VCS JOINT PROJECT DESCRIPTION & MONITORING REPORT

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

Document Prepared by

Project Title	Afforestation in Eucalyptus and Acacia plantations for Burapha Agroforestry Co., Ltd.
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LIST OF ABBREVIATIONS

AFOLU	Agriculture, Forestry and other land uses
AGB	Aboveground biomass
AR(R) (A/R)	Afforestation/Reforestation
BAFCO	Burapha Agroforestry Corporation Ltd.
BGB	Belowground biomass
C	Carbon
CDM	Clean Development Mechanism
CO_2e	Carbon Dioxide Equivalents
ERPA	Emission Reductions Payment Agreement
ERPD	Emission Reductions Program Document
ESIA	Environmental and Social Impact Assessment
ESMMP	Environmental and Social Monitoring and Management Plan
FCPF	Forest Carbon Partnership Facility
FPA	Forest Production Area
FPIC	Free, Prior, Informed Consent
FSC	Forest Stewardship Council
GHG	Greenhouse Gas Emissions
GIS	Geographic Information System
GOL	Government of Laos
GPG	Good Practice Guidance

Ha	Hectare
IFC	International Finance Corporation
INDC	Intended National Determined Contributions
IPCC	International Panel on Climate Change
LDC	Least Developed Country
LULUCF	Land use and Land use change and Forestry
MAF	Ministry of Agriculture and Forestry (Lao PDR)
FMU	Forest Management Unit
NDC	National Determined Contributions
NTFP	Non-Timber Forest Products
PD	Project Design Document
PSP	Permanent Sample Plot
RD	Root-Shoot ratio
SMA	Special Management Area
SOC	Soil Organic Carbon
SOP	Standard Operating Procedure
t	Ton (metric)
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Voluntary Carbon Standard
VCU	Verified Carbon Units
VVB	Validation Verification Body
WB	World Bank
yr	Year

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 2,946 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 approximately 72,000 ha of forests in total, consisting of approximately 60,000 ha of plantations and 12,000 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 cumaldulensis, E. pellita, E. deglupta, and E. urophylla hybrids) which is planted on 95% of the area and Acacia auriculiformis with subsequent 5% 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 **282 t CO_2/ha**. Over a crediting period of 20 years the project will generate gross removals of **898,927** tCO_2e and **44,946** tCO_2e/yr, or net removals (i.e. adjusted for baseline removals, buffer etc) of 604,015 tCO_2e or 30,201 tCO_2e/yr.

1.2 Sectoral Scope and Project Type

The project is under Sectoral Scope 14 "Agriculture, Forestry and other Land Use", in the Afforestation, Reforestation and Revegetation (ARR) category.

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. Since 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:

[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;

"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."

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

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

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."*

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.

6) Areas located in Xayabouly Province will also need to obtain a confirmation letter from the Lao Government of no double-counting with the World Bank Forest Carbon Partnership Program. The World Bank program is operating in 6 northern provinces of Lao, one of which is Xayabouly Province. This is the only province where Burapha is also establishing plantations. Any areas added to the Burapha project located in Xayabouly Province must obtain confirmation that there is no double counting[4].

1.5 Project Proponent

Organization name	Burapha Agro-Forestry Co. Ltd.
Contact person	Cliff Massey
Title	CSER Manager

[4] Note this is why the 170 hectares planted in Xayabouly have been removed from the first verification. A confirmation letter for this area is still pending.

Address	23 Singha Road, Ban Phonexay PO Box 11834 Xaysettha District Vientiane, Lao PDR
Telephone	+856 021 451 841-2
Email	cliff.massey@buraphawood.com

1.6 Other Entities Involved in the Project

Organization name	UNIQUE – Forestry and Land Use
Role in the project	Project development support
Contact person	Matthias Seebauer
Title	Senior consultant
Address	Schnewlinstrasse 10 D-79098 Freiburg Germany
Telephone	+49/761-20853428
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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)[5].

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

In non state owned land Burapha provides assistance to improve land tenure (obtain the correct documents and approvals) for individuals who can demonstrate land claim, such as paid taxes, purchase receipts etc. This in turn provides increased security to villagers and is a source of possible borrowing. It certainly increases household wealth. In state owned land, such as Production Forest Areas, customary/ existing use is acknowledged. Villagers / households are paid to plant and maintain plantations in areas once used by the family for swidden rice. In cases where families choose not to participate in labor programs that land is then provided to another family to benefit from labor wages and training.

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

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.[6]

1.8 Project Start Date

Project Start date: 31.05.2016

The project start date is marked by the beginning of the planting activities in 2016.

1.9 Project Crediting Period

Project start date	31.05.2016
Project end date	31.05.2036
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 Instance totaling a project area of 2,946 ha[7] (). 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	69,403

[6] Forestry Law, 2017

[7] Note 170 ha in Xayabouly is excluded from the verification,

2017	2	112,644
2018	3	143,710
2019	4	153,415
2020	5	142,192
2021	6	101,221
2022	7	72,449
2023	8	52,048
2024	9	4,320
2025	10	4,320
2026	11	4,320
2027	12	4,320
2028	13	4,320
2029	14	4,320
2030	15	4,320
2031	16	4,320
2032	17	4,320
2033	18	4,320
2034	19	4,320
2035	20	4,320
Total estimated ERs	898,927	
Total number of crediting years	20	

Average annual ERs	44,946

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 60,000 ha of plantations and additional 20% of conservation area (72,000 ha in total). This conservation area shall entail riparian buffers, steep slopes and additional uncleared/ unplanted area. Approximately 2,946 ha[8] 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 auriculiformis*). 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. However, harvesting activities are conducted mainly by harvesting machines.

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

[8] Note that 2,946 ha have been planted but 170 ha in Xayabouly province has not been included in the first verification.

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, however practice this rather during the first year only. The inter-row space can be used thereafter for cattle grazing. Grazing has furthermore positive effects on the tree development: It reduces the moisture and nutrient competition of the side vegetation and keeps it small, that no understory can establish. 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 13 shows the labor opportunities of villagers during plantation growth.

Table 1: Burapha Agroforestry model labor and intercropping opportunities

Year	1	2	3	4	5	6	7
Company Activity	Site Prep.	Weeding		Thinning			Harvesting
	Planting	Fertilising					
Community Opportunities	Labour (for Company Activities above)						
	Annual Intercropping		Grazing				
	Long Rotation Intercropping (e.g. Rattan)						

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.

The plywood mill of Burapha is operational since June 2021 and produces Eucalypt veneer and plywood.

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 any kind of NTFP products can be collected by farmers, such as fishing for subsistence (FSC, 2018), mushroom picking, etc.

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 (note that the 170 hectares planted in this province has been excluded from the first verification), 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 (see Appendix 3). 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. Furthermore, the exact location of each and every stand can be retrieved from the project supporting documentation (shapefile supplied).

Table 2: First Project Instance included in this project

Planting year	Area (cumulative ha)	Baseline Stratum
2016	947	Slash-and-Burn
2017	1549	Slash-and-Burn
2018	1,980	Slash-and-Burn
2019	2,210	Slash-and-Burn
2020	2,946	Slash-and-Burn
Total	2,946	

Figure 2: Project region boundary with First Project instances, (2020 red), and the project region of the grouped project (future provinces)

Figure 3: First Project Instance 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)[9].

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)[10].

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) [11]. Studies claim 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)[12].

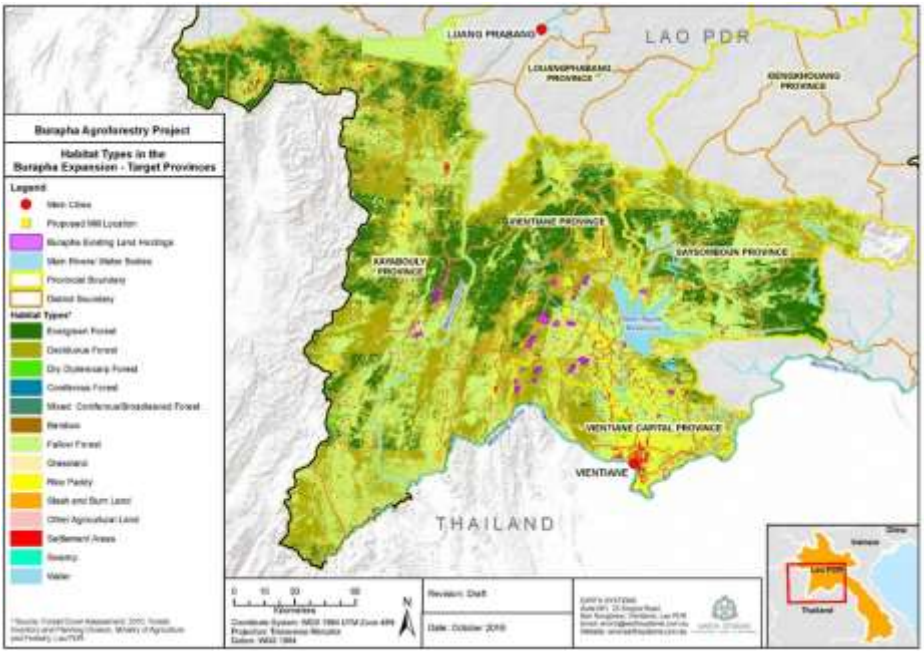


Figure 4: Vegetation of 4 of the 5 project provinces in Northern Lao PDR.

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

[10] https://core.ac.uk/download/pdf/206862708.pdf

[11] ERPD – Laor PDR: https://www.forestcarbonpartnership.org/system/files/documents/LaoPDR_ERPD_FinalDraftMay.2018-Clean.pdf

[12] https://link.springer.com/chapter/10.1007/978-3-319-67474-2_28

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, issues harvesting licenses, develops harvesting contracts, supervise 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[13].

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.

The **Forest Strategy 2020** was the primary strategy for 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	Project Compliance
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	An ESIA has been completed and an Environmental Compliance Certificate secured.
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 ▪ **Forestry Law** - Law No. 64 /NA- 2019: Regulates	▪ The main forest categories are protection forests, conservation forests and production forests. Allows for the use of Forest Land for plantations (Production Forest cat.).	Burapha's project is being implemented in Production Forest Areas (PFAs).

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

	the management and use of Forest Land	▪ 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 ▪ Art. 15: declares all forests next to roads and rivers to protection forests ▪ Art. 57: Declares forest plantations to target degraded forest land ▪ In Art. 58 legal entities are encouraged to rehabilitate degraded forests ▪ 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	Burapha complies with labour laws. This aspect is part of regular FSC certification and Burapha has been in compliance for all recent audits.
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 its own saw and plywood mills.
Administrative laws	▪ **Enterprise Law** - Law No. 46/NA - 2013	Plantation owners need to register for their operations.	Burapha is registered in accordance with Lao law.

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

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

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

1.15.1 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.

1.15.2

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)[14]. 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[15]. 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). Note that this ARR project is taking place on land that would not be eligible for a REDD project, and vice versa, areas suitable for a REDD project would not be eligible for inclusion in an ARR project. Burapha also has a Letter of Acknowledgement from the GOL, acknowledging and supporting the ARR project.

In addition, to be eligible to be added to the Burapha project, areas planted in Xayabouly Province (the only province where Burapha will have plantations and the World Bank program

[14] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Lao%20People%27s%20Democratic%20Republic%20First/Lao%20People%27s%20Democratic%20Republic%20First%20NDC.pdf

[15] https://www.forestcarbonpartnership.org/country/lao-pdr

will also be implemented), must secure a confirmation letter from the Lao Government stating that there will be no double counting of those areas[16].

Emissions Trading Programs and Other Binding Limits

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

Other Forms of Environmental Credit

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

1.16.2 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 and their food security reducing their reliance on growing upland rice cultivation. Therefore the decrease in need for shifting cultivation activities is expected. All communities are involved in the development of the plantations. Burapha conducts baseline socioeconomic and livelihood surveys of partner villagers (pre-plantation), and then conducts regular surveys (at least every 5 years) to monitor their food security and income situation.

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

Commercially Sensitive Information

A number of commercially sensitive references were made available to the validator, as listed below:

- 10a_Burapha, Investment analysis plantation only, 210916
- 10b_SilviCapital Presentation -September 2014 Summary
- 10c_Stora Enso to downsize plantation operations in Laos
- 10d_Burapha Summary list of investors that declined
- 10e_Burapha, Confirmation wood prices, Sunpaper proposal 2021
- 10k_Organisation
- 10m_Project description MIGA

[16] Note this is why the 170 hectares planted in Xayabouly have been removed from the first verification. A confirmation letter for this area is still pending.

- 10n_Rejection conversation examples, v01
- 10o_Salwood, FIP Concept IFC Draft Feb 11
- 10p_SilviCapital Burapha Agroforestry 2012 Final Draft 19 Mars

- 10q_Burapha February 2021 presentation
- 10r_Burapha Fundraising 2020 Exe
- 10s_Burapha Fundraising Oct 2019
- 10t_Burapha Investment timetable 210916
- 10u_Burapha Organogram may 2021
- 10v_2020.BURAPHA Financial Report 31 Dec
- 10w_Burapha AgroForestry pratice in Laos, 2013
- 10x_Burapha Annual report 2019
- 10y_Burapha August presentation
- 22_2018-09 UNIQUE Laos Carbon feasibility Final
- 27_Financial Model V8.5.1 No LDN Money - used for Board presentation 2021 12 03 (1)
- 28_3.12.2021 BAFCO Board Meeting Minutes_signed
- 29_Board Meeting Presentation December 3 2021
- 30_VCU Sale and Option Purchase Agreement - Burapha-Sil(1)
- 34_Ban Lapueng, A Case Study
- 35_Lenders base case v7b (carbon cert)
- IFC Upstream Level (environmental and social) Report Draft, Rina Consulting April 2022

Sustainable Development

The project aims to contribute to the following SDGs:

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Project employment and income generation is expected to provide Moderate to High benefits on economic development, creating approximately 4400 full time positions and over 8 million man-hours of casual labour opportunities valued at 32 billion Lao Kip/ 4.4million USD; as well as additional indirect employment with Project contractors over the life of the Project. The benefits of Project employment will be maximised through prioritising local employment; working to align employment opportunities with local agricultural cycles, and ensuring that employment opportunities are equitably distributed within Project communities

SDG 13: Take urgent action to combat climate change and its impacts

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)[17]. 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)[18]. Lao PDR is highly determined to tackle climate change and ratified as one of the first of ASEAN countries the Paris Climate Agreement.

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)[19], which is also declared in the NDC and Paris agreement ratification.

SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Burapha's goal is to protect 20% of its area as "Special Management areas" (SMA). This is evident by the survey database of SMA areas, as well as the FSC certification status of Burapha, which requires Burapha to set aside between 5-10% of its land, however Burapha commits to 20%.[20]

Further Information

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

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

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

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

[20] SMA survey and summary, project documentation

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)[21]. 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.

[21] Forestry Law 2019 Lao PDR

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.

Non-native Species Impact

The implementation of Eucalyptus and / or Acacia plantations provides some risk for establishment and spread of non-native invasive plants, namely: (i) the potential for the spread of the Eucalyptus/ Acacia beyond plantation boundaries; (ii) domination of plantation trees following the end of the concession period; and (iii) introduction or spread of invasive weed species. Burapha plantation trees have been found to produce viable seed during the seven-year plantation rotation. If unmanaged, plantation trees may spread beyond boundaries and alter the species assemblage of neighbouring stands. However, advancement beyond plantation boundaries is slow and easily managed. With implementation of the management and monitoring regime provided in the ESMMP, impacts are expected to be negligible.

As the Burapha Eucalyptus plantation trees rapidly coppice sprout following harvest, there is a risk that the stands will dominate the canopy in perpetuity following the end of the concession/ lease agreement. It is anticipated that a suitably effective and nationally / internationally acceptable herbicide will be applied to cut stumps (e.g. Metsulfuron) to prohibit regeneration of Eucalyptus stands following the final harvest, and likely follow-up monitoring / herbicide application after one growing season.

Since 2019 Burapha, has conducted twice yearly (dry season and wet season) biodiversity surveys of three representative Special Management (conservation) Areas (SMAs)[22]. The biodiversity studies includes vegetation species and abundance. The SMAs are within and encircled by Burapha plantations and are therefore the most likely to be affected by invasive eucalyptus. The survey data from May 2022 shows no eucalyptus had begun to colonize the SMAs.

By monitoring SMAs/buffers for the spread of Eucalyptus / Acacia beyond plantation boundaries and removing seedlings, Burapha can effectively ensure potentially invasive plantation species do not spread to neighbouring stands, and impacts are expected to be Negligible to Nil.

Burapha will consult with the GOL / villages to identify proposed end land uses for plantation areas upon decommissioning, and determine the most effective measure for ensuring the species do not re-establish and dominate the canopy. Eucalyptus can be prevented from regenerating with appropriate management. Provided a suitable method is agreeable for stakeholders, and diligent application of the selected methods, impacts are expected to be Low.

Invasive Species Assessment

Vegetation clearing and soils disturbance for site preparation provides area and conditions that favour the spread of invasive vegetation. Non-native pioneer plants such as *Chromolaena odorata* and *Imperata cylindrica*, which already occur throughout the Project region, often

[22] See Biodiversity Assessments – provided to validator.

quickly dominate cleared areas due to their ability to rapidly colonise a wide variety of soil types and disperse high volumes of seed. There is also a moderate risk that invasive plants will be introduced to plantation areas. Seed is easily move from one region to another via relocated mechanised equipment and boots. Given that plantations are managed for agriculture (with consistent weeding) and the current widespread distribution of invasive shrubs, it is anticipated that impacts will be low.

Fertilizer and Biological Control Agent Impact

Burapha currently utilises the following hazardous materials for plantation establishment and operations:

1. Herbicides, including Glyphosate and Metsulfuron.
2. Soil conditioners and fertilisers such as Dolomite, Rock Phosphate, Boron and general fertiliser (NPK 15-15-15); and

Risk management and mitigation measures are contained in the Forest Operations ESMMP and are audited annually by FSC. The measures include the following:

Training - Employees and relevant contractors will need be trained to manage hazardous materials, meet compliance with regulatory requirements, apply proper use of PPE, and understand emergency response and preparedness planning.

Personal Protective Equipment - Burapha supplies PPE for all chemical handling and routinely monitors staff to ensure PPE are utilised at all times.

Herbicide Application - Burapha manages herbicide applications accordingly:

- The use of nationally and internationally banned chemical pesticides or herbicides, as well as World Health Organization Type 1A and 1B and chlorinated hydrocarbon pesticides is prohibited;
- Herbicide is mixed and applied according to MSDS and label instructions;
- Herbicide is mixed at least 50 m from watercourses; and
- Herbicide is not applied if rain is forecasted or likely for the day.

Fertilisers - Burapha uses quality certified sources of fertilizers; and where applicable, soils are tested for nutrient status / pH prior to fertilisation to ensure that areas are not over-fertilised.

Storage - All hazardous materials storage installations are well-ventilated areas that are protected from rain. Facilities (including temporary), are designed and constructed for secondary containment which have the capacity to hold a minimum of 110 percent of the volume of the largest tank in the containment area. Where applicable, storage facilities will include suitable fencing, signage, roofing, and lighting; Incompatible materials are segregated / stored in separate facilities - corrosive, oxidizing, and

reactive chemicals are separate from flammable materials and from other chemicals of incompatible class (e.g. acids and bases, oxidizers vs. reducers, etc.).

Adherence to management and mitigation measures listed above are expected to minimise the likelihood and severity of impacts. Herbicides used in plantations have relatively low persistence, low toxicity, and are biodegraded by microbes rapidly. With the diligent application of management measures identified above, risks are minimal and impacts are expected to be Low.

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 the Burapha Agroforestry plantation project does not pose a net harm towards the environment or socio-economic related impacts.

2.2 Local Stakeholder Consultation

Burapha have developed and operate under several Standard Operational Procedures (SOPs) related to community 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.

Of particular focus during the consultations were the following activities:

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

With community and stakeholder engagement, Burapha operates on the principle of Free Prior and Informed Consent (FPIC) . The FPIC procedures are audited by FSC and also the company's

foreign investors. The different types of consultation activities are presented in more detail below.

Environmental Social Impact Assessment (ESIA), and the Environmental Social Management and Monitoring Plan (ESMMP) Consultations

Burapha has undertaken extensive consultations at the household, village, district, provincial and central levels of government between 2016 and 2021 in the development of the Environmental Social Impact Assessment (ESIA), and the related Environmental Social Management and Monitoring Plan (ESMMP).

These documents contain the project design, environmental and social impacts and also the benefits that would be derived from project implementation. The national laws and regulations as well as the company's obligations to IFC performance Standards and FSC are outlined in the ESIA and ESMMP and were also presented throughout the consultation process.

The first consultations at the village level involved meetings and interviews with the village authority, a general village meeting and focus group discussions . At the initial consultations the participants were provided and presented a project information sheet and a project poster was displayed at the village for future reference. Verbal presentations and information gathering was provided in the ethnic language of the village. The project information sheet , provided in Lao language and English, and the English version of the poster have been made available to the validator.

Note: Lao loum is the official nation language and is widely used and understood, at least verbally, by ethnic groups that are within the project area. The consultation materials, ESIA and ESMMP reports were developed and presented in Lao Loum language but translated verbally by consultation experts to languages applicable to the particular village which are one of Lao loum, Hmong and Khmu ethnicity.

Official minutes of meetings were recorded which outlined the requests from the village to be included in the first draft of the ESIA and ESMMP. Sample copies of official minutes have been provided to the validator.

There have been five formal revisions – and multiple edits and corrections - of Burapha forestry operation design which were the result of integrating comments received from consultations. In addition to having their own two consultations, affected villages were also invited and participated in consultations at the district, provincial and central government levels giving numerous opportunities to have input to the project design. The consultation steps undertaken between 2016 and 2021 are summarized in Appendix 4.

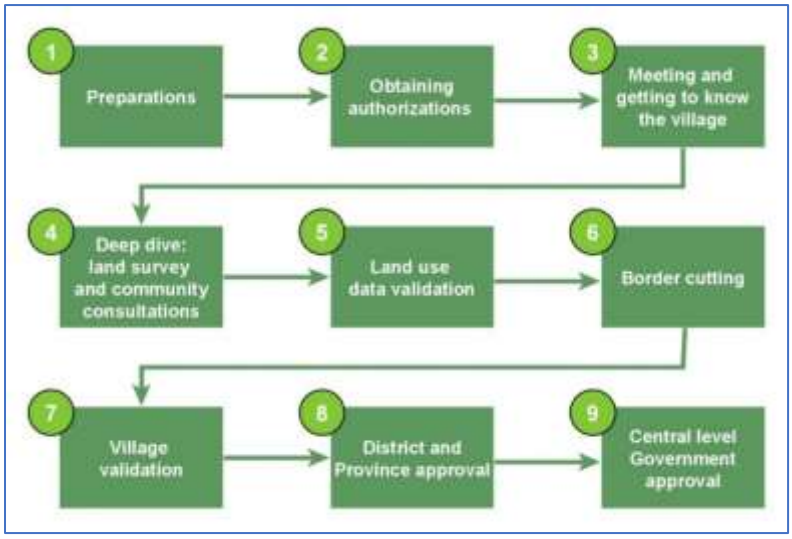
Land Acquisition Consultations

The Land Acquisition Manual (LAM) details the procedure of land acquisition. The procedure follows a 9 steps process, as illustrated below. Input from local stakeholders (here considered to be local authorities, village authorities and land users) is collected during stages 3 to 7. At

stage 3 the project design, local environmental and social impacts and also the benefits that would be derived from the project are presented to the village.

Figure 6: The 9 Land Acquisition Steps

Joint Project Description & Monitoring Report: VCS Version 4.0



At step 3, village authorities are informed of the project and the consultation process. In order to inform their decision, Burapha organizes a study tour to current plantations sites and partner villages prior to the start of the consultations. This step also reiterates the local impacts and benefits from the project. Comments/feedback from step 3 is recorded in village meeting minutes.

At step 4, the consultation dives into a household-level survey. Information is collected using a land user data collection form. At this step, all the input from each individual household is considered. This is documented in the survey forms, which are signed both by Burapha and the land user and certified by village authorities (using the village stamp).

While this household survey is conducted, the survey team also conducts a series of focus group discussions (FGD) with interest groups identified during the previous step i.e. men, women, youth, elders, ethnic group or any other relevant interest group. All the input from the FGD is considered into the next steps, and is documented in a section of the "Community Consultation Report" (internal document produced when the Land acquired is handed over to the forestry team – examples have been made available to the validator).

During step 5, the household land user survey continues for another 2 rounds until land users have received enough information and are able to meaningfully (i.e. having received enough information) agree or disagree with the project. During this meeting, community members provide any input that is relevant to their interest, and this is recorded in the meeting minutes.

At step 6, the survey team returns to the forest to clearly make the area so that land users are aware of the location of the land reserved for the project. At this stage, individual land users who had previously provided their consent may change their minds and disagree with the project. Others who were previously in disagreement may also change their minds and decide to provide their agreement. These changes are recorded in individual agreements/meeting minutes with each land user or in a group agreement signed by the village authorities.

Once the "border cutting" is complete, a final consultation meeting is held at the village, during which village authorities and the whole community may express any concern they have with the project. This is registered and documented in the meeting minutes.

During all the steps described above, all input received during the consultation is thoroughly considered, including details and justification on updates to the project design at every level, including very detailed social, environmental impacts.

ESMMP Update Consultation

Under Lao law the ESMMP of the project requires periodic updating, nominally every 3 years, and this requires consultation with affected villages, as well as updating the project design, in line with Lao regulations and laws, and company policies. The next ESMMP revision is due in 2025.

Village Notice Boards

Burapha has also installed communication notice boards in all partner villages. The notice boards describe the project activity / plantation life cycle and also the local contact name and number should any questions or grievances arise. The notice board is also used to notify villages of up and coming events, such as work opportunities at the plantations.

The notice boards also contain information on grievance management. An example village notice board is shown below.

Figure 7: Example Village Notice Board, from Nadi (Xanakham)

Joint

Burapha Village Meetings / Offices and Camps

Burapha retains an ongoing dialogue with partner villages and has staffed offices in all eight districts where plantations have been established. Notice boards are also positioned outside each district office. Within larger plantations it also has staffed permanent camps.

Burapha holds annual formal meetings with villages to discuss and advise of forthcoming (annual) forestry programs and also to receive feedback from partner villages of requests and concerns.

Verra VCS Carbon Credit Application Consultations

At the 2020 formal meetings - with 44 partner villages - Burapha presented a simplified explanation of the carbon credit application process. A copy of presentations (English and Lao version) has been provided to the validator along with two examples of village acknowledgment. The meetings were also the forums where Burapha explained that the carbon credits would be used for plantation expansion and the benefits provided to the village from their sale would be

from ongoing work and training opportunities. Site visits by carbon auditors and/or consultants are arranged in advance with villages and their purpose explained.

At those meetings the grievance mechanisms (see below) were again presented as well.

Note: Burapha operates in remote areas of Laos PDR which has low literacy rates and so the description of how carbon crediting actually operates was highly simplified. Lao loum is the official nation language and is widely used and understood, at least verbally, by ethnic groups that are within our project area. The carbon presentation was presented in Lao Loum language but translated verbally by our staff to languages applicable to the particular village which are one of Lao loum, Hmong and Khmu ethnicity.

Samples of consultations official minutes and the presentation materials used have been made available to the validator.

Communication of Relevant Laws and Regulations Covering Workers Rights

Burapha is bound to follow the Lao Labor Law, IFC Performance Standards, ILO conventions, and FSC standards. These are communicated through various consultation forums but more importantly are captured in our policies, staff rules, and operating procedures. Burapha is audited annually against these standards. Burapha has retained FSC Certification since its first application in 2013.

Grievance mechanism

Given the vagaries of land law in Laos and also a lack of law enforcement on land related matters, most grievances lodged with Burapha involve some form of land dispute – The Land Use Limitations Register. Burapha has a right-of refusal policy in that a community member or village has the right to refuse Burapha operations on land they claim, including land use that is undocumented (customary use). During plantation establishment, post-agreement, a land owner or user may wish to object or register a complaint in regards to Burapha's operations. A complainant has their issue registered on the Land Use Limitations Register and is processed in accordance with the Grievance Management and Dispute Resolution SOP (PR402 v1.). There is a dedicated team of two within the Burapha Land Department whose sole function is to resolve registered issues.

Burapha's grievance mechanism, Grievance Management and Dispute Resolution SOP, prescribes a proactive approach to conflict avoidance by promoting regular formal and informal communication to minimize areas of conflict arising from the Project.

- All conflicts or disputes shall be raised formally to the Land Use Limitations Team
- The Team shall try to resolve the conflict through consensual negotiation;
- All information relating to the conflict (meeting notes, maps, photos, agreed corrective actions etc.) is recorded for company records and distribution to relevant stakeholders as needed; and

- Corrective actions, where applicable, are agreed upon between the company and the complainant;
- Meetings can be facilitated by an independent third party mediator.
- Any conflict that cannot be resolved can be referred to the civil court system in Lao PDR.

Other types of communication Burapha undertakes with stakeholders include:

- Consultation on forest resource usage by communities through the Special Management Area bi-annual biodiversity assessments;
- Socioeconomic and livelihood monitoring / consultations of all partner villages
- A 'Living' wages assessments of daily labor and staff, first conducted in 2020 and is ongoing;
- 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.

Burapha is committed to open and transparent information disclosure with Project communities under the auspices of good faith negotiations and FPIC:

- Producing clear and culturally appropriate materials on the Project for distribution in Project villages.
- Providing 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

The public commenting period took place between the 22nd February 2021 – 24th March 2021. During this period no public comments were received by Verra.[23]

[23] 2021-03-26_Mail Verra Public commenting period.docx

2.5 AFOLU-Specific Safeguards

Burapha did identify all relevant stakeholders prior to its project as part of its Environmental and Social Impact Assessment (2016), chapter 12 – "stakeholder consultations". Burapha followed the stakeholder definition of the Lao PDR, which drafts also the identification process:

"any person, legal entity or organisation who/which are interested in, involved in or have interests in an investment project, in an activity or a matter (related to the project) because they are involved in or (are likely to be) affected by the investment project" (MONRE, 2010)."

Burpaha identified the villages impacted by the project by locating the villages, which had land lease agreement with Burapha for establishing its plantations, but also identified all villages in the direct vicinity of plantations – therefore being impacted by the project. A list of all stakeholders identified can be seen in Table 7.

Table 7: Identified stakeholders

Stakeholder group	Stakeholder
Villages in the Project area	- 35 affected villages in concession area (incl. areas not being part of Burapha carbon project). defined as those villages that may have individual or communal land, assets or livelihoods affected as the result of a Project. Villages in close proximity to the Project area also need to be considered as they may experience indirect impacts or benefits from the Project.
Government of Lao PDR	- Central Government line agencies (particularly MONRE and Ministry of Planning and Investment); - Vientiane Prefecture, Vientiane, Saysomboun, and Xayabouly Provincial governments and line agencies - District governments and line agencies for districts in the Project area.
Other Stakeholders	- Residents of villages in close proximity to the Project area; - Residents of Vientiane Prefecture, Vientiane, Saysomboun, and Xayabouly Provinces; - Private companies operating in close proximity to the Project area; and - NGOs and aid projects working in close proximity to the Project area.

Land in Lao PDR is state owned. However, Lao PDR also recognizes private land and therefore customary rights[24]. As stated in chapter 1.7, all villages and villagers are informed about the project in a FPIC approach and to give consent to survey and lease the land from them. Support is provided by Burapha to provide the required information and to clarify land tenure among villagers. Land tenure is identified via consultations with the local government authorities, as well as the villages and villagers together. A complete list of different land ownership titles and documents can be found in ESIA, chapter 6-26.

Social, economic and cultural diversity of stakeholders

There are a total of 1.7 million people living in the target Provinces with population size, density and distribution varying across the region. The overall population is growing in the project regions, with Vientiane city and capital province having also net positive migration. Most migration is happing from rural to urban areas. Higher negative net migration rates are generally found in highland areas, as people move to live close to the major roads and rivers in the lowland areas to improve their living conditions or find agricultural land to cultivate paddy rice. The economic gap between highland and lowland areas is a key driver for migration into the lowlands, major urban areas or small towns and rural areas near larger centers (ESIA chapter 6-8).

Lao PDR is a multi-ethnic country with 49 ethnic groups divided into four main language family groups including Lao-Tai, Mon-Khmer, Sino-Tibetan and Hmong-Mien. Lao Tai speaking people account for approximately 60% of the population followed by Khmu (39%), Hmong (2%) and Phou Noy (0%), which are considered ethnic minorities.

Typically, the Lao-Tai reside in the agriculturally productive lowland areas around the Vientiane Plains and are also primary residents of urban areas Mon-Khmer traditionally live in midland rural areas, whilst the Hmong-Mien are generally found in the upland and highland mountains in the north.

The national poverty rate in Lao PDR has declined over the past decade from 33.5% to 23.2% (Table 6-6, ESIA chapter 6-12), allowing Lao PDR to reach its MDG target of reducing poverty to below 24% by 2015 (World Bank, 2015).

Poverty incidence is closely associated with geography and terrain (refer to Table 6-6). Poverty incidence tends to be lowest in the lowlands and highest in highland areas. Higher incidences of poverty are reported in remote rural areas, without road access, in upland areas and in areas with steep slopes. Reflective of this, poverty rates are higher in Hmong Mien and Mon Khmer groups who generally reside in highland and midland areas respectively (WFP, 2013).

Even though, migration is happing from highland to lowland areas and rural to urban stakeholder groups do not change significantly.

[24] Land Law, 2003, Lao PDR, ESIA – chapter 2-8

A detailed description can be found in chapter 6 of the Social and Environmental Impact assessment (ESIA – 2016).

Potential impacts on ecosystem services include the collection of NTFP's, which might be impacted since degraded fallow forests are replaced with plantations. The agroforestry model of Burapha is designed to alleviate these issues. The collection NTFP's is allowed in the plantations. Furthermore, Burapha commits to protect 20% of the project areas (ESIA – chapter 9-14. The final risk is assessed with low-moderate. The full assessment can be found in chapter 9 of the ESIA.

The location of territories which stakeholders own is equal to the plantation areas used. All stakeholders have access to these areas, e.g. for collecting NTFP's.

Risks to Local Stakeholders

A full list of risks, impacts of the project on stakeholders as well as mitigation measures and the assessed rating of the risks are stated in the following chapters of the ESIA: chapter 7 – physical impacts, chapter 8 – biological impacts, chapter 9 – social impacts.

Local stakeholders will not face any risks in terms of food security, since they are allowed to practice agroforestry on the plantations and collect NTFP's, the normal timing of a swidden system also requires a fallow period, which has a similar timing to the plantation rotation. Furthermore, many villagers generate income with labor on the plantations, which enables them to buy rice, instead of growing it themselves on the uplands. This is further explained in chapter 4.3. The land is not lost to the villagers but only leased to Burapha.

Burapha has long-time experience with land management and is partnering with the villagers since the beginning of the project. To develop the carbon project it got support from Silvicarbon and Unique land use, which both have long-term experience in carbon projects.

Respect for Local Stakeholder Resources

Burapha has identified its approach to stakeholder engagement in ESIA chapter 12, all its activities are using the FPIC approach and developed a grievance mechanism for any issues arising[25][26].

Burapha carbon project uses different Eucalyptus clones, which are not native, but are not invasive and also do not impose any other risk to ecosystem services or native species[27].

[25] ESAP_1.3_BAFCO_SOP_COMMUNITY ENGAGEMENT AND COMMUNICATION 190129_FINAL

[26] ESAP_5.1_BAFCO_SOP_GRIEVANCE MANAGMENT AND DISPUTE RESOLUTION_190129_FINAL

[27] ESIA, 2016 – chapter 8 p-15/16

Fertilizer and biological control is used in the establishment phase to ensure tree survival and reduce mortality rates.

Communication and Consultation

Burapha engaged into a strong stakeholder engagement process as mentioned above. Stakeholder consultations are conducted before the land survey and land lease, and for any other changes in the project, e.g. for thinnings, harvesting and other potential events impacting the villagers.[28]

Furthermore, a grievance mechanism has been established, which has been explained in chapter 2.2. Stakeholder consultations are commonly conducted in their local language.

Forest Resource Use and Ecosystem Services

Modified and natural forest habitats provide importance economic, ecological, social and cultural functions for communities across the Project Provinces. Forests in Lao PDR are zoned under several management categories including conservation, protection and production / utilisation –at the National, Provincial, District and village levels.

The project has the potential to directly impact 55,000 ha of forest and associated forest resources across the Project region. The primary impacts are expected to occur in degraded forest land, and Burapha is committed to the protection of remnant natural vegetation in plantation areas (minimum of 10%) through retention of Special Management Areas in key locations. The establishment of the full 68,750ha Project requires a minimum of 6,875 ha of Special Management Area that will be managed for regeneration to natural forested communities, which will continue to supply NTFP (though not TFP as tree harvest will be prohibited in these areas). Current practices indicate that at least13,750 ha of SMA are more likely, given the number of streams, steep areas, etc. The extent of impact on local food security and livelihoods is likely to vary between villages and between individual households within villages depending on a range of factors including geographic preferences for collection of NTFP and TFP, the availability of access to other areas as sources of NTFP and TFP,and the overall dependence of the village or household on NTFP as a source of food and cash income.The percentage of total degraded forest land converted and the amount of remaining forest land in Project villages and across the Project region may also have an impact on forest resource based livelihoods. The Agroforestry model is expected to generate more income per hectare than that from NTFP or TFP collection and sales.

Food Security

Food insecurity and malnutrition are still major issues for many rural households in the Project Provinces. Degraded forests targeted by the Project often support swidden agriculture and natural resource based livelihoods in rural villages. Conversion of these areas to

[28] ESIA, 2016 – chapter 12, subchapter 12.5, p. 12-14

plantations has the potential to impact food security however the Project is seeking to address this issue through provision of intercropping areas within plantations. Increased household income is expected to significantly contribute to improved household nutrition as participants will have a greater capacity to purchase a variety of food from local markets.

Gender, Vulnerable Groups and Ethnic Minorities

The Project is expected to have Low impact on women, vulnerable groups and ethnic minorities with the effective implementation of FPIC consultation during land acquisition, equal opportunity employment policies; and targeted livelihood interventions through the intercropping model and village development fund initiatives. Regular monitoring through community consultations and biennial socio-economic surveying will assist Burapha in understanding the impacts (positive and negative) of the Project and the effectiveness of management and mitigation measures.

No Involvement in Discrimination or Harassment

No Burapha staff, nor any other entity involved with the project is involved in any form of discrimination or sexual harassment. There are no complaints or proceedings against any members of staff in this regard. Burapha's practices are also audited in this regard for IFC Performance Standard certification. A recent draft audit report[29] states the following:

> *"Burapha's suite of HR documentation detail its commitment to nondiscrimination and equal opportunity in decision-making processes related to the hiring, training, promotion of workers, with discrimination against employee due to factors such as race, ethnic background, gender, disability, sexual orientation, religion and others being prohibited. Recruitment practices appear to be in line with these principles, with women employed across all Burapha facilities and comprising a majority in some instances, such as 55% at the plywood mill and 60% at the plantations.*
>
> *Burapha's HR non-discrimination policies and practices are considered to be in line with IFC PS2 requirements and no gaps have been identified."*

This report has been made available to the validator.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

[29]IFC Upstream Level (environmental and social) Report Draft, Rina Consulting April 2022

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
- “Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in 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. All wetlands are excluded from Burapha operations, including roading, plantation establishment and harvesting. Not only are wetland environments unsuitable for eucalyptus plantations, more importantly, wetlands are categorized as a Special Management Area (SMA) which is an area under control of the Company reserved from plantation production for the purpose of watercourse, soil, biodiversity, natural forest, cultural heritage protection or enhancement. Refer to SMA SOP v2 .

SMAs, including wetlands, are identified either during or after land acquisition but must be identified within the plantation site development planning phase, and before vegetation clearing. Identification of SMAs employs a combination of techniques including interviews with landowners, community members, and government authorities; field reconnaissance surveys; Unmanned Aerial Vehicle (UAV - drone) imagery; and spatial analysis of remotely sensed data. Depending on the wetland size, exclusion / buffer zones are also excluded from operations. Refer to SMA SOP v2.

As evidence, a data set ‘2016-2020_SMA_wetland_V20220707’ containing all identified wetlands and other SMA categories is provided as a reference, along with sample plantation areas maps of that identifies segregated wetland (SMAs).

Following the decision tree of soil classification provided by the IPCC (Figure 8), 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. As can be seen in Figure 9

and Figure 10 there are no current plantation areas on wetlands areas. In addition, there are no planned plantation areas on wetlands.

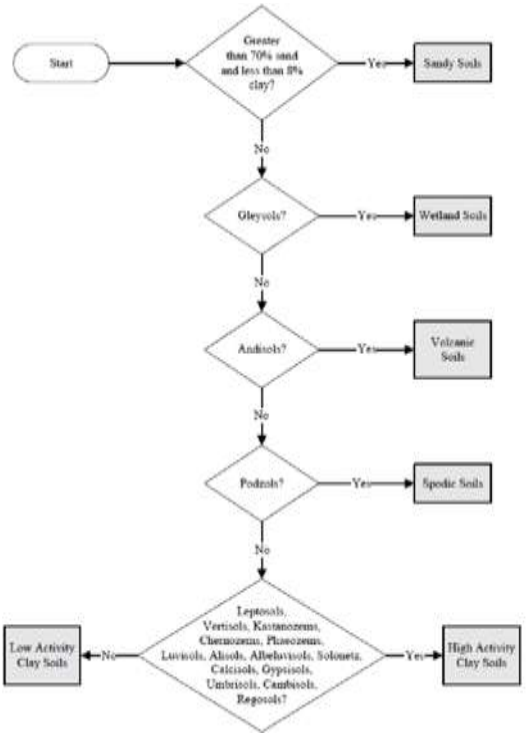


Figure 8: IPCC classification of soils

The outer boundary of the project area is plotted against the Harmonised World Soil Database (see FAO/IIASA/ISRIC/ISSCAS/JRC, 2009)[30] which summarizes the latest regional soil information as compiled by various partners

[30] https://www.fao.org/3/aq361e/aq361e.pdf

https://www.fao.org/soils-portal/data-hub/soil-maps-and-databases/harmonized-world-soil-database-v12/en/

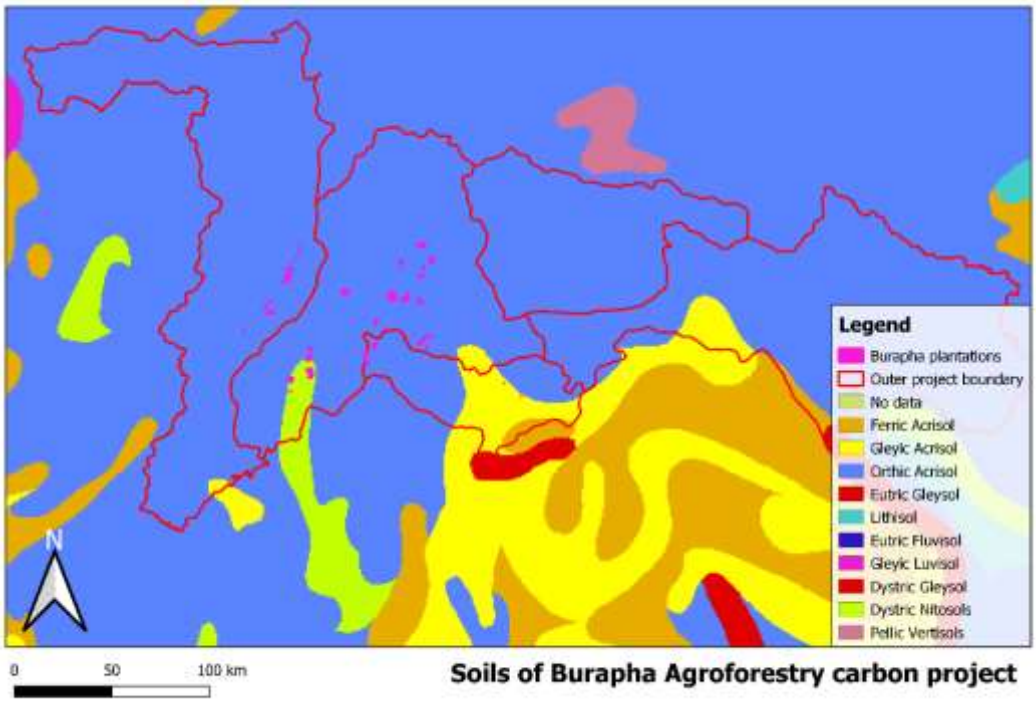


Figure 9: Overview of soils across the outer project boundary

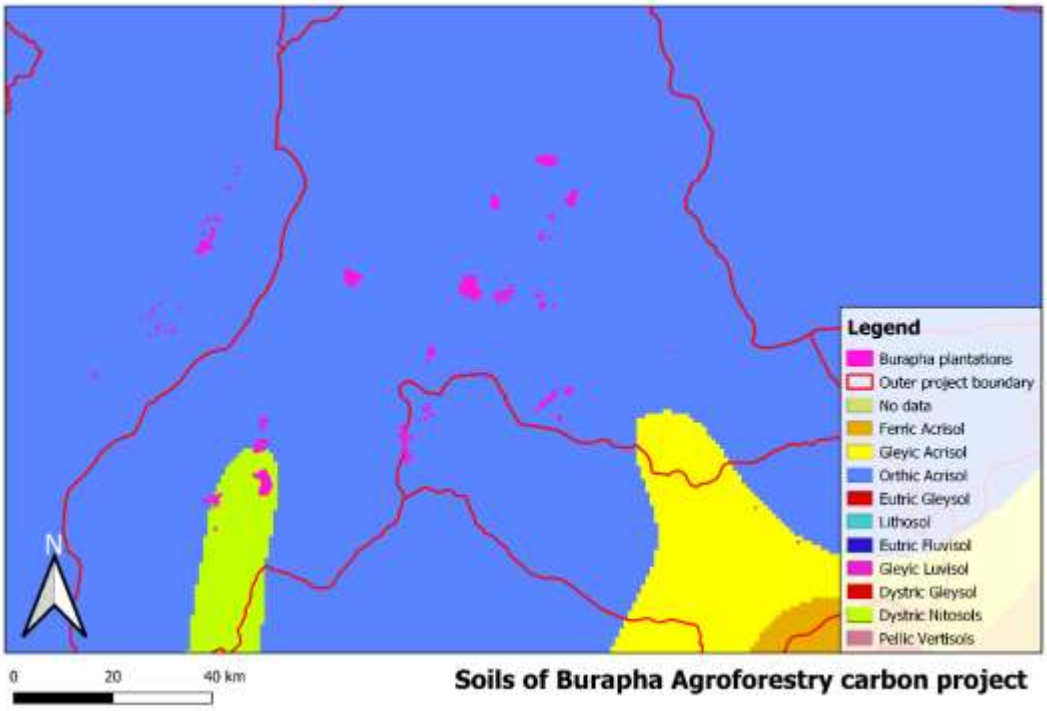


Figure 10: Soils of the first instance Burapha plantations

1. 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 8 below shows some soil parameters for this soil type in the project region.

Table 8: 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

2. By using the decision tree and the official translation of FAO soil classes to IPCC soil classes, which is referenced by Batjes (2009)[31], 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)

[31] 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 GHG 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

Five carbon pools are selected in the baseline scenario and project: above-ground and below-ground biomass, dead wood, litter, and soil organic carbon. Above-ground and below-ground biomass must be selected according to the methodology. All other carbon pools are optional, and they are also selected because they are expected to increase by the implementation of the proposed project activity.

Table 9 Carbon pools selected for accounting of carbon stock changes

Source		Gas	Included?	Justification/Explanation
Baseline	Aboveground and Belowground Biomass	CO_2	Yes	This is the major carbon pool subjected to project activity.
		CH_4	No	Excluded as per requirements of the methodology.

Source		Gas	Included?	Justification/Explanation
		N_2O	No	Excluded as per requirements of the methodology.
		Other	No	There are no other relevant GHG sources.
	Soil Organic Carbon (SOC)	CO_2	Yes	Carbon stock in these pools may increase due to implementation of the project activity.
		CH_4	No	Excluded as per requirements of the methodology.
		N_2O	No	Excluded as per requirements of the methodology.
		Other	No	There are no other relevant GHG sources.
Baseline	Dead wood and Litter	CO_2	No	Given the trend of deforestation and degradation within the project boundary, the project activities are expected to result in an increase in dead wood in comparison to the baseline scenario. Excluding this carbon pool from the baseline is therefore considered to be conservative.
		CH_4	No	Excluded as per requirements of the methodology.
		N_2O	No	Excluded as per requirements of the methodology.
		Other	No	There are no other relevant GHG sources.
Project	Aboveground and Belowground Biomass	CO_2	Yes	This is the major carbon pool subjected to project activity.
		CH_4	No	Excluded as per requirements of the methodology.

Source		Gas	Included?	Justification/Explanation
		N_2O	No	Excluded as per requirements of the methodology.
		Other	No	There are no other relevant GHG sources.
	Soil Organic Carbon (SOC)	CO_2	Yes	Carbon stock in these pools may increase due to implementation of the project activity.
		CH_4	No	Excluded as per requirements of the methodology.
		N_2O	No	Excluded as per requirements of the methodology.
		Other	No	There are no other relevant GHG sources.
	Deadwood and Litter	CO_2	No	Given the trend of deforestation and degradation within the project boundary, the project activities are expected to result in an increase in dead wood in comparison to the baseline scenario. Excluding this carbon pool from the baseline is therefore considered to be conservative.
		CH_4	No	Excluded as per requirements of the methodology.
		N_2O	No	Excluded as per requirements of the methodology.
		Other	No	There are no other relevant GHG sources.

Table 10 Emission sources and GHGs selected for accounting

Source		Gas	Included?	Justification/Explanation
Baseline	Burning of woody biomass	CO_2	Yes	CO2 emissions due to burning of biomass are accounted as a change in carbon stock.
		CH_4	No	According to the CDM tool Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity: Because slash-and-burn is common

Source		Gas	Included?	Justification/Explanation
				practice in Baseline: Non-CO2 GHG resulting from Biomass Burning estimated as 0.
		N_2O	No	According to the CDM tool Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity: Because slash-and-burn is common practice in Baseline: Non-CO2 GHG resulting from Biomass Burning estimated as 0..
Project	Burning of woody biomass	CO_2	Yes	CO2 emissions due to burning of biomass are accounted as a change in carbon stock.
		CH_4	No	According to the CDM tool Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity: Because slash-and-burn is common practice in Baseline: Non-CO2 GHG resulting from Biomass Burning estimated as 0.
		N_2O	No	According to the CDM tool Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity: Because slash-and-burn is common practice in Baseline: Non-CO2 GHG resulting from Biomass Burning estimated as 0.

Maps of the outer project boundary are shown below (see section 1.12 for more information on project location).

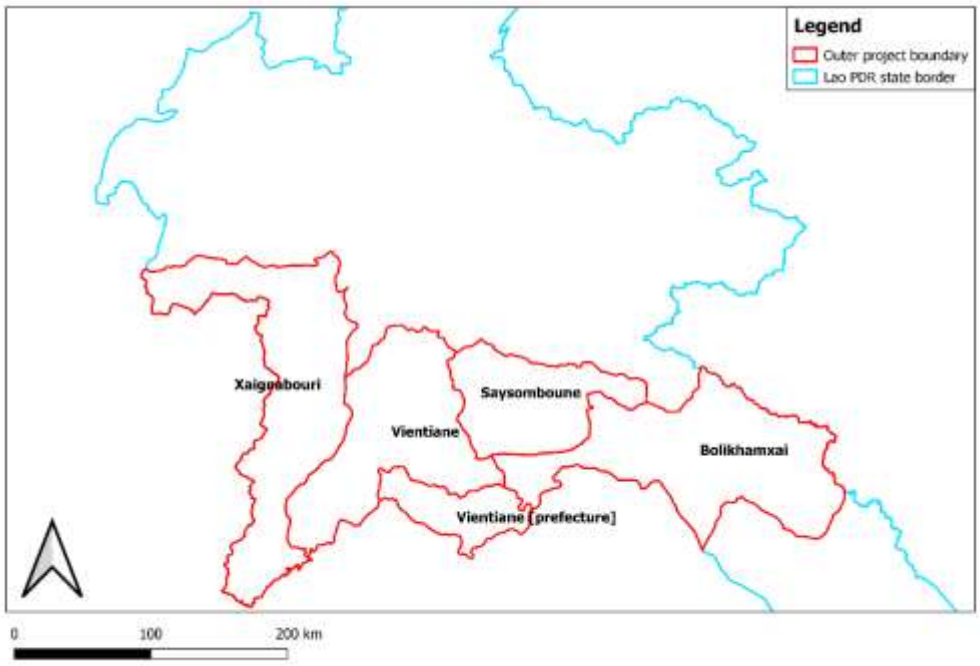


Figure 11: Outer project boundary within Lao PDR

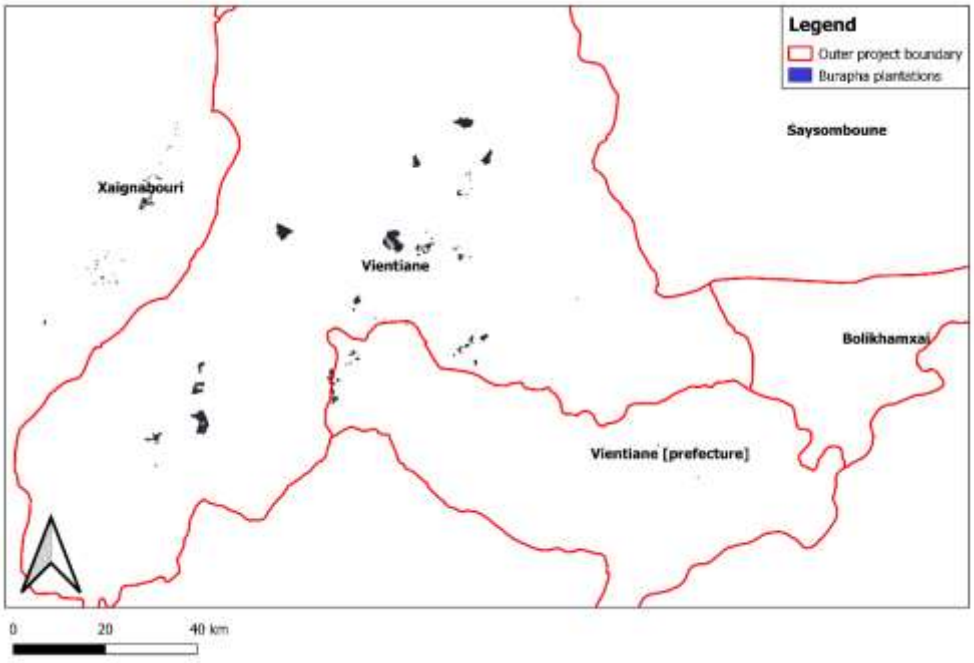


Figure 12: Burapha plantation location within outer project boundary

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

The concept of transforming degraded land in Laos through collaboration between a forestry company and villagers was initially explored through a collaboration between Burapha and Stora Enso. Stora Enso, in collaboration with the IFC, commissioned in 2010 a feasibility study that explicitly included the carbon benefits for both afforestation and avoided deforestation[32]. The study was also shared with Burapha management as Stora Enso and Burapha had very close working relations. They shared offices and had a cooperation agreement to share information on everything but clonal material.

Burapha embarked on its current business plan including the active management of forests after SilviCapital, an independent forestry management company from Sweden, acquired a majority stake in Burapha in 2011. SilviCapital was alerted to the Investment opportunity through Stora Enso, with whom the management of SilviCapital had close informal ties.

After SilviCapital acquired ownership of the Burapha platform (Burapha business and plantation licenses), additional fund raising activities were held to raise funds for the investment in the planting of trees and a plywood mill and was undertaken by SilviCapital and Burapha Management in the period 2011-2015. Various investment presentations from that period highlight the carbon benefits of the project for potential investors[33].

In the period 2011 and 2015 the company undertook initial investment in plantation activities to demonstrate the viability of its business plan that it was pitching to potential investors. The delay in fund raising it faced (as explained in step 3) resulted in considerable losses for the business and put a stress on financial resources. The company was therefore reluctant to invest in the registration of the project activity under Verra without a clear perspective that the business with carbon would be viable. When during the course of the project's lifetime VCU's became more valuable, the company hired carbon consultants Unique to do a feasibility study and subsequently after completion of the financing round and receiving firm offers for the carbon credits asked Unique to assist in registering the project retroactively with Verra.

[32] Salwood Asia Pacific, Ltd., 2011, Investment Concept for Lao PDR, for IFC Forest Investment Program

[33] See Burapha Investment Timetable (internal reference); Burapha Agrofroestry practice in Laos, 2013; Burapha Project description for MIGA (end 2011); SilviCapital Burapha Agroforestry 2012 Final Draft 19 Mars, SilviCapital Presentation – Sept 2014

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".[34]

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

Figure 13: Drivers of deforestation and degradation identified through stakeholder consultations[34]

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

The following alternatives to the project activity will be evaluated:

[34] ERPD Laos, 2018

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)[35].

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.

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

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 11: 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
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[36], Lao PDR is ranked 154 among 190 economies (most recent year: 2019). The Human Development Index (HDI) of Lao PDR is with 0.604 and rank 140 below the global average of 0.731 (UNDP, 2020)[37].

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

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

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

agriculture, and slash and burn agricultural practices (shifting cultivation). Permanent agriculture is often an intensification on former shifting cultivation areas.

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, 2018).[38]

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)[39]. As of 2015, approximately a quarter of Lao PDR's total land is subject to shifting cultivation (Figure 14).

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).

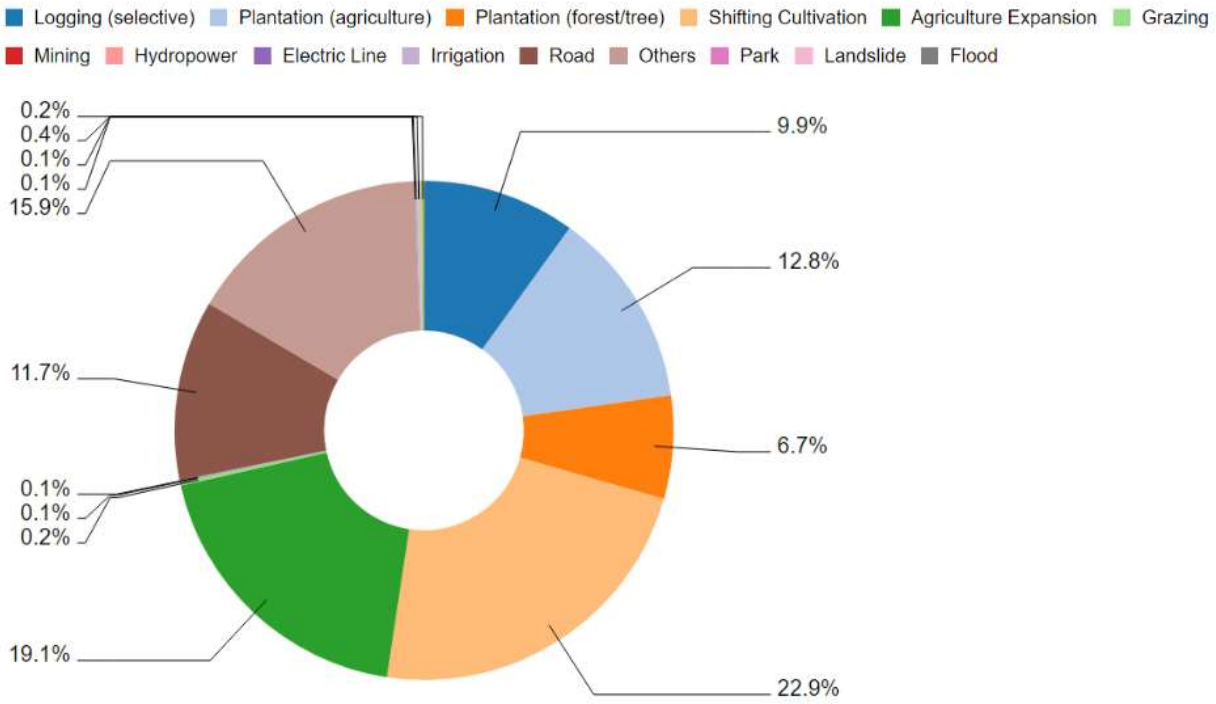


Figure 14: Disturbance by type for the ER Program area (disturbances > 5ha)[40]

[38] ibid

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

[40] REDD+ Readiness Project in Lao PDR, 2017. Satellite-based Identification of the Major Deforestation and Degradation Drivers in Lao PDR; in ERPD

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)[41].
- 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[42].

[41] 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

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

- According to Smith et al, (2016)[43], 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)[44].

- A majority of the roads are impassable during the rainy season (Statistical Year Book Lao PDR 2014, MPI)[45]: 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)
- 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.
- 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

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

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

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

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. For international markets FSC certification is a standard requirement and that is not common practice in Laos. FSC certification is a condition for any plywood mill (as they operate in international markets). As a consequence the existing available supply is even further restricted.

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). 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.”[46] The challenges related to land acquisition are reinforced by high corruption levels in the land administration[47]. “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.”

Investment barriers

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

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

At the project start date in 2016, the project had succeeded in planting 1910 hectares. This was done for the purpose of demonstrating the viability of tree planting for potential investors in the ply wood mill. There was no commercial offtake for timber in Laos meaning the project had no alternative for selling its timber. Even if the commercial price for timber from 2021 is used (at U$25/m3), it would be a loss making exercise and no positive IRR will be achieved[48]. This demonstrates that the scenario of only operating a commercial timber plantation was not a realistic scenario. This means that the only alternative to explore is the scenario of combining the investment in tree plantations together with the investment in end-use of wood (plywood or pulp).

Given the large size of the investment of a plywood mill any commercial lender would require the control a significant part of their wood supply as a pre-condition for the investment (typically 15 - 20.000 hectares, with 8.000 as a minimum). This means that a significant amount of finance needs to be generated to build a project like this, which is hampered by various investment barriers that make commercial investment by private sector participants unlikely.

A. The combination of an agroforestry plantation with a plywood mill makes it a complex investment. The agroforestry model includes extensive relationship development with local villagers including having the capacity to execute regular participatory surveys to involve local villagers into decision making, record potential grievances and address such grievances via changes in the project design. For example, respecting local culture and heritage in site selection, monitoring wellbeing to ensure the project has no negative impact on food security, ensuring access to projects fields for food facilitating income generation schemes for villagers, addressing grievances aired by villagers in conjunction with village committees. This complexity makes it hard to find the right investors for the business. Commercial investors who understand plywood mills find the social development component complex, while social investors who are familiar with the social development angle, generally don't invest in industrial plants such as a plywood mill.

B. Investment barriers in local financial sector. There is no capacity in the local financial sector in Laos to finance projects like these. The banks that were asked are not engaged in project finance for projects like these.

C. Investment barriers for international investors: Burapha / SilviCapital, run by management, with a long track-record in international forestry finance and development , have since 2011 approached over 200+ international investors that declined to invest in the project[49]. Arguments mentioned by investors (in addition to the other arguments mentioned above and below) include[50]:

[48] See internal reference: Burapha, Investment analysis plantation only

[49] Burapha Summary list of investors (Internal reference)

[50] Burapha, internal reference, Rejection conversation examples

- Long pay-back time from industrial timber operations (7years+) that does not match with the requirement for many institutional investors such as pension funds to get dividend payments within the first 5 years for investments;
- No interest in greenfield investments. Many investors willing to invest these large amounts can only invest in existing plantations not in greenfield operations. For example, this requirement is mentioned by many TIMO's (Timber Investment Management Organisation) which are dedicated investment funds focused on investing in timber plantations.

D. The existence of investment barriers and risks have very clearly materialized since the inception of the Burapha business plan since 2011[51]. The project has not turned a profit for every year since operation and has not been able to meet any of the project cashflow forecasts produced during the course of the development. Also Sotra Enso abandoned its agroforestry activities in Laos stating that "conditions for a long-term financially viable plantation industry operation will not be available within a realistic time horizon"[52].

E. Laos country risk: Laos is officially ranked as Least Developed Country (LDC) which is reflected that many conditions required for a positive enabling environment for large private sector investments such as these are still in an early stage . Many foreign investors are deterred by Laos being formally a communist country and the subsequent weak institutional environment for private sector investments (see also above). According to the World Bank Global Ease of Doing Business annual ratings, Laos is ranked 154th[53].

The consideration of the carbon, biodiversity and social development benefits of the project helped to address these barriers in a number of ways:

- SilviCapital had considered the carbon revenues prior before taking over Burapha. Even though carbon revenues in 2011 were highly uncertain as a potential financial upside they provided a counterweight to the many risks and challenges. Plus the investors at this stage were attracted by the positive carbon, biodiversity and social impact of the project and actively used these aspects in their efforts to attract new investors to the project.
- As mentioned above in the period 2011 and 2015 the company undertook initial investment in plantation activities to demonstrate the viability of its business plan that it was pitching to potential investors. By end 2014 early 2015 after four years of no

[51] Burapha Investment time table

[52] https://www.storaenso.com/en/sustainability/latest-updates-and-stories/stora-enso-to-downsize-plantation-operations-in-laos

[53] (Trading economics, Ease of Doing business in Laos, 2021 https://tradingeconomics.com/country-list/ease-of-doing-business.

successful fund raising outside SilviCapital it appeared that the business plan had been too optimistic and the company had run out of cash and the envisaged investment in the plywood mill was no longer feasible. This means that operations would have ended and the plantations built until this point would not have been sustainable[54].

- Nevertheless, some DFI's had shown interest in the project, amongst other due to the advantageous social and climate benefits. The company changed its management and adopted a new business plan with a completely changed plan for the plywood mill from 2016 onwards that relied on significantly more capital from outside investors. That business plan was then used to approach and convince a consortium of Development Finance Institutions[55] to invest in the project.
- In 2018 the project managed to get a financial arrangement with a consortium of Development Finance Institutions[56]. The carbon certification process was started by hiring carbon forestry consultancy Unique for a feasibility study of the carbon potential and process. Without the positive carbon and social development impact the development lenders would not have invested in the project and the plywood mill.
- Later on, in 2020, after delays due to covid-19 reduces the repayment capability, the lenders stops the disbursements of loans. Thanks to an updated business plan that included carbon credits and the money was disbursed.
- Finally, the company was able to attract new equity investors to invest in the expansion of the plantation. These investors were only convinced after explicit consideration of the carbon in the Financial Model[57]. Without this additional equity investment the company would not have been able to complete the deployment of the plywood mill and would not have survived by now.

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

[54] Burapha board meeting, 13-11-2014 (SilviLao AB, styrelse 2014-11-13, Attachment 4), Burapha Summary list of investors that declined

[55] Finn Fund, Development impact of Finnfund investments in 2016

FMO, Climate Action since 2013

[56] Finn Fund, Development impact of Finnfund investments in 2016

FMO, Climate Action since 2013

[57] Burapha Investment time table; Burapha Financial Model LDN 2018

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.

Along with drone and on-ground photography, Burapha undertakes a Normalized Difference Vegetation Index (NDVI) spatial cover analyses of the vegetation in the plantation areas before the plantation unit area is granted for agroforestry operations. This NDVI study uses remote sensing processing tools applied on a Landsat imagery collection. The temporal boundary of the study was 10 years before the first plantation unit established in 2016 to 2021.

Hence, the imagery review consisted of analyzing annual satellite imagery from to 2006 to 2021 to investigate the variation in the biophysical properties of the canopies of potentially forested areas within the proposed plantation management units. The NDVI index defines values from -1.0 to 1.0, basically representing vegetation vigour. Moderate values (from 0.2 to 0.3) represent degraded lands (e.g. swidden land or degraded forest) while higher values (from 0.4 to 0.8) may indicate vigorous plant growth.

Its important to note that NDVI analysis doesn't give forest structure information. It does however indicate changes in vegetation quality as an indicator of temporal changes to vegetation cover. The NDVI analysis is also complemented by two other forms of data analysis; 1) Hansen Global Forest Change v1.9 (2000-2021), and 2) Historic fire occurrence by the NASA EOSDIS Land Processes Distributed Active Archive Center.

The results of the above assessments show that plantation lands planted had undergone vegetation cover / forest clearing in the years preceding 2006. This supports the requirement that Burapha plantations were not established on areas that had been cleared within the temporal span of 10 years prior, and that the areas converted were historically and recently active swidden rotation at various stages of the cycle.

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 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.

Conclusion of the barrier analysis

As a conclusion of the barrier analysis,

Scenario 1, the pre-project agricultural and shifting cultivation land use, would not be prevented by barriers. Thus this is the only plausible baseline land use scenario not prevented by any barrier.

It is also demonstrated that the positive carbon, biodiversity and social development impact and the carbon revenues alleviated the barriers for scenario 3 and convinced equity investors and lenders to engage with the company and continue to invest despite the setbacks it has faced.

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)[58] and Baral et al. (2017)[59]. The studies provide an overview of the existing plantation reforestation activities in Lao PDR. All these investments planted or are planting Eucalyptus and Acacia:

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

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

Table 12: 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
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 13: 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. - 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). - 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. - Located in the proximity to wood markets in Thailand and Vietnam compared to Burapha, thus lower business operation costs. - 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.

		- 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-ACM003 "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)[60], 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	947	36,791.7
2017	2	602	23,414.7
2018	3	431	16,753.9
2019	4	230	8,931.6
2020	5	736	28,599.8
2021	6	-	-
Total	-	2,946	114,492

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):

[60] 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 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. Eucalyptus (95%) was estimated with a mean annual increment (MAI) of 30 m^3/ha yr and Acacia plantations with an MAI of 25 m^3/ha yr. However, this represents a linear growth, which is likely to be overestimated during the early years of plantation.

The root-to-shoot ratio (R/S) for Eucalyptus is a mean of published ratios of E. camaldulensis and E. globulus in Barton and Montagu (2006)[61] and Fabiao et al. (1995)[62] and is estimated to be 0.37. The R/S ratio for Acacia was estimated to 0.26 according to Islam et al. (2019).[63]

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 15m^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 of Eucalyptus is estimated to be 510 g/cm^3, based on average wood densities of internal Burapha wood densities. Acacia has the same wood density (Burpaha internal documents). The Biomass expansion factors is used from IPCC Good practice Guidance for LULUCF for tropical broadleaf trees (lower confidence interval): 2.[64]

Table 14: Biomass estimates for Eucalyptus, common spacing: 3x3m

Year	Stock (m^3/ha)	Total ABG (t CO2e/ha)	Total BGB (tCO2/ha)	Total Biomass (tCO2/ha)
1	30	52.7	19.7	72.4
2	60	105.5	39.3	144.8
3	90	158.2	59.0	217.2
4	120	210.9	78.6	289.6
5	150	263.7	98.3	362.0
6	180	316.4	117.9	434.3
7	210	369.1	137.6	506.7
8	225	395.5	137.6	137.6
9	30	52.7	137.6	190.3
10	60	105.5	137.6	243.1
11	90	158.2	137.6	295.8
12	120	210.9	137.6	348.5

[61] 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

[62] 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

[63] ISLAM, M. A., RAHMAN, R., & HOSSAIN, M. K. (2019). Effect of container and potting media on raising quality seedlings of Acacia auriculiformis in the nursery. Asian Journal of Agriculture, 3(01).

[64] IPCC (2003) Good Practice Guidance for LULUCF

13	150	263.7	137.6	401.3
14	180	316.4	137.6	454.0
15	210	369.1	137.6	506.7
16	225	395.5	0.0	0.0
17	30	52.7	19.7	72.4
18	60	105.5	39.3	144.8
19	90	158.2	59.0	217.2
20	120	210.9	78.6	289.6
21	150	263.7	98.3	362.0
22	180	316.4	117.9	434.3
23	210	369.1	137.6	506.7
24	225	395.5	137.6	137.6
Long-Term Average		**184.6**	**97.5**	**282.0**

Table 15: Biomass estimates for Eucalyptus, common spacing: 9x1m

Year	Stock (m^3/ha)	Total ABG (t CO2e/ha)	Total BGB (tCO2/ha)	Total Biomass (tCO2/ha)
1	30.0	52.7	19.7	72.4
2	60.0	105.5	39.3	144.8
3	90.0	158.2	59.0	217.2
4	120.0	210.9	78.6	289.6
5	150.0	263.7	98.3	362.0
6	180.0	316.4	117.9	434.3
7	210.0	369.1	137.6	506.7
8	225.0	0.0	137.6	137.6
9	30.0	52.7	137.6	190.3
10	60.0	105.5	137.6	243.1
11	90.0	158.2	137.6	295.8
12	120.0	210.9	137.6	348.5
13	150.0	263.7	137.6	401.3
14	180.0	316.4	137.6	454.0
15	210.0	369.1	137.6	506.7
16	225.0	0.0	0.0	0.0
17	30.0	52.7	19.7	72.4
18	60.0	105.5	39.3	144.8
19	90.0	158.2	59.0	217.2

20	120.0	210.9	78.6	289.6
21	150.0	263.7	98.3	362.0
22	180.0	316.4	117.9	434.3
23	210.0	369.1	137.6	506.7
24	225.0	0.0	137.6	137.6
Long-Term Average		**184.6**	**97.5**	**282.0**

Table 16: Biomass estimates for Acacia, all spacings

Year	Stock (m^3/ha)	Total ABG (t CO2e/ha)	Total BGB (tCO2/ha)	Total Biomass (tCO2/ha)
1	25	43.9	11.5	55.5
2	50	87.9	23.1	111.0
3	75	131.8	34.6	166.5
4	100	175.8	46.2	222.0
5	125	219.7	57.7	277.4
6	150	263.7	69.3	332.9
7	175	307.6	80.8	388.4
8	188	0.0	80.8	80.8
9	0	43.9	80.8	124.8
10	25	87.9	80.8	168.7
11	50	131.8	80.8	212.6
12	75	175.8	80.8	256.6
13	100	219.7	80.8	300.5
14	125	263.7	80.8	344.5
15	150	307.6	80.8	388.4
16	175	0.0	0.0	0.0
17	188	43.9	11.5	55.5
18	0	87.9	23.1	111.0
19	25	131.8	34.6	166.5
20	50	175.8	46.2	222.0
21	75	219.7	57.7	277.4
22	100	263.7	69.3	332.9
23	125	307.6	80.8	388.4
24	150	0.0	80.8	80.8
Long-Term Average		**153.8**	**57.2**	**211.0**

Table 17: Annual estimation of tree biomass GHG removals by sinks in the project scenario for the First Project Instance (2,946 ha).

Year	Accumulated tree biomass GHG removals by sinks, tCO2e	Annual estimation of tree biomass GHG removals by sinks; tCO2e
1	68,014	68,014
2	178,386	110,372
3	319,191	140,806
4	469,366	150,174
5	607,237	137,871
6	704,138	96,901
7	772,266	68,129
8	819,994	47,728
9	819,994	0
10	819,994	0
11	819,994	0
12	819,994	0
13	819,994	0
14	819,994	0
15	819,994	0
16	819,994	0
17	819,994	0
18	819,994	0
19	819,994	0
20	819,994	0
Total		819,994

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 18 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	379	0	0	0	0	379	379
2	379	241	0	0	0	620	998
3	379	241	172	0	0	792	1,790
4	379	241	172	92	0	884	2,674
5	379	241	172	92	294	1,178	3,853
6	379	241	172	92	294	1,178	5,031
7	379	241	172	92	294	1,178	6,209
8	379	241	172	92	294	1,178	7,387
9	379	241	172	92	294	1,178	8,566
10	379	241	172	92	294	1,178	9,744
11	379	241	172	92	294	1,178	10,922
12	379	241	172	92	294	1,178	12,101
13	379	241	172	92	294	1,178	13,279

14	379	241	172	92	294	1,178	14,457
15	379	241	172	92	294	1,178	15,636
16	379	241	172	92	294	1,178	16,814
17	379	241	172	92	294	1,178	17,992
18	379	241	172	92	294	1,178	19,171
19	379	241	172	92	294	1,178	20,349
20	379	241	172	92	294	1,178	21,527

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

Table 19 Annual and cumulative estimation of SOC GHG removals by sinks in the project scenario for the First Project Instance

Year	Annual SOC GHG removals by sinks; tCO_2-e	Accumulated SOC GHG removals by sinks; tCO_2-e
1	1,388	1,388
2	2,272	3,660
3	2,904	6,564
4	3,241	9,806
5	4,320	14,126
6	4,320	18,447
7	4,320	22,767
8	4,320	27,087
9	4,320	31,408
10	4,320	35,728
11	4,320	40,049
12	4,320	44,369
13	4,320	48,690
14	4,320	53,010
15	4,320	57,331
16	4,320	61,651

17	4,320	65,971
18	4,320	70,292
19	4,320	74,612
20	4,320	78,933

4.3 Leakage

According to section 6 of the AR Tool 15 "A/R Methodological tool: Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" (Version 2.0), the leakage emissions attributed to the displacement of grazing activities are considered insignificant when meeting the following conditions:

- 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.
- 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.
- Animals are displaced to cropland that has been abandoned within the last five years.
- 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.
- Animals are displaced to zero-grazing systems.

Burapha is explicitly designed as an agroforestry model that allows the local communities to conduct agroforestry practices (intercropping or grazing) in between the planting rows as well as generating additional cash income for the villagers. For that purpose, the Burapha rotation cycle mirrors the shifting cultivation cycle[65]:

- Year 1: Planting of trees and rice
- Year 2: Planting of rice when suitable due to shade from the trees
- Year 3-7: Cattle grazing
- Year 4: Thinning operations
- Year 7: Clear cut of trees and restart of cycle

For grazing activities only partial displacement takes place in the first 2 years of the project. This does not create a leakage situation since abundant fallow land is available where cattle can graze outside the project area (condition c and or d of the above list of exempted conditions applies). Another consideration is that its standard practice that cattle / livestock are mustered at the end of each day and penned in areas close to homes or nearby to the village. This practice is essential to prevent livestock theft which is common. For this practical reason, lands approved by villagers for conversion to

[65] Earth System, 2017, Environmental and Social Impact Assessment, Chapter 6, p. 6-34

plantations are often far from village centres and are not used for grazing given the distance required to daily muster.

Burapha tries to avoid the shift of pre-project agricultural activities by allowing intercropping in the first and second year of the rotation cycle. The company is well aware that it works with highly vulnerable low-income households and wants to avoid that using their land will negatively impact their food security as it follows closely socioeconomic and livelihood status on partner villages. The ESIA concludes that "the intercropping scheme appears to have had a positive effect on food security for participating households." [66] Evidence from the pilot projects shows that rice growing in the project areas produces significant higher yield than upland rice growing through shifting cultivation. In addition, because of the project clearance of land by the project it takes significant much less time to grow rice resulting in much higher labor productivity [67].

Another effect is that through the additional cash income from the project villagers appear to spend less time on upland rice cultivation. Villages earn significant cash income from labor and lease fees[68]. This allows them to purchase rice from the market and thus increase their food security[69]. The increase in income from the project and reduced time spent on upland rice production also allows villagers to invest more in productive income generation activities such as cash crops, sale of NTFP's, raising livestock[70]. Furthermore, studies in similar projects evidence that no increase of shifting cultivation could be detected while planting plantation areas[71].

In conclusion, the above points demonstrate that there is no source of leakage due to displacement of agricultural activities nor due to the displacement of grazing activities. The project has implemented sufficient mitigation measures to prevent such potential leakage. Given the importance of increasing food security for the villages, Burapha will regularly execute social project surveys confirming the practice of intercropping, food security and the increase in cash income (at least every 5 years).

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-ACM0003:

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

[66] Earth System, 2017, Environmental and Social Impact Assessment, Executive Summary, p. 5-43

[67] Stora Enso Lao, 2017, Kacham case study, p.5 – 7.

[68] Stora Enso Lao, 2017, Ban Lapeung case study, p. 9, Kacham case study, p.9 - 10

[69] Stora Enso Lao, 2017, Ban Lapeung case study, p. 7, 10 / Kacham case study, p.4

[70] Stora Enso Lao, 2017, Ban Lapeung case study, p. 6-8

[71] Assessment of Avoided Deforestation of Burapha/Stora Enso Agroforestry Model, 2016, p. 25-27

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 Instance are shown below.

Table 20: Carbon estimations for the First Project Instance[72][73]

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	36,792	69,403	7,501	-	25,110
2	23,415	112,644	20,523	-	68,706
3	16,754	143,710	29,200	-	97,756
4	8,932	153,415	33,231	-	111,252
5	28,600	142,192	26,126	-	87,466
6	-	101,221	23,281	-	77,940
7		72,449	16,663	-	55,786
8		52,048	11,971	-	40,077
9		4,320	994	-	3,327
10		4,320	994	-	3,327

[72] Note 170 hectares planted in Xayabouly are included in these calculations, but excluded from the first verification.

[73] Note this is an ex-ante estimation. Ex-post results are shown in Table 30 & 31, Chapter 6.5.

11		4,320	994	-	3,327
12		4,320	994	-	3,327
13		4,320	994	-	3,327
14		4,320	994	-	3,327
15		4,320	994	-	3,327
16		4,320	994	-	3,327
17		4,320	994	-	3,327
18		4,320	994	-	3,327
19		4,320	994	-	3,327
20		4,320	994	-	3,327
Total	114,492	898,927	180,420	-	604,015
Long-term average (tCO2e/annum)					30,201

The Long-Term Average (LTA) was calculated as the total removals during the crediting period divided by the number of years (20). They were used the sections 3.2.20 and 3.2.21 of VCS standard 4.1 and the AFOLU Guidance: Example for Calculating the Long-Term Average Carbon Stock for ARR Projects with Harvesting to calculate the LTA.

The following equation was used to calculate the long-term average GHG benefit:

$$LA = \frac{\sum_{t=0}^{n} \mathrm{PEt} - \mathrm{BE}t}{n}$$

Where:

LA = The long-term average GHG benefit.

PEt = The total to-date GHG emission reductions and removals generated in the project scenario (tCO2e). Project scenario emission reductions and removals shall also consider project emissions of CO2, N2O, CH4 and leakage.

BEt = The total to-date GHG emission reductions and removals projected for the baseline scenario (tCO2e).

As shown at the bottom of Table 20, the ex-ante estimated long-term average is 30,201 tCO2e/annum for the first project instance. Ex-post long-term average estimates are shown in Table 31.

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:	0.47
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. 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.[74]
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.[75]
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 (tropical rainforest, tropical moist deciduous and tropical dry) carbon stocks published by Hett et al. (2011).
Purpose of Data	Determination of baseline emission/removals
Comments	-

Data / Parameter	$C_{BSL\_upland\ rice}$
Data unit	t C/ha^{-1}

[74] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_04_Ch4_Forest_Land.pdf

[75] 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.

Description	Carbon stock in pre-project biomass per stratum
Source of data	Default value, IPCC (2006), Guidelines for National Greenhouse Gas Inventories - Volume 4, Agriculture, Forestry and Other Land Use, Agriculture, Table 5.9, annual cropland
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[76] 5 t CO_2/ha were also used in the FREL of Lao PDR (2018)[77].
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:	2

76 IPCC (2006), Guidelines for National Greenhouse Gas Inventories - Volume 4, Agriculture, Forestry and Other Land Use, Chapter 5 Cropland

77 https://redd.unfccc.int/files/lao_2018_frel_submission_modified.pdf p.28

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 Tropical forest, lower confidence interval[78]
Purpose of Data	Calculation of project emission removals
Comments	-

Data / Parameter	$R_{TREE\_project}$
Data unit	dimensionless
Description	Mean of Root:Shoot ratio of Eucalyptus used from the AR CDM Methodological Tool AR-TOOL 14
Source of data	Average of published R:S ratios in scientific literature. 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.[79] 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.[80]
Value applied:	0.37
Justification of choice of data or description of	Enhancing the Tier value by using published values from scientific literature and the species used, instead of default values of IPCC.

[78] IPCC (2006), Guidelines for National Greenhouse Gas Inventories - Volume 4, Agriculture, Forestry and Other Land Use, Chapter 4 Forestry

[79] 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.

[80] 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.

measurement methods and procedures applied	
Purpose of Data	Calculation of ex-ante and ex-post project emission removals
Comments	-

Data / Parameter	$R_{TREE\_project}$
Data unit	dimensionless
Description	Mean of Root : Shoot ratio of *Acacia auriculiformis* used from the AR CDM Methodological Tool AR-TOOL 14
Source of data	Average of published R:S ratios in scientific literature. ISLAM, M. A., RAHMAN, R., & HOSSAIN, M. K. (2019). Effect of container and potting media on raising quality seedlings of Acacia auriculiformis in the nursery. Asian Journal of Agriculture, 3(01).
Value applied:	0.26
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 Eucalyptus camaldulensis
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	Internal wood density database from Burapha. Aged 4

Data / Parameter	Wood density Acacia auriculiformis
Data unit	t dm./m³
Description	Weight to volume relation of Acacia auriculiformis
Source of data	Internal wood density database from Burapha. Aged 4
Value applied:	0.51
Justification of choice of data or description of measurement methods and procedures applied	Burapha measured own wood densities over the years and could therefore develop the most specific numbers to be used for this study.
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:	47
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	$f_{I,i}$
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	-

Data / Parameter	$SOC_{0,i}$
Data unit	dimensionless
Description	SOC stock at project beginning, based on FLU, FMG and FI input parameters.
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:	40.78
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 40.78 is used.
Purpose of Data	Calculation of project emission removals
Comments	-

Data / Parameter	$SOC_{0,i} - SOC_{Ref}$
Data unit	dimensionless
Description	SOC stock accountable by the project.
Source of data	IPCC value calculated based on above mentioned input parameters. 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:	6.22

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 total SOC change of 6.22/ha divided by 20 years (0.31) can be applied by the afforestation activities of the project.
Purpose of Data	Calculation of project emission removals
Comments	-
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:

Stratum (Year)	Wi
Cropland	0.25
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	Si
EUC-2016	0.42
EUC-2017	0.24
EUC-2018	0.17
EUC-2019	0.10
AC-2016	0.01
AC-2017	0.03
AC-2018	0.02

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	-

Data / Parameter	DBH
Data unit	*cm*

Description	The diameter at breast height is the diameter of a tree stem.
Source of data	Inventory
Value applied:	-
Justification of choice of data or description of measurement methods and procedures applied	Most important parameter to measure wood volume.
Purpose of Data	Calculation of project emission removals
Comments	-

Data / Parameter	Tree height
Data unit	*m*
Description	The height of a tree.
Source of data	Inventory
Value applied:	-
Justification of choice of data or description of measurement methods and procedures applied	One of the most important parameter to measure wood volume.
Purpose of Data	Calculation of project emission removals
Comments	-

Data / Parameter	Permanent Sample plot Area
Data unit	m^2

Description	The permanent sample plot is the spatial unit of a forest inventory. It is used to expand the measured wood volume to a hectare.
Source of data	Inventory
Value applied:	-
Justification of choice of data or description of measurement methods and procedures applied	Important parameter to measure wood volume.
Purpose of Data	Calculation of project emission removals
Comments	-

Data / Parameter	Tree species
Data unit	-
Description	The tree species is used to define the stratum of trees to be counted in.
Source of data	Inventory
Value applied:	-
Justification of choice of data or description of measurement methods and procedures applied	Important parameter to measure wood volume per hectare.
Purpose of Data	Calculation of project emission removals
Comments	-

Data / Parameter	Tree Spacing
Data unit	-

Description	The tree spacing is used to define the stratum of trees to be counted in.
Source of data	Inventory
Value applied:	-
Justification of choice of data or description of measurement methods and procedures applied	Important parameter to measure wood volume per hectare.
Purpose of Data	Calculation of project emission removals
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 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 monitoring's 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

Joi

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 21: Accuracy options for sampling densities in a cruising inventory[81]

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 over bark

[81] Burapha plantation review

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 31.05.2016 until 22.12.2020 for all plantations planted until 2019, excluding 170 ha in Xayabouly.

The First Project Instance consists also of plantings from 2020, which are not included in this monitoring report, since inventories for plantations are conducted after age 1. Thus, the monitoring has not been completed for the 701 ha of plantings from 2020. The total area, which is considered in this monitoring report (m1) is 2,073 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** 2016 / 947 2017 / 601 2018 / 369 2019 / 160 **Total** / ***2,076***
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) 888 trees/ha (5x2.5m): 0.1 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 "2022-03-31 Burapha Carbon Inventory M1-V6 *(Xayabouly removed)*"
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 EUC-2016: *0.44* EUC-2017: 0.25 EUC-2018: 0.16 EUC-2019: 0.08 AC-2016: *0.01* AC-2017: *0.04* AC-2018: *0.02*
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
EUC-2016	25.6
EUC-2017	21..0
EUC-2018	19.3
EUC-2019	5.9
AC-2016	-
AC-2017	26.7
AC-2018	13.2

Comments	-

Data / Parameter	n_i
Data unit	Dimensionless
Description	Number of sample plots in stratum i
Value applied:	

Stratum (Year)	ni
EUC-2016	43
EUC-2017	20
EUC-2018	22
EUC-2019	5
AC-2016	1
AC-2017	3
AC-2018	5
Total	99

Comments	-

Data / Parameter	Tree height (H)
Data unit	m
Description	Height of tree planted

Value applied:	See Excel "2022-03-31 Burapha Carbon Inventory M1-V6_APi Xayabouly removed)"
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	-

Data / Parameter	Permanent Sample plot Area
Data unit	m^2
Description	The permanent sample plot is the spatial unit of a forest inventory. It is used to expand the measured wood volume to a hectare.
Value applied:	-
Comments	-

Data / Parameter	Tree species
Data unit	-
Description	The tree species is used to define the stratum of trees to be counted in.
Value applied:	-

Comments	-

Data / Parameter	Tree Spacing
Data unit	-
Description	The tree spacing is used to define the stratum of trees to be counted in.
Value applied:	-
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 2016-2019 which are subject to this monitoring period.

Table 22: 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	946.6	36791.7	0.0	0.0	36,791.7
2017	600.5	23340.9	0.0	0.0	23,340.9
2018	368.7	14331.0	0.0	0.0	14,331.0
2019	159.8	6210.7	0.0	0.0	6,210.7

2020	0.0	0.0	0.0	0.0	-
Total	2075.7	80674.2	0.0	0.0	80,674.2

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:

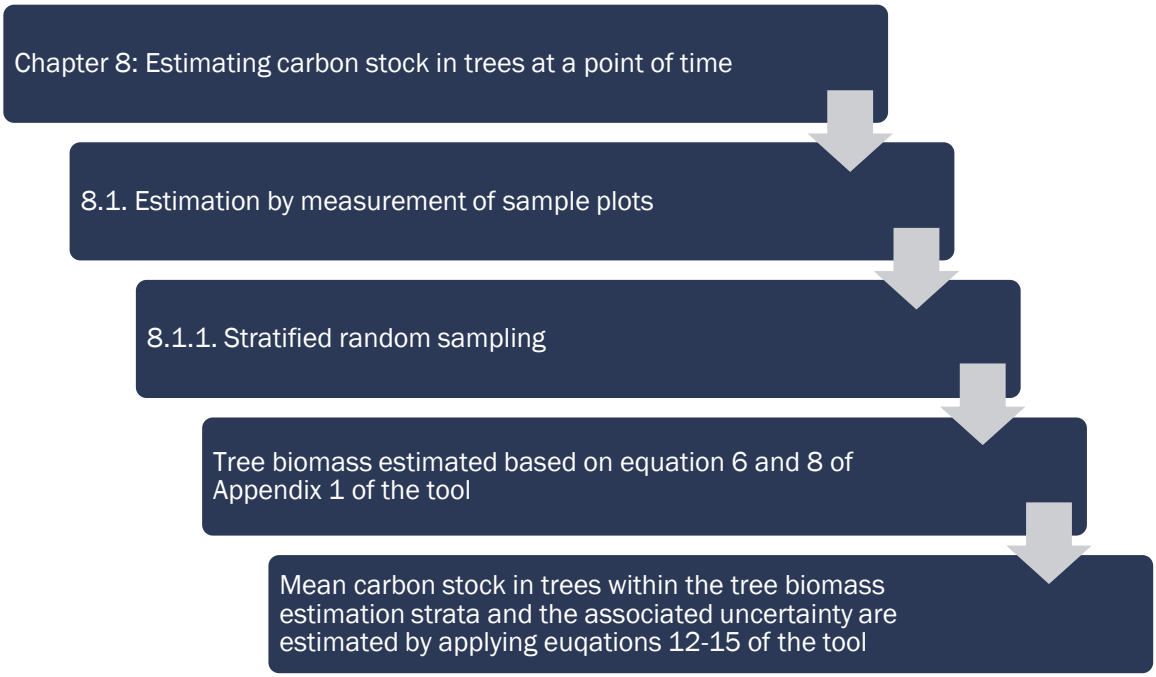
$\Delta C_{P,t}$	= Change in carbon stocks in project, occurring in the selected carbon pools, at time t; t CO2-e yr-1
$\Delta C_{TREE\_PROJ,t}$	= Change in carbon stock in tree biomass in project in year t, as estimated in AR-TOOL14; t CO2-e yr-1
$\Delta C_{SOC\_PROJ,t}$	= Change in carbon stock in the soil organic carbon (SOC) pool within the project boundary, as estimated in AR-ACM003, 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 23: 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	Burapha internal documentation
$BEF_{2,j}$	Biomass expansion factor for conversion of tree stem biomass to above-ground tree biomass, for tree species j; dimensionless	2	IPCC value, Table 3A.1.10, Broadleaf Tropical
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 '2022-03-31 Burapha Carbon Inventory M1-V6.1_APi (Xayabouly removed).xlsx' is available as supporting documentation.

Table 24: 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
EUC-2016	916	0.44	91.4	83,716	144,271
EUC-2017	526	0.25	61.8	32,516	56,035
EUC-2018	323	0.16	40.6	13,104	22,583
EUC-2019	158	0.08	8.5	1,334	2,299
AC-2016	30	0.01	23.5	710	1,224
AC-2017	74	0.04	55.4	4,108	7,079
AC-2018	46	0.02	34.1	1,553	2,677
TOTAL	2073	1.00	66.1	137,042	236,168

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

Table 25: 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)

EUC-2016	25.6	43	6%	13426	0
EUC-2017	21.0	20			
EUC-2018	19.3	19			
EUC-2019	5.9	8			
AC-2016	0.0	1			
AC-2017	26.7	3			
AC-2018	13.2	5			
Total	111.7	99			

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 26: 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	947	947	1,388	1,388
2017	601	1,547	2,269	3,658

2018	369	1,916	2,810	6,467
2019	160	2,076	3,044	9,512
2020	-	2,076	3,044	12,556
Total	2,076	8,561	12,556	12,556

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 '2022-03-31 Burapha Carbon Inventory M1-V6.1_APi (Xayabouly removed).xlsx' details the full calculation of emission reductions for this monitoring period and is available upon request.

Table 27: Change in carbon stocks during the period between two points of time t1 (pre-existing tree and shrub biomass) and t2

Year	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	947	36,792	0	0.0	29,099	0	-7,693
2017	601	23,341	0	0.0	44,878	0	21,537
2018	369	14,331	0	0.0	53,298	0	38,967
2019	160	6,211	0	0.0	54,447	0	48,236
2020	0	-	0	0.0	54,447	0	54,447

Total	2076	80,674	0	0.0	236,168	0	155,494

Actual net greenhouse gas removals by sinks

Table 28: 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	- 7,693	- 7,693	1,388	- 6,304
2017	20	13,844	21,537	2,269	23,806
2018	32	52,811	38,967	2,810	41,777
2019	44	101,047	48,236	3,044	51,281
2020	56	155,494	54,447	3,044	57,491
Total	56	155,494	155,494	12,556	168,050

6.4 Leakage

For the justification of 0 leakage please refer to section 4.3 above.

Table 29: 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 30: Net GHG Emission reductions and removals[82]

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	36,792	30,487	-	-6,304	-	0
2017	23,341	47,147	-	23,806	4,761	19,045
2018	14,331	56,107	-	41,777	8,355	33,421
2019	6,211	57,491	-	51,281	10,256	41,025
2020	0	57,491	-	57,491	11,498	45,993
Total	80,674	248,724	-	168,050	33,610	**134,440**

[82] Source: 2022-03-31 Burapha Carbon Inventory M1-V5_APi (Xayabouly removed)

The total GHG emission reductions of the First Project Instance for the 1st monitoring period 31.05.2016 until 22.12.2020 are 168,050 tCO_2e. The non-permanence risk rating is 20% (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 33,610 tCO_2e. The number of GHG credits eligible to be issued as VCUs for the First Project Instance of this monitoring period is 134,440 tCO_2e.

The long-term average method for determination is in section 4.2 and the ex post result is 22,034 tCO2e. This value has been estimated using the actual net removals achieved for the monitoring period and the ex ante values from the end of the monitoring period onwards.

Table 31: Ex-post Long-Term Average

	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)	Net GHG removals (tCO2e)
1	36,792	69,403	7,501	-	25,110	19,045
2	23,415	112,644	20,523	-	68,706	33,421
3	16,754	143,710	29,200	-	97,756	41,025
4	8,932	153,415	33,231	-	111,252	45,993
5	28,600	142,192	26,126	-	87,466	87,466
6	-	101,221	23,281	-	77,940	77,940
7		72,449	16,663	-	55,786	55,786
8		52,048	11,971	-	40,077	40,077
9		4,320	994	-	3,327	3,327
10		4,320	994	-	3,327	3,327
11		4,320	994	-	3,327	3,327
12		4,320	994	-	3,327	3,327

13		4,320	994	-	3,327	3,327
14		4,320	994	-	3,327	3,327
15		4,320	994	-	3,327	3,327
16		4,320	994	-	3,327	3,327
17		4,320	994	-	3,327	3,327
18		4,320	994	-	3,327	3,327
19		4,320	994	-	3,327	3,327
20		4,320	994	-	3,327	3,327
	114,492	898,927	180,420	-	604,015	205
Long-term average (tCO2e/yr)		44,946			30,201	22,034

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. The tool "Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities", version 01.1.0 has been used and considered by applying this allometric equation. Although N=9 is not sufficient to comply with the tool, it is however the used allometric equation to estimate stem volume prior harvest by Burapha. Since Burapha relies also on the sales of wood and therefore on precise wood estimations prior to harvest, it can be justified to use this allometric equation. Furthermore, the use of another allometric equation from global databases would not reflect the situation on the ground as muss as a Tier 3 equation by the project itself.

The number of stems used for this equation is a subsample if approximately 100 stems analyzed for developing allometric equations[83]. The equations were developed by the consulting company "Simosol", which advised Burapha after analyzing the data to stratify the stems according to spacing. Thus, the subsample of 9 stems for the equation might seem currently low, is however accurate. Because Burapha aims to be even more precise in the future, it announced to develop new allometric equations within the next monitoring period including the required minimum of 30 trees.

[83] Quote Luke McWhirter, chief forester Burapha

Estimation report

taper curve equation: 'T1 3.0 x 3.0'
Generated at 2020-03-17 02:32:50 GMT

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

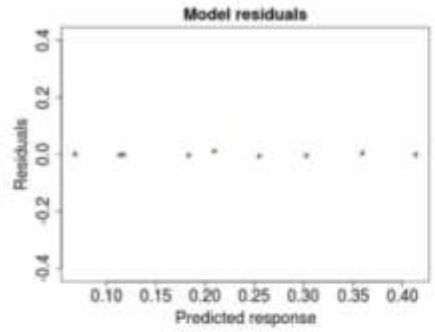
variable	description	unit
v	volume	m3
d	diameter	cm
h	height	m

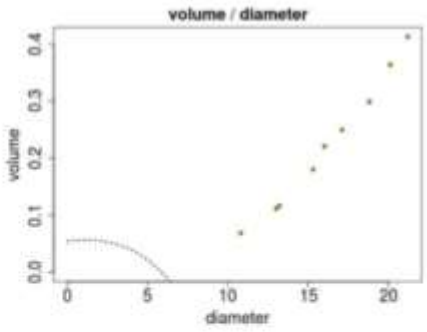
Estimation statistics

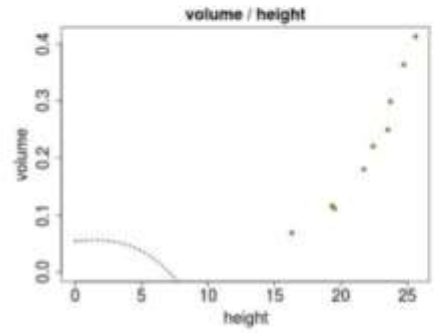
N	9
R sq	0.998171
bias	1.580849
RMSE	1.713628
sigma	0.007148

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	-0.0009632251	0.00094	-1.04333	0.35570
B3	-0.0000556542	0.00009	-0.62422	0.56632
B4	0.0000959745	0.00009	1.12314	0.32423







APPENDIX 3: PROJECT BOUNDARY

The outer boundary (regions where current and new project instances are and may be developed) of the project encompasses the provinces of:

- Bolikhamxay,
- Saysomboun,
- Vientiane Province,
- Xayabouli
- Vientiane Prefecture

There are 2,164 stands within the first project instance, therefore details of land parcels and ownership are contained in a data base (made available to the auditor). Ownership of land is categorized as follows:

- Village Concession Agreements: land is legally 'owned' by the village, so the village authorities sign agreements as representatives of villagers.
- Farmer Corporation Agreements: individual farmers own land/legal entitlement so there is a owner-polygon data set for each of these types of contracts
- Company land: land owned by the company so there is owner-polygon data for these.
- PFA Concession: this is state land so they have legal title. Through the process of land acquisition Burapha identifies all land customary users. These have user-polygon data base.
- Concession Other: this is also state land but the concession is signed through the assigned manager of the land, such as the Lao Army or other government entity.

A summary of areas and ownership (taken from the database) are shown in the tables below.

Table 32 Village Co-operative Lands

Compartment name	Sum of Planted area (ha)	Owner
Borchan	251,39	Borchan village (from Government of Laos)
Na-an	156,64	Na-an village (from Government of Laos)
Nakang-HH	102,11	Nakang village (from Government of Laos)
Namthom A	127,67	Namthom village (from Government of Laos)
Phonmouang A	13,93	Phonmouang village (from Government of Laos)

Phonmouang B	246,58	Phonmouang village (from Government of Laos)
Phonngeun-HH	259,51	Phonngeun village (from Government of Laos)
Phonthong-nuea	40,93	Phonthong-nuea village (from Government of Laos)
Grand Total	1.198,76	

Table 33 Production Forest Area Concessions (PFAs)

Compartment name	Sum of Planted area (ha)	Owner
Na-an PFA	171,06	Government of Laos
Nalang PFA	42,47	Government of Laos
Namhai PFA	126,78	Government of Laos
Namoy PFA	60,58	Government of Laos
Nasomboun PFA	63,11	Government of Laos
Nonnakaep PFA	50,47	Government of Laos
Phonngam PFA	114,95	Government of Laos
Phonsavath PFA	50,08	Government of Laos
Grand Total	679,50	

Table 34 Other Concession Areas

Compartment name	Sum of Planted area (ha)	Owner
Dansavan	2,08	Government of Laos
Hatkiang	2,54	Government of Laos
Houaydua C	63,41	Government of Laos
Nabong	6,83	Government of Laos
Xo (Nampak)	19,92	Government of Laos
Grand Total	94,77	

Table 35 Farmer Cooperative Areas

Compartment name	Sum of Planted area (Ha)	Owner
Hinngon B	8,31	Farmer co-operative
Hintit	45,69	Farmer co-operative
Khonekeo B	7,65	Farmer co-operative
Khonekeo C	29,17	Farmer co-operative
Nadi	86,40	Farmer co-operative
Nakang-PL	14,19	Farmer co-operative

Nakhan	118,27	Farmer co-operative
Namkouan	31,55	Farmer co-operative
Nampa	32,11	Farmer co-operative
Namphaet	17,11	Farmer co-operative
Namthom B	7,84	Farmer co-operative
Natoung	4,93	Farmer co-operative
Phonmouang A	122,09	Farmer co-operative
Xo (Nampak)	106,03	Farmer co-operative
Grand Total	631,35	

Table 36 Burapha Owned Areas

Compartment name	Sum of Planted area (ha)	Owner
Houaydua A	18,9	Lao shareholder and/or Burapha Agroforestry
Houaydua B	24,9	Lao shareholder and/or Burapha Agroforestry
Khonekeo B	22,1	Lao shareholder and/or Burapha Agroforestry
Vangma	10,5	Lao shareholder and/or Burapha Agroforestry
Vangmon	76,9	Lao shareholder and/or Burapha Agroforestry
Xo (Houay Oup Ya)	54,1	Lao shareholder and/or Burapha Agroforestry
Xo (Houay Sa Kanh)	3,3	Lao shareholder and/or Burapha Agroforestry
Xo (Namnaxeang)	20,0	Lao shareholder and/or Burapha Agroforestry
Xo (Nampak)	15,4	Lao shareholder and/or Burapha Agroforestry
Xo (NamSor)	48,9	Lao shareholder and/or Burapha Agroforestry
Xo (Namvean)	38,9	Lao shareholder and/or Burapha Agroforestry
Grand Total	333,9	

APPENDIX 4: SUMMARY OF STAKEHOLDER CONSULTATIONS

Summary of consultations conducted for the Burapha Agroforestry Project ESIA and ESMMP with community and government between 2016 and 2021.

1. Burapha and Earth Systems (ES) staff had a formal ESIA kick-off meeting with the Deputy Director General of the Department of Environmental and Social Impact Assessment (DESIA and now DOE), MONRE on 21 March 2016;
2. Burapha submitted first Scoping and TOR Report to DESIA, MONRE on 14 June 2016;
3. The DESIA, MONRE approved the Scoping and TOR Report on 28 June 2016, referred to the letter No. 1300/MONRE.DESIA;
4. Earth Systems conducted field visits including socio-economic surveys and initial consultations with relevant provincial, district and village authorities and general village representatives between March – May 2016;
5. Burapha submitted (first) the draft ESIA and ESMMP documents to the DESIA on 24 May 2017;
6. Earth Systems staff in collaboration with relevant district representatives conducted formal village consultations in 23 Project villages between 20 – 31 May 2017;
7. Burapha in collaboration with the DESIA, MONRE, PONRE and DONRE organized a formal public involvement / consultation workshop on 6 September 2017 in Hin Heup District, Vientiane Province;
8. Burapha resubmitted (second) the draft of the ESIA/ESMMP to the Department of Natural Resources and Environmental Policy (formerly DESIA and now DOE) on 12 December 2017 after incorporating and/or addressing comments raised during the public consultation meeting;
9. Burapha in collaboration with the DNREP/MONRE and PONRE organized a formal technical consultation meeting in Phonhong District for Vientiane Province on 5 April 2018;
10. Burapha in collaboration with the DNREP/MONRE and PONRE organized a formal technical consultation meeting in Parklai District for Xayaboury Province on 17 May 2018;
11. Burapha in collaboration with the DNREP/MONRE and PONREs organized a formal consultation meeting in Vientiane Capital on 31 May 2018 (for both Vientiane Capital and Saysomboun Province);
12. The DNREP provided official comments on the ESIA/ESMMP as per the letter No. 0583/MONRE.DNREP, dated 8 May 2018;
13. Burapha resubmitted (third) the ESIA/ESMMP documents to the DNREP on 10 July 2018 after updating and/or addressing comments (as required) raised during formal consultation meetings with four provinces as well as comments from the DNREP;
14. The DNREP provided additional comments as per the letter No. 1233/MONRE.DNREP, dated 3 September 2018. However, most of the comments were similar to previous comments provided

in the letter No. 0583/MONRE.DNREP which were already addressed with a formal response letter from the Company when resubmitted (third) the ESIA/ESMMP;

15. Burapha requested a meeting with the DNREP on 12 September 2018 to discuss the comments. At the meeting Burapha and ES representatives explicitly explained and clarified the issues associated with the Project and/or comments;

16. Burapha resubmitted (fourth) the ESIA/ESMMP documents to the Department of Environment (formerly DNREP), MONRE on 4 July 2018 after updating and/or addressing all comments;
17. Burapha and ES representatives met DNREP to discuss and plan for organizing the provincial / central consultation meeting. The discussion was held on 13 February 2019 but there was no agreement as the DNREP wanted to have a separate meeting for different Project Provinces. Burapha did not agree on the proposed approach as it was not appropriate in terms of time and resources and had suggested the DNREP to organize only one meeting in Vientiane Capital instead;
18. The Department of Natural Resources and Environmental Inspection (DNREI now Dept. of Pollution Control and Inspection), MONRE drafted indicative monitoring budget for GOL agencies and sent an invitation letter to Burapha for further discussion and negotiation – refer to the letter No. 0703/MONRE.DNREI, dated 24 May 2019. The meeting between Burapha and DNREI was held on 29 May 2019 with no concrete agreement.
19. Burapha staff maintained regular coordination and consultations with DOE officials to discuss and prepare the provincial/central consultation meeting. The DOE finally issued a letter No. 1572/MONRE.DOE, dated 30/10/2020 that the final consultation workshop can be organized in Vientiane Capital.
20. Burapha resubmitted the final (fifth) ESIA/ESMMP to DOE/MONRe on 7 November 2020 with the document register No. 2553;
21. Burapha sent a letter to DOE/MONRE on 17 November 2020 regarding the issues associated with the review and approval process of the GoL on the ESIA/ESMMP documents for the Agroforestry Project;
22. Burapha in collaboration with the DOE and PONREs organized the final provincial/central consultation meeting on 25/1/2021 in Vientiane Capital with participation of all key stakeholders from four Project provinces;
23. Burapha sent a response letter to the DOE regarding the update of ESIA/ESMMP based on comments raised at the provincial/central consultation meeting held on 25/1/2021;
24. However, the DOE had sent additional comments on the ESIA/ESMMP as per the letter No. 668/MONRE.DOE, dated 31/3/2021. Most of the comments have already been addressed through a series of consultation and meetings with MONRE staff.