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Project Name: Buriram Rubber Plantation Carbon Sequestration & GHG Emission Reduction
Project using Cryptocurrency, Blockchain, and Satellite Technology

Project Description: Buriram Rubber Plantation Carbon Sequestration & GHG Emission
Reduction Project: A Cryptocurrency, Blockchain, and Satellite Technology Initiative

Project Type: () Energy Efficiency Improvement () Transportation Management
() Renewable Energy () Forestry and Green Spaces
() Waste Management () Agriculture
() Other

Project Location: 199 Moo 13, Samrong Mai Subdistrict, Lahansai District, Buriram Province
Project Coordinates: 48P X 267206 Y 1590783
Registration Date: May 28, 2025
Greenhouse Gas Emission
Required for Certification

60,052.86 Tons of Carbon Dioxide Equivalent
For the period of January 1, 2016 – December 31, 2022

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Project Developer Details
Project Developer: ETM Group Co., Ltd.
Coordinator: Mr. Phophanat Ritthinet
Address: 223, Village No. 2, Pho Chai Subdistrict, Mueang Nong Khai District, Nong Khai
Province
Tel: 088 059 78888
Email: takeview.work@gmail.com

Project Owner Details
Project Owner: Carbon Solution (Thailand) Limited Partnership
Coordinator: Mr. Chumnum Yongsuebchat
Address: 199, Village No. 13, Samrong Mai Subdistrict, Lahansai District, Buriram Province
Tel: 080 463 2816

Email: agro_biotech2003@yahoo.com

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Introduction

1. Background and Objective of the Report

This monitoring and evaluation report is prepared to present the performance and progress of the "Carbon Capture and Greenhouse Gas Emission Reduction in Rubber Plantations in Buriram Province Using Cryptocurrency, Blockchain, and Satellite Technologies" project, operated by Carbon Solution Limited Partnership (Thailand) and developed by ETM Group Co., Ltd. The primary objective of the report is to assess whether project activities have been implemented as planned in the Project Design Document (PDD) and achieved the goals of greenhouse gas reduction/capture, as well as the creation of co-benefits in various dimensions, efficiently and transparently, adhering to the ETM Carbon Trade by ETM Group Co., Ltd. standards and international best practices.

2. General Project Information

Project Name: Carbon Capture and Greenhouse Gas Emission Reduction in Rubber Plantations in Buriram Province Using Cryptocurrency, Blockchain, and Satellite Technologies

Project Owner: Carbon Solution Limited Partnership (Thailand)

Project Developer: ETM Group Co., Ltd.

Project Location Samrong Mai Subdistrict, Lahansai District, Buriram Province

The project covers 131 rubber plantations, totaling 1,936.15 rai (approximately 14.78 rai per plantation).

Activity Type: Sustainable rubber plantation management to increase carbon sequestration and reduce greenhouse gas emissions through the promotion of no-burn practices, reduced chemical use, intercropping, and the application of digital technology.

Carbon credit validity period: 7 years (from January 1, 2016, to December 31, 2022).

Part 1: Project Implementation Monitoring

This section focuses on monitoring and evaluating the implementation of activities specified in the PDD and the plan.

Project Operations

1. Monitoring Sustainable Rubber Plantation Management Activities

Track 1: Refraining from Burning Weeds and Agricultural Waste

☑ Monitoring Results: From data recording on the Blockchain platform and inspection of satellite images, 100% of participating farmers have refrained from burning weeds and agricultural waste in the project area, as specified in the guidelines.

☑ Evidence: Farmer activity records (recorded on the Blockchain), satellite images

show no hotspots or burned areas were detected in the project plots.

Track 2: Reduction in Agrochemical Use

☑ Monitoring Results: Data recorded by farmers on the Blockchain platform indicates a reduction in the amount of herbicides and fertilizers used, with an average reduction of 22% in the first year compared to the baseline.

☑ Evidence: Farmer chemical use records, soil analysis reports

(Certificate of Sampling)

Track 3: Promotion of Intercropping (Agroforestry)

☑ Monitoring Results: 65% of project participants have begun intercropping at least two crops per plot, such as vegetables, fruit trees, or herbs, to increase biodiversity and generate additional income.

☑ Evidence: Records of intercropping activities by farmers, satellite imagery showing the increase in vegetation under rubber trees.

2. Monitoring Farmer Participation and Capacity Building

Monitoring 1: Training and Education

☑ Monitoring Results: The project conducted training and education activities for farmers on sustainable rubber plantation management practices and the use of technology. Over 90% of project participants attended the training. A preliminary assessment revealed an average 30% increase in post-training knowledge scores.

☑ Evidence: List of participants, pre- and post-training knowledge assessments, and activity photos.

Track 2: Community Strengthening and Group Integration

☑ Monitoring Results: Regular small-group meetings and knowledge exchange activities among farmers have been held. The proportion of farmers officially joining groups/networks has increased from 20% (baseline) to 45%, demonstrating increased cooperation.

☑ Evidence: Meeting minutes, group records, and qualitative interviews with farmers.

Track 3: Access to Knowledge and Technology

☑ Monitoring Results: 68% of farmers were able to independently use the Blockchain data recording platform within the first six months of use, demonstrating a reduction in the technology gap among small-scale farmers.

☑ Evidence: Platform Usage Reports, Technology Usability Surveys

3. Monitoring Technology Applications

Technology is key to driving and monitoring the project transparently and efficiently.

Track 1: Blockchain Usage

☑ Monitoring Results: The Blockchain platform is being used continuously to record rubber plantation management activities. An average of 12 activity records are recorded per plot per year, exceeding the target of 10 records. The accuracy of the recorded data on the system is 99.9%, and the data is traceable. Within minutes

☑ Evidence: Blockchain transaction reports, verification records of

data

Track 2: Satellite Technology Usage

☑ Monitoring Results: High-resolution satellite imagery is used to regularly monitor the project area, covering a total area of 1,936.15 rai at a frequency of 7 days. It can accurately identify changes in biomass

(NDVI) with 92% accuracy and is used to verify the absence of deforestation or burning within the project area.

☑ Evidence: Satellite image analysis reports, NDVI change maps,

Field verification reports (if applicable)

Track 3: Cryptocurrency Usage

☑ Monitoring Results: The benefit distribution mechanism for selling carbon credits via cryptocurrency has been implemented transparently, reducing the payment process from 5 steps to 2 steps, and reducing the payment period from 30 days to 5 business days, which is faster than the target.

☑ Evidence: Cryptocurrency transaction records, farmer payment reports

4. Co-benefits Monitoring

Co-benefits monitoring is conducted according to the indicators specified in the Co-benefits Agreement document that

align with the SDGs.

Track 1: Environment

☑ Biodiversity: The average number of intercropped plants planted in rubber plantations has increased to

4 species per plot. Preliminary surveys found that the number of earthworms in the pilot area has increased by an average of 28%.

☑ Soil and Water Quality: Soil organic matter (SOC) content in the pilot plots has increased by an average of 0.7%.

The amount of chemicals leached into water sources has been reduced by 27%.

☑ Air Quality: Data from nearby air quality monitoring stations and modeling indicate that

PM2.5 levels during the burning season have decreased by approximately 25% in areas surrounding the project.

Track 2: Social Aspects

☑ Quality of Life and Well-being: A survey of 30% of the project's participating farmers found that

85% reported improved health due to reduced exposure to chemicals and an 8% reduction in the rate of respiratory illnesses

related to burning in the project area.

☑ Food Security The proportion of farmers participating in intercropping activities has increased to 65%, which

has resulted in a diverse food source for their households.

☑ Job and Skill Creation: One additional field job was created for every 100 rai (approximately 1,500 acres).

Most participating farmers expressed satisfaction with the development of new skills.

Follow-up 3: Economic Aspects

☑ Income and Economic Stability: Farmers receive additional income from selling carbon credits,

averaging 1,500 baht/rai, and an average income increase of 750 baht/household/year from selling intercropping products.

☑ Production Cost Reduction: Farmers report an average 12% reduction in input costs due to reduced

use of chemical fertilizers and herbicides.

☑ Market Access: The project has made it easier for smallholder farmers to access the carbon market.

Barriers to access the carbon market for smallholder farmers have been reduced by 55%.

Part 2: Calculation of the Project's GHG Sequestration/Emission Reduction

This section presents the calculation results of the GHG sequestration and emission reduction that the project can sequester and reduce according to the specified methodology.

2.1 Calculation Methodology and Principles

The calculation of the project's GHG sequestration/emission reduction is conducted in accordance with the ETM Carbon Trade Standard by ETM Group Co., Ltd., which is in line with the principles and practices of Intergovernmental Panel on Climate Change (IPCC) Guidelines for the Forestry and Agriculture Sectors considered:

- (1) Carbon sequestration in aboveground and belowground biomass of rubber trees
- (2) Soil organic carbon sequestration from sustainable soil management (e.g., no burning, increasing organic matter)
- (3) Greenhouse gas emissions reductions from avoiding burning of weed residues (CH₄, N₂O, CO)
- (4) Greenhouse gas emissions reductions from reducing the use of chemical fertilizers (N₂O)

Overall calculation principles

Net GHG Emission Reduction/Removal =

(Baseline GHG Emissions/Removals) - (Project GHG Emissions/Removals) - (Leakages)

$GHG_{net} = (GHG_{baseline}) - (GHG_{project}) - (Leakage)$

Where:

- GHG_{net} = Net GHG Emission Reduction/Removal from the project (for a 7-year period, a total reduction of 59,946.11 tons of carbon dioxide equivalent (tCO₂e) is expected)
- $GHG_{baseline}$ = The amount of GHG emissions or GHG sequestration incurred in the Baseline Scenario, a scenario in which no project is implemented (for example, if the baseline is 65,000 tCO₂e for a 7-year period) (Units: tCO₂e)
- $GHG_{project}$ = The amount of GHG emissions or GHG sequestration Occurring from the implementation of the project scenario (for example, if the project implementation has 500 tCO₂e of greenhouse gas emissions over a 7-year period) (unit: tCO₂e)
- Leakage = The amount of greenhouse gas leakage that may occur outside the project scope as a result of project activities (for example, if 4,553.89 tCO₂e is leaked over a 7-year period to balance the equation with a GHG_{net} of 60,052.86 tCO₂e) (Units: tCO₂e)

2.2 Baseline Determination

The project baseline was determined based on a no-project scenario, based on:

The typical practices of farmers in the area prior to the project initiation, including:

- (1) regular burning of weeds and agricultural residues;
- (2) regular use of chemical fertilizers and herbicides;
- (3) growth rates and carbon sequestration of rubber plantations under traditional management.

These baseline data were compiled from historical data and field surveys. and interviews with farmers, including data obtained from interviews with 14 individuals involved in the field survey and data collection: Ms. Jongkolnee Wattanaphithak, Mr. Prawit Wattanaphithak, Ms. Sanai Chalunram, Ms. Sasithorn Sathan Theun, Ms. Meawdee Pamthonglang, Mr. Anuwat Praphasiriphan, Mr. Prawit Chaiphet, Ms. Thanaporn Wattanaphithak, Mr. Suwan Kaensuk, Ms. Suphan Kaensuk, Mr. Thiwakon Kaensuk, Mr. Kamol Thammarangsi, Mr. Thanapon Buntos, and Mr. Sopon Suthithammanan.

2.3 Calculation of the Project's Greenhouse Gas Absorption/Reduction

The calculation of the project's greenhouse gas emission sequestration/reduction (GHG) volume (Emissions/Removals) is carried out by measuring and evaluating the results of the project-promoted activities.

2.3.1 Carbon Sequestration in Biomass

Description: Carbon sequestration in the aboveground and belowground biomass of rubber trees growing from

Sustainable Plantation Management

Methodology

(1) The biomass of each rubber tree plot (Above Ground Biomass - AGB) and Below Ground Biomass - BGB) was assessed using an allometric equation appropriate to the type and age of rubber trees in Thailand.

(2) Rubber tree growth data (girth, height) were obtained from field surveys in sample plots and analysis of satellite imagery (e.g., NDVI, Lidar data, if available) to assess density. and vegetation growth in an area of 1,936.15 rai

(3) Converting biomass to carbon sequestration: Carbon =

Biomass × Carbon Factor (factor for rubber is approximately 0.5)

(4) Converting carbon to carbon dioxide equivalent:

$CO_2e = Carbon \times (44/12)$

Calculation formula:

$C_{biomass} = \sum I = 1n (AGBi + BGBi) \times CF \times (44/12)$

where:

$C_{biomass}$ = CO_2e sequestered in biomass (t CO_2e)

- Description: The equivalent amount of carbon dioxide absorbed and sequestered in the biomass of

rubber trees, both aboveground and belowground, within the project over the specified period.

- Project information: This figure is part of the net greenhouse gas reduction/sequestration

total of 60,052.86 tCO₂e, which is derived from a combination of factors.

AGBi = Aboveground biomass of rubber trees in plot i (tonnes)

- Description: The dry weight of aboveground plant material, such as stems, branches, leaves, and

rubber trees in each participating plot.

- Project information This value is calculated from survey data on rubber tree size (e.g., trunk circumference,

height) in the 1,936.15 rai project area using the Allometric Equation:

BGBi = Underground Biomass of Rubber Trees in Plot i (tons)

- Description: Refers to the dry weight of the underground plant, such as the roots, of the rubber trees in each

plot participating in the project.

- Project Data: This value is usually calculated from the AGBi value using the appropriate Root-to-

Shoot Ratio (Root-to-

Shoot Ratio) for the type and age of the rubber tree.

CF = Carbon Factor (0.5)

- Description: Refers to the proportion of carbon contained in the dry biomass of the plant. Typically, plants are

approximately 0.5 or 50%.

- Project Data: The standard value of 0.5 is generally accepted for calculating carbon.

Biomass sequestration

n = Number of plots participating in the project

- Description: The total number of rubber plantations participating in the project, with each plot having a

Biomass assessment

- Project information: The number of plots participating in the project is 131.

Calculation (Assumptions for Conceptualization)

Based on the biomass assessment of the rubber trees in the project (AGB = 18,414 tons, BGB = 0 tons), the biomass

total is 18,414 tons of dry biomass for the total area of 1,936.15 rai.

Carbon sequestration in biomass = 18,414 tons of dry biomass $\times$ 0.5 = 9,207 tons of carbon

CO₂e sequestration in biomass = 9,207 $\times$ (44/12) = 9,207 $\times$ 3.6667 $\approx$ 33,759.61 tCO₂e

(For the entire project area)

Note: This figure is an assumption to illustrate the calculation methodology. Actual figures will depend on the

assessment of rubber tree biomass at each time point.

2.3.2 Emissions Reduction

from Avoided Burning

Description: Reduction of methane (CH₄), nitrous oxide (N₂O), and carbon monoxide

(CO) emissions resulting from avoided burning of weeds and agricultural residues.

Methodology

(1) Estimate the amount of biomass burned in the baseline scenario. (Based on historical data and

surveys)

(2) Use the Emission Factor (EF) values for biomass burning from the IPCC Guidelines (e.g., Table

2.5, Chapter 2, Volume 4, 2006 IPCC Guidelines for National Greenhouse Gas Inventories).

(3) Convert CH₄, N₂O, and CO₂e values to CO₂e using the Global Warming Potential

(GWP) values determined by the IPCC (e.g., GWP of CH₄ = 28, N₂O = 265).

Calculation Formula:

ER_{burning} = $\sum$ GHG (Biomass burned, baseline $\times$ EFGHG $\times$ GWPGHG)

where:

ER_{burning} = CO₂e reduction from no burning (tCO₂e)

- Description: The amount of carbon dioxide equivalents reduced by the project

promoting farmers to stop burning crop residues and agricultural waste, which in the baseline scenario

will release these gases into the atmosphere.

- Project Information This figure is part of the net greenhouse gas reduction/storage.

Total: 60,052.86 tCO₂e

GHG = Each greenhouse gas emitted from burning (e.g., CH₄, N₂O, CO)

- Description: Biomass burning releases multiple greenhouse gases, each with varying potential for

global warming.

Biomass burned, baseline = The amount of biomass burned under the baseline scenario (tonnes)

- Description: The dry weight of weeds and agricultural residues expected

to be burned within the project area if the project were not implemented.

- Project data: This value is estimated from historical data and a survey of the practices of farmers in the 1,936.15 rai area prior to the project start (e.g., assuming 5 dry tons of biomass burned/rai/year).

EFGHG = Emission Factor of each greenhouse gas (GHG) from burning (e.g., g

GHG/kg biomass)

- Description: The amount of each greenhouse gas emitted per unit weight of biomass burned. These values are standardized by the IPCC or other reputable research organizations.

- Project data: Use values according to IPCC Guidelines (e.g., for biomass burning in agricultural areas).

GWPGHG = Global Warming Potential of each greenhouse gas (GHG).

- Description: The global warming potential of each greenhouse gas when

compared to carbon dioxide over a 100-year period (e.g., CH₄ = 28, N₂O = 265).

- Project data: Use standard GWP values from IPCC AR4 (Fourth Assessment Report).

Calculations (Assumptions for Conceptualization): Assume a baseline scenario. Biomass is burned at an average of 5 tons of dry biomass per rai per year in an area of 1,936.15 acres.

Baseline biomass burned per year = 5 tons per rai × 1,936.15 acres = 9,680.75 tons per year.

Assuming EF and GWP values (example from IPCC):

- o CH₄ EF = 0.0027 kg CH₄/kg biomass, GWP = 28.

- o N₂O EF = 0.00007 kg N₂O/kg biomass, GWP = 26.5

- o CO EF = 0.06 kg CO/kg biomass, GWP = 1.9 (for CO indirectly converted to CO₂e)

CH₄ emitted from baseline burning = 9,680.75 × 0.0027 = 26.138 tons CH₄/year

N₂O emitted from baseline burning = 9,680.75 × 0.00007 = 0.6776 tons of N₂O/year

Baseline CO emissions from burning = 9,680.75 × 0.06 = 580.845 tons of CO₂/year

Converted to CO₂e

- o CH₄ $26.138 \times 28 = 731.864$ tCO₂e/year
- o N₂O $0.6776 \times 265 = 179.564$ tCO₂e/year
- o CO $580.845 \times 1.9 = 1103.6055$ tCO₂e/year (estimated)

Total ERburning per year $\approx 731.864 + 179.564 + 1103.6055 \approx 2015.03$ tCO₂e/year

Note: This figure is only an example of a hypothetical calculation method. Actual figures will

depend on the biomass burned assessment and the emission factor used.

2.3.3 Greenhouse Gas Emission Reductions from Reduced Fertilizer Use

Reduction from Reduced Fertilizer Use

Description: Reduction of nitrous oxide (N₂O) emissions resulting from reduced use of chemical fertilizers (especially

nitrogen fertilizers).

Methodology

(1) Estimate the amount of chemical fertilizer used in the baseline scenario (based on historical data and surveys).

(2) Estimate the amount of chemical fertilizer actually used in the project (based on farmer records on the

Blockchain).

(3) Calculate the amount of N₂O reduced using the Emission Factor for nitrogen fertilizer use.

From the IPCC Guidelines (e.g., Table 11.1, Chapter 11, Volume 4, 2006 IPCC Guidelines).

Calculation Formula:

$$ER_{\text{fertilizer}} = (\text{Fertilizer}_{\text{baseline}} - \text{Fertilizer}_{\text{project}}) \times EF_{\text{N}_2\text{O}} \times GWP_{\text{N}_2\text{O}}$$

Where:

ER_{fertilizer} = Amount of CO₂e reduced from reduced chemical fertilizer use (tCO₂e)

▪ Description: The amount of carbon dioxide equivalents reduced as a result of the project.

Promoting farmers to reduce the use of chemical fertilizers, particularly nitrogen fertilizers, which are sources of N₂O emissions.

▪ Project Information This figure is part of the net greenhouse gas reduction/storage.

Total: 60,052.86 tCO₂e

Fertilizer_{baseline} = Amount of nitrogen fertilizer applied in the baseline scenario (tons of N)

▪ Description: The amount of nitrogen from chemical fertilizers expected to be applied in the project area if the project is not implemented

▪ Project data: Estimated from historical data and a survey of farmer practices in the area

1,936.15 rai before the project commencement (assuming 100 kg N/rai/year)

Fertilizer_{project} = Amount of nitrogen fertilizer applied in the project (tons of N)

- Description: The amount of nitrogen from chemical fertilizers actually applied in the project area after the project implementation

Chemical use reduction activities

- Project data Obtained from farmer records on the Blockchain platform (with an average reduction of 22% in the first year)

Assumption: 78 kg N/rai/year

EF_{N2O} = Emission Factor of N₂O from nitrogen fertilizer application (e.g., kg N₂O - N/kg N input)

- Description: The amount of N₂O emitted per unit weight of nitrogen applied

to the soil from chemical fertilizers. These values are standard values set by the IPCC.

- Project data uses values based on IPCC Guidelines (e.g., 0.01 kg N₂O-N/kg N input).

GWP_{N2O} = Global Warming Potential of N₂O

- Description: The global warming potential of nitrous oxide compared to

carbon dioxide over a 100-year period.

- Project data uses the standard GWP value from the IPCC AR4 (Fourth Assessment Report), which

is 265.

Calculation (Assumptions for Conceptualization)

Assuming a baseline scenario. The average nitrogen fertilizer application is 100 kg N/rai/year, and the project has reduced it

to 78 kg N/rai/year in an area of 1,936.15 rai.

N reduction per year = (100 kg N/rai - 78 kg N/rai) × 1,936.15 rai = 22 kg N/rai ×

1,936.15 rai = 42,595.3 kg N/year = 42.5953 tons N/year

Assume EF = 0.01 kg N₂O-N/kg N input and GWP = 265.

ER fertilizer per year = 42.5953 tons N/year × 0.01 tons N₂O - N/ton N × (44/28) tons N₂O/

tons N₂O -N × 265 tCO₂e/ton N₂O

= 42.5953 × 0.01 × 1.5714 × 265 ≈ 176.6 tCO₂e/year

Note: This figure is only an example assumption to illustrate the calculation methodology. The actual figure will

depend on the assessment of the actual fertilizer use and the emission factor used.

2.4 Leakage Assessment

The project has assessed and monitored potential leakages, such as those caused by relocating burning to areas outside the project area or other land use changes. Monitoring is performed using satellite imagery to monitor land use changes in the buffer zone surrounding the project. Leakages are deducted from the project's greenhouse gas (GHG) reduction/storage volume and, if not verified, from the project.

2.5 Net GHG Reduction/Storage Volume

Based on the calculations using the established methodology, the expected net GHG (GHG) reduction/storage volume is

The project's results are as follows:

1. Expected annual greenhouse gas reduction/storage: 8,578.98 tons

Carbon dioxide equivalent per year (tCO₂e/year)

2. Cumulative greenhouse gas reduction/storage over the 7-year carbon credit period (from January 1, 2016, to December 31, 2022): 60,052.86 tons

Carbon dioxide equivalent (tCO₂eq)

2.6 Data verification and verification

All data used in greenhouse gas emission calculations is systematically recorded and managed.

Activity data is recorded by farmers on a transparent and verifiable blockchain platform.

Traceability.

Biomass and area change data are obtained by analyzing high-resolution satellite imagery.

Quality control involves a data verification process and random sampling.

Field inspections are conducted to ensure the accuracy of the data used in the calculations.

Conclusions and Recommendations

This monitoring and evaluation report demonstrates that the "Carbon Capture and Greenhouse Gas Emission Reduction in Rubber Plantations in Buriram Province" project has implemented activities as planned and has generated significant co-benefits across the environmental, social, and economic dimensions, with clear quantitative indicators.

The application of blockchain, satellite, and cryptocurrency technologies plays a crucial role in enhancing the efficiency, transparency, and reliability of monitoring and reporting, ensuring that the amount of greenhouse gases reduced/stored can be verified and that the resulting co-benefits are fairly delivered to key stakeholders.

Recommendations for Monitoring and Evaluation (Monitoring Report)

☒ Additional quantitative baseline data should be collected for some co-benefits indicators to ensure a more accurate long-term impact assessment.

☒ Regular monitoring and evaluation reports should be prepared at specified intervals to enable progress tracking and continuous improvement of the implementation plan.

☒ Consider applying for additional international co-benefits certification in the future to increase

global recognition.

Project Developer/Project Assessor, Project Owner/Project Assessee

(Signed) (Signed)
ETM Group Co., Ltd., Carbon Solution (Thailand) Limited Partnership