CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

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Title of project activity : AWMS-MAP-KORBA-BILASPUR-KABIRDHAM
Version : 1
Date : 12/12/2007

A.2. Description of the project activity:

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The primary objective of the Project Activity:

The primary objective of the Project Activity is Avoidance of Methane emission from traditional Animal Waste Management System in Chhattisgarh. Methane emission is caused due to the conventional method (disposal of manure into the water filled pits called Ghurwa) of disposal of manure and animal litter in the rural areas at individual household farms, at joint house hold farms or at community based animal straying yards of Chhattisgarh region. Thus this conventional system will be replaced through aerobic treatment (Vermi-composting), by which the emission of methane will be avoided from the manure management system.

The installation of aerobic biological decomposition of organic matter process to the cattle manure and animal litter and treatment process (Vermi-composting):

The aerobic biological decomposition process consisting mixture of animal manure, organic material placed in 0.9 M high 1.5 M wide and 5 M long windrows. In windrows organic matter are broken down through activities of various invertebrates that naturally appear in compost. In windrows to enhance biological decomposition process, vermi-composting is accomplished by adding "red worms" (Eisenia Foetida), which perform best at temperature between 10^{o} to 32^{0}C. In vermi-composting, the earth worm takeover both the roles of turning and maintaining the material in aerobic condition there by reducing the need of mechanical aeration. Windrows treatment of solids and controlled decomposition of organic matter by vermi-composting is one of the few manure treatment options that reduces environmental impact of manure and generate stable organic product. The end product is safer to use than raw organic material and one that improves soil fertility, tilth and water holding capacity. Windrow vermi-composting is technical and labour intensive manure management system, it does require additional earthworms, shed, equipments for the bed to remove compost material, and separate the compost from the worms by screening and process to market. Due to the required investment cost on infrastructure, technical expertise, and on labour windrow-vermi-composting is adopted by few cattle farm in the country. The potential to sell CER's is an important source of revenue to ensure the coverage of project cost implementing the windrow-vermi-composting "aerobic treatment of manure management system".

The "aerobic treatment of manure management system" adopting windrow vermi-composting system is a significant improvement compared to current manure management practice (deep pit type system) on Chhattisgarh state cattle farms.

Purpose of the Project activity:
The main purpose of the project activity is reducing green house gas emission by implementing aerobic treatment of manure i.e. windrow- vermi-composting manure management system. The aerobic treatment of manure is one of the few options that reduce environmental impact of manure. The decomposed material will have no odour, no pathogen, better handling properties and appropriate for crop cultivation especially for organic farming thus improving the sustainability of the agriculture in this region. This improvement will replace the use of liquid/slurry manure management system (deep pit system) as the only treatment for the cattle farm manure and will reduce average 120156.5 t CO_2/year which sum up to 1201565 t CO_2 in the fixed crediting period ten years.

Project implementation arrangement: In selection of project animal farmer household, priority would be given to poor, marginal and small animal farmers. The total 30600 household /animal owners have been selected for this project activity. To undertake the vermi-composting manure management system as CDM project activity the Animal Farmer households will be authorising M/s. Indus Technical and Financial Consultants Ltd to complete the application, registration and CERs verification of project activity on their behalf. Indus Technical and Financial Consultants Ltd is participating as project entity, on behalf of all these Animal Farmer households.

The Indus Technical and Financial Consultants Ltd is the project proponent. Company will closely work with voluntary NGOs namely Lakhasar Sewa Samiti and Murli Mahila Mandal Murli, in providing technical, extension service, supervise implementation, carry out monitoring and data recording of the project activity.

A.3. Project participants:

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Indus Technical & Financial Consultant Limited (ITFCL) is promoter of "Methane Avoidance Programme" (Called as Methane Mukti Abhiyan") in Chhattisgarh as Project Proponent. ITFCL provides Environment, Technical and Financial consultancy services to the industry in Chhattisgarh and adjoining states for last 15 years. The company has also been providing CDM support related consultancy services for last 5 years. ITFCL will provide technological and operational support to N.G.O., individuals, families, farmers, local bodies, panchayat raj institution and other individuals or the organisations implementing the avoidance of methane production from manure management system under "Methane Avoidance Programme" launched by ITFCL, Lakhasar Seva Samiti (LSS) and Murli Mahila Mandal Murli (MMMM). LSS and MMMM are non government organisations working with rural people since last several years and have agreed to join and work for the avoidance of methane emission from manure management system in Chhattisgarh with ITFCL. LSS and MMMM are provider of need based extension service in rural areas. LSS and MMMM will provide, extension service for methane avoidance Programme in adopted villages regarding vermi-composting, sustainable livelihood.

Rameshwar Agro Farm Private Limited (RAFPL): - is a business group. RAFPL is producing fruits, vegetable and cereals with inorganic and organic fertilizers; RAFPL is self-user of vermi-compost, fruits, vegetable and cereals with organic and inorganic fertilizers. RAFPL is self-user of vermi-compost as well as has agreed to trade and market the vermicompost produced. RAFPL will purchase the vermi-compost from beneficiary of Methane Avoidance Programme produced under CDM activities.

The farmers and the families of the farmers and the rural organisations who have consented and who will give consent to implement the above methane avoidance programme at their respective places, under ITFCL launched Methane Avoidance Programme as the project proponent, will also be the project participants individually or through their respective organisation. All the participants have authorised ITFCL to be the nodal and chief Project Participant to act and deal, as Project Proponent with the UNFCCC – CDM and EB to receive support to implement the project activity.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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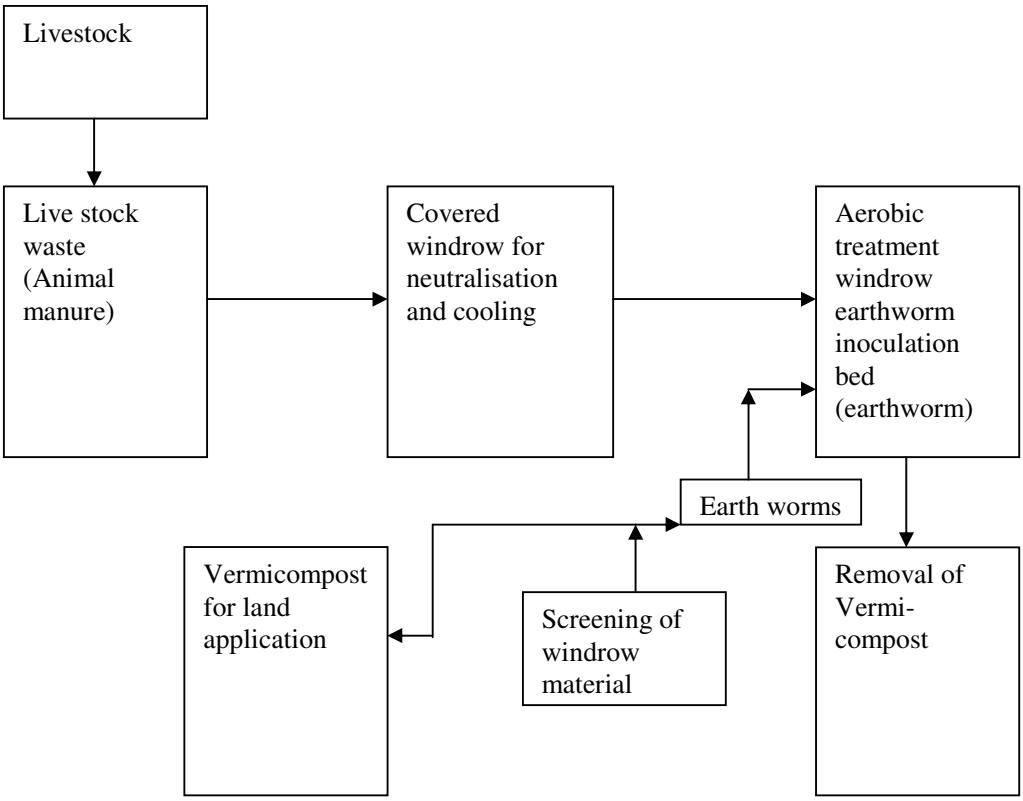
Vermi-composting:- Vermi-composting is a simple biotechnological process of composting, in which certain species of earthworm are used to enhance process of waste conversion and produce stable organic product. It is mesophilic process, utilizing microorganisms and earthworms that are active at 10-32^{0}C (temperature with in the pile of moist organic material). The process is aerobic, faster than composting, because the organic material passes through the earthworm gut.

The vermi-composting is controlled process, constructed in compartment with shed and leak proof compartment with drains; in order to ensure temperature regulation and protection against accumulation of excessive water in rainy season. For the aerobic treatment of manure, cattle dung collected from cattle farm is stored for a day or two under constructed shed in windrow measuring 0.9 M high, 1.5 M wide and 5.0 M long with distance of 75 cm between two wind rows. The cattle dung kept for one or two days to cool and then fed to windrows. Red worm (Eisenea Foetida) are put on the top of manure windrow. About 2.5 kg worms in a meter long manure windrow are inoculated. Moisture is maintained in the bed by regular sprinkling of water. Cow urine as liquid collected from cattle farm is also utilized for moistening of inoculated bed. In inoculated beds moisture, temperature and pH are maintained at optimum level to grow earthworm, the earthworm takeover both roles turn over and maintaining the material in aerobic conditions. After 60 days vermi-compost is ready. It is black granular, lightweight and humus rich. In order to facilitate the separation of the worm, from the compost watering is ceased for three days before emptying the beds. Screening is done to remove the worm from the compost. The vermi-compost is then ready for land application. One ton of cow wet dung produced about 0.30-ton vermi-compost. The worms obtained during screening are applied back to the active windrows.

Flow chart of treatment system



A.4.1.1.	Host Party(ies):

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India

A.4.1.2.	Region/State/Province etc.:

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Chhattisgarh State

A.4.1.3.	City/Town/Community etc:

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In Rural Community of Chhattisgarh. in rural areas livestock is an integral part of their life. Farmer keeps animals not as profession; but to meet out their domestic need as well as farming need too. They are comparatively poor rural people, technically, financially and socially backward.

The number of village and name of districts in which the project activities is being implemented are as follows:-

S.No.	Name of District	No. of Villages	No. of Household
01.	Bilaspur	41	12300
02.	Kabirdham	35	10500
03.	Korba	26	7800

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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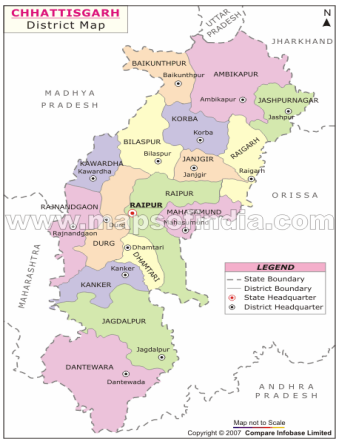
Chhattisgarh is (CG.) is vast state lies between $17^0$46' to 2505'N Latitude and $80^0$15' to $84^0$20'E longitude. CG is diverse state gifted with heterogeneous landforms such as lofty mountains, plain, reverine, and plateaus, with variety of geological formations. CG has more than 30% forest cover State has hot sub-humid climate mean average annual temperature varies between 25^0 to 27.5^0 C, with 1100 mm to 1600 mm rainfall.

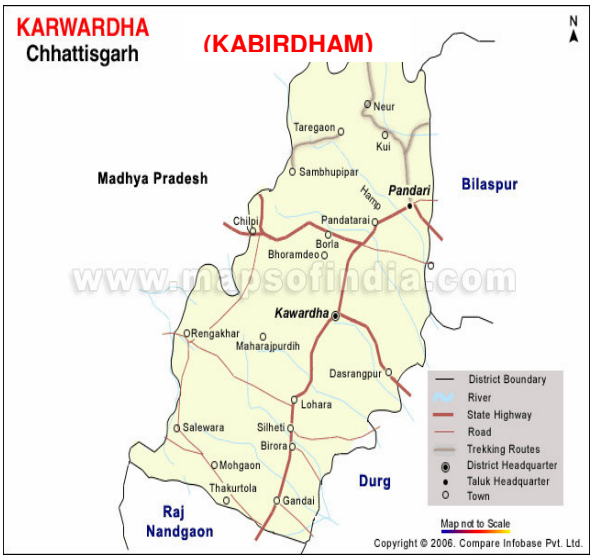
Among the social group more than 80% society is farmer or depends upon agriculture for their livelihood. Though main occupation of rural people is farming, however the concept of man-land-livestock persists. In rural areas of CG livestock is an integral part of their life. Farmers keep cows, buffaloes, sheep, goat including small number of poultry either alone or combination depending upon their need and capacity at backyard in close confinement conditions with stall-feeding. House women mainly perform livestock keeping activities. She take care of animal and during the day period when these animal goes for roaming, she cleans the animal house, flush the dung and manure with some water and collects for dispose of this refuse in the water filled earthen deep pits for conversion into compost, and for proper and quick decaying farmers periodically apply the water into manure pit. These pits generally exist just out side the animal house. In rural areas of CG cattle are kept with stall-feeding in close confinement conditions. However in day time between 10.00 AM to 5.00 PM animals are released with shepherd to near by animal yard (Gosthan) just for exercising. During this period shepherd collects excreta of animal and they also dump it in water filled earthen deep pits for decaying and for quick and proper decaying they pour water periodically. Finished compost is normally emptied once in a year before paddy sowing for the soil application. Thus except nominal excreta generated by animal at Gosthan. Animal owner for manure management dumps rest of manure into water filled earthen deep pit just out side the respective animal house. This liquid slurry type manure management system is an anaerobic system, thus generates GHGs, CH_4 and N_2O and system emit huge quantity of GHGs in the atmosphere.

The unique identification of project sites are shown in maps given below



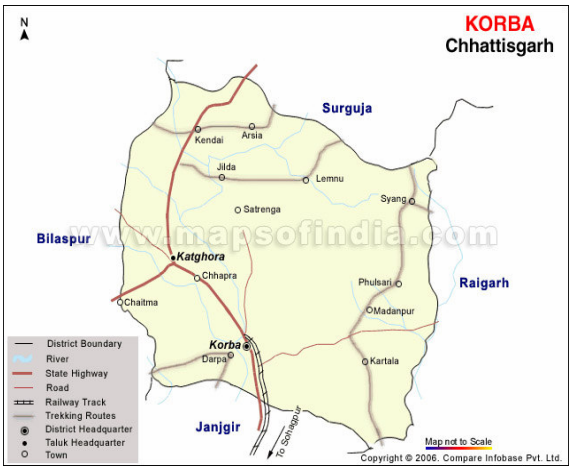
Bilaspur

Latitude	Longitude
21° 47’ to 23 ° 8’ N	81°14’ 15 to 83° 15’ E



Kabirdham (Previously known as Kawardha)

Latitude	Longitude
21 ^{o} 32’ to 22^{o} 28’ N	80 ^{o} 48’ to 81 ^{o} 48’ E



Korba

Latitude	Longitude
22 ^{o} 01’ to 23 ^{o} 01’ N	82^{o} 08’ to 83^{o} 09 E

A.4.2. Category(ies) of project activity:

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The project can be identified as “Avoidance of methane production from Animal waste & Manure through Aerobic treatment Vermi Composting” which falls in to category of GHG emission reductions from manure management system which has been categorised as consolidated baseline methodology of ACM0010/Version 02/ under Sectoral Scope – 13 and 15

A.4.3. Technology to be employed by the project activity:

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The project activity shall employ a vermi-composting technology which has been developed by International Corp Research Institute of Semi Arid Tropics (**ICRISAT**) and Andhra Pradesh Rural Livelihood Program 2003 **(APRLP)** with some modifications. The technology involves construction of

two chambers enclosed by ventilated walls, 1.5 meter wide, 5 meter long and 0.9 meter height made of materials such as bricks, flag stones, earthen tiles and locally available building materials each subdivided into five sub chambers. The separation walls contain small holes to facilitate easy movement of earthworms to one chamber to another. The bottom floor of the chamber recedes through a slide slope for collection of excess water, which is reused, or sprayed on crop as earthworm leachate. The five compartments of the tank are filled on, after the other layer by layer along with the manure and animal litter and earthworms are released. Once the first chamber feed material is converted in to compost by the earthworms then the second chamber is filled with manure and animal litter, and feeding in the first one is stopped. The earthworms naturally move through the holes to the second chamber this way the process continues. The chamber requires protection from sun and rain therefore shed can be created as per the available material. The bottom floor of the chambers is to be constructed as leach proof hence either RCC flooring can be done or cement tiles or local flagstones can be properly laid to avoid seepage to the soil strata. Design of the vermin-compost pit is illustrated in Figure 4.3.1 and Figure 4.3.2.

Figure 4.3.1 Showing shaded windrows vermi-compost pit

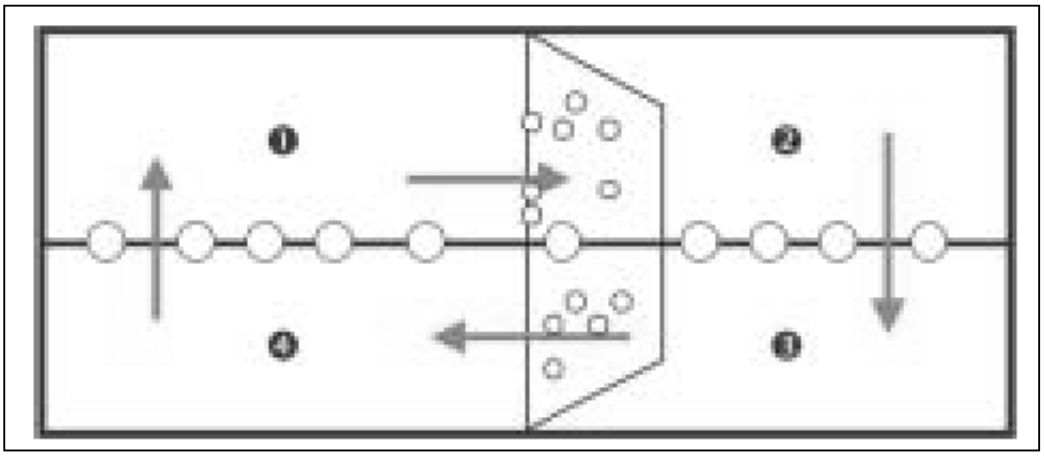

Figure 4.3.2 Showing perforated partition wall in vermi-compost pit to facilitate easy movement of earthworms

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

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Years	Annual estimation of emission reductions in tones of CO_{2e}
2008	77939
2009	97424
2010	116909
2011	129899
2012	129899
2013	129899
2014	129899
2015	129899
2016	129899
2017	129899
Total estimated reductions (tonnes of CO_2e)	1201565
Total Number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e	120156.5

A.4.5. Public funding of the project activity:

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No public funding in involved.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

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Project type	-	GHG emission reductions from manure managements systems.
Project category	-	Version-02 of ACM0010, Sectoral Scope-13 and 15,EB-28 .
Additionality tool	:	Version 04 of EB-36

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

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The project category selected for the project activity is "Consolidated baseline methodology for GHG emission reduction from manure management system" ACM0010/ Version-02, Sectoral Scopes: 13 & 15 EB 28.

This methodology is applicable to manure management project with the following conditions: -

Farms where livestock populations, comprising of cattle, buffalo, swine, sheep, goats, and/or poultry, is managed under confined conditions

- In project area live stock population comprise of cattle (cows and bulls), buffaloes, goats and poultry and managed under confined conditions (stall feeding).
  Farms where manure is not discharged into natural water resources (e.g. rivers or estuaries).
- In project area no manure is discharged in to any natural water resources i.e. river, lake etc.
  In case of anaerobic lagoons treatments systems, the depth of the lagoons used for manure management under the baseline scenario should be at least 1m **desep**.
- In project area anaerobic lagoon treatment system does not exist.
  The annual average temperature in the site where the anaerobic manure treatment facility in the baseline existed is higher than 5°C.
- The annual average temperature in the project area is ranges between 25 to 27.5 C, which is higher than 5°C.
  In the baseline case, the minimum retention time of manure waste in the anaerobic treatment system i.e. deep pits is greater than 1 month.
- In the baseline scenario, manure is retained in the anaerobic treatment system for the more than one month.
  The AWMS/process in the project case should ensure that no leakage of manure waste into ground water takes place, e.g., the lagoon should have a non-permeable layer at the lagoon bottom.
- In project activities for AWMS process, vermin-composting manure management system will be created. In vermicomposting process leak proofing of floor will ensure that no leakage of manure waste takes place in to ground water.

And in depth comparison of the requirement of the category and project are as follows.

Technology measures according to ACM0010	Technology measure relevance to project activity
This methodology is applicable generally to manure management on livestock farms where the existing anaerobic manure treatment system, within the project boundary, is replaced by one or a combination of more than one animal waste management system (AWMSs) that results in less GHG emission.	Project activity replaces existing liquid slurry deep pit type anaerobic manure management system and thereby production of methane is avoided By installing aerobic vermi-compost type manure management system, in place of the traditional GHURUWA (liquid slurry deep pit type system). Due to the proposed "windrow vermi composting" methane production will be minimized.
Farms where livestock populations, comprising of cattle. buffalo, swine, sheep, goats and/or poultry, is managed under confined conditions. Farms where manure is not discharged into natural water resources (e.g. rivers or estuaries).	In project area small farmer animal house comprises cattle and buffaloes are reared under confined conditions In project area animal farmers are not discharging any manure generated from their farms into natural resources.

B.3. Description of the sources and gases included in the project boundary

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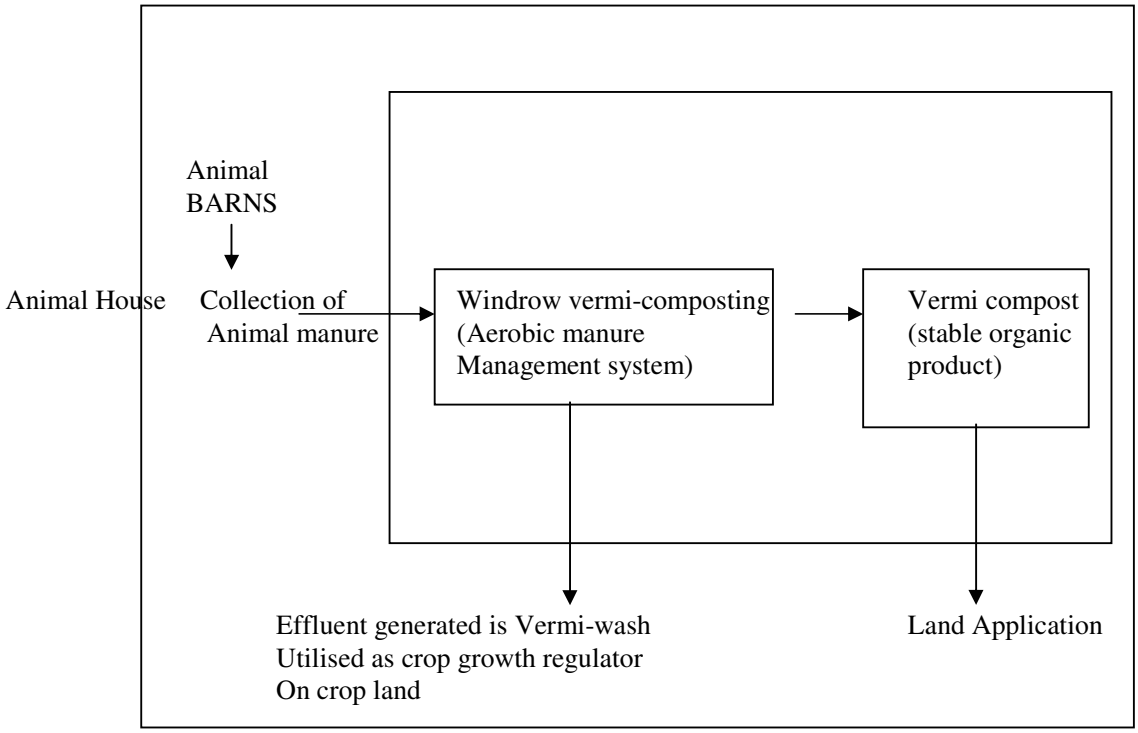
The project boundary includes all GHG emission from base line in the absence of project activity and under project activity (after installation of project) including emission from the management of soil where finished compost applied.

	Source	GHG Gases		Justification / Explanation
Baseline	Direct emissions from the waste treatment processes	CH_4	Included	The major source of emissions in the baseline
		N_2O	Included	
		CO_2	Excluded	CO_2 emissions from the decomposition of organic waste are not accounted
	Emissions from electricity consumption/generation	CO_2	Included	No electricity needed for liquid slurry manure management system
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
Project Activity	**Source**	**GHG Gases**		**Justification / Explanation**
	Emissions from onsite electricity use	CO_2	Included	No electricity needed for liquid slurry manure management system
		CH_4	Excluded	Excluded for simplification. This is conservative

		N_2O	Excluded	Excluded for simplification. This is conservative
	Direct emissions from the waste treatment processes	N_2O	Included	Emission from soil management due to application of compost
		CO_2	Excluded	CO_2 emission from the decomposition of organic waste are not accounted
		CH_4	Included	Minor emission from aerobic treatment

The animal manure would be collected and fed into windrow for aerobic treatment and inoculated earthworm for vermi-composting at the cattle shed owner's, waste source location.

Project Boundary at individual animal farmer house hold



B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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The possible scenarios have been identified to potential baseline emission.

The following steps are taken to identify the project baseline:

Step-1. Define alternative scenarios to the proposed CDM project activity

The following list of alternative scenario considered which are composed of a combination of different animal waste treatment stages. Each alternative was chosen considering as key aspects prevailing practices in the cattle farm, available technologies and treatment efficiency.

(i) **Daily spread:** manure is routinely removed from a confinement facility and is applied to cropland or pasture within 24 hours of excretion.

(ii) **Solid storage:** The storage of manure, typically for a period of several months, in unconfined piles or stacks. Manure is able to be stacked due to the presence of a sufficient amount of bedding material or loss of moisture by evaporation.

(iii) **Dry lot:** A paved or unpaved open confinement area without any significant vegetative cover where accumulating manure may be removed periodically.

(iv) **Burned for Fuel:** The dung and urine are excreted on fields. The sun dried dung cakes are burned for fuel.

(v) **Composting in vessel**: Composting, typically in an enclosed channel, with forced aeration and continuous mixing.

(vi) **Liquid/Slurry:** Manure is stored as excreted or with some minimal addition of water in either tanks or earthen ponds outside the animal housing, usually for periods less than one year.

(vii) **Anaerobic digester:** Animal excreta with or without straw are collected and anaerobic ally digested in a large containment vessel or covered lagoon. Digesters are designed and operated for waste stabilization by the microbial reduction of complex organic compounds to CO_2 and CH_4, which may be captured and flared or used as a fuel or left to the atmosphere with out any use.

(viii) **Windrows vermi-composting undertaken without considering the CDM support :** Placing raw organic material in long, narrow piles or windrows, which are agitated or turned by inoculating red worms to enhance the decomposition process to facilitate biological stabilisation.

Analysis of the manure management systems:

Daily spread: This kind of system is not common in CG farmers only used well rotten farmyard manure in their cropland. And cattle farm owner does not have any pastureland to spread the manure daily.

Solid Storage: This system does not consider decay in volatile solids or nitrogen content in treated manure and this system will not be efficient enough to control vector and odour. Farmer dislike solid storage treated manure because it has low nutritive value and work as a source of pathogen for crop instead to serve nutritive supplement. So the exclusion of this potential base line scenario can be justified.

Dry lot: This kind of practice is not seen in region. This system requires extra land for spreading and extra labour for spreading and collecting the material and further need exclusive dry climate. These reason are sufficient to ignore this system.

Burned for fuel: In past this practice was adopted in many small animal farm houses in rural areas. In this system dung cake was prepared from dung by women for the domestic fuel use. But in recent time they are unwilling to do so and further firewood or dung cake is replaced by liquid petroleum gas as a cooking fuel or by kerosene as fuel, as well as abundantly available coal is also used as fuel. In farms where animal flock size is big this practice cannot be possible due to scarcity of labour and no market support to dung cake in recent time. In small animal farm house also the female do not practice this due lack of interest and alternative available fuel.

Composting in vessel: This manure management system involves the mixing of manure with a bulking agent in a vessel under control moisture aeration temperature over a specific detention time. In this system composting is performed in an expensive sophisticated units. In rural area of CG where power supply is erratic these units are not technically viable, neither in existence. Hence this technology of composting is excluded from the base line scenario.

Anaerobic Digester: Anaerobic digester is a reactor sized both to receive daily volume of organic matter and to grow and maintain steady state population of methanogenic bacteria for degradation. Methanogenic bacteria are slow growing environmentally sensitive that grow without oxygen and require a pH greater than 6.9 to mainly convert organic acid into biogas over time. The anaerobic digester is one of the few manure management treatment options that reduces the environmental impact of manure. If generated methane is used to generate energy and earn extra revenue for farm. This reason makes alternative to potential base line scenario. Since the animal farmers household are quite small and lack in Financial and Technical capabilities, therefore it is difficult for them to adopt this expensive option.

Windrows vermi-composting undertaken without considering the CDM support: Most of barrier of this technology are described in the additionality test. The small Rural Animal Household farmers do not have required technical knowledge, financial capability to invest, lack of awareness, lack of ready market for vermicompost, etc bar the implementation of this scenario. In view of this in the Project area this option is not being practised before the introduction of the Project Activity. This will be considered as predefined scenario, representative for the project initiative.

Liquid slurry: Due to washing and flushing system of the barns, cattle waste in this area is normally liquid/slurry flush out and collected in earthen pits and left to decay under anaerobic condition in deep pits filled with water. This system is least expensive easy to handle and farmers like end product (rotten compost) for their field and for this reason this system is most commonly in existence since many years. This option is most commonly practiced and faces no barriers of any type.

In view of the above it is established that the disposal of manure in to the deep pits along with water is the most common practice, which faces no technological, financial barrier, hence is the baseline situation.

The above analysis of various scenario alternative reveals that the disposal of the Animal Manure in Deep pit liquid slurry filled system is most commonly practiced scenario, which faces no barrier. There are no other alternatives, which can be implemented with out the CDM support. Hence we identify the Deep Pit liquid slurry scenario as baseline.

Step-II Barrier Analysis
A complete list of barrier that would prevent alternative scenario to occur in the absence of the project activity are given below:

The various alternative scenarios as defined above shall face barriers that would prevent them to occur in the absence of the project activity for the following barriers:

Investment Barrier:
The "project activity" requires investment in construction of shed, leak proofing floor equipments etc., which would prevent this alternative to occur. In addition the project activity requires additional investment in red worm (Eisenea Foetida) as well as technical expertise, and regular skilled labour for treatment of animal waste in aerobic conditions through vermi-composting.

The relativity high initial cost, operational cost, lower volumes at individual site and slow rate of return, very small size restrict and disallow the attractive funding for implementation of the project.

Technology barrier:
"Alternative vii,viii as well as project activity would require technology which is not easily available to the rural masses. Vermi-composting is an aerobic treatment of manure management system earthworm takes over both the roles of turning and maintaining the material in aerobic conditions. In vermi-composting decomposition is accomplished by adding worms. This requires proper technology and know how which is not available at the baseline.

The worms needs proper moisture, temperature, ventilation and food with proper breeding and proper care. The vermi-composting needs technical experts support regularly. These technical experts and skilled labour to handle vermi-composting works is not available in this region.

Barrier due to prevailing practice
In the state of Chhattisgarh availability of space as well as time would prevent the implementation of "Alternative –i, ii, iii, iv, v, vii, viii and ix" hence these are not in common practice. Moreover in the Chhattisagarh state the animal rearing is not a basic part of commercial activity but is mostly done due to traditional practice to keep cows buffaloes for captive as well as for others, milk production, as a part time activity of farmers & villagers. Similar is the case for rearing of other animals such as Sheeps, goats, etc. Bulls and male buffaloes are reared for draft purposes like tillage, cartage etc. In the Indian context religious sentiments are also attached to cattle. Therefore, there are so many Gaushala/Cattle farms existing in the country. In all such individual or family holding cattle rearing practices or on those cattle farm or gaushalas no solid waste management environmental rules are applicable, in every cattle farm liquid/slurry type manure management system is prevailing and there is no legislation that require specific manure management on GHG emission control. Hence the normal practice in only to keep the animal barn clean and throw the generated waste in any nearest area deep pit along with the generated water

There is only one alternative scenario that is not prevented by any barrier that is alternative-vi i.e. liquid/ slurry deep pit manure disposal method. This alternative is now the proposed project activity not being registered as a CDM project activity; hence this alternative scenario is most plausible scenario. Since there are no other baseline scenario alternatives remaining therefore "step-III" is not adopted for the purpose.

Step-III & Step-IV not required.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality): >>

In the baseline scenario the manure along with the litter is disposed in the deep pits filled with water for digestion as manure, which is removed once in a year or some times twice in a year by the farmers. The project activity avoids the emission of methane to the atmosphere by substituting the above conventional method of anaerobic composting to aerobic vermi-composting therefore avoids the emission of methane to the atmosphere to the extent of manure managed through the project activity.

Additionality:
Since the baseline determination in this methodology demonstrate that the baseline is different from the project activity not undertaken as a CDM project activity therefore it is concluded that the project is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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In CG farmers have diversified animal stock, they keep cows, buffaloes, sheep, goat including small no of poultry either alone or in combination, cattle and buffaloes are kept in situation close confinement in housing with stall feeding system. During day time when animal released for roaming for short while with shepherd cattle owner clean the animal house, flush the dung and animal litter and collected this refuse in the dep earthen pit. In cleaning process they use some water, excreted dung, urine water used in cleaning make liquid slurry and this liquid slurry either manually or through connecting drain channels are stored in the same deep earthen pit, existed at just near to animal house. This is baseline scenario, where in the absence of the project activity animal waste is stored and methane is emitted to the atmosphere. The base line emission is the amount of methane emitted in year, amount of N_2O emitted in a year and CO_2 emitted from electricity used in the base line in t CO_2 year. The yearly emissions from the liquid/slurry deep pit manure management system are calculated using the equation as described in ACM 0010.

Baseline Emissions
The baseline is the AWMSs identified through the baseline selection procedure.

(i) Baseline emissions are:

$$BE_y = BE_{CH4,y} + BE_{N2O,y} + BE_{elec/heat,y} \quad (1)$$

where,

BE_y	Baseline emissions in year y, in tCO_2e/year.
$BE_{CH4,y}$	Baseline methane emissions in year y, in tCO_2e/year.
$BE_{N2O,y}$	Baseline N_2O emissions in year y, in tCO_2e/year.
$BE_{elec/heat,y}$	Baseline CO_2 emissions from electricity and/or heat used in the baseline, in tCO_2e/year.

(ii) Methane emissions

Manure Management system in the baseline could be based on different treatment systems and on one or more stages Therefore:

$$BE_{CH4,y} = GWP_{CH4}.DC_{H4} * \sum_{j,LT} MCF_j * B_{o,LT} * N_{LT} * Vs_{LT,y} * MS^{\%}_{BI,j} \qquad (2)$$

$BE_{CH4,y}$	the annual baseline methane emissions in t CO2e/y
GWP_{CH4}	Global Warming Potential (GWP) of CH_4.
D_{CH4}	CH_4 density (0.00067 t/m_3 at room temperature (20 ºC) and 1 atm pressure).
MCF_j	Annual methane conversion factor (MCF) for the baseline $AWMS_j$ from IPCC 2006 table 10.17, chapter 10, volume 4.
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated, in m_3CH_4/kg_dm, by animal type LT.
N_{LT}	Number of animals of type LT for the year y, expressed in numbers.
$VS_{LT,y}$	Annual volatile solid for livestock LT entering all AWMS [on a dry matter weight basis (kg-dm/animal/year), as estimated utilizing published 2006 IPCC default values multiplying with no. of days in year.
$MS\%_{Bl,j}$	Fraction of manure handled in sys

Estimations of various variables and parameters for above equations

(A) $VS_{LT,y}$ can be determined in one of the following ways, stated in the order of preference:

1. Using published country specific data. If the data is expressed in kg dm per day, multiply the value with nd_y (number of days in year y).

2. Estimation of VS based on dietary intake of livestock

3. Scaling default IPCC values $VS_{default}$ to adjust for a site-specific average animal weight.

4. Utilizing published IPCC defaults, multiply the value with nd_y (number of days in year y).
Developed countries $VS_{LT,y}$ values can be used provided the following conditions can be satisfied:
-The genetic source of the production operations livestock originate from an Annex I Party
-The farm use formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics
- The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.)
- The project specific animal weights are more similar to developed country IPCC default values.

Condition No. 1. is not considered. Since no published data on volatile solids (VS) of India specific is available so far.

Condition No. 2. cannot be considered because in project area animal farmers are marginal or small and in these animal farms the farmers are not capable to monitor any dietary intake data.

Condition No. 3. also omitted since W_{Site} cannot be monitored due to small character and huge number of farmers in project area.

Condition No. 4. is only way left to consider IPCC default values of VS for Indian subcontinent to estimate the CH_4 emission. Developed country Vs_{LTY} has not been used. The data for Indian sub continent has been used.

(B) Maximum Methane Production Potential ($B_{0,LT}$):
This value varies by species and diet. Where default values are used, they should be taken from tables 10A-4 through 10A-9 (IPCC 2006 Guidelines for National Greenhouse Gas Inventories volume 4, chapter 10) specific to the country where the project is implemented.

Developed countries $B_{0,LT}$ values can be used provided the following conditions are satisfied:

-The genetic source of the production operations livestock originate from an Annex I Party
- The farm use formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics
- The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.)
- The project specific animal weights are more similar to developed country IPCC default values

- For the estimation of methane emission values of B_{0LT} are 10A-4 through 10A-9 (IPCC 2006 Guidelines for National Greenhouse Gas Inventories volume 4, chapter 10) specific to the Indian subcontinent

(C) Methane conversion factors (MCFs):
The IPCC 2006 MCF values given in table 10.17 (chapter 10, volume 4) should be used, which is attached here as Annex 3. MCF values depend on the annual average temperature where the anaerobic manure treatment facility in the baseline existed. For average annual temperatures below 10 ^{o}C and above 5^{o}C, a linear interpolation should be used to estimate the MCF value at the specific temperature assuming an MCF value of 0 at an annual average of 5^{o}C. Future revisions to the IPCC Guidelines for National Greenhouse Gas Inventories should be taken into account.

A conservativeness factor should be applied by multiplying MCF values (estimated as per above bullet) with a value of 0.94, , to account for the 20% uncertainty in the MCF values as reported by IPCC 2006.

- MCF value for the estimation of methane emission are adopted from table 10.17 (chapter 10, volume 4) IPCC 2006 for the liquid slurry management system at the temperature 26^{o} C

For subsequent treatment stages, the reduction of the volatile solids during a treatment stage is estimated based on referenced data for different treatment types. Emissions from the next treatment stage are then calculated following the approach outlined above, but with volatile solids adjusted for the reduction from the previous treatment stages by multiplying by (1 - R_{VS}), where R_{VS} is the relative reduction of volatile solids from the previous stage. The relative reduction (R_{VS}) of volatile solids depends on the treatment

technology and should be estimated in a conservative manner. Default values for different treatment technologies can be found in Table 8.10 of chapter 8.2 in US-EPA (2001).[4] These values are provided in Annex 1.

- In Project area existing animal manure management systems are Deep Pit liquid slurry type. Deep Pit liquid slurry type system is single stage manure management system and does not require subsequent stage for the reduction of volatile solids. Hence the emission from the next stage is not considered.

(D) Annual Average number of animals (N_{LT}):

$$N_{LT} = N_{da} * \left[\frac{Np}{365} \right]$$

Where:

N_{LT} Annual average number of animals of type LT for the year y, expressed in numbers.
N_{da} Number of days animal is alive in the farm in the year y, expressed in numbers
N_p Number of animals produced annually of type LT for the year y, expressed in numbers

(i) N_2O emissions from manure management

$$BE_{N2O,y} = GWP_{N20} . CF_{N20-N,N} . \frac{1}{1000} . (E_{N2O,D,y} + E_{N2O,ID,y}) \quad (3)$$

where

BE_{N2O_y} Annual baseline N_2O emission in t CO_2e/yr
GWP_{N2O} Global Warming Potential (GWP) for N_2O.
$CF_{N2O-N,N}$ Conversion factor N_2O-N to N_2O (44/28).
$E_{N2O,D,y}$ Direct N_2O emission in kg N_2O-N/year.
$E_{N2O,ID,y}$ Indirect N_2O emission in kg N_2O-N/year.

$$E_{N20,D,y} = \sum_{j,LT} (EF_{N20,D,j} . NEX_{LT,y} . N_{LT} . MS\%_{Bl,j}) \quad (4)$$

where:

$E_{N2O,D,y}$ Are the direct nitrous oxide emissions in kg of N_2O per year.
$EF_{N2O,D,j}$ Is the direct N_2O emission factor for the treatment system j of the manure management system in kg N_2O-N/kg N (used default EF_3 from table 10.21, chapter 10, volume 4, in the IPCC 2006 Guidelines for National Greenhouse Gas Inventories).
$NEX_{LT,y}$ Is the annual average nitrogen excretion per head of a defined livestock population in kg N/animal/
$MS\%_{Bl,j}$ Fraction of manure handled in system j, in %
N_{LT} Number of animals of type LT for the year y, expressed in numbers.

$$E_{N20,ID,y} = \sum_{j,LT} (EF_{N20,I\,D,j} . F_{gasm} NEX_{LT,y} . N_{LT} . MS\%_{Bl,j}) \quad (5)$$

where:

$EN_{2O,ID,y}$	Are the indirect nitrous oxide emissions in kg of N_2O per year.
$EF_{N2O,ID,j}$	Is the indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces, kg N_2O-N/kg NH3-N and NOx-N emitted (used default values for EF_4 from table 11.3, chapter 11, volume 4 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories)
$NEX_{LT,y}$	Is the annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year
$MS\%_{Bl,j}$	Fraction of manure handled in system j
F_{gasm}	Percent of managed manure nitrogen for livestock category that volatilises as NH_3 and NOx in the manure management system.
N_{LT}	Number of animals of type LT for the year y, expressed in numbers.

(iv) CO2 emission from electricity and heat within the project boundary

Since in the project boundary Deep Pits liquid slurry manure management systems are existing, and such type of system neither require any electricity or heat. Thus no estimation is requiring for CO2 emission from electricity and heat.

The livestock population by different livestock types in the project boundary.

Live stock type	No. of heads	Average weight
Non Dairy cattle	128520	110 kg
Dairy cattle	42840	275 kg
Buffaloes	42840	295 kg

Utilising this information the base line emissions is calculated as follows.

Year for crediting period	Baseline annual emission t CO_2
2008	97160
2009	121450
2010	145740
2011	161934
2012	161934
2013	161934
2014	161934
2015	161934
2016	161934
2017	161934
Total	1497888

B.6.2. Data and parameters that are available at validation:

(Copy this table for each data and parameter)

Data / Parameter:	$N_{LT\,nd}$
Data unit:	Number
Description:	Annual Average Population
Source of data used:	Project proponent
Value applied:	128520
Justification of the choice of data or description of measurement methods and procedures actually applied :	The animal population considered for the baseline is based on the targeted number of village and Animal farmers and the numbers of animal reared by them. The numbers are estimated as per the village statistics provided by the respective village coordinator.
Any comment:	Animal population data collected from the individual farmers will be used to average the number of animals of this type.

Data / Parameter:	$N_{LT\,dr}$
Data unit:	Number
Description:	Annual Average Population
Source of data used:	Project proponent
Value applied:	42840
Justification of the choice of data or description of measurement methods and procedures actually applied :	The animal population considered for the baseline is based on the targeted number of village and Animal farmers and the numbers of animal reared by them. The numbers are estimated as per the village statistics provided by the respective village coordinator
Any comment:	Animal population data collected from the individual farmers will be used to average the number of animals of this type. Data will be kept for crediting period + 5 years.

Data / Parameter:	$N_{LT\,bf}$
Data unit:	Number
Description:	Annual Average Population
Source of data used:	Project proponent
Value applied:	42840
Justification of the choice of data or description of measurement methods and procedures actually applied :	The animal population considered for the baseline is based on the targeted number of village and Animal farmers and the numbers of animal reared by them. The numbers are estimated as per the village statistics provided by the respective village coordinators
Any comment:	Animal population data collected from the individual farmers will be used to average the number of animals of this type. Data will be kept for crediting period + 5 years.

Data / Parameter:	$W_{LT\,nd}$
Data unit:	Kg

Description:	Weight of Non-Dairy cattle / animal
Source of data used:	IPCC default value for Indian sub-continent.
Value applied:	110
Justification of the choice of data or description of measurement methods and procedures actually applied :	There is large variation in animal body weight and looking in to large number of population animals to be covered under the project it is difficult to identify the individual animals because tattooing of animals in India is normally not in practice. Hence the default value from IPCC has been considered.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$W_{LT\ dr}$
Data unit:	Kg
Description:	Weight of Dairy cattle / animal
Source of data used:	IPCC default value for Indian sub-continent.
Value applied:	275
Justification of the choice of data or description of measurement methods and procedures actually applied :	There is large variation in animal body weight and looking in to large number of population animals to be covered under the project it is difficult to identify the individual animals because tattooing of animals in India is normally not in practice. Hence the default value from IPCC has been considered.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$W_{LT\ bf}$
Data unit:	Kg
Description:	Weight of buffaloes
Source of data used:	IPCC default value for Indian sub-continent.
Value applied:	295
Justification of the choice of data or description of measurement methods and procedures actually applied :	There is large variation in animal body weight and looking in to large number of population animals to be covered under the project it is difficult to identify the individual animals because tattooing of animals in India is normally not in practice. Hence the default value from IPCC has been considered.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$VS_{LT\ nd}$
Data unit:	Kg/head/day
Description:	Volatile solid/day/animal from Non-dairy cattle/ animals.
Source of data used:	IPCC 2006
Value applied:	1.4
Justification of the choice of data or description of	Published data of India specific on VS is not available, estimation based on dietary intake not possible in traditionally managed small animal farms and due to large number of animals spread out in a very large and backward areas.

measurement methods and procedures actually applied :	Scaling default values for specific project area is not possible. Hence IPCC default value is considered.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$VS_{LT\ dr}$
Data unit:	Kg/head/day
Description:	Volatile solid/day/animal from dairy cattle/ animals.
Source of data used:	IPCC 2006
Value applied:	2.6
Justification of the choice of data or description of measurement methods and procedures actually applied :	Published data of India specific on VS is not available, estimation based on dietary intake not possible in traditionally managed small animal farms and due to large number of animals spread out in a very large and backward areas. Scaling default values for specific project area is not possible. Hence IPCC default value is considered.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$VS_{D\ LT\ bf}$
Data unit:	Kg/head/day
Description:	Volatile solid/day/animal from buffaloes.
Source of data used:	IPCC default value
Value applied:	3.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Published data of India specific on VS is not available, estimation based on dietary intake not possible in traditionally managed small animal farms and due to large number of animals spread out in a very large and backward areas. Scaling default values for specific project area is not possible. Hence IPCC default value is considered.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$B_{0\ LT\ nd}$
Data unit:	$M^3\ CH_4$/kg VS
Description:	Maximum methane producing potential of the volatile solid dry matter generated from Non-Dairy cattle
Source of data used:	IPCC 2006
Value applied:	0.10
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of Bo varies by diet; in Project area small animal farms have no regular diet plan. Hence IPCC default value for Indian sub continent is considered
Any comment:	Data will be kept for crediting period + 5 years.
Data / Parameter:	$B_{0\ LT\ dr}$
Data unit:	$M^3\ CH_4$/kg VS

Description:	Maximum methane producing potential of the volatile solid dry matter generated from Dairy cattle/ animal
Source of data used:	IPCC 2006
Value applied:	0.13
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of Bo varies by diet; in Project area small animal farms have no regular diet plan. Hence IPCC default value for Indian sub continent is considered
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$B_{0\ LT\ bf}$
Data unit:	$M^3\ CH_4/kg\ VS$
Description:	Maximum methane producing potential of the volatile solid dry matter generated from buffaloes
Source of data used:	IPCC 2006
Value applied:	0.10
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of Bo varies by diet; in Project area small animal farms have no regular diet plan. Hence IPCC default value for Indian sub continent is considered
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	MCF
Data unit:	%
Description:	Annual methane conversion factor for the baseline.
Source of data used:	IPCC 2006
Value applied:	66.74
Justification of the choice of data or description of measurement methods and procedures actually applied :	Baseline scenario of manure management system is Deep pit liquid slurry type. Mean annual temperature of the area is 26 ^{o} C. Corresponding values of MCF multiplying by 0.94 for uncertainty conservativeness is calculated.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	MCF
Data unit:	%

Description:	Annual methane conversion factor for the project activity.
Source of data used:	IPCC 2006
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of aerobically treated manure management system has taken from IPCC.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$EF_{N2O\ D,\ J}$
Data unit:	Factor
Description:	Direct N_2O emission in Kg N_2O-N/ year for baseline.
Source of data used:	IPCC 2006
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Estimation of emission factor (EF) for the manure management system is not possible and regional or national data is also not available. Hence EF_3 value for liquid slurry treatment process is adopted.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$EF_{N2O\ ID,\ J}$
Data unit:	Factor
Description:	Direct N_2O emission in Kg N_2O-N/ year for baseline.
Source of data used:	IPCC 2006
Value applied:	0.010
Justification of the choice of data or description of measurement methods and procedures actually applied :	Regional for National data on emission factor for N_2O emission for atmospheric deposition of N_2O on soil and water surface is not available. Hence default values for EF_4 is considered.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$EF_{N2O\ DY}$
Data unit:	Factor

Description:	Direct N_2O emission in Kg N_2O-N/ year for project activity.
Source of data used:	IPCC 2006
Value applied:	0.01
Justification of the choice of data or description of measurement methods and procedures actually applied :	Estimation of emission factor (EF) for the manure management system is not possible and regional or national data is also not available. Hence EF_3 value for aerobic treatment process is adopted.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$EF_{N2O\ IDY}$
Data unit:	Factor
Description:	In-direct N_2O emission in Kg N_2O-N/ year for baseline.
Source of data used:	IPCC 2006
Value applied:	0.01
Justification of the choice of data or description of measurement methods and procedures actually applied :	Regional for National data on emission factor for N_2O emission for atmospheric deposition of N_2O on soil and water surface is not available. Hence default values for EF_4 is considered.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$NEX_{LT\ nd}$
Data unit:	Kg/head/year
Description:	Annual Nitrogen Excretion from Non Dairy cattle/animal
Source of data used:	Calculated
Value applied:	13.65
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated by using IPCC default value of weight.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$NEX_{LT\ dr}$
Data unit:	Kg/head/year

Description:	Annual Nitrogen Excretion from Dairy cattle/animal
Source of data used:	Calculated
Value applied:	47.176
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated by using IPCC default value of weight.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$NEX_{LT\,bf}$
Data unit:	Kg/head/year
Description:	Annual Nitrogen Excretion from buffaloes
Source of data used:	Calculated
Value applied:	34.46
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated by using IPCC default value of weight.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	Fgasm
Data unit:	%
Description:	Managed manure Nitrogen for livestock category that volatize as NH_3 and NO_x in the manure management system.
Source of data used:	IPCC 2006
Value applied:	0.20
Justification of the choice of data or description of measurement methods and procedures actually applied :	Estimation of fraction of animal manure N that volatizes as NH_3 and NO_x - N in kg $NH\text{-}NO_x\text{-}N$ per kg of N is not possible at site specific and regional or national data for India specific is also not available. Hence default value of Fgasm is considered and taken from 2006 of IPCC.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	Temp.
Data unit:	^0C
Description:	Mean annual temperature of the Region
Source of data used:	Temperature Map of India
Value applied:	26^0
Justification of the choice of data or	Associated area of proposed project activities is identified and mean annual temperature of associated area is averaged. Though the averaged mean

description of measurement methods and procedures actually applied :	temperature of the area is 26.25° C however, it is considered as 26° C for simplification and conservativeness.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	Ms_{BLJ}
Data unit:	%
Description:	Fraction of manure handled in system J baseline.
Source of data used:	Observation
Value applied:	100
Justification of the choice of data or description of measurement methods and procedures actually applied :	In project boundary animal farmers managing 90 to 100% generated manure in Deep pit liquid slurry type manure management process. But for conservative point of view MS_{BLJ} is considered 80.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	nd_y
Data unit:	*Number*
Description:	Number of days treatment plant was operational in year y
Source of data used:	Observation
Value applied:	365
Justification of the choice of data or description of measurement methods and procedures actually applied :	In project boundary animal farmers dumped 365 days generated manure in to Deep pit liquid slurry type manure management process.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_{2e}/tCH_4
Description:	Global warming potential for CH_4
Source of data used:	IPCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	For the first commitment period. Shall be updated according to any future COP/MOP decisions.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	GWP_{N2O}

Data unit:	tCO_2e/tN_2O
Description:	Global warming potential for N_2O
Source of data used:	IPCC
Value applied:	310
Justification of the choice of data or description of measurement methods and procedures actually applied :	For the first commitment period. Shall be updated according to any future COP/MOP decisions.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	D_{CH4}
Data unit:	T/M^3
Description:	Density of Methane
Source of data used:	Technical literature
Value applied:	0.00067
Justification of the choice of data or description of measurement methods and procedures actually applied :	0.00067 t/m^3 at room temperature 20°C and 1 atm pressure.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$CFN_2O\text{-}N,N$
Data unit:	-
Description:	Conversion factor
Source of data used:	Technical literature
Value applied:	44/28
Justification of the choice of data or description of measurement methods and procedures actually applied :	Atomic weight of N_2O and N_2
Any comment:	Data will be kept for crediting period + 5 years.

In 6.2 Subscript LT nd, LT dr and LT bf denotes animal type non diary, diary and buffalo respectively.

B.6.3 Ex-ante calculation of emission reductions:

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The emission reduction ERy by the project activity during a given crediting period is calculated by the formula as described in ACM0010

Project emissions are estimated as follows:

$$PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N2O,y} + PE_{PL,y} + PE_{flare,y} + PE_{elec/hea} \quad (1)$$

$PE_{AD,y}$	Leakage from AWMS systems that capture's methane in t CO_{2e}/yr
$PE_{Aer,y}$	Methane emissions from AWMS that aerobically treats the manure in t CO_{2e}/yr
$PE_{N2O,y}$	Nitrous oxide emission from project manure waste management system in t CO_{2e}/yr
$PE_{PL,y}$	Physical leakage of emissions from biogas network to flare the captured methane or supply to the facility where it is used for heat and/or electricity generation in t CO_{2e}/yr
$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in t CO_{2e}/yr
$PE_{elec/heat}$	Project emissions from use of heat and/or electricity in the project case in t CO_{2e}/yr

(i) Methane emissions from AWMS where gas is captured ($PE_{AD,y}$)

- Since the project activity does not capture any methane hence, the same is not considered.

(ii) Methane emissions from aerobic AWMS treatment ($PE_{Aer,y}$):

IPCC guideline specify emissions from aerobic lagoons as 0.1% of total methane generating potential of the waste processed, which can be used as a default for all types aerobic AWMS treatment.

$$PE_{Aer,y} = GWP_{CH4} D_{CH4} * 0.001 * F_{Aer} * \left[\prod_{n-1}^{N} (1 - R_{VS,n}) \right] * \sum_{j,LT} (B_{o,LT} * N_{LT} * VS_{LT,y} * MS\%_j) + PE_{Sl.y} \quad (2)$$

$R_{VS,n}$	Fraction of Volatile solid degraded in AWMS treatment method n of the N treatment steps prior to waste being treated in Aerobic lagoon.
D_{CH4}	CH_4 density (0.00067 t.m^3 at room temperature (20^{0}C) and 1 atm pressure).
F_{Aer}	Fraction of volatile solid directed to Aerobic system.
LT	index for livestock type
$B_{O,LT}$	CH_4 production capacity from manure for livestock type LT, in m^3 CH_4/kg-VS, to be chosen based on procedure provided for in the Baseline methodology section.
$VS_{LT,y}$	Annual volatile solid excretion livestock type LT on a dry-matter basis in kg/animal/year.
N_{LT}	Population of livestock type LT for the year y, expressed in numbers.
$PE_{Sl,y}$	CH_4 emissions from sludge disposed of in storage pit prior to disposal during the year y, expressed in tons of CO2e/yr.
$MS\%_j$	Fraction of manure handles in system j

Aerobic treatment results in large accumulations of sludge. Sludge requires removal and has large VS values. It is important to identify the following management process for the sludge and estimate the emissions from that management process. If the sludge ponds are not within the project boundary, the emissions should be included in leakages. The emissions from sludge ponds shall be estimated as follows.

- The methodology requires calculating the every emission from sludge ponds in case the AWMS treatment is aerobic and generates sludge, which is disposed in to the sludge ponds. Since in the project activities the methane avoidance is managed by managing the manure in place of deep pit system to vermiscomposting system, hence the sludge is not generated, rather vermicompost is produced which is packed and shipped for application into crop land.

(iii) N_2O emissions from manure management

$$PE_{N2O,y} = GWP_{N2O}.CF_{N2O-N,N}.\frac{1}{1000}.\left(E_{N2O,D,y} + E_{N2O,ID,y}\right) \quad (3)$$

where:

$PE_{N2O,y}$	Annual project N_2O emissions in t CO2e/yr.
GWP_{N2O}	Global warming potential (GWP) for N_2O.
$CF_{N2O-N,N}$	Conversion factor N_2O-N to N_2O (44/28).
$E_{N2O,D,y}$	Direct N_2O emission in kgN_2O-N/year.
$E_{N2O,LD,y}$	Indirect N_2O emission in kg N_2O-N/year.

$$E_{N2O,D,y} = \sum_{j,LT}\left(EF_{N2O,D,j}.NEX_{LT,y}.N_{LT}.MS\%_j\right) \quad (4)$$

where:

$E_{N2O,D,y}$	Are the direct nitrous oxide emissions in kg of N_2O per year.
$EF_{N2O,D,j}$	Is the direct N_2O emission factor for the treatment system j of the manure management system in kg N_2O-N/kg N (estimated with site-specific, regional or national data if such data is available, otherwise use default EF_3 in volume 4, chapter 10, table 10.21 in IPCC 2006 Guidelines).
$NEX_{LT,y}$	Is the annual average nitrogen excretion per head of a defined livestock population in kg/N/animal/year estimated as described in Annex 2.
MS_j	Fraction of manure handled in system j, in %.
N_{LT}	Population of livestock type LT for the year y, expressed in numbers.

$$E_{N2O,ID,y} = \sum_{j,LT}\left(EF_{N2O,ID,j} * F_{gasm} * NEX_{LT,y} * N_{LT} * MS\%_j\right) \quad (5)$$

where:

$E_{N2O,y}$	Are the indirect nitrous oxide emissions in kg of N_2O per year.
$EF_{N2O,Id,j}$	Is the indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces, kg N_2O-N/kg NH_3 and NOx-N emitted, estimated with site-specific, regional or national data if such data is available. Otherwise, default values for EF_4 from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines can be used.

$NEX_{LT,y}$	Is the annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year estimated as described in Annex 2.
$MS\%_j$	Fraction of manure handled in system j
F_{gasm}	Percent of managed manure nitrogen for livestock category that volatilises as NH_3 and NOx in the manure management system
N_{LT}	Population of livestock type LT for the year y, expressed in numbers.

For subsequent treatment stages, the reduction of the nitrogen during a treatment stage is estimated based on referenced data for different treatment types. Emissions from the next treatment stage are then calculated following the approach outlined above, but with nitrogen adjusted for the reduction from the previous treatment stages by multiplying by (1-R_N), where R_N is the relative reduction of nitrogen from the previous stage. The relative reduction (R_N) of nitrogen depends on the treatment technology and should be estimated in a conservative manner. Default values for different treatment technologies can be found in Chapter 8.2 in US-EPA (2001).[6] These values are provided in Annex 1.

- The Project activities do not involve any stage of subsequent treatment hence the calculation related into further reduction of nitrogen is not required.

(iv) Physical Leakage from distribution network of the captured methane in (PE_{PL})

- The methodology requires calculating the physical leakage from distribution network of captured methane. Since the Project activities do not capture any methane hence the same not considered.

Project emissions from heat use and electricity use ($PE_{elec/heat}$):

- The project emission from the use of electricity and heat is not considered, as there is no use of electricity and heat in the proposed Project activities.

Leakage

Leakage covers the emission from land application of treated manure, outside the project boundary. These emissions are estimated as net of those released under project activity and those released in the baseline scenario. Net leakage of N2O and CH4 are only considered if they are positive.

Net leakage considered zero as both system baseline and project generate compost and treated manure in both conditions applied in the field and emit equal amount of emission

B.6.4 Summary of the ex-ante estimation of emission reductions:

>>

Year	Estimation of baseline emission tCO_2	Estimation of project activity emission tCO_2	Estimation of leakage emission tCO_2	Estimation of overall emission reduction tCO_2
2008	97160	19221	0	77939.00
2009	121450	24026	0	97424.00
2010	145740	28831	0	116909.00
2011	161934	32035	0	129899.00
2012	161934	32035	0	129899.00
2013	161934	32035	0	129899.00
2014	161934	32035	0	129899.00
2015	161934	32035	0	129899.00
2016	161934	32035	0	129899.00
2017	161934	32035	0	129899.00
Total estimated reduction tCO_2				1201565.00
Average annual emission redtion in tCO_2/annum				120156.50

B.7 Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

(Copy this table for each data and parameter)

Data / Parameter:	MCF
Data unit:	Fraction
Description:	Methane correction factor
Source of data to be used:	IPCC 2006 Guidelines
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.1
Description of measurement methods and procedures to be applied:	Corresponding value of MCF for the manure management process.
QA/QC procedures to be applied:	Not required being the IPCC value.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	B_{0LTnd}

Data unit:	Fraction
Description:	Maximum methane production from Non diary cattle.
Source of data to be used:	IPCC 2006 Guidelines
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.10
Description of measurement methods and procedures to be applied:	The value of Bo varies by diet; in Project area small animal farms have no regular diet plan. Hence IPCC default value for Indian sub continent is considered
QA/QC procedures to be applied:	Not required being the IPCC value.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	B_{0LTdr}
Data unit:	Fraction
Description:	Maximum methane production from Diary cattle.
Source of data to be used:	IPCC 2006 Guidelines
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.13
Description of measurement methods and procedures to be applied:	The value of Bo varies by diet; in Project area small animal farms have no regular diet plan. Hence IPCC default value for Indian sub continent is considered
QA/QC procedures to be applied:	Not required being the IPCC value
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	B_{0LTbf}
Data unit:	Fraction

Description:	Maximum methane production from Buffalo.
Source of data to be used:	IPCC 2006 Guidelines
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.10
Description of measurement methods and procedures to be applied:	The value of Bo varies by diet; in Project area small animal farms have no regular diet plan. Hence IPCC default value for Indian sub continent is considered
QA/QC procedures to be applied:	Not required being the IPCC value
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	VS_{LTynd}
Data unit:	Kg dry matter/animal/year
Description:	Volatile solid excretion per animal per day – Non diary cattle
Source of data to be used:	IPCC 2006 Guidelines
Value of data applied for the purpose of calculating expected emission reductions in section B.5	511
Description of measurement methods and procedures to be applied:	Published data of India specific on VS is not available, estimation based on dietary intake not possible in traditionally managed small animal farms and due to large number of animals spread out in a very large and backward areas. Scaling default values for specific project area is not possible. Hence IPCC default value is considered and calculated.
QA/QC procedures to be applied:	Not required as calculated value from IPCC data.
Any comment:	

Data / Parameter:	VS_{LTydr}
Data unit:	Kg dry matter/animal/year

Description:	Volatile solid excretion per animal per day – Diary cattle
Source of data to be used:	IPCC 2006 Guidelines
Value of data applied for the purpose of calculating expected emission reductions in section B.5	949
Description of measurement methods and procedures to be applied:	Published data of India specific on VS is not available, estimation based on dietary intake not possible in traditionally managed small animal farms and due to large number of animals spread out in a very large and backward areas. Scaling default values for specific project area is not possible. Hence IPCC default value is considered and calculated.
QA/QC procedures to be applied:	Not required as calculated value from IPCC data
Any comment:	

Data / Parameter:	VS_{LTybf}
Data unit:	Kg dry matter/animal/year
Description:	Volatile solid excretion per animal per day – Buffalo
Source of data to be used:	IPCC 2006 Guidelines
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1131.5
Description of measurement methods and procedures to be applied:	Published data of India specific on VS is not available, estimation based on dietary intake not possible in traditionally managed small animal farms and due to large number of animals spread out in a very large and backward areas. Scaling default values for specific project area is not possible. Hence IPCC default value is considered and calculated.
QA/QC procedures to be applied:	Not required as calculated value from IPCC data
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	Type
Data unit:	Confined type of barns

Description:	Type of barn and AWMS
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Small animal farm rearing under closed confined conditions established vermicomposting manure management system for manure generated from animal farm.
Description of measurement methods and procedures to be applied:	Three different types of types of animals have been classified; i.e. on dairy cattle, Dairy cattle and buffalo. All the animals are considered under confined type of barns.
QA/QC procedures to be applied:	
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	T
Data unit:	^{o}C
Description:	Annual Average ambient temperature at Project site.
Source of data to be used:	Project proponents- obtained from official sources.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	26
Description of measurement methods and procedures to be applied:	Annual mean temperature is averaged value of mean of average temperature marked for the project area where project activities are proposed.
QA/QC procedures to be applied:	Not required as the value is obtained from Govt published data.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	N_{LTnd}
Data unit:	Number
Description:	Average live stock population by specific animal type- Non dairy type.
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	128520
Description of measurement methods and procedures to be applied:	Annual average population is derived by using equation 10.1 quoted in chapter 10 volume 4 of IPCC 2006 guideline.
QA/QC procedures to be applied:	Monthly update of animal population will be done as per the achieved field reports.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	N_{LTdr}
Data unit:	Number
Description:	Average live stock population by specific animal type- Dairy type.
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	42840
Description of measurement methods and procedures to be applied:	Annual average population is derived by using equation 10.1 quoted in chapter 10 volume 4 of IPCC 2006 guideline.
QA/QC procedures to be applied:	Monthly update of animal population will be done as per the achieved field reports.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	N_{LTbf}
Data unit:	Number
Description:	Average live stock population by specific animal type- Buffalo type.
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	42840
Description of measurement methods and procedures to be applied:	Annual average population is derived by using equation 10.1 quoted in chapter 10 volume 4 of IPCC 2006 guideline.
QA/QC procedures to be applied:	Monthly update of animal population will be done as per the achieved field reports.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$W_{SiteLTynd}$
Data unit:	kg
Description:	Weight of livestock – Non Dairy cattle
Source of data to be used:	IPCC default values
Value of data applied for the purpose of calculating expected emission reductions in section B.5	110
Description of measurement methods and procedures to be applied:	IPCC default value.
QA/QC procedures to be applied:	Not required.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	$W_{SiteLTydr}$
Data unit:	kg
Description:	Weight of livestock –Dairy cattle
Source of data to be used:	IPCC default values
Value of data applied for the purpose of calculating expected emission reductions in section B.5	275
Description of measurement methods and procedures to be applied:	IPCC default value.
QA/QC procedures to be applied:	Not required
Any comment:	

Data / Parameter:	$W_{SiteLTybf}$
Data unit:	kg
Description:	Weight of livestock –Buffalo
Source of data to be used:	IPCC default values
Value of data applied for the purpose of calculating expected emission reductions in section B.5	295
Description of measurement methods and procedures to be applied:	IPCC default value
QA/QC procedures to be applied:	Not required
Any comment:	

Data / Parameter:	MS%
Data unit:	Fraction
Description:	Fraction of manure handled in system j in project activity
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	100
Description of measurement methods and procedures to be applied:	The fraction of manure handled will be determined from the Farmer wise.Village level data to be obtained on monthly basis.
QA/QC procedures to be applied:	The data will be updated every month.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	NEX_{LTynd}
Data unit:	Kg N/animal/year
Description:	Annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year estimated as described in Annex 2-Non diary cattle.
Source of data to be used:	Calculated according to Annex-2 .
Value of data applied for the purpose of calculating expected emission reductions in section B.5	13.65
Description of measurement methods and procedures to be applied:	Estimation of annual N intake per animal at animal farm site proposed under project activities is not possible and regional of national data of India specific is not available hence, the NEX values calculated on the basis of default values given in IPCC 2006 guidelines using procedure given in Annex-2.
QA/QC procedures to be applied:	Not required as IPCC value used in calculation.
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	NEX_{LTydr}
Data unit:	Kg N/animal/year
Description:	Annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year estimated as described in Annex 2- Diary cattle.
Source of data to be used:	Calculated according to Annex-2 .
Value of data applied for the purpose of calculating expected emission reductions in section B.5	47.18
Description of measurement methods and procedures to be applied:	Estimation of annual N intake per animal at animal farm site proposed under project activities is not possible and regional of national data of India specific is not available hence, the NEX values calculated on the basis of default values given in IPCC 2006 guidelines using procedure given in Annex-2.
QA/QC procedures to be applied:	Not required as IPCC value used in calculation
Any comment:	Data will be kept for crediting period + 5 years.

Data / Parameter:	NEX_{LTybf}
Data unit:	Kg N/animal/year
Description:	Annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year estimated as described in Annex 2- Buffalo.
Source of data to be used:	Calculated according to Annex-2 .
Value of data applied for the purpose of calculating expected emission reductions in section B.5	34.46.
Description of measurement methods and procedures to be applied:	Estimation of annual N intake per animal at animal farm site proposed under project activities is not possible and regional of national data of India specific is not available hence, the NEX values calculated on the basis of default values given in IPCC 2006 guidelines using procedure given in Annex-2.
QA/QC procedures to be applied:	Not required as IPCC value used in calculation
Any comment:	Data will be kept for crediting period + 5 years.

Subscript LTy.nd, LTy.dr and Lty.bf denotes animal type Non Dairy, Dairy and Buffalo respectively.

B.7.2 Description of the monitoring plan:

>>

Base line emission:

- The precise location of the each village where the animal farms i.e. the Project activities is proposed have been identified with the help global positioning systemand Topo sheets published by the Govt of India (survey of India).

- MCF and Bo default values for estimating methane emission from AWMS in the base line are adopted from table 10.17 and through table 10A-4-10A-8 chapter 10 volume4 2006IPCC Guide lines for National Green house gas Inventories respectively.

- For estimation of nitrogen emission from AWMS default values of $EF_{N2O}$is considered and EFs_3 are taken from table 10.21-chapter10 volume 4 for direct N_2O emission and $EF_4$from table 11.3 chapter 11 volume 4 of 2006 IPCC guidelines for National Green house gas Inventories considered for indirect N_2O emission.

- Existing Deep Pit liquid slurry type AWMS is single stage system therefore Rn not considered in estimation of emission.

- Ambient temperature data have taken from Annual Temperature Map of India. Map reveals that annual temperature of the region where the Project Activities to be implemented ranges between 25^{o} C-27.5 ^{o} C. For simplification purpose mean of the values is considered and conservative point of view 26 ^{o} C is used in the calculation of emission.

Project emission:

- In each animal farm data of animal population by specific animal type will be recorded in every month To estimate the population of each animal type information will be gathered about animal sold out, animal brought in, mortility and birth at animal house. These data will be recorded at village by the village level coordinator.

- No estimation of Volatile solids excretion at animal farms is required as default values of Vs by specific animal type given in table through 10A-4-10A-8 will be considered in estimation of Project emission.

- The Project Activities included only small and marginal animal farms of the rural areas of Chhattisgarh. These farms commonly managed traditionally and collection of scientific data like annual N intake is not possible at these animal farms. The published data of CG region or India specific is also not available so far; hence default values from table 10.19 of IPCC 2006 chapter 10 volume 4 will be used for the calculation of project emission.

All information will be documented at village level records for each animal farm. This village record also includes how windrows to be piled, numbering of windrow and shed, date of inoculation of worms in each windrow. Workers will be trained in organic farming regarding per hectare application dose

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>

Date of completion application of baseline study :27th Nov 2007

Preparation of this document has been done by "Indus Technical and Financial Consultants Ltd.", who is project developer & Project Participant and whose address is:
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Dr. R.K. Vishnoi
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Mobile: 094252-08189, 093011-93400

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

06/06/2004

C.1.2. Expected operational lifetime of the project activity:

>>

20 Years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

Not Applicable

C.2.1.1. Starting date of the first crediting period:

>> *Not Applicable*

C.2.1.2. Length of the first crediting period:

>> *Not Applicable*

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>> 01/07/ 2008 or from the date of registration which ever is later.

C.2.2.2. Length:

>>

10 Years 0 months.

SECTION D. Environmental impacts

>>

Contribution to sustainable development: The proposed project activity has the following sustainable development aspects.

Social well being: the vermi-composting will eliminate odour that have become disturbing problem to the surrounding community and will reduce health risks and improve the quality of life of surrounding community.

Economic well being: The vermi-composting leads to employment avenues for youth as vermi-composting is labour intensive and needs technical experts and skilled and unskilled workers regularly.

Environmental well being: Final product of vermi-compost is free flowing, easy to apply, odour free eco-friendly organic manure, improve soil that are aeration water retention capacity, rich in all nutrients, encourage plant growth, rich in micro flora as a fixers P- solubilizer and reduce the requirement of chemical fertilizer like Urea and DAP. The use of vermi compost ultimately reduces the N_2O & CO_2 emission in the atmosphere.

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

There is no adverse environmental impact due to Project activity. Rather the Project activity will help to improve the environment.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

The project activity environmental impacts are not going to be adverse. The project activity will help to improve the rural ecosystem.

SECTION E. Stakeholders' comments

>>

The members of the Lakhasar Sewa Samiti and Murli Mahila Mandal Murli were appraised about the whole process of CDM Project activity, and subsequently the individual stackholders involved in the Project activity were also explained the details of the project. Meeting on dated 14/11/2006 at Dormi,Bilaspur; on dated 26/01/2007 at Bodla,Kabirdham and on 14/02/2007 at Pali,Korba were jointly called by Lakhasar Sewa Samiti and Murli Mahila Mandal,Murli to know the stackholders comments. All the stakeholders are appreciated the initiation and requested to implement the Project as early as possible in as large area as possible .The stakeholders expressed very positive remarks about the Project.

The project proponent also invited comment from local stakeholder through newspaper advertisements. No adverse comment was received.

E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

The comments from the local stakeholders were collected by direct meeting as well a through paper advertisement

E.2. Summary of the comments received:

>> No negative comments were received.

E.3. Report on how due account was taken of any comments received:

>>

The positive suggestions made by the stakeholders is to spread the Methane avoidance campaign has been taken seriously by the Project Proponent, and efforts are being made to increase the area of vermi-composting in the State.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Indus Technical and Financial Consultants ltd
Street/P.O.Box:	Samta colony
Building:	205
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E-Mail:	indusryp@satyam.net.in
URL:	
Represented by:	Lalit Kumar Singhania
Title:	Chief Consultants
Salutation:	Mr
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

NO PUBLIC FUNDING IS INVOLVED

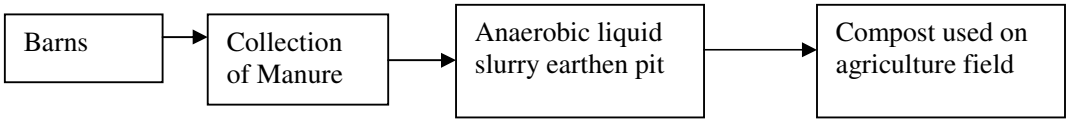
Annex 3

BASELINE INFORMATION

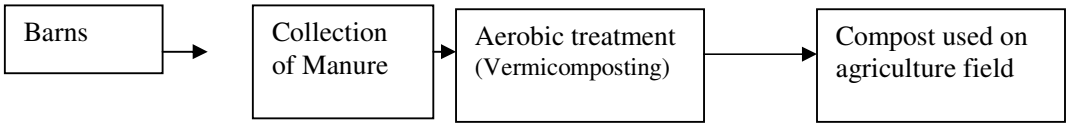
The following section includes the references used for calculating emissions in the base line and project scenarios.

Calculation is based an information obtained by "Indus Technical and Financial Consultant Limited" from the "Lakhasar Sewa Samiti", and "Murli Mahila Mandal Murli" and additional information default values of the model. The following scenarios were analysed.

- **Baseline scenario**:



- **Project scenario:**



3.1 General Data:

General description of average animal population data:-

Table-1

			Animal type		
No. of Household	Village	District	Non Dairy Cattle	Dairy cattle	Buffaloes
30600	102	03	128520	42840	42840

3.2 Climate of the region:

Hot sub humid eco-region with Red and Black soil. The climate of the region is characterised by hot summer and mild winter. The mean annual rainfall ranges 1100 to 1600 mm and means annual temperature 25^0C to 27.5^0C.

3.3 Emission from manure management system:

$$BE_y = BEC_{H4,y} + BE_{N2O,y} + BE_{elec/heat,y} \quad (1)$$

where,

BE_y	Baseline emissions in year y, in tCO_2e/year.
$BE_{CH4,y}$	Baseline methane emissions in year y, in tCO_2e/year.
$BE_{N2O,y}$	Baseline N_2O emissions in year y, in tCO_2e/year.
$BE_{elec/heat,y}$	Baseline CO_2 emissions from electricity and/or heat used in the baseline, in tCO_2e/year.

3.3.1 Methane emissions from manure management system

$$BE_{CH4,y} = GWP_{CH4}.DC_{H4} * \sum_{j,LT} MCF_j * B_{o,LT} * N_{LT} * Vs_{LT,y} * MS^{\%}_{BI,j} \quad (2)$$

$BE_{CH4,y}$	the annual baseline methane emissions in t CO2e/y
GWP_{CH4}	Global Warming Potential (GWP) of CH_4. GWP CH_4 is 21 under consideration.
D_{CH4}	CH_4 density (0.00067 t/m_3 at room temperature (20 ºC) and 1 atm pressure) for both scenario.
MCF_j	Annual methane conversion factor (MCF) for the baseline $AWMS_j$ from IPCC 2006 table 10.17, chapter 10, volume 4.
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated, in m_3CH_4/kg_dm, by animal type LT. (IPCC 2006. default value for Indian subcontinent)
N_{LT}	Number of animals of type LT for the year y, expressed in numbers.
$VS_{LT,y}$	Annual volatile solid for livestock LT entering all AWMS [on a dry matter weight basis (kg-dm/animal/year), as estimated utilizing published 2006 IPCC default values multiplying with no. of days in year.
$MS\%_{Bl,j}$	Fraction of manure handled in system j

Estimation of various variables and parameters for above equations:

Table-2: CH_4 conversion factor in different emission sources.

Manure management system		MCF %
Baseline	Liquid slurry manure management system	66.74
Project	Vermi composting Aerobic Treatment	0.10

Table 3 : Maximum methane production potential of the volatile solid generated in different animal type.

Animal type	Bo (m^3CH_4/kgdm)
Non dairy cattle	0.10
Dairy cattle	0.13
Buffaloes	0.10

Table.4: Volatile solid data of different Animal type

Animal type	Vs kg/head/Year
Non Dairy cattle	511
Diary cattle	949
Buffaloes	1131.5

Source: 2006 IPCC guide lines for National Green House Gas inventories (Table 10A-4,10A-5 and 10A-6) for Indian subcontinent)

Table.5: Fraction of manure handled in a system

	Manure management system	MS Fraction %
Baseline	Liquid slurry in earthen pit	100
Project	Vermi-composting	100

3.3.2 Nitrous oxide Emission from manure management system

$$BE_{N2O,y} = GWP_{N20} \cdot CF_{N20-N,N} \cdot \frac{1}{1000} \cdot (E_{N2O,D,y} + E_{N2O,ID,y}) \quad (3)$$

Where:

GWP_{N2O} Global Warming Potential (GWP) for N_2O.
$CF_{N2O-N,N}$ Conversion factor N_2O-N to N_2O (44/28).
$E_{N2O,D,y}$ Direct N_2O emission in kg N_2O-N/year.
$E_{N2O,ID,y}$ Indirect N_2O emission in kg N_2O-N/year.

3.3.2.1 Direct N_2O emission from manure management system

$$E_{N20,D,y} = \sum_{j,LT} (EF_{N20,D,j} \cdot NEX_{LT,y} \cdot N_{LT} \cdot MS\%_{Bl,j}) \quad (4)$$

where:

$E_{N2O,D,y}$ Are the direct nitrous oxide emissions in kg of N_2O per year.
$EF_{N2O,D,j}$ Is the direct N_2O emission factor for the treatment system j of the manure management system in kg N_2O-N/kg N (used default EF_3 from table 10.21, chapter 10, volume 4, in the IPCC 2006 Guidelines for National Greenhouse Gas Inventories).
$NEX_{LT,y}$ Is the annual average nitrogen excretion per head of a defined livestock population in kg N/animal/
$MS\%_{Bl,j}$ Fraction of manure handled in system j, in %
N_{LT} Number of animals of type LT for the year y, expressed in numbers.

Table.6: Direct N_2O emission factor (EF) of manure management system

	Manure management system	EF_3
Baseline	Liquid slurry manure management system	0
Project scenario	Vermi-compost Aerobic treatment	0.01

Source: 2006 IPCC Guideline for National Green House Gas Inventories Table.10.21

Table.7: Average nitrogen excretion rate of different animal type (NEX-kg/animal/year)

Animal type	KgN/1000Kg animal mass/day	Animal mass	NEX calculated value
Non Diary cattle	0.34*	110+	13.65
Dairy cattle	0.47*	275+	47.18
Buffaloes	0.32*	295+	34.46

** figures given in coloum-2 based on 2006 IPCC Guideline for National Green House Gas Inventories Table.10.19 for Asia*

+Figures given in coloum-3 based on 2006 IPCC Guideline for National Green House Gas Inventories Table. 10A-4,10A-5 and 10A-6) for Indian subcontinent

3.3.2.1 Indirect nitrous oxide emission

$$E_{N20,ID,y} = \sum_{j,LT} (EF_{N20,ID,j} . F_{gasm} NEX_{LT,y} . N_{LT} . MS\%_{Bl,j}) \quad (5)$$

where:

$E_{N2O,ID,y}$ Are the indirect nitrous oxide emissions in kg of N_2O per year.

$EF_{N2O,ID,j}$ Is the indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces, kg N_2O-N/kg NH3-N and NOx-N emitted (used default values for EF_4 from table 11.3, chapter 11, volume 4 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories)

$NEX_{LT,y}$ Is the annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year

$MS\%_{Bl,j}$ Fraction of manure handled in system j

F_{gasm} Percent of managed manure nitrogen for livestock category that volatilises as NH_3 and NOx in the manure management system.

N_{LT} Number of animals of type LT for the year y, expressed in numbers.

Table.8: Emission factor for N_2O emission from atmospheric deposition of nitrogen on soil for each scenario

	EF_4
Baseline	0.010
Project Scenario	0.010

Source: 2006 IPCC Guideline for National Green House Gas Inventories Table.11.3

Table.9: F_{gasm} involved in the indirect N_2O emission for each scenario

	F_{gasm}
Baseline	0.20
Project Scenario	0.20

Source: 2006 IPCC Guideline for National Green House Gas Inventories Table.11.3

3.3.3 CO_2 emission from electricity and heat within project boundary

Such type of emission is not considered because in each scenario, there is a zero involvement by heat and electricity.

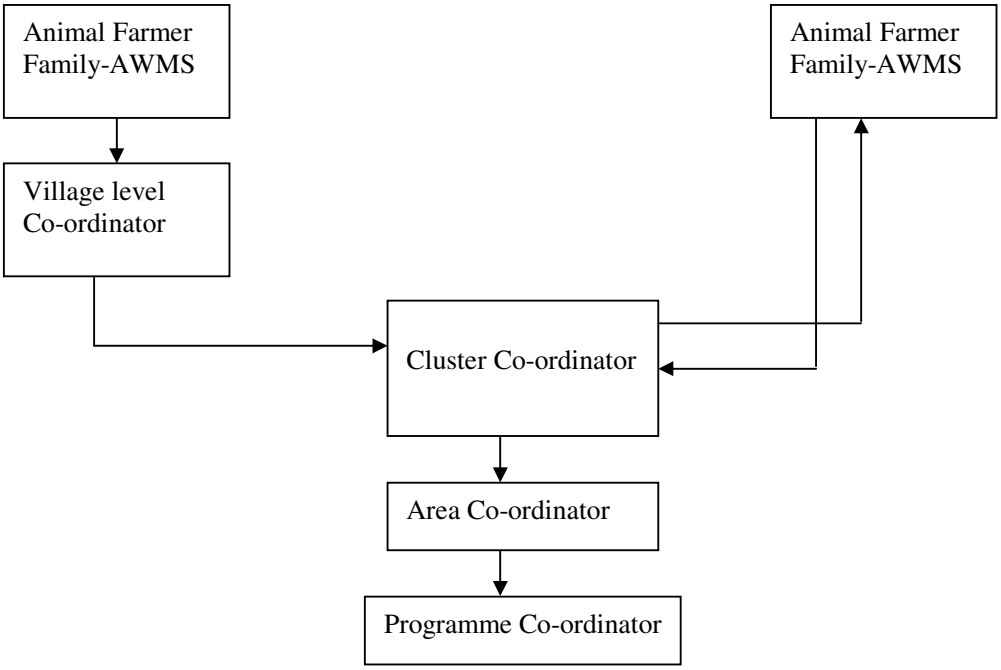
Annex 4

MONITORING INFORMATION

The following Table present the monitoring plan followed by Indus Technical & Financial Consultant Limited in order to achieve certified emission reduction after each validation and verification process.

Data variable	Uncertainty level	Data unit	Data origin
Animal population of each animal type	Low	Heads	Village wise record consisting of each animal farm site
Animal weight by each animal type	Low	Kg	Default value

ORGANISATION STRUCTURE OF MONIRORING



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