
# VCS JOINT PROJECT DESCRIPTION & MONITORING REPORT

# AFFORESTATION IN EUCALYPTUS AND ACACIA PLANTATIONS FOR BURAPHA AGROFORESTRY CO., LTD.

Document Prepared by

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| **Project Title** | *Afforestation in Eucalyptus and Acacia plantations for Burapha Agroforestry Co., Ltd.* |
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# 1 PROJECT DETAILS

## 1.1 Summary Description of the Project

The proposed VCS grouped project "Afforestation in Eucalyptus and Acacia plantations for Burapha Agroforestry Co., Ltd." (hereafter 'Burapha'), represents one of the first major afforestation projects of the private sector in Lao PDR. It promotes and implements afforestation of Eucalyptus and Acacia agroforestry plantations on degraded areas. These areas are either village owned or part of governmental "Forest Protection Areas", which entirely are degraded by swidden agriculture for rice cropping by local communities.

The plantations are established in the Prefecture of Vientiane and the Provinces of Vientiane, Xayabouly, and Saysomboun in Lao PDR. Local villagers are allowed to use the plantations for intercropping or grazing, which is part of the Agroforestry approach of the project. Burapha is a Lao-Swedish company that aims to produce high quality timber for the veneer, plywood and sawmill industry. The project generates GHG removals through tree and soil carbon sequestration. These credits are generated using the CDM methodology AR-ACM0003: "Afforestation and reforestation of lands except wetlands" (version 2).

Burapha is also FSC certified and managed to plant successfully about 3,475 ha by 2020, contracted from 23 villages and plans to scale up its plantations to 15,000 ha by 2021. The future goal is to manage 68,750 ha of forests in total, consisting of approximately 55,000 ha of plantations and 13,750 ha of protected areas. These protected areas correspond to 20% of the total area, which are set aside for conservation management.

The main tree species of the project are the exotic species of Eucalyptus cumadulensis or cross with E. urophylla, E. pellits, or E. grandis) which is planted on 66% of the area and Acacia auriculiformis with subsequent 33% of the planting area. The rotation period is 7 years and during the first years the local farmers can do intercropping. Between years 3 to 7 cattle grazing is allowed on the plantation areas and in the years 3 and 4 the plantations get thinned out. After the first rotation the Eucalypts get coppiced and replanted after each second rotation.

The project will generate average removals of **130.2 t CO2/ha**. Over a crediting period of 20 years the project will generate **408,682** $tCO_2e$ and **20,434** $tCO_2/yr$.

## 1.2 Sectoral Scope and Project Type

According to VCS Standard document version 4, the project activities fall under the eligible AFOLU project category of "Afforestation, Reforestation and Revegetation (ARR).

The proposed project is designed as a VCS grouped project.

## 1.3 Project Eligibility

The project supports the scope of the VCS program by initiating project activities that sequester carbon through afforestation of degraded lands.

### A) 10 years no clearance of native ecosystems

According to the VCS Standard (V4), eligible ARR areas must be areas that have been cleared of native ecosystems at least 10 years prior project establishment (Appendix 1.1). Furthermore, the VCS Program (V4, AFOLU requirements) states: "Activities that convert native ecosystems to generate GHG credits are not eligible under the VCS Program."[1]

Burapha establishes its plantations on degraded areas, formerly used by swidden agriculture. The occurring fallow forest is not deemed a native ecosystem. If clearing occurred 10 years prior the plantation establishment the plantations are eligible under the VCS.

In terms of the land acquisition process, Burapha follows a participatory approach to identify suitable areas for its afforestation plantations, which is described in the SOP "Land Acquisition Operations Manual" (provided as supporting documentation, see page 13):

*"Land seemingly without conflicting land use risks, in particular not with permanent agriculture. Land shall meet the government's definition for "degraded land[2]" and land allowed for forest production (not flat land suitable for agriculture/paddy rice production)."*

Burapha defined a number of guiding principles of this process, the "Land Selection Criteria" (SOP Land Acquisition Operations Manual, Appendix 1). Amongst others, the socio-economic criteria mention suitable land for Burapha plantations shall be *"land currently without any permanent agriculture production, primarily abandoned shifting cultivation land and where there is minimal risk of land use conflicts."*

And furthermore:

*"The previous land use shall be recorded, divided on a number of given land uses and the year of last use of the land for economic production shall be recorded. Representative photos shall be taken to record current land type."*

[1] https://verra.org/wp-content/uploads/2020/03/VCS-Standard-v4.0_Updated.pdf

2 Def, Forestry Law 2019; Art 2,15: "Degraded Forest Land": "Degraded forestland is a forestland area that has been heavily and continuously disturbed for many years and will take a number of decades to regenerate naturally. Degraded forestlands have a tree crown cover of no more than 10%, and a standing tree volume of no more than 20m/ha, measuring only those trees of over 10 cm in diameter;

In summary, the land acquisition process follows the following steps[3]:

1) Land scouting: Potential project land is identified by Burapha/GOL authorities or villages, which get in contact with Burapha. The Burapha field staff screens the potential sites according to Buraphas Land Selection criteria and prepares a Land Contact report for the Burapha Land Department. Areas get screened and approved by Management for which government authorities get contacted to approve an intended reconnaissance survey.
2) Reconnaissance survey: Buraphas conducts this survey with village and GOL authorities in order to rapidly assess site conditions, and among others also to determine the former land use.
3) Comprehensive Land survey: All suitable areas are investigated for the following points:
    a. Information meeting
    Introduction of Burapha to the village, FPIC process initiation
    b. Mapping
    Mapping of production areas and other special areas (HCA) in cooperation with villagers
    c. Site survey
    Quantitative and qualitative sampling to verify information from previous meetings. Confirmation of land meeting Buraphas Land selection criteria (degraded lands, etc.)
    d. Village consultation –
    Conducted including all adults from the prospective collaborative community to conduct an extensive land use verification, social baseline surveys, etc.
4) Contract signing and cooperative agreement

In addition, the project aims to receive for all plantation areas a full FSC certification. As part of the FSC certification process Burapha *"must demonstrate that vegetation cleared for plantation establishment was not 'natural forest' after 01. November 1994 or was otherwise cleared prior to Burapha involvement for Full Certification."* (FSC Principles and Criteria V5 (2015) Criteria 6.10; cited in Forest Clearance Memo, 2016).

In case areas have been cleared later than 01. November 1994 FSC certification is not issued for the respective areas. These respective areas however may still be eligible under the VCS, since deforestation of the natural ecosystem must have happened 10 years prior project start, thus June 2005.

Therefore, it can be concluded that all plantation areas with an issued FSC certification are also eligible under the VCS and for plantation areas not receiving FSC certification the deforestation date is determined by village consultations (FSC audit, 2018): *"As there are no aerial pictures and no official data SEL tries to find out by questioning the villagers, if there has been forest before 1994."*

[33] For a more detailed description please refer to the SOP "Land acquisition Manual"

Therefore, all project areas are eligible under the VCS ARR.

**B) No Drainage:**

The VCS Standard Art 3.2.5 states: *"Activities that drain native ecosystems or degrade hydrological functions to generate GHG credits are not eligible under the VCS Program."*

Burapha does not intend to alter hydrological functions of the project area (ESIA – chapter 3). Instead, Burapha identifies areas of high-conservation value and includes them into their special management areas (SMA's). SMA's are protected areas, which consist of riparian zones, remnants of native forest, etc. This will benefit the overall hydrological condition of the landscape where the project areas are located.

Therefore, this eligibility criteria does not apply for the Burapha Agroforestry carbon project.

## 1.4 Project Design

The project activity is a typical ARR activity – afforestation on degraded land. The project is a grouped project and will register different activity instances of project activities over time.

### Eligibility Criteria

The eligibility criteria for inclusion of new project activity instances are demonstrated in accordance with the paragraph 3.5.15 of the VCS Standard (Version 4). Any new instance will meet the following criteria:

1) Meet the applicability conditions set out in the methodology applied to the project.

All the new instances will comply to the applicability conditions of the methodology AR-ACM0003: Afforestation and reforestation of lands except wetlands (Version 2).

These conditions are described in section 1.3 above, to justify the inclusion of the first project instance areas.

2) Use the technologies or measures specified in the project description.

All project instances registered will follow the same project design as described under 1.11.

3) Apply the technologies or measures in the same manner as specified in the project description.

All new plantation areas included as new activity instances will be planted in the same manner and planting scheme as mentioned in the project activity (chapter 1.11). The same SOP's will be used and the same tree species will be planted. Burapha will apply the same FPIC approach

to communicate and sensitize villages and communities as described. Also, the auditing and monitoring of carbon and other socio-economic and environmental benefits will be done in the same way. Thereby all the carbon related requirements of the methodology AR-ACM0003 and required tools will be followed.

4) Are subject to the baseline scenario determined in the project description for the specified project activity and geographic area.

5) Have characteristics with respect to additionality that are consistent with the initial instances for the specified project activity and geographic area. For example, the new project activity instances have financial, technical and/or other parameters (such as the size/scale of the instances) consistent with the initial instances, or face the same investment, technological and/or other barriers as the initial instances.

The baseline scenario and the demonstration of additionality are determined for the entirety of the geographic project region where project activity instances are developed. The regional baseline scenario for all new project areas will be consistent with the baseline identified in section 3.4 where the tool "Combined tool to identify the baseline scenario and demonstrate additionality in ARR CDM project activities" has been applied. Similar barriers as presented in the analysis are presented in any new instances in order to be eligible. The boundary of the project region of this grouped project was selected to represent similar land use systems and socio-economic conditions of Northern Lao PDR.

## 1.5 Project Proponent

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|---|---|
| **Organization name** | Burapha Agro-Forestry Co. Ltd. |
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## 1.6 Other Entities Involved in the Project

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|---|---|
| **Organization name** | UNIQUE – Forestry and Land Use |

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|---|---|
| Role in the project | Project development support |
| Contact person | Matthias Seebauer |
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## 1.7 Ownership

**Legal title to the land**

Burapha consults villagers and village representatives, as well as the Lao Government in order to receive permission to survey and lease land for the project. Therefore, there are mainly four land/tenure types in the carbon project (see list below). Burapha recognizes the rights and interests of local communities as the traditional managers of their lands and follows the Free, Prior and Informed Consultation/Consent (FPIC). FPIC applies to project design, implementation and expected outcomes related to impacts affecting communities.

Only stakeholders, which can demonstrate their legal land rights are considered for lease agreements (BAFCO, 2019)[4].

As a plantation company Burapha seeks constantly to expand its plantations. Thus, Burapha is currently negotiating with the Lao Government about lands in Forest protected areas (FPA's). These are officially protected areas, however have been used by locals for shifting cultivation therefore highly degraded.

Burapha has four different kinds of how to acquire land. These are called Land tenure types or in short, Land Types:

1) Company land:
   The perpetual land use rights are acquired by the company or in the company owner's name.

2) Concession agreement
   This land is state owned land, where the procedure of acquisition follows the laws and regulations of Lao PDR.

[4] SOP: BAFCO Land Acquisition Operations Manual, available as supporting documentation

3) Farmers agreement
   Agreements are made with individuals for land for which the individual can prove their land use rights and related documents are fully in accordance with GoL' laws and regulation.

4) Village cooperation agreement
   A village cooperation agreements (VCA) are for the acquisition of a portion of village (shared) communal land. However, this land type is not in use now.

Examples of land lease agreements provided by Burapha are available as supporting documentation.

**Rights of access to the sequestered carbon**

The villages have agreed that the plantations generate various benefits to the villages and the company. While wood and carbon production is a benefit for the company, the villagers are allowed to intercrop in the plantations during the first two years and practice grazing until the end of rotation. Furthermore, the company developed an employment scheme for the villagers for all activities during plantation establishment and maintenance.

The state/villages/individuals have agreed that the property rights on the carbon credits generated by this afforestation are exclusively allocated to the proponent of the Project. Under this agreement, the beneficiary state/villages/individual is committed not to assert any property rights over the carbon credits generated and/or to be generated. In case of the state land, it is assured that the carbon ownership is guaranteed to Burapha by the Forestry law (2019), Art. 103.

## 1.8 Project Start Date

Project Start date: 22.04.2016

The project start date is marked by the beginning of the land lease agreement between Burapha and the first villages/individuals of the afforestation project stated in the Land Owner Agreement by Burapha.

## 1.9 Project Crediting Period

| | |
|---|---|
| Project start date | 22.04.2016 |
| Project end date | 22.04.2035 |
| Total No of crediting years | 20 years renewable |

However, Burapha's village cooperation agreements foresee 30 years of lease with the option for extension of another 20 years, where all stakeholders have to approve concession periods are set to 50 years with the option of a 25 year extension, pending approval by all stakeholders.

## 1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The ex-ante GHG removals are calculated for the first project activity instances totaling a project area of 3,536 ha. The estimates are presented without VCS buffer.

| Project Scale | |
|---|---|
| Project | x |
| Large project | |

| Year | Project year | Estimated GHG emission reductions or removals ($tCO_2e$) |
|---|---|---|
| 2016 | 1 | 41,320 |
| 2017 | 2 | 75,017 |
| 2018 | 3 | 102,326 |
| 2019 | 4 | 112,517 |
| 2020 | 5 | 112,522 |
| 2021 | 6 | 80,568 |
| 2022 | 7 | 55,456 |
| 2023 | 8 | 39,077 |
| 2024 | 9 | 5,096 |
| 2025 | 10 | 5,096 |
| 2026 | 11 | 5,096 |
| 2027 | 12 | 5,096 |
| 2028 | 13 | 5,096 |

| | | |
|---|---|---|
| 2029 | 14 | 5,096 |
| 2030 | 15 | 5,096 |
| 2031 | 16 | 5,096 |
| 2032 | 17 | 5,096 |
| 2033 | 18 | 5,096 |
| 2034 | 19 | 5,096 |
| 2035 | 20 | 5,096 |
| Total estimated ERs | 679,957 | |
| Total number of crediting years | 20 | |
| Average annual ERs | 33,998 | |

## 1.11 Description of the Project Activity

### General

The Burapha Agroforestry Carbon project promotes carbon sequestration through afforestation of eucalyptus and acacia agroforestry plantations on degraded lands, formerly used for shifting cultivation.

The objective is to manage 55,000 ha of plantations and additional 20% of conservation area (68,750 ha in total). This conservation area shall entail riparian buffers, steep slopes and additional uncleared/ unplanted area. Approximately 3,475 ha of plantations are established since 2016. The project is located in 5 provinces of Bolikhamxay, Saysomboun, Vientiane Province, Xayabouli and Vientiane Prefecture with a total project region of 55.605 km$^2$. Burapha has active land holdings in the latter 4 provinces, while they do not hold land in the province of Bolikhamxay, but plan to expand their plantation activities into this province as well.

### Plantation management and planting

Burapha establishes its plantations on degraded lands of former shifting cultivation, using mainly Eucalyptus (*Eucalyptus spp.*) and Acacia (*Acacia spp.*). Before plantation establishment, Burapha selects suitable sites for protection, such as any areas with high conservation value, slopes >35°, strategic areas for fire protection or areas targeted for habitat enhancement.

Areas suitable for plantation however are prepared by clearing the fallow vegetation. All work is conducted maximizing the labor input and reducing mechanical work, to guarantee employment for the villagers.

The trees are planted in a 3x3m or 4.5x2m and sometimes in a 9x1m planting scheme, adding up to approximately 1,111 trees/ha. The forest stands itself are thinned during year 3 and 4 in a 9x1m planting scheme and all plantations are harvested after 1.5 years (rotation cycle). The trees are cut to the stump during the first harvesting event, from which they re-sprout for the second rotation. After two rotations the trees will be replanted.

Maintenance of the plantations during their growth cycle involves periodic weeding, thinning and addition of fertilizer. Additional, fire breaks are established.

### Agroforestry scheme

Planting schemes get adjusted, if villagers request to practice intercropping, e.g. upland rice. This means to either apply the 4.5x2m scheme and reducing the total amount of trees stocking to approximately 880 trees/ha or to plant the trees closer, in order to maximize inter-row space to a 9x1m planting scheme. The villagers are allowed to intercrop during the first 2 years of the rotation cycle, while they can afterwards use the inter-row space for cattle grazing. The Agroforestry scheme shall ensure that the plantations do not interrupt the traditional food production scheme of farmers and force them to practice shifting cultivation in new and forested areas. The maintenance work of plantations is offered to the farmers and only if they decline 3rd parties will be contracted to conduct this work. Table 10 shows the labor opportunities of villagers during plantation growth.

**Table 1: Burapha Agroforestry model labor and intercropping opportunities**

<table>
<tr><th>Year</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th></tr>
<tr><td rowspan="2">Company Activity</td><td>Site Prep.</td><td>Weeding</td><td></td><td>Thinning</td><td></td><td></td><td>Harvesting</td></tr>
<tr><td>Planting</td><td>Fertilising</td><td colspan="5"></td></tr>
<tr><td rowspan="3">Community Opportunities</td><td colspan="7">Labour (for Company Activities above)</td></tr>
<tr><td colspan="2">Annual Intercropping</td><td colspan="5">Grazing</td></tr>
<tr><td colspan="7">Long Rotation Intercropping (e.g. Rattan)</td></tr>
</table>

Source: Burapha 2016

**Figure 1: Intercropping plantation with upland rice and cattle grazing between plantation trees**

### Industry

Burapha operates a sawmill and furniture factory at the Nabong Farm in Xaythany District / Vientiane Prefecture to process wood grown in the Company's plantations as well as timber purchased from outside entities. The sawmill uses primarily domestically grown Eucalyptus, Teak and Acacia purchased from 3rd parts, but substitutes it more and more with wood from own plantations.

Furthermore, Burapha operates a tree nursery, as well as a research and development facility for its own plantations. This nursery is situated next to the sawmill at the Nabong farm. Currently the nursery can develop approximately 3 million cuttings per year.

Currently, Burapha plans to construct a plywood mill, which will produce Eucalypt veneer and plywood and shall go operational by the end of 2020.

### Organization with partners

Areas which are leased from villages and individuals are managed by Burapha. In total, Burapha has lease contracts with 31 different villages. However, Burapha has also established an out grower scheme since 2017. In these out grower schemes Burapha provides capacity training/technical advice, seedlings and a potential end market for the interested villagers. The planned industry (sawmill and plywood mill) will provide a potential market for the out growers.

### Capacity building

The carbon project will generate a need for skilled workers capable of operating international standard plantation operations. Burapha will invest in training and capacity building initiatives with Company staff, local communities and the government. The Project will also create a

growing need for greater industry investment into advanced research facilities, learning resources, and research skills and expertise which will complement current development initiatives in the forestry sector.

**Conservation activities**

Potential conservation areas are designated during the land acquisition process, in order to not get cleared. Their further existence is confirmed and ensured.

As part of their conservation activities, Burapha takes care that no plantations are bordering directly to watercourses. Watercourse buffers are maintained in order to safeguard potential habitats for high biodiversity, which also can serve as wildlife corridors. Fire breaks established by Burapha prevent watercourse buffers from burning during site preparation and possible forest fires. Furthermore, Burapha does not clear any native forests and retains groups of large trees. On Burapha holdings only subsistence fishing is allowed (FSC, 2018).

Overall these activities will help to increase the carbon stock of the ecosystem, conserve local ecosystems, support local food production, and produce local wood products (plywood and saw wood).

**Jurisdiction of another REDD+ program**

Lao PDR is a partner country of the FCPF and runs under the REDD+ program, however the carbon project itself does not run under a JNR program of the VCS.

## 1.12 Project Location

The plantations are established in the Prefecture of Vientiane and the Provinces of Vientiane, Xayabouly, and Saysomboun in Lao PDR. The project region boundary encompasses the following provinces of Lao PDR: Bolikhamxay, Saysomboun, Vientiane Province, Xayabouli and Vientiane Prefecture. Burapha has acquired areas in these provinces or is planning as part of the next project instances to expand into these areas. All project plantations have similar baseline conditions and are established on leased land of village partners. The biggest town within the project boundary is Vientiane city, the capital of Lao PDR. The current plantations are located between 101°42'21.07E – 102°33'48.32E and 18°20'37.80N – 19°02'33.88N.

Project GIS maps are available as supporting documentation. The table below shows the first activity instances of this grouped project stratified according to the years of planting.

**Table 2: First project activity instances included in this project**

| Planting year | Area (ha) | Baseline Stratum |
|---|---|---|
| 2016 | 921 | Slash-and-Burn |
| 2017 | 751 | Slash-and-Burn |
| 2018 | 609 | Slash-and-Burn |
| 2019 | 320 | Slash-and-Burn |
| 2020 | 874 | Slash-and-Burn |
| Total | 3,475 | |

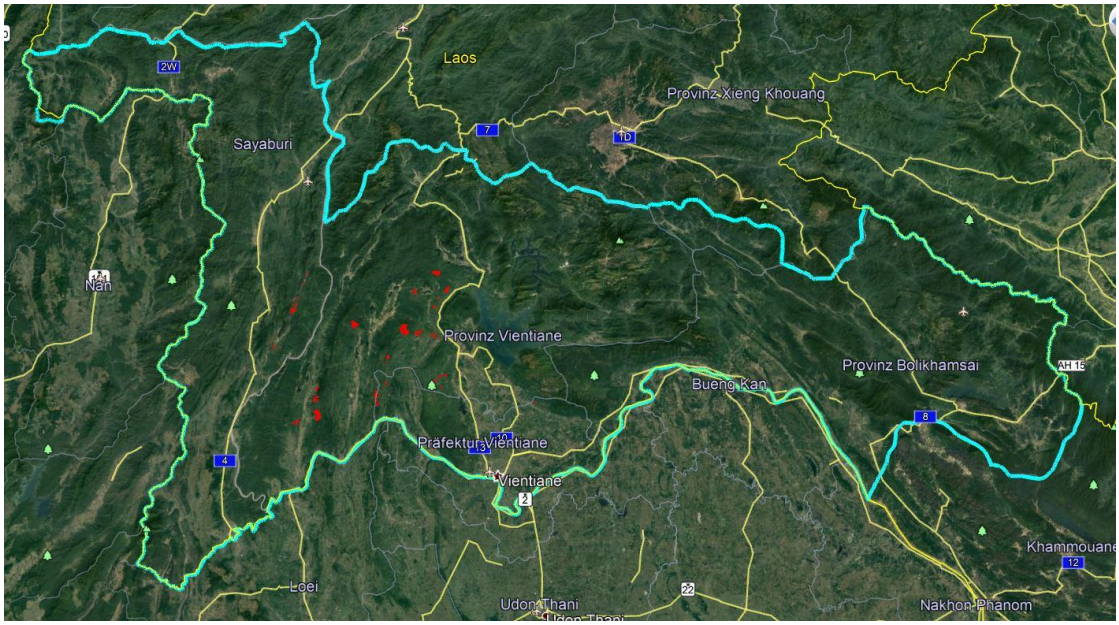



**Figure 2: Project region boundary with first project instances, 2020**

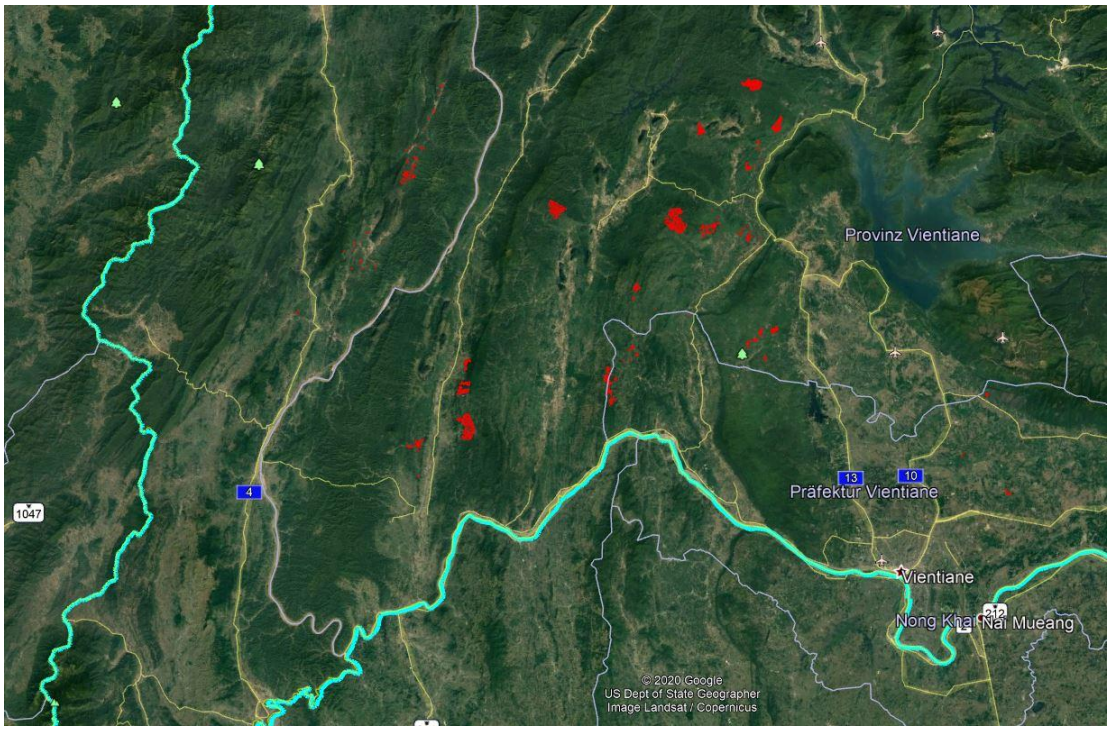



**Figure 3: First project instances in detail (red), 2020**

## 1.13 Conditions Prior to Project Initiation

As further detailed in chapter 3.4 the pre-project land use is shifting cultivation, which will also continue in the absence of the project

**Climate**

Lao PDR experiences a tropical monsoon climate, with a pronounced rainy season from May until October and a dry season (November – April). The dry season is divided into a cool dry season (November – February) and a hot dry season (March-April).

Mean temperatures in Vientiane range between 23–29 °C and peak usually during April. Although temperatures are very uniform, it typically ranges from 16°C in January/December to 34°C in April.

Annual average rainfall across the five Provinces varies from 1,300 to 2,700 mm. Highest rainfalls are observed between May and September, and can contribute 84 to 94% of the total annual precipitation.

**Hydrology**

The main drainage systems within the six Provinces are the Mekong River, Nam Ngum River and Reservoir, Nam Lik and Nam Xong, as well as their tributaries and basins.

In addition to the main rivers, drainage systems range from lowland to upland streams and rivers, with a few smaller montane streams. The hydrology of the foothills is highly influenced by rainfall patterns and therefore by the monsoon rainfall (rainy season; May – Oct.), which affects the flow and presence of intermittent and ephemeral streams. Seasonal rain is therefore important for flow volumes in foothill streams (ESIA, 2016).

### Topography

The land acquisition policy of Burapha targets foothills as the target areas for plantations, due to its preferred location for shifting cultivation. This avoids sites with sensitive habitats and productive lands, which are mainly located in the floodplains and therefore suitable for agriculture. Foothill zones are characterized by a gradual increase in elevation from plains toward the base of mountain ranges, steep hills or other upland area. Foothills therefore represent a transitional zone between plains (floodplains, lowlands) and mountains. Burapha targets foothills with slopes up to 15°. Slopes with greater inclinations require manual operations only and slopes above 35° are not considered.

### Soils

The soils of the plantation sites, which are usually established on foothills are commonly a combination of dystic Cambisols, ferric Acrisols, and haplic Acrisols. They are derived from siliceous sedimentary material, mildly acidic, leached of nutrients and therefore relatively enriched in aluminum (ESIA, 2016 citing Eswaran et al.,2005). Furthermore the ESIA states: *"Top soils have relatively low clay content, subsoils (Cambisols) have low base saturation, resulting in low nutrient and water holding capacity. Soils are generally well leached by rainfall and in some areas, have been limed for agriculture."*

### Vegetation and Ecosystem

The Northern foothills of Lao PDR cover mainly evergreen and deciduous forest as can be seen in Figure 4. The dry dipterocarp forest has been mainly deforested over the past decades which covered the valley of Laos, especially in the Mekong river basin (WWF, 2020)[5].

The vegetation on the plantation sites of Burapha consists of fallow vegetation in different successional stages. Fallow forest is a regenerating vegetative community that is re-establishing, generally after clearance for shifting / swidden cultivation. It develops through primary succession of vegetation, first herbaceous and later woody vegetation, which can be separated into fast growing pioneer and later slow-growing climax species (Rerkasem et al., 2009).

Considering the forest categories and definition of Lao PDR, studies have shown a fallow vegetation requires approximately 7 years to grow back into the forest category, which includes crown cover (>20%) and carbon/DBH accumulation (>10cm DBH) (MAF, 2018). Studies claim

[5] https://www.worldwildlife.org/ecoregions/im0202

an average cultivation time of 1 year and fallow periods between 2 and 3 years (37,5%) until the site is cultivated again (Inoue, 2018; In: Vadrevu et al, 2018).

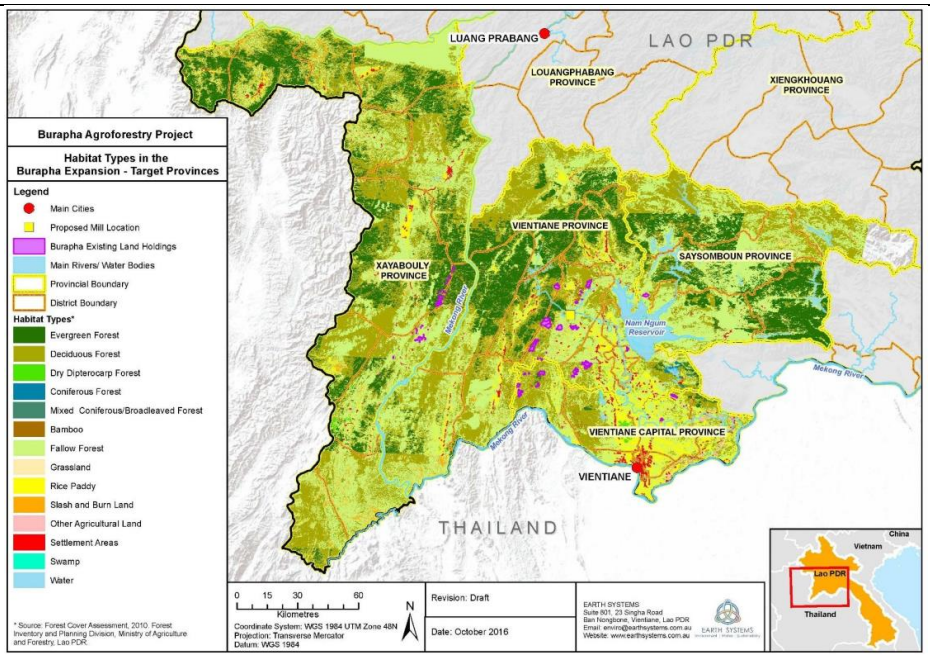



**Figure 4: Vegetation of 4 of the 5 project provinces in Northern Lao PDR.**

## 1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The ARR project activity is in compliance with all the applicable legal and regulatory requirements, as well as all applicable Central and State Government laws and regulations, which are implemented are scrutinized. A list of all concerned laws can be found below (Table 4).

The legal and institutional framework of Lao PDR is composed by a series of laws and regulations that govern the Burapha Carbon Project. Among the most important is the Forestry Law, which was reformed in 2019 and declares the use and management, protection, development, utilization and inspection of forests and forestland as public interest.

All natural forest and forestland is the property of the Lao Nation, however the forestry law also recognizes the property of legal entities, if trees have been planted by those. Thus, Burapha is the legal owner of all trees planted in the project.

For the lawful operation of the project, the activities need to get approval and/or registration by the applicable regulatory agencies as follows:

**Ministry of Agriculture and Forestry (MAF)** and its subsequent Departments, the Department of Forestry (DOF) and the Department of Forest Inspection (DOFI).

The MAF is responsible to "ensuring food security; forest management, supplying raw materials for processing industries, sustainable, modern commodity production and the creation of permanent jobs for ethnic groups in order to reduce dependence on shifting cultivation and to eradicate poverty across the country".

The **Department of Forestry (DOF)** is a central agency under MAF and has advising functions to the MAF. Main functions of the DOF are for instance to develop and implement forest activity strategies, programs and policies, undertake forest planning, and monitoring, formulate forestry laws and other legal forestry instruments. Furthermore, the DOF has to execute these through regulations, policy and technical instructions.

The **Plantation Investment Division**, a subdivision of the DOF, together with the Division of Technical Standards, is responsible for the development of regulations for plantation investment and management.

The implementation of all functions of the DOF is the responsibility of the **Provincial Agriculture and Forestry Division (PAFO)**. As such the PAFO develops provincial harvesting quota and submits these to MAF, issuess harvesting licenses, develops harvesting contracts, superves harvesting operations, prepares log source documentation, undertakes the scaling and grading of logs and creating the lists of logs at Landing 2, prior to transport and consolidating District level information for reporting to DOF[6].

The **District Agriculture and Forestry Office (DAFO)** is the district executive agency for the PAFO. They are responsible for the registration of plantations, advising on plantation management and planning, pre-harvest surveys monitoring of harvesting operations among others. PAFOs and DAFO work together to find degraded land for forest investors, such as Burapha.

The **Department of Forestry Inspection (DOFI),** is directly subsequent under the MAF and is responsible for monitoring, investigation and enforcement of the Forestry Law No. 06/NA 2007 and the Wildlife and Aquatic Law No7/2007.

Other important governmental agencies important for plantation management in Lao PDR are Department of forest resource management (DFRM), The Ministry of Natural Resources and Environment (MONRE), Department of Environmental and Social Impact Assessment and others.

[6] http://forestry-nuol.weebly.com/uploads/2/0/9/5/20955514/environmental_protection_and_management_of_plantations_in_lao_pdr_final_eng.pdf

The **Forest Strategy 2020** was the primary strategy fore forestry and was declared in 2000. Major objectives of the forest strategy are also pursued by activities of the Burapha Carbon project, amongst others: control and correct actions that lead to forest deterioration and achieving at the same time livelihood improvements for locals, ensure sustainable forest management by promoting commercial tree planting, contribution to forest ecosystem conservation.

**Table 3: Main laws relevant for the Burapha Carbon Project in Lao PDR**

| Aspect | Main laws | Description |
|---|---|---|
| **Main environmental laws** | ▪ **Environmental Protection Law** - Law No. 29/NA 2012 | Plantation owners need to establish an Environmental and Social Impact assessment (ESIA). Furthermore, an Environmental Compliance Certificates for development has to be acquired |
| **Forest and land use laws** | ▪ **Law on Land** - Law No. 04/NA - 2003: Categorizes and defines all types of land & Regulates access to land and land use rights<br>▪ **Forestry Law** - Law No. 64 /NA- 2019: Regulates the management and use of Forest Land | ▪ The main forest categories are protection forests, conservation forests and production forests. Burapha operates in the latter one.<br>Allows for the use of Forest Land for plantations (Production Forest cat.).<br>▪ Defines under the new forest strategy the main goals of forestry, e.g. by contributing to increase forest cover to 70% through reforestation of degraded forests<br>▪ Art. 15: declares all forests next to roads and rivers to protection forests<br>▪ Art. 57: Declares forest plantations to target degraded forest land<br>▪ In Art. 58 legal entities are encouraged to rehabilitate degraded forests<br>▪ Art. 103: the government encourages legal entities to conduct trade in forest carbon under int. mechanisms |
| **Main laws related to labour** | ▪ **Law on Labour Protection** - No. 43/NA - 2013 | Regulates labor regulations for employees, amongst others regulates minimum wage |
| **Main laws related to wood production and processing** | ▪ **Timber Transport and Business order**- Order No 15/PMO On Strengthening Strictness of Timber Harvest Management and Inspection - 2016 | Suspends to export of logs and unfinished wood products, Burapha has a own saw and plywood mill |

| | | |
|---|---|---|
| **Administrative laws** | ▪ **Enterprise Law** - Law No. 46/NA - 2013 | Plantation owners need to register for their operations. |

**Table 4: List of concerned laws and other regulations**

| **Laws** | **Year of publication** |
|---|---|
| Forestry Law | 2019 |
| Law on Resolving Public Complaints | 2014 |
| Environmental Protection Law | 2013 |
| Law on Labour Protection | 2013 |
| Law on National Heritage | 2013 |
| Law on Hygiene, Disease Prevention and Health Promotion | 2012 |
| Law on Investment Promotion | 2009 |
| Law on Agriculture | 2008 |
| Law on Aquatic and Wildlife | 2007 |
| Law on Fire Prevention and Management | 2007 |
| Land Law | 2003 |
| Law on Water and Water Resources | 1996 |
| **Decisions, Directives, Regulations, and other Legislation** | |
| Decree on Compensation and Resettlement Management in Development Projects | 2016 |
| Order of the Prime Minister on Strengthening the Management and Inspection of Logging, Wood Transport and Timber-Related Businesses | 2016 |
| Decree on Conservation Forest | 2015 |
| Notification from the Ministry of Labour and Social Welfares on Minimum Wage in Lao PDR | 2015 |
| Ministerial Instruction on the Process of EIA of the Investment Projects and Activities | 2013 |
| Moratorium on Land Concession for Mining, Rubber and Eucalypt Investment Projects | 2012 |
| Environmental Impact Assessment Guidelines | 2012 |
| Guidelines on Public Involvement in Environmental and Social Impact Assessment | 2012 |
| Agreement of the Minister on the Management and Use of Plant Variety | 2012 |
| National UXO and Mine Action Standards | 2012 |
| Regulation on the Control of Pesticides in Lao PDR | 2010 |
| Decree on Protection Forest | 2010 |
| Agreement on the National Environmental Standards No. 2734/PM-WREA | 2009 |
| Notification of MAF No. 1374/MAF on Development and Promotion of Sustainable Forest Plantation | 2010 |

| | |
|---|---|
| Guidelines of the Department of Forestry No. 1643/DOF on the Conduct of Economic-Technical Studies for Industrial Tree Plantation and Non-timber Forest Product | 2010 |
| Decree on State Land Lease and Concession | 2009 |
| Presidential Decree on Land Tax | 2007 |
| Order of the Minister on the Implementation and Application of Agro-biodiversity approach in Agriculture and Forestry Development | 2005 |
| Prime Minister Decree No. 96/PM on Industrial Tree Plantation and Environmental Protection | 2003 |
| Instruction of MAF No. 0115/MAF on Plantation Forest for Wood Processing Factory, Plantation Registration, Plantation Tree Harvest Permit and Export of Planted Timber | 2003 |
| Regulation of MAF No. 0196/MAF on Development and Promotion of Sustainable Forest Plantation | 2000 |
| Instruction of MAF No. 1849/MAF on Forest Plantation Registration Process | 1999 |
| Instruction of the Prime Minister No. 03/PM on the Implementation of Land and Forest Allocation Program | 1996 |
| Instruction of MAF No. 0822/MAF on Management of Tree Planting and Planted Forests | 1996 |
| Decree on the Establishment of National Forest Reserves | 1993 |

## 1.15 Participation under Other GHG Programs

### 1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

This project has not and is not seeking registration under another GHG program.

### 1.15.2 Projects Rejected by Other GHG Programs

This project has not been rejected by any other GHG program, since it did not seek registration under a different GHG program.

## 1.16 Other Forms of Credit

Lao PDR pledged under the Paris agreement to increase Forest cover to 70% by 2020 as part of the Intended National Determined Contributions (INDC's; ndcs.undp.org). Considering the current situation with widespread shifting cultivation and the new forestry law from 2019, trying to discourage farmers from practicing permanent agriculture, there is a shift in policies towards forest growth and improvement of forests. Burapha contributes with its Agroforestry scheme and plantations to this goal of increasing forest cover. However, the NDC implementation plan is still pending.

Furthermore, Lao PDR is part of the FCPF Carbon fund and registered as REDD early mover's country (forestcarbonpartnership.org). Recent documents published under this program include the Readiness-Package in 2018. Burapha and Lao PDR have an agreement that all emission reductions generated under this project account for this project and are not part of the REDD

program (and therefore not under the jurisdiction of the INDC's). When the REDD program is ready and INDC's will get implemented, it will be the GOL's responsibility to include this program and avoid double-counting.

Lao PDR is since 2008 part of the early movers program. Therefore, the completion of the process might take more time, which allows Burapha to generate emission reductions until this date by agreement with the GOL of Lao PDR.

### 1.16.1 Emissions Trading Programs and Other Binding Limits

The project does not reduce emissions in another emission trading program.

### 1.16.2 Other Forms of Environmental Credit

The project is not being used to create other environmental credits.

## 1.17 Additional Information Relevant to the Project

### Leakage Management

The Burapha carbon project aims to increase the carbon stock of degraded land through afforestation. The areas were formerly used for swidden agriculture and are currently vegetated by low fallow vegetation. Leakage could be expected through the shifting of cropping area for swidden agriculture to other areas outside the project area. However, due to the agroforestry approach, Burapha minimizes this risk. Further, the involvement and employment of locals from the villages in the vicinity of the plantations for silviculture operations increases income opportunities. Therefore the decrease in need for shifting cultivation activities is expected. All communities are involved in the development of the plantations.

Additional information about leakage is provided in the relevant sections, e.g. chapter 4.3.

### Commercially Sensitive Information

None.

### Sustainable Development

According to the Ministry of Agriculture and Forestry of Lao PDR shifting cultivation affects 170.000 ha annually, causing 3.5% of all forestry related emissions (MAF, 2018)[7]. Furthermore, Lao PDR moved from a net sink of $CO_2$ in 1990 to a net source in 2000. The land use sector and especially deforestation is the main contributor for the $CO_2$ emissions (Lao PDR, 2018)[8]. Lao PDR is highly determined to tackle climate change and ratified as one of the first of ASEAN countries the Paris Climate Agreement.

[7] https://redd.unfccc.int/files/2018_frel_submission_laopdr.pdf

[8] https://sustainabledevelopment.un.org/content/documents/19385Lao_Final_VNR_19_June_2018_web.pdf

Most of Lao PDR's $CO_2$ emissions are the result of deforestation and forest degradation, which counteracts the Burapha Carbon project through afforestation, forest conservation and agroforestry on degraded lands. Burapha supports the countries goal to achieve 70% forest cover by 2020 (MAF, 2018)[9], which is also declared in the NDC and Paris agreement ratification.

### Further Information

Additional information is provided in the Appendix and in the relevant sections.

[9] https://redd.unfccc.int/files/2018_frel_submission_laopdr.pdf page 3

# 2 SAFEGUARDS

## 2.1 No Net Harm

Every forest plantation project, which operates with concession land in Lao PDR has to conduct an Environmental and Social Impact Assessment (ESIA) (Forestry Law, Art 87, 2019). The conducted ESIA can be retrieved in the supporting documents.

**Physical and Environmental impacts**

The physical and environmental impacts of the plantations are expected to be low to occasionally moderate. Moderate levels are estimated to be usually only temporary and infrequent. The full physical (ESIA, 2016, chapter 7) and environmental (ESIA, 2016, chapter 8) impact assessment can be retrieved in the supported documents.

The plantation establishment will convert habitat with low – moderate value of fallow forests into Eucalypt and Acacia plantations with very low habitat value. However, areas with high conservation value, such as riparian buffers, and primary forest patches will minimize the impacts the plantations pose to the environment and encompass approximately 20% of the total plantation area. A list of the wildlife and flora living in the plantations of Burapha can be retrieved in the ESIA report, chapter 5 (2016).

Plantation establishment on former shifting cultivation/degraded land could lead to less available agricultural area, which might force villagers to expand their fields into not cultivated/forested areas. Buraphas Agroforestry scheme is designed to accommodate the opportunity for villagers to practice intercropping during the first 2 years of plantation and to use this space for the rest of the rotation as grazing area (FSC Audit Report, 2018).

Locally, the impacts of the plantations will be low, while on the landscape level the impacts are assessed to be low – moderate, due to the scale of planting a potential of 60.000ha.

| Taxa / Significance | Species and Threatened Status |
|---|---|
| Globally Threatened Mammals | Sunda pangolin *Manis javanica* EN ARL / C |
| | Chinese pangolin *Manis pentadactyla* EN ARL |
| | Northern pig-tailed macaque *Macaca leonina* VU PARL / C |
| | Lar gibbon *Hylobates lar* EN ARL / R |
| | Dhole *Cuon alpinus* EN ARL |
| | Fishing cat *Prionailurus viverrinus* EN LKL |
| | Asiatic black bear *Ursus thibetanus* VU ARL / R |
| | Bint urong *Arctictis binturong* VU ARL |
| | Large-spotted civet *Viverra megaspila* VU PARL |
| | Sambar deer *Rusa unicolor* VU PARL / C |
| | Northern white-cheeked gibbon *Nomascus leucogenys* CR PARL / R |
| Globally Threatened Birds | Yellow-breasted bunting *Emberiza aureola* EN |
| Globally Threatened Reptiles and Amphibians | Black and white spitting cobra *Naja siamensis* VU PARL |
| | King cobra *Ophiophagus hannah* VU PARL / R |

KEY: CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; DD – Data Deficient; LR – Lower Risk; LC – Least Concern; N/A – Not Assessed; Duckworth et al. 1999 national threatened status: ARL – At Risk in Lao; CARL – Conditionally At Risk in Lao; LKL – Little Known in Lao; PARL – Potentially At Risk in Lao; MAF 360 / 2003 Regulation: R – Restricted; C – Controlled

**Figure 5: Globally threatened fauna that have the potential to inhabit surrounding habitat**

**Table 5: Physical and environmental impacts of Burapha plantations**

| Affected trait | Level |
|---|---|
| Soil fertility | low |
| Water quality | low – moderate |
| Surface runoff | low – moderate |
| Ground water | low – moderate |
| Chemicals (pesticides, fertilizer) | low |
| General waster management | very low |
| Wildfire | moderate |
| Noise | low |
| Air quality | low - moderate |
| Invasive species | low |
| Fauna | low |
| Greenhouse Gas emissions | minor |

Burapha established a Land Acquisition Manual stating the procedure for land acquisition. This ensures that no plantations are established on protected areas. Due to land disputes and partly unclear land tenure this fact has high importance.

**Socio-economic impacts**

The socio-economic impacts of the plantation project can be seen in detail in the ESIA report chapter 9 (2016). The plantation project will help generate employment and salaries, and contribute economic development and health services. The assessed socio-economic impacts can be seen in Table 6.

The establishment of 60.000 ha of plantations requires major foreign investment. Therefore, the socio-economic impacts of the project are expected to be in terms of economic development moderate – high.

Project employment and income generation is expected to provide Moderate to High benefits, creating approximately 4,400 full time positions worth 4.4 million USD.

The Project does not involve any involuntary displacement or resettlement.

Buraphas main concept is the agroforestry scheme to prevent villagers of expanding their shifting cultivation into new, forested areas. Therefore, this agroforestry-intercropping scheme represents an integral part of the project operation planning in order to have a significant impact on village livelihoods. However, socio-economic conditions vary across different villages and therefore the results are expected to have a moderate impact (ESIA, 2016, chapter 9). The same results are expected in terms of food security.

**Table 6: Socio-economic impacts of Burapha plantations**

| Affected trait | Level |
|---|---|
| Economic development | moderate – high |
| Employment/ Income generation | moderate – high |
| Community land availability | low – moderate |
| Village livelihoods (if Agroforestry successful) | moderate |
| Food security (if Agroforestry successful) | moderate |
| Community health and safety | moderate |
| Occupational Health and Safety | low - moderate |
| Water resource use | None |
| Fishing and Aquatic Resource Use | low |
| Cultural Heritage | negligible - low |
| Gender, Vulnerable Groups and Ethnic Minorities | low |

Overall, it can be concluded that he Burapha Agroforestry plantation project does not pose a net harm towards the environment or socio-economic related impacts.

## 2.2 Local Stakeholder Consultation

Burapha developed several Standard Operational Procedures (SOPs) dealing with community sensitization and consultation: 1) Community engagement and communication, 2) Grievance Management and Dispute resolution.

These SOPs define the principles of communication of Burapha staff with all non-Burapha entities, especially the contract villages. These SOPs can be retrieved in the supporting documents.

The general communication principles of Burapha are:

1) Ensure free, prior and informed consent is applied to all negotiations and agreements.
2) Deliver information that is transparent, accurate, timely and based on facts.
3) Communications characterized by responsibility and commitment to the criteria of sustainable development.
4) Awareness and respect of the cultures, customs and values of individuals and groups in Lao PDR.
5) Sharing information promptly and advocate an open dialogue with stakeholders.

### Methods engaging stakeholders

Stakeholders are identified during the land acquisition process (SOP – manual). By identifying potential areas on a land cover map, potential villages are identified, which leads to formal engagement with the villages and communities to negotiate about a possible cooperation.

Burapha defined different approaches to engage with stakeholders and separated them into formal and informal approaches. Formal approaches include all entities and individuals concerned and involved to the discussed issue. These meetings include seeking, coordinating and recording views on relevant issues from stakeholders.

These formal meetings are of relevance, wherever needed, however of special relevance concerning the following activities:

- Land acquisition;
- Plantation establishment and management;
- Intercropping;
- Outgrowing; and
- Community development.

### Grievance mechanism

The first step in conflict resolution is conflict avoidance. Conflict avoidance is a key goal of the stakeholder consultation process. Regular consultation and engagement with local community members will effectively reduce the occurrence of disagreements and conflicting positions. Even though best practices are applied grievances may occur.

Therefore, the following conflict development phases can be summarized as follows:

- Conflict avoidance → Consultation & participation in planning, decision making;
- Simple disagreements → Informal negotiation, discussion and mediation;
- Early conflict development → Reference to Village Grievance Committee;
- Conflicting positions taken → Reference to Grievance Committee at District level;
- Conflicting positions hardened → Reference to Grievance Committee at Provincial level; and
- Intractable conflict → Refer conflict to National Court.

The SOP "BAFCO 5.1-Grievance Mechanism and Dispute Resolution" for grievance management is available in the supporting documentation. This procedure is designed to provide an open and transparent channel for communication between the community and the company. This SOP was part of the requirements for the FSC certification.

### Mechanism ongoing communication

Buraphas stakeholder consultation describe a proactive approach to conflict avoidance, promoting regular formal and informal communication to minimize potential conflict.

Ongoing communication with villagers, villages, communities and government authorities work also either in an informal or formal way, depending on the scale of importance of the meeting. Minor adjustments of plans, coordination of different views, as well as building understanding and confidence are solved by informal meetings, once formal ties have been established. Other types of communication are:

- Establishment of a Conflict/Dispute Resolution Committee that includes both the management and adequate representation of all critical groups of the community including women. Committee meetings should be held regularly about every 3-4 months;
- Consultation on forest resource usage by communities;
- Ongoing consultation on village level socio-economic development;
- Communication on the establishment and progress of any social programs; and
- Provision of relevant information on the type, scope, potential impacts and timing of operations to affected local communities.

Furthermore, Burapha set up a "Community Information Dissemination scheme", which communicates ongoing information to the communities.

Burapha is committed to open and transparent information disclosure with Project communities. The Company will:

- Produce clear and culturally appropriate materials on the Project for distribution in Project villages
- Provide training to site managers and appointed Koumban and Village representatives on their duties and responsibilities for information dissemination and FPIC.

## 2.3 Environmental Impact

A detailed assessment of the project environmental impacts can be seen in chapter 2.1 and in the ESIA report, chapters 7 and 8 (2016). Overall, the Burapha Agroforestry Carbon project is not considered to have any negative environmental impacts.

## 2.4 Public Comments

To be updated once the public comment period is completed

## 2.5 AFOLU-Specific Safeguards

See chapter 2.2 and the Environmental and Social Impact Assessment (2016) for further details.

# 3 APPLICATION OF METHODOLOGY

## 3.1 Title and Reference of Methodology

Approved CDM methodology: AR-ACM0003 " AR Large scale - Afforestation and reforestation of lands except wetlands", version 2

These CDM methodological tools will be used in accordance with the methodology:

- "Combined tool to identify the baseline scenario and demonstrate additionality", version 7
- "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, version 4.2
- "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity", version 4.0
- "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities", version 01.1.0

## 3.2 Applicability of Methodology

Applicability conditions of the methodology: AR-ACM0003: Afforestation and reforestation of lands except wetlands (Version 2):

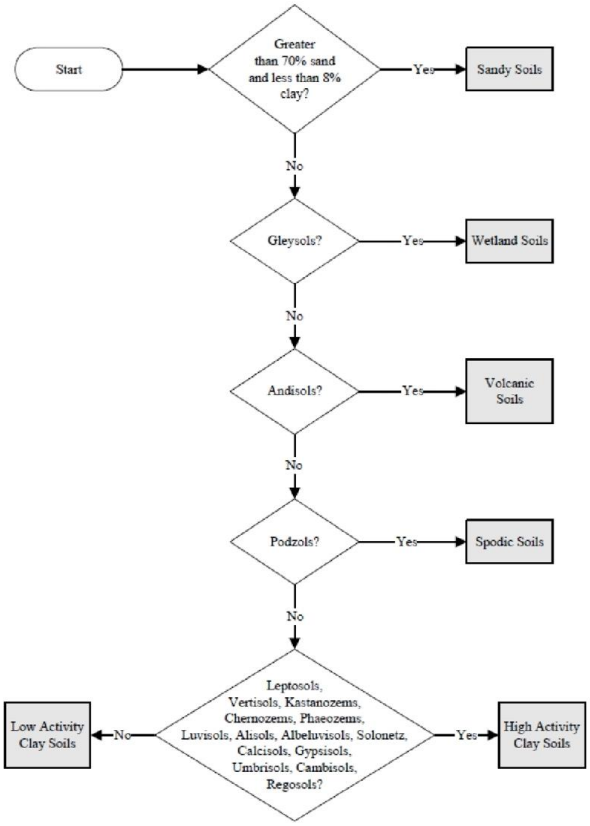
**(a) The land subject to the project activity does not fall in wetland category**

Buraphas' plantations are only established on foothills. Wetlands, as well as riparian zones are avoided and not considered for planting.

Following the decision tree of soil classification provided by the IPCC (Figure 6: IPCC classification of soilsFigure 6), all planting plots in the project plantations of the first instance belong to the IPCC class Low activity clay soils (LAC). Across the complete outer boundary, most of the soils are either LAC or a mixture of LAC and HAC soils. There is only a small area in the Southern region of Vientiane capital province with Dystric Gleysols, which belong to IPCC class wetlands.

Figure 6: IPCC classification of soils

1. The outer boundary of the project area is plotted against the Harmonised World Soil Database (see FAO/IIASA/ISRIC/ISSCAS/JRC, 2009) which summarizes the latest regional soil information as compiled by various partners. (see Figure 7Figure 8).



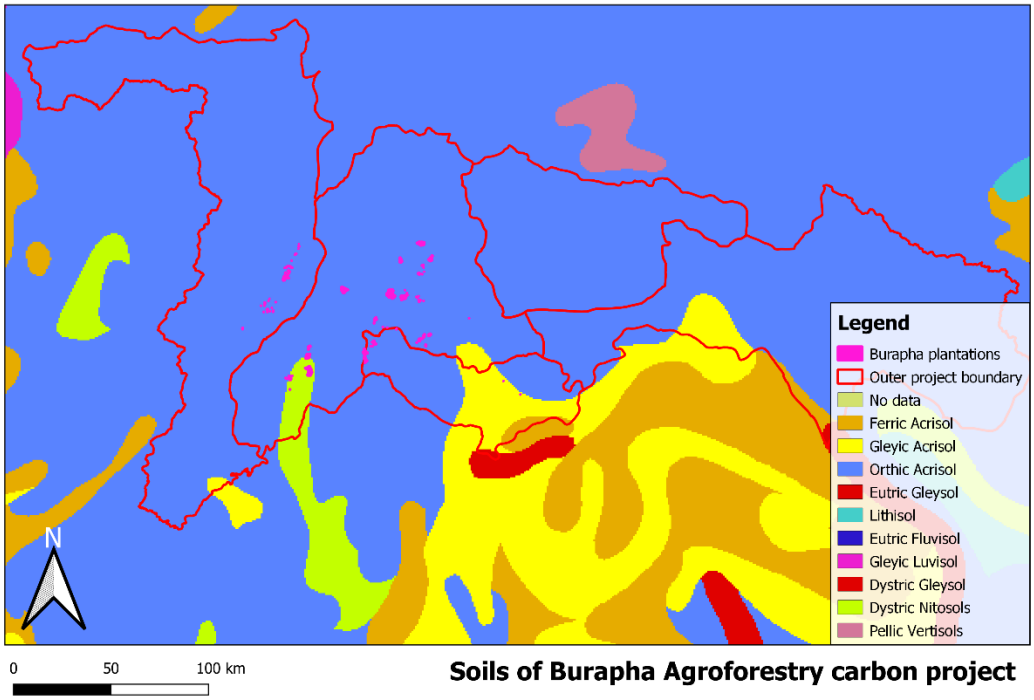



**Figure 7: Overview of soils across the outer project boundary**

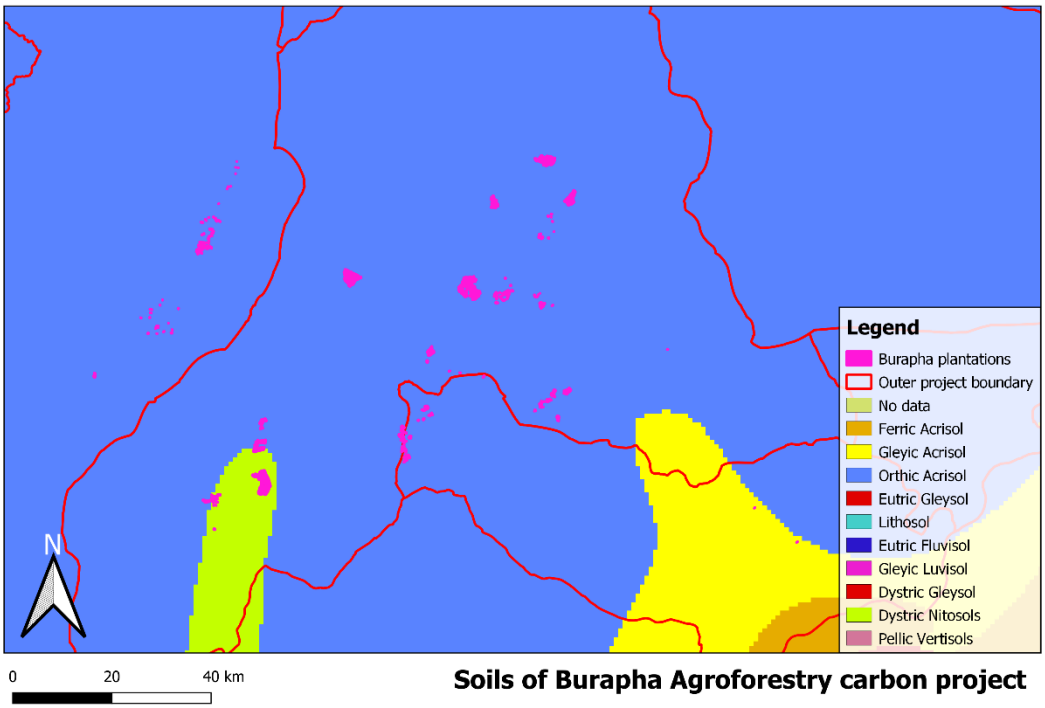



**Figure 8: Soils of the first instance Burapha plantations**

2. According to this map the project is dominated by Orthic Acrisols (IPCC: LAC). Plantations occur also on Dystric Nitosols (IPCC: LAC) and Gleyic Acrisols (IPCC: LAC/HAC).Table 7 below shows some soil parameters for this soil type in the project region.

**Table 7: Sample data of the Orthic Acrisol soil type**

| Parameter | Value |
|---|---|
| Dominant soil group | Orthic Acrisols |
| Topsoil texture | Medium |
| Drainage class | Imperfectly |
| Topsoil sand fraction (%) | 49 |
| Topsoil silt fraction (%) | 27 |
| Topsoil clay fraction (%) | 24 |
| USDA Texture classification | Sandy clay loam |
| Reference Bulk density (kg/dm3) | 1.4 |
| Topsoil gravel content (%) | 10 |
| Topsoil organic carbon (% weight) | 1 |
| Topsoil pH | 4.6 |
| Topsoil CEC (cmol/kg) | 16 |

3. By using the decision tree and the official translation of FAO soil classes to IPCC soil classes, which is referenced by Batjes (2009)[10], all Acrisols are classified as IPCC Low Activity Clay soils. None of the project areas (inner boundary) belong to the category of wetlands (FAO soil type Gleysol).

***(b) Soil disturbance attributable to the project activity does not cover more than 10 per cent of area in each of the following types of land, when these lands are included within the project boundary:***

***(i) Land containing organic soils;***

***(ii) land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in appendices 1 and 2 to the methodology.***

The project land does not contain organic soils as demonstrated above. The project land does not receive any inputs according to appendices 1 and 2 of the AR methodology (CDM), but is subject to shifting agriculture. Because of long periods of fallow vegetation however, it is not considered to be specific subject to land use.

***Applicability conditions of the tool: "Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities" (Version 01.0.0)***

[10] https://edepot.wur.nl/51469

This tool has no internal applicability conditions

***Applicability conditions of the tool: "Calculation of the number of sample plots for measurements within A/R CDM project activities" (Version 2.1.0)***

This tool has no internal applicability conditions

***Applicability conditions of the tool: "Tool for estimation of change in soil organic carbon stocks***

*Due to the implementation of A/R CDM project activities", version 01.1.0*

(a) The areas of land (i) do neither fall into the wetland category, nor (ii) contain organic soils as defined in "Annex A: glossary" of the IPCC GPG LULUCF 2003, as shown above. In the baseline scenario and the project activity, the areas of land does not experience crop- or grassland management as shown in Table 1 and 2. Shifting cultivation in the area does not include high inputs in the form of manure or fertilizer. Fallow vegetation is burned on site and the area is cultivated with upland rice for mostly one to two years under presumably reduced tillage management.

(b) The A/R CDM project activity meets the listed conditions. (i) Litter remains on site as there is no incentive to remove litter from the plots. (ii) Also, soil disturbance associated with the A/R activity only occurs for planting and is NOT repeated in less than 20 years.

## 3.3 Project Boundary

| Source | | Gas | Included? | Justification/Explanation |
|---|---|---|---|---|
| Baseline | Aboveground and Belowground Biomass | $CO_2$ | Yes | This is the major carbon pool subjected to project activity. |
| | Soil Carbon | $CO_2$ | Yes | Carbon stock in these pools may increase due to implementation of the project activity. |
| Project | Aboveground and Belowground Biomass | $CO_2$ | Yes | This is the major carbon pool subjected to project activity. |
| | Soil Carbon | $CO_2$ | Yes | Carbon stock in these pools may increase due to implementation of the project activity. |

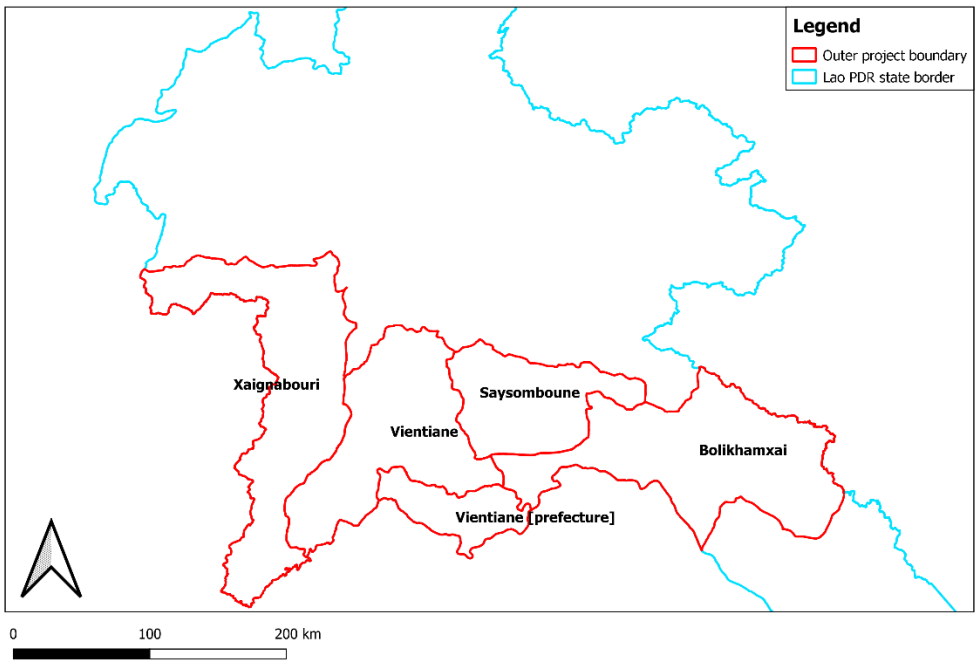



**Figure 9: Outer project boundary within Lao PDR**

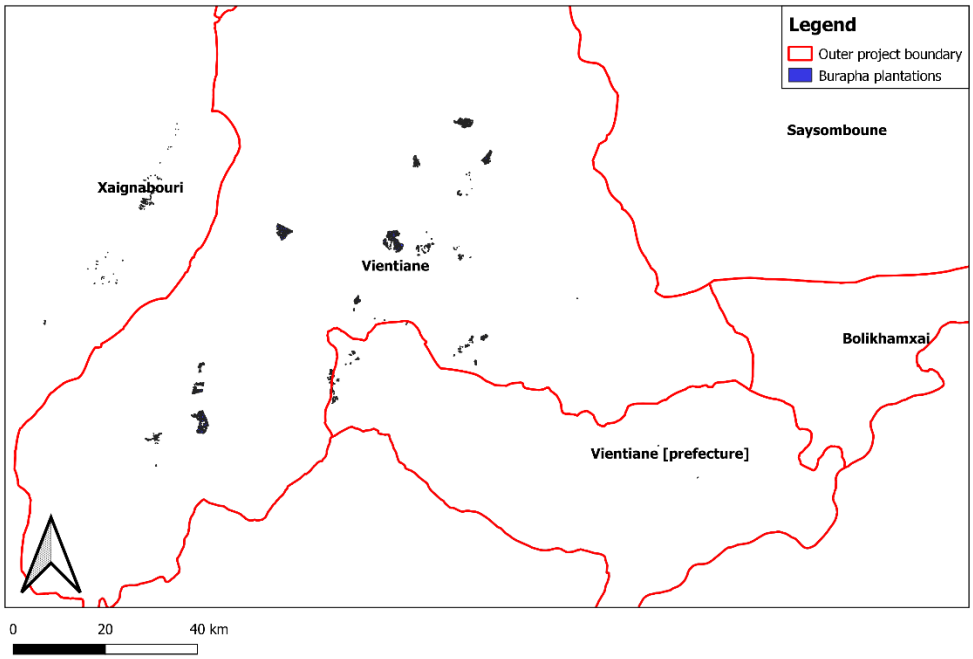



**Figure 10: Buapha plantation location within outer project boundary**

## 3.4 Baseline Scenario

The baseline scenario and additionality was defined by using the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities", version 01.

Since only one stratum was identified for the baseline scenario, the procedure is only applied once. Following is a description of the application of this tool.

**Procedure**

**STEP 0. Preliminary screening based on the starting date of the ARR activity**

Burapha started its afforestation project in April 2016 with the first planting activities which is after 31 December 1999. The eligibility justification (satellite imagery) of chapter 1.3 has shown that afforestation activities did not start before this date.

The company considered the generation of carbon credits from 2015/ 2016 which lead to a first feasibility study in 2017/ 2018 which is available on request

**STEP 1. Identification of alternative land use scenarios to the proposed ARR CDM project Activity**

The ERPD of Lao PDR analyzed the drivers of deforestation for Lao PDR on the basis of 6 Northern provinces including Sayaburi province, which is part of the project boundary. Expansion of agricultural land for cash crops as well as shifting cultivation, illegal logging, and forest fires resulting from shifting cultivation are considered as the main drivers in this region. Shifting cultivation is especially a problem due to expansion into new areas, which have not been cultivated before. Fallow vegetation requires approximately 7-9 years to grow back into a forest category leading to secondary, degraded forest. As most forest areas are state owned with long-term shifting cultivation taking place, land tenure insecurity is a prevailing issue.

| | BKO | HPN | LNT | LPB | ODX | SAY |
|---|---|---|---|---|---|---|
| **Expansion of agricultural land for cash crop cultivation by villagers and/or companies (deforestation)** | ++ | +++ | +++ | +++ | +++ | +++ |
| **Rubber** | +++ | | +++ | ++ | +++ | + |
| **Banana** | ++ | | | | ++ | |
| **Shifting cultivation and pioneering expanding agriculture for subsistence (deforestation/degradation)** | +++ | +++ | +++ | +++ | +++ | ++ |
| **Unsustainable and Illegal logging by companies (degradation)** | +++ | + | ++ | ++ | ++ | ++ |
| **Infrastructure development (hydropower, mining , road construction) (deforestation)** | ++ | + | + | + | ++ | + |
| **Forest fires from agricultural practices, shifting cultivation land expansion, hunting (deforestation/ degradation)** | ++ | + | + | + | + | ++ |
| **Unsustainable and Illegal logging and fuelwood collection by villagers (degradation)** | + | + | + | + | + | + |

Legend: The importance level of the individual drivers is based on the relative scale of deforestation and forest degradation in the provinces. "+" indicates the level of relative importance per province, "+++" being "relatively high importance" and "+" being "relatively low importance".[38]

BKO: Bokeo province, HPN: Houaphan province, LNT: Luang Namtha province, LPB: Luang Prabang province, ODX: Oudomxay province, SAY: Sayaburi province.

**Figure 11: Drivers of deforestation and degradation identified through stakeholder consultations; ERPD, 2018**

### Sub-step 1a. Identification of alternative land use scenarios to the proposed project Activity

The following alternatives to the project activity will be evaluated:

1) **Continuation of pre-project land use: Swidden agriculture and fallow regeneration**
2) **Afforestation of the land with commercial tree plantations without the incentives from the carbon market (project activity),** and
3) **Natural Forest regeneration without assistance**

### Sub-step 1b. Consistency of credible alternative land use scenarios with enforced mandatory applicable laws and regulations

All identified alternative land use scenarios are in compliance with the applicable legal and regulatory requirements, as well as applicable Provincial and State Government laws and regulations. The list of laws and regulations is presented in section 1.14. The planned project

activity is in full compliance with all national laws which is evidenced by the FSC certification (see supporting documents).

The government of Lao PDR tries to discourage farmers from shifting cultivation and promotes permanent agriculture and settlement (Forestry Law, 2019, Art. 53). Since 2019, the restriction of uncontrolled shifting cultivation is also listed under management activities of protection forests (Forestry Law, 2019, Art. 46).

The legal status of shifting cultivation remains unclear, on the one hand being illegalized and discouraged, on the other hand no enforcement takes place to incentivize a switch to permanent agriculture and abandon shifting cultivation. The ERPD (2018) states: *"insufficient and inappropriate land use planning is a major underlying cause of deforestation, either through the complete absence of plans or through the lack of compliance with usually top-down designed plans."*

Unclear land demarcations and rules lead to gradual encroachment into forests, as well as lacking incentive mechanisms and sanctions. These processes are supported and sustained by ongoing corruption. According to Transparency International, Lao PDR is ranked 130 among 180 in the Corruption Perceptions Index (CPI, 2020)[11].

### STEP 2. Barrier analysis

The guideline for objective demonstration and assessment of barriers (UNFCCC, v 1.0, Annex 13) states that "projects in Least Developed Countries (such as Lao PDR) can be assumed in general to face significant barriers to their implementation". At the same time, data availability in these countries is considerably limited which complicates the demonstration of additionality and therefore further increases transaction costs. Therefore it is sufficient "to transparently describe the relevant barriers" Without the need to carry out data intensive analyses.

### Sub-step 2a. Identification of barriers that would prevent the implementation of at least one alternative land use scenarios

The table below displays the barrier analysis matrix which shows the main barriers the alternative land use scenario are facing.

**Table 8: Alternative land use scenarios and their respective barriers**

| Alternative Land use scenarios | Investment | Institutional | Technological | Local tradition | Prevailing practice | Ecological conditions | Social conditions | Land tenure |
|---|---|---|---|---|---|---|---|---|

[11] https://www.transparency.org/en/countries/laos

| | | | | | | |
|---|---|---|---|---|---|---|
| Continuation of pre-project landuse: Swidden agriculture/shifting cultivation and fallow regeneration | | | | | | |
| Afforestation of the land with commercial tree plantations without the incentives from the carbon market (project activity) | x | x | | | | x |
| Natural Forest regeneration without assistance | | | x | x | | |

Overall, Lao PDR represents a challenging environment to invest and operate commercial forest plantations. According to the World Bank[12], Lao PDR is ranked 141 among 190 economies. The Human Development Index (HDI) of Lao PDR is with 0.604 and rank 140 below the global average of 0.731 (UNDP, 2020)[13].

**Sub-step 2b. Elimination of land use scenarios that are prevented by the identified barriers**

**Scenario 1: Continuation of the pre-project land use: Shifting cultivation**

The land-use and management prior to the implementation of the project activity has no barriers to implementation.

The population among the project provinces depends strongly on Agriculture. Approximately 73% of all households across the regions are farming households with an average farm size of 2.6 ha. Among these farming households more than 66% are considered rural households (ESIA, 2016).

According to the ERPD of Lao PDR the main driver of deforestation is the expansion of agriculture (FCPF, 2018). There are two main sub drivers: The expansion of permanent agriculture, and slash and burn agricultural practices (shifting cultivation). Permanent agriculture is often an intensification on former shifting cultivation areas.

Especially the Northern provinces of Lao PDR are subject to shifting cultivation, where approximately 40% of Lao PDR's national deforestation occurred (2000-2015; FCPF, 2018)[14]. As of 2015, approximately a quarter of Lao PDR's total land is subject to shifting cultivation (Figure 12; FCPF, 2018).

[12] Global Ease of Doing Business annual ratings: https://tradingeconomics.com/laos/ease-of-doing-business

[13] http://hdr.undp.org/en/countries/profiles/LAO

[14] https://www.forestcarbonpartnership.org/system/files/documents/LaoPDR_ERPD_FinalDraftMay.2018-Clean.pdf

In the project area more than 86.9% of all farming households practice methods of shifting cultivation, mostly cropping upland rice. (LEC5, 2012-2013; MAF,2011).

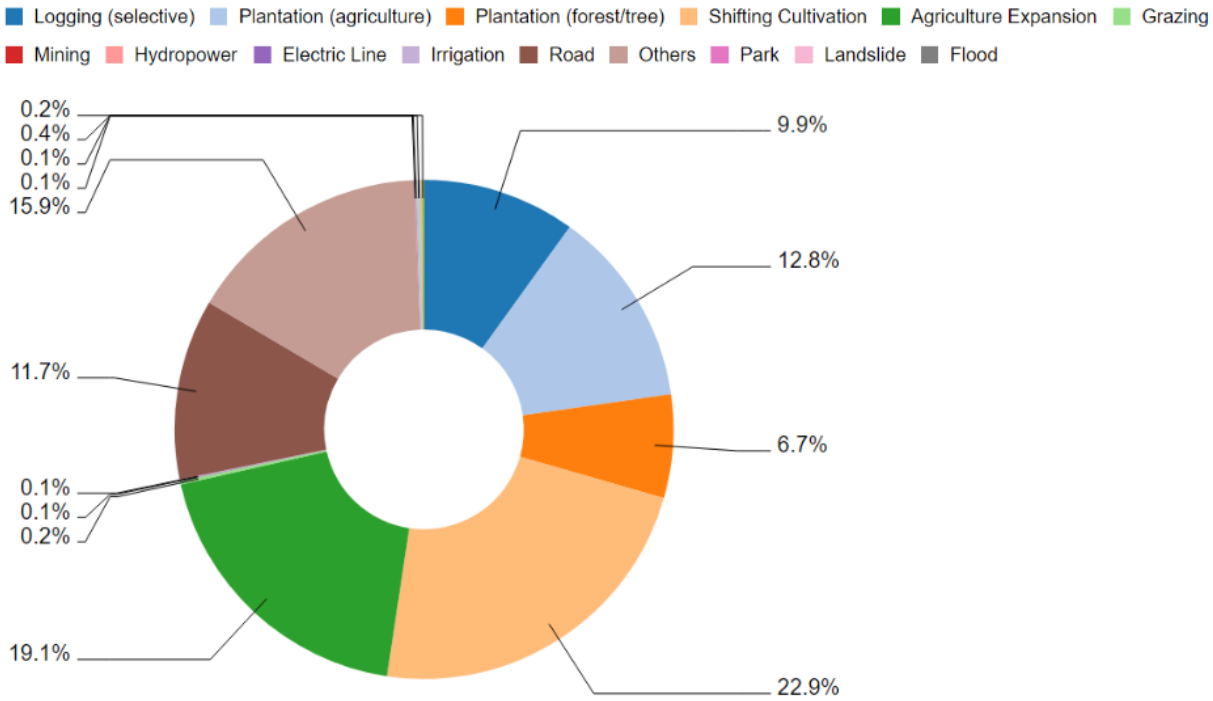



**Figure 12: Disturbance by type for the ER Program area (disturbances > 5ha),**

*(Source: REDD+ Readiness Project in Lao PDR, 2017.)*

Shifting cultivation and its connected fallow areas are problematic in terms of agricultural expansion, due to population growth and intensification. A full cycle of shifting cultivation in Lao PDR takes between 4-9 years, with an average of 5 years. A study by MAF (2018) has shown that fallow areas of shifting cultivation regrow after approximately 7 years into a forest category. Under normal conditions shifting cultivation could be thus sustainably practiced, by allowing the full regrowth.

According to the 2015 Census, Vientiane Prefecture, Vientiane Province and Saysomboun province have experienced annual population growth rates that exceed the national annual average (1.4%) over the last decade. Population growth in combination with an increasing demand for cash crops leads to shorter fallow periods and a decline in productivity of fallow areas (FCPF, 2018).

Insufficient and inappropriate land use planning and corruption lead to continued deforestation and degradation (see Sub-Step 1b).

Therefore, it can be concluded that shifting cultivation will continue to be one of the major land use practices and does not face further barriers.

**Scenario 2: Afforestation of the land within the project boundary performed without being registered as the ARR CDM project activity**

**Barriers due to Institutions**

Institutional barriers in Lao PDR are related to an inconsistent regulatory framework and the flexibility in its interpretation among the different levels of governmental authority on the national, provincial and local level. This has been experienced in practice by Burapha and can be evidence by a variety of publicly available reports:

- The World Bank reports that "country faces issues that include weak regulatory effectiveness, control of corruption and rule of law, and a largely ´deals-based´ approach, which reduces predictability and transparency" (WorldBank, 2018)[15].
- The country is ranked 135 out of 175 countries, according to the 2017 Corruption Perceptions Index reported by Transparency International (2017). A summary of the observed practices is summarized in a Lao PDR corruption report[16].
- According to Smith et al, (2016)[17], there is "an extensive and highly complex regulatory environment for plantation in Lao PDR (citing various other publications) and a list of reasons is provided.

In conclusion, the institutional barriers significantly increase the company's risk of doing business. It increases transaction and negotiation costs especially for foreign companies that operate in Lao PDR and increases uncertainty. This acts as key barrier for foreign direct investment and companies committed to legality face increasing costs to operate in such an environment. Thus, carbon revenues will be one additional way to compensate for this increased risk and higher costs.

**Barriers due to Technology – market access and public infrastructure**

Lao PDR is a landlocked country fully relying on road infrastructure for its economy. Among medium sized enterprises transportation is perceived as one of the biggest barriers in the country. Especially in the northern part of the country, many areas are mountainous with poor infrastructure (WorldBank, 2018)[18].

[15] World Bank, 2018 : Doing Business in Lao PDR - Contraints to Productivity: Available at:

(http://documents.worldbank.org/curated/en/799691518210731980/pdf/123357-WP-REVISED-Lao-PDR-PUBLIC.pdf

[16] https://www.transparency.org/en/news/corruption-perceptions-index-2017

[17] http://forestry-nuol.weebly.com/uploads/2/0/9/5/20955514/environmental_protection_and_management_of_plantations_in_lao_pdr_final_eng.pdf

[18] http://documents1.worldbank.org/curated/en/799691518210731980/pdf/Doing-business-in-Lao-PDR-constraints-to-productivity.pdf

- A majority of the roads are impassable during the rainy season (Statistical Year Book Lao PDR 2014, MPI)[19]: The Lao road network is estimated at about 46,000 Km, with only 28% paved. In general more than 60% of the total national roads are classified as in poor or bad condition. Most of the provincial and district roads are inaccessible during the rainy season. It is estimated that more than 40% of villages are 6 kilometers or more from a main road and nearly half are not accessible during the rainy seasons. Road transport is the most used mode for freight transport, accounting for more than 80% of total freight transport (ibid)
- Remoteness of the plantation area and undeveloped road and infrastructure and the lack of a formalized domestic market for Eucalyptus incur large transportation expenditures, thus eroding the competitiveness and increase the market risk for plantations in the country. This barrier fully unfolds in the case of Burapha considering its plantation location in the North of Lao PDR. Access roads are in poor condition and are not well developed for forestry operations. Forestry roads have to be built to support the project implementation.
- The market for finished products is not well established and this will take time to develop domestic demand. The company relies on export markets which needs higher investments into transportation (Smith et al, 2016). A number of domestic mills have been established for the processing of Eucalyptus, however the market is currently limited. "The development of pulp mills has stalled due to challenges with land availability for plantation establishment to make such projects economically viable. This is exacerbated by Order No. 13/PMO 2012, which placed a temporary ban on new concessions. In all cases Prime Minister's Order No.15/PMO 2016 has temporarily suspended the export of all planted wood logs and unfinished products, although some exceptions have been negotiated" (Smith et al, 2016).
- However, even though Burapha operates a saw mill and is currently building a plywood mill, it relies heavily on the export market from which 95% of the revenues are generated, due to a restricted Lao market.
- In its land acquisition process, Burapha receives mainly access to very rural areas, which tend to be steep, less productive and have a lower value to the rural population. This plantation land area is characterized by poor transport accessibility, increasing the cost of company operations. The poor infrastructure requires Burapha to invest into public infrastructure and build or upgrade rural roads in order to be able to manage their operations.

### Barriers due to Land tenure

The process for plantation approval and development follows several pathways depending on the scale of the plantation project, the nature of the investment and the land allocation process.

The company obtains land use rights for plantation establishment through four different types of land tenure agreements as described in the Burapha Land Acquisition Manual, following an extensive process compliant with a costly free, prior and informed consent (FPIC). In practice Burapha faces various barriers to access land for plantation development that leads to delays in the planned expansion of plantation area and higher expenditures for land acquisition. Land tenure if often unclear and may be conflicting (customary right vs. state level land ownership).

[19] https://dlca.logcluster.org/display/public/DLCA/2.3+Laos+Road+Assessment;jsessionid=612D9795F1A7D699E1071BC4BF3F83EB

Many land documents are conflicting (e.g. if land is assigned by the government to Burapha, there are cases where land use rights are still claimed by previous land users which needs to be clarified prior to planting). "This reduces the land availability and increase the cost of acquiring land. Although the Lao constitution theoretically protects property rights, all land is formally owned by the state and can be expropriated for state purposes."[20] The challenges related to land acquisition are reinforced by high corruption levels in the land administration[21]. "As foreign demand for agricultural concessions has increased, authorities have often disregarded these traditional rights. As a result, land issues remain one of the principal areas of injustice and contestation in Laos today. The matter has been raised increasingly in the National Assembly, as well as by the weak civil society sector."

**Scenario 3: Natural Forest regeneration without assistance**

Natural forest regeneration faces two main barriers: Prevailing practice and environmental conditions.

**Barriers due to prevailing practice**

As mentioned under scenario 1 shifting cultivation is a widely applied concept among the farming households of Lao PDR and the project provinces. Further population growth decreases rotation cycles and forces farmers to expand shifting cultivation into new areas (Sub-Step 1 and Scenario 1). Even though former shifting cultivation areas might regrow into forest stage, carbon stocks and global assessments show that secondary forest is not as diverse, and holds far less carbon compared to primary forest ecosystems. According to Hett et al. (2011), the carbon stocks of secondary forests is estimated to be half of the natural forest carbon stocks. Therefore, it can be concluded that the prevailing practice is a major barrier to the regeneration of natural forest vegetation.

**Barriers due to environmental conditions**

A full cycle of shifting cultivation in Lao PDR takes between 4-9 years, with an average of 5 years (FCPF, 2018). A study by the MAF (2018) shows that fallow areas of shifting cultivation regrow after approximately 7 years into the forest category, according to Lao PDR's forest definition (>10cm DBH, 0.5 ha, 20% tree cover). Under continuous shifting cultivation conditions a regrowth of fallow forests into the forest category is therefore less likely. Most of the areas will stay in the continuous cycle of cropping and fallow. Current developments show rather the expansion of shifting cultivation into former pristine forest areas (see scenario 1).

In general long-term fallow periods can accumulate more carbon, however carbon uptake is slowed down after an initial phase of fast growth (first 10 years of fallow). Studies show that even after several decades the biomass stored in fallow forests is 15-45% of the amount stored

[20] https://www.bti-project.org/en/reports/country-dashboard-LAO.html

[21] https://www.ganintegrity.com/portal/country-profiles/laos/

in primary forests (Jepsen 2006; Szott et al. 1999). Therefore, we conclude that regrowth of natural forests have a natural barrier of several decades to centuries and in combination with prevailing practices natural forest regrowth is not an alternative scenario to the project activity.

As a conclusion of the barrier analysis, the following major barriers were identified for the afforestation activities without CDM benefits, related to institutional challenges (1), barriers relating to land tenure (2) and the barriers relating to market access and infrastructure (3). These significantly increase Burapha's risk to operate in Lao PDR and to higher transaction costs to do business in Lao PDR and clearly justify the additional income from carbon credits. Sufficient independent publications exist that can be used to identify and address the barriers.

Also the regrowth of natural forests is prevented by barriers related to prevailing practices, such as shifting cultivation and ecological conditions, such as the regrowth rate and carbon stock development of fallow forests.

The pre-project agricultural and shifting cultivation land use would not be prevented by these barriers. Thus this is the only plausible baseline land use scenario not prevented by any barrier.

### Step 4: Common practice test

This test is a credibility check to demonstrate additionality which complements the barrier analysis (Step 2). This requires an analysis of the extent to which reforestation activity has already diffused in the geographical area of the proposed project activity. In this context similar reforestation activities are defined as activities "of similar scale, take place in a comparable environment, inter alia with respect to the regulatory framework and are undertaken in the relevant geographical area." (UNFCCC, 2017). For a successful demonstration of the common practice test, for the identified similar activities essential distinctions between the existing reforestation investment projects in Lao PDR and the Burapha Agroforestry reforestation have to be identified and documented. For this demonstration, two major studies can be referenced: Smith et al. (2016)[22] and Baral et al. (2017)[23]. The studies provide an overview of the existing plantation reforestation activities in Lao PDR. All these investments planted or are planting Eucalyptus and Acacia:

**Table 9: Foreign investment in timber plantations in Lao PDR**

| Company/Activity | Site | Area (ha) | Concession period (years) |
|---|---|---|---|
| Sun Paper | Savannakhet | 9,235 | 50 |
| Birla Lao Pulp & Plantation | Svannakhet/Khammouane | 50,000 | 75 |

[22] https://20955514-980024089191501773.preview.editmysite.com/uploads/2/0/9/5/20955514/lao_plantation_policy_framework.pdf

[23] http://forestry-nuol.weebly.com/uploads/2/0/9/5/20955514/lao_background_paper_3-_plantations_and_environment_12june2017_v1-eng.pdf

| | | | |
|---|---|---|---|
| Oji Lao Plantation Forest Company | Bolikahamxay, Khammouane | 50,000 | 50 |
| Oji South Lao Plantation forest company | Champasak/ Saravahn/ Xekong/ Attapu | 24,974 | 40 |
| Burapha Agroforestry | Vientiane Province | 2,000 | 50 |
| Stora Enso Company | Savannakhet/ Saravahn | 2,000 | 50 |
| TOTAL | | 115,732 | |

Source: Baral et al. (2017), citing Smith et al. (2017)

The essential distinction of Burapha's reforestation activities is determined by its location, utilization of degraded land, and most importantly by more limited access to wood markets. Most of these foreign investments have failed so far or have not reached their intended scale – demonstrating the difficulties to operate in Lao PDR. The following table summarizes the key distinctions and reasons for failure.

**Table 10: Common practice in Lao PDR and key distinctions from Burapha**

| Company | Location | Essential distinct from Burapha |
|---|---|---|
| Birla Lao Pulp & Plantation | Savannakhet/ Khammouane | - Project stopped and lost USD 48 million due to unsuitable land within concession area, utilization of poor clonal material, and lack of access to land.<br>- Located in the proximity to wood markets in Thailand and Vietnam compared to Burapha, thus have lower business operation costs. (Burapha needs to build an industry in the proximity of it plantation areas).<br>- Land tenure: Concession agreement (lower land acquisition costs compared to Burapha). |
| Oji Lao Plantation Forest Company | Bolikhamxayand Khammouane | - Existing plantations purchased by new investors due to insufficient access to land and plantings on unsuitable land.<br>- Located in the proximity to wood markets in Thailand and Vietnam compared to Burapha, thus lower business operation costs.<br>- Land tenure: Concession agreement (lower land acquisition costs compared to Burapha). |
| Oji South Lao Plantation forest company | Champasak/ Saravahn/ Xekong/Attapu | |
| Stora Enso Company | Savannakhet/ Saravahn | - Located in the proximity to wood markets in Thailand and Vietnam compared to Burapha, thus lower business operation costs. (Burapha needs to build an industry in the proximity of it plantation areas). |
| Sun Paper | Savannakhet | - Currently expanding plantation areas after investing into a pulpmill. Currently lack sufficient raw materials to operate at scale.<br>- For Burapha transport costs are too high to deliver raw materials due to incompatible location of raw material supply. |

Therefore, the common practice test demonstrates the credibility of the barrier analysis and regards the project activity as "not-common" practice, making the baseline scenario the only credible alternative to the project activities.

## 3.5 Additionality

Demonstration and assessment of additionality has been conducted in section 3.4. using the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" version 7.0, as it is required in the selected methodology.

Conclusion: The proposed project activity is not the baseline scenario and, hence, it is additional.

## 3.6 Methodology Deviations

No deviations.

# 4 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

## 4.1 Baseline Emissions

Under the applicability conditions of the applied methodology AR-AM0014 "Afforestation and reforestation of lands except wetlands" (Version 02.0), it is expected that the baseline carbon stocks in litter and soil organic carbon pools will not show a permanent net increase. The baseline net GHG removals by sinks are therefore calculated using Equation 1 of the methodology:

$$\Delta C_{BSL,t} = \Delta C_{TREE\_BSL,t} + \Delta C_{SHRUB\_BSL,t} + \Delta C_{DW\_BSL,t} + \Delta C_{LI\_BSL,t}$$

Where:

$\Delta C_{BSL,t}$ = Baseline net GHG removals by sinks in year t; t CO2-e

$\Delta C_{TREE\_BSL,t}$ = Change in carbon stock in baseline tree biomass within the project boundary in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO2-e; the baseline **tree carbon stock changes are assumed zero** in this project.

$\Delta C_{SHURB\_BSL,t}$ = Change in carbon stock in baseline shrub biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project

activities"; t CO2-e; the baseline **shrub carbon stock changes are assumed zero** in this project.

$\Delta C_{DW\_BSL,t}$ = Change in carbon stock in baseline dead wood biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO2-e; **No dead wood biomass** will be accounted in this project

$\Delta C_{LI\_BSL,t}$ = Change in carbon stock in baseline litter biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO2-e; **No litter biomass** will be accounted in this project

According to the methodology, the baseline emissions have to be calculated with the AR-Tool 14 A/R Methodological tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 04.0). Baseline carbon stock changes in trees and shrubs is estimated as zero. However, baseline carbon stocks for trees and shrubs have to be assessed. Chapter 5 of this tool outlines the conditions that an ARR project has to fulfil in order to estimate the change in carbon stock in the baseline as zero.

**Justification – Zero Baseline Emissions from carbon stock change for trees and shrubs**

The AR-Tool 14 mentions for zero baseline estimations of carbon stock changes the following criteria:

*12. Changes in carbon stocks in trees and shrubs in the baseline may be accounted as zero for those lands for which the project participants can demonstrate, through documentary evidence or through participatory rural appraisal (PRA), that one or more of the following indicators apply:*

*(a) Observed reduction in topsoil depth (e.g. as shown by root exposure, presence of pedestals, exposed sub-soil horizons);*

*(b) Presence of gully, sheet or rill erosion; or landslides, or other forms of mass movement erosion;*

*(c) Presence of plant species locally known to be indicators of infertile land;*

*(d) Land comprises of bare sand dunes, or other bare lands;*

*(e) Land contains contaminated soils, mine spoils, or highly alkaline or saline soils;*

***(f) Land is subjected to periodic cycles (e.g. slash-and-burn, or clearing-regrowing cycles) so that the biomass oscillates between a minimum and a maximum value in the baseline;***

*(g) Conditions (a), (b) and (c) under paragraph 11 apply.*

All afforestation activities are conducted on degraded lands, which have been subject to slash-and-burn agriculture for several decades. Periods of agriculture are followed by years of fallow vegetation. Therefore, criteria 12, b applies for this project and carbon stock changes for trees and shrubs are accounted as zero.

The baseline carbon stock of trees and shrubs differ according to different stages of fallow vegetation. Approximately 25% of the areas are upland cropland and 75% are under fallow vegetation at the planting start. However, no baseline inventory was conducted to assess the baseline carbon stock of trees and shrubs. In general, fallow vegetation growing on abandoned agricultural lands as part of swidden agriculture is very heterogeneous, representing a wide variety of different carbon stocks and grows approximately on 25% of the total land area of Lao PDR.

The baseline carbon stock has been estimated by a study of Hett et al. (2011)[24], which encompasses several ecological zones of Lao PDR and is accounted with 12.5 t C/ha.

As part of the site preparation Burapha harvests all baseline trees and shrubs of the fallow vegetation and burns it on site. Therefore, the CDM A/R Methodological Tool "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (version 4) is applied. However, since slash-and-burn practices are part of the baseline no extra deduction for non-CO2 GHG emissions have to be incorporated according to the CDM tool.

The baseline emissions are assessed as follows.

| Year | Project year | Annual planted area (ha) | Total biomass Baseline $C_{BSL}$ (t CO2e) |
|---|---|---|---|
| 2016 | 1 | 921 | 35,797 |
| 2017 | 2 | 751 | 29,194 |
| 2018 | 3 | 609 | 23,659 |
| 2019 | 4 | 320 | 12,430 |
| 2020 | 5 | 874 | 33,967.0 |
| 2021 | 6 | - | - |
| Total | - | 3,475 | 135,047 |

## 4.2 Project Emissions

The ex-ante actual net GHG removals by sinks are estimated using the equation 2 described in section 5.5 of the methodology AR-ACM0003 (Version 02.0):

[24] Hett, C., Heinimann, A., & Messerli, P. (2011). Spatial assessment of carbon stocks of living vegetation at the national level in Lao PDR. *Geografisk Tidsskrift-Danish Journal of Geography*, *111*(1), 11-26.

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t}$$

Where:

| | | |
|---|---|---|
| $\Delta C_{ACTUAL,t}$ | = | Actual net GHG removals by sinks, in year t; t CO2-e |
| $\Delta C_{P,t}$ | = | Change in the carbon stocks in project, occurring in the selected carbon pools, in year t; t CO2-e |
| $\mathrm{GHG}_{E,t}$ | = | Increase in non-CO2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year t, as estimated in the tool "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO2-e |

Further:

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta SOC_{AL,t}$$

| | | |
|---|---|---|
| $\Delta C_{P,t}$ | = | Change in the carbon stocks in project, occurring in the selected carbon pools, in year t; t CO2-e |
| $\Delta C_{TREE\_PROJ,t}$ | = | Change in carbon stock in tree biomass in project in year t; t CO2-e |
| $\Delta C_{SHRUB\_PROJ,t}$ | = | Change in carbon stock in shrub biomass in project in year t; t CO2-e |
| $\Delta C_{DW\_PROJ,t}$ | = | Change in carbon stock in dead wood in project in year t; t CO2-e |
| $\Delta C_{LI\_PROJ,t}$ | = | Change in carbon stock in litter in project in year t; t CO2-e<br>No litter biomass will be accounted in this project |
| $\Delta SOC_{AL,t}$ | = | Change in carbon stock in SOC in project, in year t; t CO2-e |

The change in carbon stock in tree biomass in this grouped project within the project boundary is estimated using the A/R methodological tool "estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 04.2). Based on the tool the stock difference method is applied and the ex-ante tree biomass is estimated using the method of "Estimation by modelling of tree growth and stand development, presented in section 8 of the tool. For the estimation of the changes in carbon stocks in tree biomass ex-post, field measurements in form of inventory data by Burapha at two points of time will be realized. The calculations will be done following the "difference of two independent stock estimations" method, available in section 6 of the tool.

The ex-ante estimation of carbon stock changes is based on an average growth assumption for the entire project area.

The ex-ante growth model was developed based on the following assumptions and is available as Excel file as supporting documentation.

For the diameter growth of Eucalyptus, company internal assumptions were used for the Ex-ante estimation. Since, species distribution is clearly biased towards Eucalyptus (87%), the growth increment was assumed for all tree plantations. A mean annual increment of 30 $m^3$/ha yr. is assumed. However, this represents a linear growth, which is likely to be overestimated during the early years of plantation.

The root-to-shoot ratio is a mean of published ratios of E. camaldulensis and E. globulus in Barton and Montagu (2006)[25] and Fabiao et al. (1995)[26] and is estimated to be 0.37.

Since the Ex-ante calculations are conducted using MAI, stem density is insignificant for the calculation. However, most of the plantations have a planting density of 1,111 plants/ha. The entire plantation cycle is 7.5 years, while in year 3 approximately 15$m^3$/ha are harvested as part of a thinning operation of the 9x1m spacing. Default carbon fraction: 0.49 as per IPCC, tropical wood (2006). Wood density is estimated to be 510 g/$cm^3$, based on average wood densities of three Eucalyptus clones (*E. pellita x E. urophylla, E. pellita x E. brassiana, E. pellita x E. camaldulensis*) and the Biomass expansion factors is used from IPCC Good practice Guidance for LULUCF for temperate broadleaf trees (lower confidence interval): 1.15.

**Table 11: Biomass estimates for Eucalyptus**

| Year | Stock ($m^3$/ha) | Total ABG (t CO2e/ha) | Total BGB (tCO2/ha) | Total Biomass (tCO2/ha) |
|---|---|---|---|---|
| 1 | 30 | 31.6 | 11.8 | 43.4 |
| 2 | 60 | 63.2 | 23.6 | 86.8 |
| 3 | 90 | 94.8 | 35.4 | 130.2 |
| 4 | 120 | 126.4 | 47.1 | 173.6 |
| 5 | 150 | 158.1 | 58.9 | 217.0 |
| 6 | 180 | 189.7 | 70.7 | 260.4 |
| 7 | 210 | 221.3 | 82.5 | 303.8 |
| 8 | 233 | 245.5 | 82.5 | 82.5 |
| 9 | 30 | 31.6 | 82.5 | 114.1 |
| 10 | 60 | 63.2 | 82.5 | 145.7 |
| 11 | 90 | 94.8 | 82.5 | 177.3 |
| 12 | 120 | 126.4 | 82.5 | 208.9 |
| 13 | 150 | 158.1 | 82.5 | 240.5 |
| 14 | 180 | 189.7 | 82.5 | 272.2 |
| 15 | 210 | 221.3 | 82.5 | 303.8 |

[25] Barton, C. V. M. and Montagu, K.D. (2006) Effect of spacing and water availability on root:shoot ratio in Eucalyptus camaldulensis, Forest Ecology and Management 221 (2006) 52–62

[26] Fabiao, A. Madeira, M. Steen, E. Kätterer, T. Ribeiro, C. and Araujo C. (1995): Development of root biomass in an Eucalyptus globulus plantation under different water and nutrient regimes, Plant and Soil 168 – 169: 215-223

| | | | | |
|---|---|---|---|---|
| 16 | 233 | 245.5 | 0.0 | 0.0 |
| 17 | 30 | 31.6 | 11.8 | 43.4 |
| 18 | 60 | 63.2 | 23.6 | 86.8 |
| 19 | 90 | 94.8 | 35.4 | 130.2 |
| 20 | 120 | 126.4 | 47.1 | 173.6 |
| 21 | 150 | 158.1 | 58.9 | 217.0 |
| 22 | 180 | 189.7 | 70.7 | 260.4 |
| 23 | 210 | 221.3 | 82.5 | 303.8 |
| 24 | 233 | 245.5 | 82.5 | 82.5 |
| Long-Term Average | | 110.6 | 58.4 | 169.1 |

**Table 12: Annual estimation of tree biomass GHG removals by sinks in the project scenario for the first project instances (3,382 ha).**

| Year | Accumulated tree biomass GHG removals by sinks, tCO2e | Annual estimation of tree biomass GHG removals by sinks; tCO2e |
|---|---|---|
| 1 | 39,969 | 39,969 |
| 2 | 112,534 | 72,565 |
| 3 | 211,515 | 98,981 |
| 4 | 320,217 | 108,702 |
| 5 | 427,643 | 107,426 |
| 6 | 503,115 | 75,472 |
| 7 | 553,475 | 50,360 |
| 8 | 587,456 | 33,981 |
| 9 | 587,456 | 0 |
| 10 | 587,456 | 0 |
| 11 | 587,456 | 0 |
| 12 | 587,456 | 0 |
| 13 | 587,456 | 0 |
| 14 | 587,456 | 0 |
| 15 | 587,456 | 0 |
| 16 | 587,456 | 0 |
| 17 | 587,456 | 0 |
| 18 | 587,456 | 0 |

| | | |
|---|---|---|
| 19 | 587,456 | 0 |
| 20 | 587,456 | 0 |
| Total | | 587,456 |

**Estimation of the changes in carbon stocks in shrub biomass: $\Delta C_{SHRUB\_PROJ,t}$**

As no shrubs are planted as part of this grouped project this carbon stock will be accounted as zero for the ex-ante and ex-post estimations.

**Estimation of the changes in carbon stocks in dead wood: $\Delta C_{DW\_PROJ,t}$**

As the plantations will be fully managed, no deadwood will occur. Therefore, this carbon stock will be accounted as zero for the ex-ante and ex-post estimations.

**Estimation of the changes in carbon stocks in soil organic carbon (SOC): $\Delta SOC_{PROJ,t}$**

Changes in carbon stocks in the SOC pool is calculated as indicated in the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" (version 01.1.0):

$$\Delta SOC_{PROJ,t} = \frac{44}{12} * \sum_{t=1}^{t} A_{PLANT,t} * dSOC_t * 1year$$

Where:

| | | |
|---|---|---|
| $\Delta SOC_{PROJ,t}$ | = | Change in SOC stock within the project boundary, in year t; t CO2-e |
| $A_{PLANT,t}$ | = | Area planted in year t, ha |
| $dSOC_t$ | = | The rate of change in SOC stocks within the project boundary, in year t, tCha-1yr-1. |

The approved IPCC spreadsheet to facilitate the calculation of changes in soil organic carbon stocks was used for calculating a one-hectare based model which is then upscaled with the planting area. The following table shows the results.

**Table 13 SOC changes over time**

| Year | Planting 2016 | Planting 2017 | Planting 2018 | Planting 2019 | Planting 2020 | Annual delta SOC (tC/yr.) | Cumulative Delta SOC (tC) |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 368 | 0 | 0 | 0 | 0 | 368 | 368 |
| 2 | 368 | 300 | 0 | 0 | 0 | 669 | 1,037 |
| 3 | 368 | 300 | 243 | 0 | 0 | 912 | 1,950 |
| 4 | 368 | 300 | 243 | 128 | 0 | 1,040 | 2,990 |
| 5 | 368 | 300 | 243 | 128 | 350 | 1,390 | 4,380 |
| 6 | 368 | 300 | 243 | 128 | 350 | 1,390 | 5,770 |
| 7 | 368 | 300 | 243 | 128 | 350 | 1,390 | 7,159 |
| 8 | 368 | 300 | 243 | 128 | 350 | 1,390 | 8,549 |
| 9 | 368 | 300 | 243 | 128 | 350 | 1,390 | 9,939 |
| 10 | 368 | 300 | 243 | 128 | 350 | 1,390 | 11,329 |
| 11 | 368 | 300 | 243 | 128 | 350 | 1,390 | 12,719 |
| 12 | 368 | 300 | 243 | 128 | 350 | 1,390 | 14,109 |
| 13 | 368 | 300 | 243 | 128 | 350 | 1,390 | 15,499 |
| 14 | 368 | 300 | 243 | 128 | 350 | 1,390 | 16,888 |
| 15 | 368 | 300 | 243 | 128 | 350 | 1,390 | 18,278 |
| 16 | 368 | 300 | 243 | 128 | 350 | 1,390 | 19,668 |
| 17 | 368 | 300 | 243 | 128 | 350 | 1,390 | 21,058 |
| 18 | 368 | 300 | 243 | 128 | 350 | 1,390 | 22,448 |
| 19 | 368 | 300 | 243 | 128 | 350 | 1,390 | 23,838 |
| 20 | 368 | 300 | 243 | 128 | 350 | 1,390 | 25,228 |

These SOC stock changes result in removals by sink as follows:

**Table 14 Annual and cumulative estimation of SOC GHG removals by sinks in the project scenario for the first project instances**

| Year | Annual SOC GHG removals by sinks; tCO2-e | Accumulated SOC GHG removals by sinks; tCO2-e |
|---|---|---|
| 1 | 1,351 | 1,351 |
| 2 | 2,453 | 3,803 |
| 3 | 3,345 | 7,149 |
| 4 | 3,814 | 10,963 |

| | | |
|---|---|---|
| 5 | 5,096 | 16,059 |
| 6 | 5,096 | 21,155 |
| 7 | 5,096 | 26,251 |
| 8 | 5,096 | 31,348 |
| 9 | 5,096 | 36,444 |
| 10 | 5,096 | 41,540 |
| 11 | 5,096 | 46,636 |
| 12 | 5,096 | 51,732 |
| 13 | 5,096 | 56,828 |
| 14 | 5,096 | 61,924 |
| 15 | 5,096 | 67,020 |
| 16 | 5,096 | 72,117 |
| 17 | 5,096 | 77,213 |
| 18 | 5,096 | 82,309 |
| 19 | 5,096 | 87,405 |
| 20 | 5,096 | 92,501 |
| Total | | 92,501 |

## 4.3 Leakage

According to the methodology AR-AM0003 (Version 02.0), the leakage emission has to be assessed with the tool "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" (Version 02). This tool evaluates the displacement of crop cultivation and grazing activities. Section 6 of this tool indicates that leakage emissions can be considered insignificant if they meet the following requirements:

1. Leakage emission attributable to the displacement of agricultural activities due to implementation of an A/R CDM project activity is estimated as the decrease in carbon stocks in the affected carbon pools of the land receiving the displaced activity.

2. Leakage emission attributable to the displacement of grazing activities under the following conditions is considered insignificant and hence accounted as zero:

(a) Animals are displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land;

(b) Animals are displaced to existing non-grazing grassland and the total number of animals displaced does not exceed the carrying capacity of the receiving grassland;

(c) Animals are displaced to cropland that has been abandoned within the last five years;

(d) Animals are displaced to forested lands, and no clearance of trees, or decrease in crown cover of trees and shrubs, occurs due to the displaced animals;

(e) Animals are displaced to zero-grazing system.

Burapha expands its plantations only into areas, where land owners voluntarily agree to lease their land to Burapha. Furthermore, only degraded lands are targeted, that are not suitable for agriculture anymore, however formerly subject to slash-and-burn practices. Since Burapha allows the local communities to conduct agroforestry practices (intercropping or grazing) in between the planting rows, sufficient mitigation measures are in place to prevent leakage.

## 4.4 Estimated Net GHG Emission Reductions and Removals

The ex-ante net anthropogenic GHG emission reductions and removals are calculated using equation 5 of the methodology AR-AM0003:

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t$$

Where:

| | | |
|---|---|---|
| $\Delta C_{AR-CDM,t}$ | = | Net anthropogenic GHG removals by sinks, in year t; t CO2-e |
| $\Delta C_{ACTUAL,t}$ | = | Actual net GHG removals by sinks, in year t; t CO2-e |
| $\Delta C_{BSL,t}$ | = | Baseline net GHG removals by sinks, in year t; t CO2-e |
| $LK_t$ | = | GHG emissions due to leakage, in year t; t CO2-e |

The results for the first project activity instance are shown below.

**Table 15: Carbon estimations for the first project instances**

| Year | Estimated baseline emissions or removals (tCO2e) | Estimated project emissions or removals (tCO2e) | Estimated discount of buffer credits and fire breaks (tCO2e) | Estimated leakage emissions (tCO2e) | Estimated net GHG emission reductions or removals (tCO2e) |
|---|---|---|---|---|---|
| 1 | 35,797 | 41,320 | 1,381 | - | 4,142 |
| 2 | 29,194 | 75,017 | 11,456 | - | 34,368 |
| 3 | 23,659 | 102,326 | 19,667 | - | 59,000 |
| 4 | 12,430 | 112,517 | 25,022 | - | 75,065 |
| 5 | 33,967 | 112,522 | 19,639 | - | 58,916 |
| 6 | - | 80,568 | 20,142 | - | 60,426 |
| 7 | | 55,456 | 13,864 | - | 41,592 |
| 8 | | 39,077 | 9,769 | - | 29,308 |
| 9 | | 5,096 | 1,274 | - | 3,822 |
| 10 | | 5,096 | 1,274 | - | 3,822 |
| 11 | | 5,096 | 1,274 | - | 3,822 |
| 12 | | 5,096 | 1,274 | - | 3,822 |
| 13 | | 5,096 | 1,274 | - | 3,822 |
| 14 | | 5,096 | 1,274 | - | 3,822 |
| 15 | | 5,096 | 1,274 | - | 3,822 |
| 16 | | 5,096 | 1,274 | - | 3,822 |
| 17 | | 5,096 | 1,274 | - | 3,822 |
| 18 | | 5,096 | 1,274 | - | 3,822 |

| | | | | | |
|---|---|---|---|---|---|
| 19 | | 5,096 | 1,274 | - | 3,822 |
| 20 | | 5,096 | 1,274 | - | 3,822 |
| **Total** | 135,047 | 679,957 | 136,227 | - | 408,682 |

# 5 MONITORING

## 5.1 Data and Parameters Available at Validation

| | |
|---|---|
| **Data / Parameter** | $CF_{TREE}$ |
| **Data unit** | t C $(t.d.m.)^{-1}$ |
| **Description** | Carbon fraction of tree biomass |
| **Source of data** | Default value |
| **Value applied:** | 0.49 |
| **Justification of choice of data or description of measurement methods and procedures applied** | According to the applied tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" IPCC default value of 0.47 is used unless transparent and verifiable information can be provided to justify a different value.<br><br>This carbon fraction was taken from IPCC (2006), Guidelines for National Greenhouse Gas Inventories - Volume 4, Agriculture, Forestry and Other Land Use, Forestry, Table 4.3, tropical/subtropical wood. |
| **Purpose of Data** | Determination of baseline emissions/removals and project emission/ removals |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | $C_{BSL\_fallow}$ |

| | |
|---|---|
| Data unit | t C/ha$^{-1}$ |
| Description | Carbon stock in pre-project biomass per stratum |
| Source of data | Hett, C., Heinimann, A., & Messerli, P. (2011). Spatial assessment of carbon stocks of living vegetation at the national level in Lao PDR. *Geografisk Tidsskrift-Danish Journal of Geography*, *111*(1), 11-26. |
| Value applied: | 12.5 |
| Justification of choice of data or description of measurement methods and procedures applied | The value is an average of the carbon stocks of different forest ecosystem carbon stocks published by. |
| Purpose of Data | Determination of baseline emission/removals |
| Comments | - |

| | |
|---|---|
| Data / Parameter | $C_{BSL\_upland\ rice}$ |
| Data unit | t C/ha$^{-1}$ |
| Description | Carbon stock in pre-project biomass per stratum |
| Source of data | Default value |
| Value applied: | 5 |
| Justification of choice of data or description of measurement methods and procedures applied | The value is a default value of carbon stocks in annual cropland under IPCC (2006), Guidelines for National Greenhouse Gas Inventories - Volume 4, Agriculture, Forestry and Other Land Use, Agriculture, Table 5.9, annual cropland |
| Purpose of Data | Determination of baseline emission/removals |
| Comments | - |

| | |
|---|---|
| Data / Parameter | BEF |
| Data unit | dimensionless |
| Description | Biomass expansion factor, expressing the additional biomass of a tree when only stem volume is known. |
| Source of data | Default factor |
| Value applied: | 1.15 |
| Justification of choice of data or description of measurement methods and procedures applied | According to IPCC Good Practice Guidance for LULUCF – Table 3A.1.10, Broadleaf Temperate forest for conservativeness, since tropical values would over estimate available wood. |
| Purpose of Data | Calculation of project emission removals |
| Comments | - |

| | |
|---|---|
| Data / Parameter | $R_{TREE\_project}$ |
| Data unit | dimensionless |
| Description | Mean of Root : Shoot ratio of trees used from the AR CDM Methodological Tool AR-TOOL 14 |
| Source of data | Average of published R:S ratios in scientific literature.<br><br>Barton, C. V., & Montagu, K. D. (2006). Effect of spacing and water availability on root: shoot ratio in Eucalyptus camaldulensis. *Forest Ecology and Management*, *221*(1-3), 52-62.<br><br>Fabião, A., Madeira, M., Steen, E., Kätterer, T., Ribeiro, C., & Araújo, C. (1995). Development of root biomass in an Eucalyptus globulus plantation under different water and nutrient regimes. *Plant and Soil*, *168*(1), 215-223. |
| Value applied: | 0.37 |

| | |
|---|---|
| Justification of choice of data or description of measurement methods and procedures applied | Enhancing the Tier value by using published values from scientific literature and the species used, instead of default values of IPCC. |
| Purpose of Data | Calculation of ex-ante and ex-post project emission removals |
| Comments | - |

| | |
|---|---|
| Data / Parameter | Wood density |
| Data unit | t dm./$m^3$ |
| Description | Weight to volume relation of three Eucalyptus clones: *E. pellita x E. urophylla, E. pellita x E. brassiana and E. pellita x E. camaldulensis* |
| Source of data | Mean value of three different Eucalyptus clones. The data is from local wood industry contacts by Burapha (Poyry). |
| Value applied: | 0,51 |
| Justification of choice of data or description of measurement methods and procedures applied | A mean of all available wood densities of all Eucalyptus clones used was calculated. |
| Purpose of Data | Calculation of project emission removals |
| Comments | - |

| | |
|---|---|
| Data / Parameter | $SOC_{REF,i}$ |
| Data unit | t C $ha^{-1}$ |
| Description | Reference SOC stock corresponding to the reference condition in native lands |

| | |
|---|---|
| **Source of data** | IPCC Default value, See CDM Tool 'tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities' |
| Value applied: | 60 |
| **Justification of choice of data or description of measurement methods and procedures applied** | According to the applied tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" a default value of 60 for tropical wet climate regions and soils with low activity clay (LAC). |
| **Purpose of Data** | Calculation of project emission removals |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | $f_{LU, i}$ |
| **Data unit** | dimensionless |
| **Description** | Relative stock change factor for baseline land-use in stratum I of the areas of land |
| **Source of data** | IPCC Default value, See CDM Tool 'tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities' |
| **Value applied:** | Short-term or set aside cropland: 0.82 |
| **Justification of choice of data or description of measurement methods and procedures applied** | Table 4 of the applied tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" gives 0.82 as a relative stock change factor for short-term or set aside cropland. |
| **Purpose of Data** | Calculation of project emission removals |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | $f_{MG,i}$ |

| | |
|---|---|
| Data unit | dimensionless |
| Description | Relative stock change factor for baseline management regime in stratum I of the areas of land |
| Source of data | IPCC Default value, See CDM Tool 'tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities' |
| Value applied: | 1.15 |
| Justification of choice of data or description of measurement methods and procedures applied | Table 4 of the applied tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" gives a default value of 1.15 for reduced tillage/ short-term or set aside cropland. |
| Purpose of Data | Calculation of SOC stock change. |
| Comments | Calculation of project emission removals |

| | |
|---|---|
| Data / Parameter | $f_{l,i}$ |
| Data unit | dimensionless |
| Description | Relative stock change factor for baseline input regime (e.g. crop residue returns, manure) in stratum I of the areas of land. |
| Source of data | IPCC Default value, See CDM Tool 'tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities' |
| Value applied: | 0.92 |
| Justification of choice of data or description of measurement methods and procedures applied | According the Table 5 of the applied tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" an input factor of 0.92 is used when low input is applied in tropical, wet climate to cropland. |
| Purpose of Data | Calculation of project emission removals |
| Comments | - |

## 5.2 Data and Parameters Monitored

| | |
|---|---|
| **Data / Parameter** | Ai |
| **Data unit** | Ha |
| **Description** | Area of tree biomass stratum i |
| **Source of data** | GIS or/and GPS |
| **Description of measurement methods and procedures applied** | Areas in project area will be tracked in the field using the GPS. Each plot which will be subject to planting is tracked - a standard procedure of the baseline and monitoring inventory |
| **Frequency of monitoring/recording** | Before the start of the project (planting) and adjusted thereafter every y since yearly with satellite imaginery |
| **Value applied:** | See project database |
| **Monitoring equipment** | GPS (Garmin), GPS Smartphones, QGIS software |
| **QA/QC procedures applied** | Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible; all field team members are trained in GPS/GIS application |
| **Purpose of data** | Calculation of project emissions |
| **Calculation method** | GIS tool |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | wi |
| **Data unit** | Dimensionless |
| **Description** | Relative weight of the area of stratum I, the area of the stratum i divided by the project area. |

| | |
|---|---|
| **Source of data** | Calculated |
| **Description of measurement methods and procedures applied** | N/A |
| **Frequency of monitoring/recording** | Calculated for each monitoring event, at least every five years |
| **Value applied:** | For ex ante Baseline situation the following values are estimated from the first project instance:<br>Stratum (Year) \| Wi<br>Cropland \| 0.25<br>regenerating fallow \| 0.75 |
| **Monitoring equipment** | N/A |
| **QA/QC procedures applied** | N/A |
| **Purpose of data** | Calculation of baseline emissions. |
| **Calculation method** | Area of the stratum i divided by the project area |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | $s_i$ |
| **Data unit** | t d.m. (or t d.m. $ha^{-1}$) |
| **Description** | Estimated standard deviation of biomass stock in stratum i |
| **Source of data** | Project based monitoring system |
| **Description of measurement methods and procedures applied** | N/A |
| **Frequency of monitoring/recording** | $s_i$ is calculated for each monitoring event, at least every five years |
| **Value applied:** | For ex ante situation the following values are estimated from the first project instance: |

| | |
|---|---|
| | Stratum (Year) \| Si<br>2016 \| 0.4<br>2017 \| 0.33<br>2018 \| 0.27 |
| **Monitoring equipment** | N/A |
| **QA/QC procedures applied** | N/A |
| **Purpose of data** | Calculation of uncertainty of project emissions/removals |
| **Calculation method** | Excel or tool available to calculate standard deviation |
| **Comments** | - |

## 5.3 Monitoring Plan

**Monitoring system structure**

Burapha has a technical team that manages and monitors the plantations. The monitoring system uses standard operational procedures in order to obtain verifiable and reliable information on the growth of the plantations, thus allowing the accounting of the sequestered carbon.

The complete monitoring system of the project includes the following parts: First, a annual monitoring ensures current and updated data every year. Second, all inputs and costs are recorded and checked to ensure high productivity and efficiency. Third, all specific operations and information regarding every plantation are kept also as spatial explicit information, such as plantation and project boundaries, location, plots and infrastructure in a GIS project. The respective databases are updated at least annually during each inventory period.

Forest growth monitoring is based on annual inventory/ field measurements, usually conducted at the end/beginning of a calendar year. During these inventories parameters, such as DBH and height are measured, while others, such as stand health, stand quality and condition, requirements for action, etc. are evaluated. Growth models are developed using this information by the third party operator “Simosol”.

The analysis of the inventory data as well as the growth models feed into the decision-making for the upcoming year. This allows the reporting of reliable information to all parties and stakeholders, the basis for adaptive management.

### Geographical delineation of project boundaries

The area of the project has been visited and reviewed with field staff and villagers. The boundaries of each sub-compartment and compartment of plantation is tracked and recorded using a GPS device. The overall plantation boundaries, are continuously re-assessed and updated with remote sensing techniques and satellite imagery.

### Stratification and update of effective areas

Site conditions in Burapha plantations are fairly similar. As such, the plantation areas are severely degraded by several cropping cycles of swidden agriculture. Thus, the plantations are stratified using political boundaries of different villages/management units as well as plantation age. This is the smallest unit used for all silvicultural measures.

### Sampling design, plot selection and location

Burapha uses a network of Permanent Sample Plots (PSPs) to conduct its inventories for the monitoring of plantation growth and yield estimations. The PSP network is distributed randomly across the plantation area and covers most of the compartments with an area larger than 2.5 ha. It is furthermore arranged to cover both age class and geography. The PSPS network is considered representative and provides sufficient data for modeling growth rates and forest attributes, such as survival rates, forest health, etc.

The network has on average one fixed radius plot (r=17.84 m, area=0.01 ha) per 15 hectares, which for the purposes of estate modelling is adjusted to projected area using the measured slope. However, to date, the real average is 1 PSP every 21 ha, and 194 PSP's in total. The number of PSPs increased with the planted area. The PSP measurement procedures have remained the same, except for the slope adjustment which is now being done by measuring the slope and adjusting the plot size accordingly (before the plot size was measured horizontally).

The company also introduced a cruising inventory at age 4 using e.g. line/transect sampling or temporary plots with a smaller fixed area. This would enable adjusting the compartment level growth assumptions. However, this data has not been incorporated into the current estimate, but will be used in the future for all monitorings from 2020 onwards.

A typical approach for this type of cruising inventory would be to carry out a mid-rotation inventory (3-4 years after planting) and a pre-harvest inventory at the age of 6-7, covering all stands. The required sampling density (amount of temporary sample plots) depends on the targeted accuracy. The adjacent table presents the requirements for sample size in Burapha's plantations with different accuracy levels. The sample size was calculated with the following assumptions:

- Size of a temporary plot: 0.05 ha
- The locations of the temporary sample plots randomized
- One age class inventoried per year with an area of approximately 500 ha

| Accuracy target* (Margin of error) | Sample plots (Mid-rotation) | Sample plots (Pre-harvest) |
|---|---|---|
| 5% | 1 plot / 1-1.5 ha | 1 plot / 2.5 ha |
| 10% | 1 plot / 5 ha | 1 plot / 10 ha |
| 15% | 1 plot / 10 ha | 1 plot / 20-25 ha |

**The accuracy refers to the estimate mean/total volume of an age class.*

**Table 16: Accuracy options for sampling densities in a cruising inventory**

Measurements are performed every year at the end or beginning of a calendar year. The first measurement takes place at least one year after planting (e.g. if one compartment is planted in June or October 2019 the first measurement takes place between November and December 2020).

### Data Collection

Following data is measured: Vitality of the tree, tree height, diameter at breast height (DBH), manifestation of diseases or damages, quality of silvicultural treatments applied, and additional observations if any. The company has SOPs for the measurement of PSPs and data collection.

### Data analysis

The growth analysis is conducted by the third party company "Simosol", based in Finnland using different models to describe the growth and yield expectations and wood flows as precise as possible. However, the PSP analysis core data area

- Mean, Maximum and Minimum diameter
- Height and dominant height of trees
- Current no. of trees

On the compartment level the following parameters are calculated per PSP using the area of the plot:

- Density of living trees
- Basal area
- Volume
- Volume below bark

**Procedures for internal auditing and QA/QC**

Monitoring requires provisions for quality assurance (QA) and quality control (QC) to be implemented via a QA/QC plan. The main parts of this QA/QC are:

- Collecting reliable field measurements
- Verifying methods used to collect field data
- Procedures to ensure reliable field measurements
- Data maintenance and archiving

Collecting reliable field measurement data

Collecting reliable field measurement data is an important step in the quality assurance plan. Those responsible for the measurement work are properly trained in all aspects of the field data collection as well as the different instruments to use during the activity. The local forest manager responsible is well trained to use the instruments and conduct the inventories. The FMU manager conducts yearly on-the-job trainings with the workers supporting the activity, ensuring new workers are properly trained.

Verifying methods used to collect field data

The field staff is trained every year in refresher trainings to ensure correct field data collection. The correct procedures are described by SOPs, which are updated whenever necessary by the monitoring responsible.

Before conducting the analysis of the data, quality control of the obtained data is conducted by the monitoring responsible. Unexpected results or high deviations between trees in the PSPs are evaluated, and PSPs are re-measured when necessary. Also, and a comparison with previous years is conducted to ensure consistency of the data throughout the project lifetime.

Verifying analysis techniques

Yield and growth analysis, as well as entire plantation reviews are done by the third party operators “Simosol” and “AFRY Management Consulting” (UK) Ltd. to ensure highest quality and independent quality control.

Data archiving

Copies of all raw data, reports of analysis and supporting spreadsheets will be stored in a dedicated long-term electronic archive for at least 2 years following the end of the last crediting period.

# 6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

The achieved GHG emission reductions presented in this chapter refer to the first monitoring period of this project **m1** from 22.04.2016 until 13.02.2020 for all plantations planted until 2018.

The first project instances consist also of plantings from 2019 and 2020. The monitoring hasn't been completed for the 1255 ha of these plantings yet. The total area, which is considered in this monitoring report (m1) is 2281 ha. The first project instances include therefore a total of 3,536 ha. Therefore, the 'no biomass increase approach' of the Methodology is applied here, since the seedlings had not reached the dimensions eligible for the annual inventory and measurement of DBH.

## 6.1 Data and Parameters Monitored

| | |
|---|---|
| **Data / Parameter** | $A_i$ |
| **Data unit** | Ha |
| **Description** | Area of tree biomass stratum *i* |
| **Value applied:** | **Stratum (Plantation year)** / **Area**<br>2016 / 921<br>2017 / 751<br>2018 / 609<br>**Total** / **2281** |
| **Comments** | Areas are yearly updated using satellite imagery |

| | |
|---|---|
| **Data / Parameter** | $A_{p,i}$ |
| **Data unit** | Ha |

| | |
|---|---|
| **Description** | Size of a sample plot in stratum i. This varies depending on the plantation density. Permanent Sample Plots have always a radius of approximately 17.4m (0.1 ha), depending on slope correction. |
| **Value applied:** | Type of Plantation: Area (ha)<br>888 trees/ha (5x2.5m): 0.1<br>1.111 trees/ha (5x2): 0.1 |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | DBH |
| **Data unit** | cm |
| **Description** | The diameter at breast height (1.3 m from the ground) |
| **Value applied:** | See Excel File "2021-02-05 Burapha Carbon Inventory M1" |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | $W_i$ |
| **Data unit** | Dimensionless |
| **Description** | Relative weight of the area of stratum I, the area of the stratum I divided by the project area |
| **Value applied:** | Stratum (Year): Wi<br>2016: 0.4<br>2017: 0.33<br>2018: 0.27 |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | $S_i$ |
| **Data unit** | t.d.m. (or t dm.m. $ha^{-1}$) |
| **Description** | Estimated standard deviation of biomass stock in stratum i |

| | |
|---|---|
| **Value applied:** | Stratum (Year) / Si<br>2016 / 15.52<br>2017 / 11.19<br>2018 / 4.10 |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | $n_i$ |
| **Data unit** | Dimensionless |
| **Description** | Number of sample plots in stratum i |
| **Value applied:** | Stratum (Year) / ni<br>2016 / 57<br>2017 / 60<br>2018 / 51 |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | H |
| **Data unit** | m |
| **Description** | Height of tree planted |
| **Value applied:** | See Excel “2021-02-05 Burapha Carbon Inventory M1” |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | T |
| **Data unit** | Year |
| **Description** | Time period elapsed between two successive estimation of carbon stock in a carbon pool |
| **Value applied:** | 1 year |

| Comments | - |
|---|---|

## 6.2 Baseline Emissions

Baseline emissions for this monitoring period m1 was calculated following the approach demonstrated in section 4.1. The table below displays the baseline carbon stocks for the pre-existing trees for the planting years 2016-2018 which are subject to this monitoring period.

**Table 17: Baseline biomass for this monitoring period**

| Year | Areas planted / restored per year (ha) | $C_{TREE\_BSL}$ Pre-existing biomass of trees ($tCO_2$-e) | $C_{CW\_BSL}$ Dead wood pre-existing trees ($tCO_2$-e) | $C_{SHRUB\_BSL}$ Pre-existing shrub biomass ($tCO_2$-e) | $C_{BSL\_TOTAL}$ Total Biomass baseline ($tCO_2$-e) |
|---|---|---|---|---|---|
| 2016 | 921 | 35,797 | 0 | 0 | 35,797 |
| 2017 | 751 | 29,194 | 0 | 0 | 29,194 |
| 2018 | 609 | 23,659 | 0 | 0 | 23,659 |
| 2019 | 0 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 |
| Total | 2,281 | 88,651 | 0 | 0 | 88,651 |

## 6.3 Project Emissions

The actual net GHG removals by sinks have been calculated using equation 2 of the methodology (AR-ACM0003: Afforestation and reforestation of lands except wetlands. Version 02.0) as described below.

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t}$$

Where:

$\Delta C_{ACTUAL,t}$ = Annual actual net greenhouse gas removals by sinks at time *t*; t $CO_2$-e $yr^{-1}$

$\Delta C_{P,t}$ = Change in carbon stocks in project, occurring in the selected carbon pools, at time *t*; t $CO_2$-e $yr^{-1}$

$GHG_{E,t}$ = Increase of non-$CO_2$ GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year t, t $CO_2$-e

Change in the carbon stocks in project have been calculated using equation 3 of the methodology, however shrub biomass is not considered in this project:

$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SOC\_PROJ,t}$

Where:

$\Delta C_{P,t}$ = Change in carbon stocks in project, occurring in the selected carbon pools, at time t; t CO2-e yr-1

$\Delta C_{TREE\_PROJ,t}$ = Change in carbon stock in tree biomass in project in year t, as estimated in AR-TOOL14; t CO2-e yr-1

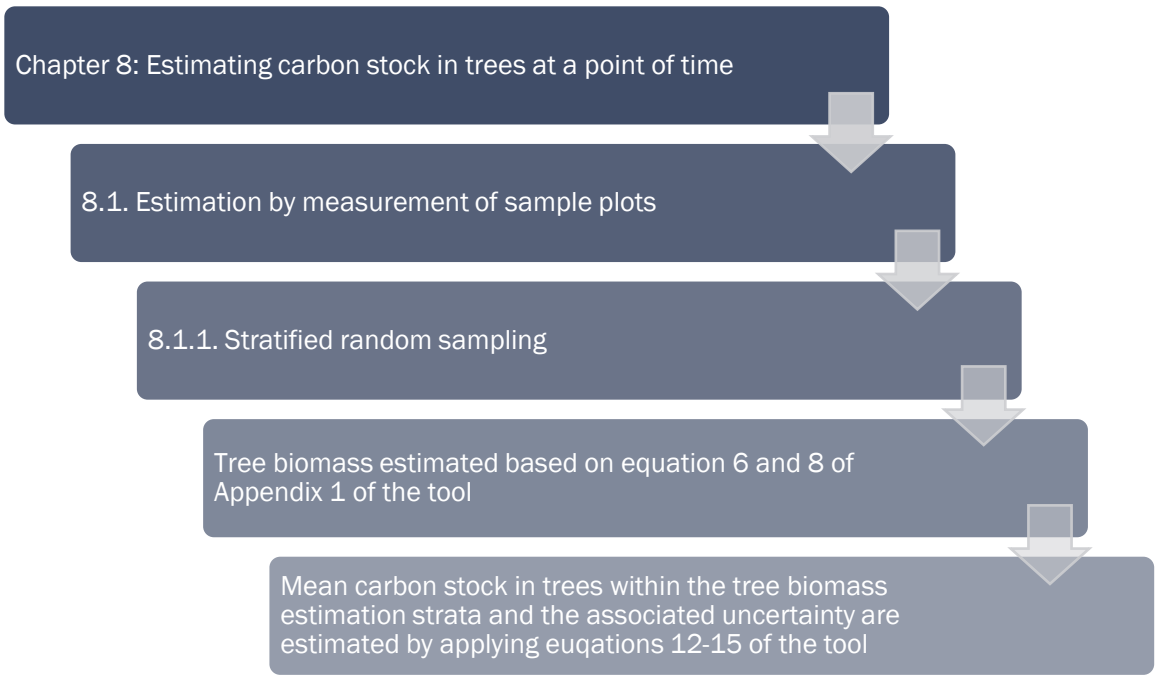
$\Delta C_{SOC\_PROJ,t}$ = Change in carbon stock in the soil organic carbon (SOC) pool within the project boundary, as estimated in AR-AM0014, in year t; t CO2-e yr-1

### Estimation of carbon stock changes in trees and shrubs

Carbon stock changes of trees and shrubs are estimated applying the AR-Tool 'A/R Methodological tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities' (Version 04.1).

Estimation of carbon stock change in trees

The following sections and equations of the tool are applied:




The following equations of the methodology have been applied:

$$C_{TREE,\,t} = \frac{44}{12} * CF_{TREE} * B_{TREE,t}$$

$B_{TREE,\,t} = b_{TREE,\,t} * A$

$$b_{TREE,\,t} = \sum_{i=1}^{M} w_i \times b_{TREE,\,t,i}$$

Where:

| | |
|---|---|
| $C_{TREE,\,t}$ | = Carbon stock in tree biomass within the project boundary at a point in time in year *t*; t CO2-e. |
| $CF_{TREE}$ | = Carbon fraction of tree biomass; t C (t d.m.)$^{-1}$. |
| $B_{TREE,\,t}$ | = Total tree biomass within the project boundary at a given point in time in year *t*; t d.m. |
| $b_{TREE,\,t}$ | = Mean tree biomass per hectare within the project boundary at a given point in time in year *t*; t d.m. ha$^{-1}$ |
| $A$ | = Project area; ha |
| $w_i$ | = Ratio of the area of stratum *i* to the sum of areas of tree biomass estimation strata ($A_i$/A), dimensionless |

$b_{TREE,t,i}$ = Mean tree biomass per hectare in stratum *i* at a given point in time in year *t*; t d.m. $ha^{-1}$

**Determination of tree biomass $b_{TREE,t,j}$**

Tree biomass estimation follows the guidance for measurement of variable plots given in Appendix 1 of the Tool, equations 6 and 8.

The following table summarizes the values applied for equation 8 (of Appendix 1 of the Tool):

**Table 18: Values applied to calculate tree biomass**

| Equation value | Description | Value applied | Source |
|---|---|---|---|
| $v_{TREE,j}(BA_{p,i})$ | Stem volume per hectare of trees of species j in sample plot p of stratum i estimated by using the basal area of the plot as entry data into a volume table or volume equation; $m^3$ $ha^{-1}$ | See Excel inventory data 2016 | Allometric equations developed by Simosol on the basis of growth parameters in Burapha |
| $D_j$ | Density (over-bark) of tree species j; t d.m. $m^{-3}$ | 0,51 | Jaakko Poyry, contacts Burapha |
| $BEF_{2,j}$ | Biomass expansion factor for conversion of tree stem biomass to above-ground tree biomass, for tree species j; dimensionless | 1.15 | IPCC value, Table 3A.1.10, Broadleaf Temp |
| $R_j$ | Root-shoot ratio for tree species j; dimensionless | 0.31 | Average from two sources: Barton and Montagu, 2006, Effect of spacing and water availability on root:shoot ratio in Eucalyptus camaldulensis & Fabiao et al. 1995, Development of root biomass in an Eucalpytus globulus plantation under different water and nutrient regimes, Plant and soil 168-169 |

The calculation of the tree biomass was done in Excel. The file '2021-01-05 Burapha Carbon Inventory M1' is available as supporting documentation.

**Table 19: Summary calculation $B_{TREE}$ and $C_{TREE}$**

| Stratum | Area (ha) | wi | bTREE,t t d.m. ha$^{-1}$ | BTREE,t t d.m. | CTREE,t t CO2-e |
|---|---|---|---|---|---|
| 2016 | 921 | 0.40 | 41.0 | 37,771 | 65,092 |
| 2017 | 751 | 0.33 | 22.0 | 16,523 | 28,474 |
| 2018 | 609 | 0.27 | 5.8 | 3,557 | 6,131 |
| Total | 2281 | 1.00 | 25.4 | 57,851 | 99,697 |

Calculation of uncertainty following the guidance of Appendix 2 of the A/R Methodological Tool

**Table 20: Calculation of uncertainty**

| Stratum | $s_i$ t.d.m. ha$^{-1}$ | $n_i$ | $u_c$ % | $u_c$ mean (t $CO_2$-e) | $u_c$ Discount (t $CO_2$-e) |
|---|---|---|---|---|---|
| 2016 | 15.5 | 57 | 6 | 6264 | 0 |
| 2017 | 11.2 | 60 | | | |
| 2018 | 4.1 | 51 | | | |
| Total | 30.8 | 168 | | | |

Based on the Tool no discount of $C_{TREE}$ is necessary as $u_c$ < 10%.

Estimation of changes in soil organic carbon stocks

For ex-post estimation of the SOC changes under the project scenario for this monitoring period, the default method of the A/R Methodological tool 'Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities' (Version 01.1.0) is applied. The application and justification of the tool is outlined in section 4.2.

The rate of change in SOC stock in the project scenario until the steady state in SOC content is reached (assumed in 20 years from the time of the initial site preparation) is calculated as 0,4 tC/ ha/ yr which represents the weighted average value over all baseline strata.

SOC stock change starts from 1 year after activity start.

**Table 21: Calculation of SOC change for this monitoring period**

| Year | Area (ha) | Cummulative SOC area (ha) | Annual SOC Carbon stock change (t CO2e) | Accumulated Carbon stock change (t CO2e) |
|---|---|---|---|---|
| 2016 | 921 | 921 | 788 | 788 |
| 2017 | 751 | 1,672 | 1,993 | 2,781 |
| 2018 | 609 | 2,281 | 2,973 | 5,755 |
| 2019 | - | 2,281 | 3,345 | 9,100 |
| 2020 | - | 2,281 | 279 | 9,379 |
| Total | 2,281 | 2,281 | 9,379 | 9,379 |

### Change in carbon stocks of trees

According to the tool AR-TOOL14 A/R Methodological tool 'Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities' (Version 04.1) at the first verification $C_{TREE}$, t2 is set equal to the carbon stock in the first verification. Based on this, the following table shows the change in carbon stock during the period between two points of time t1 (pre-existing baseline tree biomass) and t2. The Excel sheet '2020-02-05 Burapha Carbon Inventory M1' details the full calculation of emission reductions for this monitoring period and is available upon request.

**Table 22: Change in carbon stocks during the period between two points of time t1 (pre-existing tree and shrub biomass) and t2**

| Year of inclusion of project areas | Area strata included in year t (ha) | $C_{TREE,t1} = C_{TREE\_BSL,t1}$ | $C_{DW\_BSL;t1}$ | $C_{SHRUB\_BSL,t1}$ (t $CO_2$-e) | $C_{TREE\_PROJ\_DISCOUNT;t2}$ | $C_{DW\_PROJ;t2}$ | $\Delta C_{TREE+DW\_PROJ;(t2-t1)}$ |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2016 | 921 | 35,797 | 0 | 0 | - | 0 | -35,797 |
| 2017 | 751 | 29,194 | 0 | 0 | - | 0 | -29,194 |
| 2018 | 609 | 23,659 | 0 | 0 | - | 0 | -23,659 |
| 2019 | 0 | - | 0 | 0 | 99,697 | 0 | 99,697 |
| 2020 | 0 | - | 0 | 0 | - | 0 | - |
| Total | 2281 | 88,651 | 0 | 0 | 99,697 | 0 | 11,046 |

Actual net greenhouse gas removals by sinks

**Table 23: Actual net greenhouse gas removals by sinks for the different years of the monitoring period**

| Year | Project implementation (cum. months) | Cumulative tree net GHG removals by sinks, in year t; (t $CO_2$-e) | Actual tree net GHG removals by sinks, in year t; (t $CO_2$-e) | Actual SOC net GHG removals by sinks, in year t; (t $CO_2$-e) | Actual total net GHG removals by sinks, in year t; (t $CO_2$-e) |
|---|---|---|---|---|---|
| 2016 | 8 | -35,797 | -35,797 | 788 | -35,009 |
| 2017 | 20 | -64,991 | -29,194 | 1,993 | -27,200 |
| 2018 | 32 | -88,651 | -23,659 | 2,973 | -20,686 |
| 2019 | 44 | 11,046 | 99,697 | 3,345 | 103,042 |
| 2020 | 56 | 11,046 | - | 279 | 279 |
| Total | 56 | 11,046 | 11,046 | 9,379 | 20,425 |

## 6.4 Leakage

**Table 24: GHG emissions due to leakage, in year t**

| Year | Leakage (t CO2-e) |
|---|---|
| 2016 | 0 |
| 2017 | 0 |
| 2018 | 0 |
| 2019 | 0 |
| 2020 | 0 |
| Total | 0 |

## 6.5 Net GHG Emission Reductions and Removals

**Table 25: Net GHG Emission reductions and removals**

| Year | Baseline emissions or removals ($tCO_2e$) | Project emissions or removals ($tCO_2e$) | Leakage emissions ($tCO_2e$) | Net GHG emission reductions or removals ($tCO_2e$) | Buffer pool allocation | VCUs eligible for Issuance |
|---|---|---|---|---|---|---|
| 2016 | 35,797 | 788 | - | -35,009 | -7,702 | -27,307 |
| 2017 | 29,194 | 1,993 | - | -27,200 | -5,984 | -21,216 |
| 2018 | 23,659 | 2,973 | - | -20,686 | -4,551 | -16,135 |
| 2019 | 0 | 103,042 | - | 103,042 | 22,669 | 80,373 |
| 2020 | 0 | 279 | - | 279 | 61 | 217 |
| Total | 88,651 | 109,076 | - | 20,425 | 4,494 | 15,932 |

The total GHG emission reductions of the first project instances for the 1st monitoring period 22.04.2016 until 13.02.2020 are 20,425 tCO2e. The non-permanence risk rating is 22% (as determined in the AFOLU non-permanence risk report attached as a separate document). Therefore the total number of buffer credits that need to be deposited into the AFOLU pooled buffer account is 4,494 tCO2e. The number of GHG credits eligible to be issued as VCUs for the first project instances of this monitoring period is 15,932 tCO2e.

# APPENDIX 1: NON-PERMANENCE RISK REPORT

The Non-Permanence Risk report is attached as a separate document.

# APPENDIX 2: ALLOMETRIC EQUATIONS

The equation was developed by Simosol based on specific Burapha trees. The full report is available upon request.

## Estimation report

taper curve equation: 'T1 3.0 x 3.0'
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v = B0 + B1*d^2 + B2*(h-1.3)^2 + B3*(d^2*h) - B4*(d*h^2), above bark
v = B0 + B1*d^2 + B2*(h-1.3)^2 + B3*(d^2*h) - B4*(d*h^2)

Model variables

| variable | description | unit |
|---|---|---|
| v | volume | m3 |
| d | diameter | cm |
| h | height | m |

Estimation statistics

| | |
|---|---|
| N | 9 |
| R sq | 0.998171 |
| bias | 1.580849 |
| RMSE | 1.713628 |
| sigma | 0.007148 |

Parameter estimates

| coefficient | estimate | std.error | t-value | pr(>\|t\|) |
|---|---|---|---|---|
| B0 | 0.0557615700 | 0.06577 | 0.84782 | 0.44429 |
| B1 | 0.0005463168 | 0.00097 | 0.56466 | 0.60247 |
| B2 | -0.0009832251 | 0.00094 | -1.04333 | 0.35570 |
| B3 | -0.0000556542 | 0.00009 | -0.62422 | 0.56632 |
| B4 | 0.0000959745 | 0.00009 | 1.12314 | 0.32423 |