs per year)

2.2.8 Social Services

A key part of the narrative surrounding palm oil as a driver of rural development is that, in addition to livelihoods, economic growth will lead to improved access to social services such as schools and clinics. Investment in education and health services is not an analytical result of economic modeling of palm oil production, but rather the outcome of central government policy decisions with respect to annual budgets and disposition of concession revenue; negotiations between communities, civil society partners and the concessionaire on corporate contributions to community development; and internal community decisions as to use of community palm oil revenues. These will differ from year to year and from community to community.

The LRC (section 26) states that revenue collected by the Liberia Revenue Authority shall be paid into the Consolidated Fund. Thus, concession revenues are not earmarked for specific spending categories or geographic areas in Liberia. Analysis of the general GOL budget indicates that about 15% of the total budget is spent each on the health and education sectors.[22] Applying those proportions to estimated government revenue would yield an annual average of around US$1.5 million each for health and education over the first 10 years, then rising rapidly to as much as US$10 million under BAU, or nearly US$4 million under the SPO scenario. Characterizing the implications for actual access to schools and health services for communities impacted by the concession is beyond the scope of this analysis, as that depends on decisions about service delivery models and the balance of recurring versus capital investment costs.

2.2.9 Forest Cover

GIS analysis of land cover indicates that the gross concession area available for development initially has nearly 260,000 ha forest cover (166,226 ha under primary forest and 93,458 ha under secondary forest). Forest conversion to oil palm takes place under both the BAU and the SPO scenarios (Figure 9). Under BAU the concessionaire maximizes development to the full 220,000 ha specified in the concession agreement, while under SPO adherence to RSPO standards restricts clearing of HCS/HCV areas such that only 120,000 are converted to smallholder oil palm and the commercial plantation is limited to 20,000 ha. By 2038 the difference in forest loss between the two scenarios is 107,000 ha.

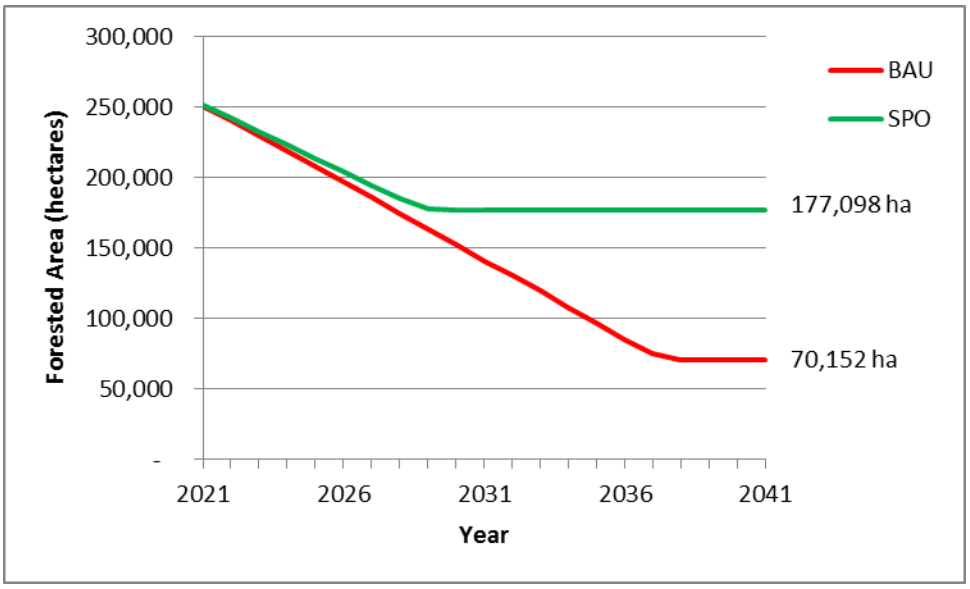

Fig. 9: Forest Cover (hectares of primary and secondary forest)

[22] The GOL passed a government budget totaling US$526,000,000 for the 2019/20 fiscal year.

The scenarios differ considerably with respect to clearing of primary versus secondary forest. The BAU scenario assumes that the concessionaire will prioritize proximity to the mill for plantation development, regardless of forest type. Based on GIS analysis, this leads to a loss of 126,000 ha of primary forest and 63,000 ha of secondary forest (Figure 10). In the SPO scenario, the RSPO prohibition on conversion of primary forest directs all conversion to secondary forest, amounting to a secondary forest loss of 82,500 ha (Figure 11). The much greater pressure on primary forest under BAU implies more significant ecological damage and carbon emissions from forest conversion (see next section).

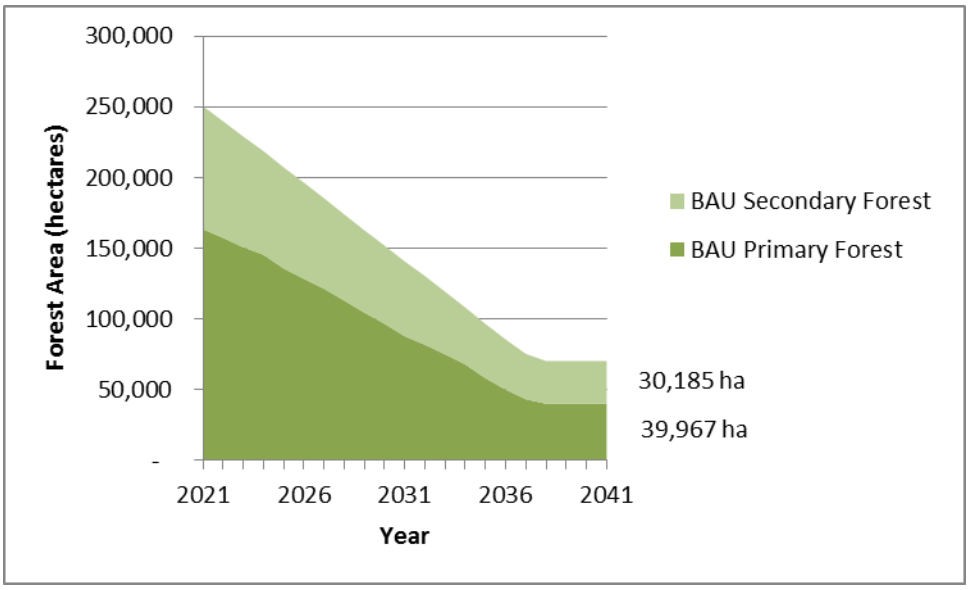

Fig. 10: Primary and Secondary Forest Cover under BAU (hectares)

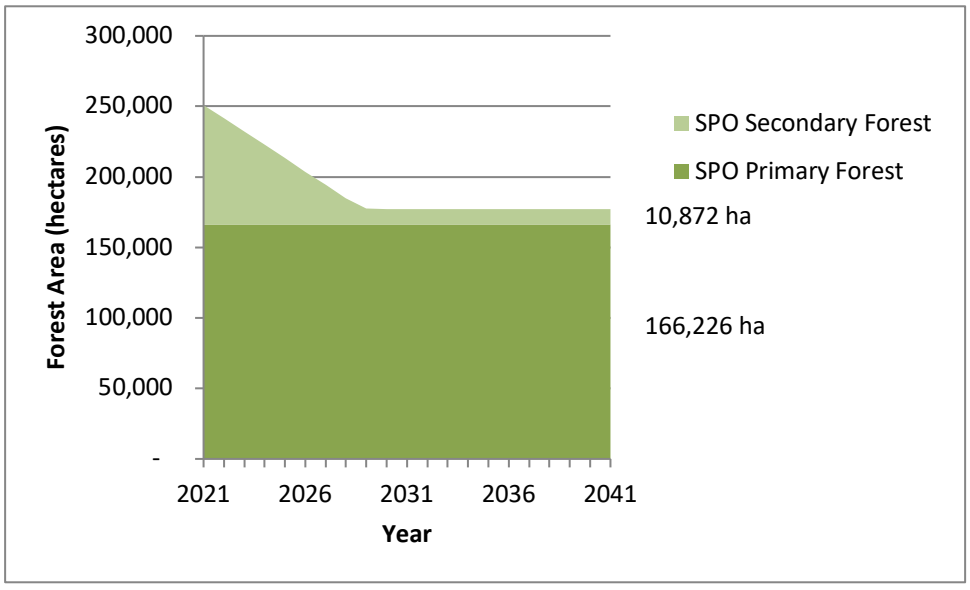

Fig. 11: Primary and Secondary Forest Cover under SPO (hectares)

2.2.10 Carbon Value

The different rates and types of forest loss under the BAU and SPO scenarios have different implications for biodiversity and other ecosystem services, depending on the spatial configuration of conversion to oil palm. Under SPO, the fact that far less forest is converted, and particularly that more primary forest is left intact, implies better habitat quality and connectivity (see Annex 3); the exact pattern of conversion of secondary forest will be the result of negotiations with communities, local land-use planning and landscape-level planning processes that are beyond the scope of this modeling effort.[23] However, we can characterize the differential impacts with respect to carbon emissions from forest conversion to oil palm. The carbon calculations in Table 3 are based on parameters derived from literature, and an assumption for the price of carbon.

Table 3: Cumulative Value of Carbon Loss under BAU and SPO Scenarios

	Primary Forest	**Secondary Forest**	**Oil Palm**
Carbon stock *(tons per hectare)*	250	144	30
Carbon loss from conversion to oil palm *(tons per hectare)*	220	114	
BAU conversion *(hectares)*	126,259	63,273	
SPO conversion *(hectares)*	0	82,585	
Carbon price *(US$ / ton)*	5		**TOTAL *(NPV at 5%)***
BAU carbon value loss *(US$)*	$138,884,374	$36,065,386	$113,395,587
SPO carbon value loss *(US$)*		$47,073,586	$37,231,505

Note that a carbon price of US$5 per ton is a conservative assumption; higher prices would increase the figures for lost carbon value (see Box 3 below). The cumulative value of carbon loss under the two scenarios is shown in Figure 12:

[23] Annex 3 includes illustrative maps of land use distribution after 20 years under the BAU and SPO scenarios, but these are only indicative as the outcomes of land use planning and negotiation processes cannot be modeled.

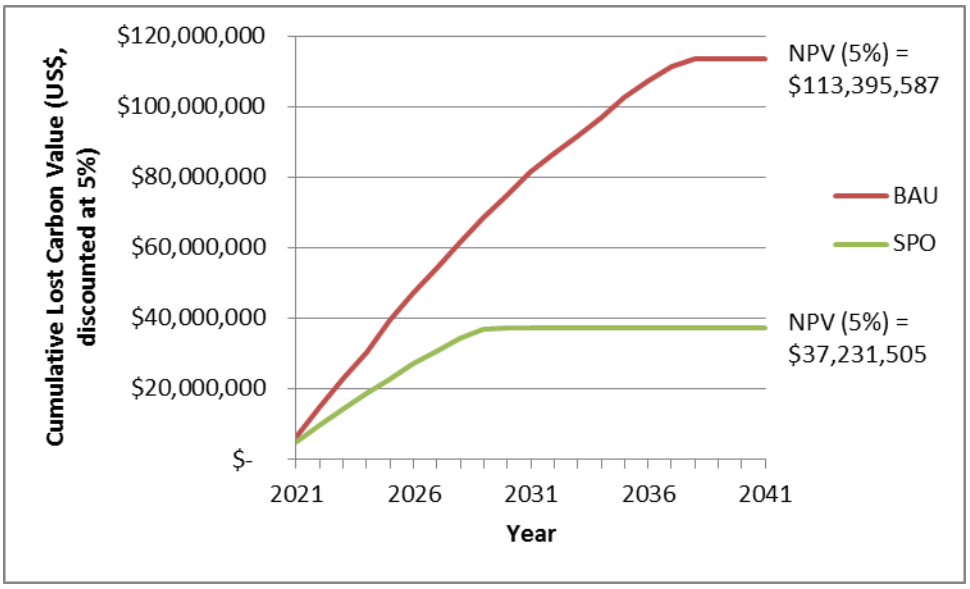

Fig. 12: Cumulative Carbon Value Lost from Forest Conversion under BAU and SPO Scenarios (US$ per year, discounted at 5%)

The curves in Figure 12 above show the net present value of cumulative losses; the annual losses average a little under US$10 million for 18 years under BAU and US$5 million for 10 years under the SPO, before leveling off to zero as the area to be planted is fully converted. Once forest conversion is completed, carbon storage here is assumed to reach a steady state under each scenario, as aging oil palms are replaced and remaining forest remnants are managed for conservation. Note that lost carbon value serves here as a very conservative proxy for the social cost of ecological damage (the revenue potential from transacting carbon credits is treated below).

Box 3: Social Cost of Carbon

The carbon value calculations above use a constant price of US$5 per ton of carbon equivalent. This is a highly conservative assumption, so as not to bias results unduly in favor of the SPO scenario. The US$5 figure reflects a rule of thumb often used in estimates of potential carbon revenues from participation in global carbon credit markets, in a world where the prospects for such markets remain uncertain. An alternative approach could consider the social cost of carbon, which conceptually reflects the value of negative impacts of climate change from additional carbon emissions (RFF 2019). For example, cost-benefit calculations by the government of the United States have used an estimated global social cost of carbon as high as US$50 per ton in 2020, and rising thereafter. (Even this value is deemed to miss a range of externalities imposed by emissions). When applying this cost in the analysis, the BAU imposes nearly US$1.3 billion more costs in terms of damage from carbon emissions than the SPO scenario.

3. Discussion: Comparing BAU and SPO Scenarios

The preceding section presented results on the basis of individual indicators identified as relevant by stakeholders. For some indicators, the BAU may appear relatively attractive compared to SPO as they increase in proportion to area converted (including employment and government revenue), such that BAU necessarily outperforms SPO for those indicators. However, the SPO scenario is considerably more attractive when accounting for the time value of money; using a low discount rate of 5% that likely overstates future values, even ignoring carbon costs, the SPO scenario offers substantially greater total value than the BAU scenario (NPV of US$378 million under SPO, versus US$301 million under BAU). Moreover, as shown in Section 2.2.9, any gains under BAU are achieved at the expense of significant forest area, particularly primary forest. To reflect the environmental cost of this greater conversion, we subtract carbon costs incurred through deforestation from net aggregate income to produce total annual value created by oil palm development.

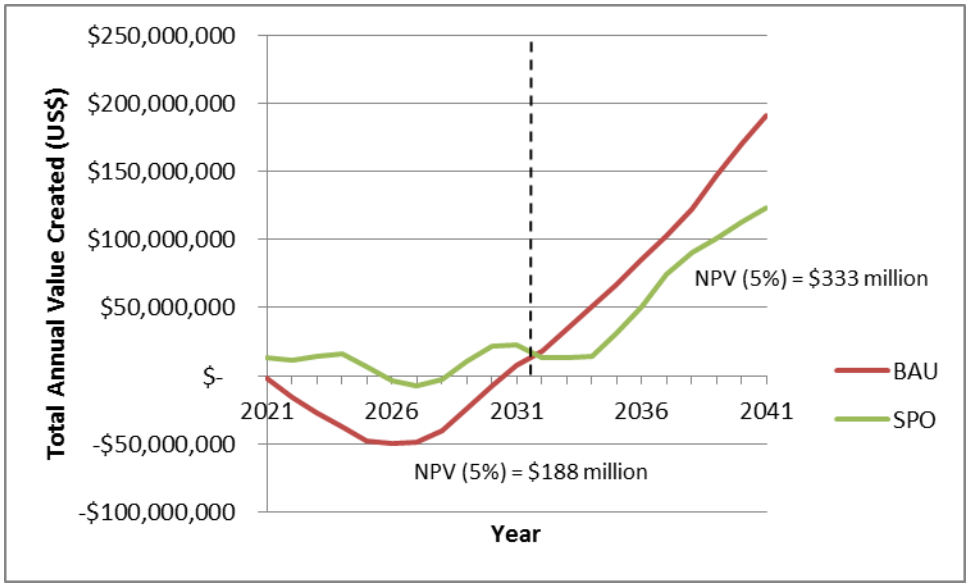

Fig. 13: Total Annual Value Created by Oil Palm Development (US$ per year)

In Figure 13, the annual total value of oil palm development under the BAU scenario dominates over SPO in later years. However, accounting for both the time value of money and carbon losses makes the SPO scenario much more attractive than the BAU; again using a low discount rate of 5%, **the net present value (NPV) of the full income stream under BAU is about US$188 million, while under SPO it is about US$333 million**. The NPV of the BAU scenario becomes negative at discount rates much above 10%; the SPO scenario remains attractive at arguably more realistic discount rates as high as 15%, at which NPV still exceeds US$100 million (see Table 4 for NPV under alternative discount rates).

Table 4: Net Present Value (NPV) of Total Value Created by Oil Palm Development[24]

	NPV	
Discount rate	*BAU*	*SPO*
5% *(applied in estimates)*	$188,235,416	$333,264,838
10%	$7,810,824	$171,843,839
15%	-$53,281,973	$100,428,168
20%	-$69,733,547	$66,274,101

This result is striking as typically higher discount rates tend to favor less sustainable choices. Key factors driving the result are the investment and carbon costs incurred in early periods. For the concessionaire, the SPO scenario is more attractive as positive net profit commences much sooner than under BAU; this is a consequence of displacing the cost of plantation investment to the smallholder sector. Consequently, SPO also results in greater Government revenue in earlier periods. Given the urgency of generating both a commercial return and Government revenue (as would be reflected in the selection of higher discount rate), SPO should be attractive to the concessionaire as well as the Government of Liberia. The feasibility of achieving the SPO hinges on success in securing affordable credit to finance initial costs of smallholder oil palm development.

The analysis above only includes the value of carbon as an avoided loss, based on an imputed value for standing carbon stocks. Success in developing the framework for a REDD+ transaction on the basis of avoided deforestation under SPO relative to BAU would increase revenue and further reinforce SPO. Under the basic model assumptions, **the NPV of a stream of annual payments equal to the value of avoided emissions under SPO would amount to about US$75 million** (Figure 14). Again, this is based on a conservation assumption for carbon value of US$5 per ton. Policies on how carbon revenue is distributed would determine the implications for community benefits and Government revenue.

[24] This is the total net income generated by oil palm development, accounting for carbon as well as SPO transition costs.

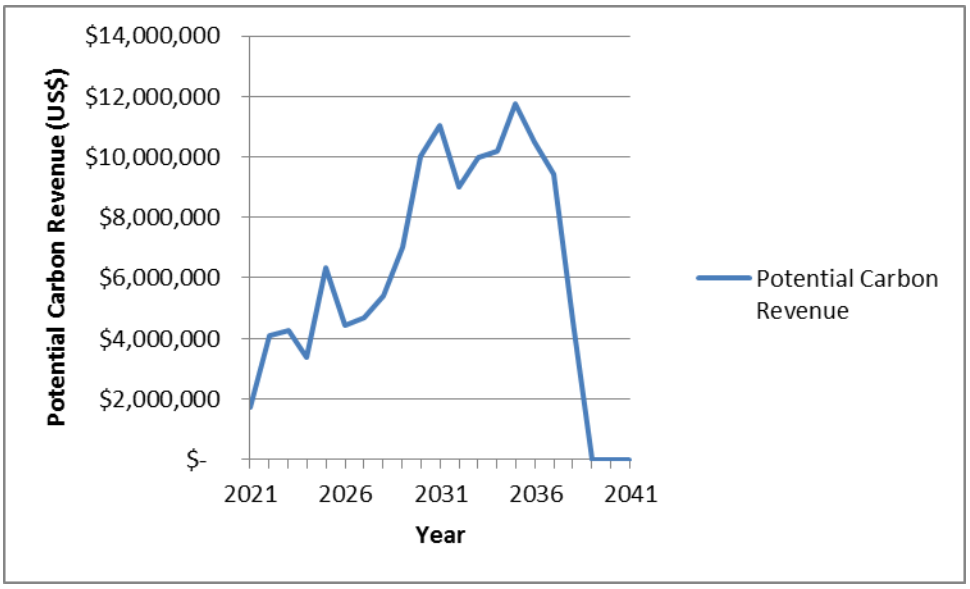

Fig. 14: Potential Annual Carbon Revenue from REDD+ Transactions for Avoided Forest Conversion under SPO (US$ per year)

As noted above, carbon value is a conservative proxy for total value of ecosystem services, such that lost carbon value resulting from forest conservation actually only captures a portion of the full environmental externalities (see Box 2). Expanding the analysis to include the value of additional negative externalities relating to biodiversity, supplies of non-timber forest products and bushmeat, and cultural values, for instance, would further reinforce the dominance of SPO over the BAU scenario. This is particularly significant in a context where reliance on these and other ecosystem services are an important part of household survival strategies. From the perspective of the concessionaire, the value of other ecosystem services, particularly hydrological services, also reinforces the SPO scenario relative to BAU; as forest loss under the BAU has negative hydrological impacts, over time the BAU will see yields decline or require substantial investment in irrigation.

The real trade-off between BAU and SPO then is the implication for employment. Since employment is directly proportional to cultivated area, indicators for total direct and indirect employment are notably greater under BAU than SPO (although SPO may result in more opportunities for direct employment of women). The question then is whether the SPO scenario can accommodate alternative employment generation that does not rely on further forest clearing. Alternative livelihood development features prominently on the agendas of the GOL, NGOs and civil society partners, such that over time other employment options will emerge (e.g. in the non-timber forest sector, land-use management roles, and eventually tourism and other service sector roles), but there is no basis for asserting how or when these will bridge the gap between the BAU and SPO scenarios. That said, one may posit that the greater aggregate value produced under SPO will do more to stimulate wider economic activity than the BAU scenario, particularly as a larger portion of that value enters the local economy through smallholder participation.

Finally, one might consider the differences between the BAU and SPO scenarios in light of the ongoing COVID-19 pandemic. As noted in Box 1, the crisis already is exhibiting negative impacts in terms of availability of inputs and transportation challenges, and is expected to hamper overall economic growth. In the near term, smallholder palm oil producers may be especially affected, as COVID-19 delays partner field activities such as concessionaire technical extension and NGO efforts to support land use planning; this would delay realization of the SPO scenario. That said, the BAU scenario relies on readily available labor supply, which likely is constrained by the pandemic response. Therefore the near-term difference in COVID-19 impacts remains ambiguous. However, the longer term highlights the important role of forest ecosystem services as part of the safety net for communities given constraints on the Government's ability to provide support. Rural communities in Liberia rely on forests as sources of food, medicine and fuel; forests are important for availability and quality of water; and healthy ecosystems provide a basis for livelihood diversification. Large-scale land conversion – including the loss of 126,000 ha of primary forest – under the BAU scenario would severely impoverish critical conditions for community resilience in the face of crises such as the current pandemic.

4. Conclusions and Recommendations

4.1 Conclusions

For a nation like Liberia with pressing development needs and extensive land resources, agroforestry in general and palm oil in particular offer an important economic opportunity. The potential benefits of oil palm plantations include employment, smallholder income, export earnings, and government revenue. However, oil palm development can take place as large, industrial commercial plantations or smallholder producers, and conversion of forest to oil palm cultivation involves trade-offs, particularly with respect to environmental values.

The history of the Sime Darby plantation epitomizes the challenges surrounding these choices. Corporate commitments as well Government of Liberia requirements stipulated in the concession agreement required adherence to RSPO principles and criteria – even as these standards remained to be fully defined through a national interpretation process for Liberia. Consequently, plantation development was stymied as the company could plant only 10,000 hectares of previously converted land, and could not support smallholder planting in the absence of clear standards. After a decade of growing losses that approached US$250 million in total, Sime Darby transferred the concession to Liberia-based Mano Palm Oil Industries Ltd. for US$1 and an earn-out payment spread out over 8 years as of 2023 (Palansamy 2020).

The exercise conducted in this Targeted Scenario Analysis examined the implications of choices surrounding the concession. The purpose of the analysis is to inform Government of Liberia decision-makers as they consider policy options for guiding oil palm development. The key decision in this respect is policy resolve to continue mandating social and environmental sustainability requirements, a resolve that has been tested by the history of the Sime Darby concession. In essence, the analysis compares

conventional oil palm development to oil palm development that emphasizes smallholder participation and environmental constraints.

Based on literature review, stakeholder interviews, GIS analysis and expert input we developed a model that captures commercial and smallholder palm oil production and net revenue; financing for smallholder oil palm plot establishment; employment, government revenue and social benefits; and forest cover impacts and attendant forest-carbon emissions. Throughout the exercise, conservative assumptions were used to minimize bias against the business-as-usual scenario; in particular, the analysis under-represents negative environmental impacts, as data constraints preclude a credible characterization of the value of ecosystem services such as biodiversity maintenance and hydrological functions, and the relationship between these functions and productivity of agroforestry or other land uses. Incorporation of such values would further reinforce the conclusions presented below.

The conclusions of the TSA for oil palm development may be summarized as follows:

- The analysis reinforces the position of sustainable palm oil, with an emphasis on smallholder producers, in the Government of Liberia's Pro-poor Agenda for Prosperity and Development. Ignoring lost carbon values, the SPO scenario offers substantially greater total value than the BAU scenario (NPV of US$378 million, versus US$301 million).
- This is achieved principally through credit to the smallholder sector provided on concessionary terms.
- Including carbon loss in the model further strengthens SPO results relative to BAU (NPV of US$333 million versus US$188 million); the SPO scenario avoids the loss of at least US$75 million (NPV) through carbon emissions from forest conversion, maintaining 107,000 hectares more forest than under the BAU scenario.
- Including other ecosystem service values maintained under SPO would further reinforce this result.
- These results hold and indeed become more pronounced with discount rates higher than the conservative 5% assumption used in the analysis.
- Greater value and greater ecosystem integrity under SPO are accompanied by lower direct and indirect employment in the oil palm sector (42,803 jobs under BAU compared to 27,891 under SPO by year 2041).

4.2 Recommendations

The recommendations that follow from the conclusions above are:

- To maximize total value generated by oil palm development, the Government of Liberia should maintain its commitment to requiring that concessionaires abide by RSPO principles and criteria. At present, this commitment is reflected mainly in the concession agreements; issuing an explicit policy through the Ministry of Agriculture would lend this commitment additional force. The IMCC could reinforce this policy by facilitating a supporting Executive Order from the Office

of the President, further strengthening the Government's position with respect to concessionaires as well as potential sources of financing for sustainable oil palm development.

- The national interpretation process for RSPO principles and criteria needs to be concluded as soon as possible, and must specifically address secondary forest in a way that is appropriate for a high forest, low deforestation, least developed country context. As an example, the model results show outcomes of a requirement that 60% of secondary forest be maintained, after protecting all primary forest as well as High Carbon Stock forest and High Conservation Value forest. Once the national interpretation has been validated and approved, including reconciliation with Liberia's National Forest Definition framework, it should be explicitly incorporated in the Ministry of Agriculture policy decree recommended in the previous point, and ideally reinforced by Executive Order. Subsequently, the Ministry, working with the NBC, LLA and FDA should require that oil palm development plans of both concessionaires and smallholder communities explicitly demonstrate how the national interpretation will be applied. Agency review of these plans would benefit from a land suitability map, which the GOL should require as part of the concession review package while national land-use suitability mapping efforts progress.

- The Government of Liberia, NGO partners, concessionaires and communities should redouble their efforts to develop a workable model for smallholder oil palm development, with an emphasis on securing affordable credit to finance start-up costs. The advantages of the SPO scenario versus the BAU hinge on this commitment. Joint work by IDH and CI on a smallholder investment and production model with Sime Darby represents a well-advanced effort to design a mutually beneficial arrangement for communities and the concessionaire. The Government, MPOI, IDH and CI should build on this effort by using the model developed for this TSA to formulate a concrete investment prospectus for presentation to potential investors, particularly in the impact investment sector; this effort should be aligned with ongoing efforts by the World Bank, IFAD and USAID to address the absence of credit options for smallholders in Liberia. At the same time, the model can inform how conventional development funding sources (e.g. ODA, philanthropy) may direct support to enabling conditions such as building capacity to facilitate participatory land use planning within County Administrations.

- Given the enormous benefits that accrue to the concessionaire under the SPO scenario relative to BAU, it is in the interest of MPOI to provide further support for smallholder development. In addition to working with Government and civil society to approach potential financing sources such as impact investors, MPOI should examine how it can provide technical, financial and credit management extension services to support smallholder palm oil producers. In addition, MPOI should work with the smallholder sector to identify cost-effective arrangements for sourcing inputs.

- The Government of Liberia and NGO partners should redouble their efforts to advance REDD+ frameworks, and consider particular attention to including compensation for avoided emissions from deforestation through sustainable plantation development. To date, the evolving national REDD+ framework leaves unclear whether avoided deforestation and forest degradation within agroforestry concessions can generate revenue from carbon credits. The Ministry of Agriculture and the FDA should convene a joint session of the national REDD+ Technical Working Group and the National Oil Palm Platform of Liberia to explore how the SPO scenario can be positioned to generate carbon revenue.[25] One use of eventual carbon revenue that should be considered is the creation of conservation-based jobs to help ensure avoided emissions from deforestation and forest degradation, and to offset the lower amount of employment generated under SPO compared to the BAU scenario.

Additional recommendations relate to possible further refinements to the modeling framework that was developed for this TSA. Refinements to consider include:

- Updating the analysis on the basis of the finalized National Interpretation process for RSPO principles and criteria.
- Analyzing intermediate scenarios reflecting alternative ratios of commercial plantation and smallholder development (and possibly variations in other parameters).
- Modeling the results of different possible contract constructions between the concessionaire and outgrowers, clearly defining royalties and benefit-sharing arrangements.
- Introducing seasonality dynamics that reflect temporal production patterns over the course of a typical year.
- Examining alternatives to sole reliance on the commercial mill, such as pre-processing of FFB using small local mills.
- Elaborating productivity parameters as a function of land suitability.
- Incorporating the value of other ecosystem services (e.g. hydrology), and their impacts on long-term productivity.

Annex 5 offers suggested steps in an Implementation Approach for these recommendations.

[25] Due to its status as a High Forest Cover-Low Deforestation (HFLD) nation, Liberia's Nationally Determined Contributions (NDCs) to achieving the goals of the Paris Climate Accord do not focus on the forest sector. Nevertheless, Liberia's NDC framework recognizes the potential of plantations to increase deforestation; the Government of Liberia's policy emphasis on HCVs, HCS and RSPO Principles and Criteria therefore are important measures that implicitly reinforce the NDCs. The impacts of such measures are captured in the country's Measurement, Reporting and Verification (MRV) framework, and reflected in Liberia's REDD+ strategy.

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Annex 1: Production Cycle after 20 Years and Discounting

20 years after planting, trees need to be cleared and the planting cycle recommences. This means that the producer will again incur the costs of replanting, while total production declines. In fact, overall production is reduced by replacement of producing trees by non-producing seedlings, while at the same time additional mature trees continue to enter into decline. Thus, average production per hectare for the plantation as a whole declines significantly. The impact of these factors is illustrated in Figure A1.1 below, which also shows the impact of discounting future values at a modest rate of 5%.

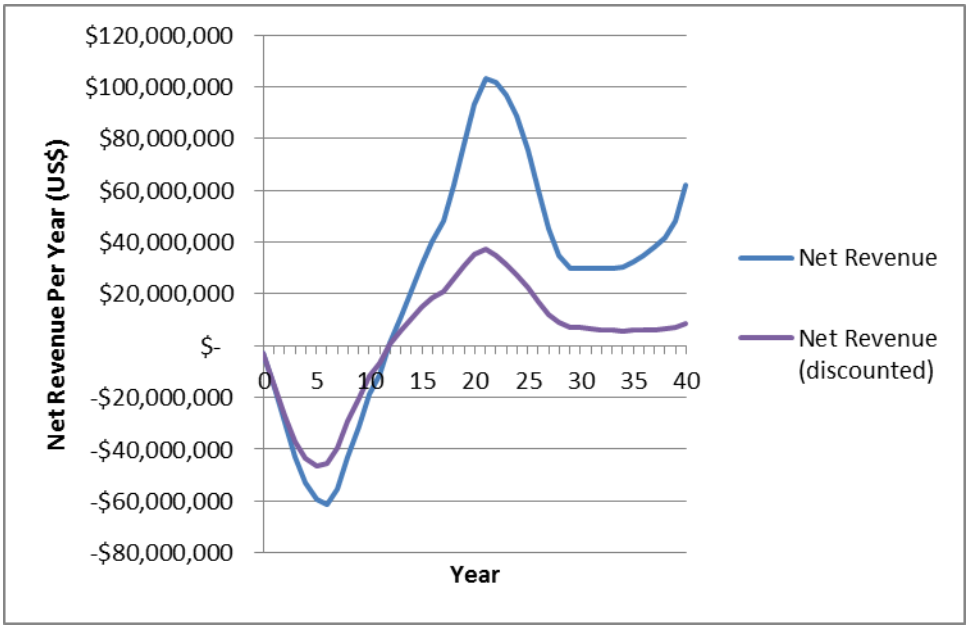


Fig. A1.1: Net Revenue from Commercial Production under BAU over 40 years (US$ per year, with replanting of trees on reaching 20 years)

An analogous pattern holds for smallholder production, and thus for the indicators driven by production such as employment and government revenue.

Annex 2: The Modeling Approach

The modeling approach used for this TSA was to develop a series of linked spreadsheets that capture the essential elements of the palm oil production system in the MPOI concession, and a parallel GIS-based spatial model of oil palm expansion in the concession. The components of the models include:

1. GIS-based characterization of land suitability for oil palm based on precipitation, slope, elevation, drainage, soil depth, soil texture, and original land cover (primary forest, secondary forest, other).
2. GIS-based characterization of potential spatial expansion based on suitability, distribution of settlements, and proximity to mill
3. Age-yield profile of oil palm trees over 20 years as of planting
4. Start-up credit and repayment plan for investment in smallholder oil palm plots (loan amount, interest rate, timing of repayment, repayment period, first payment year)
5. Production cost structure (initial clearing and planting, manuring, plot maintenance, harvest and transport, and indirect costs)
6. Age structure of total planted area, resulting from annual increments in area converted to oil palm
7. Output and revenues, including smallholder sales of FFB to the concessionaire (mill operator)
8. Taxes and fees, including personal income tax, corporate income tax, community development fund and oil palm development fund contributions, and land rental fees

The outputs of the GIS and spreadsheet models were then used to derive the results of interest to the analysis, including trends in net profit, employment (disaggregated by gender), government revenue, community benefits, and forest cover.

As described in Table A2.1 below, parameters for the model were derived from literature, including published articles, gray literature produced by non-profit organizations and research centers, laws and policies issued by the Government of Liberia (including the Liberia Revenue Code and the original Sime Darby concession agreement), and project documents developed by Sime Darby and NGO partners. Interviews with key informants were used to further fine-tune parameters. Where possible, the model used parameters applied in Sime Darby's own analyses, to reflect factors driving private sector decision-making. The BAU and SPO scenarios diverged due to different assumptions for a focused set of key variables: in the GIS modeling, this related to areas selected for conversion (with primary forest avoided under SPO), and in the production model this mainly related to different assumptions for areas under commercial plantation versus smallholder production.

Table A2.1: Assumption and Parameter Sources and Notes

Parameter	Source	Comments
Maximum Yield	D. McLaughlin (pers. comm.)	Expert McLaughlin recommended 18 MT FFB/ha for commercial, and 15 MT FFB/ha for smallholders, as a best-case scenario for

(metric tons of fresh fruit bunches per hectare – MT FFB/ha – in peak production years of tree life cycle)		West African production based on experience in Ghana. These are somewhat lower than assumptions seen in Sime Darby, GROW, and other modeling efforts; the more conservative assumption appears more in keeping with observed production.
Milling conversion (MT of crude palm oil – CPO – derived per MT FFB)	D. McLaughlin (pers. comm.)	A rate of 22% was deemed more realistic given production challenges in Liberia than rates of 24-25% seen used for analyses of production in Southeast Asia.
Mill processing cost (US$/MT CPO)	Man & Baharum (2011)	US$11/MT was high end of derived range, for conservative estimates.
Transport cost, FFB to mill (US$/MT)	GROW (2016)	Reported cost of US$20/MT used as average
Transport cost, CPO to port (US$/MT)	Sime Darby	US$17/MT reported in internal documentation
Portion of commercial plantation costs accounted for by wages	Sime Darby	40% share reported in internal documentation
Commercial plantation planting costs (US$/ha, over initial 4 years)	Own estimate	US$4,000 used as conservative estimate, based on literature on Southeast Asia establishment reporting a range of US$2,500-3,500.
Smallholder start-up costs (US$/ha, over initial 4 years)	Sime Darby	US$6,460 used in Sime Darby modeling; consistent with IDH and GROW analyses, and assumption of US$8,000 as start-up credit.
Portion of smallholder costs accounted for by wages	GROW (2016)	26% share calculated from cost/revenue model
Indirect costs as percent of total for commercial and smallholder segments	Sime Darby	27% for commercial, 5% for smallholders (commercial is higher due to benefits provided for workers)
FFB price (US$/MT)	Sime Darby	18% of CPO price
CPO price (US$/MT)	Calculated from LEITI reports	LEITI reports include export volume and revenue reported by individual companies; adjusting for transport costs between port and mill results in estimated US$700, plus US$50 as RSPO premium (per WWF 2012). Note that this is substantially lower than prices used in Sime Darby analyses (US$900 and more)
Palm Kernel Oil (PKO) price (US$/MT)	D. McLaughlin (pers. comm.)	50% of CPO price, used in McLaughlin modeling, consistent with literature
PKO production (MT)	D. McLaughlin (pers. comm.)	12.5% of CPO production, used in McLaughlin modeling, consistent with literature
Employment, direct (jobs)	GROW (2016), based on observed employment in Cote d'Ivoire	Smallholders (5 ha pp) Unskilled (5.14 ha pp) Semi-skilled (89 ha pp) Managerial (219 ha pp)
Employment, indirect (jobs)	Jelsma (2019)	2.79 jobs per direct job
Women % of employment, oil palm concessions	LEITI reporting	15% in Sime Darby; 34% in GVL and EPO

Women % of employment, labor force in general	World Bank data	46% based on ILO modeling
Personal income tax (%)	Liberia Revenue Code	20% taken as average for plantation employees, 15% for smallholders, simplified from tax table
Corporate income tax (%)	Liberia Revenue Code	25%
Concession obligation for Community Development Contribution (US$/ha/yr)	Sime Darby Concession Agreement	US$5 per ha per year of developed concession area
Concession obligation for Oil Palm Development Fund Contribution (US$/yr)	Sime Darby Concession Agreement	1% of gross revenue
Land rental fee (US$/ha/yr)	Sime Darby Concession Agreement	US$5 for developed concession area, US$2.5 for undeveloped concession area
Concessionaire other taxes and fees (US$/yr)	LEITI reports	Calculated as 27% of total tax obligation
Costs of RSPO certification	GROW (2013), based on WWF (2012)	HCV mapping US$5/ha Environmental and Social Impact Assessment US$6/ha Initial certification US$3.5/ha Recertification US$7/ha
Costs of Participatory Land Use Planning	Author's calculations based on previous projects	US$10,000 per community, or an average of about US$4.5/ha

The following tables illustrate the set-up of the model; the full spreadsheet model is available on request.

Table A2.2: Smallholder credit structure

CREDIT PER HECTARE FOR SMALLHOLDER SETUP COSTS

Rate	4.00%			Credit issued	Beginning Balance	Interest portion of payment	Principal portion of payment	Ending Balance
Loan	$ 8,000	Period						
Periods over which issued	4	0	$ 2,000	$ -				$ 2,000
		1	$ 2,000	$ 2,000	$ 80	$ -		$ 4,000
Repayment Period (years)	11	2	$ 2,000	$ 4,000	$ 160	$ -		$ 6,000
First Payment Year	5	3	$ 2,000	$ 6,000	$ 240	$ -		$ 8,000
Assume interest payments made from Y1		4	$ -	$ 8,000	$ 320	$ -		$ 8,000
		5	$ -	$ 8,000	$ 320	$ 593		$ 7,407
Annual Payment	$913	6	$ -	$ 7,407	$ 296	$ 617		$ 6,790
Total Payments	$10,045	7	$ -	$ 6,790	$ 272	$ 642		$ 6,148
		8	$ -	$ 6,148	$ 246	$ 667		$ 5,481
		9	$ -	$ 5,481	$ 219	$ 694		$ 4,787
		10	$ -	$ 4,787	$ 191	$ 722		$ 4,065
		11	$ -	$ 4,065	$ 163	$ 751		$ 3,315
		12	$ -	$ 3,315	$ 133	$ 781		$ 2,534
		13	$ -	$ 2,534	$ 101	$ 812		$ 1,722
		14	$ -	$ 1,722	$ 69	$ 844		$ 878
		15	$ -	$ 878	$ 35	$ 878		$ -
		16	$ -	$ -	$ -	$ -		$ -
		17	$ -	$ -	$ -	$ -		$ -
		18	$ -	$ -	$ -	$ -		$ -
		19	$ -	$ -	$ -	$ -		$ -
		20	$ -	$ -	$ -	$ -		$ -

Table A2.3: Concession cost model

CORPORATE COST MODEL
(per hectare, by age of trees)

Productivity (FFB MT/ha)				**Plantation Production Costs (US$/ha)**				
Age	*Max Yield*		*18*	manuring	upkeep	harvest & transport	indirect cost	**TOTAL**
0	planting	0%	-					1,000
1	pre-production	0%	-					1,000
2		0%	-					1,000
3		0%	-					1,000
4	production ramp up	10%	2	670	67	36	209	982
5		25%	5	670	67	90	223	1,050
6		45%	8	670	67	162	243	1,142
7		75%	14	670	67	270	272	1,279
8	peak production	100%	18	670	67	360	296	1,393
9		100%	18	670	67	360	296	1,393
10		100%	18	670	67	360	296	1,393
11		100%	18	670	67	360	296	1,393
12		100%	18	670	67	360	296	1,393
13		100%	18	670	67	360	296	1,393
14		100%	18	670	67	360	296	1,393
15		100%	18	670	67	360	296	1,393
16	decline	95%	17	670	67	342	291	1,370
17		90%	16	670	67	324	286	1,347
18		85%	15	670	67	306	282	1,325
19		80%	14	670	67	288	277	1,302
20		75%	14	670	67	270	272	1,279

Table A2.4: Smallholder cost model

SMALLHOLDER COST MODEL
(per hectare, by age of trees)

Productivity (FFB MT/ha)				Costs (US$/ha)					Revenue (US$/ha)			
Age		*Max Yield*	*15*	*manuring*	*upkeep*	*harvest & transport*	*indirect cost*	*TOTAL*	*Gross*	*Debt Service*	*Net Revenue*	*Local Wages*
0	planting	0%	-					1,615	$ -	$ -	$ 385	$ 428
1	pre-production	0%	-					1,615	$ -	$ 80	$ 305	$ 428
2		0%	-					1,615	$ -	$ 160	$ 225	$ 428
3		0%	-					1,615	$ -	$ 240	$ 145	$ 428
4	production ramp up	10%	1.5	670	67	30	41	808	$ 203	$ 320	-$ 926	$ 214
5		25%	3.8	670	67	75	44	856	$ 506	$ 913	-$ 1,263	$ 227
6		45%	6.8	670	67	135	47	919	$ 911	$ 913	-$ 921	$ 243
7		75%	11.3	670	67	225	52	1,014	$ 1,519	$ 913	-$ 408	$ 268
8	peak production	100%	15.0	670	67	300	56	1,093	$ 2,025	$ 913	$ 19	$ 289
9		100%	15.0	670	67	300	56	1,093	$ 2,025	$ 913	$ 19	$ 289
10		100%	15.0	670	67	300	56	1,093	$ 2,025	$ 913	$ 19	$ 289
11		100%	15.0	670	67	300	56	1,093	$ 2,025	$ 913	$ 19	$ 289
12		100%	15.0	670	67	300	56	1,093	$ 2,025	$ 913	$ 19	$ 289
13		100%	15.0	670	67	300	56	1,093	$ 2,025	$ 913	$ 19	$ 289
14		100%	15.0	670	67	300	56	1,093	$ 2,025	$ 913	$ 19	$ 289
15		100%	15.0	670	67	300	56	1,093	$ 2,025	$ 913	$ 19	$ 289
16	decline	95%	14.3	670	67	285	55	1,077	$ 1,924	$ -	$ 847	$ 285
17		90%	13.5	670	67	270	54	1,061	$ 1,823	$ -	$ 761	$ 281
18		85%	12.8	670	67	255	54	1,046	$ 1,721	$ -	$ 676	$ 277
19		80%	12.0	670	67	240	53	1,030	$ 1,620	$ -	$ 590	$ 273
20		75%	11.3	670	67	225	52	1,014	$ 1,519	$ -	$ 505	$ 268

Table A2.5: Commercial Production (SPO)

	Commercial Plantation																						
Age / *Year*	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*SUM*	
Production (MT FFB/ha)	-	-	-	-	1.8	4.5	8.1	13.5	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	17.1	16.2	15.3	14.4	13.5		**Production**	**Costs**
Production Cost (US$/ha)	1000	1000	1000	1000	981.7	1050	1142	1279	1393	1393	1393	1393	1393	1393	1393	1393	1370	1347	1325	1302	1279		**(MT FFB)**	**(US$)**
0	5000										10000											15000	180,000	18,931,900
1	5000	5000										10000										20000	180,000	23,931,900
2		5000	5000										10000									20000	180,000	23,931,900
3			5000	5000										10000								20000	180,000	23,931,900
4				5000	5000										10000							20000	189,000	23,840,450
5					5000	5000										10000						20000	211,500	24,091,900
6						5000	5000										10000					20000	234,000	24,663,400
7							5000	5000										10000				20000	270,000	25,577,800
8								5000	5000										10000			20000	310,500	26,606,500
9									5000	5000										10000		20000	324,000	26,949,400
10										5000	5000										10000	20000	315,000	26,720,800
11											5000	5000										10000	180,000	13,931,900
12	5000											5000	5000									15000	180,000	18,931,900
13	5000	5000											5000	5000								20000	180,000	23,931,900
14		5000	5000											5000	5000							20000	180,000	23,931,900
15			5000	5000											5000	5000						20000	180,000	23,931,900
16				5000	5000											5000	5000					20000	184,500	23,726,150
17					5000	5000											5000	5000				20000	198,000	23,749,000
18						5000	5000											5000	5000			20000	220,500	24,320,500
19							5000	5000											5000	5000		20000	256,500	25,234,900
20								5000	5000											5000	5000	20000	297,000	26,263,600

Table A2.6: Smallholder Production (SPO)

	Smallholders																					
Age *Year*	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*SUM*
Production (MT FFB/ha)	-	-	-	-	1.5	3.8	6.8	11.3	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	14.3	13.5	12.8	12.0	11.3	
Net Revenue (US$/ha)	385	305	225	145	-926	-1263	-921	-408	19	19	19	19	19	19	19	19	847	761	676	590	505	
Debt Service (US$/ha)	0	80	160	240	320	913	913	913	913	913	913	913	913	913	913	913	0	0	0	0	0	
of which interest is: (US$/ha)	0	80	160	240	320	320	296	272	246	219	191	163	133	101	69	35	0	0	0	0	0	
Local Wages (US$/ha)	428	428	428	428	214	227	243	268	289	289	289	289	289	289	289	289	285	281	277	273	268	
0	12000										1000											13000
1	12000	12000										1000										25000
2	12000	12000	12000										1000									37000
3	12000	12000	12000	12000										1000								49000
4	12000	12000	12000	12000	12000										1000							61000
5	12000	12000	12000	12000	12000	12000										1000						73000
6	12000	12000	12000	12000	12000	12000	12000										1000					85000
7	12000	12000	12000	12000	12000	12000	12000	12000										1000				97000
8	12000	12000	12000	12000	12000	12000	12000	12000	12000										1000			109000
9	11000	12000	12000	12000	12000	12000	12000	12000	12000	12000										1000		120000
10		11000	12000	12000	12000	12000	12000	12000	12000	12000	12000										1000	120000
11			11000	12000	12000	12000	12000	12000	12000	12000	12000	12000										119000
12	1000			11000	12000	12000	12000	12000	12000	12000	12000	12000	12000									120000
13		1000			11000	12000	12000	12000	12000	12000	12000	12000	12000	12000								120000
14			1000			11000	12000	12000	12000	12000	12000	12000	12000	12000	12000							120000
15				1000			11000	12000	12000	12000	12000	12000	12000	12000	12000	12000						120000
16					1000			11000	12000	12000	12000	12000	12000	12000	12000	12000	12000					120000
17						1000			11000	12000	12000	12000	12000	12000	12000	12000	12000	12000				120000
18							1000			11000	12000	12000	12000	12000	12000	12000	12000	12000	12000			120000
19								1000			11000	12000	12000	12000	12000	12000	12000	12000	12000	12000		120000
20									1000			11000	12000	12000	12000	12000	12000	12000	12000	12000	12000	120000

Production	**Net Revenue Pre-tax**	**Local Wages**
MT FFB	**US$**	**US$**
15,000	4638810	5,419,738
15,000	8298810	10,550,131
15,000	10998810	15,680,524
15,000	12738810	20,810,917
33,000	1627794	23,379,030
78,000	-13525690	26,097,814
158,250	-23750302	29,013,308
292,500	-28736425	32,230,146
471,750	-28596149	35,698,102
651,000	-28840873	38,738,526
830,250	-33240597	37,076,090
999,000	-37099682	35,149,420
1,179,000	-39108966	33,918,702
1,357,500	-39632332	32,473,974
1,517,250	-28038727	33,365,448
1,649,250	-13081287	34,102,064
1,736,250	6546262	34,365,667
1,761,750	19816338	34,507,968
1,737,750	28040566	34,374,038
1,706,250	35410393	34,198,255
1,665,000	41669501	33,968,062

Table A2.7: Corporate Results (SPO)

	Area Planted (ha)			Production (FFB, MT)			Output (MT)		Costs (US$)					Revenue pre tax, fee and contributions		Net Revenue after tax (US$)
Yr	Small-holders	Corp. Plantation	Total	Small-holders	Corp. Plantation	Total	CPO	PKO	Purchases from SH	Plantation Production	Milling	Transp. to Port	Total	Gross	Net	
0	13000	15000	28000	15,000	180,000	195,000	42,900	5,363	2,025,000	18,931,900	530,888	820,463	22,308,250	34,185,938	11,877,688	$ 7,354,650
1	25000	20000	45000	15,000	180,000	195,000	42,900	5,363	2,025,000	23,931,900	530,888	820,463	27,308,250	34,185,938	6,877,688	$ 3,511,670
2	37000	20000	57000	15,000	180,000	195,000	42,900	5,363	2,025,000	23,931,900	530,888	820,463	27,308,250	34,185,938	6,877,688	$ 3,542,492
3	49000	20000	69000	15,000	180,000	195,000	42,900	5,363	2,025,000	23,931,900	530,888	820,463	27,308,250	34,185,938	6,877,688	$ 3,573,314
4	61000	20000	81000	33,000	189,000	222,000	48,840	6,105	4,455,000	23,840,450	604,395	934,065	29,833,910	38,919,375	9,085,465	$ 5,209,215
5	73000	20000	93000	78,000	211,500	289,500	63,690	7,961	10,530,000	24,091,900	788,164	1,218,071	36,628,135	50,752,969	14,124,834	$ 8,882,025
6	85000	20000	105000	158,250	234,000	392,250	86,295	10,787	21,363,750	24,663,400	1,067,901	1,650,392	48,745,443	68,766,328	20,020,886	$ 13,121,332
7	97000	20000	117000	292,500	270,000	562,500	123,750	15,469	39,487,500	25,577,800	1,531,406	2,366,719	68,963,425	98,613,281	29,649,856	$ 20,020,761
8	109000	20000	129000	471,750	310,500	782,250	172,095	21,512	63,686,250	26,606,500	2,129,676	3,291,317	95,713,743	137,138,203	41,424,461	$ 28,430,108
9	120000	20000	140000	651,000	324,000	975,000	214,500	26,813	87,885,000	26,949,400	2,654,438	4,102,313	121,591,150	170,929,688	49,338,538	$ 34,009,494
10	120000	20000	140000	830,250	315,000	1,145,250	251,955	31,494	112,083,750	26,720,800	3,117,943	4,818,639	146,741,133	200,776,641	54,035,508	$ 37,204,466
11	119000	10000	129000	999,000	180,000	1,179,000	259,380	32,423	134,865,000	13,931,900	3,209,828	4,960,643	156,967,370	206,693,438	49,726,068	$ 34,213,331
12	120000	15000	135000	1,179,000	180,000	1,359,000	298,980	37,373	159,165,000	18,931,900	3,699,878	5,717,993	187,514,770	238,249,688	50,734,918	$ 34,496,845
13	120000	20000	140000	1,357,500	180,000	1,537,500	338,250	42,281	183,262,500	23,931,900	4,185,844	6,469,031	217,849,275	269,542,969	51,693,694	$ 34,743,168
14	120000	20000	140000	1,517,250	180,000	1,697,250	373,395	46,674	204,828,750	23,931,900	4,620,763	7,141,179	240,522,593	297,549,141	57,026,548	$ 38,430,507
15	120000	20000	140000	1,649,250	180,000	1,829,250	402,435	50,304	222,648,750	23,931,900	4,980,133	7,696,569	259,257,353	320,690,391	61,433,038	$ 41,477,321
16	120000	20000	140000	1,736,250	184,500	1,920,750	422,565	52,821	234,393,750	23,726,150	5,229,242	8,081,556	271,430,698	336,731,484	65,300,787	$ 44,203,822
17	120000	20000	140000	1,761,750	198,000	1,959,750	431,145	53,893	237,836,250	23,749,000	5,335,419	8,245,648	275,166,318	343,568,672	68,402,354	$ 46,453,247
18	120000	20000	140000	1,737,750	220,500	1,958,250	430,815	53,852	234,596,250	24,320,500	5,331,336	8,239,337	272,487,423	343,305,703	70,818,281	$ 48,255,442
19	120000	20000	140000	1,706,250	256,500	1,962,750	431,805	53,976	230,343,750	25,234,900	5,343,587	8,258,271	269,180,508	344,094,609	74,914,102	$ 51,298,218
20	120000	20000	140000	1,665,000	297,000	1,962,000	431,640	53,955	224,775,000	26,263,600	5,341,545	8,255,115	264,635,260	343,963,125	79,327,865	$ 54,587,178

Table A2.8: Smallholder Results (SPO)

													RSPO Certification	
	Production	Net Revenue Pre-tax	Local Wages	Avg. Wage per worker	Avg. Inc. Tax per Worker	Total SH Income Tax	Net Wages	Net Revenue after Tax	Total Debt Service	Interest Payments	ESIA	PLUP	*initial*	*recurring*
Year	MT FFB	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$
0	15,000	4638810	5,419,738	2,085	195	507,461	4,912,277	4,131,349	-	-	72,000	54,545	42,000	7,000
1	15,000	8298810	10,550,131	2,110	199	995,020	9,555,111	7,303,790	960,000	960,000	72,000	54,545	42,000	91,000
2	15,000	10998810	15,680,524	2,119	200	1,482,579	14,197,945	9,516,231	2,880,000	2,880,000	72,000	54,545	42,000	175,000
3	15,000	12738810	20,810,917	2,124	201	1,970,138	18,840,780	10,768,672	5,760,000	5,760,000	72,000	54,545	42,000	259,000
4	33,000	1627794	23,379,030	1,916	170	2,073,354	21,305,675	- 445,561	9,600,000	9,600,000	72,000	54,545	42,000	343,000
5	78,000	-13525690	26,097,814	1,788	151	2,199,172	23,898,642	- 15,724,862	20,558,308	13,440,000	72,000	54,545	42,000	427,000
6	158,250	-23750302	29,013,308	1,707	138	2,354,496	26,658,812	- 26,104,798	31,516,616	16,995,268	72,000	54,545	42,000	511,000
7	292,500	-28736425	32,230,146	1,661	132	2,555,022	29,675,124	- 31,291,447	42,474,923	20,254,414	72,000	54,545	42,000	595,000
8	471,750	-28596149	35,698,102	1,638	128	2,793,215	32,904,887	- 31,389,364	53,433,231	23,205,593	72,000	54,545	42,000	679,000
9	651,000	-28840873	38,738,526	1,614	125	2,990,779	35,747,747	- 31,831,652	64,391,539	25,836,488	66,000	50,000	38,500	763,000
10	830,250	-33240597	37,076,090	1,545	114	2,741,413	34,334,676	- 35,982,010	75,269,847	28,054,286	-	-	-	840,000
11	999,000	-37099682	35,149,420	1,477	104	2,475,913	32,673,507	- 39,575,595	85,188,154	28,965,663	-	-	-	833,000
12	1,179,000	-39108966	33,918,702	1,413	94	2,267,805	31,650,897	- 41,376,771	94,146,462	28,556,764	6,000	4,545	3,500	833,000
13	1,357,500	-39632332	32,473,974	1,353	85	2,051,096	30,422,878	- 41,683,428	102,224,770	26,893,176	-	-	-	840,000
14	1,517,250	-28038727	33,365,448	1,390	91	2,184,817	31,180,631	- 30,223,545	108,829,885	23,959,912	-	-	-	840,000
15	1,649,250	-13081287	34,102,064	1,421	96	2,295,310	31,806,755	- 15,376,597	108,909,885	20,645,113	-	-	-	840,000
16	1,736,250	6546262	34,365,667	1,432	97	2,334,850	32,030,817	4,211,412	98,031,578	17,194,522	-	-	-	840,000
17	1,761,750	19816338	34,507,968	1,438	98	2,356,195	32,151,773	17,460,143	87,666,462	13,961,040	-	-	-	840,000
18	1,737,750	28040566	34,374,038	1,432	97	2,336,106	32,037,932	25,704,460	76,708,154	11,012,823	-	-	-	840,000
19	1,706,250	35410393	34,198,255	1,425	96	2,309,738	31,888,516	33,100,655	65,749,847	8,385,010	-	-	-	840,000
20	1,665,000	41669501	33,968,062	1,415	95	2,275,209	31,692,853	39,394,292	54,791,539	6,090,416	-	-	-	840,000

Table A2.9: Overall Results (SPO)

	Land Use			Employment							Government Revenue			
	Commercial Oil Palm	*Smallholder Oil Palm*	*Other*	*Commercial Oil Palm*			*Smallholder Oil Palm*		*Indirect Employment*		*Land Rental Fees*	*Corporate Tax*	*Income taxes*	*Other taxes and fees*
Year	*Hectares*	*Hectares*	*Hectares*	*Skilled Jobs*	*Worker Jobs*	*of which Women=*	*Worker Jobs*	*of which Women=*	*Jobs*	*of which Women=*	*$*	*$*	*$*	*$*
0	15,000	13,000	268,380	169	2,918	992	2,600	884	15,870	7,300	$ 403,709	$ 2,451,550	$ 2,130,121	$ 875,920
1	20,000	25,000	251,380	225	3,891	1,323	5,000	1,700	25,440	11,702	$ 386,209	$ 1,170,557	$ 3,017,680	$ 1,017,393
2	20,000	37,000	239,380	225	3,891	1,323	7,400	2,516	32,137	14,783	$ 356,209	$ 1,180,831	$ 3,505,239	$ 1,006,297
3	20,000	49,000	227,380	225	3,891	1,323	9,800	3,332	38,835	17,864	$ 326,209	$ 1,191,105	$ 3,992,798	$ 995,201
4	20,000	61,000	215,380	225	3,891	1,323	12,200	4,148	45,533	20,945	$ 296,209	$ 1,736,405	$ 4,103,667	$ 1,004,443
5	20,000	73,000	203,380	225	3,891	1,323	14,600	4,964	52,230	24,026	$ 266,209	$ 2,960,675	$ 4,287,023	$ 1,058,396
6	20,000	85,000	191,380	225	3,891	1,323	17,000	5,780	58,928	27,107	$ 236,209	$ 4,373,777	$ 4,545,032	$ 1,151,904
7	20,000	97,000	179,380	225	3,891	1,323	19,400	6,596	65,626	30,188	$ 206,209	$ 6,673,587	$ 4,913,096	$ 1,313,167
8	20,000	109,000	167,380	225	3,891	1,323	21,800	7,412	72,323	33,269	$ 176,209	$ 9,476,703	$ 5,355,415	$ 1,520,059
9	20,000	120,000	156,380	225	3,891	1,323	24,000	8,160	78,463	36,093	$ 148,709	$ 11,336,498	$ 5,687,271	$ 1,684,540
10	20,000	120,000	156,380	225	3,891	1,323	24,000	8,160	78,463	36,093	$ 148,709	$ 12,401,489	$ 5,514,004	$ 1,823,079
11	10,000	119,000	167,380	112	1,946	662	23,800	8,092	72,162	33,194	$ 126,209	$ 11,404,444	$ 4,244,103	$ 1,465,150
12	15,000	120,000	161,380	169	2,918	992	24,000	8,160	75,591	34,772	$ 136,209	$ 11,498,948	$ 4,535,787	$ 1,770,418
13	20,000	120,000	156,380	225	3,891	1,323	24,000	8,160	78,463	36,093	$ 148,709	$ 11,581,056	$ 4,818,038	$ 2,075,331
14	20,000	120,000	156,380	225	3,891	1,323	24,000	8,160	78,463	36,093	$ 148,709	$ 12,810,169	$ 5,040,325	$ 2,211,673
15	20,000	120,000	156,380	225	3,891	1,323	24,000	8,160	78,463	36,093	$ 148,709	$ 13,825,774	$ 5,223,998	$ 2,324,330
16	20,000	120,000	156,380	225	3,891	1,323	24,000	8,160	78,463	36,093	$ 148,709	$ 14,734,607	$ 5,297,806	$ 2,396,335
17	20,000	120,000	156,380	225	3,891	1,323	24,000	8,160	78,463	36,093	$ 148,709	$ 15,484,416	$ 5,342,601	$ 2,430,296
18	20,000	120,000	156,380	225	3,891	1,323	24,000	8,160	78,463	36,093	$ 148,709	$ 16,085,147	$ 5,367,400	$ 2,445,926
19	20,000	120,000	156,380	225	3,891	1,323	24,000	8,160	78,463	36,093	$ 148,709	$ 17,099,406	$ 5,416,679	$ 2,476,823
20	20,000	120,000	156,380	225	3,891	1,323	24,000	8,160	78,463	36,093	$ 148,709	$ 18,195,726	$ 5,464,030	$ 2,506,621

Table A2.9 cont'd: Overall Results (SPO)

	Social Benefits		Ecosystem		BAU to SEM Transition Costs			
	Company Social Investments	*Oil Palm Devt. Fund*	*Primary forest*	*Secondary forest*	*SH set up costs (interest payments)*	*PLUP costs*	*ESIA*	*RSPO certification costs*
Year	*$*	*$*	*Hectares*	*Hectares*	*$*	*$*	*$*	*$*
0	$ 450,000	$ 341,859	166226	84627	$ -	$ 54,545	$ 72,000	$ 49,000
1	$ 450,000	$ 341,859	166226	75499	$ 960,000	$ 54,545	$ 72,000	$ 133,000
2	$ 450,000	$ 341,859	166226	65915	$ 2,880,000	$ 54,545	$ 72,000	$ 217,000
3	$ 450,000	$ 341,859	166226	56538	$ 5,760,000	$ 54,545	$ 72,000	$ 301,000
4	$ 450,000	$ 389,194	166226	47182	$ 9,600,000	$ 54,545	$ 72,000	$ 385,000
5	$ 450,000	$ 507,530	166226	37421	$ 20,558,308	$ 54,545	$ 72,000	$ 469,000
6	$ 450,000	$ 687,663	166226	28094	$ 31,516,616	$ 54,545	$ 72,000	$ 553,000
7	$ 450,000	$ 986,133	166226	18464	$ 42,474,923	$ 54,545	$ 72,000	$ 637,000
8	$ 450,000	$1,371,382	166226	11496	$ 53,433,231	$ 54,545	$ 72,000	$ 721,000
9	$ 450,000	$1,709,297	166226	10872	$ 64,391,539	$ 50,000	$ 66,000	$ 801,500
10	$ 450,000	$2,007,766	166226	10872	$ 75,269,847	$ -	$ -	$ 840,000
11	$ 450,000	$2,066,934	166226	10872	$ 85,188,154	$ -	$ -	$ 833,000
12	$ 450,000	$2,382,497	166226	10872	$ 94,146,462	$ 4,545	$ 6,000	$ 836,500
13	$ 450,000	$2,695,430	166226	10872	$ 102,224,770	$ -	$ -	$ 840,000
14	$ 450,000	$2,975,491	166226	10872	$ 108,829,885	$ -	$ -	$ 840,000
15	$ 450,000	$3,206,904	166226	10872	$ 108,909,885	$ -	$ -	$ 840,000
16	$ 450,000	$3,367,315	166226	10872	$ 98,031,578	$ -	$ -	$ 840,000
17	$ 450,000	$3,435,687	166226	10872	$ 87,666,462	$ -	$ -	$ 840,000
18	$ 450,000	$3,433,057	166226	10872	$ 76,708,154	$ -	$ -	$ 840,000
19	$ 450,000	$3,440,946	166226	10872	$ 65,749,847	$ -	$ -	$ 840,000
20	$ 450,000	$3,439,631	166226	10872	$ 54,791,539	$ -	$ -	$ 840,000

Annex 3: GIS Results

Annex 3.1: GIS-based characterization of spatial outcomes under BAU and SPO

To spatially characterize the BAU and SPO scenarios, we undertook the following steps:

1. **GIS analysis of land suitability for oil palm development in the concession area**: Land suitability analysis is a useful tool for land use planning and sustainable agricultural expansion.[26] From literature we derived biophysical parameters that influence palm oil growth and productivity. The selected parameters were prior land use, climatic variables (precipitation, maximum temperature, minimum temperature and number of dry months), topography (slope and elevation), and soil characteristics (drainage, depth and texture). A suitability map was generated through an overlay analysis of these parameters. Finally, potential land use was reclassified using the suitability results.

2. **Scenarios:** The scenarios for plantation area under commercial and smallholder oil palm were constructed following the rules presented in the Table A3-1.1.

Table A3-1.1: Rules to Construct the BAU and SPO Scenarios

Process	BAU	SPO
Start with (commercial)	10,000	10,000
Start with (smallholder)	1,000	1,000
End with (commercial)	220,000	20,000
End with (smallholder)	0	120,000
New planting (commercial)	210,000	10,000
New planting (smallholder)	0	119,000

3. **BAU Scenario and Results:**
    1. We identified settlements in the concession area, and defined buffer areas in a 2-km radius around each settlement (this will be referred to as smallholder area).
    2. The smallholder area was excluded from the area available for commercial oil palm plantation.
    3. Starting from the location of the mill and working outwards, the planting goal was to reach 220,000 ha of oil palm in total, avoiding (in addition to settlements and their buffer areas) current artificial surface area, existing palm oil plantation, and water bodies.
    4. We assumed a planting rate of 12,000 ha/year.
    5. With these planting parameters, the available area was distributed in 1 ha increments resulting in the planting sequence shown in the following Table A3-1.2:

[26] Raschio, G; Alei, F; Alkan, F. Methodological guideline to produce a land suitability map for palm oil in Papua New Guinea. Forest Carbon Partnership Facility, UNDP.

Table A3-1.2: Results of BAU Scenario for Commercial Oil Palm Planting

BAU								
	Commercial plantation							
Year	Primary Forest	PF cumulative	Secondary Forest	SF cumulative	Other	Other cumulative	Total	Total Cumulative
Previously Planted Oil Palm							10000	10000
1	2819	2819	6399	6399	2804	2804	12022	22022
2	6062	8880	4601	11000	1353	4157	12015	34037
3	6685	15565	4159	15159	1157	5314	12001	46038
4	5286	20852	5071	20230	1642	6956	11999	58038
5	9707	30559	1749	21978	568	7524	12023	70061
6	7301	37860	3478	25456	1252	8776	12031	82092
7	7027	44887	4016	29472	957	9733	12000	94092
8	8343	53229	3051	32522	636	10369	12029	106121
9	8574	61803	2710	35232	720	11089	12004	118125
10	7902	69706	2980	38212	1116	12206	11998	130123
11	8790	78495	2443	40655	775	12981	12008	142131
12	5977	84472	4247	44901	1792	14772	12015	154145
13	6850	91322	4307	49208	858	15630	12015	166160
14	7205	98527	3941	53149	853	16483	11999	178159
15	9674	108201	1977	55126	347	16831	11999	190158
16	8068	116270	2847	57973	1113	17943	12028	202186
17	6798	123068	3445	61418	1777	19721	12020	214207
18	1670	124738	2576	63994	1547	21268	5793	220000
Total	**124738**		**63994**		**21268**		**220000**	

4. **SPO Scenario and Results:**
    1. The most important planting rules were to exclude primary forest from the area available for oil palm. We also excluded artificial surface areas, existing palm oil plantation, and water bodies.
    2. The goal for commercial planting area was set at 20,000 ha. An initial 10,000 ha were already planted; areas for new oil palm planting (10,000 ha) were selected to maximize proximity to the mill.
    3. For the 120,000 ha of smallholder oil palm development, we assumed that 1,000 ha were already planted. Then, we assigned areas for new planting such that 60% of secondary forest in the smallholder area (settlements and their buffer areas) was maintained.
    4. Subject to the constraints above, the remaining area was allocated to new oil palm planting. The results are presented in Tables A3-1.3 and A3-1.4.

Table A3-1.3: Results of SPO Scenario for Commercial Oil Palm Planting

SPO						
Commercial plantation						
Year	**Secondary Forest**	**SF cumulative**	**Other**	**other cumulative**	**Total**	**Total cumulative**
Previously Planted Oil Palm					10000	10000
1	3647	3647	1353	1353	5000	15000
2	4015	7661	985	2339	5000	20000
Total	**7661**		**2339**		**20000**	

Table A3-1.4: Results of SPO Scenario for Smallholder Oil Palm Planting

SPO						
Smallholder plantation						
Year	**Secondary Forest**	**SF cumulative**	**Other**	**other cumulative**	**Total**	**Total cumulative**
Previously Planted Oil Palm					1000	1000
1	8831	8831	3169	3169	12000	13000
2	9128	17959	2872	6041	12000	25000
3	9583	27542	2416	8457	11999	36999
4	9378	36920	2623	11080	12000	48999
5	9356	46276	2652	13731	12007	61007
6	9761	56037	2243	15974	12005	73012
7	9326	65363	2677	18651	12003	85015
8	8867	74230	3138	21789	12005	97020
9	1033	75264	10967	32757	12000	109020
10	763	76027	401	33158	1164	110184
Total	**76027**		**33158**		**110184**	

Annex 3.2: Environmental Implications of Spatial Outcomes

The concession has 12 blocks, identified as blocks A to J. Following Sime Darby documentation, the analysis excluded A and I blocks as unavailable for future development. In the remaining blocks (n=9), primary forest and secondary forest represented 56% and 31% respectively of the concession landscape. The least common type of land cover was tall mangroves (only 1.1 ha; see Table A3-2.1 and Figure A3-2.1).

Table A3-2.1: Current Land Use in the Concession

	Area by Block(hectares)										
Land Cover Type	**C**	**D**	**K**	**B**	**J**	**F**	**G**	**E**	**H**	**Total**	**%**
Primary Forest	4.5	7473.3	7914.0	21783.7	2681.8	48011.6	8163.3	38504.6	31689.2	166226.0	55.925
Secondary Forest	181.6	6679.5	10852.2	12017.0	3228.5	21169.5	6145.2	16018.1	17166.1	93457.6	31.443
Tall Mangroves		1.0	0.1							1.1	0.0004
Grasslands	4.6	27.8	52.1	39.7	5.3	283.4	3.8	43.8	81.2	541.5	0.1822
Degraded Forest	201.2	2540.2	3735.0	4644.6	1119.7	8391.5	1585.0	4475.0	8244.1	34936.3	11.754
Palm oil	239.7	792.2	230.2							1262.2	0.4246
Artificial Surface	2.1	19.0	9.5	33.8	7.8	95.9	3.4	36.7	67.9	276.1	0.0929
Barren soil	66.8	32.7	83.1	20.7	7.7	65.4	1.2	14.5	20.5	312.5	0.1051
Water bodies		134.3		10.5		24.2		46.2	0.2	215.3	0.0724
Total	700.5	17699.9	22876.1	38550.0	7050.7	78041.4	15901.8	59138.8	57269.2	297228.5	100

Below we present illustrative maps showing the distribution of forest after 20 years under the BAU and SPO scenarios. Note that these maps were generated through a simple algorithm that selected available forest blocks, subject to constraints described above, in an expanding radius from the mill. The actual configuration will result from complex land-use planning and negotiation processes as well as more fine-tuned responses to suitability conditions on the ground.

Figure A3-2.1: Current Land Cover in the Concession

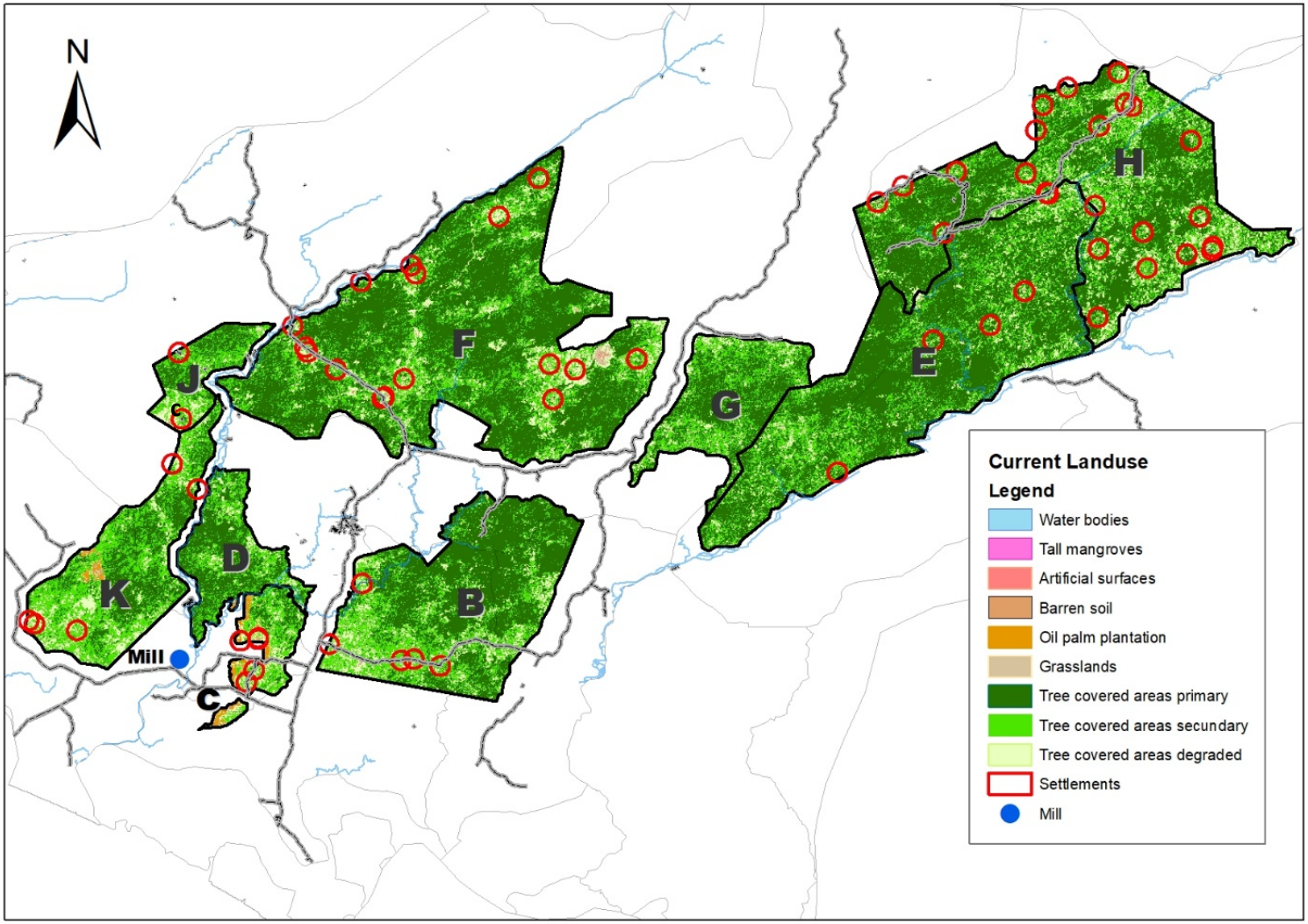
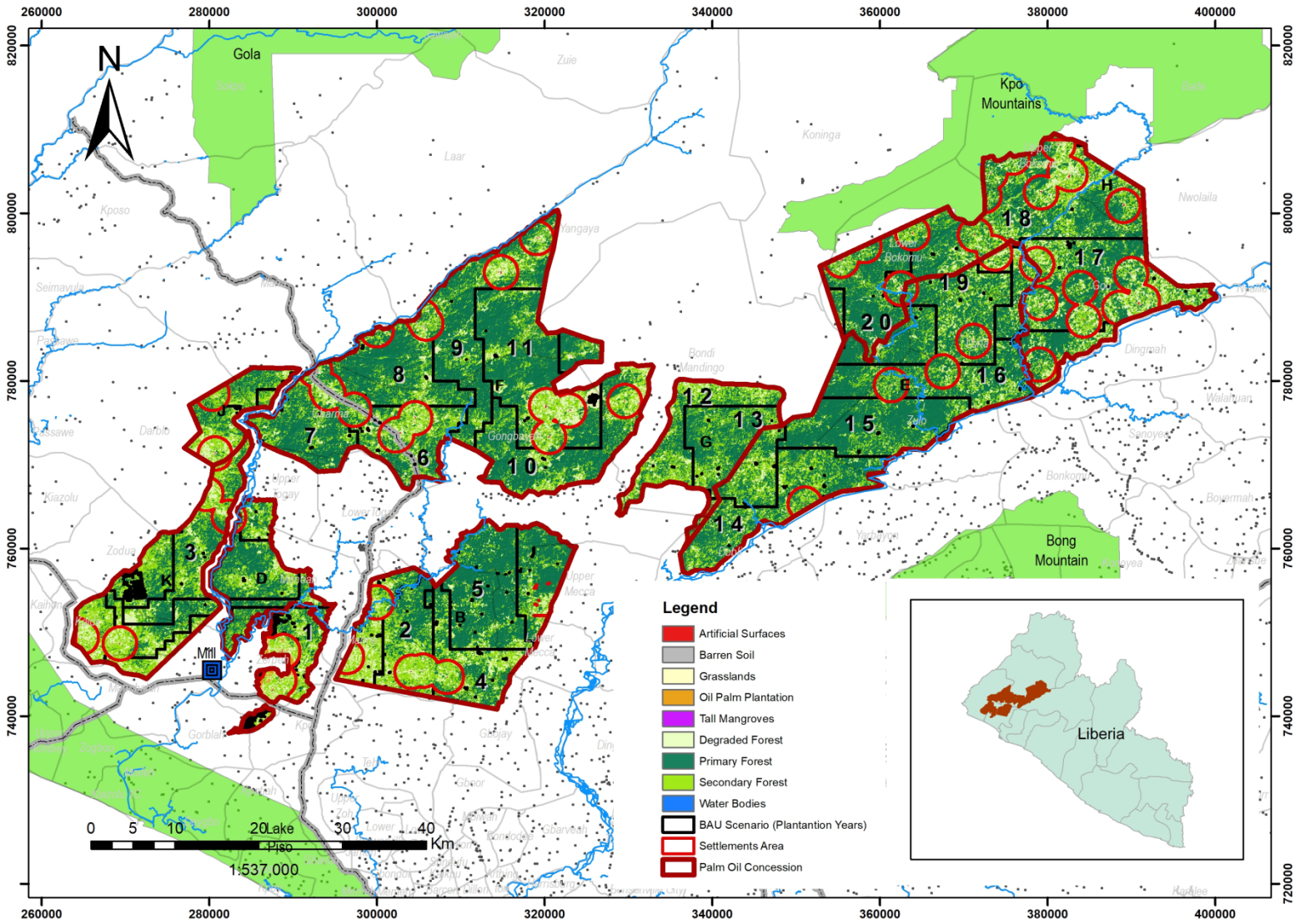
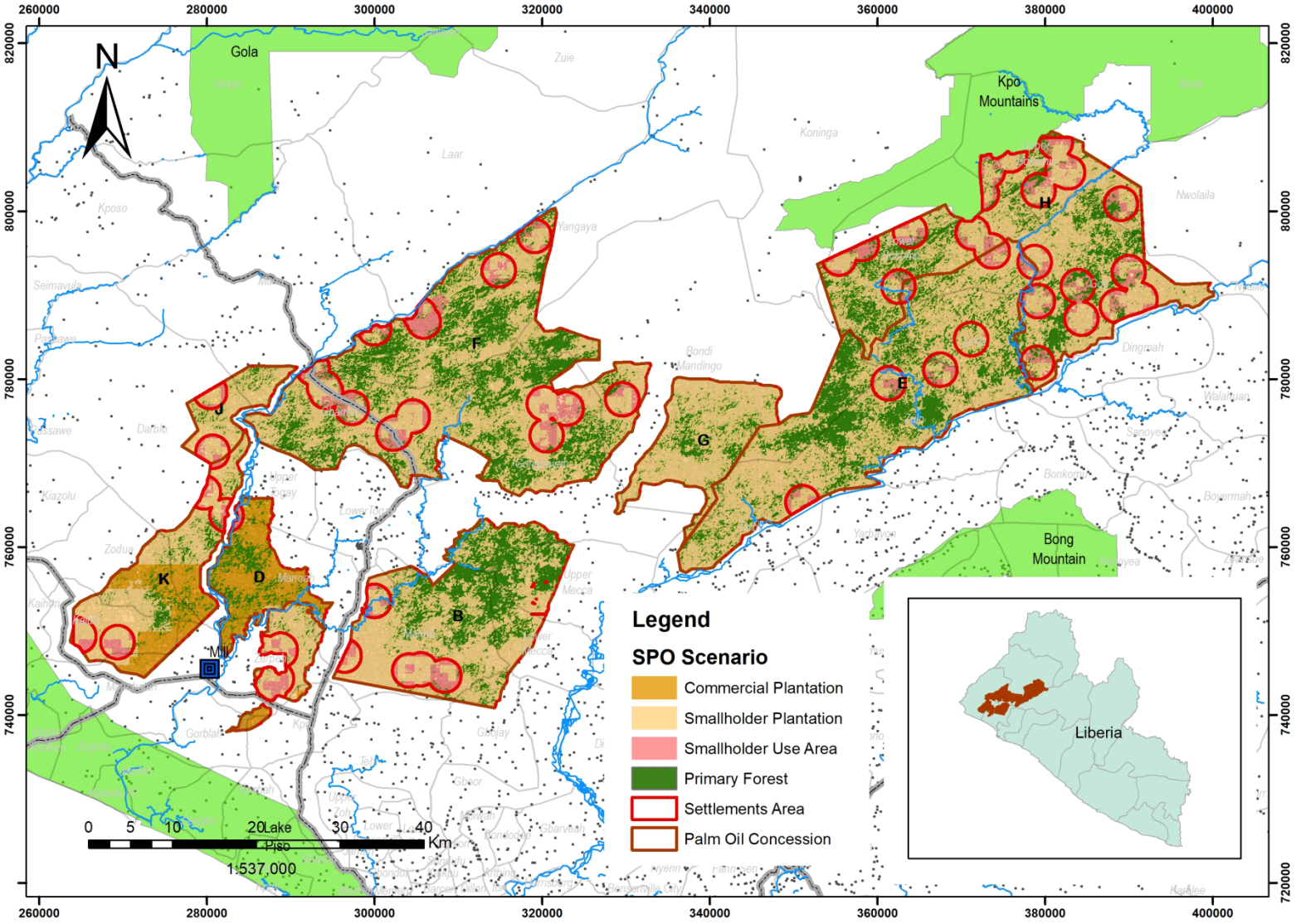


Figure A3-2.2: Land-use Distribution after 20 Years under BAU



(Note that under BAU, all green areas outside the Settlement Areas are converted to commercial oil palm)

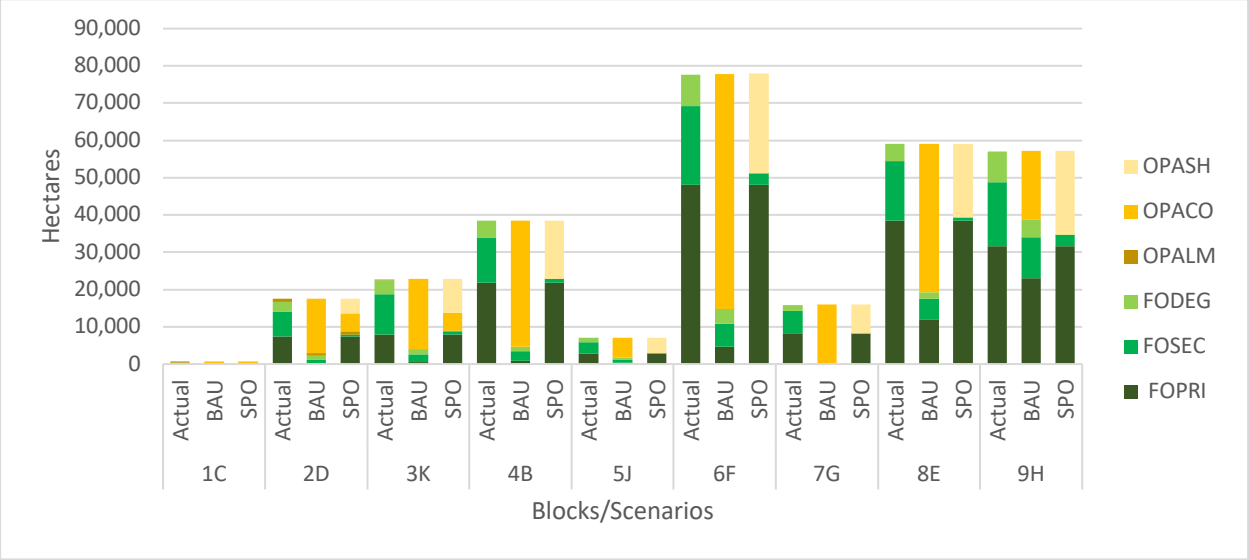
Figure A3-2.3: Land-use Distribution after 20 Years under SPO



In the current landscape of the concession, block C is the most degraded as a consequence of proximity to the mill (see Figure A3-2.2). The blocks that are most distant from the mill (blocks B, E, F, G, H and G) contain more primary and secondary forest. Blocks C, D and K contained pre-existing areas under oil palm cultivation.

Comparing changes in land use when moving from the current situation to the BAU and SPO scenarios, we see that the major difference relates to primary forest. Under SPO, there is no change in primary forest cover; under BAU, primary forest is the area with the most significant change, from 56% land cover under the current scenario to about 14%. Parallel results hold for areas under secondary and degraded forest (Figure A3-2.2).

Figure A3-2.2: Current, BAU and SPO Land Cover Distribution in Each Concession Block



Legend: FOPRI (primary forest), FOSEC (secondary forest), FODEG (degraded forest), OPALM (current/previous palm oil), OPACO (new commercial areas for palm oil), OPASH (new smallholder areas for palm oil)

Overall, the concession shows limited anthropogenic impacts in the current condition of the landscape. More than 50% is covered by primary forest with well-linked patches. The results of a landscape fragmentation analysis (Table A3-2.2) indicate that under the current scenario, blocks close to the mill have few patches of primary and secondary forest, and that these patches are isolated (separated by 50-200 m). However, in blocks D to H, the number of patches of primary forest is greater than of other land cover types, and the patches are better connected (separated by 50 to 100 m). Secondary forest patches in blocks F, E and H also are well connected (similar to primary forest), though the large number of patches (> 9,000) may indicate disturbance.

Table A3-2.2 shows the large difference in impact on primary forest under the BAU and SPO scenarios. However, relative to BAU, the SPO scenario involves a greater decrease in the number of secondary and degraded forest patches (NP) as they are converted to oil palm. The distance between patches increases,

indicating greater fragmentation (per the Euclidean Near Neighbor, or ENN, metric). This is a logical result of the fact that under SPO primary forest is maintained at the expense of other areas. Maintaining primary forest under SPO will reduce impact on biodiversity.

Table A3-2.2: Current Land Use in the Concession

		FOPRI		FOSEC		FODEG		OPACO		OPASH		OPALM	
Block	**Scenarios**	**NP**	**ENN**	**NP**	**ENN**	**NP**	**ENN**	**NP**	**ENN**	**NP**	**ENN**	**NP**	**ENN**
C	**Current**	**7**	**197**	**40**	**86**	**70**	**78**					**36**	**92**
C	BAU	3	92	21	132	21	192	60	69			36	92
C	SEM	7	197	19	148	21	196	64	69			36	92
D	**Current**	**1174**	**85**	**1954**	**76**	**1099**	**101**					**200**	**133**
D	BAU	323	162	341	149	306	155	99	77			200	133
D	SEM	1174	85	220	196	107	342	1417	79	445	113	200	133
K	**Current**	**2104**	**85**	**2050**	**72**	**1391**	**96**	**37**	**102**	**1226**	**82**	**67**	**75**
K	BAU	502	129	353	131	392	139					67	75
K	SEM	2104	85	285	145	92	397	654	76				
B	**Current**	**2125**	**87**	**4461**	**82**	**2370**	**107**						
B	BAU	805	128	403	142	555	131	1	0	3601	86		
B	SEM	2125	87	373	159	67	541						
J	**Current**	**683**	**83**	**852**	**70**	**414**	**107**			**744**	**70**		
J	BAU	267	120	219	106	185	107	1	0				
J	SEM	683	83	192	120	41	267						
F	**Current**	**3757**	**78**	**12631**	**77**	**3950**	**114**						
F	BAU	2069	102	1694	97	1276	115	6	159				
F	SEM	3757	78	1374	105	125	445			10484	81		
G	**Current**	**1373**	**73**	**2352**	**70**	**1225**	**115**						
G	BAU	100	271	115	227	56	468	2	85				
G	SEM	1373	73	109	237	55	475			1991	72		
E	**Current**	**2287**	**70**	**9665**	**75**	**4135**	**114**						
E	BAU	1060	88	3637	79	1547	123	22	71				
E	SEM	2287	70	770	104	35	1125			7611	79		
H	**Current**	**3722**	**74**	**9578**	**73**	**4416**	**105**						
H	BAU	2680	79	6244	75	2655	113	1355	79				
H	SEM	3722	74	2296	83	146	320			6232	80		

Legend: FOPRI (primary forest), FOSEC (secondary forest), FODEG (degraded forest), OPALM (current/previous palm oil), OPACO (new commercial areas for palm oil), OPASH (new smallholder areas for palm oil. NP (number of patches), ENN (Euclidean Near Neighbour)

Annex 4: Why Did Sime Darby Leave?

Although the core question of interest for the TSA was whether SPO yields superior outcomes relative to the BAU scenario, the modeling exercise can also inform reflection on why Sime Darby ultimately chose to relinquish its concession to MANCO.

First, we note that the model suggests that under the BAU with parameters as indicated above, the concessionaire faces a losing proposition. Government fees and taxes negate financial returns, exacerbated by losses due to social conflict (even modeled as a fairly modest effect). This raises the question of why Sime Darby invested in the concession to begin with. At least three factors may be noted:

1. The period during which Sime Darby and others invested in oil palm concessions in Liberia was a period of relatively high world prices for palm oil. The price since then has declined somewhat, while production costs have not (see Figure A4.1 below, noting price spikes in the 2008-2012 period).

Fig. A4.1: Price of Palm Oil, US$/MT, c.i.f. Rotterdam

2. Documentation of Sime Darby's own production modeling shows substantially higher assumptions for yields and mill conversion ratios, on the order of 20 or more MT of FFB per hectare per year for yield and 25% conversion of FFB to CPO. Our model indicates that actual average yield achieved likely was closer to 12 MT of FFB per hectare, as a result of lower intrinsic productivity and the age structure of the plantation.

3. Our model assumed a FFB price paid to smallholders equal to 18% of the CPO price. Sime Darby FFB pricing in Southeast Asia typically is closer to 15%.

Together, higher output prices, higher yields, and lower transfer prices for FFB paid to smallholders make for a much more attractive investment thesis. Thus, the modeling exercise suggests that Sime Darby's own projections may have been based on exceedingly optimistic assumptions. As true production parameters became clear (including the cost of managing relationships with communities) and financing for smallholder development remained elusive, Sime Darby's position became increasingly untenable. To this can be added the imminent prospect of increasing costs due to expiration of government incentives intended to attract investment.

Annex 5: Implementation Approach for Recommendations

Recommendations	Steps/Actions	Timeframe (months)		
		1-2	*3-4*	*5-6*
1. To maximize total value generated by oil palm development, the Government of Liberia should maintain its commitment to requiring that concessionaires abide by RSPO principles and criteria. At present, this commitment is reflected mainly in the concession agreements; issuing an explicit policy through the Ministry of Agriculture would lend this commitment additional force. The IMCC could reinforce this policy by facilitating a supporting Executive Order from the Office of the President, further strengthening the Government's position with respect to concessionaires as well as potential sources of financing for sustainable oil palm development.	1.1. MoA works with NOPPOL to designate a sub-committee (SC) to draft policy position paper 1.2. SC prepares draft policy position paper 1.3. MoA presents policy position paper to NOPPOL for feedback 1.4. SC revises policy position paper 1.5. MoA presents revised policy position to IMCC 1.6. MoA, on behalf of IMCC, engages Office of the President to explore possibility of an Executive Order to give force to policy position paper	1.1	1.2 1.3 1.4	1.5 1.6
2. The national interpretation process for RSPO principles and criteria needs to be concluded as soon as possible, and must specifically address secondary forest in a way that is appropriate for a high forest, low deforestation, least developed country context. As an example, the model results show outcomes of a requirement that 60% of secondary forest be maintained, after protecting all primary forest as well as High Carbon Stock forest and High Conservation Value forest. Once the national interpretation has been validated and approved, including reconciliation with Liberia's National Forest Definition framework, it should be explicitly incorporated in the Ministry of Agriculture policy decree recommended in the previous point, and ideally reinforced by Executive Order. Subsequently, the Ministry, working with the NBC, LLA and FDA should require that oil palm development plans of both concessionaires and smallholder communities explicitly demonstrate how the national interpretation will be applied. Agency review of these plans would benefit from a land suitability map, which the GOL should require as part of the concession review package while national land-use suitability mapping efforts progress.	2.1. MoA policy position paper SC invites input from lead consultant on RSPO NI process, to incorporate NI into policy position (part of Step 1.2) 2.2. MoA works with NBC, LLA and FDA to draft brief guidance document(s) on incorporating NI into oil palm development plans, including land suitability mapping requirements and Means of Verification, ideally through independent third party (consider amending TOR for consultant mentioned in 2.1 to include facilitating this step) 2.3. MoA works with UNDP/GGP project and other partners to prepare TOR for technical consultant to conduct national geospatial analysis of NI implications	2.1	2.2 2.3	

3. The Government of Liberia, NGO partners, concessionaires and communities should redouble their efforts to develop a workable model for smallholder oil palm development, with an emphasis on securing affordable credit to finance start-up costs. The advantages of the SPO scenario versus the BAU hinge on this commitment. Joint work by IDH and CI on a smallholder investment and production model with Sime Darby represents a well-advanced effort to design a mutually beneficial arrangement for communities and the concessionaire. The Government, MPOI, IDH and CI should build on this effort by using the model developed for this TSA to formulate a concrete investment prospectus for presentation to potential investors, particularly in the impact investment sector; this effort should be aligned with ongoing efforts by the World Bank, IFAD and USAID to address the absence of credit options for smallholders in Liberia. At the same time, the model can inform how conventional development funding sources (e.g. ODA, philanthropy) may direct support to enabling conditions such as building capacity to facilitate participatory land use planning within County Administrations.	3.1 NOPPOL tasks SC with advancing smallholder/outgrower model; invite CI and IDH to facilitate this SC effort 3.2 SC assigns a technical lead to articulate financing model for result of 3.1, using TSA analytical framework to illustrate cash flow and ROI implications 3.3 CI and IDH work with NIC to develop draft investment prospectus, for review by NOPPOL and IMCC 3.4 SC finalizes investment prospectus, including identification of funding needs appropriate for philanthropy/multilateral support, to construct a blended financing model 3.5 CI and IDH work with MPOI and NIC to identify and approach potential philanthropic sources and impact investors	3.1 3.2	3.3 3.4	3.5
4. Given the enormous benefits that accrue to the concessionaire under the SPO scenario relative to BAU, it is in the interest of MPOI to provide further support for smallholder development. In addition to working with Government and civil society to approach potential financing sources such as impact investors, MPOI should examine how it can best provide technical extension support to smallholder palm oil producers, and work with the smallholder sector to identify cost-effective arrangements for sourcing inputs.	4.1 CI and IDH work with MPOI, using TSA analytical framework, to rationalize corporate share of the blended financing model developed in Step 3.4 4.2 CI and IDH work with MPOI to design a cost-share formula that allows smallholders to benefit from MPOI sourcing relationships		4.1 4.2	

5. The Government of Liberia and NGO partners should redouble their efforts to advance REDD+ frameworks, and consider particular attention to including compensation for avoided emissions from deforestation through sustainable plantation development. To date, the evolving national REDD+ framework leaves unclear whether avoided deforestation and forest degradation within agroforestry concessions can generate revenue from carbon credits. The Ministry of Agriculture and the FDA should convene a joint session of the national REDD+ Technical Working Group and the National Oil Palm Platform of Liberia to explore how the SPO scenario can be positioned to generate carbon revenue. One use of eventual carbon revenue that should be considered is the creation of conservation-based jobs to help ensure avoided emissions from deforestation and forest degradation, and to offset the lower amount of employment generated under SPO compared to the BAU scenario.	5.1 MOA and FDA develop agenda for joint session of REDD+ TWG and NOPPOL, for review by the members of the two bodies 5.2 Convene joint session, with overarching objective of exploring how SPO will contribute to NDCs and can generate carbon revenue 5.3 Outputs anticipated from the joint session and immediate follow-up to include: explicit policy position with respect to SPO and carbon, for consideration by National Climate Change Steering Committee and Secretariat; TOR for technical support to define how SPO will be incorporated into Liberia's REDD+ frameworks; an expression of principles, objectives and vision for how SPO-derived climate revenue will support conservation-based employment.	5.1	5.2 5.3	
6. Additional recommendations relate to possible further refinements to the modeling framework that was developed for this TSA. Refinements to consider include: • Updating the analysis on the basis of the finalized National Interpretation process for RSPO principles and criteria • Analyzing intermediate scenarios reflecting alternative ratios of commercial plantation and smallholder development (and possibly variations in other parameters) • Modeling the results of different possible contract constructions between the concessionaire and outgrowers, clearly defining royalties and benefit-sharing arrangements • Introducing seasonality dynamics that reflect temporal production patterns over the course of a typical year • Examining alternatives to sole reliance on the commercial mill, such as pre-processing of FFB using small local mills • Elaborating productivity parameters as a function of land suitability • Incorporating the value of other ecosystem services (e.g. hydrology), and their impacts on long-term productivity	6.1 UNDP and CI develop TOR for technical consultancy to further develop the TSA modeling framework 6.2 CI presents TOR to NOPPOL for input, feedback and approval 6.3 NOPPOL members collectively consider possible sources of funding to support model refinement consultancy (unless funds are readily available from existing sources)	6.1	6.2 6.3	