HOUSEHOLD BIOGAS PROGRAM FOR SMALLHOLDER FARMERS IN INDIA BY SPEF AND NDDB

Document Prepared by EKI Energy Services Limited

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The consumption of non-renewable biomass firewood for household purposes in the rural areas is one of the main causes of deforestation in the surrounding areas of the state of Assam, Maharashtra, Jharkhand, Rajasthan, Sikkim and West-Bengal and others states of India and has several implications in the environmental and health aspects of such communities. The Project activity aims to replace the commonly used inefficient wood fired mud stove technology with efficient bio-gas based cook stoves, which is clean and sustainable. In view of the same, National Diary Development Board (NDDB), a body corporate constituted an ACT of Parliament called, "The National Diary Development Board Act, 1987" and Sustain Plus Energy Foundation, a Non-Profit company incorporated under Section 8 of companies Act 2013, has planned to implement a project which is clean, convenient and efficient energy can be accessed by the rural households.

Household survey was conducted to assess the baseline fuel and quantity used. As per the Survey, firewood was the main fuel used to suffice domestic energy needs (Cooking). It was sourced from nearby forest and open market. Usage of firewood in inefficient cooking system (conventional system) leads to indoor pollution and land use patterns have been showing a decrease in forest cover and increase in degradation land.

Project Scenario:
In the pre-project scenario, the rural households were using conventional cook stoves for their cooking and heating requirements. The manure used in the biogas units of the project activity was used to be left to decay and thus leading to substantial methane emissions from aerobic processes.

The main objective of the project is to facilitate and increase the penetration of household biodigesters by distributing as well as by monitoring and maintenance of the biodigesters for the consumers/end users (farmers). It involves bundling of household's biogas located in the state of Assam, Jharkhand, Maharashtra, Rajasthan, Sikkim, Uttar Pradesh and West-Bengal, India of capacities 2m^2.

The anaerobic biodigesters will be fed with animal dung and water.. Biogas generated from anaerobic biodigesters will be used for domestic cooking/heating purposes through the biogas stoves. This would lead to reduction of emission from various greenhouse gasses (GHGs), by displacing conventionally used non-renewable biomass with renewable biogas. In addition to Carbon dioxide (CO_2), the project will avoid the emission of Methane (CH_4) from the large piles of livestock manure as well as Nitrogen Oxide (NO_2) emissions taking place due to nitrification and de-nitrification from the storage of dung (manure) from domestic farm animals.

Audit Type	Period	Program	VVB Name	Number of years
Validation/ Verification	13-August-2021 to 30-November-2022	VCS joint validation and verification	TUV SUD	1.3 Years
Total				1.3 Years

1.2 Sectoral Scope and Project Type

The project activity falls under consideration of the grouped project activity. The project activity instances as part of the grouped project will have the following parameters.

Project Type – I: Renewable Energy Projects

Sectoral - 1: Energy industries (renewable -/ non-renewable sources)

Project Type – III: Other than Renewable Energy Project or Energy Efficiency Project.

Sectoral Scope – 15: Agriculture.

The project is a small-scale group project.

Project category: The biogas digester represents a renewable energy intervention of the project to replace the non-renewable fuels and falls under the Type I (renewable energy) project category whereas methane mitigation from cow dung falls under Type III (Other than renewable and energy efficiency). Each project activity instances will apply only biogas technology and each project activity instances will be small scale.

1.3 Project Eligibility

Project activity involves switch from non-renewable biomass based conventional stoves to biogas-based stoves for thermal applications by the rural households which is eligible under scope of Version 4.4 of the VCS Standard.

1.4 Project Design

☐ The project includes a single location or installation only

☐ The project includes multiple locations or project activity instances, but is not being developed as a grouped project

☒ The project is a grouped project

This is a grouped project. Each project activity instance involves a multiple number of project activity instances in the project activity. The current project instances comprise installation of 1040 units in the state of Rajasthan, Sikkim, Uttar Pradesh, West Bengal, Assam, Maharashtra and Jharkhand.

Eligibility Criteria

According to VCS Standard 4.4, section 3.6.1[1], the eligible criteria for group project using more than one methodology and multiple project activities are as follows.

1. Projects may include multiple project activities where the methodology applied to the project allows more than one project activity and/or where projects apply more than one methodology.

[1] VCS Standard, version – 4.4

Here the two methodologies has been used AMS-I.E[2], version – 13, and AMS-III.R[3], version – 4 and two project activities has been used, Project Type – 1 and Project Type – 3.

2. According to 3.6.16 of VCS standard 4.4, of new project activity instances.

Meet the applicability conditions set out in the methodology applied to the project.	The applicability condition set out in AMS-I.E and AMS-III.R has been met.
Use the technologies or measures specified in the project description.	The technologies mentioned in AMS-I.E and AMS-III.R has been used in this project description.
Apply the technologies or measures in the same manner as specified in the project description.	The technologies mentioned in AMS-I.E and AMS-III.R has been applied in this project description.
Are subject to the baseline scenario determined in the project description for the specified project activity and geographic area.	The instances are the subject to the baseline scenario determined in the project description for the specified project activity and geographic area.
Have characteristics with respect to additionality that are consistent with the initial instances for the specified project activity and geographic area.	All the instances have same characteristics with respect to additionality and are consistent for all the project activity and geographic area.

[2] AMS-I.E

[3] AMS-III.R

1.5 Project Proponent

Organization name	EKI Energy Services Ltd.
Contact person	Arijit Das
Title	Executive
Address	Office No 201, Plot No 48, Scheme 78, Part 2, Vijay Nagar, Indore-452010, Madhya Pradesh
Telephone	+919051889240
Email	arijit.das@enkingint.org / registry@enkingint.org

1.6 Other Entities Involved in the Project

Organization name	National Dairy Development Board
Role in the project	Project Participants
Contact person	Mr Meenesh Shah
Title	Executive Director
Address	NDDB Campus, Opp. Jagnath Mahadev Temple, Khetiwadi Road, Anand Gujrat - 388001
Telephone	
Email	

Organization name	Sustain Plus Energy Foundation
Role in the project	Project Participants
Contact person	Ganesh Neelam
Title	Director
Address	No,3, 14th Main Road, Agara Village, 1st Sector, Bengaluru, Karnatak - 560102
Telephone	
Email	

1.7 Ownership

Database of all the commissioned biogas plants has been established. This database contains all the information related to plant like biogas plant owner name, biogas plant identification number, year in which it was commissioned.

National Diary Development Board (NDDB) and Sustain Plus Energy Foundation (SPEF) has an agreement with EKI Energy Services Limited. All the carbon credits related rights are with EKIESL; and EKIESL will be the concerned authority for all modalities and procedure with respect to VCUs of the project activity. EKI Energy Services Limited will discuss with NDDB and NDDB must concur before sale of credits. The ownership of VCUs will be with EKIESL.

NDDB (project participant) will act as bundling agency for the subject project activity instances. This demonstrates the right of use according to clause 3.7.1 subsection (3) of VCS Standard (Version 4.4)[4] – "a project ownership arising by virtue of a statutory, property or contractual right in the plant, equipment or process that generates GHG emission reductions and/or removals".

[4] VCS Standard (4.4)

This is a grouped project, and the new instances will be added as and when the biogas plants get installed across India in the future

1.8 Project Start Date

As per the applied methodology, AMS I.E, Ver 13.0 to establish the date of commissioning, the Project Participant has opted to group the biogas units in "batches" and the latest date of commissioning of a biogas unit within the batch has been used as the date of commissioning for the entire batch. The project proponent has selected to consider all the biogas units in a particular month as an individual batch.

The first batch of biogas units of the project activity instance was commissioned in the month of August 2021. So accordingly, 13/August/2021 is considered as the start date of the project activity.

1.9 Project Crediting Period

Crediting Period Start date: 13/August/2021

Crediting Period End date: 12/August/2028

The project activity adopts renewable crediting period of 7 years period which can be renewed for maximum 2 times.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The estimated annual GHG emission reductions/removals of the project are:

☒ <20,000 tCO_2e/year

☐ 20,000 – 100,000 tCO_2e/year

☐ 100,001 – 1,000,000 tCO_2e/year

☐ >1,000,000 tCO_2e/year

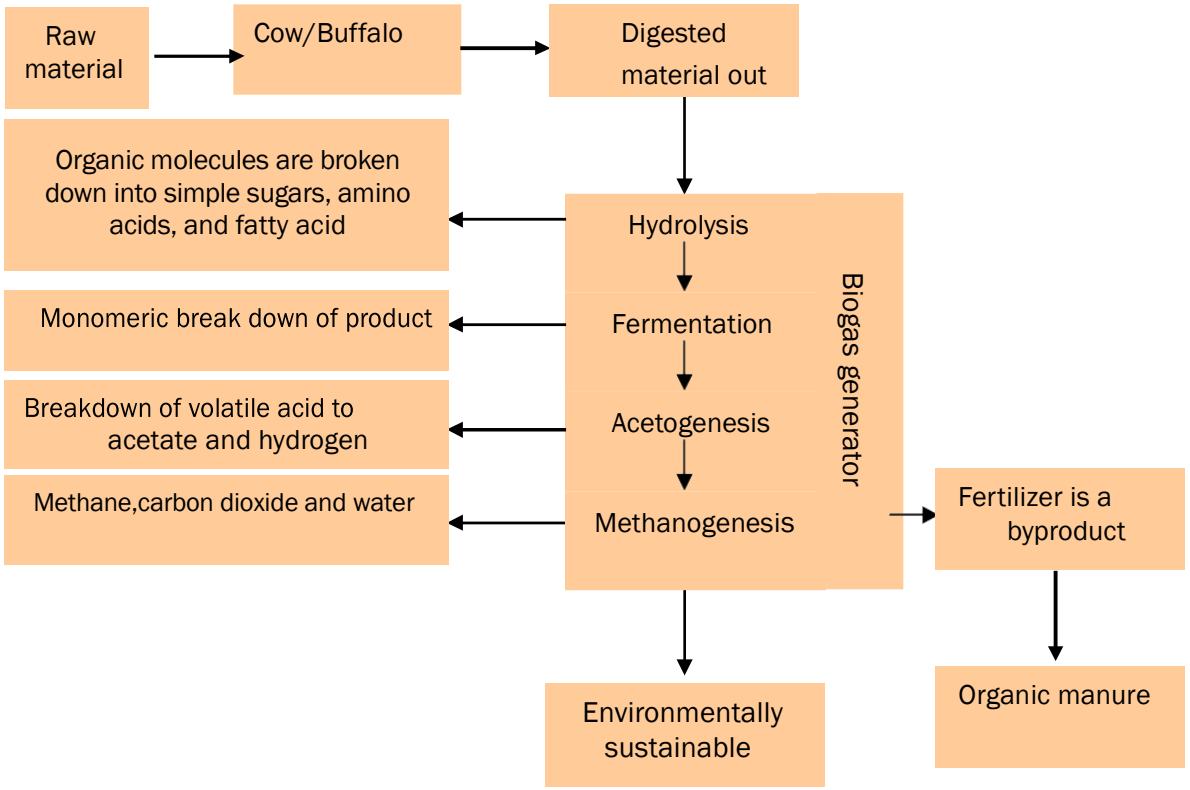
Project Scale	
Project	✓
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
Year 2021	1078
Year 2022	1078
Year 2023	1078
Year 2024	1078
Year 2025	1078
Year 2026	1078
Year 2027	1078
Total estimated ERs	7546
Total number of crediting years	7
Average annual ERs	1078

1.11 Description of the Project Activity

The project activity is a grouped project activity in which various project instances would be added from time to time.

As described above, each project activity instance involves bundling of household bio-digesters with flexi biogas technology installed in rural areas of West Bengal, Rajasthan, Uttar Pradesh, Maharashtra, Sikkim, Jharkhand, Assam and Uttar Pradesh. The "feed" is fed into the digester via the inlet pipe and undergoes digestion in the digestion chamber. Anaerobic digestion takes place in the bio digesters in which microorganisms break down biodegradable material in the absence of oxygen. This process produces methane (CH_4) rich biogas, which serves as a substitute of non-renewable biomass for cooking applications. In addition, the nutrient rich solids left in the digester can be used as fertilizer which enriches soil with essential nutrients.



Design of Biogas Digesters

The model of biogas plants used in the project activity is called Flexi biogas model. Flexi-biogas plant is a new technology in which digesters are made of PVC coated industrial textile or other such type of material. This type of biogas plant is convenient to small dairy farmers with respect to socio-economic implications on long term sustainability. In this model, the biogas plant is owned by the individual farmer. Normally the plant takes up to 30-45 days for first time gas generation, after first feeding of 300 kg dung mix with 4000 litre waters. In a day 60-75 kg cow dung mixed with equal water has to be fed through the feeding tanker. User has to ensure that fresh cow dung is fed into the digester every day. Slurry has to be disposed regularly in order to avoid blockage form the outlet.

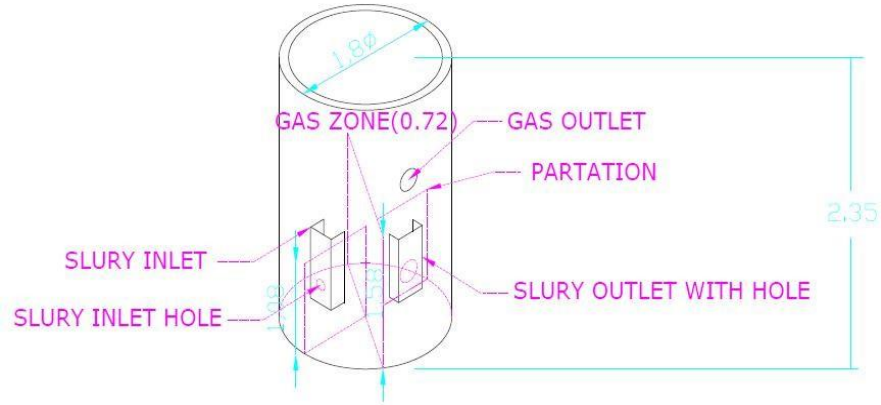


Figure: Flexi biogas model

Working of biogas plant:

Initially the digester is filled with a uniformly premixed mixture of dung and water (1:1 ratio) and the digester may be filled in three or four days or more time depending upon the availability of the dung. To facilitate gas production, addition of 5 to 10% inoculums, taken from a running biogas plant, will hasten the process by three to four days. In case no inoculums are available, active sewage sludge (which has mass of active anaerobic bacteria/microbes) can also be added. The biogas produced initially contains more percentage of CO2, (more than 50% which will either not burn at all or not burn properly to produce desired heat. Therefore, first two or three instalments of gas generated will have to be completely emptied so that the percentage of methane in the biogas comes up to 55-60%.

When the cattle dung is used as feed stock, the biogas plant is to be filled with a homogenous slurry made from a fresh dung and water in a ratio of 1:1 (1 kilogram of fresh/green dung to 1 litre of water) up to the level of the second step in the outlet chamber (as shown in below figure).

As the gas generates and accumulates in the empty portion of dome of the biogas plant, it presses down the slurry of the digester and displaces it into the outlet chamber. The slurry level in the digester falls, whereas in the outlet chamber, it starts rising with the formation of gas. This fall and rise continue till the level in the digester reach the upper end of the outlet opening, and at this stage, the slurry level in the outlet chamber will be at the slurry outlet. Any gas produced after this stage will escape through the outlet chamber till the gas is not used.

When the gas is used, the slurry which was earlier displaced out of digester and stored in the outlet chamber begins to return into the digester. The difference in levels of slurry in digester and the outlet chamber exerts pressure on the gas which makes it flow through the gas outlet pipe to the points of utilization of biogas.

The average standard lifetime of a $2m^3$ Flexi Model biogas plant more than 20 years. There are 1200 nos. of biogas units installed so far in the project activity which are included in the first project instance. The project proponent has a provision to install new biogas units and include as separate project activity instances. The number of units planned to be included as separate project activity instances is uncertain as of now.

1.12 Project Location

This is a group project; the location of project activity instances is at Rajasthan, Sikkim. Uttar Pradesh, West Bengal, Assam, Maharashtra and Jharkhand states of India.

Figure of map showing instances of project activity

Longitude

State	Latitude	Longitude
Assam	26° 11 ' 38"	92° 1 ' 19"
Assam	26° 6 ' 52"	92° 6 ' 27"
Assam	26° 10 ' 7"	92° 5 ' 12"
Assam	26° 11 ' 37"	92° 4 ' 8"
Assam	26° 11 ' 10"	92° 3 ' 14"
Assam	26° 11 ' 16"	92° 8 ' 13"

Assam	26° 11 ' 41"	92° 3 ' 11"
Assam	26° 12 ' 46"	92° 3 ' 24"
Assam	26° 12 ' 34"	92° 3 ' 16"
Assam	26° 10 ' 43"	92° 5 ' 12"
Assam	26° 10 ' 1"	92° 5 ' 8"
Assam	26° 10 ' 57"	92° 8 ' 12"
Assam	26° 10 ' 18"	92° 5 ' 30"
Assam	26° 10 ' 3"	92° 5 ' 5"
Assam	26° 10 ' 13"	92° 5 ' 6"
Assam	26° 6 ' 49"	92° 5 ' 39"
Assam	26° 10 ' 18"	92° 5 ' 30"
Assam	26° 6 ' 58"	92° 6 ' 9"
Assam	26° 12 ' 43"	92° 4 ' 24"
Assam	26° 12 ' 43"	92° 4 ' 24"
Assam	26° 10 ' 13"	92° 5 ' 6"
Assam	26° 10 ' 18"	92° 5 ' 30"
Assam	26° 10 ' 3"	92° 5 ' 5"
Assam	26° 10 ' 48"	92° 6 ' 18"
Assam	26° 11 ' 10"	92° 3 ' 14"
Assam	26° 10 ' 3"	92° 5 ' 5"
Assam	26° 6 ' 49"	92° 5 ' 39"
Assam	26° 10 ' 36"	92° 6 ' 15"
Assam	26° 7 ' 24"	92° 5 ' 40"
Assam	26° 10 ' 9"	92° 5 ' 7"
Assam	26° 7 ' 25"	92° 5 ' 40"
Assam	26° 10 ' 16"	92° 5 ' 25"
Assam	26° 10 ' 7"	92° 6 ' 49"
Assam	26° 11 ' 58"	92° 2 ' 50"
Assam	26° 7 ' 24"	92° 6 ' 38"
Assam	26° 7 ' 24"	92° 6 ' 38"

Assam	26° 7 ' 48"	92° 3 ' 45"
Assam	26° 7 ' 24"	92° 6 ' 38"
Assam	26° 10 ' 35"	92° 7 ' 5"
Assam	26° 10 ' 35"	92° 7 ' 7"
Assam	26° 7 ' 24"	92° 6 ' 38"
Assam	26° 11 ' 8"	92° 3 ' 7"
Assam	26° 10 ' 9"	92° 5 ' 7"
Assam	26° 7 ' 1"	92° 5 ' 49"
Assam	26° 12 ' 12"	92° 3 ' 30"
Assam	26° 8 ' 9"	92° 4 ' 17"
Assam	26° 12 ' 20"	92° 2 ' 55"
Assam	26° 12 ' 43"	92° 3 ' 15"
Assam	26° 10 ' 36"	92° 7 ' 8"
Assam	26° 6 ' 52"	92° 5 ' 33"
Assam	26° 10 ' 1"	92° 5 ' 8"
Assam	26° 14 ' 32"	92° 0 ' 46"
Assam	26° 7 ' 24"	92° 6 ' 38"
Assam	26° 10 ' 0"	92° 4 ' 3"
Assam	26° 10 ' 12"	92° 5 ' 35"
Assam	26° 11 ' 10"	92° 3 ' 14"
Assam	26° 6 ' 52"	92° 6 ' 27"
Assam	26° 12 ' 48"	92° 3 ' 16"
Assam	26° 9 ' 22"	92° 4 ' 14"
Assam	26° 10 ' 0"	92° 4 ' 3"
Assam	26° 12 ' 7"	92° 3 ' 4"
Assam	26° 6 ' 36"	92° 7 ' 3"
Assam	26° 12 ' 48"	92° 3 ' 14"
Assam	26° 12 ' 48"	92° 3 ' 16"
Assam	26° 7 ' 32"	92° 4 ' 43"
Assam	26° 10 ' 0"	92° 4 ' 3"

Assam	26° 10 ' 18"	92° 6 ' 3"
Assam	26° 10 ' 19"	92° 5 ' 30"
Assam	26° 9 ' 22"	92° 4 ' 13"
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Assam	26° 12 ' 7"	92° 3 ' 4"
Assam	26° 12 ' 33"	92° 4 ' 25"
Assam	26° 9 ' 14"	92° 3 ' 32"
Assam	26° 12 ' 12"	92° 3 ' 30"
Assam	26° 12 ' 7"	92° 3 ' 4"
Assam	26° 12 ' 12"	92° 3 ' 30"
Assam	26° 8 ' 45"	92° 3 ' 58"
Assam	26° 12 ' 37"	92° 4 ' 26"
Assam	26° 11 ' 10"	92° 3 ' 14"
Assam	26° 12 ' 57"	92° 3 ' 18"
Assam	26° 10 ' 19"	92° 5 ' 30"
Assam	26° 9 ' 50"	91° 43 ' 48"
Assam	26° 9 ' 50"	91° 43 ' 48"
Assam	26° 9 ' 50"	91° 43 ' 48"
Assam	26° 10 ' 18"	92° 6 ' 3"
Assam	26° 10 ' 30"	92° 4 ' 44"
Assam	26° 9 ' 52"	92° 7 ' 60"
Assam	26° 9 ' 52"	92° 7 ' 60"
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Assam	26° 9 ' 52"	92° 7 ' 60"
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Assam	26° 9 ' 52"	92° 7 ' 60"
Assam	26° 9 ' 52"	92° 7 ' 60"
Assam	26° 10 ' 44"	92° 2 ' 39"
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Assam	26° 9 ' 52"	92° 7 ' 60"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
Jharkhand	23° 19 ' 24"	85° 1 ' 49"
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Jharkhand	23° 21 ' 1"	85° 3 ' 10"
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Jharkhand	23° 19 ' 24"	85° 1 ' 48"
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Jharkhand	23° 20 ' 57"	85° 0 ' 6"
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Jharkhand	23° 17 ' 33"	85° 19 ' 24"
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Jharkhand	23° 20 ' 57"	85° 0 ' 6"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
Jharkhand	23° 20 ' 47"	85° 18 ' 30"
Jharkhand	23° 20 ' 47"	85° 18 ' 30"
Jharkhand	25° 57 ' 60"	82° 17 ' 50"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
Jharkhand	25° 57 ' 60"	82° 17 ' 50"
Jharkhand	23° 20 ' 57"	85° 0 ' 6"
Jharkhand	25° 57 ' 60"	82° 17 ' 50"
Jharkhand	23° 20 ' 47"	85° 18 ' 30"

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Jharkhand	25° 57 ' 60"	82° 17 ' 50"
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Jharkhand	23° 20 ' 47"	85° 18 ' 30"
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Jharkhand	23° 20 ' 47"	85° 18 ' 30"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
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Jharkhand	23° 20 ' 47"	85° 18 ' 30"
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Jharkhand	23° 20 ' 47"	85° 18 ' 30"
Jharkhand	25° 57 ' 60"	82° 17 ' 50"
Jharkhand	25° 57 ' 60"	82° 17 ' 50"
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Jharkhand	25° 57 ' 60"	82° 17 ' 50"
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Jharkhand	25° 57 ' 60"	82° 17 ' 50"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
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Jharkhand	23° 21 ' 1"	85° 3 ' 10"
Jharkhand	23° 20 ' 57"	85° 0 ' 6"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
Jharkhand	25° 57 ' 60"	82° 17 ' 50"
Jharkhand	25° 57 ' 60"	82° 17 ' 50"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
Jharkhand	23° 21 ' 1"	85° 3 ' 10"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 31 ' 5"	74° 8 ' 41"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	19° 0 ' 18"	73° 56 ' 53"

Maharashtra	16° 31 ' 5"	74° 8 ' 41"
Maharashtra	16° 31 ' 5"	74° 8 ' 41"
Maharashtra	16° 32 ' 1"	74° 10 ' 27"
Maharashtra	16° 31 ' 7"	74° 8 ' 38"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 31 ' 57"	74° 10 ' 28"
Maharashtra	16° 36 ' 42"	74° 7 ' 32"
Maharashtra	16° 31 ' 11"	74° 9 ' 18"
Maharashtra	16° 36 ' 42"	74° 7 ' 31"
Maharashtra	16° 36 ' 42"	74° 7 ' 31"
Maharashtra	16° 36 ' 42"	74° 7 ' 32"
Maharashtra	16° 31 ' 11"	74° 9 ' 18"
Maharashtra	16° 31 ' 11"	74° 9 ' 18"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 31 ' 57"	74° 10 ' 31"
Maharashtra	16° 31 ' 57"	74° 10 ' 31"
Maharashtra	16° 31 ' 11"	74° 9 ' 18"
Maharashtra	16° 31 ' 11"	74° 9 ' 17"
Maharashtra	16° 36 ' 43"	74° 7 ' 31"
Maharashtra	16° 36 ' 42"	74° 7 ' 32"
Maharashtra	16° 36 ' 42"	74° 7 ' 31"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 32 ' 21"	74° 10 ' 48"
Maharashtra	16° 31 ' 11"	74° 9 ' 18"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"

Maharashtra	16° 36 ' 42"	74° 7 ' 31"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 36 ' 42"	74° 7 ' 31"
Maharashtra	16° 36 ' 42"	74° 7 ' 31"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 31 ' 54"	74° 12 ' 59"
Maharashtra	16° 31 ' 54"	74° 12 ' 59"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 31 ' 54"	74° 12 ' 59"
Maharashtra	18° 49 ' 40"	74° 29 ' 18"
Maharashtra	16° 31 ' 54"	74° 12 ' 59"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 31 ' 57"	74° 10 ' 31"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	15° 45 ' 30"	74° 17 ' 50"
Maharashtra	15° 45 ' 30"	74° 17 ' 50"
Maharashtra	16° 36 ' 41"	74° 7 ' 30"
Maharashtra	15° 45 ' 30"	74° 17 ' 50"
Maharashtra	17° 11 ' 51"	74° 37 ' 30"
Maharashtra	16° 31 ' 4"	74° 8 ' 42"
Maharashtra	16° 31 ' 4"	74° 8 ' 42"
Maharashtra	18° 45 ' 17"	74° 7 ' 59"
Maharashtra	18° 45 ' 17"	74° 7 ' 59"
Maharashtra	18° 45 ' 17"	74° 7 ' 59"
Maharashtra	16° 30 ' 59"	74° 8 ' 43"
Maharashtra	18° 45 ' 17"	74° 7 ' 59"

Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 33 ' 13"	74° 9 ' 50"
Maharashtra	16° 31 ' 9"	74° 8 ' 36"
Maharashtra	16° 31 ' 4"	74° 8 ' 36"
Maharashtra	16° 31 ' 9"	74° 8 ' 36"
Maharashtra	16° 30 ' 59"	74° 8 ' 43"
Maharashtra	16° 31 ' 4"	74° 8 ' 36"
Maharashtra	16° 32 ' 29"	74° 10 ' 54"
Maharashtra	16° 33 ' 11"	74° 12 ' 49"
Maharashtra	16° 31 ' 57"	74° 10 ' 31"
Maharashtra	18° 45 ' 12"	74° 7 ' 56"
Maharashtra	16° 36 ' 44"	74° 7 ' 29"
Maharashtra	16° 31 ' 9"	74° 8 ' 36"
Maharashtra	15° 45 ' 30"	74° 17 ' 50"
Maharashtra	16° 46 ' 30"	74° 17 ' 25"
Maharashtra	18° 45 ' 14"	74° 8 ' 1"
Maharashtra	16° 31 ' 54"	74° 10 ' 26"
Maharashtra	18° 45 ' 14"	74° 8 ' 1"
Maharashtra	17° 11 ' 32"	74° 37 ' 38"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"
Maharashtra	18° 45 ' 14"	74° 8 ' 1"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"
Maharashtra	18° 45 ' 14"	74° 7 ' 53"
Maharashtra	16° 31 ' 56"	74° 12 ' 57"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"
Maharashtra	16° 31 ' 56"	74° 12 ' 57"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"
Maharashtra	16° 46 ' 9"	74° 17 ' 26"
Maharashtra	16° 31 ' 56"	74° 12 ' 57"

Maharashtra	16° 31 ' 56"	74° 12 ' 57"
Maharashtra	18° 45 ' 14"	74° 8 ' 1"
Maharashtra	16° 31 ' 11"	74° 9 ' 18"
Maharashtra	16° 31 ' 56"	74° 12 ' 57"
Maharashtra	16° 31 ' 8"	74° 9 ' 15"
Maharashtra	16° 31 ' 18"	74° 8 ' 37"
Maharashtra	16° 31 ' 59"	74° 12 ' 57"
Maharashtra	16° 31 ' 18"	74° 8 ' 37"
Maharashtra	16° 31 ' 56"	74° 12 ' 57"
Maharashtra	16° 31 ' 56"	74° 12 ' 57"
Maharashtra	16° 31 ' 18"	74° 8 ' 37"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"
Maharashtra	16° 31 ' 19"	74° 11 ' 9"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 32 ' 21"	74° 10 ' 48"
Maharashtra	16° 31 ' 57"	74° 10 ' 31"
Maharashtra	18° 45 ' 17"	74° 7 ' 59"
Maharashtra	16° 36 ' 42"	74° 7 ' 32"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 30 ' 59"	74° 8 ' 43"
Maharashtra	16° 31 ' 9"	74° 8 ' 36"
Maharashtra	16° 31 ' 11"	74° 9 ' 18"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"
Maharashtra	16° 36 ' 42"	74° 7 ' 31"
Maharashtra	16° 46 ' 9"	74° 17 ' 26"
Maharashtra	16° 31 ' 8"	74° 9 ' 15"
Maharashtra	18° 45 ' 14"	74° 8 ' 1"
Maharashtra	16° 31 ' 11"	74° 9 ' 17"
Maharashtra	18° 49 ' 40"	74° 29 ' 18"
Maharashtra	16° 31 ' 54"	74° 10 ' 26"

Maharashtra	18° 45 ' 17"	74° 7 ' 59"
Maharashtra	16° 36 ' 42"	74° 7 ' 31"
Maharashtra	17° 11 ' 51"	74° 37 ' 30"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 36 ' 43"	74° 7 ' 31"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 31 ' 4"	74° 8 ' 36"
Maharashtra	16° 31 ' 9"	74° 8 ' 36"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 32 ' 1"	74° 10 ' 27"
Maharashtra	18° 45 ' 17"	74° 7 ' 59"
Maharashtra	16° 30 ' 59"	74° 8 ' 43"
Maharashtra	16° 31 ' 18"	74° 8 ' 37"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"
Maharashtra	16° 31 ' 4"	74° 8 ' 42"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 36 ' 42"	74° 7 ' 31"
Maharashtra	16° 31 ' 11"	74° 9 ' 18"
Maharashtra	16° 31 ' 57"	74° 10 ' 31"
Maharashtra	16° 31 ' 18"	74° 8 ' 37"
Maharashtra	16° 31 ' 56"	74° 12 ' 57"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 31 ' 5"	74° 8 ' 41"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"
Maharashtra	16° 36 ' 42"	74° 7 ' 32"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 31 ' 7"	74° 8 ' 38"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"

Maharashtra	15° 45 ' 30"	74° 17 ' 50"
Maharashtra	18° 45 ' 12"	74° 7 ' 56"
Maharashtra	16° 36 ' 42"	74° 7 ' 31"
Maharashtra	16° 31 ' 57"	74° 10 ' 31"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 33 ' 13"	74° 9 ' 50"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"
Maharashtra	16° 31 ' 57"	74° 10 ' 28"
Maharashtra	15° 45 ' 30"	74° 17 ' 50"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 36 ' 41"	74° 7 ' 30"
Maharashtra	16° 31 ' 59"	74° 12 ' 57"
Maharashtra	18° 45 ' 14"	74° 8 ' 1"
Maharashtra	15° 45 ' 30"	74° 17 ' 50"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 31 ' 54"	74° 12 ' 59"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 36 ' 42"	74° 7 ' 31"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 31 ' 11"	74° 9 ' 18"
Maharashtra	16° 31 ' 54"	74° 12 ' 59"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 31 ' 56"	74° 12 ' 57"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"

Maharashtra	16° 31 ' 4"	74° 8 ' 42"
Maharashtra	16° 46 ' 30"	74° 17 ' 25"
Maharashtra	16° 31 ' 5"	74° 8 ' 41"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"
Maharashtra	16° 31 ' 58"	74° 10 ' 26"
Maharashtra	16° 31 ' 19"	74° 11 ' 9"
Maharashtra	16° 31 ' 9"	74° 8 ' 36"
Maharashtra	16° 31 ' 56"	74° 12 ' 57"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 31 ' 56"	74° 12 ' 57"
Maharashtra	19° 0 ' 18"	73° 56 ' 53"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 36 ' 44"	74° 7 ' 29"
Maharashtra	16° 31 ' 54"	74° 12 ' 59"
Maharashtra	16° 31 ' 56"	74° 12 ' 57"
Maharashtra	16° 36 ' 42"	74° 7 ' 32"
Maharashtra	16° 31 ' 56"	74° 12 ' 57"
Maharashtra	16° 32 ' 29"	74° 10 ' 54"
Maharashtra	16° 36 ' 42"	74° 7 ' 31"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 31 ' 4"	74° 8 ' 36"
Maharashtra	16° 31 ' 54"	74° 12 ' 59"
Maharashtra	18° 45 ' 17"	74° 7 ' 59"
Maharashtra	16° 31 ' 56"	74° 12 ' 57"
Maharashtra	16° 33 ' 11"	74° 12 ' 49"
Maharashtra	15° 45 ' 30"	74° 17 ' 50"

Maharashtra	16° 31 ' 5"	74° 8 ' 41"
Maharashtra	17° 11 ' 32"	74° 37 ' 38"
Maharashtra	16° 31 ' 57"	74° 10 ' 31"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	16° 31 ' 11"	74° 9 ' 18"
Maharashtra	16° 32 ' 11"	74° 11 ' 9"
Maharashtra	18° 45 ' 14"	74° 8 ' 1"
Maharashtra	18° 45 ' 14"	74° 7 ' 53"
Maharashtra	16° 31 ' 18"	74° 8 ' 37"
Maharashtra	16° 32 ' 1"	74° 12 ' 56"
Maharashtra	18° 45 ' 14"	74° 8 ' 1"
Maharashtra	16° 31 ' 11"	74° 9 ' 18"
Maharashtra	16° 31 ' 11"	74° 9 ' 18"
Maharashtra	16° 32 ' 3"	74° 10 ' 17"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 42 ' 13"	74° 25 ' 53"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 41 ' 34"	74° 26 ' 28"
Maharashtra	26° 10 ' 45"	74° 55 ' 28"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 41 ' 33"	74° 26 ' 29"
Maharashtra	26° 10 ' 45"	74° 55 ' 28"
Maharashtra	26° 10 ' 45"	74° 55 ' 28"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	26° 10 ' 45"	74° 55 ' 28"

Maharashtra	26° 10 ' 45"	74° 55 ' 28"
Maharashtra	26° 10 ' 45"	74° 55 ' 28"
Maharashtra	26° 10 ' 45"	74° 55 ' 28"
Maharashtra	25° 41 ' 34"	74° 26 ' 28"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	26° 10 ' 45"	74° 55 ' 28"
Maharashtra	25° 40 ' 37"	74° 27 ' 32"
Maharashtra	25° 40 ' 37"	74° 27 ' 32"
Maharashtra	26° 10 ' 45"	74° 55 ' 28"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 40 ' 37"	74° 27 ' 32"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 41 ' 34"	74° 26 ' 28"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 31"	74° 38 ' 4"
Maharashtra	25° 20 ' 30"	74° 38 ' 4"
Maharashtra	25° 20 ' 38"	74° 37 ' 57"
Maharashtra	25° 20 ' 14"	74° 37 ' 47"

Maharashtra	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 44 ' 5"	74° 25 ' 40"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 38 ' 23"	74° 35 ' 51"
Rajasthan	25° 20 ' 14"	74° 37 ' 47"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 42 ' 8"	74° 29 ' 14"
Rajasthan	25° 42 ' 8"	74° 29 ' 14"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 42 ' 8"	74° 29 ' 14"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 42 ' 8"	74° 29 ' 14"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 20 ' 14"	74° 37 ' 47"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"

Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 42 ' 8"	74° 29 ' 14"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	25° 20 ' 14"	74° 37 ' 47"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 42 ' 8"	74° 29 ' 14"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 42 ' 8"	74° 29 ' 14"
Rajasthan	25° 42 ' 8"	74° 29 ' 14"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"

Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 21 ' 29"	74° 37 ' 28"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 43 ' 56"	74° 30 ' 44"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 20 ' 38"	74° 37 ' 57"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	25° 20 ' 30"	74° 38 ' 4"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 30 ' 2"	73° 40 ' 48"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 17"	73° 43 ' 15"
Rajasthan	23° 33 ' 12"	73° 43 ' 12"
Rajasthan	23° 32 ' 51"	73° 43 ' 45"
Rajasthan	23° 32 ' 12"	73° 44 ' 13"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 44"	73° 41 ' 15"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"

Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 36"	73° 42 ' 58"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 17"	73° 42 ' 44"
Rajasthan	23° 30 ' 2"	73° 40 ' 49"
Rajasthan	23° 32 ' 10"	73° 44 ' 14"
Rajasthan	23° 33 ' 42"	73° 42 ' 10"
Rajasthan	23° 32 ' 22"	73° 38 ' 42"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"

Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 33 ' 50"	73° 42 ' 4"
Rajasthan	23° 33 ' 50"	73° 42 ' 4"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 56"	73° 42 ' 34"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"

Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 33 ' 47"	73° 42 ' 9"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 31 ' 48"	73° 38 ' 38"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 33 ' 34"	73° 43 ' 16"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 4"	73° 38 ' 58"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"

Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 14"	73° 43 ' 46"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 14"	73° 43 ' 46"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Rajasthan	23° 32 ' 5"	73° 38 ' 36"
Sikkim	27° 12 ' 12"	88° 33 ' 42"
Sikkim	27° 12 ' 12"	88° 33 ' 42"
Sikkim	27° 12 ' 12"	88° 33 ' 42"
Sikkim	27° 12 ' 18"	88° 33 ' 35"
Sikkim	27° 12 ' 12"	88° 33 ' 47"
Sikkim	27° 12 ' 17"	88° 33 ' 33"
Sikkim	27° 12 ' 12"	88° 33 ' 42"
Sikkim	27° 12 ' 20"	88° 33 ' 54"
Sikkim	27° 12 ' 20"	88° 33 ' 52"
Sikkim	27° 12 ' 6"	88° 34 ' 30"
Sikkim	27° 12 ' 6"	88° 34 ' 30"
Sikkim	27° 12 ' 6"	88° 34 ' 30"
Sikkim	27° 12 ' 12"	88° 33 ' 42"
Sikkim	27° 12 ' 40"	88° 34 ' 55"
Sikkim	27° 12 ' 38"	88° 34 ' 55"
Sikkim	27° 12 ' 24"	88° 33 ' 36"

Sikkim	27° 12 ' 6"	88° 34 ' 30"
Sikkim	27° 12 ' 6"	88° 34 ' 30"
Sikkim	27° 12 ' 18"	88° 34 ' 23"
Sikkim	27° 12 ' 6"	88° 34 ' 30"
Sikkim	27° 12 ' 6"	88° 34 ' 30"
Sikkim	27° 12 ' 40"	88° 35 ' 6"
Sikkim	27° 12 ' 6"	88° 34 ' 30"
Sikkim	27° 12 ' 6"	88° 34 ' 30"
Sikkim	27° 12 ' 16"	88° 34 ' 32"
Sikkim	27° 12 ' 3"	88° 34 ' 13"
Sikkim	27° 12 ' 5"	88° 34 ' 14"
Sikkim	27° 12 ' 19"	88° 33 ' 49"
Sikkim	27° 12 ' 18"	88° 34 ' 25"
Sikkim	27° 12 ' 6"	88° 34 ' 24"
Sikkim	27° 15 ' 55"	88° 29 ' 47"
Sikkim	27° 12 ' 15"	88° 33 ' 48"
Sikkim	27° 11 ' 56"	88° 33 ' 27"
Sikkim	27° 12 ' 16"	88° 33 ' 48"
Sikkim	27° 12 ' 22"	88° 33 ' 49"
Sikkim	27° 12 ' 12"	88° 33 ' 50"
Sikkim	27° 13 ' 20"	88° 34 ' 52"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 12 ' 6"	88° 34 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"

Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 12 ' 11"	88° 33 ' 45"
Sikkim	27° 11 ' 59"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 12 ' 7"	88° 34 ' 35"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 12 ' 40"	88° 33 ' 55"
Sikkim	27° 12 ' 40"	88° 33 ' 55"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 12 ' 15"	88° 33 ' 47"
Sikkim	27° 12 ' 11"	88° 33 ' 45"
Sikkim	27° 12 ' 10"	88° 33 ' 45"
Sikkim	27° 12 ' 22"	88° 34 ' 34"
Sikkim	27° 12 ' 31"	88° 34 ' 51"
Sikkim	27° 12 ' 40"	88° 34 ' 50"

Sikkim	27° 11 ' 59"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 13 ' 16"	88° 34 ' 53"
Sikkim	27° 12 ' 7"	88° 34 ' 33"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	27° 11 ' 59"	88° 33 ' 30"
Sikkim	27° 12 ' 16"	88° 33 ' 55"
Sikkim	27° 13 ' 19"	88° 34 ' 49"
Sikkim	27° 13 ' 21"	88° 34 ' 56"
Sikkim	27° 12 ' 34"	88° 35 ' 7"
Sikkim	27° 12 ' 39"	88° 35 ' 5"
Sikkim	27° 13 ' 12"	88° 34 ' 49"
Sikkim	27° 12 ' 11"	88° 33 ' 45"
Sikkim	27° 12 ' 11"	88° 33 ' 45"
Sikkim	27° 13 ' 16"	88° 34 ' 53"
Sikkim	27° 13 ' 19"	88° 34 ' 35"
Sikkim	27° 12 ' 35"	88° 35 ' 1"
Sikkim	27° 13 ' 17"	88° 34 ' 58"
Sikkim	27° 12 ' 40"	88° 35 ' 11"
Sikkim	27° 13 ' 12"	88° 34 ' 56"
Sikkim	27° 12 ' 42"	88° 35 ' 14"
Sikkim	27° 12 ' 11"	88° 33 ' 45"
Sikkim	27° 13 ' 7"	88° 35 ' 7"
Sikkim	27° 13 ' 3"	88° 34 ' 59"
Sikkim	27° 12 ' 41"	88° 34 ' 53"
Sikkim	27° 13 ' 9"	88° 34 ' 48"
Sikkim	27° 12 ' 42"	88° 34 ' 58"
Sikkim	27° 12 ' 54"	88° 37 ' 14"
Sikkim	27° 12 ' 49"	88° 34 ' 8"

Sikkim	27° 13 ' 11"	88° 34 ' 47"
Sikkim	27° 12 ' 50"	88° 37 ' 11"
Sikkim	27° 11 ' 27"	88° 22 ' 21"
Sikkim	27° 11 ' 60"	88° 33 ' 30"
Sikkim	23° 20 ' 57"	85° 0 ' 6"
Sikkim	27° 12 ' 50"	88° 37 ' 11"
Sikkim	27° 12 ' 43"	88° 34 ' 5"
Sikkim	27° 13 ' 20"	88° 34 ' 52"
Sikkim	27° 12 ' 16"	88° 33 ' 55"
Sikkim	27° 12 ' 17"	88° 33 ' 34"
Sikkim	27° 13 ' 1"	88° 34 ' 14"
Sikkim	27° 12 ' 11"	88° 33 ' 45"
Sikkim	27° 12 ' 40"	88° 33 ' 55"
Sikkim	27° 12 ' 16"	88° 33 ' 48"
West Bengal	22° 6 ' 45"	88° 39 ' 48"
West Bengal	22° 6 ' 27"	88° 39 ' 53"
West Bengal	22° 6 ' 45"	88° 39 ' 24"
West Bengal	22° 6 ' 3"	88° 40 ' 3"
West Bengal	22° 6 ' 58"	88° 41 ' 44"
West Bengal	22° 6 ' 44"	88° 39 ' 50"
West Bengal	22° 6 ' 48"	88° 39 ' 49"
West Bengal	22° 6 ' 44"	88° 39 ' 22"
West Bengal	22° 5 ' 15"	88° 39 ' 56"
West Bengal	22° 6 ' 45"	88° 42 ' 43"
West Bengal	22° 6 ' 25"	88° 42 ' 13"
West Bengal	22° 6 ' 44"	88° 39 ' 14"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 6 ' 30"	88° 42 ' 16"
West Bengal	22° 6 ' 35"	88° 42 ' 16"
West Bengal	22° 7 ' 59"	88° 42 ' 56"

West Bengal	22° 6 ' 45"	88° 39 ' 35"
West Bengal	26° 7 ' 24"	92° 5 ' 40"
West Bengal	22° 6 ' 29"	88° 39 ' 56"
West Bengal	22° 6 ' 24"	88° 40 ' 52"
West Bengal	22° 6 ' 2"	88° 40 ' 1"
West Bengal	22° 6 ' 37"	88° 40 ' 7"
West Bengal	22° 6 ' 23"	88° 39 ' 44"
West Bengal	22° 9 ' 13"	88° 42 ' 5"
West Bengal	22° 8 ' 37"	88° 42 ' 41"
West Bengal	22° 9 ' 6"	88° 42 ' 18"
West Bengal	22° 5 ' 51"	88° 41 ' 12"
West Bengal	22° 6 ' 8"	88° 41 ' 28"
West Bengal	22° 6 ' 21"	88° 40 ' 58"
West Bengal	22° 7 ' 54"	88° 42 ' 37"
West Bengal	22° 6 ' 21"	88° 40 ' 58"
West Bengal	22° 5 ' 39"	88° 40 ' 9"
West Bengal	22° 5 ' 19"	88° 40 ' 45"
West Bengal	22° 5 ' 26"	88° 40 ' 51"
West Bengal	22° 6 ' 7"	88° 40 ' 53"
West Bengal	22° 5 ' 28"	88° 40 ' 34"
West Bengal	22° 5 ' 38"	88° 40 ' 11"
West Bengal	22° 5 ' 35"	88° 40 ' 16"
West Bengal	22° 5 ' 16"	88° 40 ' 5"
West Bengal	22° 6 ' 23"	88° 40 ' 57"
West Bengal	22° 5 ' 56"	88° 40 ' 45"
West Bengal	22° 5 ' 56"	88° 40 ' 45"
West Bengal	22° 6 ' 21"	88° 40 ' 59"
West Bengal	22° 10 ' 7"	88° 46 ' 41"
West Bengal	22° 10 ' 8"	88° 46 ' 40"
West Bengal	22° 6 ' 50"	88° 40 ' 13"

West Bengal	22° 5 ' 27"	88° 40 ' 51"
West Bengal	22° 6 ' 49"	88° 40 ' 8"
West Bengal	22° 9 ' 19"	88° 42 ' 10"
West Bengal	22° 10 ' 6"	88° 46 ' 41"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 10 ' 6"	88° 46 ' 37"
West Bengal	22° 10 ' 6"	88° 46 ' 36"
West Bengal	22° 9 ' 26"	88° 46 ' 17"
West Bengal	21° 59 ' 32"	88° 28 ' 57"
West Bengal	22° 9 ' 29"	88° 46 ' 17"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 5 ' 35"	88° 40 ' 2"
West Bengal	22° 5 ' 51"	88° 40 ' 39"
West Bengal	22° 10 ' 4"	88° 46 ' 33"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	21° 59 ' 41"	88° 29 ' 24"
West Bengal	22° 4 ' 19"	88° 27 ' 42"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	21° 59 ' 31"	88° 29 ' 27"
West Bengal	22° 0 ' 6"	88° 28 ' 47"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 7 ' 59"	88° 39 ' 56"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 10 ' 4"	88° 46 ' 37"

West Bengal	22° 5 ' 55"	88° 41 ' 54"
West Bengal	21° 59 ' 13"	88° 29 ' 45"
West Bengal	21° 59 ' 5"	88° 30 ' 15"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 7 ' 26"	88° 40 ' 40"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 9 ' 41"	88° 46 ' 28"
West Bengal	22° 9 ' 42"	88° 46 ' 27"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 5 ' 5"	88° 40 ' 48"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 9 ' 32"	88° 46 ' 22"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 5 ' 24"	88° 40 ' 53"
West Bengal	21° 59 ' 14"	88° 28 ' 57"
West Bengal	22° 6 ' 16"	88° 40 ' 16"
West Bengal	22° 5 ' 58"	88° 41 ' 50"
West Bengal	21° 59 ' 33"	88° 29 ' 51"
West Bengal	21° 59 ' 16"	88° 30 ' 22"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	21° 59 ' 4"	88° 30 ' 22"
West Bengal	22° 9 ' 35"	88° 46 ' 26"
West Bengal	22° 10 ' 5"	88° 46 ' 41"
West Bengal	22° 9 ' 27"	88° 46 ' 16"
West Bengal	21° 59 ' 31"	88° 28 ' 57"
West Bengal	21° 59 ' 32"	88° 29 ' 50"
West Bengal	21° 59 ' 21"	88° 28 ' 55"
West Bengal	21° 59 ' 2"	88° 29 ' 57"
West Bengal	22° 7 ' 59"	88° 39 ' 57"

West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 10 ' 7"	88° 46 ' 40"
West Bengal	22° 6 ' 17"	88° 41 ' 32"
West Bengal	22° 6 ' 18"	88° 41 ' 27"
West Bengal	21° 59 ' 31"	88° 28 ' 58"
West Bengal	22° 10 ' 4"	88° 46 ' 37"
West Bengal	22° 7 ' 46"	88° 39 ' 52"
West Bengal	22° 7 ' 51"	88° 40 ' 4"
West Bengal	21° 59 ' 24"	88° 29 ' 53"
West Bengal	21° 59 ' 28"	88° 30 ' 3"
West Bengal	22° 5 ' 44"	88° 40 ' 50"
West Bengal	22° 5 ' 36"	88° 40 ' 6"
West Bengal	22° 4 ' 19"	88° 27 ' 42"
Uttar Pradesh	29° 24 ' 15"	77° 31 ' 53"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 23 ' 59"	77° 32 ' 3"
Uttar Pradesh	29° 24 ' 10"	77° 31 ' 55"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	29° 24 ' 20"	77° 32 ' 13"
Uttar Pradesh	29° 24 ' 15"	77° 31 ' 53"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	29° 24 ' 15"	77° 31 ' 46"
Uttar Pradesh	29° 24 ' 22"	77° 32 ' 6"
Uttar Pradesh	29° 24 ' 22"	77° 32 ' 5"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	29° 24 ' 20"	77° 32 ' 13"

Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 24 ' 12"	77° 31 ' 55"
Uttar Pradesh	29° 25 ' 33"	77° 32 ' 30"
Uttar Pradesh	29° 25 ' 37"	77° 32 ' 46"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 23 ' 58"	77° 32 ' 4"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	29° 24 ' 15"	77° 31 ' 53"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 16"	77° 42 ' 42"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 24 ' 20"	77° 32 ' 13"
Uttar Pradesh	29° 24 ' 15"	77° 31 ' 53"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	29° 23 ' 59"	77° 32 ' 3"

Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	29° 23 ' 58"	77° 32 ' 4"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 24 ' 20"	77° 32 ' 13"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	29° 1 ' 16"	77° 42 ' 56"
Uttar Pradesh	28° 59 ' 16"	77° 42 ' 42"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	29° 24 ' 19"	77° 32 ' 9"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	29° 24 ' 15"	77° 31 ' 53"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 23 ' 59"	77° 32 ' 3"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 24 ' 10"	77° 31 ' 45"

Uttar Pradesh	29° 23 ' 59"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 24 ' 20"	77° 32 ' 13"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	28° 59 ' 16"	77° 42 ' 42"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 24 ' 20"	77° 32 ' 13"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 23 ' 58"	77° 32 ' 4"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	29° 25 ' 50"	77° 32 ' 39"
Uttar Pradesh	29° 23 ' 59"	77° 32 ' 3"
Uttar Pradesh	29° 24 ' 25"	77° 32 ' 3"
Uttar Pradesh	29° 24 ' 20"	77° 32 ' 13"
Uttar Pradesh	29° 23 ' 59"	77° 32 ' 3"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"

Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 7"	77° 42 ' 20"
Uttar Pradesh	29° 25 ' 33"	77° 32 ' 30"
Uttar Pradesh	29° 25 ' 33"	77° 32 ' 30"
Uttar Pradesh	29° 24 ' 20"	77° 32 ' 13"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 1 ' 16"	77° 42 ' 56"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	29° 24 ' 15"	77° 31 ' 53"
Uttar Pradesh	28° 59 ' 24"	77° 42 ' 36"
Uttar Pradesh	28° 59 ' 9"	77° 42 ' 22"

1.13 Conditions Prior to Project Initiation

Please refer Section 3.4 (Baseline Scenario)

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

Biogas plants are not prohibited by any statute law or regulations in India. The Ministry of New and Renewable Energy (MNRE), Government of India promotes installation of biogas plants in rural region of the country by launching various schemes and incentives[5].

The New National Biogas and Organic Manure Program (NNBOMP) promotes the use of biogas produced from cattle manure and other organic wastes available in rural areas. The program helps establishing multiple small-scale biogas plants with installed capacity ranging from 1 to 25 m^3 per day. Families in rural areas use the plants to obtain cooking fuel and organic fertilizer. The NNBOMP also supports

[5] https://mnre.gov.in/bio-energy/schemes

community-scale biogas plants with installed capacity ranges of up to 2500 m^3 per day. MNRE provides 30 to 35 percent of project costs in the form of back-ended subsidies for setting up the biogas plants. In addition to this, MNRE also supports the stakeholders involved by providing various training & skill development courses and conducts awareness programs among the rural households. MNRE has provided special finance assistance to the backward and scheduled casts (SC) and scheduled tribes (ST) category populations to make them available the biogas units available at affordable costs.

1.15 Participation under Other GHG Programs

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

The project activity has not been registered or currently seeking registration under any other GHG programs. The project has not participated under any other GHG program.

1.15.2 Projects Rejected by Other GHG Programs

The project has not been rejected by other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

Emission Trading Programs and Other Binding Limits: The PP has not applied this project in any Emission Trading Programs and other Binding Limits.

1.16.2 Other Forms of Environmental Credit

Emission Trading Programs and Other Binding Limits: The PP has not applied this project in any Emission Trading Programs and other Binding Limits.

Has the project sought or received another form of GHG-related credit, including renewable energy certificates?

☐ Yes ☒ No

1.16.3 Supply Chain (Scope 3) Emissions

Not applicable.

As the project activity does not involve producing, delivering and selling any product or service to the consumer hence no scope 3 emissions is emitted.

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

Project implementation in rural areas improves the socio-economic condition of the rural population and reduces GHG emissions. It is expected that this project will contribute to the improvement of the living standard of the population. The advantages of the projects are given in brief below:

Environmental well being

- The project utilizes biomass residues and cow dung which in the absence of the project activity would be left to decay and thus leading to substantial methane emissions from anaerobic processes.
- Utilizing biogas as an energy resource contributes to clean environment.
- Transformation of organic wastes into high quality fertilizer.
- Due to the anaerobic processes, the digested slurry of the bio digesters has a very high degree of purity, i.e., it contains no parasites. This reduces the danger of parasitic infestations in people and animals
- During fermentation, part of the nitrogen content is changed into the form of ammonium, more easily absorbed by plants. In the direct spreading of unfermented manure, this process takes place in the soil and requires more time. Thus, fermented liquid manure can be applied during the growth period of the plants (top dressing): This direct absorption by plants means that the danger of nitrogen seepage is reduced.
- Contribute to the global environment improvement by reducing deforestation and improving biodiversity

- Improvement of hygienic conditions through reduction of pathogens by utilizing the animal and other organic wastes in the bio digesters.
- It will lead to improvement in soil condition by providing high quality manure.

Social – Economic well being

- The project activity creates job opportunities for local people during construction and operation period. The project activity provides business opportunity for local stakeholders such as master masons, skilled artisans, technicians, supervisors, suppliers, manufacturers, contractors, etc.
- The project will reduce the cooking time, thus providing women to take up other activities. It improves the overall health situation by reducing smoke in the kitchen, thus eliminating health hazards from indoor air pollution by reducing eye and lungs disease.

Technology well being

- Better biogas digester models, thus improving biogas yield
- The project activity is an initiative of the project proponent and involves utilization of manure to eliminate use of non-renewable biomass in the region for cooking.

1.17.2 Sustainable Development Contributions Activity Monitoring

Contribution to sustainable development:

Project implementation in rural areas improves the socio-economic condition of the rural population and reduces GHG emissions. It is expected that this project will contribute to the improvement of the living standard of the population. The advantages of the projects are given in brief below:

Environmental well being

- The project utilizes biomass residues and cow dung which in the absence of the project activity would be left to decay and thus leading to substantial methane emissions from anaerobic processes.
- Utilizing biogas as an energy resource contributes to clean environment.
- Transformation of organic wastes into high quality fertilizer.
- Due to the anaerobic processes, the digested slurry of the bio digesters has a very high degree of purity, i.e., it contains no parasites. This reduces the danger of parasitic infestations in people and animals

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- Contribute to the global environment improvement by reducing deforestation and improving biodiversity
- Improvement of hygienic conditions through reduction of pathogens by utilizing the animal and other organic wastes in the bio digesters.
- It will lead to improvement in soil condition by providing high quality manure.

Social – Economic well being

- The project activity creates job opportunities for local people during construction and operation period. The project activity provides business opportunity for local stakeholders such as master masons, skilled artisans, technicians, supervisors, suppliers, manufacturers, contractors, etc.
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Technology well being

- Better biogas digester models, thus improving biogas yield
- The project activity is an initiative of the project proponent and involves utilization of manure to eliminate use of non-renewable biomass in the region for cooking.

The project activity fulfils SDG Target 7.0 and 13.0 of SDG Goals

- **SDG 7.0:** According to SDG target 7.0, indicator 7.1, the project activity must ensure, "Ensure access to affordable, reliable, sustainable and modern energy for all". The project activity includes converting cow dung into biogas to use as fuel for cooking purpose. The cow dung is taken from the live-stock which the villagers already have. Thus, the energy is affordable, reliable and sustainable.

- **SDG 13.0:** According to SDG target 13.0, it states "Take urgent action to combat climate change and its impact". By mitigating 6,336 tCO_2 which is greenhouse gas, the project activity has contributed towards SDG target 13.0. for present monitoring period.

- **SDG 8.0**: According to SDG target 5.0, it states "Decent work and economic growth". By generating direct and indirect employment, this project activity has contributed towards SDG target 8.0 for the present monitoring period.

- **SDG 5.0**: According to SDG target 5.0, it states "Gender Equality". By proving job to women, this project activity has contributed towards SDG target 5.0.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	7.0	7.1.2 Proportion of population with primary reliance on clean fuels and technology	Implemented activities to decrease		
2)	13.0	13.2 Total Greenhouse gas emissions per year.	Implemented activities to decrease		
3)	5.0	Gender Equality	Implemented activities to increase		
4)	8.0	Decent Work and economic growth			

1.18 Additional Information Relevant to the Project

Leakage Management

Leakage monitoring and management is adequately taken care of by the project proponent.

Commercially Sensitive Information

Not applicable. No commercially sensitive information has been excluded from the public version of the project description. There is no commercially sensitive information.

Further Information

Not applicable

2 SAFEGUARDS

2.1 No Net Harm

Host party do not consider that environmental impacts arising from the project activity to be significant. The construction related impacts are very minimal and do not induce negative impacts on the surrounding environment.

The high-quality organic manure produced from solid waste shall be used for agricultural purposes. Land application of organic manure can be tailored to reduce the emission of GHGs and their impact on the environment. Application of more nitrogen than a crop needs via manure will result in excess nitrogen accumulation in soil and will increase the release of nitrogen as nitrous oxide. Application of manure at the wrong time of year will increase the release of nitrous oxide. It is envisaged that timing manure application correctly and ensuring proper application amounts will contribute to an overall reduction in GHG emissions from agricultural operations.

2.2 Local Stakeholder Consultation

Local Stake-Holder's meeting was conducted in below given venue at given dates

Venue	Date
Pune	10-June-2021
Kolahpur	23-June-2021
Sunderban	08-January-2022
Jharkhand	04-March-2022

Bhilwada	08-March-2022
Pedo	09-June-2022
Harit Pradesh	21-June-2022
Purio Village	08-October-2022
Pakyong	5-Decmen-2021

The Stakeholders were invited by sending invitation letters to the respective local panchayat members. All the panchayat members and local residents were invited.

NDDB's representatives explained about their project activity and the benefits about the project. It was informed that reduction in emissions by implementing bio digesters will improve the ambient air quality of the house.

After discussions about the project, the stakeholders were asked to raise their doubts and concerns of the proposed project activity. The comments were summarized as positive and mostly on environmental benefit aspects due to the installation of bio digesters for thermal energy applications and Socio-economic benefits from the project activity. The stakeholders appreciated the effort of the project proponent to bring such project in the interior part of the country. No negative comment was received during the course of the consultation process. A more detailed description has been given in the local stakeholder consultation report.

2.3 Environmental Impact

As per the guidelines[6] of the Ministry of Environment and Forests, Government of India, this project activity does not belong to the category that is mandated to perform Environmental Impact Assessment.

2.4 Public Comments

Not any negative comments received during stakeholder meeting.

2.5 AFOLU-Specific Safeguards

The project activity comes does not comes under AFOLU as this project consist of bio-gas digester and the purpose is to mitigate methane gas.

[6] http://www.environmentwb.gov.in/pdf/EIA%20Notification,%202006.pdf

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Methodology: AMS-I.E[7]

Project Type: Type-I - Renewable Energy Projects

Title: Switch from non-renewable biomass for thermal applications by the user.

Version No.: Ver 13.0,

Sectoral scope: 01

Reference: CDM Methodology

The methodology refers to following CDM Tools:

Tool- 3[8]: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion, ver. 03.0

Tool-19[9]: Demonstration of additionality of microscale project activities, ver. 10.0

Tool- 30[10]: Calculation of the fraction of non-renewable biomass, ver.04.0

Other methodology referred:

Methodology: AMS-III.R[11]

Title: Methane recovery in agriculture activities at household/small farm level.

Version No.: Ver 04.0

Sectoral scope: 15

Reference: CDM Methodology

[7] AMS-I.E

[8] Tool 3

[9] Tool 19

[10] Tool-30

[11] AMS-III.R

3.2 Applicability of Methodology

Criteria for the applicability of the methodology	Justification
According to AMS-I.E. "Switch from non-renewable biomass for the thermal applications the user", version, 13.	
This methodology comprises of activities to displace the use of non-renewable biomass by introducing renewable energy technologies to households, communities, and/or institutions such as schools, prisons or hospitals (herein after referred as end-users). Examples of these technologies include, but are not limited to: a) Cookstoves using renewable biomass, such as briquettes, pellets, and woodchips; b) Biogas stoves; c) Bio-ethanol stoves; d) Electric cookstoves including induction cookstoves (hereafter electric cookstoves) that receive electricity entirely from: i. An integrated renewable energy generating device, grid or mini-grid that is 100 per cent powered by renewable energy sources; or ii. A renewable energy system that is also connected to the grid via net metering, where, on an annual basis, the electricity generated by the renewable energy system is larger than the annual electricity consumed by the electric cookstoves and any other loads (e.g., lighting, fans, TV connected.	This project activity compromises of displacing the use of non-renewable biomass by introducing biogas stoves.
Project participants are able to show that non-renewable biomass has been used since 31 December 1989, using survey methods.	The project has introduced small, family-size biogas systems (bioreactors and stoves) that supply thermal energy for household cooking needs. The fraction of non-renewable biomass (NRB) consumed in the baseline scenario has been estimated for the following states as follows

	<table><tr><th>States</th><th>Percentage</th></tr><tr><td>Maharashtra</td><td>90.38%</td></tr><tr><td>West Bengal</td><td>91.38%</td></tr><tr><td>Rajasthan</td><td>91.38%</td></tr><tr><td>Assam</td><td>81.75%</td></tr><tr><td>Sikkim</td><td>97.34%</td></tr><tr><td>Jharkhand</td><td>75.69%</td></tr></table> For households participating in this project, their fuel wood is replaced with the use of biogas generated in small biogas reactors (renewable energy derived from cattle dung). A number of studies on bio resource use in the project states, which show that non-renewable biomass has been used since 31 December 1989. A cursory glance over the forest survey report of India for the year 1987 (https://fsi.nic.in/documents/sfr_1987_hindi.pdf, page no. 45/46/47) would reveal that the use of non-renewable biomass in the region was prevalent in the 1950s which staggeringly increased till the late 1970s. Hence it is substantiated that non-renewable biomass has been used in the project area since 31-December-1989. Since this is a grouped project and proposed to be implemented throughout India, the criteria will be demonstrated for each new state when the new project activity instances are included in the project.
In the case that technologies using renewable biomass are used under the project activity, this methodology is applicable where all emissions related to processing of biomass are fully accounted for and biomass is sourced from biomass residues and/or a dedicated plantation of the CDM project activity, meeting the following conditions: a. For projects that use biomass residues, prior to the implementation of the project activity, the biomass residues have not been collected and used but been left for decay and would, in	a. The project utilizes biomass residues and cow dung which in the absence of the project activity would be left to decay and thus leading to substantial methane emissions from anaerobic processes b. The project does not intend to use biomass residue from the production process (e.g. production of sugar or wood panel boards). Hence, this condition is not applicable. c. The manure produced from the household cattle is used continuously in the biogas digesters not stored for more than 1-2 days. d. No biomass is to be used in the project from the dedicated biomass plantation. Hence, this condition is not applicable.

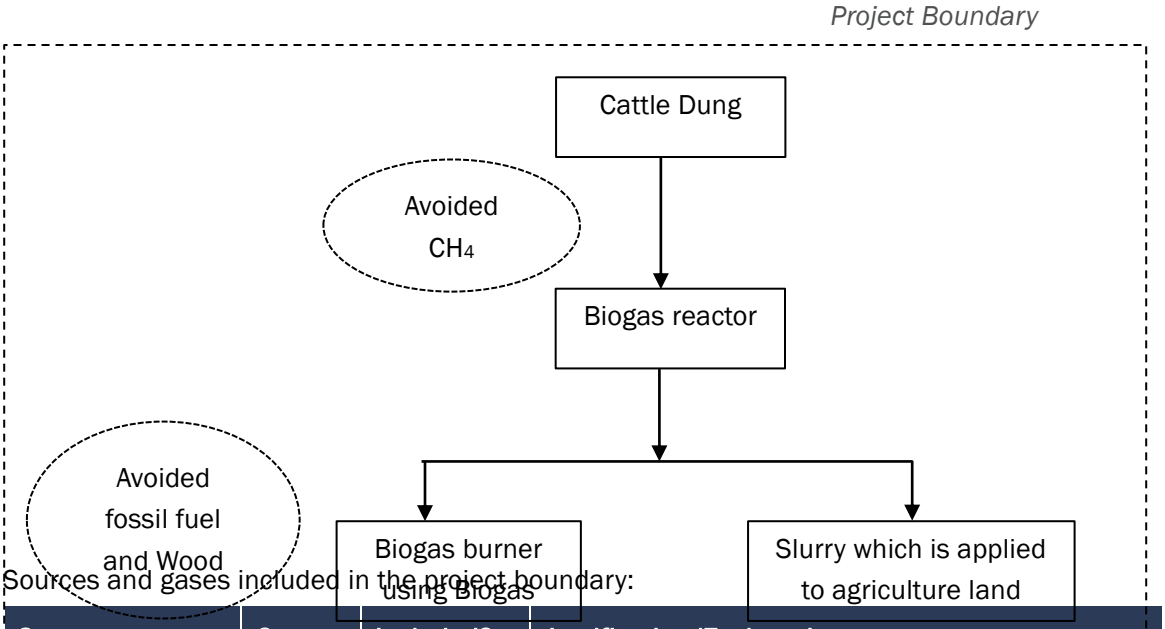
the absence of the project activity, continue to be left for decay; and b. For projects that use biomass residues from a production process (e.g., production of sugar or wood panel boards), the implementation of the project does not result in an increase of the processing capacity of raw input (e.g., sugar, rice, logs, etc.) or in other substantial changes (e.g. product change) in this process; and c. The biomass used by the project facility is not stored for more than one year; and d. In the case biomass from dedicated plantations are used, the applicability conditions of TOOL16 "Project and leakage emissions from biomass" are satisfied.	
For electric cookstoves with integrated renewable energy device or with grid connected renewable energy system employing net metering, project participants shall demonstrate that, on an annual basis, at least 80% of the electricity generated is consumed by the electric cook stoves (i.e., 20% or less of electricity is consumed by other loads connected).	Not applicable as the project activity does not involve electric cookstoves.
For electric cook stoves, in all cases under paragraph 2(d) above where back-up diesel generators are used, this methodology is only applicable when no more than 1% of total electricity supply occurs from back up diesel generators on an annual basis.	Same as above.
Under this methodology, emission reductions cannot be claimed only due to fuel-switch aspect and proposed project activities shall introduce new renewable energy-based technologies, i.e., technology switch is also involved.	The project also involves installation of biogas digesters and biogas stoves apart from fuel switching aspect from non-renewable to renewable biomass.

Project participants shall describe in the PDD/PoA-DD the proposed method for distribution of project devices and how the double counting of emission reductions has been addressed, for example, using methods such as unique identifications of product and end-user locations (e.g. programme logo), to prevent double counting of emission reductions from the project devices (e.g. between end users, distributors and producers of stoves, producers of renewable energy, producers of processed renewable biomass).	Systema Bio has provide a bill for each digester that has been delivered along with individual person's name and phone number for all 7 instances.
For project activities introducing bioethanol cookstoves, project participants shall demonstrate that the bioethanol cookstoves are designed, constructed and operated to the requirements (e.g., with regard to safety) of a relevant national or local standard or comparable literature. Latest guidelines issued by a relevant national authority, or an international organization may also be used.	Not applicable as the project activity does not involve bioethanol based cookstoves.
AMS-III.R. Small-scale Methodology: Methane recovery in agriculture activities at household/small farm level, Version 04.0.	
This project category comprises recovery and destruction of methane from manure and wastes from agricultural activities that would be decaying anaerobically emitting methane to the atmosphere in the absence of the project activity. Methane emissions are prevented by: (a) Installing methane recovery and combustion system to an existing source of methane emissions; or (b) Changing the management practice of a biogenic waste or raw material in order to achieve the controlled anaerobic digestion	The project activity consists of biogas digester where Cow dung is anaerobically treated for generating biogas. Here the methane is destroyed which would otherwise would have been emitted from the cow dung into the atmosphere.

equipped with methane recovery and combustion system.	
The category is limited to measures at individual households or small farms (e.g., installation of a domestic biogas digester). Methane recovery systems that achieve an annual emission reduction of less than or equal to five tons of CO_2e per system are included in this category. Systems with annual emission reduction higher than five tons of CO_2e are eligible under "AMS-III.D.: Methane recovery in animal manure management systems".	The project activity consist of individual households where domestic biogas has been installed. Also methane recovery systems that has been achieved is less than 5 tons of CO_2e.
This project category is only applicable in combination with "AMS-I.C.: Thermal energy production with or without electricity" and/or "AMS-I.I.: Biogas/biomass thermal applications for households/small users" and/or "AMS-I.E.: Switch from non-renewable biomass for thermal applications by the user".	The project category is being used along with AMS-I.E.
The project activity shall satisfy the following conditions: a) The sludge must be handled aerobically. In case of soil application of the final sludge the proper conditions and procedures that ensure that there are no methane emissions must be ensured; b) Measures shall be used (e.g., combusted or burnt in a biogas burner for cooking needs) to ensure that all the methane collected by the recovery system is destroyed.	
This methodology is applicable only to the portion of the manure, which would decay anaerobically in the absence of the project activity that is established by a survey.	The project activity consist of cow dung and the number of cows has been established by the base-line surveys

Aggregated annual emission reductions of all systems included shall be less than or equal to 60 kt CO_2 equivalent.	Aggregated annual emission reductions of all systems is less than 60 kt CO_2 equivalent.

3.3 Project Boundary



Sources and gases included in the project boundary:

Source		Gas	Included?	Justification/Explanation
Baseline	Thermal energy need – non-renewable biomass shares of the fuel wood use	CO_2	Yes	Major source of emissions
		CH_4	No	Major source of emissions
		N_2O	No	Excluded for simplification
Project	Emission due to cultivation of biomass	CO_2	No	Excluded as no cultivation is involved
		CH_4	No	Excluded as no cultivation is involved
		N_2O	No	Excluded as no cultivation is involved
	Leakage	CO_2	No	

Source	Gas	Included?	Justification/Explanation
	CH_4	No	(a) avoided N_2O emissions from cattle manure that goes into the bio digester, (b) avoided CO_2 emissions from avoided application of chemical fertilizer due to improved fertilizer from the biogas slurry, and (c) avoided emissions of products of incomplete combustion of fuel wood. (d) Avoided emissions by replacing kerosene use in cooking.
	N_2O	No	

3.4 Baseline Scenario

As per the applied methodology, "AMS-I.E.[12] Switch from non-renewable biomass for thermal applications by the user, Version 13," the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs."

The proposed project activity involves the installation of anaerobic bio-digesters for the production of biogas which will replace non-renewable biomass which is fuel wood, used as a fuel for household cooking and heating purposes i.e., domestic needs.

As per as applied methodology, "AMS-III.R. Methane recovery in agricultural activities at household/small farm level, Version 4," The baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay anaerobically within the project boundary and methane is emitted to the atmosphere."

The proposed activity involves decomposing cow dung in to the anaerobic digester. Absent of that the cow dung were left to decay anaerobically within the project boundary and methane is emitted to the atmosphere.

3.5 Additionality

According to Tool 19[13], version 10, para 13 b, the project activity consists of one or more of the following technology/measures related to an emission reduction activity where end users of the technology/measure are households, communities or SMEs:

a) Solar Lamps

b) Biogas Digester

[12] CDM AMS-I.E

[13] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-19-v10.0.pdf

Since the project activity consist of biogas digester for households, hence the project is auto additional.

3.6 Methodology Deviations

Not applicable

4 IMPLEMENTATION STATUS

4.1 Implementation Status of the Project Activity

The project activity consists of distribution of biogas digester for following locations

States	District	Number of units
Rajasthan	Bhilwara	120
	PEDO	120
Sikkim	Pakyong	120
Uttar Pradesh	Muzzafarnagar	120
West Bengal	Sundarbans	120
Assam	Kamrup	100
Maharashtra	Kohlapur	120
	Pune	120
Jharkhand	Ranchi	100
Total		

Animal waste is feed in the biogas digester for the production of biogas. In absence of project activity, the food would be prepared using traditional three stone cook stove which is further not only injurious to health, also it would emit CO_2 in the atmosphere due to burning of renewable biomass. Also, the due to distribution of 1040 units of biogas digester the animal waste which was

5 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

As per the applied methodology, Baseline emissions are calculated as:

$$BE_y = B_y \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected\_fossil\_fuel}$$

Where:

BE_y	=	Baseline emissions in the year *y* (tCO_2e)
B_y	=	Quantity of woody biomass that is substituted or displaced in year *y* (tonnes)
$f_{NRB,y}$	=	Fraction of woody biomass used in the absence of the project activity in year *y* that can be established as non-renewable biomass (fraction or %)
$NCV_{biomass}$	=	Net calorific value of the non-renewable woody biomass that is substituted (TJ/tonne) (IPCC default for wood fuel as per applied methodology, 0.0156 TJ/tonne)
$EF_{projected\_fossilfuel}$	=	Emission factor of fossil fuels projected to substitute non-renewable woody biomass by similar consumers (tCO_2e/TJ), 64.4 tCO2/TJ[14]

Determining B_y:

B_y is determined by using option (a), as per the methodology as follows:

Calculated as the product of the number of households multiplied by the estimate of average annual consumption of woody biomass per household that is displaced by the project activity (tones/household/year);

$$B_y = N_{HH,y} \times (BC_{BL,HH,} - BC_{PJ,HH,y})$$

Where:

$N_{HH,y}$	=	Number of households with functional cookstoves distributed under the project activity in year *y* (number)
$BC_{BL,HH,}$	=	Average annual consumption of woody biomass per household before the start of the project activity or at the renewal of each crediting period, whichever is later (tonnes/household/year)

[14]Default IPCC emission factor as per the applied methodology, AMS-I:E

$BC_{PJ,HH,y}$ = Average annual consumption of woody biomass per household in the pre-project devices during the project activity (tonnes/household/year). This parameter shall be considered if it is found that pre-project devices were not completely displaced but continue to be used to some extent

Values considered Ex-ante emission reduction calculation of first/current project activity instance.

Parameter	Value	Unit	Justification
B_y			
Maharashtra			
West-Bengal			
Rajasthan			
Assam			
Sikkim			
Jharkhand			
Uttar Pradesh			
$N_{HH,y}$		Absolute	Actual Biogas digesters installed in the project activity
$BC_{BL,HH,}$		tonnes/household/year	As per baseline survey
$BC_{PJ,HH,y}$			Considered 0 for Ex-ante calculation

Determination of f_{NRB}:

In accordance with Paragraph 28 of the applied methodology, Type AMS-I.E.version 13.0, the value of *f*NRB shall be calculated using either of the following two options:

(a) **Ex ante:** the *f*NRB value is determined once at the validation stage, thus no monitoring and recalculation of the fNRB value during the crediting period is required;
(b) **Ex post:** the *f*NRB,y value is determined for the year *y* in the crediting period, requiring the *f*NRB value to be updated annually, following a consistent calculation procedure throughout the crediting period.

The project proponent has calculated the value of *f*NRB using the option (a), i.e., **Ex ante:** the *f*NRB value is determined once at the validation stage, thus no monitoring and recalculation of the *f*NRB value during the crediting period is required.

The applied methodology again required the *f*NRB to be calculated as per the "TOOL30: Calculation of the fraction of non-renewable biomass".

As per the latest version, (version 02.0) of the TOOL 30, the fraction of woody biomass that can be established as non-renewable is:

$$f\text{NRB} = \frac{NRB}{NRB + RB}$$

Where,

f_{NRB} = Fraction of non-renewable biomass in the country/region or project area (fraction or %)

NRB = Quantity of non-renewable biomass (t/yr) in the country/region or project area, determined

RB = Quantity of renewable biomass in the country/region or project area

The value of NRB thus determined as below,

Maharashtra	51.80	tones
West-Bengal	25.54	tones
Rajasthan	24.43	tones
Assam	15.86	tones
Sikkim	8.07	tones
Jharkhand	9.26	tones
Uttar Pradesh	57.60	tones

The Value of RB

Maharashtra	2.12	Tones/Year
West-Bengal	0.58	Tones/Year
Rajasthan	2.30	Tones/Year
Assam	1.80	Tones/Year
Sikkim	0.22	Tones/Year
Jharkhand	0.49	Tones/Year
Uttar Pradesh	1.73	Tones/Year

The value of f_{NRB}

Maharashtra	96.07%
West-Bengal	97.78%
Rajasthan	91.40%
Assam	89.89%
Sikkim	97.34%
Jharkhand	94.38%

Uttar Pradesh	97.08%

The baseline emission is thus calculated as,

Baseline emissions, B_y (tCO_2e/Yr) =

5.2 Project Emissions

No biomass cultivation is involved in the project activity as the manure produced from the household animals is used in the biogas digesters.

Hence, as per the applied methodology, AMS-I.E,ver.13,

Project Emission. P_{EY}= 0 tCO2.

5.3 Leakage

According to applied methodology AMS-I.E, version 13, para 39,

Leakage emissions related to the non-renewable woody biomass saved by the project activity shall be assessed based on ex post surveys of users and the areas from which this woody biomass is sourced (using 90/30 precision for a selection of samples). The following potential source of leakage shall be considered: the use/diversion of non-renewable woody biomass saved under the project activity by non-project end-users that previously used renewable energy sources. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass used by the non-project end-users that is attributable to the project activity, then By is adjusted to account for the quantified leakage. Alternatively, By is multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required.

Baseline emission, By multiplied by a net to grass adjustment factor of 0.95 to account for leakage. Hence, the ex-post surveys are not required to collect the data on biomass use.

5.4 Estimated Net GHG Emission Reductions and Removals

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
13-August-2021 to 30-	1134	0	0.95	1078

November-2022				
Total	1134	0	0.95	1078

6 MONITORING

6.1 Data and Parameters Available at Validation

Data / Parameter	$N_{HH,Y}$
Data unit	Number
Description	Number of households with functional cookstoves distributed under the project activity in year y
Source of data	Actual number of units commissioned in the first project instance
Value applied:	1040
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of Baseline
Comments	This parameter is fixed for the entire crediting period for the first project instance.

Data / Parameter	$BC_{BL,HH,Y}$
Data unit	Tonnes/household/year
Description	Average annual consumption of woody biomass per household before the start of the project activity.
Source of data	Baseline survey data

Value applied:	2.045
Justification of choice of data or description of measurement methods and procedures applied	The values are arrived by multiplying average of quantity of biomass (firewood) consumed per day by a household in the surveyed region with 365.
Purpose of Data	Calculation of baseline
Comments	This parameter is fixed for the entire crediting period.

Data / Parameter	f_{NRB}
Data unit	Fraction
Description	Fraction of woody biomass saved by the project activity during year y that can be established as non-renewables biomass
Source of data	Estimated as per the latest version, (version 02.0) of the TOOL 30, Calculation of the fraction of non-renewable biomass based on data provided by Forest Survey of India, 2011, Ministry of Environment and Forests, Government of India.
Value applied:	

States	f_{NRB}
Maharashtra	96.07%
West Bengal	97.78%
Rajasthan	91.40%
Assam	89.83%
Sikkim	97.34%
Jharkhand	94.98%
Uttar Pradesh	97.08%

Justification of choice of data or description of measurement methods and procedures applied	The values are based on the Forest Survey of India report, 2011 published by the Ministry of Environment and Forests, (MOEF), Government of India. The values are specifically captured from chapter 7, Socio-Economic Contribution of forests: Production &consumption of forest resources in India. The forest survey reports are published by the Ministry of Environment and Forests (MoEF) biennially at the official website. Though there are survey reports available for the subsequent

	years at the official website of MoEF, the study on socio-Economic Contribution of forests: Production & consumption of forest resources in India was not conducted in the subsequent years. Therefore, the latest study report of 2011 available has been used for estimation of the parameter.
Purpose of Data	Calculation of baseline emissions
Comments	This parameter is fixed for the entire crediting period.

Data / Parameter	$NCV_{biomass}$
Data unit	TJ/tonne
Description	Net calorific value of the non-renewable woody biomass that is substituted
Source of data	AMS-I.E, Version 13, Parameter table - 13
Value applied:	0.0156 TJ/tonnes
Justification of choice of data or description of measurement methods and procedures applied	IPCC default for wood fuel, 0.0156 TJ/tonne, based on the gross weight of the wood that is 'air-dried', may be used if fuel used in project device is woody biomass.
Purpose of Data	Calculation of baseline emissions
Comments	This parameter is fixed for the entire crediting period.

Data / Parameter	$EF_{Projected,fossil\ fuel}$
Data unit	tCO_2e/TJ
Description	Emission factor of fossil fuels projected to substitute non-renewable woody biomass by similar consumers
Source of data	AMS-I.E, version 13, Table 2

Value applied:	
Justification of choice of data or description of measurement methods and procedures applied	The value is chosen for South Asia region which is appropriate.
Purpose of Data	Calculation of baseline emissions
Comments	This parameter is fixed for the entire crediting period.

6.2 Data and Parameters Monitored

Data / Parameter	$N_{i,y}$
Data unit	Number
Description	Number of project biogas digesters operational in year y
Source of data	Monitoring Survey
Description of measurement methods and procedures applied	Determined for all end-users or based on a representative sample (e.g.using survey methods). The "Standard: Sampling and surveys for CDM project activities and programme of activities" shall be used for determining the sample size to achieve 90/10 confidence/precision levels. Separate samples shall be taken for each batch. Here 100% baseline survey methods have been used.
Frequency of monitoring/recording	At least once every two years (biennial)
Value applied:	1040
Monitoring equipment	-
QA/QC procedures applied	-

Purpose of data	Calculation of baseline survey
Calculation method	-
Comments	-

Data / Parameter	Date of commissioning of project device of type i.
Data unit	Date
Description	Actual date of commissioning of the project device
Source of data	Internal records
Description of measurement methods and procedures applied	The commissioning dates of the biogas units will be recorded by the project proponent.
Frequency of monitoring/recording	Fixed and recorded at the time of commissioning/distribution
Value applied:	The commissioning of units included in the first project activity instance spans from August 2021 to December 2022.
Monitoring equipment	-
QA/QC procedures applied	-
Purpose of data	Calculation of baseline
Calculation method	-
Comments	-

Data / Parameter	$BC_{PJ,BL,HH,y}$
Data unit	Tonnes/household/year
Description	Average annual consumption of woody biomass per household in the pre-project activity in year y
Source of data	Monitoring Survey
Description of measurement methods and procedures applied	Determined for all end-users or based on a representative sample (e.g.using survey methods). The "Standard: Sampling and surveys for CDM project activities and programme of activities" shall be used for determining the sample size to achieve 90/10 confidence/precision levels. Separate samples shall be taken for each batch. Here 100% baseline survey methods have been used.
Frequency of monitoring/recording	Once in every two years (biennial)
Value applied:	0
Monitoring equipment	Consider 0 for ex-ante baseline calculation
QA/QC procedures applied	-
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	$N_{LT,y}$
Data unit	Number
Description	Annual average number of animals of type LT for the year y
Source of data	-
Description of measurement methods and procedures applied	The PDD should describe the system on monitoring the number of livestock population. The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed
Frequency of monitoring/recording	Annually.
Value applied:	9
Monitoring equipment	-
QA/QC procedures applied	-
Purpose of data	To calculate base-line emission
Calculation method	-
Comments	-

6.3 Monitoring Plan

Surveys shall be conducted as explained above to monitor all the monitoring parameters required as per the applied methodology.

NDDB will ensure monitoring of the functioning of the biogas plants. In case of any malfunctioning of the bio digesters, plant owner will inform NDDB or any of its representatives and the same shall be inspected and rectified at the earliest.

As per paragraph 32 of the applied methodology, AMS I.E, the project proponent shall replace the project instances biogas stoves whose lifetime has ended with the same type of new stoves for the existing, as long as they are replaced within the crediting period. No new project instance and project activity for the same purpose shall be formed.

At the end of the life span of project devices, one of the following three options shall be demonstrated:

a) Project devices are replaced with the same or more efficient devices;

b) Project devices are retrofitted/repaired, i.e., essential parts of the stoves (e.g., the burning chamber) are replaced so as to meet the additional conditions described below;

c) If none of the conditions above can be demonstrated, no emission reductions can be claimed for the stoves.

If project devices are retrofitted/repaired before or at the end of the devices' estimated life span, emission reductions shall be claimed for these devices during the extended lifetime only if the details of the retrofits/repairs undertaken (e.g., parts replaced, specifications followed, personnel conducting the repairs and date of retrofitting) on each device are documented, and in addition, one of the following options shall be implemented:

a) Extended lifetime is demonstrated through a warranty from the original manufacturer, or a guarantee from a company with demonstrated experience in cookstove repair that assures the performance of the stove in its entirety comparable to the original device including with regard to efficiency, safety and indoor emissions; or

b) Extended lifetime or the durability of the retrofitted device is demonstrated through a durability test performed according to requirements in ISO 19867-1 for durability or a comparable national standard. Certification by a relevant national standard body or an appropriate certifying agent recognized by that body may be supplied based on sample tests specified by the standard applied.

NDDB shall be responsible to co-ordinate among the local for monitoring of the operation of the biogas units at household level and maintain the centralized database of all the units installed and operated under each project activity instance.

All the data required for verification and issuance will be kept for two years after the end of the crediting period.

7 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

7.1 Data and Parameters Monitored

Data / Parameter	$N_{i,y}$
Data unit	Number
Description	Number of project biogas digesters operational in year y
Value applied:	1040
Comments	All the households surveyed during the monitoring period are found to be using the biogas digester/stoves satisfactorily. Here 100% survey has been done and after that the result has been taken into account.

Data / Parameter	Date of commissioning of project device of type i
Data unit	Date
Description	Actual date of commissioning of the project device
Value applied:	The commissioning of units included in the first project activity instance spans from August 2021 to December 2022 for 1040 units.
Comments	-

Data / Parameter	$BC_{PJ,HH,y}$
Data unit	Tonnes/household/year
Description	Average annual consumption of woody biomass per household in the pre-project activity in year y
Value applied:	2.045
Comments	-

Data / Parameter	$N_{LT,y}$

Data unit	Number
Description	Annual average number of animals of type LT for the year y
Value applied:	9
Comments	-

7.2 Baseline Emissions

The baseline emission for the current monitoring period, 13/08/2021 to 30/11/2022 has been calculated as below.

According AMS-I.E, Version - 13

$$BE_y = B_y \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected\_fossil\_fuel}$$

Where:

BE_y = Baseline emissions in the year *y* (tCO_2e)

B_y = Quantity of woody biomass that is substituted or displaced in year *y* (tonnes)

$f_{NRB,y}$ = Fraction of woody biomass used in the absence of the project activity in year *y* that can be established as non-renewable biomass (fraction or %)

$NCV_{biomass}$ = Net calorific value of the non-renewable woody biomass that is substituted (TJ/tonne) (IPCC default for wood fuel as per applied methodology, 0.0156 TJ/tonne)

$EF_{projected\_fossilfuel}$ = Emission factor of fossil fuels projected to substitute non-renewable woody biomass by similar consumers (tCO_2e/TJ), 64.4 tCO2/TJ[15]

$$B_y = N_{HH,y} \times \left(BC_{BL,HH,} - BC_{PJ,HH,y}\right)$$

Where,

B_y = Baseline emission in the year y (tCO_2)

$N_{HH,y}$ = Number of households with functional cook-stoves distributed under the project activity in year y (number)

$BC_{BL,HH}$ = Average annual consumption of woody biomass per household before the start of the project (tonnes/household/year)

[15]Default IPCC emission factor as per the applied methodology, AMS-I:E

$BC_{PJ,HH,y}$	=	Average anuual consumption of woody biomass per household in the pre-project devices during the project activity (tonnes/household/year). This parameter shall be considered if it is found that pre-project devices were not completely displaced but continue to be used to some extent.

The values used and calculation of baseline emission for the current monitoring period are tabulated below.

According AMS-III.R, Version – 4

$$BE_y = GWP_{CH_4} \times UF_B \times \sum_{LT} \left(\frac{EF_{LT} \times N_{LT,y}}{10^6} \right)$$

BE_y	=	Baseline emissions in the year *y* (tCO_2e)
GWP_{CH_4}	=	Global Warming potential (GWP) of CH4 applicable to the relevant period tCO_2/tCH_4 = 28[16]
UF_B	=	Net-to-gross adjustment factor to account for uncertainties. The Value applied is 0.898
$NCV_{biomass}$	=	Net calorific value of the non-renewable woody biomass that is substituted (TJ/tonne) (IPCC default for wood fuel as per applied methodology, 0.0156 TJ/tonne)
$EF_{projected\_fossilfuel}$	=	Emission factor of fossil fuels projected to substitute non-renewable woody biomass by similar consumers (tCO_2e/TJ), 64.4 tCO2/TJ[17]

7.3 Project Emissions

No biomass cultivation is involved in the project activity as the manure produced from the household animals is used in the biogas digesters.

Hence, as per the applied methodology, AMS-I.E,ver.13, Project Emission. PE_Y= 0 tCO_2.

7.4 Leakage

Leakage emissions related to the non-renewable woody biomass saved by the project activity shall be assessed based on ex post surveys of users and the areas from which this woody biomass is sourced (using 90/30 precision for a selection of samples). The following potential source of leakage shall be considered: the use/diversion of nonrenewable woody biomass saved

16 Box 3.2, Table-1, AR 5 Synthesis Report - Climate Change 2014, Page 87

17 Default IPCC emission factor as per the applied methodology, AMS-I:E

under the project activity by non-project end-users that previously used renewable energy sources. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass used by the non-project end-users that is attributable to the project activity, then B_y is adjusted to account for the quantified leakage. Alternatively, B_y is multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required.

Therefore $LE_y = 0.95$

7.5 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
13-October-2021 to 30-November-2022	1,134	0	0.95	1,078
Total	1,134	0	0.95	7,078

Ex-ante emissions reductions /removals	Achieved emissions reductions /removals	Percent difference	Justification for the difference
7,754	998	7.42	Due to use in actual value

APPENDIX 1: STAKEHOLDER'S CONSULTATION