Regenerative agriculture in Rice-Wheat-Maize system for income generation

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Grow Indigo Private Limited

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1 Project Details

1.1 Summary Description of the Project

The Rice-Wheat-Maize system in North-West India accounts for a significant portion of the food supply in the country. Depletion of underground water, declining fertility status associated with multiple nutrient deficiencies, increased concentration of greenhouse gases (GHGs) in the atmosphere owing to soil methanogenesis from rice cultivation and burning of rice residues are some of the end results of the intensive system. Thus, there is a challenge to balance the food production and sustainability goals simultaneously. Recent advancements in regenerative agriculture methods improve environmental outcomes without negatively impacting yields. However, agronomic, and socio-economic factors such as access to agro-advisory and the cost of technology adoption remain a crucial barrier to adopting regenerative agriculture practices. By linking smallholder farmers to carbon marketplaces, this project aims to overcome these critical barriers to adoption by enabling additional income opportunities.

About 16% of the gross GHG emissions in India come from agricultural practices combined with rapid degradation of soil quality (MoEFCC, I., 2018). GHG emission-reducing agricultural practices are well known but not implemented at scale due to the fragmented land holding, traditional farming practices and lack of knowledge/incentive to value such practices. If in the Rice-Wheat-Maize system of more than 4 million hectares in the NW India region alone, at least two regenerative agricultural practices are adopted, it would lead to 8 to 15 million tons Kg CO_2e per year reduction of GHG. There are significant barriers for farmers to adopt the soil organic carbon (SOC) sequestration practices because of the trade-offs involved, lack of incentives and adequate information. For example, crop residue removal from the field for other uses such as fodder, fuel and fencing is traditional practice for managing residue. To clear the fields for the timely sowing of wheat, most of the paddy straw is burnt in-situ by the farmers causing environmental pollution and loss of plant nutrients and organic matter. Similarly, going to no or reduced-tillage requires altering farm implements/equipment and substituting conventional crop and weed-control methods. As more of these solutions become available, projects for incentivizing farmers for adoption of practices in India will enhance SOC and/or GHG avoidance.

The project will cover the states Punjab, Haryana, and the adjoining National Capital Region (NCR), and primarily focus on the Rice - Wheat - Maize cropping system, without excluding other crops, with regenerative agricultural practices that are known to reduce

GHG emissions and thus generate carbon credits by way of CO_2e and SOC. A small percentage of farmers in the project area have started implementing one or more of the regenerative agriculture practices. The exact number of farmers following these practices is very small and not documented in large part. This project will also focus on the type and precision of nitrogen fertilizer application, use of N fixer species, no and low tillage practices such as direct seeding of rice (DSR) and no-till wheat, thus avoiding flooding of fields and the implication for methanogenesis, water use, and crop diversification. Other regenerative practices such as biological straw degradation, laser levelling of fields, biochar, grazing practices and more will also be evaluated for inclusion. The partners in this project have been working in biological treatments, conservation agriculture (CA), sustainability and remote sensing technologies that can be used for monitoring, verification, biological treatments, and digitization of agriculture, enabling validation. Beginning with 4,000 hectares, this project aims to reduce GHG emission by an average of 4,267,622-ton CO_2e each year and for the life of the twenty-year project, with the assumption of enrolled farmers adopting at least two new regenerative agriculture practices.

While many initiatives in India have focused on promoting CA practice, there has not been a project that measures, monitors, and validates GHG reduction and issues carbon credits, thus generating additional income for the smallholder farmers in India. With a cash incentive, the smallholder farmers in the project boundary will adopt these practices more readily and contribute to sustainability and reduce GHG emissions. A voluntary carbon marketplace for carbon credits, for the first time will create income opportunities for smallholder farmers in India via this project.

With the engagement of global agri-extension experts and educational institutions, this project will bridge critical information barriers to adopting regenerative agriculture practices. The traditional rice transplanting method is also quite labour intensive. About 7-9 labourers, majorly women, are required to transplant one hectare of paddy. Moreover, the ongoing Covid-19 pandemic has highlighted the issue of shortage of labour available for agriculture. Thus, the adoption of direct-seeded rice would directly address labour shortages and further reduce the drudgery for farm women. The project communication will look at new opportunities to engage the labour in more physically friendly jobs and transition to resilient systems.

1.2 Sectoral Scope and Project Type

This project will be under the sectoral scope 14 -Agriculture, Forestry and other land use (AFOLU), under the Agriculture Land Management (ALM) category.

This is a grouped project, with a geographical reach of NCR, Punjab and Haryana, and practices that may vary on some farms. See **Figure 1** for the project boundary.

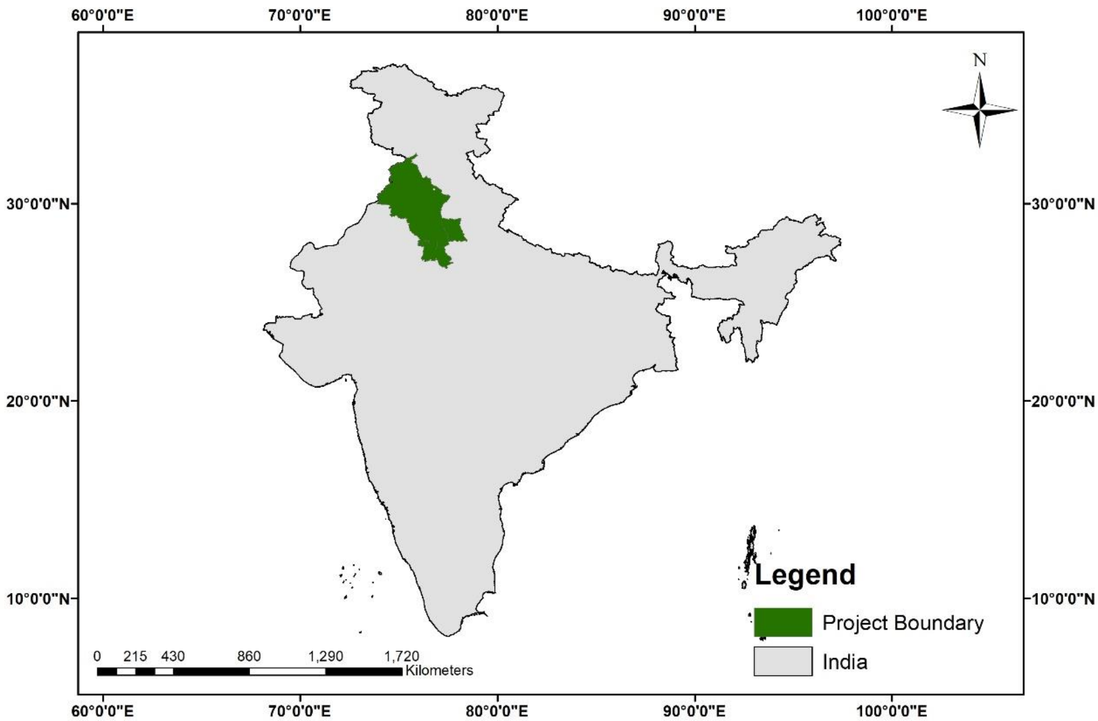

Figure 1: Project boundary on map of India.
KML (Keyhole Markup Language) file attached.

1.3 Project Eligibility

The planned project activities fall under the VM0042 Methodology for Improved Agricultural Land Management. Version 1.0. This methodology quantifies the GHG emission reductions and SOC resulting from the adoption of improved agricultural land management (ALM) practices. Eligible ALM practices include, but are not limited to reductions in fertilizer application, tillage practices, use of biofertilizers, improvements in water management, residue management, cash crop and cover crop planting and harvest, and grazing practices.

1.4 Project design

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

1.5 Project Proponent

Organization name	Grow Indigo Private Ltd
Contact person	Umang Agrawal and Usha Barwale Zehr
Title	Lead Carbon and Executive Director
Address	19, Raj Mahal, 84, Veer Nariman Road, Churchgate, Mumbai, India, Pin - 400 020
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1.6 Other Entities Involved in the Project

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

1.7 Ownership

Ownership of the grouped VCS project and associated emission reductions will be of the project proponents. The rights of emission reductions and/or removals (ERRs) shall be established by a signed agreement with the farmer, wherein the farmer shall attest that the farmer has not sold, and will not sell, any GHG reductions of any kind arising from the adoption of regenerative agriculture practices to any party other than Grow Indigo and agrees to assign all its legal rights to any such ERRs or GHG reductions to Grow Indigo, including all the rights to issuances, forwarding, and sale of such ERRs as issued units under any applicable carbon standard.

1.8 Project Start Date

The project start date shall be June 1, 2019. With the completion of the Rabi (winter season) and anticipation of the main Kharif (rainy season), Rice or maize will be the main crop that will be sown. With this, we will begin implementing the regenerative agriculture practices, which will include- tillage practices, water management, including direct-seeded rice, nitrogen fertilizer and biofertilizer applications, practices such as biomass management, grazing practices, laser levelling and crop rotation. The project will also compile the baseline/ historical data to build the additionality of the adoption of new practices.

1.9 Project Crediting Period

The project activities do not focus exclusively on GHG emission avoidance but also on increasing SOC stock. Thus, the project crediting period is 20 years, starting 1/07/2019 and up to 30/06/2038. This crediting period may be renewed four times with a total project crediting period not to exceed 100 years, i.e. the final project crediting date is 30/06/2118 unless the programme ceases to exist before that date.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Large Project	Starting with 4,000 hectares, the project will scale to 1.7 million hectares in Punjab, Haryana and NCR region, over a 5-year period.

Year	**Estimated GHG emission reductions or removals (tCO_2e)**
2019	11,024
2020	179,064
2021	961,464

2022	2,526,264
2023	5,104,664
2024	5,104,664
2025	5,104,664
2026	5,104,664
2027	5,104,664
2028	5,104,664
2029	5,104,664
2030	5,104,664
2031	5,104,664
2032	5,104,664
2033	5,104,664
2034	5,104,664
2035	5,104,664
2036	5,104,664
2037	5,104,664
2038	5,104,664
Total estimated ERs	85,352,440
Total number of crediting years	20 years
Average annual ERs	4,267,622

1.11 Description of the Project Activity

There is no REDD+ component to the project, and the project is not located within a jurisdiction covered by any jurisdictional REDD+ program.

In the western Indo-Gangetic plains, deterioration in soil, water, and environment quality coupled with low profitability jeopardize the sustainability of the dominant rice-wheat (RW) system. To address these issues, regenerative agricultural practices, including crop diversification and CA-based management, hold considerable promise, but the adoption to date has been low. Compared to prevailing farmers' practices (FP), results suggest that CA-based rice management increased profitability by 13% and energy use efficiency (EUE) by 21% while reducing irrigation by 19% and global warming potential (GWP) by 28%. By substituting CA-based maize for rice, similar mean profitability gains were realized (16%), but transformative improvements in irrigation (−84%), EUE (+231%), and GWP (−95%) were observed compared to FP. Inclusion of mungbean in the rotation (i.e. maize-wheat-mungbean) with CA-based management increased the system productivity, profitability, and EUE by 11, 25 and 103%, respectively, while decreasing irrigation water use by 64% and GWP by 106% compared to FP. Despite considerable benefits from the CA-based maize-wheat system, adoption of maize is not widespread due to uneven market demand and assured price guarantees for rice.

The work in NCR, Punjab and Haryana is going on for 20+ years in CA, inputs, biological treatments, and remote sensing by the partners in this project and have generated multi-year data on rice-wheat-maize cropping systems. The partners will further promote the use of these and other practices with the enrolled farmers in this project and establish the additionality for the practices employed, which will help in further validation and monitoring. Science-based evidence on regenerative agricultural practices will be used during this project, and the potential GHG mitigation potential will be determined. **Table 1** lists a range of technologies/practices (not an exhaustive list) that will be deployed during this project.

1.12 Project Location

The project will be run in the States of NCR, Punjab and Haryana, India (see **Figure 1**). Several clusters have been identified, and farmer enrollment has begun. Many of the farms have already been geotagged, and the KML file attached gives the coordinates of the larger project area.

1.13 Conditions Prior to Project Initiation

The project has not been implemented to generate GHG emissions for the purpose of their subsequent reduction, removal, or destruction. Rather, the project has primarily been implemented to improve agricultural management practices in the project area, in the absence of any regulations.

The environmental conditions that are relevant to the project include information on climatic and edaphic conditions in the project area and are demonstrated in soil map **(Figure 2)**, rainfall map (**Figure 3)**, elevation map (**Figure 4)**, ground water level map (**Figure 5)**, and surface water river network map (**Figure 6)** respectively. The land use and land cover map is presented in **Figure 7**.

The project builds on the following practices, which are known, and one or more of them are being used by farmers, but are not common practice in the region. The project will work with multiple practices as described below:

1. **Tillage – no or reduced tillage with drill/ direct-seeding**

Traditional (Common) practices among farmers in the region include burning crop residue followed by tillage. In a no-tillage system, crops are sown without prior cultivation of the soil. Very shallow (<5 cm) disturbance is made during seed sowing, which significantly benefits soils by minimizing SOC loss during wind and water erosion. SOC build-up in a no-tillage and reduced tillage system is associated with microbial activity and root growth, improved nutrient and water availability, better soil structure, and aggregation by protecting C from mineralization, pH, and temperature. The energy requirement of no-tillage and reduced tillage is less, so GHGs emission is lower. GHG emissions were reduced by 1.5 $MgCO_2e$ ha−1 year−1 in no-tillage-based wheat and maize systems.

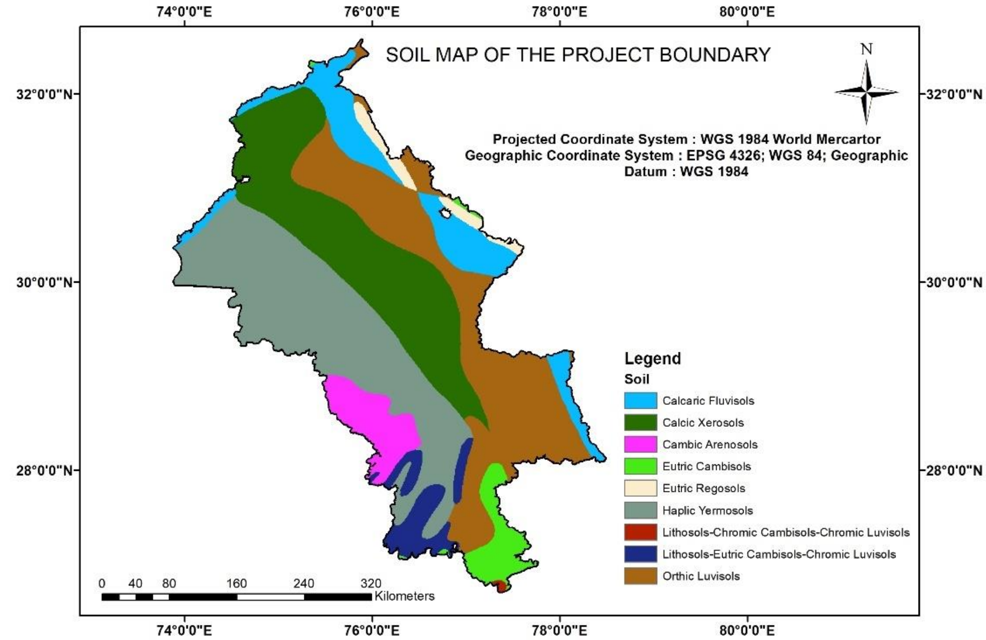

Figure 2: Soil map for the project boundary.

Rice cultivation is one of the most significant sources of methane emission. Conventional transplanted rice requires continuous flooding of rice fields, which creates anaerobic conditions that promote the activity of methanogenic bacteria. A large amount of methane is produced by the action of these methanogens in flooded rice fields. Contrary to the transplant method, the direct seeding of rice (DSR) method does not require the fields to be continuously submerged with water, leading to less anaerobic conditions and lower methane emission. Thus, the DSR method not only consumes a relatively lower amount of water compared to conventional transplanted rice, but it also emits a lower amount of methane and reduces the energy demand for pumping water for irrigation. Moreover, a reduction in groundwater demand would also lead to improvement in groundwater levels and quality.

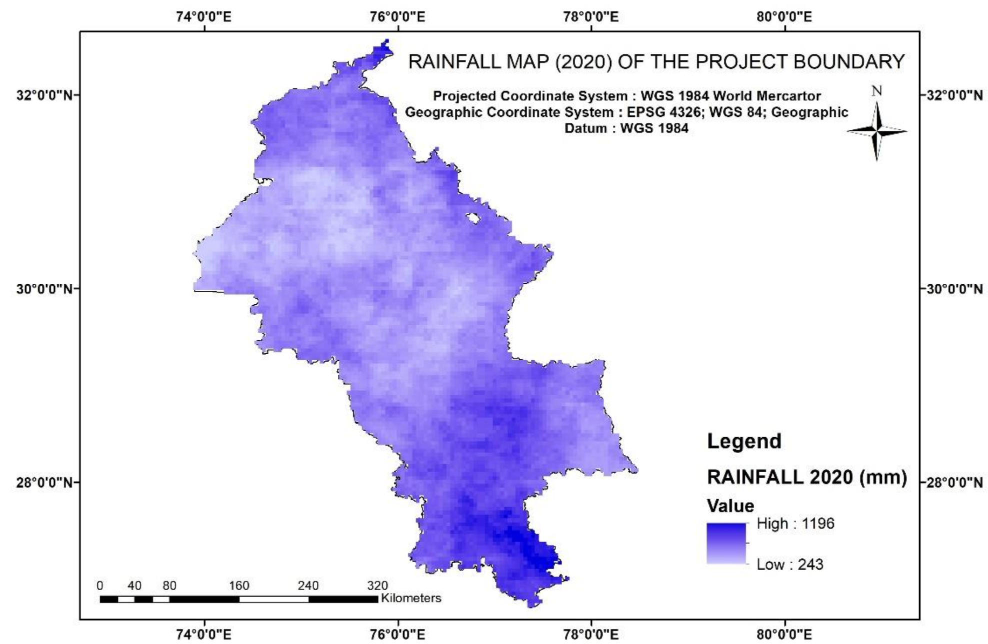

Figure 3: Annual rainfall map for the project boundary.

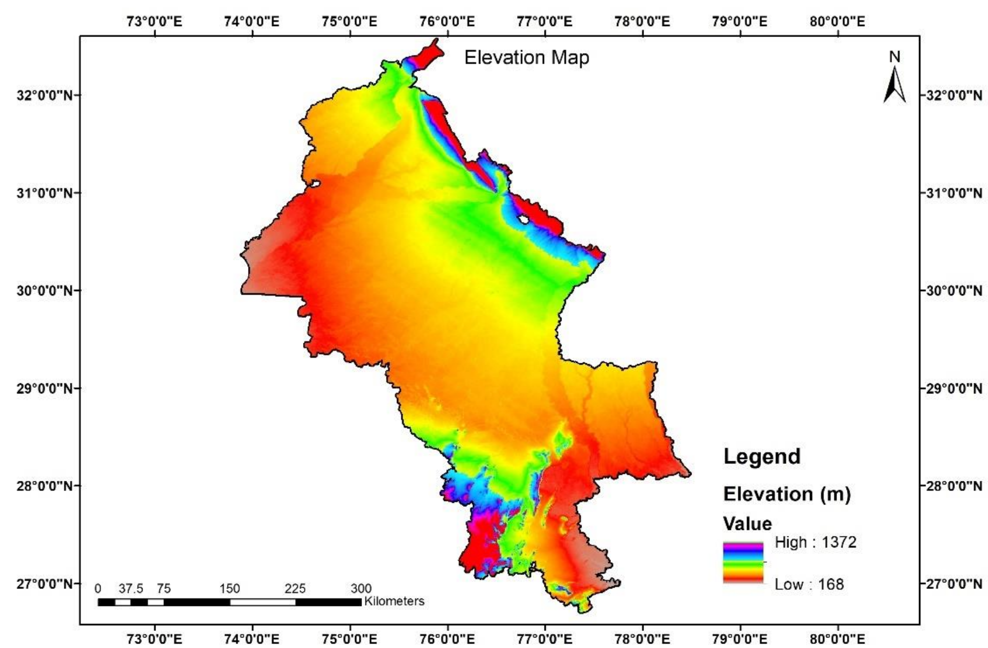

Figure 4: Elevation map for the project boundary.

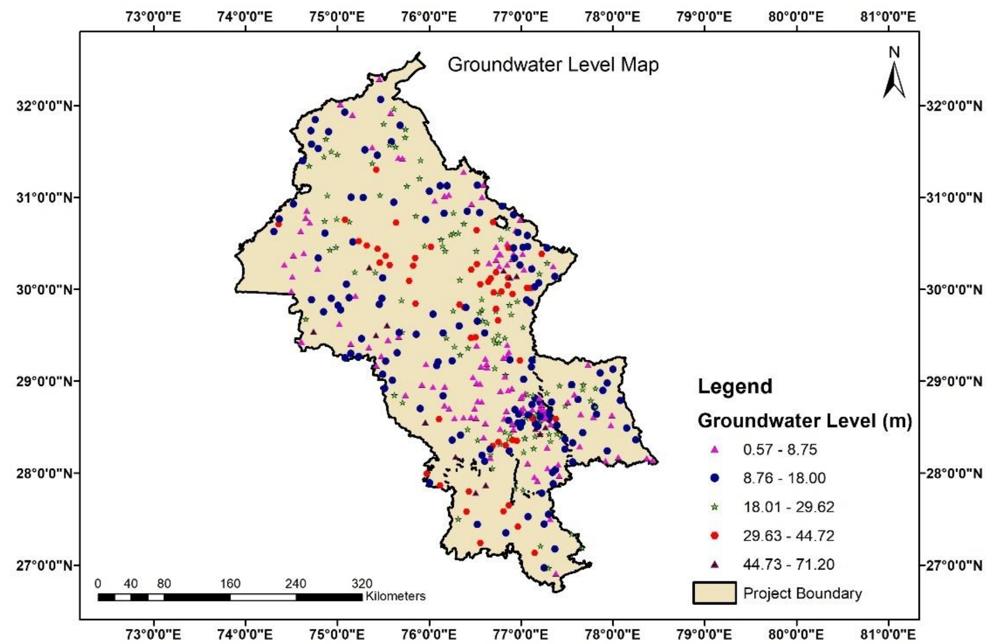

Figure 5: Groundwater level for the project boundary.

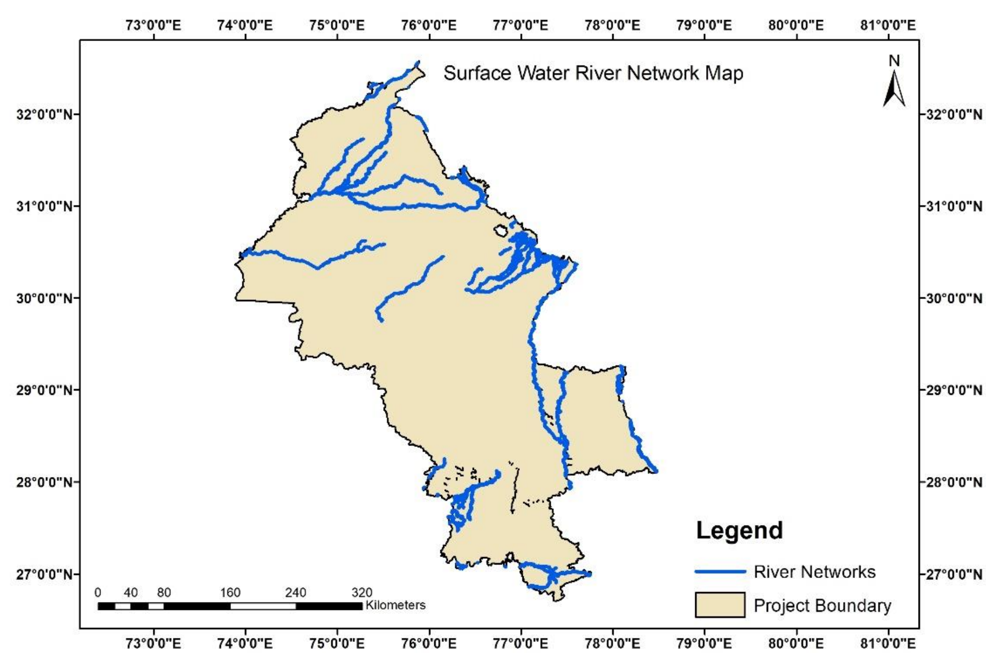

Figure 6: Surface water river network map for the project boundary.

Table 1: Impact of various regenerative agriculture practices on the Rice-Wheat system in North-Western India.

Technology/ practice	Crops or cropping systems	Productivity gain (kg/ ha)	Profitability ('000 INR / ha)	Water Saving (%)	GHG mitigation (kg CO_2 eq/ ha)
Laser land leveling (LLL)	Rice-Wheat & Maize-Wheat	350-645	11-16	15-20	400-600
Zero tillage (ZT) without residue	Wheat	300-450	8-12	-	1000-1500
ZT with residue	Wheat	410-660	11-17	6-10	1500-2000
Direct seeded rice (DSR)	Rice	±150-22	9-11	12-18	1000-2250
Permanent beds	Maize-Wheat	450-950	16-26	65-70	800-1000
Site-specific nutrient management (SSNM)	Rice-Wheat & Maize-Wheat	350-650	12-16	-	500-1000
Sub-surface drip irrigation	Rice-Wheat	280-550	11-16	40-50	500-1500
Legumes inclusion (Mungbean)	Rice-Wheat; Maize-Wheat	320-350	13-18	-	65-120
Portfolio of practices (LLL+ZT+Mulch+SSNM)	Rice-Wheat	110-220	20-26	15-20	2800-3000

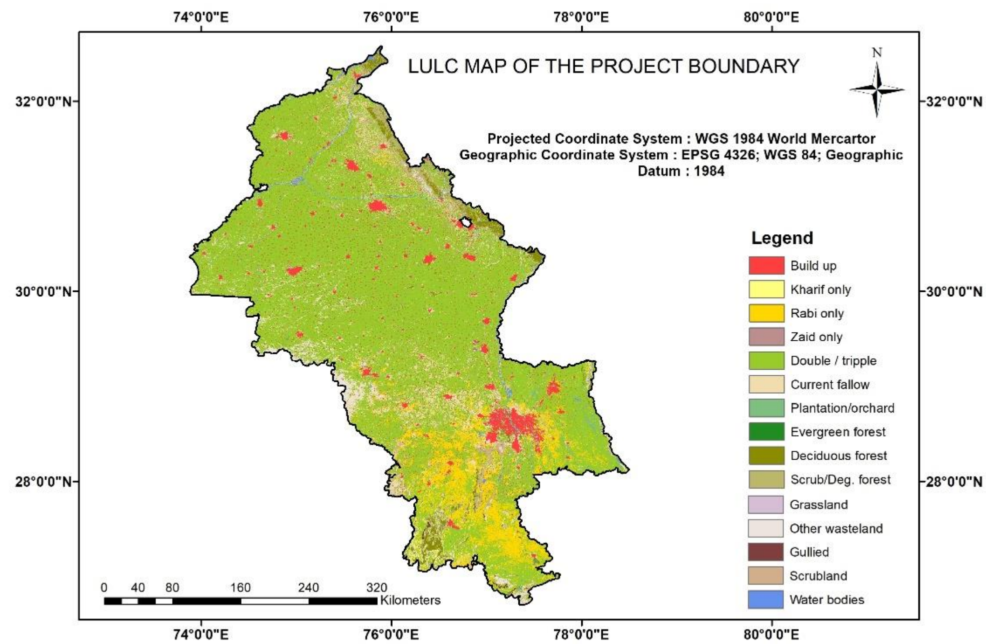

Figure 7: Land use and land cover map for the project boundary.

2. **Crop residue management**

Crop burning practices mainly in the rice system prevailing in NCR, Punjab and Haryana. It is estimated that about 23 million tons of rice stubble are burnt in North-western India during October-November, to prepare the land for the subsequent wheat crop. Like Happy Seeder, the use of alternative crop residue management is known to improve soil quality and health by incorporating the residue in the soil itself. However, the penetration of such regenerative crop residue management practices is relatively low. The impact of increasing biomass incorporation in soil is estimated to have a positive impact of about 500 kg CO_2e/ ha in terms of GHG and soil health improvement. Farm implements, e.g. Turbo Happy Seeder, developed by various agencies, specifically tackles straw management, and there is the adoption of these tools in some areas of the project. Recent advancements to management of stubble include biological products that use microbial formulations for in-situ straw degradation in the fields.

3. **Water management**

Water is becoming an increasingly scarce resource in agriculture primarily because of poor management. The groundwater table is falling in India, and the level of salinity has increased dramatically, prompting some states to advise farmers not to plant rice. The traditional rice crop is transplanted into a flooded field. Rice, however, is crucial in our food system and economy that this shift will take a long time. Under flooded rice, because of slow microbial decomposition of SOM, SOC losses are low. Adoption of direct-seeded rice addresses this as well as residue management. The direct-seeding of rice method does not require the fields to be continuously submerged with water and thus consumes a relatively lower amount of water compared to conventional transplanted rice. Lower water demand reduces the energy demand for pumping water for irrigation and leads to improved groundwater levels and quality. Additionally, as the fields are not submerged in water, the DSR method leads to lower methane emissions compared to conventional transplanted rice method.

4. **Nutrient management**

   To improve soil health and soil productivity through balanced fertilization, Govt. of India has started the Soil Health Management (SHM) program under National Mission for Sustainable Agriculture (NMSA, 2017). In this context, Soil Health Card (SHC) has become instrumental in India since 2015. It assesses the current status of soil health and, when used over time, to determine changes in soil health that are affected by land management practices. It also recommends dosage and kind of nutrients to be applied to improve soil fertility. The SHM program promotes Integrated Nutrient Management (INM) through judicious use of chemical fertilizers, including secondary and micronutrients in conjunction with organic manures and bio-fertilizers. The adoption of these is varying from farmer to farmer.

5. **Crop rotation, incorporation of legumes and other practices:**
   The adoption of these are at low levels across the project region.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

India does not regulate GHG emissions from Agriculture in the smallholder farming systems. However, the project will comply with all applicable laws and regulatory frameworks. The following legislations are considered in the legal review for the project:

- Essential Commodities (Amendment) Act, 2020
- Fertilizer Control Order, 1985

- Seeds Bill, 2004
- Insecticide (Amendment) Act, 2000
- Protection of Plant Varieties and Farmers' Rights Act, 2001
- Farmers & Farm Workers Commission Act, 2017
- National Biodiversity Act, 2002
- Punjab Preservation of Subsoil Water Act, 2009
- Haryana Preservation of Subsoil Water Act, 2009
- The Haryana Water Resources (Conservation, Regulation And Management) Authority Act, 2020
- Uttar Pradesh Ground Water (Management And Regulation) Act, 2019
- Delhi Groundwater Regulation Direction, 2010
- Environment (Protection) Act, 1986
- Air (Prevention and Control of Pollution) Act, 1981
- Water (Prevention & Control of Pollution) Act, 1974

1.15 Participation under Other GHG Programs

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

The project or any of its activities have not been registered and are not seeking registration under any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

1.16.2 Other Forms of Environmental Credit

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

1.17 Additional Information Relevant to the Project

Leakage Management

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

Commercially Sensitive Information

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

Sustainable Development

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

Further Information

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

2 SAFEGUARDS

2.1 No Net Harm

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

2.2 Local Stakeholder Consultation

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

2.3 Environmental Impact

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

2.4 Public Comments

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

2.5 AFOLU-Specific Safeguards

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

1. VM0042: Methodology for Agriculture Land Management, version 1.0, 19 October 2020, sectoral scope 14 will be used.
2. VMD0053: Model calibration, validation, and uncertainty guidance for the methodology for improved agricultural land management, version 1.0, 19th October 2020, Sectoral scope 14

3.2 Applicability of Methodology

With the project activities envisaged, the methodology VM0042 and with that VMD0053 are applicable. This methodology quantifies the GHG emission reductions and SOC removals resulting from the adoption of improved agricultural land management (ALM) practices. Such practices include, but are not limited to, reductions in fertilizer application and tillage, and improvements in water management, residue management, cash crop and cover crop planting and harvest, and grazing practices. This methodology quantifies the net emissions of CO_2, CH_4 and N_2O from farmer operations. The methodology is global in scope and applies to a broad range of agricultural management project activities that increase SOC storage and/or decrease net emissions compared to the baseline scenario. The methodology is applicable for this project due to the following:

1. Project must introduce or implement one or more new changes to pre-existing agricultural management practices, which:
   i. Reduce fertilizer application
   ii. Improve water management
   iii. Reduce tillage, residue management
   iv. Improve crop planting and harvesting
   v. Improve grazing practices

The project activities with Rice-Wheat-Maize system will be primarily looking at the eligibility of one or more of the above-listed management practices. Any additional activities other than those listed above will not be considered for quantification of emissions removed and/or reduced under the project.

2. The project activities must be implemented on either cropland or grassland:
   The Rice-Wheat-Maize system in the project boundary fulfils these criteria.

3. The project area must not have been cleared of Native ecosystems within the last ten years:
   The project will focus on lands that have been in the cropping system proposed for at least 10 years.

4. The project activity proposed is not expected to result in a sustained reduction of greater than 5% in productivity:
   Several reports published in peer-reviewed journals, Govt. and industry reports, and farmer yield reports will be used to indicate this.

5. If the project activity involves the application of biochar, it must be produced using feedstock that would otherwise have been left to decay in aerobic or anaerobic conditions or been burned in an uncontrolled manner:
   If used, only the biochar produced using feedstock that would otherwise have been left to decay in aerobic or anaerobic conditions or burned uncontrolled will be considered in the project activity.

The inclusion of new project instances will ensure that they do not occur on wetland.

Additional conditions where models are applied: The methodology does not mandate the use of any specific model. Rather, this methodology is applicable where empirical or process-based models used to estimate stock change/emissions meet specific conditions. Models must be:

1. Publicly available
   The project would use either or an ensemble of RothC, DNDC, InfoCrop, models for quantification of SOC and methanogenesis. These models are publicly available and have been demonstrated for use in project boundary.
2. Shown in peer- reviewed scientific studies to successfully simulate changes in SOC and trace gas emissions resulting from changes in agricultural management included in the project description
   Peer-reviewed studies (e.g. Jha et. al., 2021 and Pathat et. al., 2005) have shown the applicability of the selected models in the project area and conditions.

3. Able to support repetition of the project model simulations. This includes clear versioning of the model use in the project, stable software support of that version, as well as fully reported sources and values for all parameters used with the project version of the model. Where multiple sets of parameter values are used in the project, full reporting includes clearly identifying the sources of varying parameter sets as well as how they were applied to estimate stock change/emissions in the project. Acceptable sources include peer-reviewed literature and statements from appropriate expert groups (i.e., that can demonstrate evidence of expertise with the model via authorship on peer-reviewed model publications or authorship of reports for entities supporting climate smart agriculture, such as FAO or a comparable organization), and must describe the data sets and statistical processes used to set parameter values (i.e., the parameterization or calibration procedure)

   The datasets to be used are under preparation and clear guidelines for stratified sampling shall be defined to meet the requirements as per VMD0053 - Model calibration and validation guidance for the methodology for improved agricultural land management. Any modified or alternative models shall be used only as per VMD0053.
4. Validated per datasets and procedures detailed in VMD0053 "Model Calibration and Validation Guidance for the Methodology for Improved Agricultural Land Management", with model prediction error calculated using datasets as detailed in the same module, using the same parameters or sets of parameters applied to estimate stock change/emissions in the project.

   The model calibration and validation is to be carried out as per VMD0053.
5. The same model version and parameters/parameter sets must be used in both the baseline and project scenarios.

   Same models, model versions, and parameters shall be used for both baseline and project scenarios.

3.3 Project Boundary

The relevant GHG sources identified for the project and baseline scenarios are listed in **Table 2**.

Table 2: GHG Sources included or excluded from the baseline and project scenarios

Source	Gas	Included?	Justification/ Explanation
SOC	CO_2	Yes	Adoption of project activities would have an overall net impact on the SOC pool. It will be quantified as stock changes in the SOC pool.
Fossil fuel	CO_2	Yes	Reduction in the use of power or fuel driven farm equipment (tractors, vehicles, fossil fuel powered energy generators, water pumps, etc.) by adoption of project activities.
Soil methanogenesis	CH_4	Yes	Methane emissions resulting from baseline and project scenarios will be included. The models DNDC and/or infoCrop have the capability to quantify soil methanogenesis.
Enteric fermentation	CH_4	Yes	Some project participants are livestock farmers, so CH_4 emissions from enteric fermentation are included for qualifying project activities.
Manure deposition	CH_4 and N_2O	Yes	Some project participants are livestock farmers, so CH_4 and N_2O emissions from manure deposition and management are included for qualifying project activities.
Use of nitrogen fertilizers	N_2O	Yes	The project activities encourage reduction of N fertilizer by either site-specific nutrient management or use of biologicals.
Use of nitrogen fixing species	N_2O	Yes	Nitrogen fixing legume crops that are planted either as cover crop or as intercrop and that improve nitrogen use efficiency are included in the project activities.
Biomass burning	CO_2 CH_4 and N_2O	No	Excluded from the project, as burning of crop residue is prohibited by law and

			hence does not meet the requirement of additionality.
Woody biomass	CO_2	No	Woody biomass is excluded since agroforestry and other tree plantations are not part of the project scenario and will not affect emissions compared to the baseline scenario.

The project activities shall take place only in some parts of the project boundary. The baseline information on common farmers practice in the region has been documented in several publications (e.g. see Jat et al., 2020). The locations included at the time of validation will be limited to those for which the baseline data on farmer practices, climatic, and soil conditions are available from Govt. reports or farmer surveys and the SOC measurements are available for farms spread across various strata in the project boundary. The map in **Figure 8** indicates the physical locations for which such information is collected.

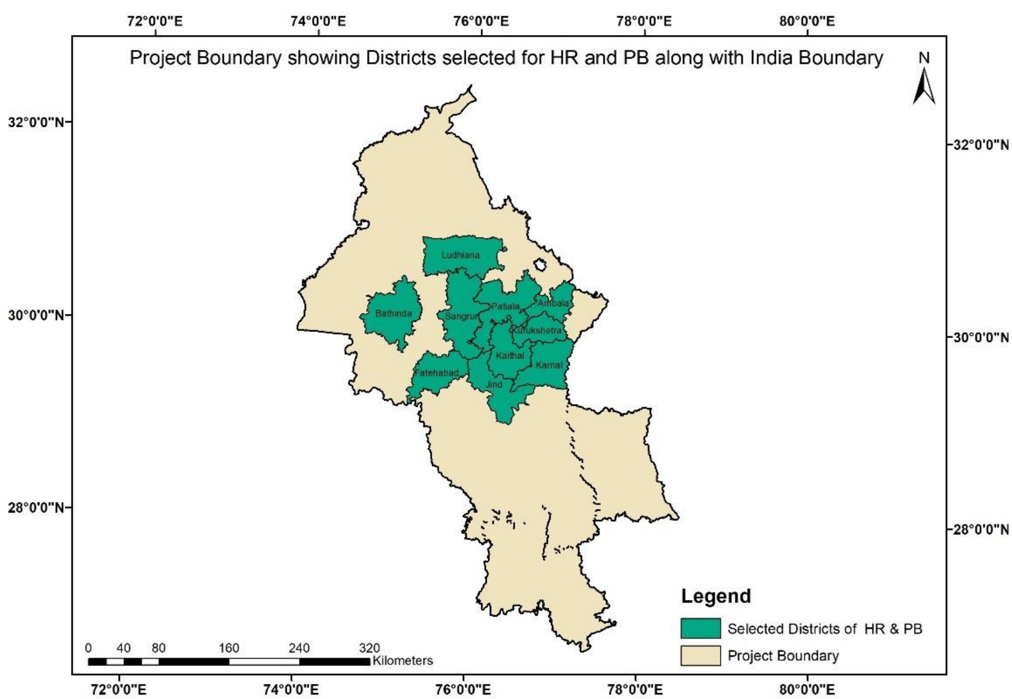

Figure 8: Physical locations of districts where the initial project activity instances are located.

3.4 Baseline

The most plausible baseline scenario is the continuation of traditional pre-project agricultural practices. Such practices have been well documented in literature (e.g. see Jat et al., 2020; Keil et et al., 2020; Shyamsundar et al., 2019; Vidhi Centre for Legal Policy, 2017).

The baseline scenario is determined by applying a historic look-back period. The schedule of activities, beginning with year t = -3, will be applied in the baseline scenario, from t = 1 onward. Emission/stock changes in the baseline scenario are modeled using Quantification Approach 1. Information on the baseline schedule of agricultural management activities for model calibration used for SOC and methane quantification is obtained from the State Agricultural Department and Agriculture Universities. If this is not available, the information shall be obtained from farmer surveys. The locations included at the time of validation of the project will be limited to those for which baseline information is available.

A stratified random sampling approach is used to improve precision and reduce the required number of soil samples to be taken to quantify baseline emissions without increasing uncertainty.

3.5 Additionality

In India, agriculture is a state subject. In exercise of their powers under Section 19(5) of the Air (Prevention and Control of Pollution) Act, 1981, the State Governments Punjab, Haryana, and Uttar Pradesh have issued prohibitions on the burning of crop residue within their jurisdictions. Even though crop residue burning is rampant in the region, it does not qualify for regulatory surplus and is kept out of the calculations for carbon credits. There is no legal, policy, or regulatory framework to enforce the regenerative agricultural practices being prescribed under this project. Thus, the regulatory surplus requirements of the VM0042 methodology are met.

In addition to regulatory surplus, additionality assessment has also been done using the 2-step framework prescribed by the VM0042 methodology and is provided below:

1. ***Identify barriers that would prevent the implementation of a change in pre-existing agricultural management practices***

   There are significant cultural, knowledge, financial and technical barriers to the adoption of regenerative agriculture practices. This project will leverage the support from international educational institutions and extension agencies to overcome these barriers. Financial barriers due to costs and lack of adequate incentives will be addressed by income generation and overall increase productivity.

   a. Tillage: Traditional (Common) practices among farmers in the region include burning crop residue followed by tillage. The common belief among the farmer community is that the burning of crop residue helps control pests and diseases. Adoption of no-till or low-till is present only on some of the farms in the project today.
   A critical barrier is the relatively short planting duration of typically 15-20 days between Kharif (rice) crop and rabi (wheat) crop. The lack of sufficient time between rice harvesting and sowing of wheat provides farmers with limited alternatives to the burning of crop residue. Other significant barriers include lack of alternate uses of the straw, and harvesting and planting mechanical solutions. In recent years, the mechanization initiatives of the Government of India with some research institutes have developed and made available harvesters and planters such as Happy Seeder, which allows the straw to be chopped up and distributed, making room for direct planting of wheat seed. Based on historical data collected, the project will demonstrate a shift to these practices on the farms where it is not followed today.

   b. Direct-seeded of rice: Much of the rice in the project area is transplanted rice. A key barrier for not adopting direct-seeded rice is weed control challenges, availability of suitable varieties for cultivation under this system, and a potential yield impact. We will promote suitable varieties and weed control solutions to make the shift to direct-seeded rice.

2. ***Demonstrate that the adoption of the suite of proposed project activities is not common practice***

About 26,000 hectares in Haryana and 500,000 hectares in Punjab are estimated to have taken up DSR (The Indian Express, 2021 and The Tribune, 2021), of about 5 million hectares under rice cultivation in the project boundary. The data for the adoption of DSR in NCR areas of Uttar Pradesh and Rajasthan is not available, but the adoption is negligible based on some surveys. Thus, the common practice of transplanted rice exceeds the common practice threshold of 80% as laid out by the VM0042 methodology. Except for DSR, Government statistics on regenerative agricultural practices are generally lacking. The adoption of no-till, and water management practices in the rice-wheat-maize systems are not common in Punjab, Haryana, and the NCR region, and are estimated to be much below the 20% threshold.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

4.2 Project Emissions

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

4.3 Leakage

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

4.4 Net GHG Emission Reductions and Removals

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

5 MONITORING

5.1 Data and Parameters Available at Validation

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

5.2 Data and Parameters Monitored

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

5.3 Monitoring Plan

This part has been omitted under section 3.1.3 of the Verra Registration and Issuance Process v4.0.

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