For auditors

Certificate Verification /Certificate of Verification

Name of Verification company / Name of auditor :	Mr. Poppanat Rittinet
Name of Product / Product Name :	Rubber (cup lump)
Name of Company / Company Name :	Carbon Solution (Thailand) Limited Partnership
Scope of Product / Scope of Product :	☐ B2C ☑ B2B
Functional Unit / Unit of product :	
Type of Label Registration / Label applied for :	☑ Product Carbon Footprint Label ☐ Global Warming Reduction Label ☐ Carbon Footprint Label for Circular Economy Products
Amount of CO2e / Amount of verified carbon footprint	312.84 Ton/ CO2e
Amount of Percent Reduction / Percent reduction compared to the verified base year	The information contained in the prepared document does not specify information about the "Base Year" .
Amount of Percent Reduction / Percent reduction compared to performance benchmark through verification	Comparative value__-_(No specified performance benchmark data) Percentage reduction__-__(There is no base year data or comparison criteria to calculate the reduction.)
Amount of Percent Re cycled content / Percentage of recycled material content in the composition of circular economy products	Percentage __ - _ (not in the project)
Amount of CO2e of the same product using virgin material / Carbon footprint of the same product using virgin material	(Not in the project)

Review the following items:

Sequence number	list	Evaluation results	note
1	Functional Unit Definition	✓	
2	Scope determination	✓	
3	Selection of Emission Factor (EF)	✓	
4	Selecting the Global Warming Potential (GWP) value	✓	
5	Allocation	✓	
6	Transportation	✓	
7	GHG Emission Cut - off	✓	
8	Raw material acquisition process	✓	
9	Production process	✓	
10	Distribution and sales process	✗	Not included in the project
11	Usage steps	✗	Not included in the project
12	Disposal after use	✗	Not included in the project
13	Calculating the percentage reduction	✓	
14	Review of the performance benchmarks used for comparison	✓	
15	Reviewing the proportion of recycled materials in the composition of circular economy products	✗	Not included in the project
16	Review of the carbon footprint of the same product using new materials in the case of requesting certification of the carbon footprint of circular economy products.	✗	Not included in the project

I hereby certify that the product carbon footprint and /or reduction percentage and / or the product carbon footprint , circular economy and calculation methodology verified above are in compliance with the requirements of the product carbon footprint assessment guidelines and /or the carbon footprint reduction assessment guidelines. Product print and / or product carbon footprint assessment guidelines, Circular Economy, to apply for registration of product carbon footprint mark and /or global warming reduction label and / or product carbon footprint mark , Circular Economy with ETM Group.

Signed..... ....Auditor
(Mr. Poppanat Rittinet)
Position Managing Director of ETM GROUP
Date of Issue: *June 30, 2025*

ETM-018-CFP-01BR01S1

For auditors

Notification of Stakeholders Form

I , *Mr. Phopnat Ritthinet* .
Affiliation *ETM Group* .

Act as a verifier of product carbon footprint data and/or global warming reduction label and/or circular economy product carbon footprint for registration to use product carbon footprint mark and/or global warming reduction label and/or circular economy product carbon footprint with Carbon Solution (Thailand) Limited Partnership Project owner.

During the period of my performance of the assigned activities, I hereby confirm that I have no stake in or relationship with any other organization involved in the system verification activities of products applying for registration of carbon footprint of products and/or global warming reduction label and/or carbon footprint of circular economy products as follows:

(1) I have no business or financial relationship with any organization.

(2) I am not involved in the development of the product or process being reviewed.

(3) I have no personal or indirect interests that may affect the neutrality of the review.

(4) I do not receive any benefits based on the results of this review.

Produced by Carbon Solution (Thailand) Company Limited

I hereby confirm the following details:

(1) Never worked or provided advice to the above companies for the past 2 years or for which there has been a prior commitment.

(2) No direct family member has worked or consulted with the above manufacturing companies in the past 2 years or for which there has been a prior commitment.

(3) Not being a shareholder or not having a direct family member being a shareholder in the above manufacturing company.

(4) Not being an executive or not having a direct family member as an executive or may have commercial benefits for the above manufacturing company.

Signature .....
(Mr. Phopnat Ritthinet)
Date of Issue: *June 30, 2025*

Carbon Footprint of Product (CFP) report for rubber (upstream to factory)

Footprint Assessment Project for Rubber Products

From cultivation to rubber cup lump purchasing or collection business (Rubber purchasing point)

In the area of Lahansai District, Buriram Province

CFP study

1. To identify and assess the amount of greenhouse gas emissions throughout the life cycle of rubber products. From cultivation to the door of the rubber cup lump purchasing or collection business (rubber purchasing point) (Cradle-to-Gate)
2. To identify the main greenhouse gas emission sources (Hotspots) at each stage of the rubber production process.
3. To identify opportunities and propose approaches to reduce greenhouse gas emissions to increase environmental efficiency.
4. To create transparency and credibility of environmental information, meeting the needs of consumers, carbon markets and stakeholders.
5. future development of Carbon Credit Tokens.

Product Scope

This study focuses on rubber products of the following types: **Cup lump rubber**

The importance of rubber and environmental issues

The rubber industry is a key sector in Thailand's economy. However, operations within this sector, including fertilizer use, plantation management, and processing, contribute to greenhouse gas emissions. Therefore, a CFP assessment is essential to understand and mitigate environmental impacts.

Technology adoption

This project will leverage cryptocurrency, blockchain , and satellite technologies to enhance data collection, verification, and reporting, thereby increasing the credibility and transparency of CFP assessment results.

1. Defining the scope of the product and product life cycle (Goal and Scope Definition)

ISO 14040/14044 and ISO 14067 guidelines

1.1 Goal

- Assessment of the total greenhouse gas (GHG) emissions throughout the life cycle of rubber products **Cup lump rubber** From cultivation in rubber plantations in Buriram

Province To the front door of the rubber cup lump purchasing or collection business (rubber purchasing point) (Cradle-to-Gate) for the year **2024**

- Identify hotspots of GHG emissions throughout the rubber production process .
- possible approaches and measures to reduce GHG emissions .

1.2 Product Scope

Functional Unit

"1 kilogram of dry rubber content (DRY RUBBER CONTENT: DRC) At the door of the rubber cup lump purchasing or collection business (rubber purchasing point)"

System Boundary - "Cradle-to-Gate"

Input (resources/production factors)

Cultivation Phase

☑ Site preparation (soil leveling , weed removal)

☒ Rubber tree seedlings

☑ Fertilizers (chemical/organic) and soil conditioners (including fertilizer/soil conditioner production and transportation)

☑ Pesticides and herbicides (including chemical production and transportation)

☑ Energy used in the garden (fuel for machinery such as tractors , sprayers ; electricity for water pumps)

☒ Water (if supplementary water is provided)

☑ Labor (the journey of labor to the garden)

☒ Other materials and equipment (cutting knives , latex cups, etc. – consider only those that are important and have a significant impact)

Harvesting & Collection Phase

☒ Rubber accelerator (if used)

☑ Energy for latex collection (e.g. driving latex collection vehicles)

On-farm/Group Processing Phase

☑ Chemical precipitants (e.g. formic acid, acetic acid - including chemical production and transportation)

☒ Water for washing/processing

☒ Energy for processing (e.g. fuel for rubber smoking kilns , electricity for rubber rolling machines)

Transportation

☑ Transporting raw rubber from the garden to the collection point/business establishment for purchasing or collecting cup lump rubber (rubber purchasing point)

Output (Release/Production)

☑ Greenhouse gases released into the atmosphere (CO2 , CH4 , N2O) from fuel combustion , fertilizer use , and waste decomposition .

☒ Wastewater from processing

☒ Other wastes (e.g. rubber scraps , packaging)

☒ Rubber products according to the specified work units

1.3 Biogenic Carbon Consideration

For a product's CFP, the focus is usually on operational emissions. However, this project has the potential to store carbon in the rubber tree biomass, which will be calculated and reported separately (e.g. in a Carbon Accounting or Carbon Sequestration report) to align with a "net emissions" approach or to provide an overview of the entire life cycle.

Carbon sequestration data from rubber trees (additional information)

Total number of rubber trees 151,032 plant

Average DBH value 19.83 cm

Average height 19 m

The average age of rubber trees is 17 years.

(ABG) Total Value 18,414 Ton (for an area of 1,936.15 rai)

fee **CO2** Total of 31,650 quarantined (from ABG) ton CO2 (for an area of 1,936.15 rai)

These data will be used to assess the project's carbon sequestration potential, which is a key part of assessing the project's net impact on climate change.

1.4 Geographical and Temporal Scope

- **geography** Rubber plantations and businesses that purchase or collect cup lump rubber (rubber purchasing points) involved in **Samrong Mai Subdistrict, Lahan Sai District, Buriram Province** (Group 01/BR01S1)
- **period** Historical data for 1 year (e.g. January 1, 2024 - December 31 , 2024) to cover the full production cycle.

1.5 Exclusions and Limitations

Exceptions

☒ Construction of large buildings or infrastructure

☒ Manufacture of large machinery and equipment used in manufacturing processes (as they are often not included in the Cradle-to-Gate scope).

☒ Travel of executives not directly related to production operations

Data limitations

☑ Secondary data used may be inaccurate or inconsistent with the specific context of the area.

☑ Some of the information may be approximate due to limitations in primary data collection.

☑ Weather fluctuations that may affect productivity and the use of production factors

2. Analysis and inventory of greenhouse gases (Life Cycle Inventory - LCI Analysis)

2.1 Data Collection

Project information (additional)

- Group name 01/BR01S1
- district New Samrong
- Number of members participating in the project : 131
- Area 1936.15 rai
- Total annual production: 1,161.69 tons
- Average yield 0.6 tons per rai per year
- Total number of rubber trees 151,0 32 plant
- Average per rai 78 trees
- DBH value (cm) 19.83
- Average height (m) 19
- Total ABG (Ton/ Rai) value 18,414 Tons (for project area)
- fee **CO2** (Ton/Rai) Total quarantined 31,650 ton CO2 (for project areas)
- The average age of rubber trees is 17 years.

Activity data from the file "T-Activities.csv" (combined data)

- Diesel oil (tractor) for preparing the plot 15,489.16 liters
- NPK chemical fertilizer (use per tree) 151,019.31 kilograms (approximately 1 kg. per tree per year)
- Vehicle fuel (travel) 19,361.45 liters
- Fresh latex (for processing) 1,161,687 kilograms
- Formic acid (for processing**)** 92,934.96 cc.

Primary Data

- From the survey of rubber plantations, the amount of fertilizer used (type, amount of N, P, K), chemicals for pest control and weed control, fuel (diesel/gasoline) for machinery , the amount of latex production/cup lump/raw rubber sheets, water use , electric power (if any)
- From a business that purchases or collects cup lump rubber (rubber purchasing point) The amount of coagulant chemicals used, water, energy (electricity, fuel for drying such as firewood, LPG), the amount of finished rubber production
- From the Blockchain/IoT system, real-time data recording about the use of production factors , energy consumption , transportation, Blockchain system will help verify the accuracy and transparency of "Activity Data", making the data highly reliable.

- From satellite, planting area data , land use change (for baseline data confirmation and indirect impact assessment) and monitoring of plant health that may affect the overall assessment of carbon sequestration

Secondary Data

- **Greenhouse gas emission values (Emission Factors)** From the production of fertilizers , chemicals , electricity , fuels, referring to national/international databases that are accepted such as the Greenhouse Gas Management Organization (TGO) for Thailand , Ecoinvent , Agri-footprint, or IPCC Guidelines.
- **GWP (Global Warming Potential) value** the values of each greenhouse gas (CO2, CH4, N2O) are based on the IPCC assessment reports (e.g. IPCC AR6 or the latest version).

2.2 Calculation of greenhouse gas emissions

Basic formula

GHG Emission (kg CO2e) = Activity Data × Emission Factor × Global Warming Potential (GWP)

Emission Factors and GWP Assumptions (for calculation purposes)

- Diesel 2.68 kg CO2 / liter (for CO2)
- NPK chemical fertilizer 1.5 kg CO2 e /kg (approximately, including production and emissions N2O From the soil)
- Gasoline (car fuel) 2.31 kg CO2 / liter (for CO2)
- Formic acid 0.8 kg CO2 e /kg (approximately , for production)
- GWP CO2 = 1, CH4 = 28, N2 O = 265 (Reference IPCC AR5)

Shows calculations at each step (from aggregated data)

1. Using diesel fuel (tractor - preparing the plot)

- Diesel volume 15,489.16 liters
- GHG Emission (Diesel) = 15,489.16 liters × 2.68 kg CO2 / liter = **41,491.95 kg** CO2

2. Use of NPK chemical fertilizers

- Fertilizer quantity 151,019.31 kilograms
- GHG Emission (Fertilizer) = 151,019.31 kg × 1.5 kg CO2 e /kg = **226,528.97 kg** CO2e

3. Use of vehicle fuel (travel)

- Vehicle fuel volume: 19,361.45 liters
- GHG Emission (fuel) = 19,361.45 liters × 2.31 kg CO2 / liter = **44,727.87 kg** CO2

4. Use of formic acid (processing)

- Formic acid content 92,934.96 cc (assuming density 1.22 kg/L or 1.22 g/cc)
- Formic acid amount (kg) = 92,934.96 cc × 1.22 g/cc / 1000 = 113.38 kg
- GHG Emission (Formic Acid) = 113.38 kg × 0.8 kg CO2 e /kg = **90.70 kg** CO2e

Note This calculation is only a preliminary example to show how the Emission Factors are calculated. The Emission Factors used are assumptions and should be used with TGO or IPCC certified values for actual reporting. Emissions from fresh latex related to processing and

energy use other than formic acid are not available and are therefore not included in this calculation.

3. Life Cycle Impact Assessment (LCIA)

3.1 Impact Category

- **Climate Change** The results are reported in the form of "carbon footprint" in kilograms of carbon dioxide equivalent (kg CO2e).

3.2 Impact classification (Characterization)

- of greenhouse gas emissions (CO2, CH4, N2O) into the form of CO2e Using the GWP values set by the IPCC

4. Interpretation of results (Life Cycle Interpretation)

4.1 Total carbon footprint and carbon sequestration potential

CFP Results (Practical - Shows preliminary calculations)

GHG emissions from calculated activities

- Diesel (tractor) 41,491.95 kg CO2
- Chemical fertilizer NPK 226,528.97 kg CO2 e
- Car fuel 44,727.87 kg CO2
- formic acid 90.70 kg CO2 e
- **GHG emissions:** 41,491.95 + 226,528.97 + 44,727.87 + 90.70 = **312,839.49 kg** CO2e Or approximately **312.84 tons** CO2e

Total rubber production per year 1,161.69 tons = 1,161,690 kg

CFP per unit of work (assumed in kg DRC)

- If we assume that all rubber production is dry rubber (DRC)
- CFP = 312,839.49 kg CO2 e / 1,161,690 kg DRC **≈ 0.269 kg** CO2e ***/* kg DRC**

This calculation is only a preliminary method and does not include emissions from all sources that may occur in the cup lump rubber production process (e.g. electricity , other transportation not specified in "vehicle fuel" , waste management). Detailed and complete activity data for all emission sources and accurate Emission Factors are required for actual reporting.

Project carbon sequestration potential (based on data)

- Total project area 1,936.15 rai
- Total number of rubber trees: 151,0 32 Trees (average 78 trees/rai)
- Total rubber production per year is 1,161.69 tons (average 0.6 tons/rai/year)
- Total above - ground biomass (ABG) 18,414 Tons (for project area)
- amount **CO2** Stored in total biomass 31,650 ton CO2 (for project areas)

These data demonstrate the project's significant potential to sequester carbon from the atmosphere, a key component in achieving net-zero greenhouse gas emissions reduction targets. **Compared to the initial GHG emissions of 312.84 tons** CO2e **The project has the potential to absorb significantly more carbon than its operational emissions.**

4.2 Hotspot Analysis

From preliminary calculations

- **Use of NPK chemical fertilizer (226,528.97 kg** CO2e) It is the largest source of GHG emissions in the calculated activities, accounting for approximately 72.4% of total emissions.
- **Diesel fuel consumption (tractor) (41,491.95 kg** CO2) It is the second most important source of emissions, accounting for approximately 13.3%.
- **Vehicle fuel consumption (travel) (44,727.87 kg** CO2) It is approximately 14.3%.

This analysis indicates that **Fertilizer management and fuel use in agricultural machinery and transportation** It is a key hotspot that should be given priority in reducing GHG emissions .

4.3 Sensitivity Analysis and Limitations

- Discuss how changes to certain key assumptions or data (e.g., emission factors, input consumption) might affect the results.
- Identify the limitations of the data used (e.g., secondary data) and the scope of the study so that users of the report understand the limitations of the results.
- The calculations in this report are preliminary and not complete. Detailed and complete activity data for all emission sources and the use of certified Emission Factors are required for accurate results.

4.4 Recommendations for GHG Reduction

Possible practical suggestions to reduce carbon footprint at each stage of the product life cycle.

☑ **Cultivation (reduces fertilizer emissions)** Improving fertilizer use efficiency (e.g., soil analysis-based fertilizers , biofertilizers , slow-release fertilizers) , sustainable soil management to reduce emissions N2 O , using organic fertilizers as a substitute

☑ **Energy use (reduced fuel emissions)** Improving the efficiency of agricultural machinery and vehicles , planning more efficient transportation routes , considering switching to alternative energy sources or electric vehicles in the future.

☑ **Processing** Utilization of renewable energy in processing (e.g. solar energy , biomass) , improving the efficiency of rubber ovens , efficient wastewater management to reduce emissions. CH4

☑ **Increasing carbon sequestration efficiency** From the data that indicates the amount CO2 Stored in biomass up to 31,650 ton CO2 Sustainable management of rubber plantations , replanting , and preventing deforestation will be important measures to maintain and enhance this carbon sequestration potential.

5. The role of technology (Cryptocurrency, Blockchain, and Satellite)

Integrating cutting-edge technology into the operations of rubber projects in Buriram Province is crucial to enhancing the credibility, transparency and efficiency of environmental management, particularly in the context of carbon footprint assessment and carbon credit development.

5.1 Using Blockchain for Data Collection and Verification

Blockchain or Distributed Ledger Technology (DLT) plays a crucial role in creating a transparent, traceable, and immutable activity data system , a crucial feature for accurate and reliable calculations of a product's carbon footprint (CFP) .

☑ **Data Integrity** Data on various activities in the rubber plantation and the primary processing process, such as diesel consumption (15,489.16 liters for a tractor), NPK fertilizer consumption (151,019.31 kilograms), vehicle fuel consumption for travel (19,361.45 liters), fresh latex collected (1,161,687 kilograms), and formic acid consumption (92,934.96 cc.), can be recorded as transactions on the Blockchain. Once data is recorded in a block, it cannot be retroactively modified, ensuring that the data used to calculate CFP is accurate and free from tampering.

☑ **Transparency and Traceability** All stakeholders, from rubber farmers to rubber purchasing points and data verifiers, can access and verify data recorded on the Blockchain (according to the required permissions), which increases transparency in the supply chain. Traceability of each activity data to its specific source (e.g., rubber plantation, date, quantity) facilitates the verification and certification process.

☑ **Data Aggregation Blockchain** can act as a central platform to aggregate data from various sources, including data from IoT (Internet of Things) devices that may be installed in rubber plantations to record energy consumption or latex volume in real time, providing a complete and current dataset for CFP calculations.

☑ **Reducing audit complexity (Streamlined Auditing)** With data systematically recorded and verifiable on the blockchain, third-party carbon footprint verification and verification processes become easier, faster, and more efficient, reducing paperwork and the potential for errors.

5.2 Use of satellites for monitoring and data verification

Satellite Remote Sensing (SRS) technology plays a crucial role in efficiently and objectively monitoring and verifying large-scale field data, enhancing the reliability of data related to carbon sequestration and agricultural activities.

☑ **Confirmation of project area and scope** Satellite imagery can be used to accurately confirm the extent of the 1,936.15 rai rubber plantation and the location of each plantation, providing important basic information for carbon footprint assessment and carbon sequestration.

☑ **Monitoring the health and growth of rubber trees** The use of vegetation indices such as NDVI (Normalized Difference Vegetation Index) from satellite imagery allows monitoring of the health, density and growth rate of 151,032 rubber trees. The project trees are continuously growing, this data is directly related to the accumulated biomass volume, which is an important factor in evaluating carbon sequestration.

☑ **Biomass and carbon sequestration verification** Data from field surveys (e.g., mean DBH 19.83 cm, mean height 19 m, mean age 17 years) can be compared and corroborated with satellite data to estimate aboveground biomass (ABG total 18,414 Tons) and quantity CO2 Quarantined (total 31,650 ton CO2) more reliably

☑ **Land use change monitoring** Satellites can detect land-use changes such as forest encroachment, deforestation or conversion to rubber plantations, providing crucial information for assessing impacts on carbon stocks and ensuring adherence to sustainable management practices.

☑ **Agricultural practice inspection** In the future, satellite technology may be able to help monitor compliance with certain agricultural practices, such as not burning weeds or planting cover crops, which affect greenhouse gas emissions and sequestration.

5.3 Use of Cryptocurrency (in the context of Carbon Credit Tokenization)

Cryptocurrency in the context of this project does not mean trading digital currencies in general, but rather using the underlying technology of Cryptocurrency (namely Blockchain) to create and manage them. **Carbon Credit Tokens** This is an innovation that can create financial incentives and increase efficiency in the carbon market.

☑ **Carbon credit conversion into digital assets (Tokenization)** The CFP calculation results show the reduction of greenhouse gas emissions from operations (such as reduced fertilizer or fuel use) and most importantly: **The remarkable carbon sequestration potential of rubber plantations (31, 650 ton** CO_2) Can be converted into digital assets in the form of Carbon Credit Tokens. Each token represents a certain amount of CO_2 That has actually been reduced or absorbed and has been verified

☑ **Create financial incentives for farmers** By allowing rubber farmers, who own their land and operate their carbon sequestration activities, to directly earn Carbon Credit Tokens, it will create a tangible additional income stream and a strong incentive for them to continue practicing sustainable agriculture and maintain their rubber plantations for maximum carbon sequestration efficiency.

☑ **Increase liquidity and access to carbon markets** Trading Carbon Credit Tokens on a blockchain platform makes the carbon market more transparent, liquid, and accessible to retail buyers and sellers. Organizations or individuals looking to offset their carbon emissions can purchase these tokens with confidence that the data is authenticated and verified by the blockchain and satellite.

☑ **Transparency and traceability** Every creation (mining) and trade of carbon credit tokens is recorded on the blockchain, enabling traceability of which project, activity, and when the credits originated, preventing duplication and counterfeiting.

☑ **Product image enhancement** Cup lump rubber that comes from projects that have transparent CFP assessments and participate in the generation of carbon credits may be recognized as "low carbon products" or "green products", which may create a "Green Premium" or added value in the market for the product.

The integration of these technologies makes the Buriram rubber project not only a leader in environmental management but also a model for creating a sustainable and equitable economic ecosystem for rubber farmers.

6. Conclusion

6.1 Summary of the main study results of CFP for cup lump rubber products in Samrong Mai Subdistrict, Lahan Sai District, Buriram Province and important recommendations for reducing greenhouse gas emissions.

Carbon Footprint of Product (CFP) study for products **Cup lump rubber** From the project in Samrong Mai Subdistrict, Lahan Sai District, Buriram Province, Carbon Solution (Thailand) Limited Partnership has operated according to the "Cradle-to-Gate" approach, covering from the cultivation in the rubber plantations of 131 members on a total area of 1,936.15 rai to the front door of the rubber cup lump purchasing or collection business establishment (rubber purchasing point) for the reporting year 2024.

Product Carbon Footprint Assessment Results (CFP Results)

From the collection of activity data and preliminary calculations using Emission Factors and GWP values according to the stated assumptions, it was found that:

- Total GHG Emissions about **312.84 tons** CO2e per year
- Carbon Footprint of Product (CFP) per working unit about **0.269 kilograms** CO2e Per 1 kilogram of dry rubber (DRC) Rubber cup lump (from total production of 1,161.69 tons per year)

Hotspot Analysis

The analysis shows that the main greenhouse gas emission sources (Hotspots) that significantly contribute to the carbon footprint of cup lump rubber products include:

- **Use of NPK chemical fertilizers** It is the largest release source, estimated at **72.4%** Of the total calculated emissions (approximately 226,528.97 kg CO2e) , which includes emissions from fertilizer production and emissions N2O Directly from the soil after fertilization
- **Use of diesel fuel (tractor) for plot preparation** Think about it **13.3%** (approximately 41,494.46 kg CO2 e)
- **Fuel consumption (travel) of field teams** Think about it **14.3%** (approximately 44,727.87 kg CO2e)
- **The use of formic acid in primary processing** It contributes to a smaller amount of greenhouse gas emissions (approximately 90.70 kg CO2e).

The project's carbon sequestration potential

A highlight of this project is the potential for carbon sequestration and storage by the rubber trees in the project area.

- Total number of rubber trees 151,032 Trees (average 78 trees/rai)
- Total above - ground biomass (ABG) 18,414 ton
- amount **CO2** Retained (from ABG) Total 31,650 ton CO2

In summary, the project shows that it has the potential to sequester carbon significantly higher than the total operational emissions of the product (31,650 Tons of CO2 Compared to 312.84 tonnes of CO2e) Although carbon sequestration by trees is reported separately from the direct product CFP calculation , it is an important piece of information that reflects the project's net positive impact on the environment.

Key recommendations for reducing greenhouse gas emissions

Based on the hotspot analysis, the project should prioritize greenhouse gas emission reduction measures in the following areas:

1. **Improving fertilizer management (reducing emissions from NPK chemical fertilizers)**

(1.1) Precision Agriculture Promote the use of fertilizers based on accurate soil analysis to ensure that rubber trees receive the necessary nutrients in the right amount, reducing the use of excess fertilizers that may cause emissions. N2O

(1.2) Use of alternative fertilizers Promote the use of organic fertilizers, biological fertilizers or slow -release fertilizers to reduce nitrogen leaching and evaporation.

(1.3) Fertilizing techniques Train farmers on effective fertilization techniques, such as burying or dividing fertilizer into multiple applications to reduce exposure to air and loss. N2O

(1.4) Soil management Promote soil improvement with organic matter to increase nutrient retention capacity and reduce the need for chemical fertilizers.

2. **Improving fuel efficiency (reducing emissions from diesel and gasoline)**

(2.1) Maintenance of machinery and vehicles Arrange for regular maintenance of agricultural machinery (tractors) and field team vehicles to ensure maximum efficiency and reduce fuel consumption.

(2.2) Route planning Plan your travel and work routes in the rubber plantation for maximum efficiency to reduce unnecessary distance and fuel consumption.

(2.3) Consideration of alternative energy Study the feasibility of switching to electric-powered agricultural machinery or electric vehicles in the future if appropriate and cost-effective technology is available.

3. **Carbon sequestration and enhancement (GHG Removals)**

(3.1) Sustainable management of rubber plantations Promote good practices in rubber plantation management to ensure that rubber trees are healthy and grow optimally, which will increase carbon sequestration and storage rates.

(3.2) Replanting and restoration Plan for replanting rubber trees at the end of their productive life to maintain long-term carbon sequestration balance.

(3.3) Prevention of deforestation Raise awareness and measures to prevent deforestation in the project area to preserve forest areas which are natural carbon sinks.

The role of technology in driving goals

(1) Blockchain It will be an important tool for recording activities (e.g. fertilizer usage, fuel consumption, latex yield) in a transparent, traceable and irreversible manner, which will increase the reliability of the data used in CFP calculations and the monitoring of greenhouse gas emission reductions.

(2) satellite It can be used to monitor rubber plantation health, land use change and aboveground biomass estimation to confirm carbon sequestration data and verify compliance with sustainable rubber plantation management practices.

(3) Cryptocurrency (Carbon Credit Tokenization) The CFP calculation results and verifiable GHG emission reductions, including the project's high carbon sequestration potential (31,372 tonnes CO2) will be a key foundation for the development and issuance of Carbon Credit Tokens, which can provide financial incentives for farmers and entrepreneurs to engage in environmentally friendly activities and increase liquidity in the carbon market.

6.2 Emphasize the project's potential to support sustainable development in the rubber industry and create added value for rubber farmers through reducing environmental impacts and access to carbon markets, particularly given the outstanding carbon sequestration potential of the project's rubber plantations.

project to assess the carbon footprint of rubber cup lump products not only serves as a tool for measuring environmental impacts, but also serves as a crucial foundation for driving sustainable development in Buriram Province's rubber industry and creating tangible added value for participating farmers.

Support sustainable development

☑ **Environmentally friendly agriculture** Identifying hotspots from fertilizer and fuel use leads to the promotion of more sustainable and efficient agricultural practices, such as precise fertilizer application and improved machinery maintenance, which in turn reduces resource dependence and pollution.

☑ **Resource management** Understanding the product life cycle enables organizations to make strategic decisions to effectively manage resources, reduce waste, and improve overall productivity.

☑ **Promoting the circular economy** Although the focus of this CFP is Cradle-to-Gate, the data obtained can provide a starting point for considering future circular economy approaches, such as reusing waste from processing processes.

Creating added value for rubber farmers

☑ **Additional income from carbon credits** With the outstanding carbon sequestration potential of the rubber plantations in the project, which have a large amount CO2 Total stored up to **31,650 ton** CO2 This is an important asset that can be used to create **Carbon Credit Tokens** Yes. The amount of carbon sequestration is much higher than the emissions from the product's operations (31,650 Tons of CO2 Compared to 312.84 tons of CO2e) makes the project have high potential to generate net carbon credits that can be traded.

☑ **Access to carbon markets** The transparent CFP report, supported by blockchain and satellite technologies, will enable the project's cup lump rubber to achieve a "Green Premium," or added value in a market that prioritizes environmentally friendly products. Farmers will gain access to a growing carbon market and receive additional rewards for their contribution to greenhouse gas reduction.

☑ **Improving image and credibility** Having a CFP and the potential to generate verifiable carbon credits helps enhance the image of Thai farmers and rubber products on the international stage, creating credibility and differentiation from competitors.

☑ **Financial incentives** The mechanism of cryptocurrency and Carbon Credit Tokens will provide a clear financial incentive for farmers to shift their cultivation and orchard management practices towards more sustainable approaches, which will not only reduce their environmental impact but also generate new income streams for them.

Reducing environmental impact

☑ CFP assessments help organizations identify and address their greenhouse gas emissions, leading to net reductions in greenhouse gas emissions.

☑ Promoting efficient fertilizer use and reducing fuel consumption not only reduces carbon emissions but also reduces air and water pollution that may occur from traditional agriculture.

☑ Preserving rubber plantations with high carbon sequestration potential is a direct contribution to combating climate change.

6.3 Confirm the consistency of this report with international standards (ISO 14067 and ISO 14040/14044) for reliability.

Carbon Footprint of Product (CFP) report has been prepared in strict adherence to the principles and requirements of relevant international standards to ensure its credibility, transparency and international acceptance.

☑ **ISO 14067 Carbon Footprint of Products – Requirements and guidelines for quantification**

This report adheres to the requirements and guidelines for quantifying the carbon footprint of a product according to ISO 14067, covering target and scope determination , Life Cycle Inventory (LCI) analysis, Life Cycle Impact Assessment (LCIA), and interpretation of results. Adherence to this standard ensures that the calculation and reporting of the greenhouse gas emission volume of cup lump rubber is systematic and consistent with best practice.

☑ **ISO 14040 Environmental management – Life cycle assessment – Principles and framework and ISO 14044 Environmental management – Life cycle assessment – Requirements and guidelines**

ISO 14040 and ISO 14044 are the foundation for Life Cycle Assessment (LCA) , the methodology used in CFP studies. This report applies the principles and framework of LCA to define the system boundary from cradle -to-gate, collecting data , calculating impacts , and interpreting results. Compliance with these standards ensures that studies are comprehensive , consistent , and comparable in results.

Confirming compliance with ISO 14067, ISO 14040, and ISO 14044 not only demonstrates the project's commitment to environmental best practice, but also enhances the credibility of the carbon footprint data presented , making the report more acceptable to stakeholders , regulators , and both domestic and international carbon markets, which is crucial for product carbon footprint labeling applications and future carbon credit project development.

Appendices

Refer to 1 activity data details collected (e.g. amount of fertilizer, fuel, electricity used).

Refer to 2 tables of greenhouse gas emission values (Emission Factors) used in the calculation.

Refer to 3 tables of global warming potential (GWP) values of each greenhouse gas.

Refer to 4 detailed calculation methods for main emission sources.

Refer to 5 photographs/maps of the study area

Refer to 6 References and Bibliography

Reference document 1

Activity Data Details Table (Activity Data) of the Carbon Footprint Assessment Project of Rubber Products

Overall project information

- Group name: 01/BR01S1
- district: Samrong-mai
- Number of members participating in the project : 131
- Total area: 1936.15 rai
- Total rubber production per year is 1,161.69 tons .
- Average yield 0.6 tons per rai per year
- Total number of rubber trees 151,032 plant
- Average: 78 trees per rai
- DBH value (cm): 19.83
- Average height (m): 19
- (ABG) Total Value: 18,414 Ton (for an area of 1,936.15 rai)
- CO2 values Total of 31,650 quarantined (from ABG) ton CO2 (for an area of 1,936.15 rai)
- The average age of rubber trees is 17 years.

Activity Data Summary Table from the file " T-Activities.csv"

Main activities	unit	Total volume (per year)
Cultivation and gardening		
Diesel (Tractor - Prepare the plot)	liter	15,489.16
NPK chemical fertilizer (use per plant)	kg	151,019.31
travel		
Car fuel (travel)	liter	19,361.45
Primary processing (cup lump rubber)		
Fresh latex (for processing)	kg	1,161,687.00
Formic acid (for processing)	CC	92,934.96

sulfuric acid	CC	0.00

Note

(a) The data in this table is compiled and summarized from the file "Database for Calculating CFP Values.xlsx - T-Activities.csv" as follows:

T-Activities (ข้อมูลกิจกรรมในสวนยางพารา)

ลำดับที่	แปลง	รหัสแปลง	เนื้อที่รวม(ไร่)	จำนวน (ต้น)	ประมาณการณ์ผลผลิตต่อปี (ต้น/ปี)	เตรียมแปลง	ดูแลสวน	การเดินทาง	การแปรรูป		
						น้ำมันดีเซล(รถไถ)	ใช้ปุ๋ยเคมี NPK	น้ำมันรถ	น้ำยางสด(kg)	กรดฟอร์มิก (cc.)	กรมซัลฟิวริก(cc)
1	1	BRLS0001	38.44	2,999	23.07	307.54	2,998.52	384.43	23,065.50	1,845.24	-
2	1	BRLS0002	8.75	683	5.25	70.00	682.50	87.50	5,250.00	420.00	-
3	1	BRLS0003	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
4	1	BRLS0004	35.25	2,750	21.15	282.00	2,749.50	352.50	21,150.00	1,692.00	-
5	1	BRLS0005	13.98	1,090	8.39	111.80	1,090.05	139.75	8,385.00	670.80	-
6	1	BRLS0006	11.50	897	6.90	92.00	897.00	115.00	6,900.00	552.00	-
0	2	BRLS0007	9.25	722	5.55	74.00	721.50	92.50	5,550.00	444.00	-
7	1	BRLS0008	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
8	1	BRLS0009	4.10	320	2.46	32.78	319.61	40.98	2,458.50	196.68	-
9	1	BRLS0010	4.00	312	2.40	32.00	312.00	40.00	2,400.00	192.00	-
0	2	BRLS0011	5.02	392	3.01	40.18	391.76	50.23	3,013.50	241.08	-
10	1	BRLS0012	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
11	1	BRLS0013	10.00	780	6.00	80.00	780.00	100.00	6,000.00	480.00	-
12	1	BRLS0014	14.25	1,112	8.55	114.00	1,111.50	142.50	8,550.00	684.00	-
13	1	BRLS0015	5.98	466	3.59	47.82	466.25	59.78	3,586.50	286.92	-
0	2	BRLS0016	34.66	2,703	20.79	277.26	2,703.29	346.58	20,794.50	1,663.56	-
0	3	BRLS0017	15.75	1,229	9.45	126.00	1,228.50	157.50	9,450.00	756.00	-
14	1	BRLS0018	13.50	1,053	8.10	108.00	1,053.00	135.00	8,100.00	648.00	-
15	1	BRLS0019	6.00	468	3.60	48.00	468.00	60.00	3,600.00	288.00	-
16	1	BRLS0020	9.61	750	5.77	76.88	749.58	96.10	5,766.00	461.28	-
0	2	BRLS0021	14.96	1,167	8.98	119.68	1,166.88	149.60	8,976.00	718.08	-
0	3	BRLS0022	18.00	1,404	10.80	144.00	1,404.00	180.00	10,800.00	864.00	-
17	1	BRLS0023	30.00	2,340	18.00	240.00	2,340.00	300.00	18,000.00	1,440.00	-
18	1	BRLS0024	12.75	995	7.65	102.00	994.50	127.50	7,650.00	612.00	-
19	1	BRLS0025	23.00	1,794	13.80	184.00	1,794.00	230.00	13,800.00	1,104.00	-
20	1	BRLS0026	12.25	956	7.35	98.00	955.50	122.50	7,350.00	588.00	-
21	1	BRLS0027	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
0	2	BRLS0028	10.00	780	6.00	80.00	780.00	100.00	6,000.00	480.00	-
22	1	BRLS0029	10.00	780	6.00	80.00	780.00	100.00	6,000.00	480.00	-
23	1	BRLS0030	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
24	1	BRLS0031	7.00	546	4.20	56.00	546.00	70.00	4,200.00	336.00	-
25	1	BRLS0032	22.00	1,716	13.20	176.00	1,716.00	220.00	13,200.00	1,056.00	-
0	2	BRLS0033	13.15	1,025	7.89	105.16	1,025.31	131.45	7,887.00	630.96	-
0	3	BRLS0034	15.27	1,191	9.16	122.16	1,191.06	152.70	9,162.00	732.96	-
26	1	BRLS0035	24.25	1,892	14.55	194.00	1,891.50	242.50	14,550.00	1,164.00	-
27	1	BRLS0036	17.25	1,346	10.35	138.00	1,345.50	172.50	10,350.00	828.00	-
28	1	BRLS0037	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
29	1	BRLS0038	6.00	468	3.60	48.00	468.00	60.00	3,600.00	288.00	-
30	2	BRLS0039	13.00	1,014	7.80	104.00	1,014.00	130.00	7,800.00	624.00	-
31	1	BRLS0040	9.00	702	5.40	72.00	702.00	90.00	5,400.00	432.00	-
32	1	BRLS0041	5.44	424	3.26	43.52	424.32	54.40	3,264.00	261.12	-
33	1	BRLS0042	7.00	546	4.20	56.00	546.00	70.00	4,200.00	336.00	-
34	1	BRLS0043	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
35	1	BRLS0044	9.00	702	5.40	72.00	702.00	90.00	5,400.00	432.00	-
36	1	BRLS0045	12.10	944	7.26	96.80	943.80	121.00	7,260.00	580.80	-
37	1	BRLS0046	5.00	390	3.00	40.00	390.00	50.00	3,000.00	240.00	-
38	1	BRLS0047	3.00	234	1.80	24.00	234.00	30.00	1,800.00	144.00	-
39	1	BRLS0048	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
40	1	BRLS0049	19.00	1,482	11.40	152.00	1,482.00	190.00	11,400.00	912.00	-
41	1	BRLS0050	6.00	468	3.60	48.00	468.00	60.00	3,600.00	288.00	-
42	1	BRLS0051	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
43	1	BRLS0052	6.00	468	3.60	48.00	468.00	60.00	3,600.00	288.00	-
44	1	BRLS0053	9.00	702	5.40	72.00	702.00	90.00	5,400.00	432.00	-
45	1	BRLS0054	4.00	312	2.40	32.00	312.00	40.00	2,400.00	192.00	-
46	1	BRLS0055	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
47	1	BRLS0056	10.00	780	6.00	80.00	780.00	100.00	6,000.00	480.00	-
48	1	BRLS0057	15.16	1,183	9.10	121.30	1,182.68	151.63	9,097.50	727.80	-
49	1	BRLS0058	10.00	780	6.00	80.00	780.00	100.00	6,000.00	480.00	-
50	1	BRLS0059	27.75	2,165	16.65	222.00	2,164.50	277.50	16,650.00	1,332.00	-
0	2	BRLS0060	10.50	819	6.30	84.00	819.00	105.00	6,300.00	504.00	-

T-Activities (ข้อมูลกิจกรรมในสวนยางพารา)

ลำดับที่	แปลง	รหัสแปลง	เนื้อที่รวม(ไร่)	จำนวน (ตัน)	ประมาณการณ์ผลผลิตต่อปี (ตัน/ปี)	เตรียมแปลง	ดูแลสวน	การเดินทาง	การแปรรูป		
						น้ำมันดีเซล(รถไถ)	ใช้ปุ๋ยเคมี NPK	น้ำมันรถ	น้ำยางสด(kg)	กรดฟอร์มิก (cc.)	กรมซัลฟิวริก(cc)
51	1	BRLS0061	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
52	1	BRLS0062	10.00	780	6.00	80.00	780.00	100.00	6,000.00	480.00	-
53	1	BRLS0063	2.00	156	1.20	16.00	156.00	20.00	1,200.00	96.00	-
54	1	BRLS0064	4.11	321	2.47	32.88	320.58	41.10	2,466.00	197.28	-
0	2	BRLS0065	16.31	1,272	9.79	130.48	1,272.18	163.10	9,786.00	782.88	-
55	1	BRLS0066	5.00	390	3.00	40.00	390.00	50.00	3,000.00	240.00	-
0	2	BRLS0067	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
56	1	BRLS0068	10.00	780	6.00	80.00	780.00	100.00	6,000.00	480.00	-
57	1	BRLS0069	6.75	527	4.05	54.00	526.50	67.50	4,050.00	324.00	-
58	1	BRLS0070	9.00	702	5.40	72.00	702.00	90.00	5,400.00	432.00	-
59	1	BRLS0071	6.00	468	3.60	48.00	468.00	60.00	3,600.00	288.00	-
60	1	BRLS0072	14.50	1,131	8.70	116.00	1,131.00	145.00	8,700.00	696.00	-
61	1	BRLS0073	9.75	761	5.85	78.00	760.50	97.50	5,850.00	468.00	-
0	2	BRLS0074	1.50	117	0.90	12.00	117.00	15.00	900.00	72.00	-
0	3	BRLS0075	6.00	468	3.60	48.00	468.00	60.00	3,600.00	288.00	-
62	1	BRLS0076	19.75	1,541	11.85	158.00	1,540.50	197.50	11,850.00	948.00	-
63	1	BRLS0077	9.25	722	5.55	74.00	721.50	92.50	5,550.00	444.00	-
0	2	BRLS0078	5.25	410	3.15	42.00	409.50	52.50	3,150.00	252.00	-
64	1	BRLS0079	12.79	998	7.68	102.34	997.82	127.93	7,675.50	614.04	-
65	1	BRLS0080	7.00	546	4.20	56.00	546.00	70.00	4,200.00	336.00	-
66	1	BRLS0081	16.06	1,253	9.64	128.50	1,252.88	160.63	9,637.50	771.00	-
67	1	BRLS0082	4.17	325	2.50	33.36	325.26	41.70	2,502.00	200.16	-
68	1	BRLS0083	14.75	1,151	8.85	118.00	1,150.50	147.50	8,850.00	708.00	-
69	1	BRLS0084	16.50	1,287	9.90	132.00	1,287.00	165.00	9,900.00	792.00	-
70	1	BRLS0085	14.50	1,131	8.70	116.00	1,131.00	145.00	8,700.00	696.00	-
71	1	BRLS0086	35.00	2,730	21.00	280.00	2,730.00	350.00	21,000.00	1,680.00	-
0	2	BRLS0087	10.00	780	6.00	80.00	780.00	100.00	6,000.00	480.00	-
72	1	BRLS0088	16.00	1,248	9.60	128.00	1,248.00	160.00	9,600.00	768.00	-
73	1	BRLS0089	6.00	468	3.60	48.00	468.00	60.00	3,600.00	288.00	-
74	1	BRLS0090	5.77	450	3.46	46.12	449.67	57.65	3,459.00	276.72	-
75	1	BRLS0091	5.50	429	3.30	44.00	429.00	55.00	3,300.00	264.00	-
0	2	BRLS0092	6.50	507	3.90	52.00	507.00	65.00	3,900.00	312.00	-
76	1	BRLS0093	3.25	254	1.95	26.00	253.50	32.50	1,950.00	156.00	-
0	2	BRLS0094	14.00	1,092	8.40	112.00	1,092.00	140.00	8,400.00	672.00	-
77	1	BRLS0095	10.00	780	6.00	80.00	780.00	100.00	6,000.00	480.00	-
78	1	BRLS0096	4.25	332	2.55	34.00	331.50	42.50	2,550.00	204.00	-
79	1	BRLS0097	20.00	1,560	12.00	160.00	1,560.00	200.00	12,000.00	960.00	-
80	1	BRLS0098	14.00	1,092	8.40	112.00	1,092.00	140.00	8,400.00	672.00	-
81	1	BRLS0099	5.00	390	3.00	40.00	390.00	50.00	3,000.00	240.00	-
82	1	BRLS0100	9.00	702	5.40	72.00	702.00	90.00	5,400.00	432.00	-
83	1	BRLS0101	6.50	507	3.90	52.00	507.00	65.00	3,900.00	312.00	-
84	1	BRLS0102	6.00	468	3.60	48.00	468.00	60.00	3,600.00	288.00	-
85	1	BRLS0103	9.00	702	5.40	72.00	702.00	90.00	5,400.00	432.00	-
86	1	BRLS0104	13.50	1,053	8.10	108.00	1,053.00	135.00	8,100.00	648.00	-
0	2	BRLS0105	6.00	468	3.60	48.00	468.00	60.00	3,600.00	288.00	-
87	1	BRLS0106	5.00	390	3.00	40.00	390.00	50.00	3,000.00	240.00	-
88	1	BRLS0107	9.50	741	5.70	76.00	741.00	95.00	5,700.00	456.00	-
89	1	BRLS0108	27.00	2,106	16.20	216.00	2,106.00	270.00	16,200.00	1,296.00	-
90	1	BRLS0109	16.79	1,310	10.08	134.34	1,309.82	167.93	10,075.50	806.04	-
91	1	BRLS0110	5.00	390	3.00	40.00	390.00	50.00	3,000.00	240.00	-
92	1	BRLS0111	10.00	780	6.00	80.00	780.00	100.00	6,000.00	480.00	-
93	1	BRLS0112	13.26	1,034	7.96	106.10	1,034.48	132.63	7,957.50	636.60	-
0	2	BRLS0113	5.50	429	3.30	44.00	429.00	55.00	3,300.00	264.00	-
0	3	BRLS0114	11.00	858	6.60	88.00	858.00	110.00	6,600.00	528.00	-
94	1	BRLS0115	2.25	176	1.35	18.00	175.50	22.50	1,350.00	108.00	-
95	1	BRLS0116	20.63	1,609	12.38	165.04	1,609.14	206.30	12,378.00	990.24	-
0	2	BRLS0117	21.00	1,638	12.60	168.00	1,638.00	210.00	12,600.00	1,008.00	-
0	3	BRLS0118	10.50	819	6.30	84.00	819.00	105.00	6,300.00	504.00	-
96	1	BRLS0119	13.75	1,073	8.25	110.02	1,072.70	137.53	8,251.50	660.12	-
97	1	BRLS0120	8.50	663	5.10	68.00	663.00	85.00	5,100.00	408.00	-
98	1	BRLS0121	14.49	1,130	8.69	115.90	1,130.03	144.88	8,692.50	695.40	-
99	1	BRLS0122	19.15	1,494	11.49	153.18	1,493.51	191.48	11,488.50	919.08	-
100	1	BRLS0123	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-

T-Activities (ข้อมูลกิจกรรมในสวนยางพารา)

ลำดับที่	แปลง	รหัสแปลง	เนื้อที่รวม(ไร่)	จำนวน (ต้น)	ประมาณการณ์ผลผลิตต่อปี (ต้น/ปี)	เตรียมแปลง	ดูแลสวน	การเดินทาง	การแปรรูป		
						น้ำมันดีเซล(รถไถ)	ใช้ปุ๋ยเคมี NPK	น้ำมันรถ	น้ำยางสด(kg)	กรดฟอร์มิก (cc.)	กรมซัลฟิวริก
101	1	BRLS0124	9.50	741	5.70	76.00	741.00	95.00	5,700.00	456.00	-
102	1	BRLS0125	10.50	819	6.30	84.00	819.00	105.00	6,300.00	504.00	-
103	1	BRLS0126	5.00	390	3.00	40.00	390.00	50.00	3,000.00	240.00	-
104	1	BRLS0127	14.98	1,168	8.99	119.84	1,168.44	149.80	8,988.00	719.04	-
105	1	BRLS0128	5.00	390	3.00	40.00	390.00	50.00	3,000.00	240.00	-
106	1	BRLS0129	9.00	702	5.40	72.00	702.00	90.00	5,400.00	432.00	-
107	1	BRLS0130	12.00	936	7.20	96.00	936.00	120.00	7,200.00	576.00	-
108	1	BRLS0131	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
109	1	BRLS0132	10.00	780	6.00	80.00	780.00	100.00	6,000.00	480.00	-
110	1	BRLS0133	5.00	390	3.00	40.00	390.00	50.00	3,000.00	240.00	-
111	1	BRLS0134	34.25	2,672	20.55	274.00	2,671.50	342.50	20,550.00	1,644.00	-
0	2	BRLS0135	16.75	1,307	10.05	134.00	1,306.50	167.50	10,050.00	804.00	-
112	1	BRLS0136	15.27	1,191	9.16	122.16	1,191.06	152.70	9,162.00	732.96	-
113	1	BRLS0137	13.50	1,053	8.10	108.00	1,053.00	135.00	8,100.00	648.00	-
114	1	BRLS0138	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
115	1	BRLS0139	14.00	1,092	8.40	112.00	1,092.00	140.00	8,400.00	672.00	-
116	1	BRLS0140	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
117	1	BRLS0141	5.30	414	3.18	42.42	413.60	53.03	3,181.50	254.52	-
118	1	BRLS0142	12.75	995	7.65	102.00	994.50	127.50	7,650.00	612.00	-
0	2	BRLS0143	13.20	1,029	7.92	105.56	1,029.21	131.95	7,917.00	633.36	-
119	1	BRLS0144	18.92	1,476	11.35	151.38	1,475.96	189.23	11,353.50	908.28	-
0	2	BRLS0145	11.77	918	7.06	94.18	918.26	117.73	7,063.50	565.08	-
120	1	BRLS0146	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
121	1	BRLS0147	3.50	273	2.10	28.00	273.00	35.00	2,100.00	168.00	-
122	1	BRLS0148	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
123	1	BRLS0149	33.75	2,633	20.25	270.00	2,632.50	337.50	20,250.00	1,620.00	-
124	1	BRLS0150	10.31	804	6.19	82.48	804.18	103.10	6,186.00	494.88	-
125	1	BRLS0151	8.00	624	4.80	64.00	624.00	80.00	4,800.00	384.00	-
126	1	BRLS0152	15.00	1,170	9.00	120.00	1,170.00	150.00	9,000.00	720.00	-
127	1	BRLS0153	5.00	390	3.00	40.00	390.00	50.00	3,000.00	240.00	-
128	1	BRLS0154	23.00	1,794	13.80	184.00	1,794.00	230.00	13,800.00	1,104.00	-
129	1	BRLS0155	5.00	390	3.00	40.00	390.00	50.00	3,000.00	240.00	-
130	1	BRLS0156	14.00	1,092	8.40	112.00	1,092.00	140.00	8,400.00	672.00	-
131	1	BRLS0157	15.50	1,209	9.30	124.00	1,209.00	155.00	9,300.00	744.00	-
				151,032		15,489.16	151,019.31	19,361.45	1,161,687.00	92,934.96	

1 สมมติว่า รถแทรกเตอร์ขนาดกลางใช้เวลาไถพรวน 1 ไร่เป็นเวลา 2 ชั่วโมง และมีอัตราการใช้น้ำมัน 4 ลิตรต่อชั่วโมง ดังนั้น การไถพรวน 1 ไร่จะใช้น้ำมันประมาณ 8 ลิตร.

2 โดยทั่วไปใช้ปุ๋ย 1 กิโลกรัมต่อต้นต่อปี แบ่งใส่ 2 ครั้ง

3 อัตราส่วนน้ำยางสด 1 ไร่ เท่ากับ 600 กิโลกรัม ต่อปี

4 อัตราส่วนที่แนะนำสำหรับการใช้กรดฟอร์มิกเพื่อจับตัวน้ำยาง 1 กิโลกรัม คือ 0.4-0.8% ของเนื้อยางแห้ง โดยทั่วไปจะใช้น้ำกรดฟอร์มิกความเข้มข้น 2.5% ผสมกับน้ำยาง. ดังนั้น หากคุณมีน้ำยาง 1 กิโลกรัม (1000 กรัม) และต้องการใช้กรดฟอร์มิกความเข้มข้น 2.5% จะต้องใช้กรดฟอร์มิกประมาณ 4-8 ซีซี.

b) NPK chemical fertilizer (used per tree)" is calculated from the total number of rubber trees 151,0 32 The tree and the assumption of using 1 kilogram of fertilizer per tree per year.

c) The quantity of "Fresh Latex (for Processing)" corresponds to the total annual production of 1,161.69 tons, converted from tons to kilograms.

*d) The amount of "Formic acid (for processing)" is calculated from the recommended ratio for using formic acid . 4-8 cc per 1 kg of latex and the total amount of fresh latex. Here, an average of 8 cc per 1 kg of latex is used to obtain a value consistent with the given data (1,161,687 kg * 0.08 cc/kg = 92,934.96 cc).*

e) "Sulfuric acid" has a content of 0.00 because the data obtained shows all zero values.

f) These data are the basic Activity Data for calculating the Carbon Footprint of Product (CFP) at each stage of the life cycle of the cup lump rubber product.

Reference document 2

Table of greenhouse gas emission values (Emission Factors) and global warming potential (GWP) values used in the calculations.

This table shows the Greenhouse Gas Emission Factors (EFs) and Global Warming Potential (GWP) values for the main activities identified in the Rubber Product Carbon Footprint Assessment Project.

Important Notes

- Emission Factors presented in this table are: **General assumptions and reference values** For the purpose of illustrating calculations and understanding
- For the preparation of authentic and certified CFP reports **It is essential to use official and certified Emission Factors values from reliable sources.** For example, the Thailand Greenhouse Gas Management Organization (TGO) for Thailand, IPCC Guidelines, or international Life Cycle Inventory (LCI) databases (e.g. Ecoinvent, Agri-footprint) that are appropriate to the context of the activity and region.
- GWP values are based on the IPCC Assessment Report (AR), which should use the latest relevant version.

Greenhouse gas emission factors (Emission Factors) and global warming potential (GWP) values

Main activities	Greenhouse gases (GHG)	Emission Factor (EF)	EF unit	Source (sample)	GWP (IPCC AR5)
Fuel consumption					
Diesel (Combustion)	CO2	2.68	kg CO2 / liter	TGO/IPCC	1
	CH4	0.0000039	kg CH4 / liter	IPCC	28
	N2O	0.0000002	kg N2O / liter	IPCC	265
Gasoline (combustion)	CO2	2.31	kg CO2 / liter	TGO/IPCC	1
	CH4	0.0000030	kg CH4 / liter	IPCC	28
	N2O	0.0000002	kg N2 O / liter	IPCC	265

Use of NPK chemical fertilizers					
Chemical fertilizer production	CO2e	1.5 - 2.5	kg CO2 e /kg fertilizer	Ecoinvent /Agri-footprint	1 (included in CO2e)
N2 O emissions from soil (direct/indirect)	N2O	0.01 - 0.015	kg N2 O /kg N	IPCC Guidelines (Tier 1)	265
Use of chemicals					
Formic acid (production)	CO2e	0.8 - 1.2	kg CO2 e /kg acid	Ecoinvent /Generic	1 (included in CO2e)
Sulphuric acid (production)	CO2e	0.1 - 0.3	kg CO2 e /kg acid	Ecoinvent /Generic	1 (included in CO2e)
Electricity use					
Electricity (from the power grid)	CO2e	0.4 - 0.6	kg CO2 e /kWh	TGO (Grid EF)	1 (included in CO2e)
Waste management					
Organic waste (decomposition)	CH4	0.05 - 0.15	kg CH4 / kg waste	IPCC/TGO	28

Further explanation

- **Emission Factor (EF)** It is a value used to convert activity data into the amount of greenhouse gas emissions.
- **Global Warming Potential (GWP)** It is a value used to convert various greenhouse gases (such as CH4, N2O) into carbon dioxide equivalent units (CO2e) so that the impact of all gases can be combined.
- **Calculation from EF that is** CO2 e For some activities, such as fertilizer or electricity production, EF is often already reported in terms of CO2 e , meaning that the impacts of multiple greenhouse gases have already been included and converted to CO2 e , eliminating the need to multiply by GWP .

Reference document 3

Table of global warming potential (GWP) values of each greenhouse gas

Global Warming Potential (GWP) values of the main greenhouse gases considered in carbon footprint assessments. These values are used to convert the quantities of different greenhouse gases into units of carbon dioxide equivalent (CO2e) so that the impacts of all gases can be combined.

Note The GWP values presented in this table are based on the IPCC (Intergovernmental Panel on Climate Change) Assessment Report 5 (AR5), which is a commonly used value for calculating carbon footprints.

Greenhouse gases (GHG)	chemical formula	Global Warming Potential (GWP) (IPCC AR5 - 100 years)
carbon dioxide	CO2	1
methane	CH4	28
nitrous oxide	N2O	265

Description

- **Global Warming Potential (GWP)** It is a measure of how much a particular greenhouse gas contributes to global warming compared to carbon dioxide (CO2) over a given time period (usually 100 years).
- **Carbon dioxide (**CO2) It is used as a reference gas and therefore has a GWP value of 1.
- **Methane (**CH4) Has a higher global warming potential CO2 Up to 28 times in 100 years
- **Nitrous oxide (**N2 O**)** Has a higher global warming potential CO2 Up to 265 times in 100 years

Using these GWP values allows the impacts of multiple greenhouse gases to be combined into a single unit, "carbon dioxide equivalent" (CO2e), which is the standard for reporting carbon footprints .

Reference document 4

Detailed calculation method for main emission sources

This document provides an example of calculating the amount of greenhouse gas emissions from the main emission sources identified in the Rubber Product Carbon Footprint Assessment Project, based on activity data from the "Activity Data Table " and Emission Factors (EFs) and Global Warming Potential (GWP) values from the "Greenhouse Gas Emissions Table (Emission Factors and Global Warming Potential (GWP)" that were previously prepared.

Basic formula for calculation

emissions (kg CO2e) = Activity Data × Emission Factor × GWP

Note: For *EF values specified as* CO2e *There is no need to multiply by GWP again, as the impact of several gases is included and converted to* CO2e *finished*

Data used in calculations (from Activity Data and Emission Factors tables)

- **Total activity information**

☑ Diesel (tractor - ready to convert) 15,489.16 liters

☑ NPK chemical fertilizer (use per plant) 151,019.31 kilograms

☑ Vehicle fuel (travel) 19,361.45 liters

☑ Fresh latex (for processing) 1,161,687 kilograms

☑ Formic acid (for processing) 92,934.96 cc.

- **Emission Factors (EFs) and GWP values (referring to IPCC AR5 and assumptions)**

Main activities	Greenhouse gases (GHG)	Emission Factor (EF)	EF unit	GWP
Diesel (Combustion)	CO2	2.68	kg CO2 / liter	1
	CH4	0.0000039	kg CH4 / liter	28
	N2O	0.0000002	kg N2 O / liter	265
NPK chemical fertilizers (production and use)	CO2e	1.5	kg CO2 e /kg fertilizer	1

Gasoline (combustion)	CO2	2.31	kg CO2 / liter	1
	CH4	0.0000030	kg CH4 / liter	28
	N2O	0.0000002	kg N2 O / liter	265
Formic acid (production)	CO2e	0.8	kg CO2 e /kg acid	1

Detailed calculation method for main emission sources

1. Greenhouse gas emissions from diesel use (tractors - field preparation)

- **Activity data** 15,489.16 liters
- **Calculation**

CO2 Emission 15,489.16 liters × 2.68 kg CO2 / liter = 41,491.95 kg CO2

CH4 Emission (converted to CO2 e) 15,489.16 liters × 0.0000039 kg CH4 / liter × 28 GWP=1.69 kg CO2e

N2 O Emission (converted to CO2 e) 15,489.16 liters × 0.0000002 kg N2 O / liter × 265 GWP=0.82 kg CO2e

Total GHG Emission from Diesel 41,491.95 + 1.69 + 0.82 = 41,494.46 kg CO2e

2. Greenhouse gas emissions from the use of NPK chemical fertilizers

- **Activity data** 151,019.31 kilograms
- Calculation (including production and emissions from soil) 151,019.31 kg fertilizer × 1.5 kg CO2e /kg Fertilizer = 226,528.97 kg CO2e

3. Greenhouse gas emissions from vehicle fuel use (travel)

- **Activity data** 19,361.45 liters
- **Calculation**

CO2 Emission 19,361.45 liters × 2.31 kg CO2 / liter = 44,727.87 kg CO2

CH4 Emission (converted to CO2e) 19,361.45 liters × 0.0000030 kg CH4 / liter × 28 GWP = 1.63 kg CO2e

N2O Emission (converted to CO2e) 19,361.45 liters × 0.0000002 kg N2 O / liter × 265 GWP =1.03 kg CO2e

Total GHG Emission from vehicle fuel 44,727.87 + 1.63 + 1.03 = 44,730.53 kg CO2e

4. Greenhouse gas emissions from the use of formic acid (processing)

- **Activity data** 92,934.96 cc.
- Convert units from cc to kg (assuming formic acid density 1.22 g/cc or 1.22 kg/L) 92,934.96 cc × 1.22 g/cc/1000 g/kg = 113.38 kg

- Calculation 113.38 kg formic acid × 0.8 kg CO2 e /kg Acid = 90.70 kg CO2e

GHG Emission calculation results from main emission sources

Main emission source	Emission (kg CO2e)
Diesel (tractor)	41,494.46
NPK chemical fertilizer	226,528.97
Car fuel (travel)	44,730.53
formic acid	90.70
Total	**312,844.66**

- **Total GHG Emissions** 312,844.66 kg CO2 e Or approximately **312.84 tons** CO2e **CFP per working unit (1 kg DRC)**
- Total rubber production per year 1,161.69 tons = 1,161,690 kg
- CFP = 312,844.66 kg CO2 e /1,161,690 kg DRC≈0.269 kg CO2 e /kg DRC

Important Notes

- This calculation is a detailed method based on available Emission Factors data and assumptions.
- **Greenhouse gas emissions from other sources** that may be related to the cup lump rubber production process, such as electricity use , other transportation not specified in "vehicle fuel", waste management , or emissions from other energy-consuming processing processes (e.g. firewood). **Not included in this calculation** Due to the lack of specific activity or emission factors data
- formal and certified CFP reporting **The most complete and accurate activity data is required.** Including **Emission Factors are certified by official sources** (e.g., NBTC or IPCC Guidelines, as appropriate to the context) to ensure the most reliable results.

Reference document 5

Photographs/maps of the study area

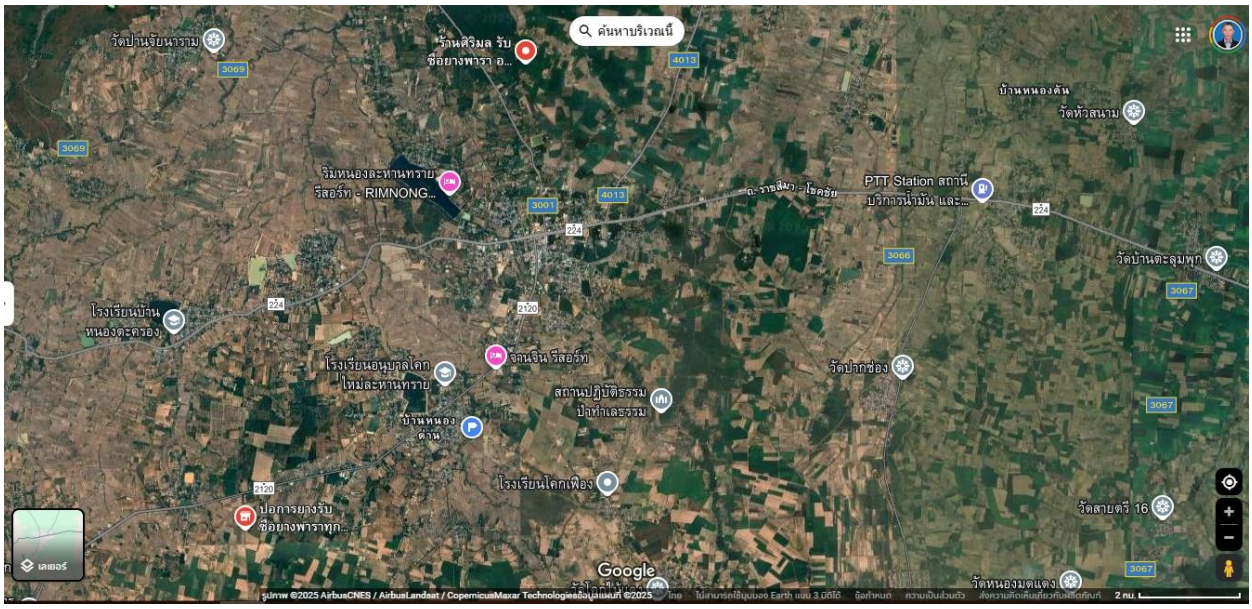

Figure 1 shows the location of the rubber purchasing points.

Figure 2 shows the rubber purchasing point "Ball Rubber Shop" (Sirimon Shop) .

Figure 3 shows the location of the Km.2 Rubber Shop (Pokarn Yang Shop).

Reference document 6

Reference documents and data sources used in preparing the Carbon Footprint for Organization (CFO) and Carbon Footprint of Product (CFP) reports for the Carbon Capture and Greenhouse Gas Emission Reduction Project in Rubber Plantations, Buriram Province, using Cryptocurrency, Blockchain and Satellite technologies.

International standards and practices

- **International Organization for Standardization (ISO)** ISO 14064-1:2018, Greenhouse gases – Part 1 Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals
- **International Organization for Standardization (ISO)** ISO 14067:2018, Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification
- **International Organization for Standardization (ISO)** ISO 14040:2006, Environmental management – Life cycle assessment – Principles and framework
- **International Organization for Standardization (ISO)** ISO 14044:2006, Environmental management – Life cycle assessment – Requirements and guidelines
- **Greenhouse Gas Protocol (GHG Protocol)** The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Revised Edition). World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD)
- **Intergovernmental Panel on Climate Change (IPCC)** IPCC Guidelines for National Greenhouse Gas Inventories (various editions, eg, 2006 IPCC Guidelines, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories)
- **Intergovernmental Panel on Climate Change (IPCC)** Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5). [or the latest relevant version, such as AR6]

Data source for emission factors and databases

- **Gas Management Organization** (TGO) Thailand Greenhouse Gas Emission Database (for Emission Factors specific to the Thai context, such as Grid Emission Factor for electricity)
- **Ecoinvent** (A global Life Cycle Inventory database for manufacturing processes and materials such as fertilizers and chemicals)
- **Agri-footprint** (LCI database specifically for the agriculture sector)

Concepts and technologies related to the project

- **Blockchain Technology** (Referring to research, academic articles , or technical documents related to the application of Blockchain in environmental data tracking , traceability , and Big Data management)
- **Satellite Remote Sensing** (Reference to research, academic articles, or technical documents related to the use of satellite imagery and vegetation indices for monitoring plant health, land use change, and biomass/carbon sequestration assessments)
- **Cryptocurrency and Carbon Credit Tokenization** (Reference to research, academic articles, or technical documents related to the application of blockchain technology and cryptocurrency to create and trade Carbon Credit Tokens)

Project specific information

- **Database for calculating CFP.xlsx - T-Activities.csv** (activity data collected from the project)
- **Information on carbon sequestration and greenhouse gas emission reduction projects in rubber plantations in Buriram Province** (specific information on the project such as number of members, area, production, rubber tree data, ABG values, values CO2 (that is confined)