Secured Landscapes:
Financial modeling for sustainable land use

Prepared for The World Agroforestry Centre (ICRAF)
by
The Munden Project
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This report presents summary conclusions from the financial viability modeling exercise carried out by The Munden Project on three test site landscapes chosen by ICRAF as part of the Secured Landscape project.

The purpose of this paper is to establish whether the sustainable land use projects being developed by ICRAF are potentially financially profitable, and how they compare to the practices currently in place.

In each case we found that enhanced environmental impact and improved financial performance were compatible. However, our key conclusion is that moving beyond improved production practices, to consider the producers’ place in the market and value chain are necessary conditions of interventions with the potential to generate transformative change.
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1. Introduction

As part of its “Secured Landscapes” initiative, ICRAF has asked The Munden Project to analyze the financial viability of a specific set of sustainable practices. The aim of the project is to improve the social and environmental impact of smallholder agriculture, agroforestry and forestry activities, while achieving better financial performance in three developing countries: Cameroon, Indonesia and Vietnam. The end goal is to foster sustainable land use practices that are attractive targets for financial investors to deploy capital.

To enable intelligent investment decisions for both public and private actors, we have developed a model to assess the financial performance of different land use activities. We have used this model to compare the income derived from existing production relative to the agroforestry practices that ICRAF would like to implement in Indonesia, Vietnam and Cameroon. This process introduces a basic and reliable cost-benefit analysis of the proposed investments.

The Introduction provides context for our quantitative findings by briefly describing the key features of the landscape under analysis. The second part of the report provides background analysis of each landscape, followed a detailed description of how the model was constructed and how it operates in the third section before presenting our results in the fourth.

1.1 Case studies: Financial performance highlights

The results conclude the first phase of our analysis in Efoulan in Cameroon, Bac Kan (Ba Be) in Vietnam, and Tanjung Jabung Barat District (hereafter referred to as Tanjabar), in Indonesia.

The practices in the three locations are highly labor intensive with large operational expenditures. Households tend to operate individually, rather than cooperating, which contributes to performances below the Poverty Line Income, with the exception of Tanjabar.

- In Efoulan, households consistently performed well below the poverty line under the Base Case Scenario. Providing a market platform for community cooperation significantly increases their returns to almost double the Poverty Line Income.

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2 The original remit included a fourth practice in Peru, however. We were, however, forced to exclude Peru from the financial modelling because the activities in question are too immature and we were unable to collect the relevant data, either by interview or fieldwork.

3 See Appendices for the dull results of the financial model and Section 3 for a full explanation of the results.

4 Otherwise known as Kabupaten Tanjung Jabung Barat
In Ba Be, farmers consistently made a loss well below the Poverty Line Income for maize mono-cropping, and intercropping maize with either Acacia or Melia.

In Tanjabar, coffee agroforestry, oil palm, and Jelutong systems all earn a return significantly above the Poverty Line Income\(^5\), year-on-year. Jelutong only yields a positive cash flow from year 9 on.

It is clear that farmers need to move away from current practices that seek to sell raw products in small quantities on an individual farm basis. For tree cultivation that takes long periods to yield a positive cash flow, these practices need to be supplemented with public capital to attract smallholders. The success of sustainable land use program adoption will go beyond agricultural extensions\(^6\), and will also depend on good access to capital, technology, energy, and markets.

### 1.2 Supporting smallholders

Leading studies suggest that population growth will require worldwide food production to double by 2050\(^7\). However, we are also told that:

> The world faces a looming and growing agricultural crisis. Yields are not improving fast enough to keep up with projected demands in 2050\(^8\).

If we want to address the problem of how to feed a growing population sustainably, in the face of a changing climate and deteriorating natural environment, we have to recognize the importance of smallholders:

> 80 percent of the farmland in Asia and Sub-Saharan Africa is managed by smallholders (working on up to 10 hectares)\(^9\).

Smallholders can be key contributors to global food security and nutrition if they are adequately supported. Our ability to provide smallholders and investors with tools to facilitate efficient capital allocation could be a decisive factor in this struggle for improved environmental, as well as developmental, outcomes\(^10\).

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\(^5\) The average return earned for Coffee agroforestry and Jelutong are almost double the Poverty Line Income, while that earned for oil palm is more than double the Poverty Line Income.

\(^6\) Agricultural extensions refer to the application of knowledge and scientific research to enable change in agricultural practices through farmer education and agricultural technology.


\(^9\) FAO, “Smallholders and Family Farmers”, Sustainability Pathways, 2012

\(^10\) Agriculture, forestry, and agro-forestry
In 2010, the International Food Policy Research Institute further noted that:

Most rural households lack access to reliable and affordable finance for agriculture and other livelihood activities.  

The capital deficit is key to explaining the low uptake of sustainable land use practices. These activities typically require relatively large upfront investments that take time to deliver revenue. This puts them out of reach of most smallholders.

Better financial support will afford smallholders the opportunity to adopt sustainable practices. By providing tools to generate this information we can help to catalyze private sector investment while making public sector investment more targeted and efficient. However, there is no basis for evaluating investments in smallholders to which finance can be released to them. Until this issue is addressed, a lack of capital available to smallholders will persist.

This paper seeks to enable such concerted efforts by providing an accessible and scalable tool for evaluating financial performance of different spending decisions and by extension their relative impacts.

1.3 Implementing change

One necessary condition of successful outcomes is smallholder confidences in new techniques. To enable this, implementation strategies must seek to deploy new capital, technology and diversified practices in a phased approach.

Graduation from one phase to the next should be determined by well-defined and measureable performance standards. For example, a phased approach would start with new techniques for one particular crop; when that first new practice is embedded and begins to show livelihood improvements for the farmers, the next cultivation or processing phase can be introduced.

Other possible phases include establishing or enabling:

- A platform for cooperation;
- Shared storage facilities to prolong the life of the produce;
- Diversification of farming activities;
- Access to processing facilities, transportation, and markets; and
- Product commercialization.

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12 Product commercialization was identified as one of the most important factors in lifting smallholders in developing countries out of poverty. See Harris, D., Orr, A., Op. Cit., for a full list of factors that significantly affect smallholders' income in developing countries.
Enabling environment
There are three key factors that determine the performance of smallholders: organization, energy access and diversification.

1) **Organization**: Cohesive producer groups capable of collectively agreeing on a business plan and sticking to it are at a significant advantage. Pooling production creates a better bargaining position when selling their product.\(^1\)

2) **Access to sufficient energy** can improve yields, reduce losses and help producers move up the value chain. Energy supply in most rural areas in developing countries is intermittent at best, with power outages that can last up to several months. Yet the available natural resources should be sufficient to allow these communities access to a reliable supply of electricity.

3) **Diversification** is a necessity in places where farmers have no government-backed safety nets. A diversified business model is more resilient than one focused on only one or two products. Historically, the path to financial security in agriculture has been one of simplification: larger and larger farms focusing on a reduced variety of crops, leading to monoculture and intensification.

   It has more recently become apparent that there is a need to build mechanisms and infrastructure directed towards diversification. Practices like agroforestry help to achieve diversification, but also maintain soil productivity, and help increase yields on a long-term basis. Furthermore, they help reduce the overall cost of operations because they do so without the need to increase chemical inputs like fertilizer.

In this respect, we think that ICRAF’s expertise in dealing with agroforestry systems is a key advantage that should be leveraged with a commercial approach to the implementation of sustainable practices. Developing and implementing new practices requires first that we identify and validate such practices, and then extend the practices to producers.

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\(^1\) In one case we encountered in Efoulan, cocoa producers refused to pool their product together and sell it in bulk; they were receiving a price for their yield that was on average between 20% and 50% below the market price.
2. Background Analysis

This section provides an overview of the Efoulan, Ba Be and Tanjabar landscapes. It details existing land use practices in each landscape, describing key factors such as constraint, threats, and opportunities.

The purpose of this overview is to generate an understanding of which aspects of each context may either hinder or facilitate the implementation of proposed improvement projects, (which are described in detail in section 3).

2.1 The Efoulan Landscape

I. Current Land Use Practices and Farming Systems

Land use in the Efoulan landscape can be broken down into the following: home gardens near the dwelling; perennial plantations, at a somewhat greater distance; and shifting cultivation fields away from the home (see Table 1). It is also common to find a forest patch between the home garden and the perennial plantations where domestic animals, mainly pigs, stay.

<table>
<thead>
<tr>
<th>Land cover type</th>
<th>Current land use/farming practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home gardens</td>
<td>Cassava, egusi, plantain, peanuts, sweet potatoes, pepper, tomatoes, local and domesticated forest fruit trees, livestock: goats, pigs, chickens, sheep and ducks</td>
</tr>
<tr>
<td>Perennial plantations</td>
<td>Cocoa, oil palm, raphia palm, fruit tress such as wild mangoes, wood materials*</td>
</tr>
<tr>
<td>Animal System (on shifting cultivated land)</td>
<td>Pigs, goats, sheep, and fowl</td>
</tr>
<tr>
<td>Non timber forest products (NTFP)</td>
<td>Bush meat, fisheries, traditional grafting</td>
</tr>
</tbody>
</table>

*Used for firewood, building, repair and construction

Arable crops for both subsistence and commerce dominate, accounting for 80% of available land. There are three major categories of cropping in Efoulan landscape farming systems:

1) Extensive, highly shaded cocoa growth with low input level and low yields
2) Mixed food crops grown on young to medium fallows
3) Melon seed fields (egusi), developed on forest or old fallows

See Box 1 in the Appendix for an overview of the Efoulan Landscape
Cocoa farms are rarely established directly after forest clearing or thinning. More commonly, households will establish egusi farms and/or other mixed food crops with a short fallow rotation before establishing cocoa farms.

a. Inputs
All of the listed practices are considered relatively labor intensive, with most dependent manual tillage with a hoe. Yet the use of hired labor is largely restricted to felling trees during land preparation. Men and women in a household share day-to-day farm work, with children providing help during school vacations.

b. Subsistence and food security
More than 75% of food crop production is for self-consumption. Egusi and peanuts are major crops, often either rotated or grown alongside each other. Both crops are important for subsistence farmers in West Africa because they are rich in protein and other nutrients, providing a range of health benefits.

Partly as a result of this focus on subsistence, egusi production is still immature from a commercial perspective, with 80% of production geared towards subsistence. But in areas with better market access, egusi fields are dominated by the production of the more commercial plantain.

c. The size of farms
The majority of farmers are smallholders but Efoulan also hosts some large-scale plantations. Semi-industrial plantations of oil palm are becoming increasingly attractive to local elites and international agri-business firms. These are mainly carved out of primary forest land to avoid conflicts with farmers who have customary rights over existing crop and fallow land.

The elites in question are natives of the village and by custom have the right to clear forest which no one else is using. These rights were established to allow growing families to expand their subsistence production but are now applied with more aggressive commercially aims.

II. Problems
Agricultural development faces several typical constraints in Efoulan:

- Local agricultural markets are small
- Agricultural input markets are underdeveloped
- Road infrastructure is limited and poorly maintained

Forests are mostly considered by local farmers as land reserves for future agricultural use; the value that could potentially be derived from forests through sustainable logging or environmental preservation is overlooked.
Examples of communities getting organized to start the exploitation of timber in community forests do exist in Cameroon. However, this requires significant preparatory work, including the establishment of a forest management plan, creation of an enterprise to manage the operation, as well as obtaining a license to exploit the timber.

Well-structured organizations within the Efoulan community are rare; groups are formed by affinity and their dissolution is often caused by mismanagement of funds

The area as a whole suffers from poverty. Though most income is from agriculture, little is re-invested in agricultural production, except occasionally to buy fungicides and insecticides for cocoa. Very little chemical fertilizer is used in these farming systems. Cash is used chiefly for kerosene, soap, medicines, and school fees.

In addition, Efoulan suffers acutely from poor transportation links, poor access to technology and services, and lack of secure tenure rights.

  a. Transportation
Transportation is a major challenge for commercial crop producers in the area: although numerous pathways exist, there are only two roads suitable for motor vehicles, and these are unpaved.

The roads become very slippery during the rainy seasons, making access to market problematic (although most agricultural products still end up in the market). In extreme conditions, the roads become flooded, cutting off access for motor vehicles.

Public transport is available but prohibitively expensive: the farmers revealed that a one-way ticket can cost as much as FCFA 2,000 (~USD 4) for an average distance of 75 km.

  b. Access to technology, capital and inputs
Farmers in Efoulan have limited access to technology, using minimal manual equipment and little to no fertilizer or pesticide input. Agricultural extension services are rudimentary, mainly due to the lack of transportation for the agents and because the farmers have limited resources, both financially and in terms of time available for training.

  c. Land rights
Land tenure is insecure, particularly for certain groups. For example, women are rarely allocated land rights for themselves. Their right to use land generally comes through men, from a husband or other male family members, leaving them fully dependent on others for access to basic resources.

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16 Ibid.
Customary land rights are usually based on lineage; the original rights to land being gained through settlement or clearing. As a result, land is allocated on a “first come, first served” basis, with plots of land along the roadsides the preferred location for farm establishment. Rights are then retained through continuous use. But this unclear arrangement precipitates numerous land conflicts\textsuperscript{17}.

ICRAF’s results confirm that the ‘first use’ land tenure system promotes shifting cultivation in preference to sedentary systems with higher investment. Shifting cultivation is considered to be detrimental to the environment, as it destabilizes the soil and reduces soil cover.

Young farmers and migrants prefer to gain access to new lands in primary forest along road and logging tracks rather than trying to transform local subsistence agriculture into market-oriented farming systems.

III. Opportunities

Although productive agricultural land has expanded rapidly, the activities themselves have undergone very little innovation in the last ten years. This is probably explained by the problems listed above, along with unpredictable prices for key commodities. For example, few farmers have expanded or intensified their cocoa farms through tree planting and farm renewal in recent years.

This suggests a number of opportunities for sustainable intensification. These include providing regular access to new cocoa hybrids or introducing improved farm management techniques (reduced shade, increased plant density and use of chemical inputs).

There are also opportunities to protect the forest through community forestry enterprises and small and medium-sized forest enterprises. Net rates of deforestation are low in the areas occupied by smallholders: just 12% of food crop expansion so far has displaced primary forest.

Where the opportunity costs of foregoing forest conversion to other land uses are too high, a combination of policy options involving positive incentives and direct regulation will be necessary if deforestation is to be avoided\textsuperscript{18}.

IV. Threats

Once the main axis to Ebolowa is paved – connecting through Lolodorf, Yaounde to the future Kribi deep seaport – there is a risk that deforestation may accelerate. Some steps to improve agricultural prospects could thus have unintended consequences for forest health and environmental integrity.

\textsuperscript{17} Ibid. 17, p.24

\textsuperscript{18} Ibid. 17, p.26-27
One preeminent threat here may be the growing involvement of local elites in plantations. No solid data is available to support this hypothesis, but it seems likely that industrial plantations could become key drivers of deforestation because of their size, and also because they are usually developed on primary forest in order to avoid land conflicts.

V. Conclusion

A lack of innovation in agricultural production helps to explain the low level of economic development in this area. By addressing a series of constraints, such as links to market and access to services, it is possible to develop opportunities for agricultural production that are both commercially viable and environmentally sustainable.

To take advantage of these opportunities smallholders must seek to pool production and so increase the aggregate scale of their operations. To do this, smallholders will require extensive support. If this support is not forthcoming, it seems likely that local elites and external investors will expand palm oil plantations and so drive unsustainable land use change.
2.2 The Ba Be, Bac Kan Landscape

I. Current Land Use Practices and Farming Systems

In Ba Be district, in compliance with national land management policies, the majority of forest land in the district is allocated to individuals or households, while state actors manage less than 20% of forest land. Portions of land remain unallocated and are minimally managed by Commune People's Committees (CPCs), making them “open access” forest areas for all intents and purposes.

Table 2. Forest management allocation in Ba Be district (hectares and percent of total area)

<table>
<thead>
<tr>
<th>District</th>
<th>Total area (ha)</th>
<th>Household, Individual</th>
<th>CPC</th>
<th>State organization</th>
<th>Economic organization</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ba Be</td>
<td>57,693</td>
<td>25,670 (44%)</td>
<td>19,757 (34%)</td>
<td>9,142 (16%)</td>
<td>3,122 (5%)</td>
<td>1 (1%)</td>
</tr>
</tbody>
</table>

Current land tenure arrangements in Ba Be district present challenges for the sustainable management of forest land and resources. The majority of forest lands are managed by individual households, but a significant area remains nominally unallocated or without tenants, in part because the process of entitlement is long and tedious. And since uncertified village members are not allowed to participate in forest conservation programs, this legal hurdle creates damaging social outcomes.

Major farming systems in Bac Kan

Land use in the Bac Kan is under four dominant farming practices: plantations forests, such as Acacia; perennial crops, such as tea; rice farming in lowland areas; and maize mono-cropping in the uplands.

Table 3. Land use dynamics in Bac Kan province

<table>
<thead>
<tr>
<th>Land cover type</th>
<th>Current land use/farming practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection and Special Use forest</td>
<td>Timber, bamboo, mixed timber species</td>
</tr>
<tr>
<td>Production forest</td>
<td>Acacia, Melia, Mangletia</td>
</tr>
<tr>
<td>Agroforestry areas</td>
<td>Tea, home gardens, mixed crops</td>
</tr>
<tr>
<td>Monocropping areas</td>
<td>Rice, maize, cassava</td>
</tr>
</tbody>
</table>

The household farm systems in Ba Be are relatively uniform. Most farmers are engaged in highly labor intensive activities in both upland and lowland areas. Farmers often cultivate a diverse range of products, reflecting the fact that they grow for both commercial and subsistence needs.

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10 See Box 2 in the Appendix for an overview of Bac Kan (Ba Be) Landscape

20 Legitimate land users should possess formal land titles in the form of “red book” certificates or LURCs but the process to obtain red book certificates is onerous and highly bureaucratic
In the upland areas, the average farmer has around 2-4 Bunz (1 hectare = 10 Bunz) where they grow maize and some cassava. In the lowlands, on average 3 Bunz is dedicated to rice farming, of which 1 Bunz is rotated with maize\textsuperscript{21}. Up to 50% of these main products (maize, rice and cassava) is consumed by the households. Closer to home, many also tend home gardens and fruit trees for subsistence purposes.

Tree-based systems such as tea plantations or mixed fruit gardens occupy a relatively small portion of the landscape. Similarly agroforestry techniques such as alley cropping of trees and maize are fairly novel and are still only practiced by a few households\textsuperscript{22}.

However local livelihood opportunities in protection forests\textsuperscript{23} are constrained, particularly in national parks, by conservation requirements that prohibit the extraction of forest resources\textsuperscript{24}.

II. Problems

Some of the activities currently pursued appear to be unsustainable, potentially degrading forest land over the long term. These damaging practices include: slash and burn agriculture, illegal logging, agriculture on sloping and forest land, mono-cropping of maize and free grazing of cattle\textsuperscript{25}.

a. Deforestation and land conversion

Growing populations in combination with scarce agricultural land\textsuperscript{26} have pushed farmers from the lowland river banks to the forested uplands.

Free grazing of cattle is common on unallocated forest and community lands, causing further damage to forests. Several projects have been initiated that promote fodder cultivation (stylo grass, elephant grass) instead of free grazing. However, most of these have failed, apparently because of very limited local markets for fodder products.

Illegal logging of the natural forest, seemingly driven by local demand for construction materials, is another serious problem.

\textsuperscript{21} Maize is primarily cultivated for cattle and poultry fodder with very little transformation to the final product, which is dried and grounded maize.

\textsuperscript{22} REALU Report on Incentives. World Agroforestry Centre (ICRAF) Vietnam.

\textsuperscript{23} Ba Be has the largest area of protection forests in Bac Kan province

\textsuperscript{24} LURC holders of planted production forests may convert them for commercial purposes, but stakeholders without formal rights in the form of LURCs are unable to extract resources. Holders of LURCs in protection forests, which are often located in watersheds, may not convert the forests and have the duty to prevent their exploitation. Special use forest LURC holders have the duty to maintain forests as protected areas.

\textsuperscript{25} Ibid. 25, p.80-81.

\textsuperscript{26} Farmers are forced to practice agriculture on hilly lands with slopes ranging from above 300 to 600
b. Mono-cropping cultivation
Most of the upland fields, including former forest land, have been dominated by mono-crop maize since the 1950s. Farmers find growing maize and other cash crops to be more economically profitable than planting trees on what are supposedly forest protection areas. Slash and burn practices were common on this land and now many of the fields have been completely cleared of trees.

c. Shifting Cultivation
Unclear land tenure has contributed to unregulated expansion and intensification of land use change. Field observations show farmers do not move to new plots of land to increase household income, but rather as a way to secure family needs and nutrition. For example, maize and cassava grown through this shifting cultivation pattern are normally diverted to household consumption or fattening cattle.

III. Opportunities
Community-based forest conservation models have been piloted and practiced in Bac Kan province for more than 10 years. Provincial authorities, keen to combat the spread of unsustainable practices, have encouraged forest protection by granting support to obtain forest land allocation, plus seedlings and financial assistance for sustainable plantations.

Effective community forest management models in the province were found to have the following features: they involve the allocation of forest land to communities by virtue of red book certificates; they had a clear benefit distribution mechanism; and they had high levels of support among the local population. For example, community-based agroforestry practices combining sloping land agriculture – mostly maize production – with trees such as Acacia mangium, Mangletia glauca and Melia azedarach have garnered local support.

If Bac Kan province can implement the “Payment for Forest Environmental Services Scheme”, a forest protection contract will entitle households in Ba Be under Nang River basin an equivalent

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27 Policy makers consider shifting agriculture to be detrimental to the environment, particularly as a cause of deforestation and soil erosion, and especially given the greatly reduced forest cover as compared with the past (from 43% in 1945 to 28% in 1993). In Vietnam, according to Ministry of Forestry statistics, the forest area lost annually was 100,000 ha, of which about 50% was due to shifting cultivation. In some areas in Vietnam, deforestation due to shifting cultivation represents 20-40% of the total deforested area.


28 Over 600 ha in Bac Kan’s forest areas were planted with high value tree species, such as Dendrocalamus membranaceus, Dendrocalamus ohhlami and Amomum aromaticum.

29 Payment to local households is offered through two state organizations, Ba Be national Park and/or district forest protection and development fund
amount of 200,000 VND/ha/year\(^{10}\) (~USD 9) from water services. Although the numbers aren’t large, this scheme and other forest environmental services can all help augment household incomes on an incremental basis with little extra time input from beneficiaries.

IV. Threats

Forest land concessions and large-scale plantations appear to have a damaging impact on the local environment without making a meaningful contribution to local livelihood improvements. Indeed these commercial projects often undermine the legitimate claims of local communities to customary land\(^{31}\).

In addition, the FALLOW\(^{32}\) model used to assess land use dynamics in the wider Bac Kan province demonstrated that stimulation of tree-based systems like Acacia plantation can result in a loss rather than a gain to the landscape’s carbon stock.

V. Conclusion

Accelerating the land entitlement process and/or re-arranging the current tenure system to increase participation in forest conservation programs appears to be a necessary, if not sufficient, condition of improved social and environmental outcomes.

Agroforestry initiatives that intercrop maize with timber trees can assist in preventing communities from exploiting the forest unsustainably to supplement their income, but these will need to be complemented with activities that generate short-term cash flows for the farmers. While a local and international market exists for timber goods, selling the raw timber material does not provide sufficient returns to raise smallholders above Poverty Level Income.

It would also be vital to provide access to capital, technology, and assistance for smallholders if they are to fully benefit from the opportunities provided by timber trees. Having the capacity to process the timber would significantly increase their income by enabling them to sell a higher value product to traders.

\(^{10}\) Dam et al, 2014 Environment and Natural Resources Research; Vol. 4, No. 1

\(^{31}\) Ibid. 25, p.6

\(^{32}\) Forest, Agroforest, Low-value Landscape Or Wasteland (FALLOW) model is a landscape-dynamics model with the aim of improving both economic (income per capita) and ecological (carbon stock at landscape level) output. The FALLOW model comprises: plot-level soil fertility; food storage use and sale at the village level; farmer’s decisions on cropped area; spatial implementation of choices for clearing land; and impact assessment of land cover types mosaic.

See ICRAF website for a full description of the inputs of the FALLOW model: http://www.worldagroforestry.org/regions/southeast_asia/resources/fallow-forest-agroforest-low-value-landscape-or-wasteland
2.3 The Tanjung Jabung Barat Landscape

I. Current Land Use Practices and Farming Systems

The four categories described in Table 4 are the dominant farming systems in the landscape of Tanjabar.

Table 4. Major land use systems in Tanjabar

<table>
<thead>
<tr>
<th>Land use type</th>
<th>On mineral soil</th>
<th>On peat areas</th>
<th>Scale of operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil palm</td>
<td>Nucleus Estate Smallholder (NES) oil palm</td>
<td>Independent smallholder oil palm plantation</td>
<td>1-2 ha</td>
</tr>
<tr>
<td>Coconut</td>
<td>Coconut monoculture</td>
<td>Coconut mixed with coffee and betel nut</td>
<td>1-2 ha</td>
</tr>
<tr>
<td>Rubber</td>
<td>Rubber monoculture</td>
<td>Rubber monoculture, rubber agro-forest</td>
<td>1-2 ha</td>
</tr>
<tr>
<td>Coffee</td>
<td>n/a</td>
<td>Coffee-based mixed garden with betel nut</td>
<td>1-2 ha</td>
</tr>
</tbody>
</table>

Rubber agroforestry system
Rubber agroforestry is a popular practice and has been an important income source for Tanjabar households since the 1950s. Smallholder farmers plant rubber together with non-rubber secondary succession trees on up to one-third of the rubber garden. On average, rubber can be sold for IDR 16,000,000 per ton (~USD 1,300).

Coconut agroforestry (coconut-betel nut)
Coconut monocultures for copra production have been cultivated in peatland villages for decades. However, following the fall in prices of the 1990s, production declined and farmers began to intercrop coconut with other cash crops such as betel nut palm (Areca catechu) and coffee. On average, coconut can be sold for IDR 3,800,000 per ton (~USD 320).

Betel is often planted as live fencing to mark land ownership. As prices of betel nut increased with market demand, farmers began to intercrop with betel nut more frequently and it has now become a major commodity for local households.

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33 See Box 3 in the Appendix for an overview of Tanjabar Landscape
35 Such trees include as pulai (Alstonia sp.) and tutup (Macaranga hypoleuca), fruit trees and valuable timbers such as durian (Durio zibethinus), duku (Lansium domesticum), petai (Parkia speciosa), jengkol (Archidendron pauciflorum), jackfruit (Artocarpus heterophyllus) and rambutan (Nephelium sp.). Aside from these, coffee (Coffea excelsa), betel (Areca sp.) and cempedak (Artocarpus integer) are also planted in rubber agro-forests.
36 Average density of rubber with 30 cm diameter or higher is about 100 trees/ha. Trees with less than 30 cm diameter is about 400 trees/ha, while non-rubber trees are about 150 trees/ha.
37 Average density of coconut is about 156 trees/ha and betel nut is about 400 trees/ha.
Coffee agroforestry (coffee-betel nut)
Widely adopted by smallholders in Tanjabar, coffee agroforestry systems are dominated by coffee bushes, intercropped with betel nut and/or coconut planted sparsely as productive shade trees or as live fencing.

Excelsa is the most popular coffee variety planted in this area, as it grows especially well in Tanjabar’s mature peatland. Excelsa starts to produce beans 3.5 years after planting and annual peatland productivity is 600-700kg of dry coffee grains per ha. The average price of coffee is IDR 16,500,000 per ton (~USD 1,400).

Oil palm monoculture
Indonesia is the world’s largest oil palm, controlling more than 45% of the global palm oil market. This rapid expansion is driven by both private companies and the state.

In Tanjabar, oil palm is a particularly popular crop in mineral soil areas. Plantations have increased at a rapid pace, from 79 ha in 1990 to 103,000 ha in 2009. This growth pattern began when private plantation companies provided trans-migrant farmers with assistance cultivate and sell oil palm.

Some households participating in the government’s transmigration program received land grants of 2 ha for planting oil palm, and 0.5 ha to build a shelter. Land was cultivated through a credit scheme offered by the companies, where farmers pay the credit debt upon sale of their crops.

In general, the productivity of oil palm smallholdings on mineral soil was up to 13 tons/ha/year, with medium to high levels of fertilization. In peatland areas, the productivity of oil palm was up to 10 tons/ha/year.

The average price of oil palm harvested on peat areas is IDR 1,200,000 per ton (~USD 100), while oil palm on non-peatland is sold at IDR 1,400,000 per ton (~USD 120). But smallholder oil palm on peatland is less profitable than on mineral soils because of the higher costs in establishing a drainage system, lower productivity and the difficulty of getting produce to market.

II. Problems

a. Land grabbing and forest encroachment
Land rights violations are relatively common in Tanjabar. Large-scale logging concessions from the 1970s and 1980s have been abandoned and were then considered as “open access” lands. This so-called “open access” phenomenon has contributed to widespread deforestation, land grabbing, and uncontrolled land conversion in Tanjabar.

38 Density of coffee in this farming system is about 2,240 trees/ha while betel nut is about 60 trees/ha.
b. **Active land use change/ land conversion**
Major land use change is shifting towards large-scale plantations of oil palm and acacia. Oil palm development is notably fast and extensive in Tanjabar because of the enabling market infrastructure\(^39\). This growth in large-scale plantations is squeezing out smaller and more sustainable farmers who focus on cash crops such as coffee.

c. **Income inequality**
Overall the level of income equality\(^40\) income is higher in peat areas than in mineral soil areas despite lower absolute income generation\(^41\). On the other hand, income from oil palm plantations on private land leads to unequal income distribution in the mineral soil areas. Wealthy farmers often extended their private land holdings, which seems to have concentrated income in the hands of fewer people.

Income inequality be between trans-migrants and local villagers is very high in mineral soil areas. In a vicious cycle, trans-migrants often use surplus oil palm income to buy new lands from local villagers that enable further expansion.

d. **Gender**
In Tanjabar, as in most of Indonesia, agricultural improvement programs commonly focus on male farmers\(^42\). For instance, agricultural information sessions held in villages only invite ‘household heads’ (a term long since synonymous with ‘men’, and also stated in the marriage law No. 1/1974), giving them exclusive access to assistance programs, such as agriculture loans.

In contrast, nearly 90% of women in some villages confirmed that they carry out most of the work\(^43\) in the agricultural lands, whilst men go to the forests to harvest timber for long stretches at a time.

III. **Opportunities**
ICRAF proposes two land use models as part of the conservation program in Tanjabar. First, the REALU scenario aims to reduce emissions and support forest diversification. It seeks to achieve

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\(^{39}\) The expansion of oil palm in Indonesia has increased rapidly due to the establishment of several government plantations followed by private plantations and ‘people’s plantations’ that promote Nucleus Estate Smallholders or NES, a scheme which has been popular in Tanjabar. The success of NES then encouraged the development of oil palm smallholdings.

\(^{40}\) Income equity/inequity refers to distribution of total income from all sources (e.g. farm and non-farm income) in the area among all the population.

\(^{41}\) *Ibid. 42, p.23*


\(^{43}\) In Tanjabar, women play a major role in vegetable production, cocoa cultivation, and various post harvesting activities where activities are not too physically demanding.
this by protecting both existing forests and rubber and coffee agroforestry systems from conversion to other uses\textsuperscript{44}.

The second model called Green REALU is similar but it also allows new oil palm plantations to be established on non-productive mineral soils such as grass or shrub lands. In theory this addition should increase profitability and carbon stock in the landscape.

Another promising option in Tanjabar is to bring back the practice of tapping Jelutong (\textit{Dyera lowrii}). This is a commercially viable tree species which produces latex, used by industries for chewing gum, cable coating and cellophane.

Jelutong timber is also sold for plywood, as material for pencils and other wood products\textsuperscript{45}. This could be a potential source of income for local people while enabling the conservation of peat forests. As such, the local government of Tanjabar has introduced the planting of Jelutong between oil palm trees within plantations in peat areas\textsuperscript{46}.

In addition, as part of the REALU scenario, oil palm plantations can be converted into Jelutong plantations as a way to rehabilitate the area and maintain the protection function of peat forest. Jelutong is also a natural tree species found in Tanjabar peatland forest, before locals over-exploited the tree almost to the point of extinction.

IV. Threats

\textbf{a. Profit reduction}

A business-as-usual (BAU) scenario assumes extensive conversion of remaining peat forest into smallholder oil palm plots. New oil palm plantations replace most of the coffee and coconut agroforests in the peat areas, while in mineral soil, oil palm competes with existing rubber systems. Overall, the landscape will be dominated by oil palm monoculture plantations, at small or large scale, offering higher returns but lowering carbon-stock content compared to other land-use systems.

Results of the simulation show that both REALU and Green REALU scenarios lead to a lower income per capita compared to BAU. Potential income losses may be attributed to preventing the conversion of agroforestry systems into oil palm, which is currently the most profitable model.

\textsuperscript{44} For rubber agro-forests in mineral soils, and coffee systems in peat areas, no conversion is allowed into another livelihood option, i.e. oil palm. Coconut agroforestry is excluded due to its lower market price compared to products from coffee and rubber agro-forests.

\textsuperscript{45} In Tanjabar, wild Jelutong in peat forest has vanished, owing to logging operations, which extracted the timber to fulfill the needs of the frame and pencil industries. In recent years, Jelutong has been promoted by the Forestry Agency as a forest restoration species and as commercial species alternative to oil palm.

\textsuperscript{46} The current recommendation for intensive planting is approximately 300 trees/ha. Tapping can start at 10 years after planting and continue for 30 years with latex productivity of 0.36 kg/tree with a 7-day tapping interval.
Even under Green REALU, where conversion of unproductive lands to oil palm is allowed, the impact on income is not significant as only a few shrub/grass lands are available in the landscape.

b. Deforestation
A general pattern of persistent forest loss has been observed in the district from 1990 to 2009. The remaining forest cover in 2009 is approximately 110,000 ha (24% of district area), down from 330,000 ha in 1990. Decreasing forest cover is directly related to increasing population density driven by in-migration to the area.

V. Conclusion
The implementation of land use systems that place a premium on forest conservation or restoration usually produces tradeoffs that lead to negative or reduced economic benefits for communities.

This was evident in the mineral soil areas of Tanjabar: oil palm provides farmers with a high amount of income; rubber agroforestry, another dominant and more sustainable land use system, provides farmers with far lower profits. Hence, the threat of converting land to oil palm is higher on mineral soils, unless a more profitable alternative for mineral soil areas is proposed.

While sustainable agroforestry practices in peat areas compete well with oil palm monoculture in terms of profitability, simulations show that there is considerable risk that peat forests will be converted to oil palm plantation. The financial viability and competitiveness of existing practices needs to be clearly established to enable smallholders to make logical land use choices that provide economic and environmental benefits.

The potential success of REALU relies on proposing land use models that are both competitive and attractive to smallholders in terms of profitability, ease of production and market access. Exploring indigenous practices such as Jelutong may augment local people’s income so that it could compare with the profitability of oil palm. These practices are also well-adapted to the local biophysical environment and climate. However, the financial viability of practices including Jelutong remains to be determined.

Another aspect we would like to understand further is the current productivity of existing agriculture and forestry practices. It would be highly advantageous to know whether they are already optimized or could be improved with better management, and whether higher incomes can be achieved through these improvements.
3. Financial model

This section describes the construction of the financial model for the sustainable land use practices described above. The following pages describe where and how the data was collected, how data is used to construct the model, the assumptions of the model, its details, and the simulation of results.

The financial model is designed with the aim to accomplish the following objectives:

- Determine the financial performance of the different agricultural and agroforestry practices in each landscape
- Analyze the viability and implication of adopting enhanced agriculture practices that require additional funding and/or technical assistance.
- Develop a clear understanding of the financing requirements of sustainable land use practices, as a means of understanding how they can be filled.

By basing the financial assessment on a discounted cash flow model, we can determine the financial attractiveness of the agriculture and agroforestry practice. For profitable opportunities that would be attractive to investors, we can then proceed to match financing or technical assistance to the needs of the farm practice.

3.1 Constructing the financial model

The construction of the model has 6 sections:

I. Data collection
II. Modelling the “standard” farm
III. Additional assumptions
IV. Data gaps
V. Projecting the results
VI. Running scenarios

I. Data collection

During research visits to Cameroon, Vietnam and Indonesia, we conducted interviews with farmers from communities living in each respective landscape. The interviews lasted between two and three hours and were conducted through group discussion, rather than one-on-one interviews, because of time constraints. The groups ranged from 10 to 25 participants in size.

To ensure that we collected comparable data to develop a generalized financial model, a similar approach was adopted for each group interview, using the same list of questions during every session. These questions were organized thematically, first focusing on the main crops being cultivated, then on the revenue profile for each crop, and finally the key costs. Given time constraints, cost and revenue data was only collected for the primary activities that were identified by the farmers.
Efforts were made to ensure a representative sample by including farmers, village leaders and the staff of the local partner organization, as well as ICRAF’s staff and field expert. In addition, the groups were generally composed of different genders, ages, and economic situations. The interview process therefore allowed us to collect data on a relatively diverse sample of the livelihood conditions and farming practices in each village.

Table 5 provides a summary of the communities and households represented in the interviews.

<table>
<thead>
<tr>
<th>Country</th>
<th>District</th>
<th>No. of group interviews (and avg. size)</th>
<th>Community Name</th>
<th>Total No. of Households involved in the project</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Through group interviews we were still able to collect multiple responses, giving us an idea of the distribution of possible responses to any given question (for example on yields). But one advantage of this approach is that we were also witnessed disagreements, which were sometimes vehement, between community members. This reaction can help to highlight sensitive points that need to be addressed with great care.

Once the data had been collected through interview, it was compared and rationalized through a process designed to exclude obvious outliers. We then verified the information and plugged any obvious gaps through a review of the data with ICRAF representatives.

II. Modelling the “standard” farm

The information gathered during field interviews was used to construct a “standard farm” model. This is composed of the main production activities that the farmers were engaged in for each landscape. We then extrapolate the performance of our “standard farm” as a template and expand it to the landscape, using the total number of households (since each farm is tended by a family, which we equate to a household).

By asking farmers engaged in a variety of practices to rank the crops that contributed most to their income, we were able to identify the most commercially important farming activities. Perhaps unsurprisingly, we found a number of similarities in the lists of crops and practices valued by communities in each country (see table 6).

Table 6. Standard farm commercial activities

<table>
<thead>
<tr>
<th>District</th>
<th>Main Farming activities</th>
<th>Other Farm Activities (largely small scale subsistence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efoulan</td>
<td>1. Cocoa</td>
<td>Macabo, Maize, Wild Mangoes,</td>
</tr>
<tr>
<td></td>
<td>2. Plantain</td>
<td>Nijinseng, Cola Nut, Safou,</td>
</tr>
<tr>
<td></td>
<td>3. Cassava</td>
<td>Palm Oil(^{51}), Sweet Potatoes, and</td>
</tr>
<tr>
<td></td>
<td>4. Peanuts</td>
<td>Garden Vegetables</td>
</tr>
<tr>
<td></td>
<td>5. Egusi</td>
<td></td>
</tr>
<tr>
<td>Tanjung Jabung</td>
<td><em>Protected peat land</em></td>
<td><em>Arecanut, Pineapple, Banana,</em></td>
</tr>
</tbody>
</table>

\(^{47}\) This was achieved through conversations with ICRAF and local partners organization field experts, shortly after the interview process.

\(^{48}\) Where estimated household data wasn’t provided, estimates were deducted from the population of the landscape and the total number of persons per household.

\(^{49}\) For the sake of simplicity, in this report, the term crop will also include NTFPs like cocoa.

\(^{50}\) Farm practices that are purely for subsistence purposes have been excluded from our analysis.

\(^{51}\) Small quantities are grown for palm wine.
Since the topography, soil composition and altitude within each landscape were relatively homogeneous, we decided to aggregate data by farming activities, rather than by individual farm in the model.

In the case of Indonesia, we developed two standard farm models for the peat land – one for the protected forest areas and the second for privately owned land. One could argue that, since all the farms on the protected forest area are very similar, modeling one farm is equal to modeling them all. The same logic applies to the privately owned land.

III. Additional assumptions
In order to build a comprehensive financial model, we had to complement our primary data with the series of assumptions. These assumptions were based on our direct observations during fieldwork and on our discussions with members of ICRAF:

- Most of the products identified are both consumed and sold by the smallholders. This overlap between subsistence and commerce creates some difficulty in acquiring accurate data on revenue generation. So where data wasn't provided, we assume a 50:50 split. But we made exceptions in products that were apparently wholly commercial i.e. cocoa in Cameroon; coffee and palm oil in Indonesia.

- We concluded from the homogeneity of the landscapes and consistency of responses in the focus groups that the market and business conditions are essentially uniform for all villages represented within each landscape in the study. We therefore assume the same input costs, processing costs and revenues received for all the farm households. We made an exception for transportation, which varies according to distance from market.

- Where labor and employment data were unavailable, we assumed that around 35-40% of the population were employed. We also accounted for children helping their parents by equating three children working part-time equates to one adult working full-time.
• Where the number of households is unknown, we use population figures in conjunction with a ranged estimate of how many people compose the average household.

IV. Data gaps
It was logistically impossible to discover revenue and cost data for cocoa intensification in Efoulan. We therefore propose a simple project that can deliver direct benefits – the creation of local marketplaces based on shared storage units. This approach would have a number of advantages: it would allow farmers to reduce their post-harvest losses; pooling produce would improve the farmers’ bargaining position; and it would reduce collective transportation costs.

We also support this proposal because it incurs limited additional expenses (mostly the construction of storage units) relative to significant potential revenue increases.

V. Projecting the results
Once Year 1 costs and revenue were determined for each crop, we projected them over n-years using an estimate of inflation. The projected cash flows of each activity through time are then discounted by the expected risk-free rate.

We started by generating projections for the baseline scenario. We then used data on the practices that ICRAF is intending to introduce to each landscape to create projections for the project scenario.

We factored in a learning curve to account for the novelty of the practices: we assumed that farmers would require time to adjust and implement the practices. We therefore increased the financial benefits of most practices periodically.

However, for practices that require long implementation periods (like forestry), we assumed that farmers will have grown accustomed to the practices by the time they start to bear fruit, and as such we have not included periodic enhancement for these scenarios.

VI. Running scenarios

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52 This term describes agroforestry that mixes cocoa with fruit trees
53 During the interview sessions, farmers told us that they could potentially achieve a sale price up to 50-60% higher for plantain, and 25% higher for cocoa, if they pooled their products together to reach a certain scale
54 Inflation estimate is calculated using the 10-year average from the World Bank Data
55 Baseline case scenario represents the current existing business running as usual
56 As a consequence, practices that create benefits other than financial would most likely result in an apparent deterioration of the situation compared to the baseline case scenario because they would most likely incur additional costs while bringing no additional revenue. This does not mean that such practices should not be implemented.
The method of projection described in the previous paragraph is static i.e. it only gives one n-year projection\textsuperscript{57}. However, land use activities are, in reality, subject to significant variations.

To reflect this diversity of possible outcomes we ran multiple scenarios in which we varied the values assigned to pre-identified factors (like yields or prices) within pre-determined boundaries. This process, known as a Monte Carlo simulation, results not in a single projection but in a distribution of projected outcomes: instead of informing us on what the n-year projection will be, it tells us what it could be within a certain level of confidence.

Results are usually presented as: “there is an X\% probability that the revenue for this practice will be higher than Y or comprised between Y and Z”.

3.2 The model: A detailed description

The financial model has five sections:

I. General Information
II. Cost and Revenue Inputs
III. Cash Flow
IV. Summary
V. Monte Carlo Simulation

I. General Information\textsuperscript{58}

This portion of the model contains micro and macro data relevant to the location in question. The micro data are specific to each location and practice, which include items such as the total population and the labor force; macro data include factors such as the inflation rate and the exchange rate of the local currency vs. a hard currency, usually the US dollar.

II. Cost and Revenue Inputs\textsuperscript{59}

This part of the model contains all cost and revenue items for the different crops grown in the landscape. Cost items are further broken down into Capex\textsuperscript{60} and Opex\textsuperscript{61}. Meanwhile, the revenue items are composed of the yields and market prices of different crops.

\textsuperscript{57} Where n stands for the number of years of the projection
\textsuperscript{58} See Box 4 in the Appendix for a list of the items contained in the general information
\textsuperscript{59} See Box 5 in the Appendix for a list of the items contained in the cost and revenue inputs
\textsuperscript{60} Capital expenditure, i.e. non-recurring, usually fixed and important cost items
\textsuperscript{61} Operating expenditure, i.e. recurring costs, usually variable
For each primary crop, total costs and revenue are calculated based on the specifics of the way it is grown (use of pesticide, etc.) and transformed (need for dryers, etc.), the yields obtained and the market prices.

A learning curve was applied for crops targeted by new practices; we have applied a learning curve, which represents the time it will take before farmers can reap full benefits of the new practice or increase the relative costs as the practice expands. It is expressed as a yearly abatement to the full additional revenue resulting from the implementation of the practices. Costs are expressed as a percentage of the Base Case Scenario total costs.

III. Cash Flow

This section of the model contains the itemized cost and revenue projections over the entire holding period (usually 10 years), for all crops sold, and for both the baseline case scenario and the project scenario (when the new practices are implemented).

The total profit/return per household through time is discounted by the expected rate of return required, which is equal to the expected discounted future cash flow (EDCF) (see equations below).

The discounted cash flow is a valuation method used to assess the profitability of an investment. The discounted cash flow model sums the projected future cash flows, and then discounts them, in this case, with the government-lending rate.

\[
EDCF = \sum_{t=0}^{N} \frac{CFt}{(1+r)^t}
\]

\[
DCF = \frac{CF1}{(1+r)^1} + \frac{CF2}{(1+r)^2} + \cdots + \frac{CFn}{(1+r)^n}
\]

\[
(E)CF = (Expected) future Cash Flow (adjusted for Inflation)
\]

\[
r = Discount Rate(Government lending interest rate)\]

\[
n = time in years before the future cash flow occurs\]

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See Box 6 in the Appendix for a list of the items contained in the cash flow section, and see Diagram 1 in the appendix for the Elements of the cash flow.
IV. Summary

This section summarizes the cash flow projections for the entire farm for both the baseline case and the project scenarios. The data is used to calculate the main results for the household and for each farm crop individually.

V. Monte Carlo Simulation

This portion of the model provides the results of the Monte Carlo simulation run on several variables.

The Monte Carlo section contains:

- Histograms: this is a graphic depiction of the normal distribution of the simulation results. It displays the minimum, median, maximum, various quartiles, and average (mean) values of the simulated performance results. 100% is equivalent to achieving the poverty line income of 1.25 per day.
- Cumulative Chart: this is a graphic depiction of the cumulative distribution of the simulation results. This tells us the probability that a household will achieve above X or Y.

The simulations were repeated over 10,000 times and we can state our results with approximately 99% confidence level.

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61 See Box 7 in the Appendix for a list of the items contained in the summary.
4. Results of the modelling exercise

This section presents the results from our financial model for the most profitable production activities that surveyed farmers pursued in each landscape. As noted in the previous section, the “Base Case Scenario” results represents business as usual for the farm communities, while the “project scenarios” results account for the impact of the agroforestry initiatives that ICRAF plans to implement with the farm communities.

The post value chain analysis provides information about the trade options available to the farmers at different stages of the value chain, for the various locations. This information, along with the results of the model provides the base on which we make our recommendation.

4.1 Efoulan Landscape (Cameroon)

Efoulan was chosen for its scope to implement agroforestry intensification, identified by ICRAF as a suitable pathway for limiting agricultural expansion into forest lands and improve the household income.

The Base Case Scenario combines household performance for cocoa, cassava, plantain, egusi, and peanuts. The project we propose is to create a market platform that allows farmers to cooperate, thereby achieving higher sale prices for cocoa and plantain. The results of the model for the Base Case Scenario, along with those for the project scenario, are presented in Table 7.

Table 7. Efoulan Landscape Results

<table>
<thead>
<tr>
<th>Household Category</th>
<th>Base Case Scenario</th>
<th>Project (Market Platform for cooperation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Capex (USD)</td>
<td>904,907</td>
<td>998,120</td>
</tr>
<tr>
<td>Total Opex (USD)</td>
<td>33,048,940</td>
<td>32,943,615</td>
</tr>
<tr>
<td>Total Expense (USD)</td>
<td>33,953,847</td>
<td>33,941,735</td>
</tr>
<tr>
<td>Transportation Cost (% of Overall Costs)</td>
<td>61.17%</td>
<td>54.78%</td>
</tr>
<tr>
<td>Operating costs (% of Overall Costs)</td>
<td>97.33%</td>
<td>97.08%</td>
</tr>
<tr>
<td>Plantain and Cassava Transportation cost (%) of Overall Costs</td>
<td>60.69%</td>
<td>54.35%</td>
</tr>
<tr>
<td>Total Revenue (USD)</td>
<td>31,965,695</td>
<td>31,965,695</td>
</tr>
<tr>
<td>Total operating Profit (USD)</td>
<td>-1,083,245</td>
<td>6,129,546</td>
</tr>
<tr>
<td>Total Profit (USD)</td>
<td>-1,988,152</td>
<td>5,131,426</td>
</tr>
<tr>
<td>Total Profit/household (USD)</td>
<td>-338</td>
<td>873</td>
</tr>
<tr>
<td>Household Return (% PLI)</td>
<td>-75%</td>
<td>194%</td>
</tr>
</tbody>
</table>

64 The performance of individual and combined household agricultural products are measured as the average yearly profit per household, and the return earned is expressed as a percentage of the international poverty line income adjusted for inflation over the production period.

65 We propose this project because it was logistically impossible to discover revenue and cost data for cocoa intensification. The market platform involves constructing several warehouse venues, equipped with sufficient storage capacity, where the farmers can sell their produce.
I. Base Case Results

The results from the Base Case Scenario financial model show that on average, a household will make a loss from the combined practices equivalent to -$338.

The Monte Carlo simulation shows that although there is a wide range of possible outcomes, over 80% of the time a farm household will make a loss year-on-year over the 10-year period. This means that households will only earn an income above the poverty line less than 3% of the time.

Negative performance is largely driven by operating expenditure, which accounts for approximately 97% of overall costs (i.e. capital expenditure + operating expenditure). While the practices are highly labor intensive, transportation costs make up the largest portion of the costs (61.2%), of which 60.7% is attributed to getting plantain and cassava products to market.

Of the five individual crop practices, cassava appears to have the greatest profit potential, achieving an average return equivalent to $271, which is still just 60% of the Poverty Line Income. The Monte Carlo simulations show that cassava has the widest range of possible outcomes, but only makes a loss 25% of the time. This large variability of possible outcomes is likely driven by the fact that cassava is processed into four final products for sale at different prices.

Cocoa is the only practice that achieves a positive return 100% of the time year-on-year, but with a lower average return than cassava of $163 (48% of the Poverty Line Income). Cocoa’s positive return is driven by the structure of the trade deal with Collectors, who travel to the communities to directly purchase the cocoa beans, hence farmers do not incur the transportation cost associated with taking the product to distant markets.

Plantain, peanuts and egusi all make a loss year-on-year 100% of the time; plantain is the worst performer, losing on average -$521.

II. Project Results

The rationale for the market platform project has been drawn directly from farmer feedback during our fieldwork. According to the farming community, pooling produce could increase the sale price of plantain by 50-60%, and cocoa by approximately 25%. In addition, we identified transportation costs as the largest proportion of overall expenditure. Constructing several market platforms within the Efoulan landscape would reduce these costs, thereby boosting profit and income.

Under the market platform proposal, the model results show that transportation now accounts for approximately 54.8% of the overall cost, a decrease of 11%. Total operating expenditure

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66 The figures discussed in the base case and project scenario are provided in Table 7 for the combined household results in Efoulan. Please refer to Appendix A for full results of the individual practices in Efoulan and the Monte Carlo Simulation results.

67 Maximum earnings of $1,220 (over 2.5 times the Poverty Line Income), and minimum earnings of -$1,485.

68 The four final products are: raw cassava tuber, gari, couscous, and cassava sticks. Each product incurs different losses to the yield during processing, which further increases the variability of income.
(including labor) remains steady at approximately 97% of overall expenditure. Labor and other 
general costs are increased to account for the additional expense associated with increased 
cooperation and higher quality standards.

The results from the financial model show that households earn average profits from the 
combined practices equivalent to $873 (194% of Poverty Line Income). This is, of course, a 
significant financial improvement from current farming practice.

We find that increased revenue from plantain and cocoa combined with reduced transport costs 
easily compensate for the increased expenditures. The Monte Carlo simulation suggests in over 
95% of modelled scenarios, households will make a profit year-on-year. In approximately 75% of 
modelled scenarios, a farm household generates income greater than the Poverty Line Income.

Under the market platform proposal, cocoa is the most profitable practice: farm households would 
be expected to earn on average $879 (195% of the Poverty Line Income). At the very least, a farm 
household can expect to be above the poverty line in 97% of modelled scenarios.

Cassava also yields a significant positive return, and each farm household can expect to earn the 
equivalent of $514 (114% of the Poverty Line Income). But plantain remains a poor 
performer, losing on average -$261. Egusi and peanuts also continue to make a net loss year-on-year.

The capital requirement for the market platform project is $594,400. The high initial outlay is 
more than justified by annual aggregated earnings over the landscape, which rise to more than 8 
times above the cost of establishing the market platform.

III. Post-harvest Value Chain

The cocoa supply chain between Cameroon and final consumption is both long and complex.
Farmers have three options: to join a farmer’s organization and bundle their production; to sell to 
a coeur, an intermediary that usually purchases from farmers in their houses; or finally to sell 
directly to licensed buying agents in the South-West of the country (some exporters set up their 
own internal purchasing organization).

In the first option, 10% of cocoa farmers were estimated to be organized into producers’ 
associations, primarily through Common Initiative Groups. These farmers can afford to wait 
longer to sell their products at a higher price, but also maintenance of warehouses and costs of 
transportation comes into play.

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69 In just over 15% of scenarios with a variance in the input data, plantain can now be expected to achieve a positive return
70 The capital requirement is simply the cost of constructing six storage facilities in the initial years. The six storage units provided 
should serve the entire landscape, if they pool their cocoa together, given the small quantities that each household produces.
71 The investment will payback from income earned in the first production year, after completion of the storage facilities.
72 See Cocoa Value Chain Diagram in Appendix – Figure 2
73 Retrieved through FAOLEX (at http://faolex.fao.org/faolex/)
Farmers who take the second option and sell through an intermediary are typically in need of fast cash. They generally do not get the best prices for their product, but the convenience of not having to deal with transport or storage appears to be attractive to some.

Finally, those who sell directly to exporters, are formed mostly of merchants engaged in other businesses. They collect cocoa from some sub-collectors, along with their own production, and pool it into a large shipment for consignment to an exporter.

Table 8. Cocoa price linkages in 2002

<table>
<thead>
<tr>
<th>Country</th>
<th>Côte d'Ivoire</th>
<th>Ghana</th>
<th>Nigeria</th>
<th>Cameroon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmgate prices</td>
<td>625</td>
<td>974</td>
<td>1,232</td>
<td>1,135</td>
</tr>
<tr>
<td>Pisteur costs</td>
<td>57</td>
<td>57</td>
<td>57</td>
<td>129</td>
</tr>
<tr>
<td>Buying center prices</td>
<td>682</td>
<td>1,031</td>
<td>1,289</td>
<td>1264</td>
</tr>
<tr>
<td>Trader costs</td>
<td>105</td>
<td>90</td>
<td>64</td>
<td>77</td>
</tr>
<tr>
<td>Exporter prices</td>
<td>786</td>
<td>1,121</td>
<td>1,252</td>
<td>1342</td>
</tr>
<tr>
<td>Export tax</td>
<td>501</td>
<td>169</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Ocean freight</td>
<td>78</td>
<td>91</td>
<td>80</td>
<td>75</td>
</tr>
<tr>
<td>Exporter margins</td>
<td>470</td>
<td>737</td>
<td>437</td>
<td>331</td>
</tr>
<tr>
<td>Processor Prices (cif)</td>
<td>1,836</td>
<td>2,117</td>
<td>1,876</td>
<td>1748</td>
</tr>
<tr>
<td>Country of Origin Premium or Discount</td>
<td>-29</td>
<td>252</td>
<td>11</td>
<td>-117</td>
</tr>
</tbody>
</table>

Table 8 shows the cocoa value captured across the supply chain for several African countries, including Cameroon. Cocoa was sold at farms at $1,135 per ton. Buying Centers are able to buy cocoa through coxeurs (pisteurs) at $1,265 per ton. Exporters then buy them at $1,342 per ton. By the time the cocoa from Cameroon reaches the processors, it’s already worth $1,748 per ton. Money generally flows in reverse to the physical flow of cocoa: exporters provide credit to intermediates, who then pay collectors and farmers.

*Prices are in USD per metric ton, cocoa bean equivalent basis.

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These are the latest available data that contrast the prices received by the various actors in the cocoa value chain in West Africa.

76 Cocoa in Cameroon is relatively cheaper than the other West African countries, in large part because there is no export tax placed on cocoa going out of the country and also because Cameroon’s exporters have the smallest margins.
Pisteur/coxeur costs are higher for Cameroon than other West African countries. By adding processing and manufacturing, Cameroon cocoa’s value could almost quadruple by the time it reaches retailers.

IV. Recommendation

Farmers in the Efoulan Landscape will continue to live well below the poverty line if no action is taken to improve current, labor intensive farming practices. Given the three options for selling their product, it seems clear that working with a structured association of producers is the best way to achieve the best prices for both product sales and input purchases.

The market platform project recommended aims to accomplish this by providing a base for closer and more efficient cooperation. This level of cooperation translates into a stronger bargaining position in price negotiations. This substantially increases a farmer’s income from combined farm practices by $1,217 annually, and would play a significant role in lifting Efoulan farmers out of poverty.

Incorporating appropriate storage units would extend the life of the produce, allowing the smallholder to sell off-season at a higher price and maximize their revenue. Further down the line, farmers can pool their resources to provide basic processing facilities for newly harvested cocoa to improve drying and fermentation, reducing labor costs.

Income earned from the two cash crops (cocoa and cassava) effectively subsidizes the production of peanuts and Egusi. We would not recommend excluding these two loss-making crops because of their role in food security and nutrition.

Peanuts and Egusi are generally considered to be important staples in West Africa, rich in nutrients and providing a range of health benefits. Both contain high levels of protein and unsaturated fatty acids (specifically mono-saturated fats), which are free of cholesterol, as well as other nutrients that contribute to reducing the risk of cardiovascular disease. But if alternative sources could be found to replace these nutrients in their diet, it would make sense to exclude peanuts and Egusi. The land this frees up could be used to expand profitable farm practices or seek new ventures.

\[ \text{We estimate that earning double the Poverty Line Income would be sufficient to lift households well out of poverty. Earnings above $1,005 annually would be in line with the World Bank income assessment for lower middle-income countries.} \]

\[ \text{Peanuts also contain magnesium, folate, vitamin E, copper, arginine and fiber, all of which have cardiovascular disease risk-reducing properties.} \]

\[ \text{Egusi is also contains palmitic, stearic, linoleic and oleic acids, which help to protect the heart. Egusi is further rich in vitamins A, B1, B2, C and alpha-tocopherol, a component of vitamin E.} \]
4.2 Ba Be Landscape (Vietnam)

Ba Be landscape in Bac Kan was chosen because of the potential to mitigate illegal logging in protected and special use forest, thereby increasing carbon stock. By expanding production forests to cultivate timber products you could provide the communities with additional income and replace maize mono-cropping on sloping land.

The Base Case Scenario combines mono-cropping of maize, cassava and rice at the household level. But according to ICRAF, timber trees such as Acacia Mangium and Melia Azedarach provide good options due to relatively low opportunity cost and diversity of final products. The project scenario therefore replaces maize mono-cropping with intercropping of maize and either Acacia or Melia.

The results of the model for the Base Case Scenario, along with those for the project scenarios, are presented in Table 9.

Table 9. Ba Be Landscape Results

<table>
<thead>
<tr>
<th>Household Category</th>
<th>Base Case Scenario</th>
<th>Inter-cropping Acacia</th>
<th>Inter-cropping Melia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Capex (USD)</td>
<td>2,789,575</td>
<td>2,901,444</td>
<td>2,821,533</td>
</tr>
<tr>
<td>Total Opex (USD)</td>
<td>11,437,798</td>
<td>10,258,883</td>
<td>9,505,783</td>
</tr>
<tr>
<td>Total Expense (USD)</td>
<td>14,227,373</td>
<td>13,160,326</td>
<td>12,327,316</td>
</tr>
<tr>
<td>Labor Cost (% of Overall Costs)</td>
<td>57.52%</td>
<td>54.41%</td>
<td>53.78%</td>
</tr>
<tr>
<td>Operating costs (% of Overall Costs)</td>
<td>80.39%</td>
<td>77.75%</td>
<td>76.94%</td>
</tr>
<tr>
<td>Total Revenue (USD)</td>
<td>9,410,304</td>
<td>8,855,632</td>
<td>8,294,812</td>
</tr>
<tr>
<td>Total operating Profit (USD)</td>
<td>-2,027,494</td>
<td>-1,403,250</td>
<td>-1,210,971</td>
</tr>
<tr>
<td>Total Profit (USD)</td>
<td>-4,817,069</td>
<td>-4,304,694</td>
<td>-4,032,503</td>
</tr>
<tr>
<td>Total Profit/Household (USD)</td>
<td>-439</td>
<td>-392</td>
<td>-367</td>
</tr>
<tr>
<td>Household Return (% of PLI)</td>
<td>-97%</td>
<td>-87%</td>
<td>-82%</td>
</tr>
</tbody>
</table>

See Vietnam results Appendix for full results of the individual practices and Monte Carlo simulations.

I. Base Case Results

The results from the Base Case Scenario show that households will make an average loss equivalent to $-439 from the combined maize, rice, and cassava practices. The Monte Carlo simulations reinforce the point by indicating that households appear to make a loss well below the Poverty Line Income year-on-year, 100% of the time.

All three crops show a negative return year-on-year over the 10-year period:
- **Maize** - $131
- **Cassava** - $166
- **Rice** - $141

79 The figures discussed in the base case and project scenario are provided in Table 9 for the combined household results in Ba Be. Please refer to Appendix B for full results of the individual practices in Ba Be and the Monte Carlo Simulation results.

80 The maximum income earned under this scenario is approximately $150, and the minimum income earned is $643.
The performance is primarily driven by two factors: first, these are not purely commercial products. A large percentage of produce is consumed by the household as part of their daily dietary requirement, and in the case of maize for feeding the cattle. Second, all three practices are highly labor intensive, with labor costs making up 57.5% of the overall operating expenditure\(^1\).

II. Project Results

The Ba Be project proposes to intercrop maize on productive land with high value trees, namely Acacia and Melia. The aims of this proposal are to increase economic return while enhancing the ecological health of the landscape.

Acacia is cultivated in 7-year rotations and intercropped with maize in the first three years as a means of generating more immediate income. This system performs better than maize monocropping but still generates a loss year on year. The average return is -$72, which improves the household return by approximately $50 to -$392.

Melia is cultivated in 10-year rotations, and is intercropped in the same way as Acacia. This appears to offer the best performance of any system, but again it still generates a loss year on year, well below the Poverty Line Income. The household average return for this scenario is -$367\(^2\).

One problem with the project scenarios is that both Acacia and Melia incur large expenses\(^3\), and produce consistent net losses in the years leading up to maturity. The main income\(^4\) is derived from the final sale of timber products in the harvest years, which isn’t sufficient to fully compensate for the expenses incurred in the previous year.

The capital expenditure requirement\(^5\) is $612,300 for Acacia and $727,700 for Melia, per rotation. As both Acacia and Melia are not profitable practices, making a loss year-on-year, they can’t generate sufficient net income to payback the investment over the lifetime of the projects.

While Acacia and Melia financially perform slightly better than mono-cropped maize, if farmers were to adopt these practices, public capital would be needed to incentivize them to do so – due to the large costs incurred in establishing the projects, and a positive cash flow only earned once in the harvest year\(^6\).

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\(^1\) Total operating expenditure accounts for 80.4% of the overall costs, which includes labor costs.

\(^2\) The Average return earned for Melia intercropped with maize is -$60.

\(^3\) Operating expenditure as a percentage of total cost is very high, at 77.75% for Acacia and 76.94% for Melia. Labor costs account for 54.41% and 53.78% respectively.

\(^4\) Apart from maize revenue which is harvested twice a year in the initial three years.

\(^5\) The capital requirements for both Acacia and Melia are primarily composed of the cost of tree seeding for planting and the equipment required to harvest the timber.

\(^6\) Acacia is harvested in year 7 and Melia is harvested in year 10.
III. Post-harvest Value Chain

On the basis of research and a series of interviews, Robert Pietrzak has developed data-driven recommendations to establish a proper Acacia value chain. We believe that the same lessons learned here, for smallholder farmers selling the raw Acacia, also apply to Melia.

The problem for smallholders, from the supply chain perspective, is that much of the value is captured by intermediaries. The role played by intermediaries is not necessarily bad, given the different skills involved in each process, but we should still seek to target opportunities to eliminate inefficient middlemen, thereby channeling more value to producers.

Diagram 2. Actors involved in Vietnam’s domestic and international Acacia commodity chains

In November 2008, after a six or seven year lead-time, harvested Acacia trees can be sold to middlemen for up to $17.15 per ton. Meanwhile, middlemen are able to resell Acacia to processing plants for $49 per ton at Chan May Port.

As such, the average middleman receives more than three times the revenue earned by villagers from Acacia cultivation. However, their profits are usually modest: operating costs remain

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67 They are the main suppliers for furniture and woodchip processing companies, even though in most cases no supply contract is established.

very high as they must harvest the trees and manage transport. As a result, the average middleman earns only slightly higher profits than upland farmers who grow Acacia.

The processors pay around US$ 46-49 per ton of Acacia timber and sell finished boards for US$ 63-80 per ton, depending on the quality of the work and the current demand (values from 2008).

IV. Recommendations

Smallholders are at a disadvantage in the Acacia value chain. Without proper government oversight, there is no transformational change in sight. The lack of purchasing contracts benefits only the upper levels in the value chain.

The returns and value chain associated with Melia paint a similar picture of unfavorable conditions that are not sufficient to lift the farmers out of poverty. Furthermore, the market for Melia in Bac Kan province isn’t as developed as for Acacia.

Smallholders do not have access, or any realistic prospect of access, to formal lines of credit. They are forced to accept usurious informal loans from middlemen and processing companies. The terms of this finance compel producers to harvest early, depressing both productivity and price per unit.

It appears that smallholders require either subsidies for inputs or new lines of credit to break away from the existing cycle. Absorbing the role of middlemen could also help producers to move up the value chain, but that demands the creation of cooperatives. Such an arrangement could incorporate certification to add value and increase market access for to their produce.

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89 Middlemen are required to rent and maintain trucks, pay wages to workers, and supply those workers with equipment as well as the gasoline and oil to operate the equipment.

90 Prices are set up upon sale of standing timber or upon delivery to a particular buyer.

91 Melia timber is generally exported as raw material.


4.3 Tanjabar Landscape (Indonesia)

Tanjabar was chosen for our data gathering because it has active deforestation, rapid conversion of peatlands, reforestation for the pulp and paper industry, oil palm plantations and a proportionally high number of smallholders, thanks to extensive immigration.

The Base Case Scenario consists of one coffee agroforestry system that intercrops coffee bushes with betel nut and coconut trees on private owned land, and one oil palm system which intercrops oil palm trees with maize in protected forestland.

The proposed project replaces oil palm plantations with Jelutong, which previously grew as a natural tree species in the area and provides an efficient means of rehabilitating the peatland.

The results of the model for the Coffee agroforestry system, oil palm system, and Jelutong project scenarios, are presented in Table 10.

Table 10. Tanjabar Landscape Results

<table>
<thead>
<tr>
<th>Household Category</th>
<th>Coffee Agroforestry System</th>
<th>Oil Palm System</th>
<th>Jelutong Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Capex (USD)</td>
<td>61,869</td>
<td>6,330</td>
<td>5,591</td>
</tr>
<tr>
<td>Total Opex (USD)</td>
<td>1,054,735</td>
<td>49,566</td>
<td>56,691</td>
</tr>
<tr>
<td>Total Expense (USD)</td>
<td>1,116,604</td>
<td>55,895</td>
<td>62,282</td>
</tr>
<tr>
<td>Labor Cost (% of Overall Costs)</td>
<td>87.45%</td>
<td>79.45%</td>
<td>77.88%</td>
</tr>
<tr>
<td>Operating costs (% of Overall Costs)</td>
<td>94.46%</td>
<td>87.51%</td>
<td>89.28%</td>
</tr>
<tr>
<td>Total Revenue (USD)</td>
<td>1,751,535</td>
<td>157,530</td>
<td>148,854</td>
</tr>
<tr>
<td>Total operating Profit (USD)</td>
<td>696,800</td>
<td>107,965</td>
<td>92,163</td>
</tr>
<tr>
<td>Total Profit (USD)</td>
<td>634,931</td>
<td>101,635</td>
<td>86,572</td>
</tr>
<tr>
<td>Total Profit/Household (USD)</td>
<td>827</td>
<td>1,016</td>
<td>866</td>
</tr>
<tr>
<td>Household Return (% of PLI)</td>
<td>184%</td>
<td>226%</td>
<td>192%</td>
</tr>
</tbody>
</table>

See Indonesia results Appendix for full results of the individual practices and Monte Carlo simulations.

I. Base Case Results

a. Agroforestry System

The agroforestry system practiced on privately owned land intercrops coffee bushes with betel nut and coconut trees, which were used as productive shade or live fences.

This arrangement seems to allow farm households to earn a year-on-year average return of $827 (184% of the Poverty Line Income). The Monte Carlo simulation results suggest that, in 99% of modelled scenarios, households can expect to earn above the Poverty Line Income.

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94 The figures discussed in the base case and project scenario are provided in Table 10 for the combined household results in Tanjabar. Please refer to Appendix C for full results of the individual practices in Tanjabar and the Monte Carlo Simulation results.
Coffee is by far the most profitable commodity, creating an average annual return of $1,428 (317%), more than three times the Poverty Level Income. The Monte Carlo simulations indicate that coffee achieves a return that is at least double the Poverty Level Income 100% of the time.

Both coconut and betel nut make a loss 100% of the time. Betel nut performs worst, yielding an average return of $452. But, despite their deleterious direct impact on profit, both betel and coconut are required to provide shade for optimal coffee production. This suggests that an effort to identify more profitable commodities that can serve the same purpose as betel nut and coconut could significantly improve financial returns.

b. Oil Palm System

Plantations on the protected peatland in Tanjabar intercrop oil palm trees with maize. Maize provides cash flow for the first few years, then trees start yielding fruit from year 3 onwards. Since plantations have been operating in this location for between 3 to 7 years, there is no actual lead time at this point.

The average income earned over the productive years of the oil palm trees is $1,016 (226% of the Poverty Line Income). The Monte Carlo simulations show that oil palm plantation farmers on peatland can earn between $756 (167% of the Poverty Line Income) and $1,202 (266% of the Poverty Line Income).

The earning spread of palm oil is much smaller than that of the coffee agroforestry system because we are dealing with only one main commodity where large collectors dominate the market and the price is fairly fixed.

II. Project Results

Under our proposed scenario, Jelutong is intercropped with maize in the initial years to provide immediate income because the tree can only be tapped for latex from year 9 on.

Despite the long lead-time, Jelutong is highly profitable. The Monte Carlo simulation indicates that the average annual income earned is $866 (192% of the Poverty Line Income), and that practitioners will always earn above the Poverty Level Income in every modelled scenario.

The capital requirement for investment on protected peatland, where oil palm is mostly grown, covers the cost of seeding and equipment for tapping the Jelutong tree. These establishment costs are significantly reduced by the fact the infrastructure required for Jelutong - border canals - has already introduced to support oil palm plantations.

95 The coffee planted is a high value species trading at premium to regular coffee.
96 The minimum return was $1,087 (241% Poverty Line Income) and the maximum $1,790 (398%).
97 The capital requirement for investment on protected peatland, where oil palm is mostly grown, covers the cost of seeding and equipment for tapping the Jelutong tree. These establishment costs are significantly reduced by the fact the infrastructure required for Jelutong - border canals - has already introduced to support oil palm plantations.
III. Post-harvest Value Chain

The value chain for Jelutong latex in Indonesia varies according to location. Usually, farmers take water-containing condensed latex\(^\text{98}\) to nearby trading posts, 1.5 to 2km from their home. If the distance between tappers and collectors or traders is too large, producers can opt go to local markets, where more than one trader is present, which increases their chances of getting a better price\(^\text{99}\). Another advantage of farmers establishing close relationships with multiple latex traders is that these traders occasionally provide them with short-term credit\(^\text{100}\).

Evidently the concentration of water in condensed latex is a key factor in determining price. This fact encourages traders to invest in equipment capable of extracting water from latex.

According to interviews with farmers in March 2008\(^\text{101}\), the price of liquid latex is $0.58/liter, $0.81/kg for water-containing condensed latex, and $1.10 /kg for water-extracted condensed latex. If a farmer can sell liquid latex, they will earn roughly $1,907 per hectare each year\(^\text{102}\).

Traders purchase condensed latex for $1.10 /kg, and often sell it for $1.22/kg to processing factories. Deducting roughly $87 for machinery depreciation, fuel, water and labor for water extraction as seen in Table 11, traders get around $85 per ton of raw material they sell\(^\text{103}\).

Table 11: Profit gain for trader in trading of liquid and condensed latex\(^\text{104}\).

<table>
<thead>
<tr>
<th>Cost Item</th>
<th>Trade in Liquid Latex (VND)</th>
<th>Trade in Liquid Latex (USD)</th>
<th>Trade in condensed latex (VND)</th>
<th>Trade in condensed latex (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buying cost per ton of raw latex</td>
<td>10,000,000</td>
<td>1,031</td>
<td>19,000,000</td>
<td>1,959</td>
</tr>
<tr>
<td>Depreciation cost</td>
<td>140,000</td>
<td>14</td>
<td>200,000</td>
<td>21</td>
</tr>
<tr>
<td>Electricity and water cost</td>
<td>80,000</td>
<td>8</td>
<td>300,000</td>
<td>31</td>
</tr>
<tr>
<td>Labor cost</td>
<td>150,000</td>
<td>15</td>
<td>200,000</td>
<td>21</td>
</tr>
<tr>
<td>Transportation cost</td>
<td>540,000</td>
<td>56</td>
<td>650,000</td>
<td>67</td>
</tr>
<tr>
<td>Loss during collection and overhead costs</td>
<td>80,000</td>
<td>8</td>
<td>150,000</td>
<td>15</td>
</tr>
<tr>
<td>Total production costs</td>
<td>11,000,000</td>
<td>1,134</td>
<td>20,500,000</td>
<td>2,114</td>
</tr>
<tr>
<td>Price per ton</td>
<td>13,000,000</td>
<td>1,340</td>
<td>22,000,000</td>
<td>2,268</td>
</tr>
<tr>
<td>Profit per ton</td>
<td>2,000,000</td>
<td>206</td>
<td>1,500,000</td>
<td>155</td>
</tr>
</tbody>
</table>

\(^\text{98}\) Latex naturally transforms into condensed latex 8 hours after tapping. Farmers mix water and substances like potassium to keep the latex in its liquid state for a longer period increasing the life of the product.

\(^\text{99}\) Op cit.

\(^\text{100}\) Farmers can receive anywhere between 3 to 5.6 million Rp in credit, depending on the farmer’s regular output.

\(^\text{101}\) Latex figures are generated in IDR for rubber which paints a very similar story to Jelutong latex. The conversion to USD used the 2008 USD to IDR exchange rate of 9,698.96 from The World Bank Data.

\(^\text{102}\) Agricultural Diversification Project (ADP) in Quang Binh, 2006, Project Phase-end Report

\(^\text{103}\) Nga, H. Upgrading Strategy for the Rubber Value Chain of Smallholders in Bo Trach District, Quang Binh Province. June 2008

\(^\text{104}\) Ibid.
IV. Recommendations

The financial model suggests that Jelutong cultivation is just as profitable as the coffee agroforestry system. However it generates a little less incomes than oil palm plantations.

Markets for Jelutong are busy with traders and processors creating demand, which seems promising for local farmers. However, the elevated demand builds pressure for cash-strapped farmers to harvest latex prematurely, which decreasing both price and revenue.

A number of agricultural extension staff and local authorities are also concerned that overexploitation, which decreases a tree’s productive lifespan from 30 to 15 years, may have very damaging impact on future productivity. This problem, combined with high volatility in latex prices105 and long lead-times106, makes Jelutong less attractive an investment choice for local farmers.

Profitable farm practices that yield positive short-term cash flows are needed to augment the income from Jelutong in the first 9 years of cultivation, when the Jelutong tree is ready for tapping latex.

The need for cooperation cannot be overstated here, as existing markets for Jelutong are not consolidated. The lack of bargaining power of most producers plays a decisive role in persistently low incomes, early and over-harvests, and the negative long-term consequences of both.

5. Conclusion

Our financial model demonstrates both the need to improve smallholder livelihoods and that there are opportunities to do it by combining improved operations and better access to capital, technology, markets\textsuperscript{107} and land\textsuperscript{108}.

Crop production can be a pathway out of poverty. Agroforestry practices such as intercropping can lead to increased yields and unlock the potential of diversification benefits\textsuperscript{109} to smallholders.

But in many cases it seems that a more ambitious approach is needed, one that allows smallholders to sell better quality products at a higher price thanks to better links with the market and a stronger position in the supply chain.

However, when considering effective implementation of new initiatives, existing operational conditions and procedures must be taken into consideration. This is probably the only way to enable a smooth transition as the farmers grapple with the new challenges associated with processing raw materials into market-ready products.

The combined lack of capital and labor constraint creates a situation where the amount of capital needed is extremely important and the additional labor required from the farmers is such that proper compensation will take a long time\textsuperscript{110}. Projects like that developed by KfW in Vietnam\textsuperscript{111} offer a potential route: a mix of grants to cover additional costs incurred (both capital and operational expenditures) and cash deposited in savings accounts opened for the farmers, from which they can withdraw a limited amount every year.

One problem common to all three landscapes was that farmers have little bargaining power because of the small-scale of their operations. Buyers dominate most markets for agricultural products. Farmers need to be offered the option of cooperating to pool their production. This would introduce economies of scale, reducing input costs\textsuperscript{112} per unit as quantity increases, thus improving the profit margin.


\textsuperscript{109} A larger number of crops not only increases the resilience of the portfolio to market uncertainties, but can lead to economical, environmental, ecological, health and social improvements.

\textsuperscript{110} This is a result of the time value of money: from an individual’s point of view, income received in the future is worth less than income received today.


\textsuperscript{112} Farmers face production risks from bugs, molds, mosses, etc, that severely reduce crop outputs. Treatment with better inputs like insecticides or fungicides increases yields, however, these inputs are too costly and not easily accessible for the individually farmers.
APPENDIX

BOX 1. Overview of the Efoulan Landscape

Efoulan is a municipality of southern Cameroon. In the rest of this document, we use the name Efoulan to refer to the Efoulan council area. This landscape covers around 830 km², encompassing 37 villages. The total population is roughly 28,000 people.

The average population density is 10 people/km², and with most residents living in rural areas. But population density doubles to around 20 people/km² along the two roadways that traverse the forested area.

The vegetation of the area can be characterized as dense evergreen forest. Altitude varies from 193 meters to 1,027 meters, and the vegetation changes with increasing altitude and decreasing rainfall from west to east. There are two rainy seasons, which define the two growing seasons: March-June and September-November. Average rainfall is 2,000 mms and average temperature is 24°-25° C. Soils in the area are fertile but subject to rapid erosion under annual agricultural use, pushing farmers to practice shifting cultivation and slash and burn agriculture.

The forested area falls into four categories: Council forest, Community forest, Forest Management Unit and Forest Reserve. Slash and burn cropping systems as well as illegal logging have resulted in a landscape mosaic system, defined as:

*Spatial and temporal heterogeneity of aggregated elements of distinct boundaries, where the mixed local ecosystems or land uses are repeated in similar form over a defined area*

For most inhabitants, the household is the key unit for all activities, including cropping, animal husbandry, and non-agricultural practices.

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113 Efoulan Council is one of the poorest municipalities of southern Cameroon
114 Ibid. 25, p.12
115 Ibid. 25, p.17
116 Ibid. 25, p.15
117 Ibid. 25, p.16
118 Ibid. 25, p.18
119 Hunting, fishing and other off-farm activities
BOX 2. Overview of Bac Kan (Ba Be) Landscape

Bac Kan province is part of Vietnam’s north-eastern midlands and mountain region. The province area is approximately 4,861 km² with a total population of 293,628 people. The average population density is 61 people/km². In Ba Be district the total population is estimated to be 49,750 people.

The Bac Kan landscape is dominated by natural forest land (59% of total land cover). Ninety percent of the province is mountainous and the terrain is divided by streams and rivers, the most important being the Nang River, Cau River, Bac Giang River, and Hien River. There are three large nature reserves, Ba Be National Park, Kim Hy Nature Reserve, and Nam Xuan Lac Nature Reserve. In total, these reserves cover approximately 26,000 ha of special use forests. The average elevation of the province is 500-600 m above sea level, with the highest point being 1,640m in the Nam Hoa Son Mountain. The average annual rainfall is 1,400 – 1,600mm.

There are three types of forest management regimes in Bac Kan province: special use forest (e.g. protected areas or natural reserves), production forest and protection forest (see Table 12).

Table 12. Forest management regimes in Bac Kan

<table>
<thead>
<tr>
<th>Tenure status</th>
<th>Special use forest</th>
<th>Protection forest</th>
<th>Production forest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100% under PAMBS</td>
<td>Largely managed by PFMBs25</td>
<td>Largely managed by individual households</td>
</tr>
<tr>
<td>Current Arrangements</td>
<td>A certain area is subcontracted (annually or 5 year) to local communities for forest protection126</td>
<td>No contract to local people The “un-allocated” area is temporarily managed by CPC. No benefit to local people.</td>
<td>Red book (land use right certificate) is being given for 50 years to various representatives.</td>
</tr>
</tbody>
</table>


121 Ibid. p.3


123 These forest land types and their management are defined by the 2004 Law on Forest Protection and Development (LFPD)

124 Ibid. 25, p.16

125 Program Forest Management Board (PFMB), Protected Area Management Board (PAMB), and State-owned Forest Enterprise (SFE) are the state actors that manage that forest lands

126 These contracts cover activities including: forest plantation, forest protection, management and assisting natural forest regeneration, usually for a 5-year cycle
BOX 3. Overview of Tanjabar Landscape

Tanjabar is located on the east coast of Jambi province in Sumatra. The district area is approximately 500,000 ha with a population around 280,000, and an average density of 56 people/km\(^2\). Tanjabar is largely a ‘migrant land,’ with in-migration starting in the mid-1900s\(^\text{128}\).

The distinct biophysical characteristics of Tanjabar lie in the vast peat areas covering major parts of coastal and lowland areas. The landscape mosaic in Tanjabar is complex, consisting of both peatlands and non-peatlands that provide a diverse range of potential land uses for both smallholders and large concession holders. The district has been mapped with peatland covering approximately 40% of the total area or as large as 133,000 ha, with varying depth from 0-50 cm to 400 cm. The remaining 60% of the area, in the southwestern part, is mineral soils\(^\text{129}\).

About 48% or 240,000 ha of the total district area is classified as ‘forest area’, which is under the jurisdiction of the Ministry of Forestry. Nearly 90% of this ‘forest area’ is classified as production forest and limited production forest, 6% is protected peat forest, and 4 percent is national park.

The ‘non-forest area’ in the district is dominated by coconut agroforestry, rubber agroforestry, rubber monoculture, and, most recently, oil palm\(^\text{130}\). The income from oil palm plantations largely affects the income of people in Tanjabar. Smallholder farming using agroforestry or mixed garden system is the largest traditional land use system in peat soil areas in Tanjabar. In mineral soil areas, monoculture plantations, such as acacia and oil palm, are being established but by large-scale private companies.

A large part of the peatland in Tanjabar has been drained and cultivated, mostly for smallholder coconut and coffee agro-forests\(^\text{131}\). Coffee-based farming systems are still expanding, and this type of farming system now has the largest coverage in peatland areas in Tanjabar\(^\text{132}\). Oil palm, while relatively new to local people, is of great interest because of its high commercial value\(^\text{133}\).

On mineral soils, rubber appears to be the largest traditional land-use system\(^\text{134}\). Apart from rubber, mineral soil areas are currently dominated by oil palm, particularly the lands owned by migrants where more than 90% of their total landholdings are planted with oil palm.

\(^{127}\) Ibid. 42, p.6
\(^{128}\) The history of the transmigration program in Indonesia began in 1905 during the Dutch colonial era. In the mineral soil area, significant migration occurred in the 1980s and 1990s with the transmigration program that was associated with developing large-scale oil palm plantations and industrial forestry estates.
\(^{129}\) Ibid. 42, p.5
\(^{130}\) Ibid. 42, p.36
\(^{131}\) Ibid. 42, p.4
\(^{132}\) Ibid. 42, p.38
\(^{133}\) Ibid. 42, p.89
\(^{134}\) Ibid. 45, p.38
**BOX 4. General Information**

The general information portion of the model contains:

- **Total population:** the total number of people living in the landscape
- **Number of farms:** this is equivalent to the number of households as we assume that each household tends one farm\(^\text{135}\)
- **Labor:** this is equivalent to the number of full-time adults working per farm.
- **Yearly inflation:** this is a 10-year average (2004-2013)\(^{136}\) expressed as a range of possible inflation rates from the World Bank data.
- **Interest rate:** this is the 5-year average (2009-2013) government-lending rate adjusted for inflation from the World Bank Data.
- **Exchange rate USD vs. local currency:** expressed as a range of annual exchange rates, from the World Bank Data.
- **International absolute poverty line:** this is the poverty line, per capita, in USD, expressed both per day ($1.25 a day [PPP]) and per year, as calculated by the World Bank\(^{139}\).

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\(^{135}\) One farm represents a standard farm with the various farming activities/crops

\(^{136}\) Except for Cameroon where data was only available for 5-years

\(^{137}\) The interest rate is used as a proxy for the risk free rate, which is the expected interest an absolutely risk-free investment over a specified period of time - this is the rate used for discounting cash flows.

\(^{138}\) XAF is the currency code for the Central African CFA Franc BEAC; VND is the currency code for the Vietnamese Dong; IDR is the currency code for the Indonesian Rupee

BOX 5. Cost and Revenue Inputs

The cost portion of the model contains:

- **Household expense**: this covers the pieces of equipment that any household needs, regardless of the crops they are growing. For each piece of equipment, the description, the number of pieces necessary, unit of measurement, the lifespan, and cost per unit are provided, expressed either in the local currency or USD. Annual replacement value is estimated where the lifespan is unknown. This is the fixed rate used to depreciate all farming equipment.
- **Activity Equipment expense**: these are all of the equipment needed for each farm activity. For each piece of equipment we have provided a description, the number of items necessary, unit of measurement, lifespan, and cost per unit are provided, expressed either in the local currency or USD.
- **Labor**: this is the monthly salary paid to laborers. This value is applied to family farmers as well as hired workers because we want to ensure that all labor is financially compensated. The salary is expressed as a percentage of the national minimum salary, currently set at XAF 28,000/month\(^{140}\) in Cameroon, VND 50-75,000/month in Vietnam, IDR 100,000/month in Indonesia.
- **New Plantation**: labor costs associated with planting annual crops. Because we were given a precise cost for this item, we apply that rather than a percentage of the minimum wage.
- **Input cost**: this captures the costs of materials needed for maintenance, transformation and sowing, per crop per season.
- **Transport cost reduction factor for the project**: this is an example of how costs might be reduced by adopting a new practice\(^{141}\).
- **Market building**: this is an example of an additional expense resulting from a new practice\(^{142}\).

The revenue\(^{143}\) portion of the model contains:

- **Yield**: for each crop, the yield is expressed in kg/ha\(^{144}\).
- **Price**: the price expressed in local currency/kg.
- **Percentage sold**: this is the percentage of production that is sold. It is assumed that the farmer or their animals consume the percentage of the remainder.
- **Land size**: the average areal extent under cultivation for this crop.
- **Number of harvests**: the number of harvest(s) per year or per season.

\(^{140}\) Taken from the following website: [http://www.cameroon-info.net/stories/0,23035,@,petits-salaires-entre-smig-et-realites.html](http://www.cameroon-info.net/stories/0,23035,@,petits-salaires-entre-smig-et-realites.html)

\(^{141}\) In the case of Cameroon, the construction of a storage facility would allow farmers to sell directly in the village, saving on transportation.

\(^{142}\) In the case of Cameroon described above the main component would be investment in the shared storage facility.

\(^{143}\) In cases where we were provided with ranges (best, actual and worst cases) for the yield and/or the market price, we used the actual figure in the baseline case scenario, and the range between actual and best case for the project scenarios.

\(^{144}\) Often the yield figure provided is in bag/ha. Other measurements provided include tree, ster, ton, M3. Where possible, this is converted into kg/hectare, unless the price is also expressed in the other units.
BOX 6. Cash Flow Information

The Cash Flow Information Section contains:

- Compounded inflation factor: for any given year of the holding period, this is the total inflation measure from year one.
- Discount factor: for any given year, this is the rate at which the cash flow items are discounted = $\frac{1}{(1+r)^n}$, where $r$ is the government lending interest rate.
- Household: for each line item of household equipment listed, this is the $n$-year projection for the entire landscape, calculated by increasing the year one total figure by the compounded inflation, and discounting back to today’s prices.
- Crops: for each line item of crop revenue and expense, this is the $n$-year projection, calculated as described for households.
- Landscape Total: this sums up the expenses and revenue for households and for each crop. The profit is calculated by deducting the total expenses from the total revenue, for every year of the $n$-year projection. The total profit is then converted to USD and divided by the total number of farms.
BOX 7. Summary Section

The summary contains:

- Base cash flow summary: this present the main results from the Base Cash Flow section, with all crops aggregated
- Project cash flow summary: this present the main results from the Project Cash Flow section, with all crops aggregated
- Project performance: this presents profit as a percentage of the international poverty line, therefore showing how farmers who implement the new practices will improve their livelihoods. This is in our mind the best way to measure the return farmers will garner by implementing new practices
- Crop base summary: this summarizes the main result, crop by crop, of the Base Cash Flow section. These are total Capex, total Opex, total Expenses and Revenue, operating Profit (difference between total Revenue and total Opex) and Profit (difference between total Revenue and total Expenses)
- Crop project summary: as above, this summarizes the main results, crop by crop, of the project Cash Flow section. These are total Capex, total Opex, total Expenses and Revenue, operating Profit (difference between total Revenue and Opex) and Profit (difference between total Revenue and total Expenses)
- Capital Requirement: the total amount of capital investment required to establish the projects in the landscape
- Other Metrics: this summarizes various cost items as a percentage of the overall cost:
  - Total operating expense as a percentage of the overall cost for both the base and project cash flows
  - Total labor cost as a percentage of the overall cost for both the base and project cash flows
  - Transportation cost as a percentage of the overall cost for both the base and project cash flows

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145 Although traditionally the best indicator of financial performance is the IRR, we consider the IRR to be of little value here since the practices are not traditional financial investments with little to no alternative investment possibilities – and an IRR is essentially used as a tool for comparison
Diagram 1. Elements of the Cash Flow
Figure 2: The cocoa process is substantially more complex than most commodities, as there are several intermediate stages with traded outputs.\textsuperscript{146}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{cocoa_value_chain}
\caption{Cocoa Value Chain in West Africa}
\end{figure}

\textit{Source:} Abbott, Muir and Wilcox, 2006