PROJECT REPORT

Adoption of a Cluster of Villages for Agricultural Sustainability and Food Security through Clean Food Program

Project Site : Haringhata Block, Nadia district,
West Bengal, India.

Project Duration : 2021 – 2022

Submitted By
Inhana Organic Research Foundation (IORF)
168 Jodhpur Park, Kolkata – 700068, West Bengal, India
Email : inhana.rftprojects@gmail.com
Website : www.inhana.in

Adoption of a Cluster of Villages for Agricultural Sustainability and Food Security through Clean Food Program

PROJECT TEAM
Inhana Organic Research Foundation (IORF)
Dr. Antara Seal
Dr. Ranjan Bera
Dr. Anupam Dutta
Mrs. Susmita Saha
Mr. Somesh Dutta
Mr. Atanu Das

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TECHNICAL ASSOCIATION

Dr. Koushik Mukhopadhyay,
Nadia Krishi Vigyan Kendra, ICAR

Dr. Arun Kumar Barik
Viswabharati University, Santiniketan

Dr. Rambilash Mallick
Calcutta University, Kolkata

Dr. Pardip Bhattacharya
Indian Statistical Institute, Giridi

ORGANIZATIONAL SUPPORT
Manobjomin Agro producers Company Limited , Kolkata

Safe You Agricultural Pathways Limited, Kolkata

IBM - IORF SUSTAINABILITY PROJECT

Modern agriculture has changed dramatically since the end of World War II and the development helped to increase food production**. However, this new found surplus food came at a significant ecological cost** resulting in threats to food security as well as to human health and safety due to increasing risk of food chain toxicity. Looking back; India, being primarily an agrarian country, the problem became complex considering that more than **80% of the farming community belonged to small and marginal categories, that are more vulnerable to climate change** due to livelihood dependency on tiny farm lands and lesser risk taking abilities w.r.t. newer sustainable initiatives.

In this background, IORF conceived the Safe & Sustainable 'Clean Food' initiative in the early part of 2020 in collaboration with Nadia KVK (ICAR) with introduction of Inhana Rational Farming (IRF) Technology, an exclusive innovation of IORF. IRF Technology is a Comprehensive Crop- Technology which facilitates Safe & Sustainable Agriculture through its unique Energy Management Approach towards Plant Health Management along with Rejuvenation of Soil Health – meaning, utilization of **'Clean Energy to Produce Clean Food'**.

The initiative transformed into a Comprehensive

Safe and Sustainable 'Clean Food Program'

(Elimination of Chemical Pesticides & Nitrate Fertilizers)

with Impetus from

IBM Sustainability Project

Clean Food Movement is probably the first initiative toward Healthy Life & Farmers' Empowerment; through the development of Safe & Sustainable 'Clean Food' (Elimination of Chemical Pesticides & Nitrate Fertilizers), i.e. crop sustainability without raising the cost of production, and establishment of a transparent supply mechanism from farmers' field to consumers in order to ensure affordable safe food for all.

The objective of 'Clean Food' Program is in accordance **with Sustainable Development Goals** of **United Nations** specially **SDG 2** (End Hunger, Achieve Food Security and Improved Nutrition and Promote Sustainable Agriculture)

This innovative Farmers'-Participatory Program is based on a Scientific- Nature Friendly Sustainable Agricultural Practice and a Transparent/ analytically backed Evaluation System with an objective to develop a Self-sustainable Consumer Connect Agriculture Model; which can fuel livelihood upliftment of the farming community. 'Clean Food' is the first & only offer in the direction of Safe & Sustainable food - enable large scale production of safe food, ensure producers' profitability & enable value added product at affordable pricing.


IBM-IORF SUSTAINABILITY PROJECT
CLEAN VEGETABLE DEVELOPMENT PROGRAMME
- under Safe and Sustainable Agriculture
Location:
MODEL FARM
Nadia, West Bengal
2022 -23
Sponsored by : IBM
Zero Pesticides
Zero Nitrate Fertilizers
1ST Ever Model for Net Zero Clean Vegetables


IBM-IORF SUSTAINABILITY PROJECT
CLEAN FOOD
NET ZERO MODEL
Net Zero Paddy Seeds
Net Zero Vegetable Seeds
Net Zero Vegetables
Net Zero Oilseeds & Pulses
Evaluation of Novcom Compost


IBM-IORF SUSTAINABILITY PROJECT
IBM-IORF Sustainability Project under
Safe & Sustainable Agriculture & Clean Food Production under
Inhana Rational Farming (IRF) Technology
Soil Health Card for Every Farmer &
Climate Smart
Climate Smart,
SEED' Develop


IBM Sustainability Project
100 ha. Model Project
An IBM – IORF Sustainability Project
'CLEAN FOOD'
Project Area
Sponsored by : IBM
Nadia KVK, ICAR


IBM-IORF SUSTAINABILITY PROJECT
Safe & Sustainable Agriculture & Clean Food Production under
Inhana Rational Farming (IRF) Technology
Colorimetric Pesticide Assay Test
in
Inhana Laboratory

The project was initiated in the indo-gangetic alluvium soils of Nadia district, West Bengal. The area belongs to hot, moist subhumid ecological sub region (15.1) (Sehgal, 1992). The climate of the study area is characterized by oppressively hot summer, high humidity and high rainfall during the monsoon. The program started with Farmers' Meeting and Awareness program along with field survey for gathering information regarding the land demography, land use, agrochemical usage, farming activities, etc.

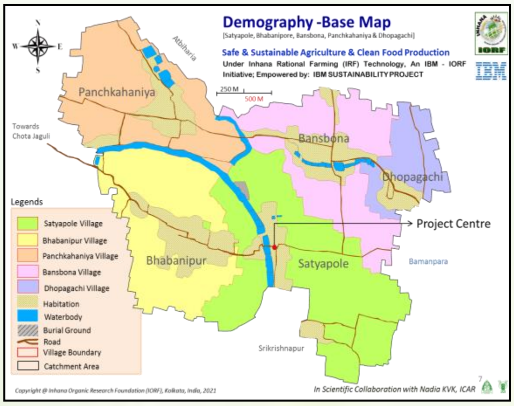
We developed a comprehensive Soil Test Protocol with 26 Parameters Study that encompassed Physical, Fertility and Biological Parameters. We also developed **5 Soil Quality Indices with Colour Coding** to facilitate better understanding of Soil Health by the farmers through the **Improved Soil Health Card**.

The average land holding size of the small and marginal farmers in India is about 0.38 hec., which is less than 80% of the classified range of 2.0 hec. (< 1.0 hec. for marginal & 1-2 hec. for Small farmers). **With the Sustainability Stimulus from IBM India, IORF took up the mandate for Resource Mapping of 100 hec. Project Area comprising about 350 to 400 farmers. For this about 350-400 soil samples were to be analyzed. But actual field evaluation revealed the critical land fragmentation with land holding size even <0.26 ha and they were not contiguous but scattered in two or more locations. Hence for appraisal of land specific Soil Quality Status (SQS); IORF had to go down to the micro grid size of 0.16 hec. So IORF took up an exhaustive Soil Analysis Program, considering four different Sampling Grids : 10 hec., 2.5 hec., 0.6 hec. & 0.16 hec. – which led to about 1200 Soil Samples**.

A Comprehensive Soil Analysis of about **1200 Sample pool was undertaken as per 26 Quality Parameters.** Gradually we also developed comprehensive Soil Health Cards for the project farmers towards facilitating soil test based Soil Health Management.

Soil Textural Analysis in the project area showed dominance of medium textured soil with highest presence of silt loam in 42.80 % area. Majority of area had slightly acidic pH (5.5-6.5), while assessment of the soil organic carbon indicated it to be as one of the major limitations; as more than half of the area had low (0.5 to 0.75%) to very low (<0.5%) status. Analysis showed low (200-280 kg/ ha) to moderate (280-360 kg/ ha) Soil available- N in about 72% area, while available phosphate was in the relatively higher range (>90.0 kg/ ha) in close to 86% of the area. Available Potash content was moderate (250-340 kg/ ha) to moderately high (340-450 kg/ ha) in most of the area. High to very high value of soil available nitrate in majority of the area indicate higher usage of N-fertilizers in the project area.

The major soil limitation in the project area is the microbial population and its dynamics considering that both microbial biomass (indicator of microbial pollutions) and Soil Fluorescein Diacetate Hydrolysis (FDAH) values (indicator of working efficiency of microbial population) were low to very low in majority of the area.



Demography -Base Map
[Satyapole, Bhabanipore, Bansbona, Panchkahaniya & Dhopagachi]
Safe & Sustainable Agriculture & Clean Food Production
Under Inhana Rational Farming (IRF) Technology, An IBM - IORF Initiative; Empowered by: IBM SUSTAINABILITY PROJECT
250 M
500 M
Atbiharia
Panchkahaniya
Towards Chota Jaguli
Bansbona
Dhopagachi
Project Centre
Bhabanipur
Satyapole
Bamanpara
Srikrishnapur
Legends
Satyapole Village
Bhabanipur Village
Panchkahaniya Village
Bansbona Village
Dhopagachi Village
Habitation
Waterbody
Burial Ground
Road
Village Boundary
Catchment Area
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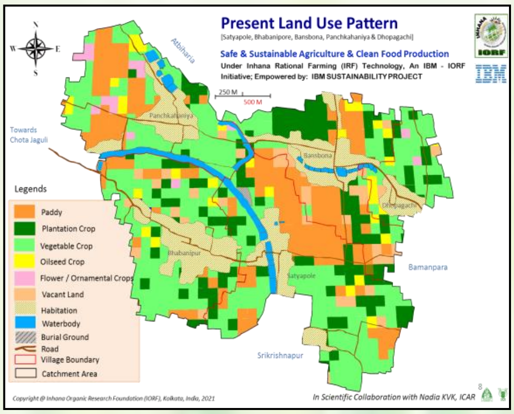
In Scientific Collaboration with Nadia KVK, ICAR



Present Land Use Pattern
[Satyapole, Bhabanipur, Bansbona, Panchkahaniya & Dhopagachi]
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Under Inhana Rational Farming (IRF) Technology, An IBM - IORF Initiative; Empowered by: IBM SUSTAINABILITY PROJECT
Towards Chota Jaguli
Bamanpara
Srikrishnapur
Legends
Paddy
Plantation Crop
Vegetable Crop
Oilseed Crop
Flower / Ornamental Crops
Vacant Land
Habitation
Waterbody
Burial Ground
Road
Village Boundary
Catchment Area
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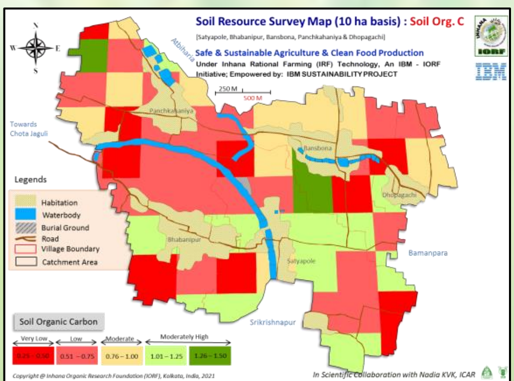

Soil Resource Survey Map (10 ha basis) : Soil Org. C
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Towards Chota Jaguli
Bamanpara
Srikrishnapur
Legends
Habitation
Waterbody
Burial Ground
Road
Village Boundary
Catchment Area
Soil Organic Carbon
Very Low
Low
Moderate
Moderately High
0.51 – 0.75
0.76 – 1.00
1.01 – 1.25
1.26 – 1.50
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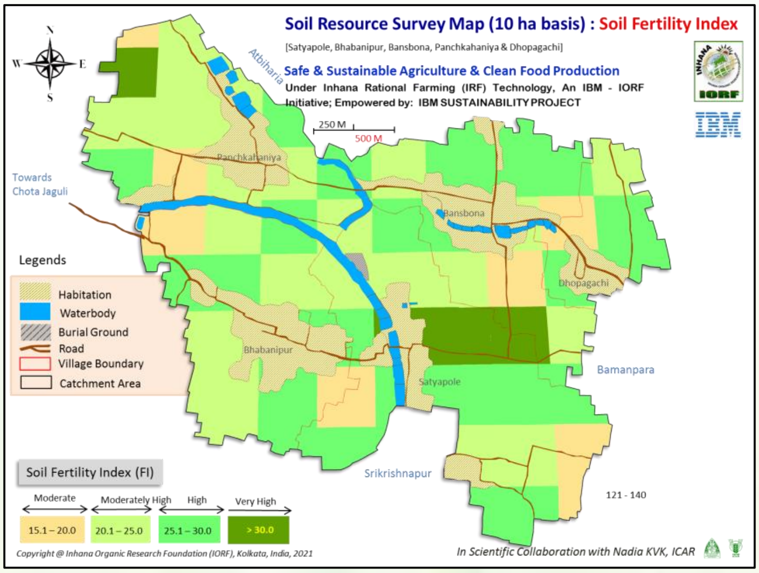

Soil Resource Survey Map (10 ha basis) : Soil Fertility Index
[Satyapole, Bhabanipur, Bansbona, Panchkahaniya & Dhopagachi]
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Under Inhana Rational Farming (IRF) Technology, An IBM - IORF Initiative; Empowered by: IBM SUSTAINABILITY PROJECT
250 M
500 M
Atbiharia
Panchkahaniya
Towards Chota Jaguli
Bansbona
Dhopagachi
Bhabanipur
Satyapole
Bamanpara
Srikrishnapur
121 - 140
Legends
Habitation
Waterbody
Burial Ground
Road
Village Boundary
Catchment Area
Soil Fertility Index (FI)
Moderate
Moderately High
High
Very High
15.1 – 20.0
20.1 – 25.0
25.1 – 30.0
> 30.0
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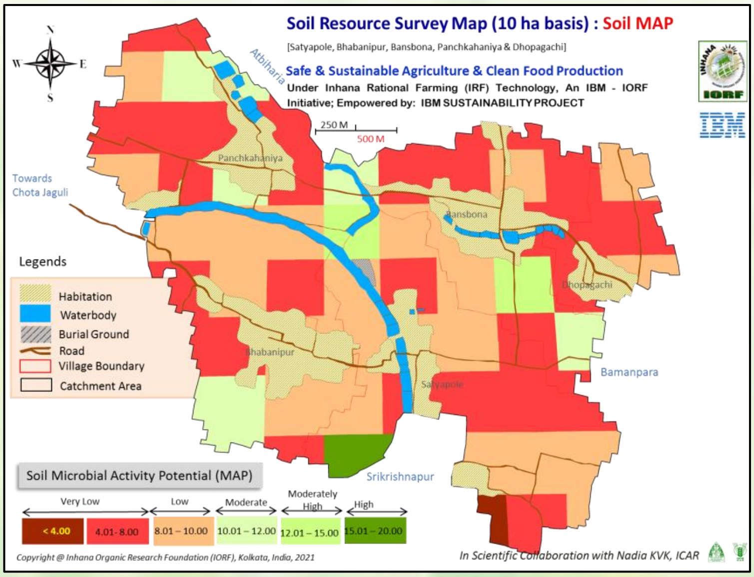

Soil Resource Survey Map (10 ha basis) : Soil MAP
[Satyapole, Bhabanipur, Bansbona, Panchkahaniya & Dhopagachi]
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250 M
500 M
Atbiharia
Panchkahaniya
Towards Chota Jaguli
Bansbona
Dhopagachi
Bhabanipur
Satyapole
Bamanpara
Srikrishnapur
Legends
Habitation
Waterbody
Burial Ground
Road
Village Boundary
Catchment Area
Soil Microbial Activity Potential (MAP)
Very Low
Low
Moderate
Moderately High
High
< 4.00
4.01- 8.00
8.01 – 10.00
10.01 – 12.00
12.01 – 15.00
15.01 – 20.00
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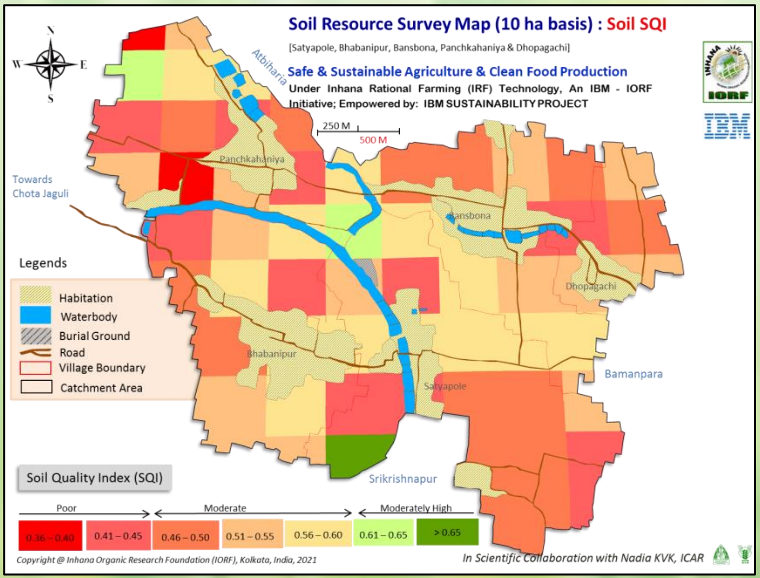

Soil Resource Survey Map (10 ha basis) : Soil SQI
[Satyapole, Bhabanipur, Bansbona, Panchkahaniya & Dhopagachi]
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250 M
500 M
Atbiharia
Panchkahaniya
Towards Chota Jaguli
Bansbona
Dhopagachi
Bhabanipur
Satyapole
Bamanpara
Srikrishnapur
Legends
Habitation
Waterbody
Burial Ground
Road
Village Boundary
Catchment Area
Soil Quality Index (SQI)
Poor
Moderate
Moderately High
0.36 – 0.40
0.41 – 0.45
0.46 – 0.50
0.51 – 0.55
0.56 – 0.60
0.61 – 0.65
> 0.65
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95 Soil Resource Maps of 5 Project Villages to benefit more than 1000 farmers in respect of Soil Test Based Soil Health Management

Also the comparatively lower value of soil Microbial Quotient ($_q$MBC) and corresponding high Soil Microbial Metabolic Quotient (qCO_2) indicate stressful conditions of the residing microbial population leading to depleted soil health. And thus despite no major limitation in soil physical and physicochemical characteristics, Soil Quality Index (SQI) of the soil in the Project Area is moderate (0.46 – 0.60) in majority of area (72.4 % area) followed by poor status in 22.2 % area and moderately high status only in about 5.4 % area.

Crop specific Soil and Plant Health Management Schedule was developed under IRF Technology after consideration of the soil analytical data and pesticide footprint study, to propel the objectives of Reduction of Pest/ Disease Pressure *vis-à-vis* Reduction of External Chemical Inputs while enabling Crop Sustenance/ Improvement. IORF's classroom and on-field training regarding development of different organic concoctions, organic alternatives for pest control along with Plant Health Management; helped the farmers to eliminate chemical pesticides in majority of the vegetables (with few exceptions), without incurring any crop loss or increasing the cost of production.

1600 – 2000 ton of Safe and Sustainable 'Clean Food' was produced encompassing a wide variety of vegetable crops. About 400 farmers were benefited in terms of access to Sustainable Crop Technology that facilitates Reduction of Unsustainable Inputs while enabling Crop Sustainability, especially under the existential climate change impact.

The problem of pesticide residue is very high in India. And the situation is no different in the project area where the critical land fragmentation and the contrasting High Cropping intensity, leads to High Dependence on land and therefore extreme reliance on the unsustainable inputs like fertilizers and pesticides. Hence, the ecological footprint of pesticides have increased significantly over time. In this context reliable pesticide risk indicators are pivotal to assess the potential risk associated with the pesticide use, particularly in the case of limited data availability and before undertaking any Safe & Sustainable Agricultural Initiative. **This was the Background behind the development of Pesticide Pollution Indices by IORF**

The **IBM Sustainability Project** provided the opportunity to IORF to Standardize its **Crop & Soil Pesticide Footprint Assessment Tool** (*originally developed and used in Plantation crops*) **for the Field Crops** (Vegetables) as no such evaluation Pathway is presently available in this sector.

Two Pesticide Pollution Indices : i) Crop Pesticide Pollution Index (CPPI) & ii) Soil Pesticide Pollution Index (SPPI) were used to assess the Risk Potential related to Crop Sustainability, Soil Quality Degradation, Pesticide Residue in the End Product and Future vulnerability of crop sustainability under climate change impact.

Among the different vegetable families evaluated, a higher consumption was documented in case of solanaceae, and cucurbitaceae, with the highest in case of malvaceae family. Higher SPPI value noted under solanaceae, cucurbitaceae and malvaceae families, indicated a high toxicity load on the soil, especially in relation to the microbial population and their functional dynamics. **And the lack of sustainable soil management, raises a big question mark on the future sustainability of these vegetable farm lands.** Evaluation of the Pesticide Load on Crop (AI/kg) *vis-à-vis* Crop Pesticide Pollution Index (CPPI) under different vegetable cultivation indicated higher values for Brinjal , Chilli, Okra and Pointed Gourd, which are also the higher revenue generating crops. The finding indicated that **farmers need to reduce the pesticide use and migrate toward Safe & Sustainable Agriculture in order to save themselves from future economic distress**.

‘Clean Food’ means Safety authentication through actual analysis. And here a major challenge arose, considering that the present chromatographic techniques are hugely expensive, complex and time-taking process. So batch wise testing of Vegetables for Consumer Safety Compliance is out of question especially considering that the majority of the vegetable producers are small and marginal farmers. These farmers need a scientific pathway that can provide an economic solution for Safety Compliance.

Colorimetric Pesticide Assay Test can be a Game Changer in Food Safety Analysis

&

Global Applicability for Speedy (1/10th of Conventional Time), Effective & Economic Analysis of Food Safety for Consumer Compliance at

1/10th to 1/15th of the Cost under present HPLC testing methods.

The search for a sustainable alternative led us to the Colorimetric Assay Test for pesticide residues. This test method although utilized round the globe to identify the pesticides residues, lacked Standard Protocol towards Safety Evaluation of Vegetables. **Hence, IORF took up the massive task of process Standardization for which more than 1200 samples comprising 30 Major Vegetables** (*produced in India*) **were tested in IORF laboratory**. **The newly standardized protocol can enable both Qualitative & Quantitative Estimation of the Major Pesticide Groups in Vegetables, detect Heavy Metals as well as Other Toxic Substances of known/unknown origin related to human health and safety.**

The Colorimetric Pesticide Assay Test can serve as a Real Game Changer in the Food Safety Arena & a ‘Sustainability Tool’ for Safe & Sustainable Agriculture

Vegetables are the source of Nutrition for Human Health, but only when this Nutrition comes from a Safe Source- it can Sustain Life & Promote Good Health. And Only Safe and Sustainable Agriculture can Produce Safe Vegetables for its Nutrition to provide Actual Health Benefits and Immunity. Quality evaluation of 'Clean Food' was done in terms of three parameters *viz*. Vitamin – C content, Protein Richness and Antioxidant Richness; which have crucial relevance towards human health. **Twelve major vegetables grown in the project area were taken for the assessment; i.e., Potato, Tomato, Brinjal, Carrot, Cauliflower, Cabbage, French Beans, Green Peas, Spinach, Okra, Green- Chilli and Red Onion.**

There was an indication of comparatively higher value of nutrition in the vegetables grown under Clean Food Program as compared to their conventional counterparts. **This might be primarily attributed to the Plant Health Management, which forms an integral part of IRF Technology.** The findings suggested that adoption of Inhana Rational Farming Technology not only helped to sustain crop yield, it also demonstrated the potential towards enhancement of the qualitative components of the vegetables.

Following the development of 'Clean Food' we assessed its sustainability quotient in terms of GHG Mitigation and Energy Use Efficiency.

In the 1st phase of the IBM Sustainability Project, we calculated the GHG offsetting potential under 'Clean Food' production. Primarily we used the Cool Farm Tool developed by 'Soil & More' (Hamburg, Germany) for calculation of GHG offsetting / carbon saving under 'Clean Food' production. But the stimulus from IBM Sustainability, enabled the generation of data base that will be used for the **development of Advanced GHG Calculator; considering all aspects, including 'Plant Efficiency' following the induction of Sustainable Clean Energy.**

The developed database and its interpretation provided insights for developing a '**Compost Carbon Footprint Assessor**' and '**Agriculture System Sustainability Assessor**' which could become crucial Sustainability Tools to assess the impact of any **Agriculture Initiative towards the objective of Net Zero** – the Ultimate Goal of Safe & Sustainable Agriculture

As per the primary estimate, this 100 ha 'Clean Food' Project showed a **GHG Offsetting Potential of upto 750 ton CO_2 Equivalent.** But if Soil Health Management undertaking Bioconversion of Waste (landfill material) through Novcom Composting Method is taken up under the 'Clean Food' (Vegetable Crops) Program **then the same 100 ha Program can generate a GHG Mitigation Potential of upto 10,000 MT CO_2 Eqv. (*case specific*) which can be the most meaningful way to accomplish the Net Zero Carbon Objective**.

Thus the IBM Sustainability Program not only spearheaded the '**Clean Food Movement**' by giving a comprehensive shape to the program, but most importantly facilitated the generation of **unique offsprings which could help to remove the bottleneck in the pathway of successful Safe and Sustainable Agricultural initiatives on a global scale.**