

# Socio Economic Empowerment of Marginalized Communities through Science & Technology Inputs

Experiences based on interventions in Uttar Pradesh and Bihar, with the support of Department of Science & Technology, Government of India





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Science & Technology Inputs**

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# 1

## Introduction

Over 60% of the population in north eastern plains of Uttar Pradesh (UP) and Bihar depend directly or indirectly on agriculture. Of those more than 84% are small and marginal farmers, with less than 1 hectare farm size. The region also faces a low Human Development Index (HDI), high reliance on weather-based livelihood systems, insufficient information and extension on resilient farming techniques and technologies, lack of post-harvest technology, low market return from perishable agroproducts, mono-cropping culture, and a lack of irrigation facilities.

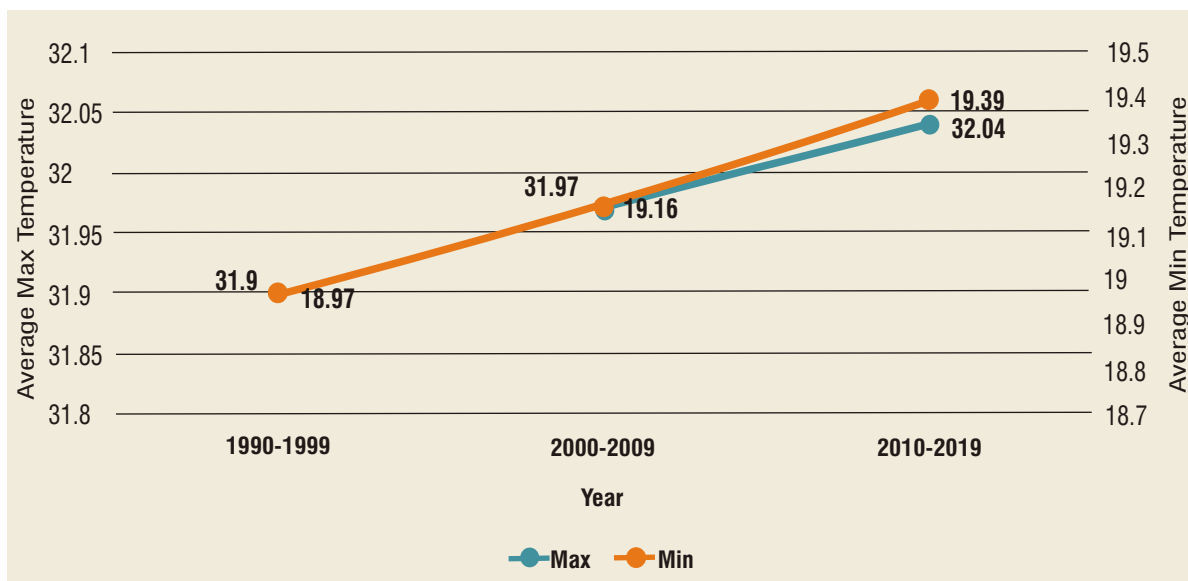
Furthermore, climate change has exacerbated the situation by increasing water scarcity, flood frequency, and intensity. It affects long-term crop yields and has had a detrimental influence on

agricultural production. Although climate change impacts all farmers, it is the small and marginal farmers who are disproportionately affected due to a lack of adaptation capacity.

### a. Climate Variabilities

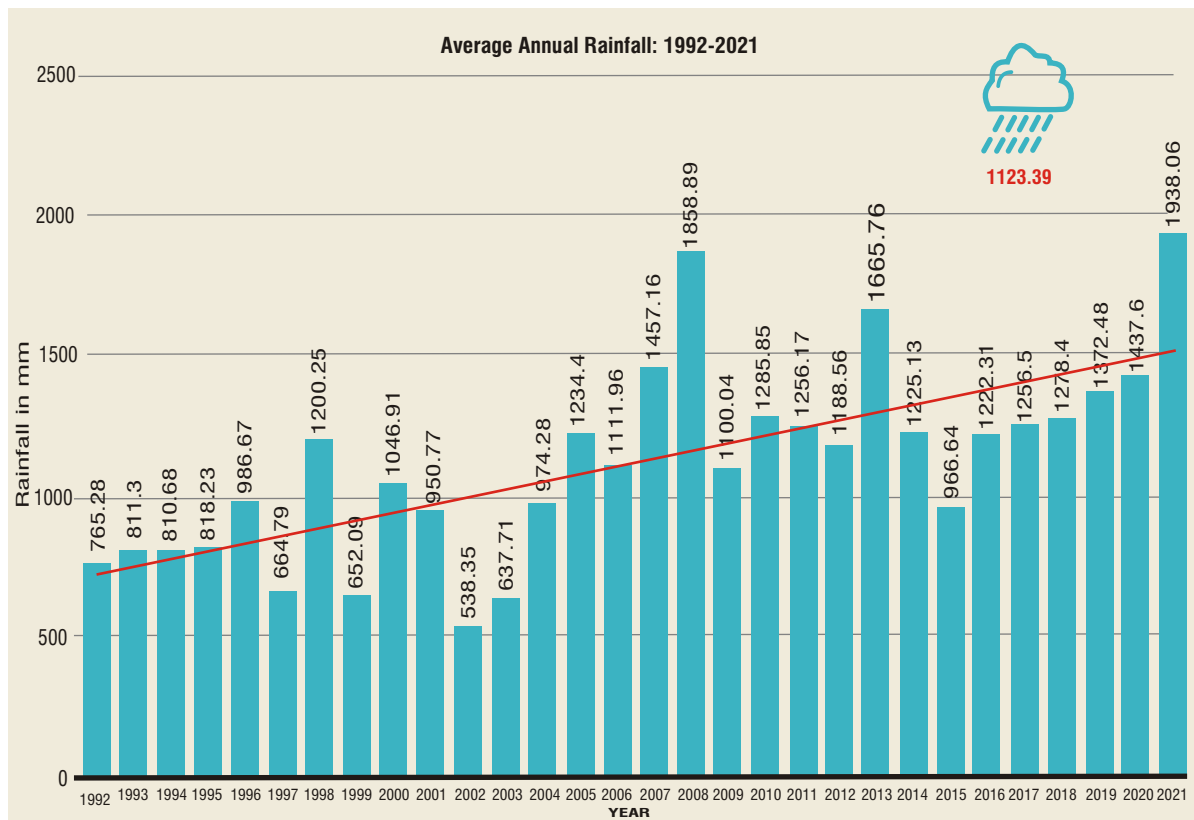
The eastern UP region has witnessed shifts in temperature patterns, precipitation levels, and atmospheric moisture content in the recent past. A comparison of the last three decades annual average temperatures (maximum and minimum) reveals an upward trend. Between 1990 and 2019, there was a notable increase of 0.42°C in minimum temperatures and 0.14°C in maximum temperatures.

**Decadal trend of average maximum and minimum temperature in Gorakhpur district, Eastern U.P region**



(Source: IMD, GoI)

## Annual trend of rainfall in Gorakhpur District, Eastern U.P.



The figure above showcases notable variations in precipitation levels over this time period. The lowest recorded rainfall was 538.35 mm (2002), while the highest was nearly four times, a substantial 1938.06 mm (2021). This wide range indicates significant year-to-year fluctuations in rainfall. On an average, annual rainfall appears to have increased over this period, with a noticeable surge starting since 2003. This has consistently increased, with pronounced peaks in the years 2008 (1858.83 mm), 2013 (1665.76 mm), and most recently in 2021, which recorded the highest-ever rainfall at 1938.06 mm. This suggests that over the last two decades, the region has experienced more extreme rainfall events, which has led to an increase in the annual rainfall volume.

### b. Impact of climate change

Climate change has a direct impact on agriculture by altering temperature and precipitation patterns, leading to droughts, floods, and extreme weather events. These variations often result in crop failures, lower yields, and livestock losses, that contribute to food shortages and a surge in food prices. All of this makes it increasingly challenging for farmers to grow crops and support their families, which further leads to a growing disinterest in agro-based livelihoods.

Small and marginal farmers, who rely heavily on agriculture for their livelihoods, are particularly vulnerable to the impacts of climate change, which include increased competition for limited resources, such as water and land; and changes in market demand and prices. These farmers may also lack access to information, technology, and resources to adapt to changing conditions, leading to further economic and social challenges. From droughts and floods to pests and diseases, climate change has made it increasingly difficult for farmers to continue with their livelihoods. It has led to the marginalization of farmers, particularly where agriculture is a major source of income and employment. The inequitable impact of climate change on farmers exacerbates existing inequalities and reinforces poverty, making it harder for marginalized communities to escape the cycle of poverty.

As effects of climate change worsen, farmers face complex challenges. Rising temperatures and changing rainfall patterns leads to decreased crop yields, increased pest infestations, and soil degradation. The changing climate is one of the major reasons causing vulnerability among the poor, including women, children, the elderly, the disabled, migrants, and displaced communities.



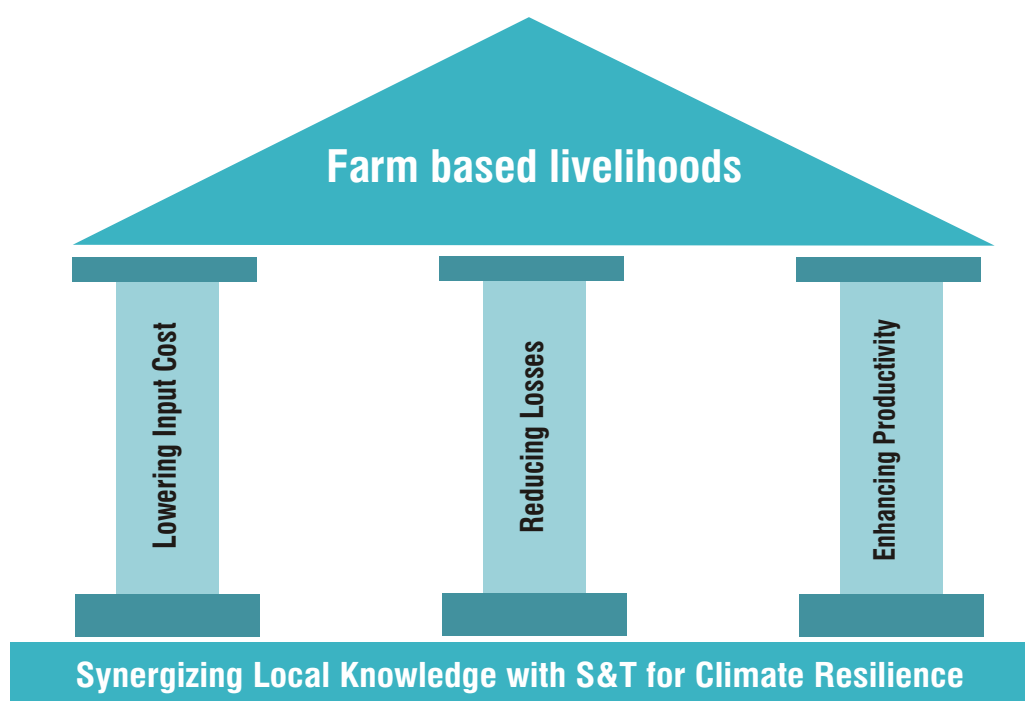
# 2

## Measures to increase resilience of small and marginal farmers

To address climate change related issues in agriculture and livelihood-related problems of small, marginal, and women farmers, it is necessary to develop a resilient farm production system. This can be achieved through lowered input costs, increased productivity, and reduced losses, all of which contribute to increased net gains, and help improve farm production system sustainability.

- ♦ **Lowering input costs:** Small and marginal farmers often struggle with high input costs. However, it is possible to lower these costs and still maintain productivity by reduction in cost on labour, seed, irrigation, fertilizer, pesticide etc. using economical and effective

- ♦ sustainable farming approaches such as organic manure, robust seed types, and efficient irrigation systems. By emphasizing the benefits of chemical free farming and providing education and support, small and marginal farmers can reduce their input costs and build a more resilient livelihood.
- ♦ **Enhancing productivity:** Productivity can be enhanced even in adverse climatic scenario by adopting modern farming techniques, such as multi-layered farming, jute bag farming, and intercropping. Crop rotation helps maintain soil fertility and reduces the risk of pests and diseases; intercropping maximizes land use and reduces soil



- ♦ erosion; and improved seeds resist pests and diseases, and require less water and fertilizer, which further reduces input costs. By adopting these techniques, small and marginal farmers can increase their productivity and improve their livelihoods.
- ♦ **Reducing losses:** Farmers often face significant losses due to poor storage practices and inadequate post-harvest management. However, there are several steps to reduce these losses and improve their overall profitability that include usage of proper storage techniques, such as keeping crops in dry and well-ventilated areas to prevent spoilage. They can also adopt post-harvest management practices, such as sorting and grading their crops to ensure that only high-quality produce is sold.

This is possible by synergizing local knowledge with science and technology. Local knowledge, also known as traditional knowledge refers to the knowledge and practices developed by local

communities over time, based on their experiences and observations of the natural environment. It provides an insight to the local ecosystems, weather patterns, and crop varieties best suited to the area, whereas science and technology play the crucial role of complementing this localised information. While traditional practices have sustained farmers for generations, modern innovations can help increase productivity and resilience. However, it is important to strike a balance between the two, creating a symbiotic relationship that benefits both farmers and researchers.

Thus, synergizing local knowledge with science and technology can significantly increase the resilience of small and marginal farmers. One such successful collaboration is the use of mobile apps to provide farmers with real-time weather information and market prices. This initiative has helped farmers make informed decisions and reduce losses due to weather and market volatility.



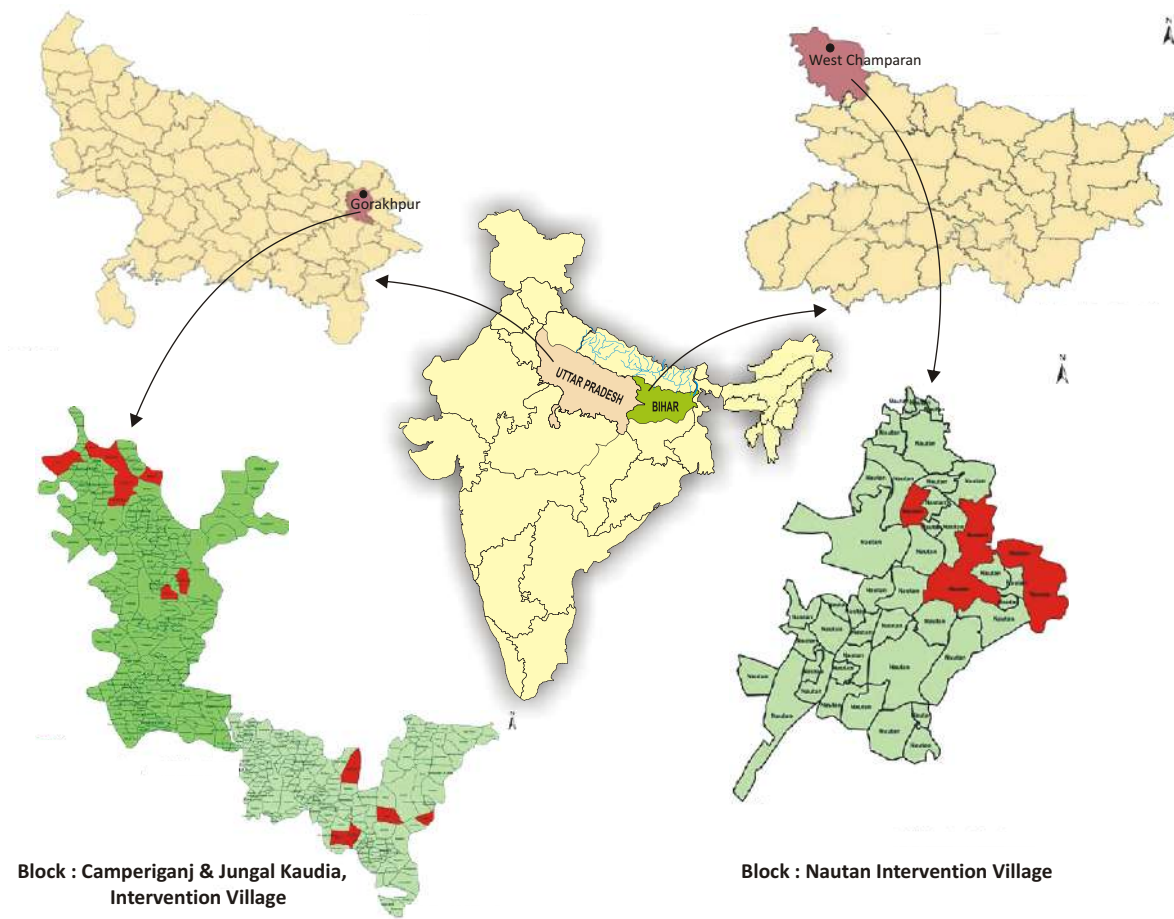
# 3

## Intervention Area

Campiorganj and Jungle Kauriya, in Gorakhpur district, eastern Uttar Pradesh and West Champaran in Nautan Prakhand, Bihar, were identified as flood and water logged prone regions. For the intervention programme, a total of 36 small and marginal farmers from 18 villages, who face these problems almost every

year in rainy season, were selected. Stress was on those who live below poverty line (57 % chosen from SC & ST communities). The objective was to promote technology innovations, with a focus on the socio-economic upliftment of the underprivileged and vulnerable sections of society in these rural areas.

**Map showing intervention area in Gorakhpur and West Champaran districts**



# 4

## Development of Resilient Technologies: Strategy and Approach

Prior to interventions, a brief survey was conducted for a detailed feasibility analysis of the field-related problems among the communities of these marginal farmers, and a baseline data was created through FGDs (Focused group discussions). Based on the feasibility study, the main problems identified in the intervention area were: mono-cropping pattern, lack of resilient seeds, cultivation in waterlogged areas, increased input costs, crop losses, low farm productivity, diminished incomes, ecosystem degradation, women's drudgery, non-accessibility to knowledge, lack of post-harvest technology limiting returns from perishable agro products, absence of market and institutional support, etc.

Innovations in science and technology have an important role in small-scale farming and can considerably improve the socio-economic conditions of small and marginal farmers, particularly women farmers. The shared learning dialogues highlighted that their socio-economic vulnerabilities need to be addressed through specific interventions to enhance their resilience and empowerment.

### Criteria for selection of S&T solutions

- ◆ Situation of area (Flooding & water logging, silted and upland)
- ◆ Need assessment of small and marginal farmers
- ◆ Cost of technology
- ◆ Availability of local resources
- ◆ Potential to scale
- ◆ Potential to leverage fund from government and other institutions

### Coevolution process for S&T solutions

#### Synergy of local wisdom & scientific knowledge

Local wisdom refers to the knowledge and practices developed by communities over time, based on their experiences and interactions with their environment while scientific knowledge refers to the systematic study and understanding of the natural world through observation, experimentation, and analysis.

#### Benefits of combining local wisdom and scientific knowledge

- ⊕ Preserves local knowledge and practices that may be lost over time.
- ⊕ Improves understanding of the natural world, and interaction between humans and environment.
- ⊕ Develops sustainable and effective solutions for local environmental and social challenges.

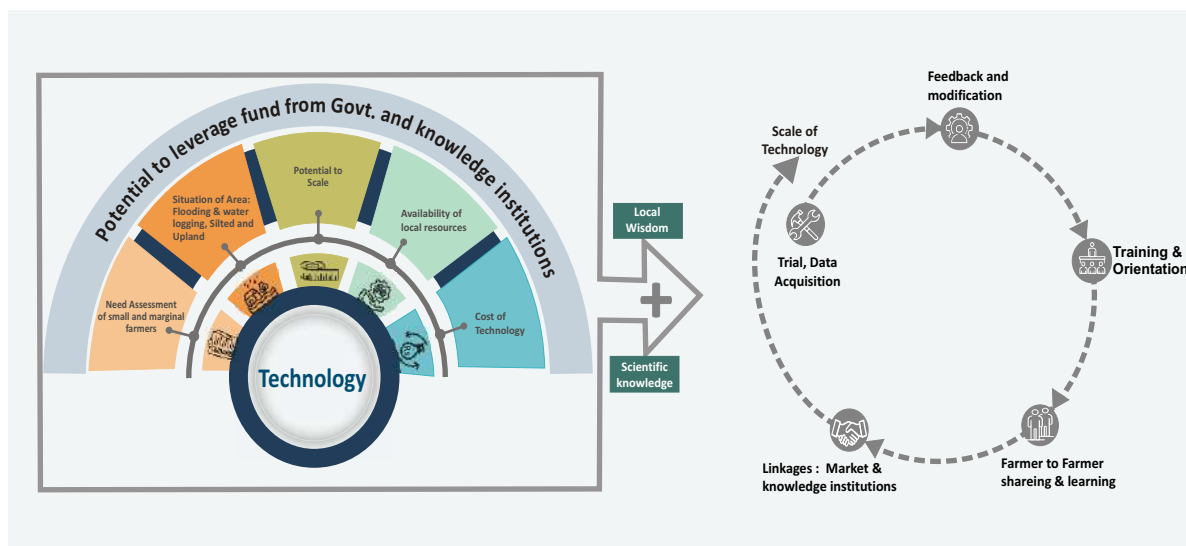
Increasing the resilience of small and marginal farmers is crucial for ensuring food security and sustainable development. By synergizing local knowledge with science and technology, we can find innovative solutions to the challenges faced by these farmers. For them, this translates to greater economic stability, and access to healthy and nutritious food.

#### Developing new technology

- ⊕ **Trial:** The trial phase is an essential part to develop new technology. During this phase, the technology is tested in real-world scenarios to ensure that it performs as expected.
- ⊕ **Data Acquisition:** During the trial phase, data is collected to evaluate the performance of



## Coevolution process for S&T solutions



the technology, which is analysed to identify areas for improvement and generate modifications where needed.

- ✦ **Feedback:** User feedback, a critical component of the trial phase provides insight into how users interact with technology, and highlights areas for improvement. Feedback was collected through surveys, interviews, and other methods.
- ✦ **Modifications in Technology:** Based on the data and feedback collected during the trial phase, modifications are made to the technology to improve its performance and usability. These range from minor tweaks to major overhauls, depending on the nature of the issues identified.

### Training & Orientation

At the heart of our training and orientation programs for technology beneficiaries is a commitment to continuous improvement. We ensured that our beneficiaries incorporate the skills and knowledge related to these technologies.

### Linkages

Market linkage is about connecting farmers and producers directly with markets. There are platforms through which farmers connect to each other and directly with commercial or institutional buyers. An awareness is created among them about marketing and selling of produce so that an uninterrupted, liberal flow of produce and price is maintained.



# 5

## Evolving Resilient Techniques Details



**Multi-layered farming**

Amidst the risk of recurrent floods and prolonged waterlogging with changing climate thresholds, small and marginal farmers have transformed flood-risks into an opportunity, by developing flood resilient multi-layered vegetable farming techniques with appropriate crop combinations as per the local situation.

Multilayer cropping system, an appropriate mechanism for farmers in the flood affected regions helps minimise risk of yield loss in kharif season and boosts opportunities for diversifying income. Using this technique, vegetable growers farm appropriate crop combinations and take two to three crops from the same pocket of land

thereby increasing their net profit. For all those farmers, whose land is frequently water logged and inundated for more than one to three months, it has the potential to ensure earnings throughout the year as there is lesser risk of crop failure. The purpose of the technique is to maximise efficiency, enhance soil quality, increase crop yield, and reduce plant competition while using lesser space on the field.

### **Technical specifications**

- ◆ Inclusion of appropriate low-height crops compatible with creepers and *machan* plants.



- ◆ Choices of alteration in the crop calendar and selection of appropriate varieties help prepone and postpone sowing and harvesting time to avoid crops in the field during floods or waterlogging.
- ◆ Platform for creeper crop is built at a height of 5 feet .
- ◆ In crop combination planning, properties of the root zone depth, sunlight, mix of runners, and other crops is considered.
- ◆ Soil pH value must be appropriate for selected crops.

Under the DST project, several appropriate crop combinations are sown, of which some of the important groups of vegetables are as follows:

**Lady finger + Radish + Beet root + Bean**  
**Bitter gourd + Potato**  
**Bottle gourd + Cabbage + Coriander**

Through this technique, farmers can improve their income by up to 1.5 times, and reduce losses by 30-35 percent, caused due to problems like water logging and flooding.







## Bio insect repellent

Chemical pesticides and fertilisers have an adverse effect on human health and related ecosystems. Given the harmful effects of chemical pesticides, farmers were trained in the development and application of eco-friendly insect repellents to avoid toxicity in their land and produce.

Features of eco-friendly bio-repellents:

- ◆ Natural alternatives to chemical pesticides
- ◆ Prepared by using medicinal leaves
- ◆ Effective on shoot borer, fruit borer, fruit fly, aphids, grasshoppers, and *gondi* bugs by 75%
- ◆ Anti-fungal and anti-microbial in nature, they act against soil-borne pathogens, viz. *Alternaria* sp., *Fusarium* sp., and *Pythium*

The Insect repellent has been prepared by using the leaves of selected easily available medicinal plants viz., *Azadirachta indica* (Neem), *Datura stramonium* (Datura), *Cascabela thevetia* (Kaner), *Calotropis gigantea* (Madar), *Cannabis indica* (Bhang) and *Allium sativum* (Garlic bulbils) together with cow urine as in the given quantities.

Contents	Quantities
<i>Azadirachta indica</i> leaf	400 gm
<i>Datura stramonium</i> leaf	250 gm
<i>Cascabela thevetia</i> leaf	400 gm
<i>Calotropis gigantea</i> leaf	400 gm
<i>Cannabis indica</i> leaf	300 gm
<i>Allium sativum</i> bulbils	200 gm
Cow urine	2.00 L
Water	10.00L



**Method of preparation:** Fill appropriate amount of cow urine and water in an earthen pitcher of 12 litre capacity. Dip collected leaves into the liquid medium. Cover mouth of the pitcher with a double-layered cotton cloth. Incubate for 22 days under shade until the desired product is obtained.

Tested on a variety of vegetable crops viz., *Lagenaria siceraria* (Bottle gourd), *Abelmoschus esculentus* (Ladies 'finger), *Solanum melongena* (Brinjal), *Brassica campestris* (Mustard) and *Oryza sativa* (paddy) against insects viz., *Leucinodes orbonalis* (Shoot borer), *Leucinodes* sp. (Fruit borer), *Drosophila melanogaster* (Fruit fly), *Aphidoidea* (Aphids), *Caelifera* (Grasshopper), *Gondi* bug Maize worm, and Army worms etc., it also increases the chlorophyll content of leaves significantly.





## Compost Filter Tool

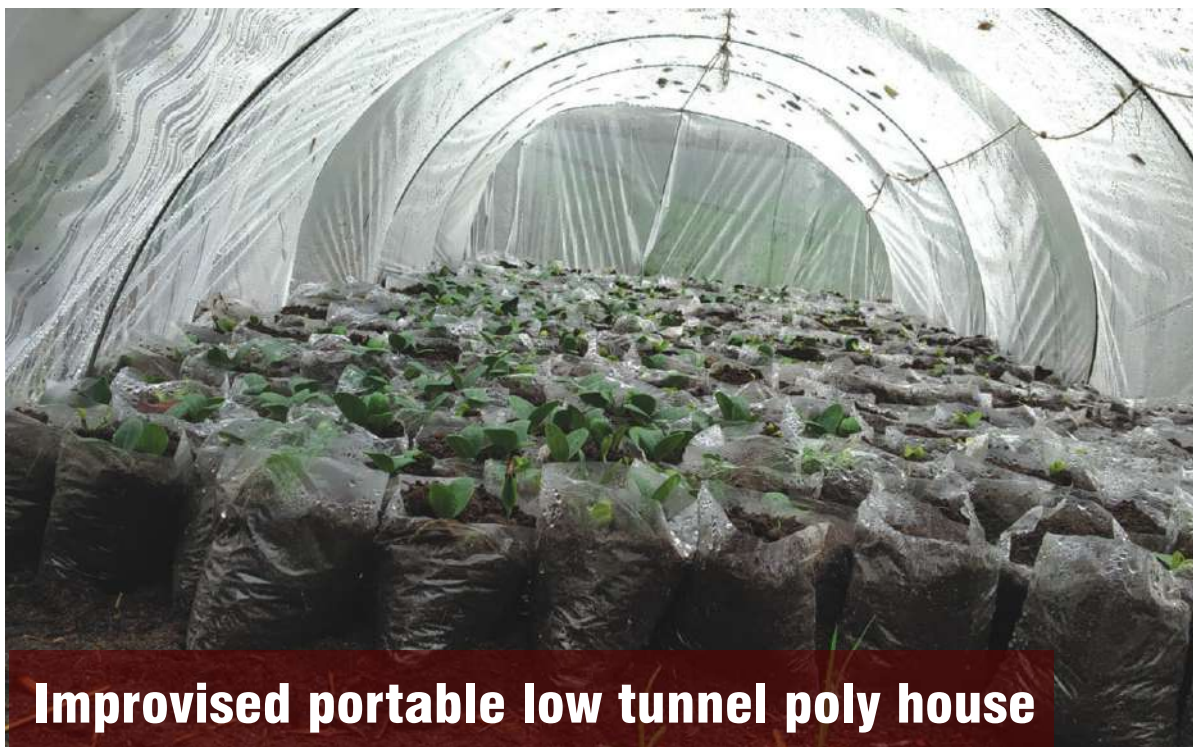
The introduction of technology in the intervention area has also brought about a change in the health status of the women. A manual filter machine has several shortcomings; it is labour-intensive and time-consuming, and cuts the skin, causing blisters on hands. The conversion from manual to motorised filter machines eases workload as it is single person operable and time saving; all of which reduces drudgery of women farmers and their health-related vulnerabilities. This motorised tool works automatically on electricity, although in its absence can also be operated manually.

This locally prepared iron device, is easily operable by both men and women. The instrument has a mesh at two levels. A 5 inch long iron frame is fitted with one of the mesh and a handle is attached to it. Through this handle, one person runs the machine and the other person places compost on the upper mesh. Thus, the compost is easily filtered,

falls and is filled directly in a packet. This compost filter tool is increasingly popular among women due to its simplicity and convenience of use.



**The traditional method takes an hour to filter 60 kg of compost, while the compost filter tool filters more than 8 times that amount in the same time (30 minutes for 2.50 quintal).**



## Improved portable low tunnel poly house

In the intervention area, 75 percent of the small and marginal farmers are vegetable producers. Establishing vegetable nurseries during the summer for transplanting in the winter is extremely difficult due to extensive water logging in the monsoon period. Availability of nursery products in the market is neither appropriate nor very reliable or of good quality.

The portable and movable nursery technology is a low tunnel-type structure, a semi-circle shaped construction with a low height. It is made with an iron stand and wire, with plastic sheets as roof covering. These tunnels facilitate entrapment of carbon dioxide, thereby enhancing the photosynthetic activity of the plants and, hence, stimulating healthy plant growth. These structures also protect the plants from high winds, rain, frost, and, most importantly, pest attack. Besides being low-cost, they are easy to construct and dismantle, and reusable the next year.

Portable and movable nurseries are used for producing high-demand nurseries and vegetables such as bottle gourd, bitter gourd, brinjal, cauliflower, tomatoes, and cucumber. This technique facilitates small and marginal vegetable growers to develop an early nursery and produce good-quality vegetables in advance to get the benefit of a high market price and compete with outside vendors.

The key specifications and advantages of the technology are summarised below:

- ◆ It is constructed on the raised iron bed (up to 4 feet) above normal field level so that it is not affected by water stagnation.
- ◆ It conserves warmth, stimulates germination and early growth, protects plants from injury, and improves crop quality
- ◆ Can be used during winter and summer seasons .
- ◆ Used for raising healthy and early nursery seedlings.
- ◆ Maintains optimum temperature for plant growth and enhances nutrients uptake by the plants.
- ◆ Maintains soil texture and protects crops from birds and pests attack, wind, rain, frost, and cold and hot waves.

**In both regions, after pilot testing, more than 30 farmers are developing early nursery crops of tomato, cauliflower, cabbage, chilli, brinjal, and creeper vegetables like bottle gourd, cucumber, bitter gourd, pumpkin, etc. using this technology. This saves them 20-30 days of waiting time due to waterlogging, and provides them with high-quality seedlings early on.**





## Weeding & hoeing tool

Weeds in crops are a major problem, and the removal of weeds is a challenge for farmers. It is difficult for farmers because it is a time, labour, and cost intensive task.

This weeding and hoeing tool is constructed from locally accessible materials and consists of a bicycle wheel with an iron frame grip. Three V-shaped (bent inside) blades are fastened to the bottom of this frame with nut bolts. These blades are changeable and can be replaced based on crop requirements or the distance between the two ridges in a lined-sown crop. Weeds in the field can be readily cut and uprooted using this tool, which uses a push and pull action.

The capacity of this tool is 120 m<sup>2</sup>/hr/person. That means that with the help of this tool, a farmer, even a woman farmer, can easily complete weeding and hoeing activities on one acre of land in just two days. From an economic point of view, too, this is beneficial for every farmer. The tool does work more effectively in moist soil, usually 20-25 days after sowing and when weeds are around 13 cm in height. Moreover, it is durable and does not require maintenance or regular repair costs.

**The average labour cost for weeding and hoeing per acre reduced by nearly 35% (From Rs. 1,032 to Rs. 675 per acre).**

**Time spent to weed/hoe per acre fell to 1/4<sup>th</sup> as compared with traditional tools (A male farmer earlier took 8-10 days/acre to complete weeding and hoeing work, whereas there is only 2 days requirement now).**







## Water retention tank based on phytotrid technology

This technology is one of the low cost methods to treat domestic wastewater in rural areas (small communities) to improve the village eco system. The system follows a natural way of biologically processing domestic effluents, and consists of a planted filter bed containing gravel, sand, and soil.

The drainage system of 80 houses in a village has improved with this technology. It serves a dual purpose in rural areas- resolves water logging problem which in turn allows farmers to use this land for cultivation, and reuse the treated water for agriculture purposes.

This technology, a practical solution for domestic waste water treatment, incurs zero maintenance and low operating costs as it considers the natural slope of the ground where the water flows from one device to another without any external energy input such as a motor pump, etc. The designed system is a good method for treating village waste water and its subsequent reuse.

**The results obtained indicate that the technology works effectively in reducing 70% of pollutants, and the treated water can be used directly for irrigation.**





## Value added fungicide based bio compost

Soil-borne fungal diseases are common in leguminous crops in the intervention area; 60% of legume crops and 10% of vegetable crops are damaged by wilt disease. Value added fungicide-based bio compost proved helpful in the treatment of such diseases as well as increased the carbon content in the soil.

### Method of use

- ◆ Used during the preparation of field.
- ◆ For 1 acre of agriculture field 120-125 kilogram bio compost is mixed in soil before ploughing.
- ◆ For trees, 1-2 kg bio compost is added to the root of trees and covered with soil.

**An extra bonus to fungicide-based bio compost is the 0.65% increased carbon content in the soil.**







## Low cost energy efficient zero energy cool chamber for perishable vegetables

The perishability and short shelf life of vegetables, particularly green and leafy crops, is one of the biggest issues for growers, resulting in losses and distress sales. Vegetable farming is very sensitive to temperature and suffers greatly from post-harvest losses due to poor storage system. In the intervention regions, about 20-40% of green and leafy vegetables are lost or spoiled after harvesting within a short period of time. Apart from this, remote villages are still devoid of an interrupted power supply, due to which refrigeration systems for storing vegetables is not a viable option. Thus, the need for evolving cost effective and eco-friendly storage mechanisms become even more important to preserve, especially for the small and marginal farmers whose livelihoods are dependent on vegetable farming.

In recent years, improvements like maintaining cold chains and deep freezing have been helpful, but owing to their high cost and power-intensive nature, these technologies are not very feasible for small and marginal farmers. Taking all these factors into consideration, a low-cost on-farm storage system, the Zero Energy Brick Cooling Chamber (ZEBCC), that works on the principles of the evaporative cooling technique was established to reduce the problem of short-term perishability of green and leafy vegetables, particularly during the summer. The chamber is constructed using locally available raw materials such as bricks, sand, bamboo, dry grass, jute cloth, etc.

ZEBCC is effective in maintaining the cold temperature by lowering the temperature and increasing the relative humidity inside the chamber. The lower temperature and high relative humidity slows down the deteriorative processes, including the sagging and yellowing of vegetables. In leafy vegetables, sagging is one of the major factors that contribute to not only loss of weight but also loss of aesthetic value, which in turn affects the saleability of the vegetables.

This chamber not only extends the marketing period for perishables but also allows the farmers to stock the quantity of vegetables that remain unsold. Apart from this, due to its low cost and ease of construction, the possibility of expanding or adopting such technology among small and marginal farmers increases greatly.

**ZEBCC maintains the quality of the green vegetables for an additional 2 days and keeps them in a saleable state for 5 days, even as vegetables kept inside the house in plastic boxes totally spoil by the 5th day of storage.**



## Turmeric steam boiler

Boiling turmeric is a laborious and costly task. Along with this, the smoke emanating from the burning of firewood and agricultural residues for a long time adversely affects health and the environment.

Specifically, when women are exposed to such an environment for an extended period, it causes eye, headache, and respiratory problems. The comparison table below highlights the advantages of this technique.

Parameters	Steam Boiler	Traditiional Boling
Turmeric	25 kg	25 kg
Fuelwood	5 kg	12.5 kg
Time in drying	40 min.	2 - 2.5 hrs
Water	20 litres	30 litres
Temperature	90 to 100 centigrade	No idea
Boiled in %	100	85
Boiling	Steam	with water
Time to time mixing	No	3 times



**In the traditional method, 25 kg of turmeric takes about 2.5 hrs to boil while in the steam boiler this is reduced substantially and takes only 40 minutes.**





## Threshold based loft farming

Owing to increased land fragmentation, the proportion of small landholdings in intervention regions is quite high. Besides this, widespread waterlogging and changing intensity and frequency of extreme rainfall events due to climate change have added a new dimension and altered the historic threshold of flooding, thereby engulfing more productive agricultural land for a longer duration (beyond the monsoon season). Developmental activities, largely related to earthwork, have not adequately considered water drainage provisions, resulting in increased waterlogged land areas.

Weaker sections of society, comprising mainly of scheduled castes and other backward classes, have very small landholdings, mostly in low-lying areas prone to floods and waterlogging. About 56.6 percent of the intervention areas remain waterlogged (1-3 feet) for 1-2 months during the season. This is quite a large area and affects several vegetable growers in the region. Farmers get only one crop (during the season) as they must leave their land vacant in other seasons. This also eventually affects the production of crops and the overall income of these small and

marginal farmers. To develop suitable resilient farming techniques for the fields inundated during the season, threshold-based loft farming techniques for creeper vegetables has evolved.

### Key Characteristics

- ◆ A low-cost technique appropriate for creeper varieties of vegetables, it is for small and marginal farmers whose lands are in low-lying areas and get inundated by 1-3 feet during the season.
- ◆ Thermocol boxes (2x1.5x1.5 cubic feet) are placed at an appropriate height based on the depth and duration of waterlogging in that area.
- ◆ Ploughing is not required, so it is less labour-intensive, hence reduced input costs.
- ◆ Boxes do not let soil nutrients drain out after rain, so the technique promotes optimum utilisation of nutrients available in the limited space for plants.

This farming technique is being promoted in areas that are inundated for a longer period. Loft farming, where water stands in the field up to a height of 1-2 feet for months together, is an innovative way of farming. Farmers fill jute bags or thermocol boxes with soil and manure, and plant seeds of climber vegetable crops. Lofts or stilts are made from wooden sticks, and these support the climber plants as they grow, thus saving the produce from spoiling in a waterlogged field.







## Polythene mulching

This technique utilises polyethylene film to shield plants from natural elements. Plastic mulches being completely impermeable to water prevent direct evaporation of moisture from soil and thus limit water losses and soil erosion from the surface. In this manner, it plays a positive role in water conservation.

### Advantages of plastic mulching

- ◆ It is completely impermeable to water.
- ◆ It prevents direct evaporation of moisture from the soil and thus limits water losses and conserves moisture.
- ◆ Mulch facilitates fertiliser placement and reduces loss of plant nutrients through leaching.
- ◆ Mulches also provide a barrier to soil pathogens.

**On 0.8 acres of land in Jungle Kaudia, Gorakhpur, polythene mulching technology was used (2019-20). Irrigation costs reduced by 48%, weeding and hoeing expenditures came down by 90% and production increased by 22.2% (due to more branches, less insect-pest attack, microclimate near the root zone, etc.)**

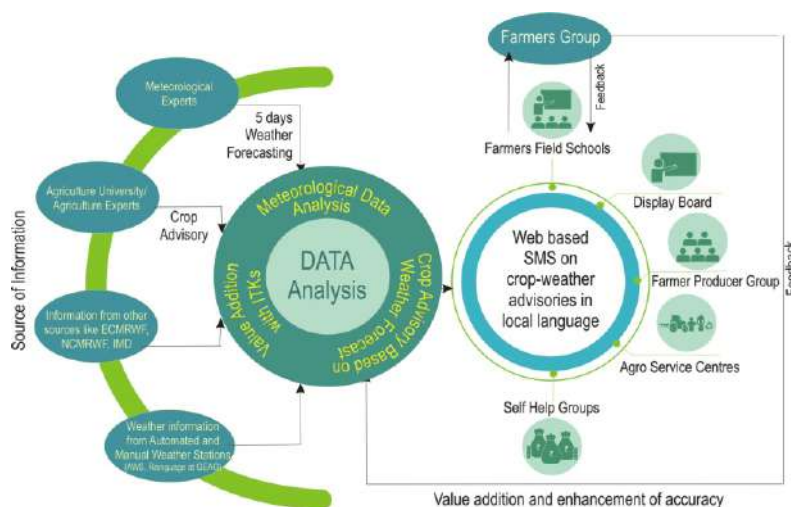






## Digital weather and agro advisory services

To counter climate uncertainties and their impact on agriculture, it is important to reach out to a large number of affected people with farm advice and practical solutions. Appreciating the fact that under flooded conditions, the farmer could access weather data on his mobile, GEAG established two Automatic Weather Stations (AWS). The data collection is through AWS and rain gauges, and formulation of weather forecasts are done through three processes: (i) data processing, (ii) quality control, and (iii) objective analysis.



Automatic Weather Monitoring Systems is a mobile SMS-based climate information advisory service. An information advisory set up provides farmers with advance weather information at intervals of 5 days. Information on temperature, rainfall, wind, and humidity is also sent to farmers through SMS (in the local language), which acts as an early warning system and helps the farmers schedule their irrigation, sowing, harvesting, use of bio-pesticides, or other crop activities.

Through a digital smartphone-based initiative, farmers are informed about the forecast of weather conditions such as the probability of rainfall (light to heavy), temperature (maximum, minimum, and diurnal temperature variation), maximum and minimum relative humidity, cloud situation, and wind direction and speed for the

forthcoming 5 days. Within the same weather forecast message, in general, farmers are also informed about the appropriate time for sowing crops. during Kharif, Rabi, and Zayad seasons, scheduling of irrigation, application of fertiliser and pesticides in the field, harvesting as per the prediction of rainfall, and vaccination of pet animals.

Farmers are alerted in advance to prepone or postpone the timing of sowing of major crops and their varieties, breeds, and plants based on rainfall occurrence. Along with this, information on possible diseases at different stages of plant growth and their remedial measures for season-specific crops and vegetables and health care for domestic animals is also provided.





## Groundnut de-husker

Women in the region shell groundnut, which is a difficult, time-intensive, and laborious task which leads to blisters on their hands. An iron device has been prepared, which can be operated easily even by women. A 23 inches wide and 36 inches long iron frame is fitted with a mesh and a handle is attached to it. This handle has 24 small cast iron points.

Peanuts are put in an iron mesh frame and rubbed lightly with this handle. By rubbing this handle on the grate, the peel of the peanut is easily removed. The technology has become popular at the local level and is increasingly in demand.

**Groundnut de-husker device is portable and takes only 15 minutes to de-husk 5 kg of groundnut, which would take 2-4 hours if done by hand.**



# 6

## Resilient technologies: Role in socio-economic empowerment

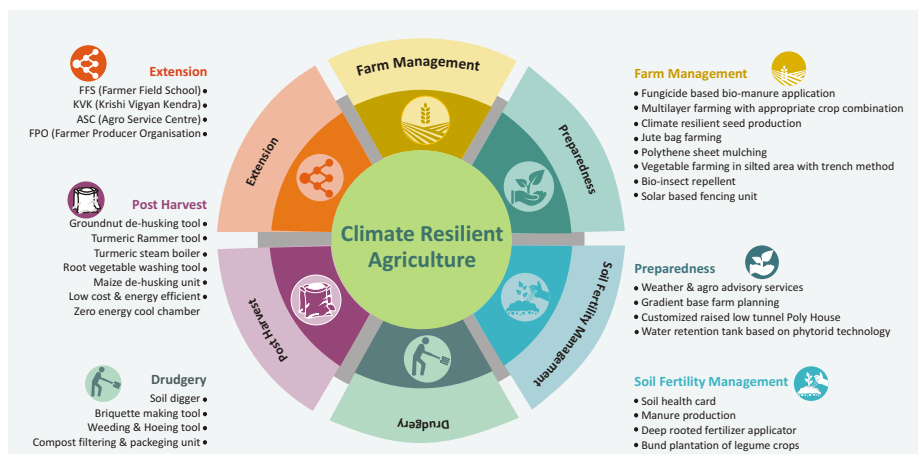
Socio-economic empowerment is the process of liberating people and communities from the cycle of poverty and assigned social roles, and giving them the resources (employment, education, health services, etc.) to raise their and their communities social and economic opportunities. It is the process of economic and social development based on cultural and environmental factors. In the empowerment context, it means the improvement of people's lifestyles through improved education, skill development, income, and employment.

Innovations in science and technology have an important role in small-scale farming and can considerably improve the socio-economic conditions of small and marginal farmers, particularly women farmers. It was realised that in the intervention region the communities' socio-economic vulnerabilities need to be addressed through specific interventions that enhance their resilience and empowerment. For such empowerment, localised and customised science and technology innovations are needed that can contribute to climate resilience in farming in flood-affected areas, along with their positive impact on the socio-economic status of the farmers. The DST-developed technologies addressed agriculture and livelihood-related problems of all, marginal, and women farmers for a resilient farm production

system, resulting in increased productivity and reduced losses, thereby increasing net gains while improving farm production system sustainability through environmental conservation measures. Gender-friendly technologies reduced women's agricultural drudgery, boosting their ability to contribute to agro-based livelihoods.

The implementation of such techniques by target farmers in their own fields helped develop live models for wider learning, dissemination, and adoption by other farmers. Farmer Field Schools and Field Days helped horizontal farmer-farmer extension and needed retrofitting for tailor-made applications according to the specific situations of farmers. Science and technology know-how and developed confidence helped marginalised farmers, especially women, access relevant government programmes and social empowerment, asserting their interests and rights.

Fig 2: Climate resilient agriculture



# 7

## Indicators of socio-economic empowerment

### Production increase



#### a. Input in decision making

Empowering farmers, especially women, to make informed decisions is a key component of socio-economic empowerment. Studies have shown that when women are involved in decision-making processes related to agriculture, there is a significant increase in agricultural production and food security (FAO, 2011). Women bring unique perspectives and knowledge, which can lead to more effective and sustainable solutions. When women are given the opportunity to participate in decision-making processes, they gain a sense of empowerment. This can lead to increased confidence and motivation to take on leadership roles in their communities.

#### b. Income enhancement

Socio-economic empowerment refers to the process of enabling individuals or communities to improve their economic and social standing. It involves providing access to resources, education, and opportunities that can help people increase their income, reduce poverty, and achieve greater financial stability. Income enhancement is a key indicator of socio-economic empowerment. When people have access to money, training, and education, they are more likely to achieve financial independence and improve their quality of life (World,2022). Income enhancement can also lead to greater economic mobility, as individuals are able to save money, invest in their future, and build wealth over time.

## Resource Control



### a. Ownership of assets

Ownership of resources is a fundamental indicator of socio-economic empowerment for marginalized communities. Policies and programs aimed at increasing access to and ownership of resources can have a significant impact on improving the economic well-being of these communities. Resource ownership refers to the possession and control of assets such as land, property, and financial capital. It is an important indicator of socio-economic empowerment, as it provides individuals with greater economic security and the ability to generate income (UN Women, 2016).

### b. Purchase, sale of assets

Purchase sale of assets, a key indicator of socio-economic empowerment, allows individuals to have greater control over their lives and make decisions that impact their overall wellbeing. The sale and purchase of assets can be an indicator of socio-economic empowerment, as it signifies an individual's ability to accumulate wealth and make investments (Alkire, 2013).

### c. Access to, and decisions on farm inputs

An important measure of socio-economic empowerment in agricultural communities is access to, and control over farm inputs. This includes seeds, fertilizers, pesticides, and other materials necessary for successful farming. Farm input access is a critical factor for socio-economic empowerment in rural areas. Farmers who have access to high-quality inputs such as seeds, fertilizers, and pesticides are more likely to have higher crop yields and incomes, which can lead to improved living standards and greater economic opportunities. The ability to make decisions about farm inputs is also an important aspect of socio-economic empowerment (Tekinerdogan, 2018). When farmers have the knowledge and resources to make informed decisions about which inputs to use, they can optimize their crop production and increase their profitability. This can lead to greater control over their economic futures and increased bargaining power in local markets.

### d. Access to market

Access to markets can provide communities with opportunities to sell their goods and services, leading to increased income generation (USAID). This can have a significant impact on poverty reduction, as families are able to earn more money to meet their basic needs. Access to markets is a critical component of socio-economic empowerment for marginalized communities. Government policies play a significant role in promoting market access and creating opportunities for these communities.

### e. Access to government schemes

Access to government schemes is important in gauging socio-economic empowerment. The schemes are designed to provide support and assistance to individuals and communities in need, with the aim of improving their economic and social well-being (National policy on environment, 2011). Improved access and an effective facilitation will only improve farmers economic conditions, where these schemes can provide financial support, education and training, and access to healthcare, among other benefits.

### f. Loan, repayment

Microfinance programs aim to promote socio-economic empowerment by providing financial services, such as loans, to low-income individuals and communities. One key indicator of the effectiveness of these programs is loan repayment rates, which can reflect the success of the program in supporting borrowers and promoting financial stability. Several factors can impact loan repayment rates, including the borrower's financial literacy, income level, and access to resources. Additionally, the terms of the loan, such as the interest rate and repayment schedule, can also play a role in determining the likelihood of repayment.



## Income enrichment



### a. Control over use of income

With a greater control over their income, a farmer can improve the economic viability and sustainability of his farmland. Economic empowerment helps them exercise greater control over both their life choice and resources. One of the key ways to empower individuals and provide them with control over their income is through education and training programs (UN, 2012). These programs can provide individuals with the skills and knowledge necessary to succeed in the workforce and increase their earning potential. Additionally, these programs can help to address systemic inequalities by providing opportunities to marginalized communities.

### b. Better education

Access to quality education can also help reduce poverty by providing individuals with the tools and resources they need to improve their economic situation. With better education, individuals are more likely to secure stable employment and increase their earning potential, which can help lift them out of poverty. Educated farmers are better equipped with skills and knowledge, all of which enables efficient usage of resources and an improved productivity.

### c. Reduced distress migration

Distress migration, or forced migration due to economic, social, or political factors, is a growing concern in rural areas. In many cases, socio-economic empowerment has been identified as a key factor in reducing the number of individuals who are forced to migrate (Brucker, 2011). By providing the resources and support and developing skills among the farmers, their economic opportunities can grow. This, can lead to a reduction in the number of individuals who are forced to migrate due to economic hardship.

## Leadership qualities



### a. Group membership ( FPO, SHG,FFS,ASC)

Besides the engagement of small landholdings and women farmers in appropriate technology development and adaptation in the local context, the farmers led community institutions like farmer field schools (experience sharing and problem solving platforms), agro-service centres (self-managed farm input centres), and farmer producer organisations (sale of produce), help in scaling the developed tools and techniques and developing farmer trainers and resource persons. Group models have the potential to improve market access and income for smallholder farmers by enabling them to pool resources and knowledge. By working together, farmers have negotiated better prices for their produce and access to larger markets. (Bisht.et. al, 2018) It also provides opportunities for farmers to learn from one another and adopt new technologies and practices.

### b. Contest in local elections

A powerful tool, elections provide a platform for the common person to shape the decisions that affect their everyday lives. A farmer in such a vital role can result in tangible gains for the whole community. Socio-economic empowerment plays a crucial role in encouraging women to participate in local elections. Women who have access to education, healthcare, and economic opportunities are more likely to contest elections and engage in the political process. The gained awareness, confidence, self-esteem, self-assurance, and dignity as a result of their empowerment gives them the opportunity to contest and represent themselves on various political platforms.

### c. Self esteem

There seems to be a direct link between self-esteem and crop income earning in agriculture. Women farmers make invaluable contributions to the agricultural sector, but rarely have much say in any decision making at home or for the land they toil. With more control in their hands, both families and communities can only thrive and benefit.

## Time efficiency



### a. Reduction in workload

Reduced workload is one indicator of socio-economic empowerment, as it can provide individuals with more time and resources to pursue other opportunities and improve their overall well-being. In addition, reducing workload can lead to improved health outcomes, as individuals may have more time to engage in physical activity, prepare healthy meals, or seek medical care when needed. This can result in lower healthcare costs and increased productivity.

### b. Leisure time

There is a positive correlation between increased income and access to leisure activities. As individuals earn more money, they are more likely to have the resources to participate in activities such as sports, travel, and cultural events. This can lead to improved physical and mental health, as well as increased social connections and cultural awareness. For a woman farmer, the burden of agricultural chores typically pushes her to respond at the expense of her leisure and sleep, making her and consequently her children more vulnerable.

## Human attributes



### a. Health & Nutrition

Improved socio-economic empowerment can lead to better health and nutrition outcomes, as individuals have greater access to healthy food options, healthcare, and education. (UN women, 2018) Farm machinery is becoming vast, better, and more productive. This is because of the role of technology in digital public infrastructure, allowing more efficient cultivation of wider areas reducing drudgery, thus improving health conditions.

### b. Skill and knowledge ( working as trainer/facilitator)

Education and training are essential components of socio-economic empowerment and pull households out of poverty. Learning about improved production technologies and methods, new products and markets, business, and life skills (such as health management, decision making, self-confidence, or conflict management) can make a big difference. Skills development is particularly important to rural women who are more likely to be contributing family workers, subsistence farmers or home-based micro entrepreneurs in the informal sector, or performing low-paid, unskilled work as seasonal workers.



# 8

## Impact of the technologies: Reflections from the field

### 1. Production

#### a. Input in decision making

Techniques based on science and technology like multi-layered farming, portable low tunnel poly-houses, loft farming, and time management for climate-resilient vegetable farming lead to enhanced crop intensity of up to 148 percent. The farmer-led development of such techniques helped build the confidence of farmers, especially women farmers, who with their newly acquired capacity, skills, and knowledge at different levels of farm production and livestock, enhanced their decision making capacity. Another example is the adoption of SWI technique by a woman farmer, Koila Devi. She decided to sow seeds at a fixed distance with the use of seed dibbler and harvested 220 kg of wheat (DSW 187) from a small area of 266 sqm (Highest production in UP.

#### b. Income Enhancement (Reduced losses)

Rising input costs in chemically intensive farming poses a serious challenge for small landholder farmers, preventing them from increasing their income. Farming techniques like multi-layered farming, vegetable farming in silted areas, groundnut integration, appropriate mechanisms for reducing losses (jute bag farming, time management, raised bed nursery, flood-resilient seed production, solar fencing, polythene sheet mulching); and production and use of bio-inputs (bio-manure, bio-insect repellent, etc.) helped significantly reduce input costs and losses due to floods and waterlogging, leading to improved income. Also, this introduction of technology into the daily lives of women in the intervention area saves time, thus allowing them to work longer hours and earn more money. For example, usage of the turmeric steam boiler and packaging tool reduces time spent on these

activities. And so, women are able to pack extra packets and generate more revenue. Further, farmers' increased use of technology has a positive impact on their social standing in addition to increased revenue levels at the local level.

### 2. Resources

#### a. Ownership of assets

Farmers producing farm inputs such as bio-insect repellent, value-added fungicide bio-compost, *matka khad*, and vermicompost, on one hand assisted in lowering input costs and on the other gave them a sense of ownership over these resources. Community-based waterbody management and grey water treatment through phytoplankton-based built wetlands also aided farmers to improve their access to, and control over common property resources that provide ecosystem benefits.

Women farmers in the area were usually vulnerable to losing their land to money lenders or alcoholic husbands. As they joined organisations like SHG and FPO and gained access to other government institutions, such as KVK and agricultural universities, they began to understand and appreciate their critical role in agriculture and household management. This empowerment has increased their awareness, confidence, self-assurance, and dignity. It has enabled people to be enthusiastic participants in decision-making and, for the first time, have equitable access to and control over resources.

#### b. Purchase, sale of assets

With enhanced income-generating activities, aspects of sale and purchase of assets is better facilitated. Farmers, especially women farmers, learned skills and engaged in

income-generating activities, enabling them to access financial aid. They make money by adding value to the produce and selling it, which increases their income. Farmers in the intervention area are buying agricultural tools, land, cattle, homes, and other assets for themselves.

#### c. Access to, and decision about farm inputs

Improving access to farm inputs and empowering farmers to make informed decisions is crucial for enhancing socio-economic empowerment in agricultural communities. However, there are several challenges and opportunities that need to be considered. Increasing input prices in chemically intensive farming are a significant barrier for small landholder farmers, preventing them from earning a better living and resulting in economic marginalisation. The in-farm production of farm inputs such as *matka khad*, bio-pest repellent, and bio compost allowed farmers to have access to agricultural inputs, generate assets as needed and allowed them to make independent decisions.

#### d. Access to market

Improved access to markets allows farmers to sell their produce easily, efficiently and at higher prices. As women farmers joined institutions like SHGs and FPOs, they gained access to markets, which allows them to buy and sell produce directly. This gives them greater bargaining power across the value chain from farm to market. Direct marketing, on-time electronic payments, and fair weighing practices have resulted in higher price realisation for SHG and FPO members.

#### e. Access to government scheme

Though the government encourages farmers through various welfare schemes, unawareness, and inability to benefit from them limits the efficacy of the same. Improved access and an effective facilitation have only improved farmers economic conditions. Self-help groups (SHGs) and farmer field schools (FFS) have evolved as efficient tools in the intervention region that assist farmers in accessing government schemes and programmes. These programmes equip farmers with the required skills, information, and resources to take advantage of numerous government programmes aimed at promoting agricultural development and improving farmers' livelihoods. Farmers have profited from initiatives such as *Pradhan mantri krishi sinchayee yojana*, *Pradhan mantri kisan samman nidhi*, and *Pradhan mantri fasal bima yojana*.

#### f. Loan, repayment

Loan recovery can be a daunting process, especially for women who face unique challenges such as discrimination and a lack of access to resources. However, only by empowering women, can there be a more equitable system that benefits everyone involved.

To empower women in loan repayment, their financial education was initiated through institutions like SHG. They were introduced to financial literacy and savings, budgeting, and investing. Thus, they are better equipped to manage their finances and make informed decisions. They have better access to resources, technological support, support networks, and a marketing platform which eases input costs reduction, enhances income, and contributes to their family's loan repayment.

### 3. Income

#### a. Control over use of income

Economic empowerment helps people exercise greater control over their life choice and resources. It plays a role towards reduced poverty, increased economic growth, improved health and education, greater social and political participation. Platforms like SHG, FPO provided the small and marginal farmers an opportunity to understand the value of money and financial stability. One successful example is a women's self-help Group, the Jai Maa Laxmi SHG, which has 12 -16 members and provides training and resources for women to create and grow their businesses. The group has had a significant impact on the economic standing of its members in their communities.

#### b. Better education

Educated farmers are better equipped with skills and knowledge, all of which enables efficient usage of resources, an improved productivity, resulting in higher income. As the women's economic status improved, they gained access to resources and became more aware of their rights. Recognising the importance of education in moulding livelihoods and social systems, many women farmers and SHG members began to save money and contribute to their children's further education. Their belief that education helps develop skills and expertise, crucial for employment, financial security, and a social status in society has now been strengthened.

### c. Reduced distress migration

Distress migration of farmers, a complex issue has far-reaching consequences for communities and individuals. It occurs when farmers are forced to leave their homes and land due to environmental, economic, or social factors. Usually a forced mobility, people migrate to urban areas in search of work or better living conditions.

In the intervention region, these climate-resilient tools and technologies have created hope for adapting to changing conditions. Multi-layered farming with appropriate crop combinations, gradient-based farm planning, jute/cement bag farming, and polythene mulching; all these technologies have helped farmers generate income in adverse climatic conditions. Weather advisory services helps farmers receive timely weather alerts, actionable weather information and related advice on crop management; all which aid farmers strategize and increase profits.

## 4. Leadership

### a. Group membership ( FPO, SHG,FFS,ASC)

Farmers with a shared goal and interest, as that in a group membership, enhance an individual farmers productivity, expertise, and gains. Group models also have the potential to improve market access and income for smallholder farmers by enabling them to pool resources and knowledge. Farmer Producer Organizations (FPOs), Self-Help Groups (SHGs), and Agro Service Centres (ASCs), Farmer Field School are four key institutions that have emerged in the intervention area to support farmers and promote rural development. These institutions play a critical role in empowering farmers, especially women and marginalized communities, by providing them with access to finance, technology, and markets.

They have helped scale up the tools and techniques and develop a new set of farmer trainers and resource persons. By working together, farmers negotiated better prices for their produce and improved their access to larger markets. This also provided opportunities for farmers to learn from one another and adopt new technologies and practices.

### b. Contest in local elections

As women became members of institutions such as SHG and FPO, and gained access to other government institutions such as KVK and agricultural universities, they were able to understand their critical contribution in

agriculture and household work, as well as the importance of change they could bring about in order to achieve sustainable growth. This empowered them to create their own identity at home, and motivated them to move forward. A number of women farmers were recognised in the process, and their established credibility helped develop their leadership role in the community.

On such woman farmer, Shanti Devi, is a classic example of empowerment. She not only improved her financial state, but also helped improve the situation of the other 30 women in her community by involving them in value addition and marketing of products. She acts as a master trainer in her community, encouraging people to adopt climate-resilient farming techniques that can reduce agricultural input costs and boost income. She now holds the title of master trainer and her success and popularity prompted her to fight local elections and emerge as a member of the panchayat.

### d. Self esteem

As women got access to tools and technology that reduce their physical workload and manual labour, drudgery is less prevalent. The time and energy saved, is redirected to improve their skills and capacities, as well as engage in other income-generating activities. They are involved in social functions, participate in active decision making, become members of institutions and gain access to other government institutions. All these actions have given them more self-esteem, and greater participative power. They are aware, confident and self-assured as a result of their empowerment.

## 5. Time

### a. Reduction in workload

For a woman farmer, agricultural work tends to increase their time burden and workload, and have unintended negative consequences on their and their family's health and nutrition. In the intervention region, this drudgery has been reduced manifold due to the adoption of technology. Weeding and hoeing tools, groundnut de-husking tools, turmeric steam boilers, root vegetable washing tools, soil diggers, compost filtering tools, etc. helped in a significant reduction of work load and improved time savings.

### b. Leisure time

The burden of agricultural chores typically pushes a woman farmer to respond at the expense of her leisure and sleep, making her



and consequently her children more vulnerable. These technologies adopted by women have resulted in better time management. Devices like the groundnut de husker, turmeric steam boiler, and compost filter tool, weeding and hoeing tool not only saved time but has also helped improve their productivity and work efficiency, reduce drudgery, and free up women's availability to engage in alternative income-generating opportunities. Moreover, they utilize this saved time for themselves, their family, children, friends, and social commitments.

## 5. Human attributes

### a. Health & Nutrition

The use of technology in the intervention area has also resulted in a shift in women's health status. For example, the manual filter machine used by women had various flaws. It is labour-intensive, time-consuming, as well as cuts the skin and creates blisters on the

hand. The switch from manual to motorised filter machines has been beneficial. It can be operated by a single person, cuts workload, reduces the workload of women farmers and eliminates their health-related vulnerabilities.

### b. Skill and knowledge ( working as trainer/ facilitator)

Tools, technologies, and platforms like SHG and FFS have significantly improved farmer knowledge and skills compared to traditional farming practices. These tools provide farmers with access to up-to-date information on weather patterns, crop management, and soil health, allowing them to make informed decisions about their crops and increase their yields. Many farmers have adopted technologies and are serving as master trainers in their village, encouraging community members to use climate-resilient farming practices (*Matka Khad*, vermi compost, nadep compost) to minimise agricultural input costs and enhance income.



# 9

## Case Study



**A diamond cutter shines in agriculture**

Ramjeet, 41, of Loharpurwa village in Campianganj block in Gorakhpur district, was the sole breadwinner at a young age due to poverty and family responsibilities. He left for Gujarat in 1996, when he was 17 years old. After months of roaming, he began working for a private diamond cutting company in Surat, Gujarat, for Rs 400 per day. Initially, he had to work 12 hours a day to earn money and support his wife and two young children, who lived in the village. When his circumstances improved, he decided to settle there. But his hopes were shattered when the pandemic struck, and he struggled for 46 days to return home amid the nationwide lockdown.

***"When Prime Minister Shri Narendra Modi declared Janta curfew on March 22, 2020, I had no idea that the lives of daily wage labourers like us would become dark due to this pandemic,"***

**Ramjeet said.**

He went on to say that, ***"despite the company owner's assurances that the company would reopen after March 22, due to the escalating breakout of the virus, a nationwide lockdown was declared on March 24, 2020, creating a livelihood problem for wage labourers."***

During the 36-hour train journey from Surat to Gorakhpur, Ramjeet was worried about the uncertainty of the future. Sharing his feelings with us, Ramjeet said, ***"I was worried and was not sure of what I would do now or when I would return to Surat to continue my job. I realised that I had no other option but to do farming in the village."***

He further added, ***"God is kind, when he closes a path; he opens many other others. I decided that I should practice farming to sustain his family."***

He holds 2.20 acres of land as ancestral property, but one acre of it is inundated every year owing to waterlogging. Only 1.2 acres of land are suitable for farming all year. His family traditionally grows sugarcane and paddy for the family's dietary needs. When he returned home, he learned about the resilient farming techniques used by Smt. Nirmala Devi, a model farmer. After observing Smt. Nirmala Devi's farming and income, Ramjeet decided to plant vegetables on a 0.45 acre field using multi-layered farming techniques and organic manure. He had never grown vegetables before, but soon planted vegetables like ivy gourd (*Kundru*) and colocasia root (*Arvi*) in his field as per Smt. Nirmala Devi's advice.

In comparison to other vegetables, both these plants are disease-resistant. As a result, it does not necessitate the use of pesticides or chemical fertilisers. Furthermore, cultivating crops in conjunction with a multi-layered farming technique has lowered input costs. Ramjeet has learned a lot in the last few months while discussing the cost-benefits of vegetable cultivation. He stated that ***"if both crops were grown in different fields, more land would be required, and the cost of farming would rise. Currently, the multi-layered farming technique costs only Rs.12000, whereas cultivating both vegetables independently would cost Rs.15000"***.

From his 0.45-acre land, his earnings from the combined production of the two vegetables have totalled Rs. 8,000. He anticipates that these crops will bring in a lumpsum of about Rs. 40,000. It is also crucial to note that he has removed colocasia roots from the field and placed ivy gourds on machan, an elevated platform made of bamboo, so the constant rain has no impact on his produce. Ramjeet is overjoyed with his decision; he says, ***"I will not leave farming now and will cultivate the vegetables on my lower land as well, with technical assistance from GEAG."***





### Earthen pitcher bio-insect repellent: An eco-friendly boon for SHG

Since 2018, core support projects of the DST (Seed Division) operated under the Gol in collaboration with the GEAG have supported the women farmers of Rakukhor to form the "Jai Maa Lakshmi Self Help Group". The SHG has provided a platform for them to establish themselves as social entrepreneurs and promote them as a model to encourage other farmers.

Chhohari Devi, a member, says-

*"Women of the group hold regular group meetings to discuss group transactions, loan savings, as well as other project activities. They deliberate on the adverse effects of fertilisers and pesticides which make people sick and deteriorate soil health."*

These women farmers received many types of training on manure preparation, such as Nadep, Vermiwash, Vermi compost, CPP, etc. Since this entire region is dedicated to growing vegetables, the women also learned how to make insect repellent in order to protect their crops and vegetables from pests. The insect repellent called the "Earthen Pitcher Bio-Insect Repellent" (*Matka Khad*), intended for all types of insects was prepared by the members of Jai Maa Laxmi Group, with technical support from GEAG staff.

Considering the benefits provided by *matka khad*, it is in huge demand by community members. The president of the group, Shanti Devi, says-

*"We decided to convert this "demand" into an opportunity." We were already in the process of producing different insect repellents on a small scale, but now looking at the huge demand for matka khad, the group decided to produce it collectively on a large scale."*

Another member, Meena Devi, shares,

*"When we decided to prepare biopest repellent, simultaneously we divided the responsibilities of each member. I and Meena have taken up the task of collecting cow urine, while Shanti and Chohadi collect leaves such as Bhang, Dhatur, Madar, and cane leave."*

She elaborates, further, *"Cow urine costs us Rs. 4-5 per litre, as all of us didn't own a cow, we decided to buy cow urine and garlic. Once the biopesticide is ready, we can sell it after the deduction of input costs, with equal profit shared among the members"*. Due to the mass production of bio insect repellents, a large market was also needed for this. For this they contacted GEAG staff who advised, *"If this medicine is packed in a bottle with information written on it, it will be more and effective easier to sell. Also, once the price has been set in print, no one will ask to lower it."*

The GEAG team assisted in the repellent's production and promotion. The women packaged the finished product, in the form of 200 bottles of 400-ml each. Information, dosage, precautions, and costs are all marked on the bottle. According to Chohari Devi, *"The price of insect repellent is calculated in such a way that our costs and wages are paid and the remaining money is used for SHG."*

The bio-insect repellent was made available at all six cluster-level agri-service facilities, allowing farmers in villages to purchase and utilize it as well. The Jai Maa Lakshmi self-help group has now produced 100 litres of bio-insect repellent and has recently partnered with a local farmer-producer company, "Surabhi" for product marketing. As a result of the technical information obtained from the DST project, not only were crops and vegetables safeguarded, but women also established themselves as savvy entrepreneurs.





**Women friendly weeding wheel**

Premsheela was exhausted, and with no aid on the farm, the physically taxing farm labour in the form of weeding was exacerbating her problems. But the weeding had to be done quickly, or her crops would be swamped and destroyed by the weeds. She wished she did not have to spend hours on her heels, pulling out tenacious clumps of grass!

Her story is similar to that of many women farmers in this region. Holding onto their small piece of land and farming it successfully is becoming a greater challenge for them, day by day. Farming equipment available is built and designed for large farms and is generally heavy and cumbersome for a woman to hold and run. And many of the men here have migrated to the cities and towns to look for a stable livelihood. Thus, running the farm here usually falls on a woman's frail shoulders. More importantly, with limited incomes, paying for labour to work with borrowed or rented machinery eats into their profits and keeps them dependent on an unreliable factor.

These small patches of land make it even more difficult to run under such trying circumstances. Tired and weary, she reached her land, and she saw Manju in the adjoining field, walking merrily

across her field, pushing a wheeled contraption in front of her. Excitedly, Manju waved her over and showed off her new tool. It was a wheel hoe with a handle like a cycle for pushing. It had cutting blades attached to the sides, and Manju proudly demonstrated how these allowed weeding while walking.

**"No need to bend and twist your back to weed anymore",** she gurgled.

Premsheela looked in amazement. She recalled Manju talking earlier about going to meet the GEAG team, who are implementing the Core Support programme supported by the SEED division, Department of Science and Technology, New Delhi. Understanding the issues concerning the women farmers, this women-friendly weeding and hoeing tool had been developed by the team officials. Cheap, convenient, and easy to wield, it is a labour-saving device made with ergonomics specific to women in mind. Made with locally available resources, it consists of a bicycle wheel with an iron frame handle.

At the bottom of this frame, three V-shaped (bent inside) blades are attached with nut bolts. These blades are adjustable and can be replaced as per need or the distance between the two ridges in a lined-sown crop. Apart from this, another blade to dig up potatoes can also be attached. Cutting and uprooting weeds in the field is easily possible through a push-and-pull type action with this tool.

Premsheela took a go at this new implement; it was so easy to use, just as simple as pushing a bicycle wheel ahead of her. The effort required was also so much less, and it was so very efficient! She seemed to be whizzing across her fields, pulling out the weeds with a precision and effort not imaginable before. At this rate, her work would be done much, much quicker. Women like Premlata and Manju play a critical role in producing food for their families and their livelihoods. And when life is made a little easier for them, courtesy the DST (Seed Division) Core Support Programmes, who with their acute interest have crafted this women-friendly tool, they and their fields are both all smiles. And this wheel weeder sure brightens their smiles a little bit more.





## Institutions (FPO, SHG, ASC and FFS): A stepping stone for women empowerment

In the intervention area, women are increasingly in charge of community-based agricultural institutions. Farmers gather each month at Farmer Field Schools to discuss issues relating to agriculture, horticulture and animal husbandry, and specialists are invited to offer environmentally appropriate solutions. Agro Service Centres, which are rooted in the community and sell and rent ecological inputs like bio-manure, bio-fertilizers, and agricultural equipment, are also included. Women also work as Master Trainers to deliver trainings on

eco-friendly agriculture. Women's improved earnings and leadership roles in the programme have helped boost their confidence. And their new found confidence shines, thanks to the knowledge and skills shared here. As Shanti Devi, a trainee shares,

*“When planting, we used to simply broadcast gram seed on the soil. Now we sow it in a line. It was a simple change, but the yield improved. And now, my husband has started listening to me.”*

The effort to empower women has yielded positive results far beyond the fields and into their homes and communities. Indeed, there is anecdotal evidence that these positive changes, in turn, are encouraging the next generation of young women, the daughters, to put off early marriage and pursue higher education. Also, women in leadership roles in climate-smart agriculture seems to be reducing the incidence of domestic violence.

*“There is about a 25% change in the attitudes (of men) towards women. And the women are more fearless now,”*

**Pankaj Yadav**  
Head of Janakpur village.

Sangeeta, a resident of Pachgawa village in the Jungle Kaudia block, is such a role model. She enrolled in the value addition and marketing program for turmeric and compost manure. The application of mechanics in value addition reduced her workload and she utilised the time saved to learn tailoring and stitching. She thus gradually increased her income by starting this second business. Further, she achieved her aim of sending her girls to the desired school through her determination, and is now able to pay the education expenses for both of her daughters on her own.







### Bringing digital technology to farmers door step

Flooding and waterlogging have rendered thousands of small and marginal farmers in eastern Uttar Pradesh and northern Bihar landless and homeless. A major portion of the farming community has been forced to rely on subsidies, relief, and compensation. Heavy rainfall, intermittent dry spells, drought followed by floods, insect attacks, and increasing crop diseases have been prominent in the region as a result of climate change.

Thus, it is critical to reach out to a broad number of affected farmers with farm-related advice and practical solutions while comprehending climate uncertainties and their influence on agriculture. However, in flood-prone areas, reaching out to farmers via traditional means becomes difficult. As a result, digital technology becomes the primary mode of communication.

Most farmers in the intervention villages now have mobile phones and can get agricultural advice via simple text or voice messages, even if they do not have internet access. As a result, farmers benefit from getting weather and climatic information via digital smartphone technology, allowing them to make an informed decision even in difficult situations. This will undoubtedly be critical in reducing associated

risks, expanding opportunities, improving the efficient use of limited resources, lowering costs, and increasing crop and livestock production and productivity.

*"I work on my farm every day to examine the crop growth and occurrences of pest attacks or crop losses due to erratic weather. I raise my queries via my smartphone to GEAG's professionals, who advise me within a few minutes", says Durgesh Kannaujia, Bhuidharpur village, Jangle Kaudia block of Gorakhpur district in Uttar Pradesh.*

Altogether, six such advisories in the interval of 5 days, are disseminated regularly every month directly to the farmers and to the DST field staff's mobiles, through the web-based platform as short text messages. Besides this, the DST field staff writes these advisories on a display board placed outside every agro-service centre so that farmers visiting the centre also stay informed.

Ramanivas, through the weather advisory, was informed that rainfall was expected during the last week of April and the first week of May. Being an innovative farmer, he took the information seriously and scheduled the sowing of peanuts for the first week of May in his 0.20 decimal land. His investment of Rs. 2,300 earned him an income of Rs. 4,300. He also reduced his input cost by 30 percent (through timely scheduling of irrigation and use of fertiliser) by following the crop advisories during the summer season of 2020.

*"Weather information helps us in effective decision-making in all our farm activities,"* agrees Ramniwas, of Rakhukhor village in Gorakhpur.

This paradigm shift towards digital technologies has enabled nearly 1200 small farmers to cultivate with higher precision, in the emerging weather shock environment.





## Case Study



### Climate-smart agriculture turns farmers resilient

Smt. Koila Devi, an elderly marginal farmer of a Rakhukhor village in Gorakhpur district of Uttar Pradesh, had given up hopes of earning a decent living from the produce of her agricultural land. Like many farmers in northeastern Uttar Pradesh and Bihar, floods and associated water logging for

more than three to four months affected her agricultural produce severely each year. Apart from this, the rising cost of seed, fertiliser, and pesticides reduced her income over the years. She had been scouting for alternative income options when help came in the form of GEAG under the support of the SEED Division, DST, Gol.

GEAG provided her with technical support on effective farm planning like gradient-based cropping systems, multi-layered farming with time and space management, appropriate crop combinations, raised bed low tunnel poly houses, and appropriate utilisation of weather advisory. Such support at the systemic level helped and empowered the 64-year-old farmer to cultivate 20 crops in a single year, thereby raising her annual income by 30 percent.

She harvested 220 kg of wheat on 266 sqm of land (82.52 quintals per hectare) using her homemade compost, biopesticides, and other technological methods. This is the highest yield among the farmers in Uttar Pradesh who received DBW 187 demonstration seeds. She has been able to lessen the market's reliance on agricultural inputs like seed, fertiliser, and pesticides thanks to these S&T based initiatives.

*Model women farmer Mrs. Koila Devi has received awards from national (ICAR) and international agencies (Earth Network) for her outstanding contribution to technology development (composting and adopting SWI technology) for the highest wheat productivity in Uttar Pradesh.*







Smt. Koila Devi is one of the several model farmers in flood-affected areas who empower communities through scalable technologies and transformation at the rural level, ensuring forward and backward linkages facilitated by GEAG. She has shown a new direction towards flood-resilient livelihoods and transformed flood risks into an opportunity for socio-economic gain.

Similarly, Harishchandra, a 58-year-old farmer from Pachgawa, also a marginal farmer who owns 1 acre of land, earlier followed chemical farming. After joining the DST project, he realised the adverse effects of high-cost pesticides and fertiliser-based farming on health and the environment. He then switched over to chemical-free farming and became interested in low-cost farming after attending farmer field schools. He prepared vermicompost, vermi wash, *matka khad*, green manure, neem cake, and oil; all of which reduced his reliance on the market by 40- 45%.

He raised 50 different varieties of crops and vegetables on one acre of land in a year adopting climate resilient techniques. For example, beans, fenugreek, peas, radish, coriander, wheat, mustard, potatoes, lady finger, bottle gourd, beetroot, bottle guard, ivy gourd, bitter gourd, etc. Additionally, he constructed polyhouses and greenhouses to grow vegetable

seedlings. He prepares them for early, seasonally appropriate planting and timely harvesting. Additionally, he sells it to the farmers in surrounding areas, helping them earn better too.

Harishchandra says,

***"Despite the unpredictable weather, I grow a variety of crops on an acre, so even if one crop fails, the yield from another crop ensures minimal losses. And so my family's necessities are met, as these techniques aid in mitigating losses brought on by climate-related losses".***

Today, other farmers are inspired to embrace climate-resilient farming after seeing Harishchandra's success. In addition to his own community, Harishchandra provides farming advice at farmer schools in adjacent villages. He serves as a specialist for the village farmers, sharing his knowledge and experience.





## Improved intercropping techniques, increase production

Chhatiya Devi, a 50-year-old woman farmer, owns an acre of property that provides a living for her five-member family. She used to practice intercropping farming, which was more profitable than monocrop cultivation, but there was a decline in the yield since last several years. She suspected that changing climatic conditions were affecting the crop.

At the same time, GEAG, under the core support project of DST, implemented climate-resilient farming interventions in the block. Chhatiya Devi became associated with the project and, on the advice of experts, made the following innovations in the intercropping pattern for potato and maize:

- ♦ She changed the potato sowing time. Potatoes are typically sown in October, but she sowed them after the 10<sup>th</sup> of November, followed by maize on the same day.
- ♦ Maize is typically sown directly. She, however, soaked the maize seeds in water for 12 hours first. After then, the sowing was completed, and the maize sprouted quickly.
- ♦ The distance between potato and maize is regulated at 18 inches, but she kept it at 22 inches so that both get adequate space to grow.

- ♦ This time, she added 10 kg of compost by combining 1 kilograms of CPP with manure before sowing.

Chhatiya Devi implemented the above innovations in her 0.30 acre farm and saw the following benefits:

- ♦ First and foremost, there was minimized irrigation for maize crop as there was sufficient moisture in the field.
- ♦ The potato crop was protected from frost and burning disease as maize was growing along with it, casting a shadow over it.
- ♦ There was a reduction in the cost of weeding, compost, and irrigation because by weeding one crop, the land became friable for the second crop as well. In the case of compost and irrigation, both crops benefited. Thus, at one cost, she collected the yield of two crops, due to which her income increased.
- ♦ Using the traditional approach, she would obtain 14 quintal potatoes, but after implementing these modifications, a 40-quintal potato crop was harvested.

Chhatiya Devi's use of intercropping techniques not only lowered her input costs but also increased profits. The success of Chhatiya Devi's intercropping technique motivated other farmers to adopt the technique. She suggests, *"It is necessary to promote this technique on a large scale so that, like me, other farmers may benefit from it."*







### The success story of a woman farmer

Smt. Shanti Devi, a resident of Pachgawa village in Jungle Kaudia, is a great example of women's empowerment since she not only improved her financial and family circumstances but also helped improve the status of other women in her community by including them in value addition and marketing of products.

She also serves as a master trainer in her village, encouraging residents to use climate-resilient farming practices (*Matka Khad*, vermi compost, and Nadeb compost) to minimise agricultural input costs and enhance income. This ability has earned her the title of master trainer and gained her social respect.

She acknowledges that the varied training and exposures she has had as a result of GEAG intervention, have helped her deliver these results. She earned her reputation in the area as a trainer, and as a result of her popularity and success, decided to participate in the local elections. Through her hard work and work

ethos, she was able to win a seat in the panchayat election.

*"I never imagined reaching the point where I am now. It is overwhelming to feel the community's love and respect for me. Their confidence in me inspires me to keep working hard to improve people's lives and bring about great social change".*











# 10

## Matrix: Developed Technologies Vs SDGs

All these initiatives are actionable techniques that work towards fulfilling the SDGs. The following matrix details the same, how each technique has the potential to strengthen SDGs, the universal

call to action to reduce poverty, inequality, protect the planet and ensure health, justice, and prosperity for all.

	<b>Goal 1: No Poverty</b> “End poverty in all its forms everywhere”
	<b>Goal 2: Zero Hunger</b> “End hunger, achieve food security and improved nutrition and promote sustainable agriculture”.
	<b>Goal 3: Good Health and Well-Being</b> “Ensure healthy lives and promote well-being for all at all ages”.
	<b>Goal 4: Quality Education</b> “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all”.
	<b>Goal 5: Gender Equality</b> “Achieve gender equality and empower all women and girls”.
	<b>Goal 6: Clean Water and Sanitation</b> “Ensure availability and sustainable management of water and sanitation for all”.
	<b>Goal 7: Affordable and Clean Energy</b> “Ensure availability and sustainable management of water and sanitation for all”.

<b>8</b> DECENT WORK AND ECONOMIC GROWTH 	<b>Goal 8: Jobs and Growth</b> “Promote sustained, inclusive and sustainable economic growth, full and productive employment”.
<b>9</b> INDUSTRY, INNOVATION AND INFRASTRUCTURE 	<b>Goal 9: Industry, Innovation, and Infrastructure</b> “Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation”.
<b>10</b> REDUCED INEQUALITIES 	<b>Goal 10: Reduced Inequality</b> “Reduce income inequality within and among countries”.
<b>11</b> SUSTAINABLE CITIES AND COMMUNITIES 	<b>Goal 11: Sustainable Cities and Communities</b> “Make cities and human settlements inclusive, safe, resilient, and sustainable”.
<b>12</b> RESPONSIBLE CONSUMPTION AND PRODUCTION 	<b>Goal 12: Responsible Consumption and Production</b> “Ensure sustainable consumption and production patterns”.
<b>13</b> CLIMATE ACTION 	<b>Goal 13: Climate Action</b> “Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy”
<b>14</b> LIFE BELOW WATER 	<b>Goal 14: Life Below Water</b> “Conserve and sustainably use the oceans, seas and marine resources for sustainable development”.
<b>15</b> LIFE ON LAND 	<b>Goal 15: Life on Land</b> “Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss”
<b>16</b> PEACE AND JUSTICE STRONG INSTITUTIONS 	<b>Goal 16: Peace, Justice, and Strong Institutions</b> “Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels”
<b>17</b> PARTNERSHIPS FOR THE GOALS 	<b>Goal 17: Partnership for the Goals</b> “Strengthen the means of implementation and revitalise the global partnership for sustainable development”



SDG Goals																		
S. No	Technologies	No Poverty	Zero Hunger	Good health & Well being	Quality Education	Gender Equality	Clean Water & Sanitation	Affordable & Clean energy	Decent work & Economic growth	Industry, Innovation & Infrastructure	Reduced inequalities	Sustainable Cities & communities	Responsible production & consumption	Climate Action	Life below water	Life on Land	Piece, Justice & strong Institutions	Partnership for the goals
1.	Multi-layered Farming	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
2.	Bio insect repellent	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
3.	Compost filter tool	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
4.	Improvised probable low tunnel poly house	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
5.	Weeding & Hoeing tool	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
6.	Water retention tank based on phytoid technology	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
7.	Value added fungicide based bio compost	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
8.	Low cost energy efficient zero energy cool chamber for perishable vegetables	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
9.	Turmeric steam boiler	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
10.	Threshold based loft farming	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
11.	Polythene mulching	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
12.	Digital weathr and agro advisory services	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
13.	Groundnut de husker	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
14.	Need of developed technologies and their role in socio-economic empowerment	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>

# 11

## Conclusion

Based on past experiences, it is essential to state that Eastern UP and North Bihar regions have significant potential for agro-based life. The development of locally relevant technologies is essential to reduce the effects of changing climatic circumstances on the agro-based livelihood systems of small landholder farmers. Collaboration with relevant government schemes and programmes aids in the mobilisation of resources that pave the way for resilient livelihoods. The connection with the research and knowledge centre enables farmers to gain access to resilient mechanisms for strengthening farm-based livelihoods. Local weather-based agro-advisories have been extremely beneficial in building the livelihood system. It is also critical to create platforms for farmer-farmer knowledge and exchange so that farmers can contribute to the development and dissemination of resilient practices.

For marginal and small farmers dealing with flood or water-logging challenge, established tools and technology are extremely profitable. Our trained farmers have become role models for others considering relocating to big cities for work. Science and technology aided underprivileged farmers, particularly women, in accessing relevant government programmes and social empowerment, as well as claiming their interests and rights. Some of the farmers are well-known for their efforts to inspire community farmers to adopt climate-resilient technologies and ideas.

Resilient farm system technologies helped farmers enhance net gain (34%), reduce losses with time and space management, and integrate bio-inputs. The farm system linkages with improved ecosystem services helped reduce input costs (38%), crop losses, bio-input, and

needed value addition, helping farmers (especially women farmers) develop business models for off-farm gains. Improved and energy-smart post-harvest technologies established a better market and reduced perishability. Flood-resistant, multi-layered farming is more profitable since farmers can harvest two or more crops in a single field at the same time. As a result, each combination generates more profit, ranging from 115%-147% from the same piece of land. Both crops' needs are met by the same irrigation, manure, weeding, and hoeing. On average, this reduces input costs by 33%, boosting the profit margin.

Overall, small-marginal farmers, particularly women farmers, were capacitated and empowered, allowing them to earn a better living through access to government programmes and knowledge institutes. They have created their identity as women farmers and trainers, and gained respect in the region.

In the flood-affected areas of Gorakhpur (UP) and West Champaran (Bihar), scientific innovations and interventions in agriculture have shown a paradigm shift in the overall approach to farming, especially by small, marginal, and women farmers. Resilient farming techniques and technologies have resulted in reducing farm losses and decreasing input costs, thereby enhancing overall gains in farming. The benefit has not only been monetary, but also social, in that it has empowered farmers and given them a sense of identity through numerous platforms. It has also enhanced an overall interest and continued inclination towards farming in small-marginal farming communities.



# 12

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Gorakhpur Environmental Action Group (GEAG) is a voluntary organization working in the field of environment and sustainable development since 1975. Ever since its inception, GEAG has been actively engaged in implementing several development projects addressing livelihood issues of small and marginal farmers, particularly women, based on ecological principles and gender sensitive participatory approach. Besides this, GEAG has accomplished several appraisals, studies, researches at the micro and macro levels as well as successfully conducted a number of capacity building programmes for various stakeholders including women farmers, civil societies groups and government officials etc.

GEAG has established its identity in North India as a leading resource institution on sustainable agriculture, participatory approaches, methodologies and gender. Acknowledging its achievements, GEAG was awarded with the Lighthouse Activity Award by UNFCCC in 2013. GEAG also holds the Observer status to Green



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