

# IBM - IORF SUSTAINABILITY PROJECT



**Assessment of Quality Potentials of the First generation 'NET ZERO' Clean Vegetable Seeds produced under Phase-II Continuation Project in West Bengal, in respect of Yield Improvement and Climate resilience**

## PHASE - III



## **Introduction**

Organic or sustainable crop production is the need of the day for agricultural sustainability as well as to mitigate the increasing risk of food chain contamination due to synthetic pesticides. The risk increases under the climate change impact and conventional farming has practically no answer towards meeting the safe and sustainable objectives. However shifting over from the conventional farming practice to nature friendly, sustainable crop production is not easy. It needs a great effort starting from suitable technological intervention to efficient resource utilization along with market support. However, the most important thing to start with is 'Quality Seeds' which can perform under low input environment and show resilience towards biotic and abiotic stress factors. Furthermore, adaptation is the key for achieving resilience in our food and agricultural system. Adapting seed to changing climates, resource availability, and environmental conditions is one way to mitigate risks for farmers and the food supply they serve.

It is estimated that more than 95% of organic/ low input agriculture is dependent on seeds varieties that were bred for the conventional high input sector. Recent findings have shown that such varieties lack important traits required under organic and low –input production system, which have major importance towards climate change mitigation strategies. A range of breeding goal desired for the climate resilient agriculture such as reduce reliance on inorganic N-inputs, higher nutrient use efficiency, greater resistance against diseases as well as other biotic and abiotic stress; are severely compromised under the conventional high input dependent seed development program. Especially the vegetable crops are highly sensitive to climatic vagaries, where sudden rise in temperature or irregular precipitation at any phase of crop cycle can affect growth, flowering, pollination and fruit development, which may subsequently lower the crop yield. To mitigate the adverse impact of climate change on the productivity and quality of vegetable crops there is need to develop sound adaptation strategies.

At the same time, organic/Net Zero Clean Seed development can reduce agriculture's reliance on a seed industry based on proprietary control and chemical-intensive farms leading to . Organic seed systems – when viewed as an alternative to the dominant seed system – can help address bigger problems in agriculture. Expanding organic seed systems can also increase economic opportunities for farmers who successfully produce organic seed on their farm. The economic benefits include selling organic seed commercially, becoming more seed self-sufficient and reducing input costs, and reducing financial risks by having seed that's better adapted to their farm. Farmer involvement decentralizes how organic seed is bred, produced, and distributed, and expands the diversity of seed grown and available.

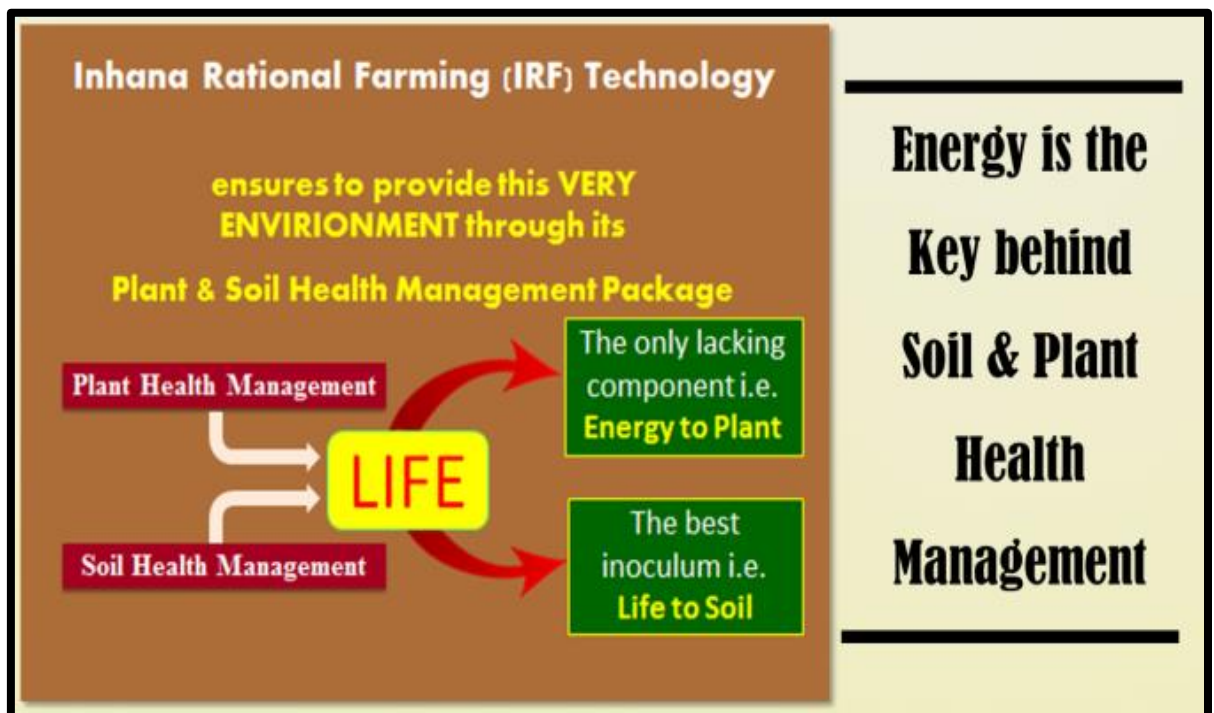
In this background, we have taken a initiative to study the Assessment of Quality Potentials of the First generation 'NET ZERO' Clean Vegetable Seeds produced under Phase-II Continuation Project in West Bengal, in respect of Yield Improvement and Climate resilience . At the same time we also tried to develop second generation net zero clean seed development under the same study



## The roads towards assessment of Net Zero Clean Seed

Net Zero Clean vegetable seed development program was initiated in the farmers field at Satyapole village, one of the 5 project village under IBM-IORF Sustainability project. It was second year continuation of seed development project . The study area falls under the New Alluvial and old Alluvial Agro-climate zone of West Bengal. Soils here are moderately well drained, deep and medium textured, pH varies from 6.5 - 7.5 with a good base saturation. Annual rainfall in the area varies from 1,401-1,671 mm; maximum and minimum temperature ranges between 25.2 - 37.9°C and 9.8 - 26.7°C respectively.

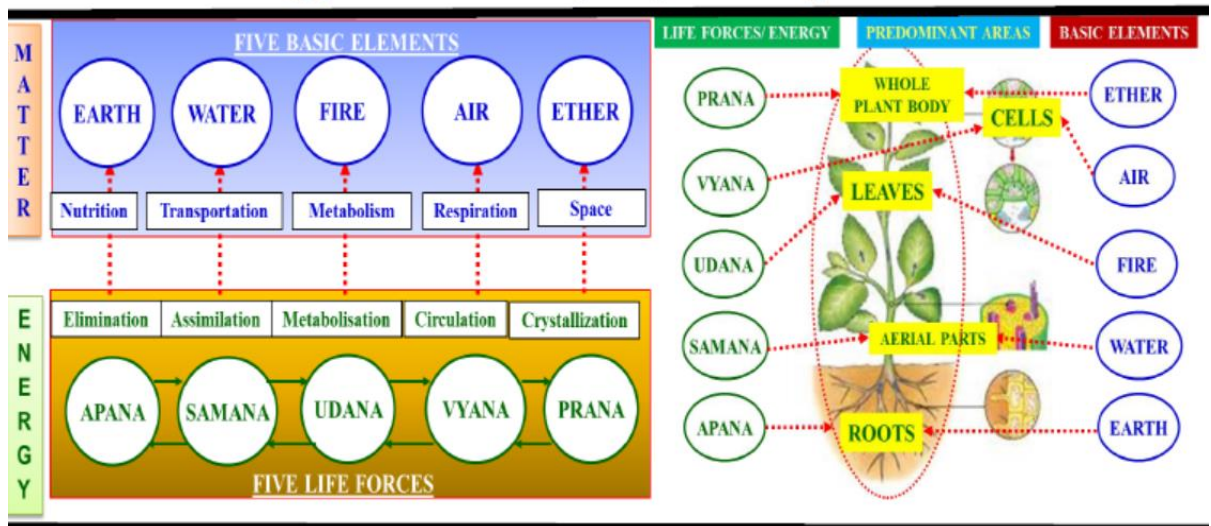
Inhana Rational Farming (IRF) Technology : Inhana Organic Farming Technology developed by the Indian scientist, Dr. P. Das Biswas, is a comprehensive organic approach towards Ecologically and Economically Sustainable Crop Production. Inhana Organic Farming focuses on Energy Infusion or Energization of the two critical influential components of crop production i.e., Soil and Plant System. The approach is aimed to restore the population and functional abilities of the native soil microflora and to reactivate the two lost qualities of the plant kingdom i.e., Sense of Self- Nourishment and Sense of Self- Protection.



Energization of Soil System aims to reactivate the soil- plant- microflora dynamics by providing an ideal environment and food source for natural regeneration of the population and functional abilities of the native soil microflora. This is primarily done through application of on-farm produced Novcom Compost as well as Soil Energizers prepared on- farm from cow based and locally available organic inputs. Along with this different cultural practices viz. mulching, in-situ composting, green manuring, cover cropping, etc. are also recommended as per specific requirement.

Energization of Plant System aims to energize, stimulate and reactivate the plants' physiological, metabolic and biochemical functions, through the scheduled application of 'Inhana Energy Solutions'. These solutions are the **potentized and energized botanical extracts developed under Element-Energy-Activation (E.E.A) Principle.**

## Element Energy Activation (EEA) Principle



**Energy specific plants which store the radiant solar energy or the basic life force in differential forms can serve as a potential medium of energy components, which when released at the right time and in the right proportion can make matter (hereby the plant physiological functions) functional at the desired level and to restore/ bring equilibrium.**

### **Cultivation Practice :**

Eight different crop varieties were selected for the study viz. Brinjal (*Solanum melongena*; variety Tara BWX, DEB - 721), Chilli (*Capsicum frutescens* L.; variety Bullet, DEB - 1301 ), Okra (*Abelmoschus esculentus*; variety Deb Swarna, DEB - 411), Amaranthus Red (*Amaranthus cruentus*, variety : Lal Kanaka, DEB - 2603), Tomato (*Solanum lycopersicum*, variety :Kashi Aman, DEB- 2929), Spinach (*Spinacia oleracea*; variety : Pusa Bharati, DEB - 1905), mustard (*Brassica nigra*, variety : local) and Potato (*Solanum tuberosum*, variety ).

### **Organic Soil Management**

Organic soil management was done primarily with application of Novcom poultry compost @ 40 ton/ha followed by application of enriched cow dung slurry prepared as per the guideline of IRF Technology. Seeds were treated with IRF seed treatment solutions before sowing. Standard cultivation guideline along with IRF Plant Health Management was followed strictly from seed sowing to harvesting.



Development of Novcom poultry compost heap at the project area under IBM-IORF Sustainability Project

## Quality of Novcom poultry compost

Compost samples were analysed for different quality parameters as per National and international standards. Unpleasant smell and flies around the raw poultry litter disappeared 3 to 4 days after the compost heap prepared, which may be due to the rise of temperature within the compost heap due to initiation of prolific microbial activity. High temperature generated within the heap compost ( $> 62.8^{\circ}\text{C}$ ) for more than 3 continuous day confirm destruction of pathogens within the compost heap. The final compost appeared blackish brown in colour with earthy smell which was an essential criteria for mature compost.

Organic carbon content in Novcom poultry compost ranged between 22.92 and 24.93 percent, total nitrogen content in the Novcom poultry compost samples ranged between 1.69 and 2.14 percent, which was well above the reference range (1.0 to 2.0 percent) and C/N ratio varied from 13:1 to 14:1 indicating that all the compost samples were mature and suitable for soil application.

Microbial population (in the order of  $10^{16}$  c.f.u to  $10^{14}$  c.f.u in case of total bacteria, total fungi and total actinomycetes count) in Novcom compost was significantly higher (at least  $10^3$  to  $10^6$  c.f.u times) than the population obtained in case of other compost samples.

Sl No	Parameter	Range value	Mean Value	Std. E
1.	Moisture percent (%)	59.21 – 64.12	62.14	$\pm 1.10$
2.	pH (H <sub>2</sub> O)	6.77 – 7.81	7.58	$\pm 0.12$
3.	Organic Carbon (%)	22.91 – 24.79	23.91	$\pm 1.03$
4.	Total NPK (%)	3.96 – 4.71	4.35	$\pm 0.10$
5.	C:N Ratio	13 : 1 – 14 : 1	13 : 1	$\pm 0.15$
6.	Total Microbial population	$21 \times 10^{16}$ – $43 \times 10^{16}$	$31 \times 10^{16}$	$\pm 2.1 \times 10^{16}$
7.	Compost Quality Index (CQI)	4.68 – 5.81	4.76	$\pm 0.36$

## Productivity of the vegetables under IRF package of practice

Productivity of vegetables grown under the Clean Food ‘NET ZERO’ (CFNZ) Program in the Project Area Model Farm was compared with the productivity range of the respective vegetables under conventional farmers’ practice in this zone.

Productivity of almost all the vegetables under IRF package of practice was higher than the average productivity of the same under conventional farmers practice. The findings indicated that adoption of IRF technology as an effective nature friendly package of practice for increasing crop productivity. This initiative could be a benchmark study for sustainable management of vegetables and the technological advancement can be transfer to farmers field for facilitates sustainable crop production specially when excessive use of fertilizer and pesticides enhance the risk of deterioration of soil health as well surrounding ecology.

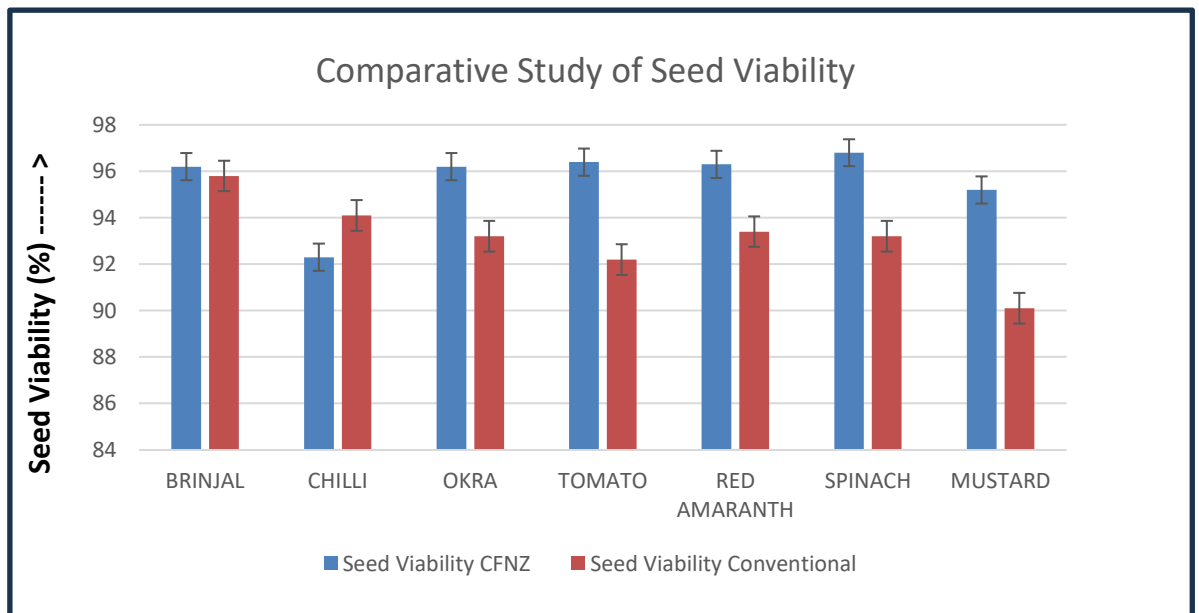
### Productivity of Vegetables & Oilseed under Clean Food ‘NET ZERO’ Program

Crop		Clean Food ‘NET ZERO’ Yield (Tonne/ ha)	Conventional Farmers Yield (Tonne/ha)	‘NET ZERO’ Clean Seed Yield (Tonne/ ha)
BRINJAL	:	32.14	26.2 – 30.4	0.290
CHILLI	:	18.96	14.6 – 18.2	0.310
OKRA	:	19.41	13.4 – 16.6	1.340
TOMATO	:	33.20	24.5 – 30.7	0.242
RED AMARANTH	:	17.21	12.04 – 15.8	1.780
SPINACH	:	37.10	28.4 – 32.2	3.740
MUSTARD	:	0.558	0.46 – 0.50	0.558
POTATO	:	34.12	27.68	21.12

## Evaluation of Seed Quality

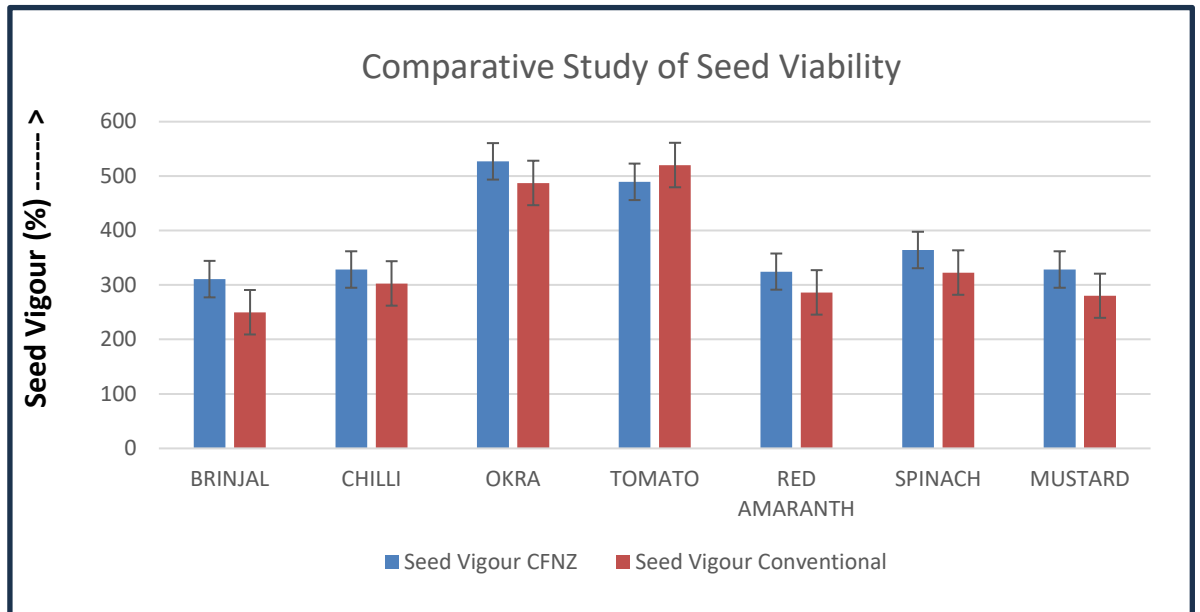
Seed quality is the key to successful crop production and food security. Crop yield and resource use efficiency depend on successful plant establishment in the field, and it is the vigour of seeds that defines their ability to germinate and establish seedlings rapidly, uniformly, and robustly across diverse environmental conditions. Improving vigour to enhance the critical and yield-defining stage of crop establishment remains a primary objective of the farmers to develop their own seed in their field.

### Comparative study of Seed Viability between Conventional and Net Zero Clean Seeds.



Seed viability was tested through Tetrazolium test to study the degree of activity of the dehydrogenase enzyme system closely related to seed respiration and viability. Seed viability test showed value high score (ranged between 92.3 and 96.8) irrespective of the vegetable varieties indicating high quality of the organically developed seeds .

### Comparative study of Seed Vigor between Conventional and Net Zero Clean Seeds.



Seed Vigour (SV-II) : Seed vigour is the combination of characteristics that determine the potential for high performance after sowing. The basic objective of seed vigour testing is to provide a precise identification of important differences in physiological potential among seed lots of commercial value, aiming to identify lots of higher probability to perform well after sowing and/or during storage. In fact, seed vigour is an interaction of characteristics that could be considered as independent attributes of physiological potential such as speed of germination, seedling growth and ability to germinate under abiotic stresses. Therefore two seeds might have similar germination percent but when subjected to the more stressful conditions experienced in the field, they might show vastly contrasting abilities to establish plants due to differences in their vigour. Seed vigour test showed significantly higher value in the case of Net Zero Clean Seed irrespective of seed varieties as compared to conventional seeds. The values clearly indicated superiority of Net Zero Clean Seed over the conventional ones.



Net Zero Clean Seed production under IBM-IORF Sustainability Project



Field validation of Net zero clean seed in farmer's field under IBM-IORF Sustainability Project



## **Conclusion**

Seed forms the foundation for sustainable agriculture and more than 40 % of crop loss can attributed alone to poor seed quality. More than 70% farmers of our country do not have the access to authenticated quality seeds (both availability and/ or economic strength). On top that the hybrid/high yielding seeds have gradually captured more than 80% of the seed market and we are gradually losing out our seed diversity.

The ‘Net Zero Clean Seed’ development program done under IBM-IORF Sustainability Project has come forth as a benchmark study towards economically viable net zero clean seed production through the adoption of a comprehensive organic technology namely Inhana Rational Farming in the farmers’ field.

The findings have indicated the qualitative superiority of the seeds over conventional seeds in terms of seed vigour and seed germination. These qualitative changes in the seeds produced might have been influenced by the completely new approach of ‘Plant Health Development’ under IRF Technology; that was adopted for the programme. The approach helped in activating the plant physiology, which in turn led to the production of quality, climate resilient seeds.

In the case of IRF management, yield of the vegetables and the related economics were found to be much better as compared to the average productivity and the cost of vegetable production in the Nadia District of West Bengal. But most importantly, if this program can be transferred to the farmers’ field, the farmers can produce quality seeds to fulfill their own requirements at less than 10% expenses in relation to the market rates of quality seeds and to get higher yield which in turn help to sustained their livelihood,