



Efforts that Brought Happiness



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Abstract

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is implementing a project supported by Sir Dorabji Tata Trust (SDTT) for the last ten years in the states of Madhya Pradesh and Rajasthan and a project supported by Sir Ratan Tata Trust (SRTT) in four districts of Madhya Pradesh and Jharkhand for improving livelihoods of small and marginal farmers through sustainable management of natural resources. ICRISAT has adopted consortium approach in partnership with Non-Governmental Organizations (NGOs), State Agricultural Universities (SAUs) and Government line departments in the respective states. The project interventions have piloted science-led farmer-centric integrated watershed management for enhancing natural resource use efficiency for crop production. Based on the various interventions for improved management of land, water and crops, the consortium team identified the success stories from different districts covering various activities such as balanced nutrient management, farmer participatory selection of improved varieties, enhancing water-use efficiency, using improved landform treatments, minimizing rainy season fallows, income-generating activities like goat rearing, vermicomposting and improved livestock breed rearing including vegetable farming which can be shared with other areas for benefiting the farmers. This compendium of success stories is based on the detailed interviews with the farmers, collecting required information through targeted visits and interacting with the community in the districts, their capacity enhancement and the continuity of the technology. The analysis is based on factual data from the users and other views.

The success stories clearly revealed that crop productivity significantly improved with improved management and also resulted in increased family incomes through use of intensification of the systems with balanced nutrient management, water management, improved seeds of high-yielding short-duration cultivars and crop diversification; microenterprises benefiting women, self-help groups and individuals also enhanced the family incomes and empowered women in the project areas. This compendium comprises many success stories from districts of Madhya Pradesh, Rajasthan and Jharkhand.

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Efforts that Brought Happiness

Stories of change from the people

Learning through

Case Study

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Introduction

To aid reading and understanding, the case studies are in three parts. This section introduces the case studies and shows their range.

Section One: Technology promoted and adopted

1. Enhancing productivity by balanced nutrient management and improved variety

This case study describes what led to the adoption of nutrient management by many farmers, their capacity enhancement and the continuity of the technology. The analysis is based on factual data from the users and on their views.

2. Enhancing productivity through water-use efficiency and improved seeds

Leguminous crops require water at defined intervals so that nitrogen fixing is accomplished. This can only happen with moisture available in the soil. The broad-bed and furrow (BBF) was designed so that when a field is irrigated, water moves through the furrow and is retained as moisture, which can be taken up by the plant as required.

3. Micronutrient deficiency in Indian soils

How to apply any nutrient? What is “balanced nutrient application”? This study answers these questions for farmers in the village.

4. Enhancing productivity of soybean by addressing nutrient deficiency and with better management

Better nutrient management is still not being practiced or widely known by farmers. Obtaining a good production, but with unknown supporting factors, farmers feel that their farming practice is perfect. In reality it is not true. Bumper production is not an indicator of success in sustainable agriculture. The concept of productivity enhancement is closely linked with better nutrient management especially micronutrients. This case explains the outcome of three treatments for the same variety.

5. Leveraging technology for productivity enhancement

Seeing is believing. This case describes how one farmer demonstrated a technology and shared his success with his relatives and friends from other villages to become the “change” agent. The study looks at pigeonpea variety ICPL 871119 (Asha) with BBF and intercropping.

6. BBF saved my crops in heavy rains: The story of an innovative farmer

The BBF is a technology that conserves soil moisture and drains excess water from the field. Farmers feel that if they adopt this technology they have to lose some land and so get less production. But they were proved wrong when it was practically done in farmers’ fields. Actually water-use efficiency increases and helps in better use of land. Farmers who have adopted BBF technology benefit compared to other farmers. In Ukawad village, Mr Devendra Sharma adopted BBF technology and got the best production in heavy rains out of the entire cluster of more than 20 villages. He says, “I made it only because of BBF.”

7. Convergence approach helps in scaling-up best bets

This is the story of a village which proved that with proper knowledge and better links then change is possible, even in a remote location.

Section Two: Crop varieties promoted

8. A step toward productivity enhancement

To understand how different farmers in different locations respond to the same issues and approaches, this case study looks at building awareness of balanced nutrition to enhance soil capacity for better production in another project location with a different farming community.

9. Variety that fulfilled farmers' demand

This case study talks about the adoption of groundnut variety ICGB 91114, released by ICRISAT/ICAR and how a relationship was built up with the community. The Jat and Meena communities are known for their hard work and for adopting advanced agricultural practices. Groundnut is one of the major crops of the *kharif* season in this village. The traditional variety gives a good return if the rains are good and last long. If the monsoon fails, then groundnut production goes down drastically. How the new variety addresses the problem is discussed here.

10. Variety brought change in the farming practices

This case study concerns balanced nutrient application based on soil testing applied on a new variety of maize. The work was done in a remote village of Rajasthan where such technology is usually a dream and farmers never get an opportunity to interact with scientists. How an essentially simple process can bring immense change to an area is elaborated.

11. Market forced farmers to adopt new varieties

This is an interesting story about a remote village where a short-duration crop variety and an integrated package changed the cropping pattern.

Section Three: Livestock, vegetable farming, vermicomposting

12. Improved goat breeding program in Bundi watershed area of Rajasthan

Social and economic inclusion is the main theme of this case study. The project is mainly focused on agricultural productivity enhancement but when the project team learned that some landless farmers were not covered a decision was taken to work on their priorities. These families were completely dependent for their survival on local (*deshi*) goats. Most of these have slow physical growth but are locally adapted. The main objective was to improve the *deshi* breed with a Sirohi buck and change the livelihood of the herd dependent community. The Sirohi breed has a much faster weight gain than the *deshi*.

13. Small support made vegetable farming profitable

This is the story of a farmer who wanted to scale-up the returns from his field and was supported once he showed his commitment by taking water from a very small but perennial water source close to his farm. He was cultivating vegetables for home consumption. He was sure that he would go for organic

vegetables rather than applying chemicals. He got support from the “Foundation for Ecological Security” project and proved himself by producing quality vegetables and making a profit. He told us that his primary objective was to have good vegetables for own consumption, and to earn money was secondary. He could achieve both successfully.

14. Worms changed thinking of tribal farmers

How proper follow-up made the four-pit model of vermicompost a successful intervention is the base of this case study. The concept of vermicompost had been introduced to Jhabua by various agencies but was not widely adopted by the tribal farmers. The only reason was lack of follow-up at field level after introducing the methodology. Construction of the pits and time taken for filling them and applying the compost in the field are the most commonly cited difficulties for farmers in adopting the technology.

About the Tata-ICRISAT Project

To address the problems of poverty, malnutrition and low agricultural productivity in parts of Madhya Pradesh and Rajasthan, Sir Dorabji Tata Trust (SDTT) has taken proactive action by supporting ICRISAT to implement an innovative pilot project to develop and validate science-led farmer-centric community watershed approach for combating land degradation and increasing productivity in Madhya Pradesh and eastern Rajasthan since 2002. This project enabled validation of the new consortium approach as well as developed scaling-out methods for enhancing productivity and minimizing land degradation in the nucleus and satellite watersheds in the selected three districts of the target agro-ecoregion. The agro-ecological approach and strategy to develop benchmark nucleus watersheds as representative sites of learning in three pilot districts enabled scaling-out from seven to 60 villages. During the last year of the pilot project scaling-out strategy through initiating activities in additional nine districts of Madhya Pradesh and Rajasthan demonstrated the feasibility of scaling-out at the ecoregional level. Following the encouraging results from the benchmark locations during 2002–06, the SDTT supported ICRISAT to undertake scaling-up the benefits through empowering the community by sharing the knowledge and training which enabled the stakeholders to choose the improved options to manage the natural resources for increasing the productivity as well as rural incomes from the rainfed areas while minimizing land degradation.

The target ecoregion for this project is the dryland areas of Madhya Pradesh and eastern Rajasthan with assured rainfall, with medium water-holding capacity soils. The districts covered for scaling-out activities for productivity enhancement are Rajgarh, Shajapur, Sehore, Raisen, Vidisha, Indore, Badwani, Dewas and Guna in Madhya Pradesh and Alwar, Banswara, Bhilwara, Bundi, Jhalawar, Sawai Madhopur and Tonk in Rajasthan. The overall goal of the proposed initiative is to improve the livelihoods of rural people in the target agro-ecoregion through sustainable management of natural resources by adopting the science-led, holistic, community watershed management approach.

During 2011, the consortium team identified the success stories from different districts covering various activities such as balanced nutrient management, farmer participatory selection of improved varieties, enhancing water-use efficiency, using improving landform treatments, minimizing rainy season fallows, income-generating activities like goat rearing, vermicomposting and improved livestock breed rearing including vegetable farming stories which can be shared with other areas for benefiting the farmers. This compendium of success stories is based on the detailed interview with the farmers, collecting required information through targeted visits and interacting with the community in the districts. The SDTT-ICRISAT-ICAR project has resulted into a number of exemplar interventions which have contributed significantly to increase in the agricultural productivity and incomes while minimizing land degradation in the target ecoregions. This compendium of success stories shares the success of the SDTT-ICRISAT-ICAR project on “Improving Rural Livelihoods and Minimizing Land Degradation through the Community Watershed Approach for Sustainable Development of Dryland Areas” from 15 districts of Madhya Pradesh and Rajasthan.

Enhancing productivity by balanced nutrient management and improved variety

Location: Kariaya, District: Sagar, State: Madhya Pradesh

1. Introduction

A good healthy crop puts a smile on the faces of a farming community and leads to food security for the season and a happy life. But a lot of effort is required to get assured production and a lot has to be done at ground level with a really needy farming community. Most farmers do not adopt the correct techniques and practices to get good production. There is a knowledge gap and poor delivery of services.

Farmers manage crop nutrients generally by applying urea and diammonium phosphate (DAP) only. This shows their poor understanding of the concept of balanced nutrient management. The Tata/ICRISAT project addresses this issue and the results are highly visible at the grassroots. BAYPASS is the implementing partner in this cluster of villages with ICRISAT.

Another important point which requires immediate action is 'use of quality seed'. Typically the seed farmers use every cropping season gradually becomes impure. Awareness of the value of pure, healthy clean seed needs rebuilding. Crop diversification is another big issue, given the limited range of crops grown by the farmers.

2. Why is this case documented?

This case study describes what led to the adoption of soil test based Balanced Nutrient Management (BNM) by many farmers, their capacity enhancement and the continuity of the technology. The analysis is based on factual data from the users and on their views.



3. The settlement

Karaiya village is located in the well-known Bundelkhand region of Madhya Pradesh which has low rainfall since last 5 years (300 to 500 mm yr⁻¹) and recurring droughts. The village is situated about 20 km away from Sagar district and block headquarters and is well connected by road. It is a middle-sized village of 2100 people representing all sections of society. Of a total 742 ha in the village, agricultural land covers 537 ha and is both upland and lowland.

The landholding is small with an average of only 1.3 ha per household. The soil is mostly black cotton soil. Some pockets have a mix of black cotton soil with moorum. In the upland, soil depth varies from 1.5 to 6 ft, followed by a layer of moorum (*kopra*). In the lowland, soil depth is up to 12 ft, followed by moorum. The underlying rock stratum is basalt from 8 ft up to 40 ft. Groundwater level in open wells ranges from 25 to 40 ft and in tube wells it ranges from 30 to 250 ft. There is good opportunity for using efficient water management with a pumping system. Agriculture is the central livelihood of the families who have land and of those who work on the land as agricultural labor. These two groups account for about 80% of the total households.

Most cropping in the village is rainfed. Only 140 ha agriculture land is under irrigation. If the rains are good then irrigated area may increase depending on water availability in wells and tube wells. There is no perennial river near the village. The main crops are soybean, chickpea, wheat and onion. The farmers are industrious. In spite of water scarcity they are trying hard to get the maximum output from agriculture.

4. Why balanced nutrition?

Soil in this area is of poor quality with low nutrient reserves. The land has been over-used with almost nil supplementation of nutrients. Erratic rainfall causes poor soil moisture availability during crucial periods of crop growth. Nutrient and micronutrient deficiencies, low organic matter, poor moisture availability and erratic rainfall, all damage soil health, increase nutrient imbalance and lead to low yields.

Soil nutrient disproportion is certainly a big challenge for sustainable agriculture in this region. To address this crucial issue the concept of BNM was introduced by the Project. A yield gap analysis was carried out for the major crops. This measured existing yields in the farmers' fields and compared them with what should be achievable with correct management.

5. Conducting representative soil analysis

Nutrient analysis is an important first step to improve the soil health. To understand the basic soil structure and its health, soil testing was conducted for this region and this village. Thirty-five soil samples were collected in summer 2008, and sent to ICRISAT for analysis. The steps followed for sample collection and use of soil analysis report are as follows:

- Adoption of stratified soil sampling technique;
- One-day orientation-cum-training organized for farmers;
- Why and how to carry out soil analysis was explained;
- Soil health cards were distributed to the farmers and findings discussed with them.

Defining deficiency

- The soil analysis report showed most farmland to be deficient in boron, zinc and sulfur.
- Phosphorus and carbon are present in low to medium range.
- Potassium is in the high range in some plots.

The findings

Soil health information	Normal	Observed
Soil pH (1:2)	6.5–8.5	7.5–7.7
Electrical conductivity (dS m ⁻¹)	<0.8	0.19–0.41
Major nutrients		
Organic carbon (%)	0.5–0.75	0.60–0.83
Available phosphorus (mg kg ⁻¹)		3.6–5.4
Available potassium (mg kg ⁻¹)	50–125	270–281
Secondary nutrients		
Available sulfur (mg kg ⁻¹)		6.6–9
Micronutrients		
Available zinc (mg kg ⁻¹)	0.75	0.55–0.8
Available boron (mg kg ⁻¹)	0.58	0.34–0.4

6. The farmer practice

- Cultivation is common without soil testing. Soil fertility and crop productivity decline due to continued uptake of nutrients from soil.
- Farmers mostly apply only the major nutrients NPK but not as per recommendation for each crop.
- Farmers apply pesticides and herbicides to various crops but without understanding their use or proper application.
- Excessive use of chemical fertilizers with declining use of organic fertilizers.
- Monotonous cropping pattern.
- Inappropriate irrigation practices result in soil and nutrient loss.
- Use of grain as seed.
- A higher seed rate than necessary through broadcast sowing.

7. Defining Balanced Nutrient Management (BNM)

Besides hydrogen, oxygen and carbon, plants require 13 elements for proper growth and development:

Major nutrients	Secondary nutrients	Micronutrients
<ul style="list-style-type: none">• Nitrogen (N)• Phosphorus (P)• Potassium (K)	<ul style="list-style-type: none">• Calcium (Ca)• Magnesium (Mg)• Sulfur (S)	<ul style="list-style-type: none">• Zinc (Zn)• Boron (B)• Iron (Fe)• Copper (Cu)• Molybdenum (Mo)• Chlorine (Cl)• Manganese (Mn)

Increased use of chemical fertilizers as source of major nutrients, combined with the declining use of organic sources of nutrients over time has led to deficiency of micronutrients in the soil, resulting in decreasing soil fertility and productivity. Nutrients such as B, Fe, Mn, Cu, Zn, Mo and S are as important to plant growth as N, P and K. When these micronutrients are not available to the plant in required quantities, growth of the plant gets affected.

Intake of only a very little quantity of micronutrient plays a significant role in plant growth, nutrition and production. Fulfilment of both the major and micronutrient requirements of a crop is called Balanced Nutrient Management (BNM).

8. The process of BNM demonstration

As a first step, villages were identified and demonstrations were conducted in Shobhapur and four other villages of Sagar district. Based on the soil analysis report, brain storming sessions were conducted in these villages. Field trials on balanced use of nutrients, improved variety (IV) and water-use efficiency were conducted from the *kharif* and *rabi* seasons of 2008.

The second step was Community to Community exposure visits organized from village Karaiya to village Shobhapur where trials were conducted under the Tata/ICRISAT initiative for agricultural productivity enhancement. After village meetings, and seeing the confidence shown by the farmers of Karaiya village, interventions in Shobhapur were initiated from *kharif* 2009.

Season	Crop	Type of trial	Number of trials	Major observations
Kharif (2009)	Soybean	Balanced nutrient + IV (JS 9305)	10	• Maximum yield up to 2.6 t ha ⁻¹ . More yield as compared to control.
	Pigeonpea	ICPL 871119 intercropping with soybean	5	• Introduction of new variety. Better yield with quality grains.
Rabi (2009)	Wheat Chickpea	Only residual effect of micronutrients was observed		• 10–16% increase in yield.
Kharif (2010)	Soybean	Balanced nutrient + IV (JS 9752)	35	• 14 to 22% more yield as compared to control. Maximum yield up to 2.2 t ha ⁻¹ observed in just 50% rain condition; it would be more under normal rainfall.
	Pigeonpea	ICPL 871119 Intercropping with soybean	10	• Best results: yield 130 to 180 times per kg seed sown. Local (<i>desi</i>) variety destroyed in frost.
Rabi (2010)	Wheat	Balanced nutrient + IV (HI 1531)	7	• Less water required for irrigation. Better plant strength, and more no. of tillers and no. of grains/ear in treatment plot.
	Chickpea	Balanced nutrient + IV (JG 11)	24	• Less water required for irrigation. Better plant strength, and more no. of branches and pods/plant in treatment plot.

As a third step, focus group discussions were organized in June 2009 on how to enhance agricultural productivity with less water.

As a fourth step, fertilizers containing the micronutrients Zn, B and S (zinc sulfate, agribor and gypsum) were introduced for the first time in this region by the project. For soybean, the farmers of the area use 50 kg DAP and 50 kg single super phosphate for a 1-ha plot.

The fifth step was to use a balanced seed rate of 75 kg ha⁻¹ for soybean to allow the plants to grow properly.

Crop	2009			2010		
	Improved variety	Micronutrient	Other inputs ¹	Improved variety	Micronutrient	Other inputs
Soybean	JS 9305	Agribor, zinc sulfate and gypsum	Seed treatment using <i>Rhizobium</i> and PSB culture	JS 9752	Agribor, zinc sulfate and gypsum	Seed treatment using <i>Rhizobium</i> and PSB culture
Pigeonpea	ICPL 871119			ICPL 871119		
Chickpea	Residual effect of micronutrients			JG 11		Seed treatment using <i>Trichoderma</i>
Wheat	Residual effect of micronutrients			HI 1531		Seed treatment using Thiram

1. PSB = Phosphate solubilizing bacteria

9. Results

Kharif 2010

In Karaiya village, soybean variety JS 9752 was introduced in different locations. There were 35 trials (23 Satellite and 12 Scale-up). In spite of 50% less rainfall than the normal, the variety performed well. The Satellite plot yields were as follows:

Soybean	Treatment plot (JS 9752 + Balanced nutrient)	Control plot (JS 9752 + Farmer practice)
Grain yield (t ha ⁻¹)	1.76–2.22	1.28–1.8
No. of nodules plant ⁻¹	30–60	25–48
Plant height	80–110	65–98
No. of pods plant ⁻¹	70–150	52–135
No of branches plant ⁻¹	16–22	14–20

Farmers' perception about soybean varieties

- The average annual rainfall for this region is 1000 mm. In 2010 the rainfall in the area was just about 50% of average rainfall and the variety JS 9752 gave highest production of 2.22 t ha⁻¹ in balanced nutrition plot whereas, the same variety gave highest production of 1.8 t ha⁻¹ with farmers' practice. In congenial conditions JS 9752 gives maximum production of 2.8 t ha⁻¹.
- The seed quality (grain weight, color, luster) of JS 9752 is very good compared to the traditional or local variety. Market rates of JS 9752 were also higher (₹ 50–100) than local varieties.
- Now the farmers have seeds of both varieties: JS 9305 (early variety, ie, 90–95 days) and JS 9752 (mid late variety, ie, 98–102 days). Both the varieties showed better performance in local conditions.
- Earlier farmers were using JS 335 and JS 7546, but during last few years fertility was declining and also pest attack was more in these varieties.
- In *kharif* 2009 the yield of soybean JS 9305 recorded was up to 2.6 t ha⁻¹.

Promotion of crop diversification: pigeonpea

Variety ICPL 871119, introduced by the project, gives good production compared to the local cultivar. Generally production is more than 120 times the total quantity of seed sown which is very high compared to the local cultivar. The farmers' traditional variety gives the same yield but takes 60 to 75 days more to mature than ICPL 871119. This new variety has larger grain which fetches ₹ 1000–1500 more per ton in the market than the local cultivar. During frost there is also less damage to ICPL 871119.

Farmers' perception about chickpea variety

- Village farmers have been using a local chickpea variety named "Khajjiya". The area is severely affected by wilt disease (*Ugra*). *Ugra* is much less common in JG 11 than in the farmers' varieties.
- The introduced variety has bigger grain with an attractive pink color, and fetches a good price in Sagar market. Also the plant growth, branching and podding are better.
- Aberrant weather, frost and low moisture availability in the *rabi* season, both occurred in 2010–11 resulting in low production of the chickpea crop, but JG 11 still performed better than the local varieties.

Chickpea (<i>Rabi</i> 2010–11)	Treatment plot (JG 11 + Balanced nutrient)	Control plot (JG 11 + Farmer practice)
No. of nodules plant ⁻¹	16–25	14–21
Plant height	45–56	40–51
No. of pods plant ⁻¹	60–80	54–66
No. of branches plant ⁻¹	14–20	12–17

Farmers' perception about wheat variety

- Wheat variety HI 1531 was introduced in *rabi* 2010. Farmers currently sow Lok One and C 306 varieties.
- Plant growth and strength were good in HI 1531 and production and grain quality were definitely better.

Wheat	Treatment Plot (HI 1531 + Balanced nutrient)	Control Plot (HI 1531 + Farmer practice)
No. of tillers plant ⁻¹	14–18	11–15
Plant height	79–95	75–86
No. of grains earhead ⁻¹	38–56	32–45

10. Capacity building of community

- Capacity building of the farming community is a core feature of the program. Knowledge sharing was through interactive group discussion and field visits with farmers.
- Farmers' day is a platform to disseminate knowledge to larger farmer groups, with beneficiary farmers, scientists and resource persons all exchanging ideas and views and experiences.
- Before every season, group discussions with farmers helped in planning seed varieties, nutrient requirements and the techniques to be applied.
- Hands-on training gave major benefit to the farmers.
- The focus of the discussions in *kharif* and *rabi* season largely remained on soil health/micronutrients and pest management.
- Seed treatment techniques were explained to farmers during the session. As the crops of the region are regularly affected by a fungal disease known locally as *Ugra*, cultivators were motivated to use *Trichoderma* for seed treatment.
- A lead farmer from the village, Bharat Yadav, visited ICRISAT for three days training and exposure; now he has become a resource person for the Project and he himself motivates the farmers through sharing the information he has gained.

Main points of the discussions

- Micronutrient application
- Seed selection
- Water-use efficiency
- Observations of farmers while using any new input
- Exploring possibility for enhancing productivity through various interventions

11. Farmers' observation about micronutrient application

Germination was 10 to 15% better in improved variety.

- Soil texture is improving. It strengthens the root system of the plant.
- Seed treatment resulting in decrease in impact of *Ugra* as compared to control plots in chickpea and soybean.
- The number of branches or tillers, and number of pods or earheads per plant are more in treatment plot resulting in better yield. Also crop in treatment plot took 4 to 5 days more for drying during harvesting stage.
- The grain size, weight and color is better in improved variety and treatment plot as compared to control in all crops (soybean, pigeonpea, chickpea, wheat).

Recommended package of practice

- Seed quantity for soybean and chickpea is 75–80 kg ha⁻¹ and for wheat it is 100 kg ha⁻¹.
- The nutrient recommendation for 1 ha plot is as follows:

Gypsum	200 kg ha ⁻¹
Agribor	2.5 kg ha ⁻¹
Zinc	25 kg ha ⁻¹
Urea	50 kg ha ⁻¹
DAP/Super phosphate	100 kg ha ⁻¹
Seed treatment	Thiram, <i>Rhizobium</i> , PSB, <i>Trichoderma</i>

12. Popularizing improved crop varieties

- Farmers' Day in Karaiya village was organized on 12th January 2011 with the participation of 155 farmers. The issues discussed on the occasion were: the concept of the Tata-ICRISAT intervention, soil health, application of micronutrients, challenges in agriculture development, management of the farmyard manure (FYM) and livestock and need of farmers' organization.
- The Day gave an opportunity for village farmers to communicate with ICRISAT scientists, and with the Krishi Vigyan Kendra (KVK), Sagar, which in future will help the farmers.
- This platform for interface with the scientist community extended to an interface with the Agricultural and Veterinary Departments and the staff told farmers about their schemes and motivated farmers to work with them.

13. Links and sustainability

- Improved varieties, balanced nutrition, application of technology and group formation for knowledge-driven cropping practices are the four pillars of the Tata/ICRISAT project. The vision is an overall improvement in quality of living by enhancing productivity and livelihoods.
- Many farmers can now distinguish between grain and seed. Through the project, institutional links have developed between KVK, Department of Agriculture, Veterinary Department and farmers. This has made available new extension services for the villages and helped with the timely availability of improved varieties.
- Village seed banks have been established which will ensure farmers maintain, and can easily access, quality seeds.
- Now farmers really appreciate micronutrient application from what they have been told and from their own learning through action research trials of the marked difference it makes to germination, plant vigor and health, plant growth, podding, productivity and quality. Though micronutrients are available locally through the Agriculture Department, they are being applied for the first time in the region. Of course, the results are observed by other farmers, hence more and more cultivators are seeking information about balanced nutrition.

- Through project intervention, a group of progressive farmers came forward and organized themselves as a “Farmers Club”. Having realized the benefits of balanced nutrition through practical demonstrations, they now want to translate this technical knowhow into practical gains. To meet the rising demand for micronutrients, it is planned to put together a collective order through their Farmers Club, and other clubs, to the producer company. This will also reduce costs.
- They are also planning to develop their collective bargaining power for the purchase and sale of seed, grain, nutrient, etc. They are also conceptualizing a proposal for water conservation/storage structures in the village and are willing to contribute towards such a move.
- Three farmers of the village have applied for a drip irrigation system for vegetable cultivation, which they will receive from the Agriculture Department in the summer season.

14. Learning from project activities in the village

Nutrient related

- Balanced nutrition and improved variety increase farmers’ yield by 20 to 40%.
- There is about 15 to 30% increase in production the following season due to the residual effect of the micronutrient.
- Micronutrient application costs about ₹ 1,500 ha⁻¹ whereas farmers can get a benefit of ₹ 5000 ha⁻¹ or more. The profitability may be greater in other crops.
- Micronutrient application yielded qualitative and quantitative improvement in vegetable production too.

Seed related

- Popularization of pigeonpea variety ICPL 871119 in the area cushioned farmers from adverse climatic conditions.
- Through variety change and promotion of intercropping, the problem of declining fertility is addressed to some extent.
- The project demonstrated more yield from the same area by applying a balanced seed rate.

Information and capacity building

- The project creates a common platform for information sharing among farmers in a village.
- The farmers of the village are now thinking about organizational and institutional links to converge information and resources.
- Learning has been disseminated, farmer to farmer, in the neighboring cluster of villages.

15. What farmers are saying

1. We never applied zinc sulfate, Agribor and gypsum in our fields, but the project facilitated us to practically observe the effects of micronutrient application. Now we are confident to use these techniques in future – **Bharat Yadav**
2. The onion in my plot itself is showing the effect of micronutrient application. When I grew the same seed in the plot having micronutrients, I got 35% more production in micronutrient plots with improved quality – **Sanjay Rajoriya**
3. Due to *Ugra*, since last few years I stopped growing the chickpea crop in my plot and I just used to sow wheat. Now I sow JG 11 with seed treatment with *Trichoderma* and micronutrient application; my chickpea is best in the village. Even before harvesting, other farmers from village are approaching me to book some quantity as seed for next year – **Kashiram Rathore**
4. For the first time we have got this kind of agriculture extension services in the village and we have done this kind of demonstration with constant follow-up and organized the farmers' day in the village to discuss about agriculture. It is really good learning for us – **Shyam Sunder**



Shri Bharat Yadav, Karaiya



Shri Sanjay Rajoriya, Karaiya



Shri Kashiram Rathore, Karaiya



Shri Shyam Sunder, Karaiya

16. Status of produce in market

- In the market, the price of produce differs only on quality of grain.
- In 2009, the soybean JS 9305 produced by project farmers was sold at ₹ 22000–23000 per ton as compared to JS 335 or JS 7546 at ₹ 19000–22000 per ton. In 2010 due to moisture stress the grain size was not up to the mark and the soybean rate went down. But JS 9305 and JS 9752 sold at ₹ 20000–21000 per ton as compared to local variety at ₹ 19000–20000 per ton.
- In 2009–10 the pigeonpea ICPL 871119 was sold in Sagar at ₹ 42600 per ton as compared to local red pigeonpea at ₹ 32000 per ton and Desi pigeonpea at ₹ 36000 per ton. In 2010–11 the local variety crop almost failed due to frost and the traders of Sagar are demanding ICPL 871119 at ₹ 45000 per ton.
- The new chickpea varieties do not sell any more for a higher price. The varieties ICCV 37 and JG 11 have been sold at ₹ 20000–23000 per ton. The local chickpea also is sold at the same rate.

17. Economic benefit to farmers

- Earlier micronutrient application on 1 ha had cost the farmer an additional cost of ₹ 1500. Practical experience in the project area proved that through micronutrient application the yield increases by 0.4 to 0.5 t ha⁻¹. For soybean the additional gain will be ₹ 8000 to 10000. For chickpea also the additional gain will be ₹ 8000 to 10000. This more than meets the additional cost.
- The residual effect of micronutrients in the next season increases productivity by 15 to 25%, earning the farmer additional ₹ 4500 to 6000 without additional input cost.
- In using the improved variety, the farmer has additional cost of ₹ 1000 to 1500 for seed. But the yield will be enhanced by at least 10 to 15%. In soybean, chickpea or wheat the farmer can gain additional income of ₹ 2500 to 3000.
- In the recommended package of practices by the project, the quantity of seeds sown has been reduced in soybean, chickpea by 20 kg ha⁻¹ and in wheat by 30 kg ha⁻¹. This reduces the input cost by about ₹ 500 ha⁻¹.
- The chickpea varieties JG 11 and ICCV 37 introduced by the project have a lower water requirement (1–2 irrigations) than the local variety (3–5 irrigations). This saves the monetary and labor costs of irrigation. The wheat variety HI 1531 requires just two irrigations as compared to the local variety which requires two to four. A reduced input cost is also an economic gain for the farmer.

Enhancing productivity through water-use efficiency and improved seeds

Location: Shobhapur, District: Sagar, State: Madhya Pradesh

1. Introduction

Where rainfall is consistently good, farmers have few concerns. But where rainfall is erratic, then how best to manage it becomes important. There is world-wide concern to improve water-use efficiency (WUE). The solution lies in the proper application of technology and its adoption on a big scale. There are some really effective methods of water management which help in the optimum utilization of ground and surface water.

Flood irrigation is a common practice which uses much water and energy and increases the cost of production. The broad-bed and furrow (BBF) is a method of landform that helps in proper water management. It was introduced mainly for soil moisture conservation during dry spells and to avoid waterlogging during heavy rainfall, especially on Vertisols. It can be used on all soils but more benefits are evident when applied on Vertisols with less infiltration rate which cause waterlogging. BYPASS is the implementing partner in this cluster of villages with ICRISAT.

2. Why is this case documented?

Leguminous crops require water at defined intervals so that nitrogen fixing is accomplished. This can only happen with moisture available in the soil. The BBF was designed so that when a field is irrigated, water moves through the furrow and is retained as moisture which can be taken up by the plant as required.

This Case Study discusses the outcome of this technology introduced in *kharif* and *rabi* crops in project villages. The happy faces of the farmers show that it made an impact.



3. The settlement

Shobhapur, where agriculture is the main source of livelihood for most households, is a small village in Sagar district. The story of the village and its problems is more or less similar to other Bundelkhand villages: low rainfall, recurring droughts and low production. The village is located about 28 km from Sagar District headquarters, 2 km from Jasinagar Block headquarters. It is well connected by road. The Panchayat headquarter is Agariya village.

Population	515
Total area	329 ha
Agriculture land	171 ha
Forest land	128 ha
Irrigation	57 ha
Average landholding	1.5 ha

The village has shallow soil. On the upper slopes, the soil is 1.5 to 3.0 ft deep and underlain by moorum (*kopra*). In low-lying areas, the soil depth is up to 4.5 ft, again with moorum underneath. A basalt stratum underlies the soil at 8 ft up to 40 ft.

Rainfed agriculture is mainly practiced in the village. If the rains are good, ie, more than the normal, the irrigated area may increase depending on water availability in the wells and tube wells. There is no perennial river near the village. The main crops are soybean, chickpea, wheat and maize.

4. Need of the area

The farmers of the area face the problem of low agricultural yield. This affects their socioeconomic well-being. Moisture stress is the biggest challenge. To address this crucial issue, the concept of water-use efficiency was introduced by the project. The BBF system was demonstrated to the farmers who were filled with awe.

Village farmers have tended to keep one part of the land fallow due to moisture stress. Depending on the rainfall and the crop, and the soil condition of a particular field, a farmer will decide to keep the land fallow either in the rainy season (*kharif*) or the postrainy season (*rabi*).

5. How was the issue addressed?

Following regular visits and debates with the local farmers, the team saw a need to introduce technologies to address water issues for assured crop production.

The main concern of the farmer was lack of knowledge of how to cultivate in the region with limited and erratic rains. A second concern was the need for soil to hold water for longer time; without this they are forced to keep land fallow. Thirdly, some parts of the village with less productive soil do not hold water for long.

It was clearly not possible to introduce one technology which would address all these issues, so the team decided to promote mixed technology. Thus the particular issues of each zone would be properly addressed and farmers' participation ensured. It was planned that the introduced techniques should be adopted on a large scale.

Groundwater – The area is situated in a basaltic zone. Groundwater availability is a major challenge. Tube well is not successful. Water level in open wells starts at 40 ft deep and ends at 60 ft. In summer, most wells dry up.

Surface water – Seasonal streams are there but not able to recharge surface water for long. Earlier no water body to store and conserve surface water but due to “Bundelkhand package”, tanks are constructed in forest area. But situation is not very good.

Soil – Soil in the village is shallow to medium and underlain by hard moorum. Soils have major nutrient deficiencies.

Land – Lands in the village are of moderate slope and due to lack of soil-water conservation work topsoil erosion is at its peak in every rainy season.

The following steps were taken:

- Promotion of varieties requiring less water
- Promotion of intercropping to minimize the risk of crop failure
- BBF technique for efficient management of rain water
- Motivation of farmers for adoption of improved technologies

6. BBF demonstration

As a first step, Shobhapur village was identified as a nucleus village and all demonstrations were conducted in this village. In June 2008, a group discussion with the farmers was organized in Shobhapur. To improve water-use efficiency, the BBF technique was explained to farmers. For participatory research-cum-demonstration, two pairs of furrow openers were provided. From *Kharif* 2008, 12 farmers of the village demonstrated BBF in their soybean crop. They also used the BBF technique for soybean + pigeonpea intercropping system. The demonstrations covered ten hectares. In the *rabi* season, the farmers also used the BBF system for chickpea. They found BBF very effective in both soybean + pigeonpea and chickpea cultivation.

For the rainy season, improved varieties of soybean and pigeonpea had already been introduced. The effect of BBF with these varieties was observed in participatory trials.

The second step was an exposure visit at ICRISAT, Patancheru, for two farmers of Shobhapur. This was their first exposure to improved and innovative agriculture technologies. They learned about productivity enhancement initiatives as well as soil water conservation and soil enrichment techniques. After returning from ICRISAT, they shared their learning with the other farmers of the village.

With the BBF technique, farmers are advised to sow 30 to 35 kg of seed per acre to get good soybean establishment.

What is BBF

- Relatively raised flat bed about 0.9 to 1.2 m broad
- Shallow furrow 0.15 m deep and 0.45 m wide

Recommended agro-ecology for BBF

- Soils – Medium to deep black soils (Vertisols)
- Rainfall – 700–1500 mm
- Slope – 5% maximum

Benefits of BBF

- Soil and moisture conservation
- Good surface drainage prevents waterlogging
- Better aeration in seed bed and root zone
- Reduces runoff and soil loss; improves soil properties over the years
- Width of bed can be adjusted as per spacing of the crop
- Furrow provides trafficking zone for all inter-culture operations which saves time, energy and money

Trials with BBF technique

Season	Year	Crop	Variety	Other inputs
Rainy season (<i>Kharif</i>)	2008	Soybean	JS 9305	Seed treatment using <i>Rhizobium</i> and PSB (phosphate solubilizing bacteria) culture
		Pigeonpea	ICPL 871119	
	2009	Soybean	JS 9305	
		Pigeonpea	ICPL 871119	
2010	Soybean	JS 9752, JS 9305		
	Pigeonpea	ICPL 871119		
Postrainy season (<i>Rabi</i>)	2008	Chickpea	JAKI 9218	Seed treatment using <i>Trichoderma</i> and Thiram
	2009	Chickpea	ICCV 37	
	2010	Wheat	HI 1531	

The results of BBF system observed by farmers are:

- Runoff water absorbed in field itself by providing more opportunity time for infiltration.
- Alleviating waterlogging through safe removal of excess water in a guided manner.
- Reduced soil loss and runoff loss.
- Better growth of plants due to better exposure to air and sunlight.
- Softness in seed bed preserves moisture for a long time.
- Trafficking zone provides easier observation and field operations.

7. Results

Variety in Treatment plot	Yield in BBF plot with IV	Yield in non-BBF with local variety
<i>Kharif 2008</i>		
JS 9305	1.825 t ha ⁻¹ (Avg.)	1.530 t ha ⁻¹ (Avg.)
<i>Rabi 2008</i>		
JAKI 9218	1.493 t ha ⁻¹ (Avg.)	1.143 t ha ⁻¹ (Avg.)
<i>Kharif 2009</i>		
Soybean	BBF plot (JS 9305)	Non-BBF plot
Average yield (t ha ⁻¹)	1.92	1.62
Plant population/m ²	36 to 48	38 to 50
No. of nodules/plant	18 to 32	12 to 24
Plant height (cm)	55 to 63	48 to 56
Branching/pant	12 to 22	11 to 19
<i>Rabi 2009</i>		
Chickpea	Yield in BBF plot ¹	Yield in non-BBF plot ¹
ICCV 37	14.92 (Avg.)	11.53 (Avg.)
Lok-1	17.4 (Avg.)	14.4 (Avg.)

1. Yield in t ha⁻¹.

8. Performance of pigeonpea with BBF system

Particulars	ICPL 871119 with BBF	Local variety (Red pigeonpea)	Local variety (<i>Desi</i>)
2008–09			
Yield (t kg ⁻¹ seed sown)	12.5	9	7
Market rate (₹ per t)	35000	3250	3000
2009–10			
Yield (t kg ⁻¹ seed sown)	14	8.5	7.5
Market rate (₹ per t)	42600	35000	32000
2010–11			
Yield (t kg ⁻¹ seed sown)	11 (20% damage due to frost)	7 (50% damage due to frost)	More than 80% crop damage due to frost
Market rate (₹ per t)	45000	37000	34000

9. Farmers' perception and adoption

Farmers' perception about chickpea and soybean varieties

- The local chickpea variety used by farmers needs 2 to 4 irrigations but the varieties promoted by the project (ICCV 37, JAKI 9218) have less water requirement (1 or 2 irrigations), and are very conducive in moisture stress condition.
- The soybean variety JS 9305 was not popular in the area earlier. Most of the farmers were using JS 335 but JS 9305 gives better results and quality of grain is also good.

Farmers' perception about pigeonpea

- Pigeonpea is the best option for our area having slope and shallow soil with less moisture.
- The pigeonpea variety ICPL 871119 promoted through the project gave best yield with best quality grain as compared to local variety. The market value of this variety is also more.
- In the coming year *Desi* pigeonpea will be replaced by ICPL 871119 in the whole village.

Farmers' perception about intercropping

- "Soybean and pigeonpea intercropping proved the best option for our area. We have got better results these last three years, and we get two crop seasons."

Farmers' perception about BBF

- "Through BBF system in farm the rain water is absorbed rapidly as compared to non-BBF farm. With more moisture, the growth of plants was better in the BBF farm."
- "Through BBF system less seed is required, so we get more yields with less input."

Popularization of techniques

- The BBF system initiated on ten ha in 2008–09, has now reached 40 ha in 2010–11.
- Agriculture Department, Sagar officials visited Shobhapur village to see the pigeonpea sowing on the BBF system.



- Eight farmers of the village purchased a sprinkler system for efficient use of water and ten more have applied to the Agriculture Department and will get them this year.

Fallow management through BBF/intercropping

- Before the project intervention in 2008, about 20 ha of the village was under single cropping and for a second crop farmers were solely dependent on winter rains otherwise the land was kept unsown.
- In 2010, in 15 ha of such land intercropping of soybean and pigeonpea was done with BBF.

10. Links and sustainability

With the project focusing on the dryland areas, where soils are not just hungry but thirsty too, the BBF technique of bed preparation was popularized over two years. Seeing the benefits of better plant growth and rain water conservation or efficient irrigation, many non-participant farmers came forward to adopt the system on their farms. Since most farms are rainfed, BBF coverage will probably increase in future. We have planned to ensure a substantial number of furrow openers in the area by promoting local implement manufacturers to produce it and by training farmers in their proper use during plowing and seeding. Project farmers have been motivated to purchase an improved seed drill with furrow openers, through which the BBF preparation will become easier.

The benefits of improved varieties in different crops have been successfully demonstrated to the participating farmers and through them, using the platform of a Farmers' Day, to the wider agrarian community of the contiguous region. Also farmers have been shown how to distinguish between grain and seed, and so help with the availability and conservation of quality seeds. Through the project, institutional links have been established with the KVK, Department of Agriculture, and Veterinary Department and with farmers of other villages. Various extension services are now available and obtaining new improved varieties is timelier.

Sustaining the present initiative largely depends upon the regular feeding of relevant and useful information and knowledge to the farmer community. For the purpose, Farmers' Clubs are being promoted. These

will be the focal point for communications and will pass information and learning by peer communication. Later on, these clubs will also work towards collective action for purchasing inputs and selling produce.

11. Learning from the project activities in village

Seed related

- Popularization of ICPL 871119 variety in the area cushioned farmers from adverse climatic conditions.
- Short-duration varieties (soybean and pigeonpea) are very suitable for Shobhapur village with its water scarcity.

Technique related

- The BBF technique is good for water conservation. It just takes time and effort, no financial input is required.
- The BBF system reduces the risk of crop failure due to inadequate rains or excess rain during a storm.
- Farmers also learned that dense sowing is not the correct way to get more yield, plant strength is more important.

12. What farmers are saying

“In first year the BBF technique was new for us, we just took it as burden but in last 3 years we got better yields in adverse climatic conditions, which practically proved the applicability of BBF. Also the pigeonpea ICPL 871119 got popularized and next season it will spread out from our village to ten nearby villages. Traders from Sagar are coming to Shobhapur and demanding the pigeonpea at ₹ 45000 per t.”

Shri Mahendra Yadav, Shobhapur



“After returning from the Kothapally watershed visit, I did water recharging by constructing a recharge pit and in the rains my well got more water. This helps me in the *rabi* season. Now I have also got a sprinkler system, so less water is required for irrigation. I intercropped soybean and pigeonpea with the BBF system. Now we are also motivating other farmers to conserve water.”

Shri Bhadai Shobhapur

“We saw that with BBF the runoff water in the plot was less after the rains and the soil got softened. Due to this the plant growth and yield was improved in soybean and chickpea.”





Shri Ram Sharan, Shobhapur

“We never differentiated between seed and food grain. This is the first time we got improved variety and got better results.”

Ram Sharan (36 years old) is one of many farmers of Shobhapur village in Sagar district, who were pursuing low yield/high risk cultivation. Though he did take two crops, the second crop was largely dependent on *Mawtha* (the returning monsoon rains) which have a skewed distribution, and are highly erratic and unreliable. He has one well on the farm which holds water only till December. This, in-effect, means absence of irrigation during vital phases of plant growth and seed development. Average yield during *rabi* is 1 to 1.2 t ha⁻¹ During training-cum-exposure visit to ICRISAT in 2008–09, he, along with other farmers of different project villages, visited Kothapally watershed. There he took a keen interest in understanding work related to well recharging, and learnt various aspects of well-recharging techniques. After returning he discussed his intention of replicating same, on the well at his farm with the BYPASS team. After careful assessment of the field conditions, technical support was extended to him by the team. Shri Ram Sharan executed the entire work of well recharging through his own resources. His efforts yielded a positive result in the very next monsoon. Today (April 2010) his well holds 4 ft of water, after irrigating 3 ha of agricultural land. He got 20% increase in yield.

Addressing micronutrient deficiency by better management

Location: Dhamred, District: Alwar, State: Rajasthan

1. Introduction

Indian farmers used to depend on organic manure for crop production. They never applied chemical fertilizers so their soil was healthier than at present. The Green Revolution changed the entire agriculture scenario in the country and now Indian agriculture totally depends on chemical fertilizers. With the change in production practices, the animal herd shrunk and thus organic manure is not available to meet the demands of crop production.

Rajasthan soils are deficient in the major nutrients and in micronutrients like boron, sulfur and zinc. Agriculture Department officials were concerned about the adoption of micronutrient application by farmers. Twelve years ago the Department of Agriculture tried, but due to various reasons it did not succeed or could not reach the level planned originally. A repeat initiative now by the Tata-ICRISAT-BAIF productivity-enhancement team has been successful with farmers increasingly adopting micronutrients and balanced nutrition in their soil.

BAIF is working in a village cluster for the past few years with the main focus earlier on livestock activities. With this project the approach has changed and the team started discussing broader agricultural issues with the farmers.



Several farmers of the village Dhamred shared their views about the changes which have taken place in the village in the last 15 years and how people responded. Here we discuss the adoption of micronutrients by the farmers and their impact on production. Some basic questions were: How to apply any nutrient? What is balanced nutrient application? In discussion with farmers it was clear that they knew how to apply nutrients and how much is required.

2. Settlement in the village

Rajgarh area of Alwar district is known for its vegetable production. The village Dhamred and other project villages are 8 km from this town which is the market place for these villages. The District headquarters is 45 km from these villages. Agriculture is the mainstay of livelihoods. People also work as laboring and government jobs. The inhabitants of Dhamred are a mix of all categories. It is an old and big settlement compared to other villages of the cluster. Major crops of the area are maize, sorghum, pearl millet (*bajra*), sesame, cluster bean (*gwar*), green gram, black gram and vegetables in rainy season. Chickpea, wheat, mustard, barley and vegetables are mainly grown in post-rainy season.

3. Agriculture system in the watershed

Interestingly, while discussing with the villagers about the village and crops and how they farm, they told how seed sowing is not done using a seed drill. Most farmers broadcast the seeds after land preparation. They told how they experienced less production after line sowing most crops. This was confirmed by other farmers with their own data and logic. This raises the question: What can be done? Some research has to be done in these villages on priority basis.

Pawan Kumar Sharma, a big and progressive farmer, is well versed with the input supply requirements of the crops as per his soil condition. He explained exactly what has to be applied to the crops and when. This is a good indicator that farmers have started taking interest in improved farming practices. Here arises another big question: Does the approach start with big farmers or there should be a balance with a mixed farmers' group? This is a big debate and will continue. Sharma applies the following inputs to his field for maize and pearl millet:

- First dose of chemical fertilizers for one *beegha* (0.5 acre) of land: 15 kg DAP and 25 kg urea.
- First dose of micronutrients: Zinc 5 kg, gypsum 32 kg and boron 400 g.
- How to apply: Zinc is mixed with sand and then applied in the field. Boron is applied along with sand and broadcast before sowing maize.

Another observation that the farmer shared is that application of DAP alone reduces production if compost is not applied along with it. Soil testing is done in selective fields of the village.

Production analysis with micronutrients (MN) as shared by Pawan Kumar Sharma of Dhamred.

Particulars	Without MN	With MN
Maize crop on one <i>beegha</i> of land		
Production (t)	0.48	0.6
Color	White	Yellow
Zinc (kg)	No	5
Gypsum (kg)	No	33
Boron (g)	No	400
DAP (kg)	15	11
Urea (kg)	25	25
Benefit	Low production	Better production; shining grains
Market rate (₹ per t)	9500	10500
Gross return (₹)	4750	6300
Cost of MN	-	268
Net profit difference (₹)	-	1282
Wheat crop on one <i>beegha</i> of land		
Gypsum (kg)	No	5–10
Boron (g)	No	400
DAP (kg)	15 kg	20–25
Urea (kg)	30–35	50
Compost	Yes	No
Production (t)	1.4	1.6
Market rate (₹ per t)	11000	11000
Benefit (₹)	Low production	Better production; shining grains
Gross return (₹)	15400	17600
Cost of MN (₹)	-	230
Net profit difference (₹)	-	1970

4. Process of area collection and scale-up the activities

In 2007, ICRISAT decided to scale-up the activities of the nucleus watershed districts to other districts. Alwar district was chosen based on the work done by Rajasthan government on watershed development. After a field visit by a team of professionals from BAIF to various watersheds treated in the district, the villages Dhamred, Annawada and Dubby of Rajgarh block were chosen. The Tata-ICRISAT productivity enhancement project is under implementation in these villages.

A few progressive farmers were also selected in these villages. Participatory demonstrations were undertaken on their fields as part of project interventions. In that season farmers of the villages

experienced the outcome of the demonstrations and observed better production on the same land with better practices. Thirty farmers were selected in each village including Annavara and Dubby. A training program and Farmers' Day were effective tools used by the project team. This brought awareness about how to use micronutrients. Scale-up of micronutrient application started in vegetable crops also in the next season. Farmers who were not part of any demonstration got information to purchase micronutrients from the market.

Adoption took a long time but results are encouraging. Cost of inputs also plays a major role. As seen in this village, gypsum is more adopted by farmers for two reasons: easy availability and low cost. Hundreds of farmers are using gypsum in their fields. Zinc is applied by only 50–60 farmers and boron much less, only 8–9 farmers, even after getting better results from its application. This is due to inadequate availability at the local market. But now things are changing.

Knowledge level about micronutrient application

- Application of zinc every alternate year
- Application of boron is necessary.
- Application of gypsum after one year.

Seed rate

- Wheat 30 kg/*bigha*
- Maize 8–10 kg/*bigha*
- Sorghum 3–5 kg/*bigha*
- Sesame 250–500 g/*bigha*
- Mustard 1 kg/*bigha*
- Barley 25–30 kg/*bigha*
- Gwar 3 kg/*bigha*

Market

A market near the village is a good indicator for agriculture development in the area. People buy inputs from the market but for quality they totally depend on the shopkeeper. By making a visit to the local market one can get a sense of adoption of micronutrients by the farmers of nearby villages. Ram Khiladi Sarin of Prakash Sales Corporation, Rajgarh shared his experience. He said that earlier nobody was aware about micronutrients but last few years farmers are demanding micronutrients, mainly boron and gypsum. Farmers use these nutrients for vegetables mainly and food grain crops.

Steps adopted at field level to understand the process

- Random selection of villages under treated watershed area
- Soil sampling and testing in the selected villages
- Baseline survey
- Demonstration on technology of balanced nutrient management (BNM)
- Capacity building through training and focused group discussion (FGD)
- Dissemination of technology through farmers' day and exposure visit
- Sharing of findings among the farmers through FGD and farmers' day
- Residual study of BNM plots and sharing of findings

5. How the technology scaled-up and reached other villages

Firstly, three villages were selected under the project area and two villages were taken to scale-up in the second year of the project. The technology of micronutrient application is being gradually upscaled

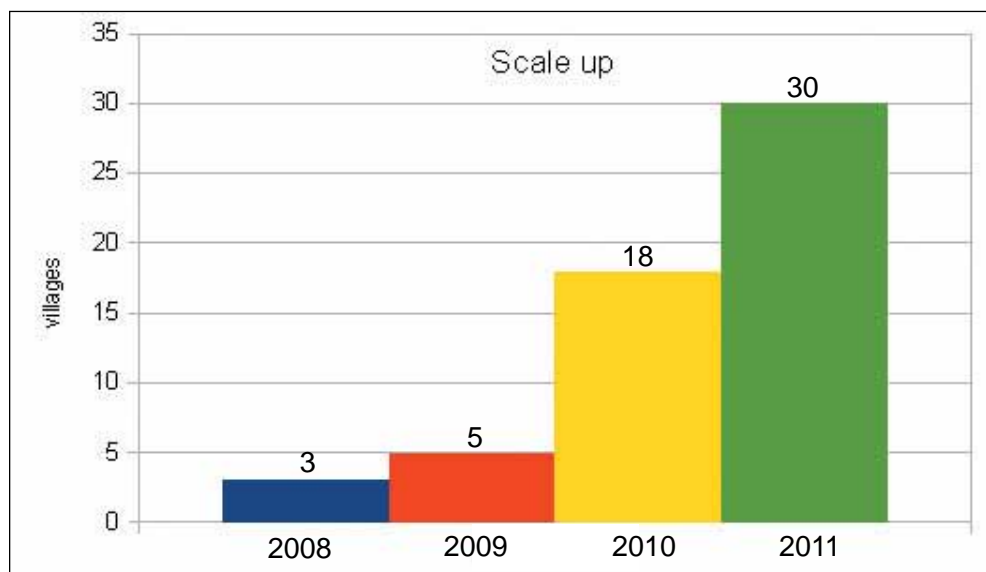
through networks of relatives, the initiative of local dealers of agri-inputs and the efforts of the BAIF team in the different projects. Presently 80% vegetable growers are using micronutrients in the cluster. The increasing trend of scaling-up is indicated in the graph.

6. Major issues of micronutrient application

- Poor awareness, which is common across the area, is the major issue to promote balanced application and adoption of micronutrients.
- Most farmers here try to take any additional risk in her/his production process. Therefore they just apply chemical fertilizer the way they were doing for years. The reason is lack of soil testing. Thus they do not know what is the deficiency and how to address it.
- There is no proper demonstration of improved technology in this area. Therefore there is a need for extension officials to conduct demonstrations on a large scale for cost-effectiveness and easy adoption by all categories of farmers.
- There is no follow-up mechanism to get feedback from farmers on their problems.

7. Scope and opportunity

- Farmers are progressive in nature in these villages.
- Local market is nearby.
- Better approach road is needed.
- Delhi is close to these villages. This can be considered as a big opportunity and strategic planning can be done.
- Micronutrients can be introduced with planned approach in these villages.
- The area is known for its vegetable production. Onion is the main vegetable grown by large number of farmers. Balanced use of micronutrients in vegetable production to enhance production and maintain soil health can be a good strategy for the farmers.
- An interface between the local shopkeepers and farmers is needed at a common place as a major and regular intervention at village or cluster level. A small working group may be formed to promote new technology in the area.



8. Learning

- After starting crop productivity work by BAIF and ICRISAT in the area, farmers are very keen about micronutrients like gypsum (sulfur) and zinc. Timely availability of these micronutrients is the major issue for the farmers.
- After initial training regular follow-up with the farmers and interactive discussion with them addresses their concerns and enhances adaptability.
- Working only with large farmers will not serve the purpose. There is a need to involve small and marginal farmers in these villages.
- Adoption of micronutrients on large scale needs strategic long-term planning.
- Economics of micronutrients is very crucial in its adoption.
- There is a need to define market role in the process.

9. Farmers' views



“Earlier, we were using 15 kg DAP and 25 kg urea in one *bigha* land and we were not aware of other fertilizers. About 12 years ago, the agriculture supervisor provided gypsum in my village but none of the farmers agreed to use gypsum in their fields. But when Mr Gohil contacted me and conducted demonstration, I was convinced and started applying micronutrients in my maize crop. One cannot believe, I got 0.15–0.2 t more yield compared to traditional practice.”

Pawan Kumar Sharma, Dhamred



“I have 11 *bigha* land and I grow maize, *bajra*, sorghum, sesame, *tur* (pigeonpea), black gram and mung in *kharif* and wheat and mustard in *rabi*. I use improved varieties of all crops. Every year I am using zinc and gypsum alternatively in my field.”

Ram Swaroop Meena, Dubby

“The first time when I used agribor in wheat crop, I saw that the color of the crop was very good and the grains were bright and then I have used micronutrients in vegetables crops. I got

better production compared to last year and also fruit drop control by using micronutrients. But I feel that after using zinc, irrigation demand has increased.”

Mohan Singh Chauhan, Dhamred

Enhancing the productivity of soybean by addressing nutrient deficiency and with better management

Location: Barkheda, District: Shajapur, State: Madhya Pradesh

1. Introduction

Malwa, the famous plateau of Madhya Pradesh, is known for its rich agriculture and good climate. The region is now famous for its soybean production. Madhya Pradesh is now known as the Soybean State. The Agar block of Shajapur district in Malwa was selected under the SDTT-ICRISAT-ICAR project by the Centre for Advanced Research and Development (CARD).

The main objective of the project is to minimize land degradation and increase productivity and income. This is done by Sustainable Crop Management and Farmer Participatory Research cum Demonstration (PR&D). Soybean now constitutes about 20% of total agricultural production. Sustainable crop management was initiated with soybean and wheat and other major crops of the area.

Better management of nutrients, both macro and micro, is a must for better production and maintaining soil health. This lesson was shared while doing action research. Farmers' had not learnt various crucial practices like soil health management and balanced application of fertilizers. Maintaining soil health by better farming system is fundamental to sustainable agriculture.

This region needs a short-duration soybean variety which gives good production so variety JS 9305 was introduced along with a package of practices. The outcomes of participatory research with technical backstopping were excellent. Discussion with farmers gives an idea that next year more farmers will go for this variety.



2. Concept of case documented

Better nutrient management is still not being practiced or widely known to farmers. Obtaining a good production, but with unknown supporting factors, farmers feel that their farming practice is perfect. In reality it is not true. Bumper production is not an indicator of success in sustainable agriculture. The concept of productivity enhancement is closely linked with better nutrient management especially micronutrients. This case explains the outcome of three treatments for the same variety.

3. The settlement

The ICRISAT project area is located between 23°50' – 23°54' North Latitude and 76°02' – 76°06' East Longitude. It lies in the north-western part of Agar block of Shajapur district of Madhya Pradesh. This region is situated approximately 60 km west of Shajapur town and 15 km to the north of Agar town. The reasons for selecting the area were its remoteness, lack of knowledge amongst farming community and their willingness to work with the agency. The project includes the agricultural land of five villages namely, Barod, Barkheda, Khanota, Mahudiya and Moyakheda villages.

The case discussed here is Village Barkheda, located in Barod block of Shajapur district. The Block headquarters is far from the village; thus villagers could not benefit from various government schemes. The area is connected by road from Agar and surrounding areas but is isolated, and the approach road is not good. This is a big constraint for development. Houses are close to one another. The cropping pattern is shifting from sugarcane to maize plus cotton, and now to soybean.

The annual average rainfall is 838.3 mm with most of it received in the monsoon season. About 90% of rainfall of the year is received in 38 average rainy days.

The soils are shallow to medium black and red soils, derived from Basalt, Shales, Dharwar and Alluvium rock formations. With a normal slope, soil depth ranges between 3 and 6 feet which increases up to few meters in the valley or plain. Soil texture varies; normally sandy loam with clay loam in depressions.

4. Define the problem

Undulating terrain, erratic rainfall, poor soil in some pockets, soil erosion, mostly in the rainy season, are common issues for this village. But the most crucial issues were: lack of proper knowledge related to agriculture, poor financial conditions and remoteness. All these factors made the village farmers vulnerable. The issues which this case tried to address were lack of proper knowledge about soil health management and selection of proper varieties based on the village climate.

Soil health management was the biggest issue identified in focused group discussions with the farmers. Their main concern was, due to poor quality of soil, they are looking for a variety which can give better results in low rainfall and poor soil, especially in undulating areas.

Soil status

This was basic for balanced nutrient management. Soil testing was done for this area. Few results are as follows:

- Soil pH is 7.7
- Soils were deficient in organic carbon (10%), available P (25%), available S (25%), available B (80%) and available Zn (40%)

5. Selection criteria for PR&D with farmers

The outcome of the project mainly depends on the committed involvement of the farmers, and on the process of implementation. This case study talks about Shri Ratanalal Sisodiya s/o Pooralalaji Sisodiya

of Barkheda village, who owns four hectares of land, of which two hectares are irrigated. He grows soybean and wheat as his major crops.

6. Conceptual framework of technology

Introduction of improved technology

In the agricultural productivity enhancement program, both *kharif* and *rabi* crops are included. In the *rabi* season technical inputs are tried out on wheat and gram crops in farmers' fields, and in the *kharif* season on soybean.

Training and capacity building

Without appropriate training and knowledge sharing it is difficult to exchange any technology. Thus farmers of the village were orientated on better crop production and their capacity was built by organizing various types of training on agriculture technology and better farm practice. In all, 49 training programs were arranged in different project villages and 846 farmers participated. Apart from this, there was "hand holding" support in the form of various demonstrations.

Soil testing

Twenty soil samples were collected from the project area for chemical analysis. The soil testing pointed the way towards the inputs needed for proper results. On the basis of soil requirement, different inputs are administered.

Nucleus trials

In this case study, a nucleus trial of soybean was conducted on farmers' fields. There were three treatments: (1) Control plot of Farmer practice, (2) T_1 plot with improved soybean variety JS 9305 + a balanced dose of nutrients; and (3) T_3 plot with improved soybean variety JS 9305 + 50% use of FYM + 50% use of balanced dose of nutrients. Of the three treatments T_3 treatment was the best.

Green manuring

Gliricidia seeds were procured from ICRISAT, Patancheru to produce green manure, fuel and fodder. It is also used as a rodenticide. The introduction of vermicompost and vermi-wash among the farmers also helped in soil fertility enhancement.

Quality inputs

In remote locations progressive farmers also face a problem of getting quality inputs on time. The project provided various inputs including quality seeds and micronutrients and ensured they were correctly applied.

Farmer selection criteria

- Progressive farmers with irrigation facility.
- Farmers willing to try out improved practices.
- Farmers recognized by the community.
- Farmers of all categories (marginal, small, medium and large).

Training program

- Technical training provided to 846 farmers.
- Planning exercise carried out in all 8 villages for *kharif* agriculture program.
- SHGs trained for management of Seed Bank.
- Exposure visit to ICRISAT with 5 lead farmers.

Why JS 9305?

- It is medium-duration variety and matures 10–15 days after JS 9560
- Production is better as compared to JS 9560
- Farmer is not aware about its production in the village

Calculating production

The production was estimated from 1.5 x 2.0 m plot size. Observations on growth parameters were recorded from time to time. All helped in understanding the impact of different inputs on productivity levels of different crops of the region.

Supportive activities

Exposure visits of five lead farmers to ICRISAT, Patancheru helped to introduce new agricultural technologies among the farmers of the region. This exposure visit was an eye opener for these farmers who earlier never saw such technologies in their life which can upgrade their farming practices.

Major issues with soybean

- Diseases like collar rot and yellow vein mosaic (YVM) of soybean is a major problem in this area
- Caterpillar and cut worm
- No or low rainfall 60–65 days after sowing (DAS) of crop
- No water conservation

Package of practice for nucleus trial

No.	Activities in farmers' fields	Control (per ha)	T1 (per ha)	T2 (per ha)
1	Preparation of the field	2 deep plowing, 1 harrowing and planking	2 deep plowing, 1 harrowing and planking	2 deep plowing, 1 harrowing and planking
2	Soil testing	Done	Done	Done
3	Variety and seed rate	JS 9305, 75 kg	JS 9305, 75 kg	JS 9305, 75 kg
4	Seed treatment	(1) Bavistin 2.5 g kg ⁻¹ seed (2) <i>Rhizobium virdi</i> 4 g kg ⁻¹ seed	(1) Bavistin 2.5 g kg ⁻¹ seed (2) <i>Rhizobium virdi</i> 4 g kg ⁻¹ seed	(1) Bavistin 2.5 g kg ⁻¹ seed (2) <i>Rhizobium virdi</i> 4 g kg ⁻¹ seed
5	Sowing method	By seed drill method	By seed drill method	By seed drill method
6	Manure and fertilizer	N=20 kg ha ⁻¹ and P ₂ O ₅ =60 kg ha ⁻¹	N=10 kg ha ⁻¹ , P ₂ O ₅ =30 kg ha ⁻¹ , Zn=5 kg ha ⁻¹ , S=15 kg ha ⁻¹ and B=0.5kg ha ⁻¹	FYM 1875 kg ha ⁻¹ , N=5 kg ha ⁻¹ , P ₂ O ₅ =15 kg ha ⁻¹ , Z _n =2.5 kg ha ⁻¹ , S=7.5 kg ha ⁻¹ and B=0.25 kg ha ⁻¹
7	Control of weeds	Control of weeds 15–20 days (Emazathaper 1 L ha ⁻¹)	Control of weeds 15–20 days (Emazathaper 1 L ha ⁻¹)	Control of weeds 15–20 days (Emazathaper 1 L ha ⁻¹)
8	Blue beetle, pod borer	(1) Spray of Neem Ark 2 ml/L of water (2) Endo Sulphan 35EC, 1.5 ml/L of water	(1) Spray of Neem Ark 2 ml/L of water (2) Endo Sulphan 35EC, 1.5 ml/L of water	(1) Spray of Neem Ark 2 ml/L of water (2) Endo Sulphan 35EC, 1.5 ml/L of water
	Girdle beetle	Trizophos 40 EC 1.5 ml/L of water	Trizophos 40 EC 1.5 ml/L of water	Trizophos 40 EC 1.5 ml/L of water
	Disease	Not observed	Not observed	Not observed
9	Yield (Nucleus-9305)	1860 kg ha ⁻¹	2050 kg ha ⁻¹	2310 kg ha ⁻¹

7. Outcome of new technologies

The different agricultural technologies introduced helped to improve productivity in various crops of the region. By just how much is shown by the example of the results of the soybean crop in the Table below. The bottom line is a 36% increase in net income.

Particulars	Cost of cultivation (₹ ha ⁻¹)		
	T1	T2	T3
Summer deep plowing (3000*1)	3000	3000	3000
MB plowing (1 pair bullock 2000*1)	2000	2000	2000
Harrowing and planking (600*1)	600	600	600
Seed transportation (Local market to home)	50	50	50
Sowing by seed drill (₹ 750 ha ⁻¹ + Labor ₹ 125)	875	875	875
<i>Dora</i> (One bullock pair @ ₹ 300 + 3 Labor @100 = ₹ 300)	600	600	600
Weedicide Pursuit 1 L ha ⁻¹ @ ₹ 1700 + 2 Labor @ ₹ 100 for spraying = ₹ 200	1900	1900	1900
Fertilizer	-	-	-
FYM application 4 labor ha ⁻¹ @ ₹ 100 per labor – By Home Production 3.75 tons	400	400	400
(RDF:10:30:0:15:5:0.5 N, P ₂ O ₅ , K ₂ O, S, Zn and B kg ha ⁻¹)	-	-	-
DAP – 65 kg @ ₹ 11 kg ⁻¹	715	715	715
Gypsum – 100 kg @ ₹ 2 kg ⁻¹	-	200	100
Zinc sulfate – 25 kg @ ₹ 30 kg ⁻¹	-	750	375
Agribor – 2.5 kg @ ₹ 110 kg ⁻¹	-	275	137.50
Insecticide	-	-	-
(a) Adneem (Neem oil) 1 L ha ⁻¹	300	300	300
(b) Endo Sulphan 35 EC – 1 L ha ⁻¹	425	425	425
(c) Trizaophos 40 EC – 1 L ha ⁻¹	450	450	450
Harvesting – 10 labor ha ⁻¹ @ ₹ 100	1000	1000	1000
Threshing (tractor threshing)	450	450	450
Threshing 6 labor @ ₹ 100	600	600	600
Transportation of produce from field to home	200	200	200
Transportation of produce from home to market @ ₹ 400 t ⁻¹	925	925	925
Labor cost for loading unloading	125	125	125
Cost of cultivation (COC)	14615	15840	15227.50
Gross monetary return (GMR) (Produce * market rate kg ⁻¹)	39060	43050	48510
Net monetary return (GMR – COC)	24445	27210	33282.50
Benefit:Cost ratio (GMR/COC)	2.67	2.71	3.18

8. Overall success

The present project activities involved 350 farmers (168 in *Kharif* + 182 in *Rabi*) of eight villages. With motivational and technical training, the farmers are well equipped with the latest technologies appropriate to the region. Different micronutrient trials, conducted on farmers' fields gave some of the best results. The various activities have stimulated an increase in area, production, productivity and good vegetative growth of various crops; and a demand for good quality seed in all the villages.

- Productivity increase in food crops.
- 3–4 months of additional food security.
- The HYV of chickpea is a success with minimum investment and less irrigation.
- Vermicompost production was adopted by several farmers.
- Ten farmers installed drip irrigation.
- Green gram showed vigorous vegetative growth and gave high yields for several farmers.
- Yield increase in vegetables due to Zn and B application.
- *Gliricidia* nursery established; seedlings planted on field boundaries and bunds and used as green manure gave good results.
- Area expansion plan achieved.

9. Lessons learnt

Late and erratic rainfall commonly led to crop failure in the villages. This attracted farmers to a variety which would overcome these problems. After several attempts to persuade them, farmers are unwilling to adopt drip irrigation. They believe it is unsuitable for the Agar region and does not give results up to the mark. Soil and water conservation practices require more attention in the light of depletion of groundwater in the project villages. This would lead to increased crop intensity. It is too early to assess in full the changes in crop production and in farmers' perceptions. Such work would in any case need more time and resources. All the agricultural development activities and technologies introduced require cooperation and a longer period to assess their impact on productivity enhancement in the region. Farmers appreciate project efforts in capacity building and the impact on crop productivity. The lessons in brief are:

- Late rainfall and erratic nature led to failure of soybean crop.
- Farmers' belief about drip system is still not up to the mark.
- Soil and water conservation practices are required in project villages to increase crop intensity.
- It is too early to assess the change in production, and farmers' perception towards the suggested farming system techniques in the limited time and with limited resources.
- Farmers appreciated the project efforts for their capacity building.

10. Popularization and dissemination of seed of improved crop varieties

Before the project, most farmers in the area were using varieties susceptible to insects and pests. For example, with continuous use, soybean JS 335 has decreased in production and is more susceptible to diseases. In the project trials, we introduced variety JS 9305 which performs better and farmers have shifted to it and get higher production. The improved variety (JS 9305) has been adopted by approximate 1250 small and medium farmers in the eight villages of the project area of Agar in Shajapur district.

11. Farmers' view about JS 9305 variety

- After sowing if there is a heavy rain then germination is poor and farmers have to re-sow the seed which increases the cost of cultivation. This is an apprehension but not experienced.
- If rains come in between 15 and 20 June then JS 9305 variety is very good for our area. If rainfall is delayed, then JS 9560 is better than JS 9305. Because in critical stage JS 9305 requires water and we do not have sufficient water for irrigation. Without irrigation then production goes down.
- If we go for three varieties such as JS 9560, JS 7322 and JS 9305 then farmers will have less risk and at least one variety will give us bumper production under whatever conditions.

12. Farmers' demand

- Farmers are demanding a short-duration variety with high production capacity in soybean
- More information about vegetable farming
- How to go about organic farming for soybean
- Trial should be of two *beegha* and each plot should have only two treatments rather than three

Leveraging technology for productivity enhancement

Location: Shobhapur, District: Sagar, State: Madhya Pradesh

1. Introduction

Mahendra Yadav tells of his success with better production using good variety seeds and improved technology. For listeners it is like a dream because in only a short time the practice and the variety spread in the area almost unbelievably.

Shobhapur is a small village located in the southern part of the Block headquarter Jaisi Nagar, District Sagar. The village is predominantly scheduled caste. Farming is the main occupation.

Bundelkhand is known for its traditional agricultural practices and poor production and recurring drought. Farming is just one activity rather than the main source of livelihood for most of the small and marginal farmers.

In such circumstances it is difficult to introduce new technologies and farming practices. Farmers are distrustful and do not adopt the technology as per instructions. In this situation identification of a progressive farmer and ensuring that he follows all instructions is a big challenge.



2. The case study

Seeing is believing. How did one farmer, who demonstrated one technology and shared his success with his relatives and friends from other villages, become the change agent? The case talks about pigeonpea variety ICPL 871119 (Asha) with BBF and intercropping and its results.

3. Sphere of action

Information sharing

Problem analysis was carried out with the group of farmers to understand their issues pertaining to low production, knowledge gap, input requirements, etc. The biggest gap identified was lack of information followed by supply of quality inputs as per their requirements.

Water-use efficiency through BBF system

Water availability and management is an important issue raised by the farmers. Sometimes delay in rains and heavy rains also cause damage to their crops and they were not able to address both the issues. They were told about BBF system and a few demonstrations were undertaken at field level. This was the turning point for the team in the field which could now make headway with the community.

Introduction of improved variety

Similarly improved genotypes of pigeonpea were also provided to the farmers for demonstration. Small but crucial issues like seed treatment, germination test and seed rate were also explained to them and shown in demonstration plots.

Risk management through intercropping

Failure of crops due to erratic rainfall and droughts is common in this region. ICRISAT and BYPASS reviewed rainfall for the last ten years, the drought years and their impact on production. These are natural calamities and management and water conservation are the best options to cope with such situations. A twin approach was introduced in the villages: BBF and intercropping.

4. Sequence of activities

- Identification of village Shobhapur as part of productivity enhancement project supported by Tata-ICRISAT.
- Brain storming sessions with farmers in each season.
- Exposure visit to ICRISAT and training of lead farmers.
- Introduction of BBF technique for better moisture management and soil erosion.
- Field trials on water-use efficiency.
- Introduction of improved variety pigeonpea ICPL 871119 (Asha) with BBF and intercropping.

About the farmer

- Mahendra Yadav is a progressive farmer of Shobhapur village, Block Jasinagar, Dist Sagar.
- He is youngest in the family of six brothers, each having farm of 5 acres land.
- He belongs to a middle class farmer family and is committed towards village development.

Major challenges in agriculture

- Poor soil and stressed moisture regime
- Application of traditional and inappropriate variety
- Agricultural productivity too low

5. How Mahendra adopted better practices and scaled it up in the region?

- A progressive farmer with little land was very active when he learned about the program jointly implemented by BYPASS and ICRISAT in his village to address the agriculture issues. His active participation was mainly to learn about new technologies, knowledge to improve his own agriculture. This was the motive behind his pro-activeness. His support to the project team allowed interaction with him to know more about the issues related to agriculture within the village. He became a link person in the village.
- Selecting an active farmer for any demonstration is a big task. During interaction with him he was given a proposal to join as demonstration farmer with the program. He was very happy when he learned about this proposal. This way he joined the movement of change in his village.
- The year 2008–09 was the first year when he was given new genotype of pigeonpea as part of a small demonstration in his field. He was also given training before undertaking demonstration in his field. The results were encouraging and he himself demanded to take up another demonstration for the same crop (2009–10) in rainy season.
- As a progressive farmer he always analyzes his crops and production in every season. He did the same for this variety and new technologies too. He himself analyzed the results by comparing it with local varieties sown in the area. He found the variety Asha more productive and suitable to the local situation as compared to local varieties sown in the area. Also he got better market price for Asha.
- He also visited ICRISAT, Patancheru in 2009–10 to participate in training/exposure visit and to learn about best practices from ICRISAT and Kothapally watershed area.
- The best part of the story is his proactive knowledge sharing attitude. He tried to share new knowledge and technology, which he learned in the project, with his friend and relatives. He propagates the message about success of the variety Asha to his friends and relatives residing in other villages. Moreover he also distributed seeds of Asha to farmers in neighboring villages. About 20 farmers from 6 villages received the pigeonpea seed for demonstration and seed preparation.
- The year 2010–11 was the turning point for adoption at big scale in the area as he decided to go for a large area under this variety by renting some land. He planned to expand the area of cultivation under pigeonpea. He adopted the technology in this land by sowing one quintal seed as an intercrop with soybean.
- Success brings ownership. This happened in this case also. The growth of plants and pods were very good; hence the team of Agriculture Department also visited his farm to see the performance.
- He again shared the results with different farmers and in *Kharif* 2011 gave or sold seed to about 15 farmers living in different areas.
- Through learning and motivational efforts of Mahendra, the pigeonpea variety Asha got popularity in nearby 10–12 villages and about 60 farmers replaced *Desi* pigeonpea seed with Asha. Also traders from Sagar came to Shobhapur to purchase the seed.

6. Production

- Despite a heavy frost, he got production of 112 quintals whereas the local varieties were severely damaged by the frost. Grain quality was good too.
- He sold the pigeonpea in the local market (*mandi*) at different intervals for ₹ 3000 to 4200 per quintal, but all the time due to good quality grain he got ₹ 600 to 1000 more than the local variety.
- In 2010–11, he earned (gross) ₹ 3.50 lakhs by selling the pigeonpea.

Performance of pigeonpea

Particulars	ICPL 871119	Local variety (Red pigeonpea)	Local variety (Desi)
2008–09			
Yield (q/kg seed sown)	125	90	70
Market rate (₹/q)	3500	3250	3000
2009–10			
Yield (q/kg seed sown)	140	85	75
Market rate (₹/q)	4260	3500	3200
2010–11			
Yield (q/kg seed sown)	112 (20% damage due to frost)	70 (50% damage due to frost)	More than 80% crop damage due to frost
Market rate (₹/q)	4200	3600	3200

7. Farmers' perception about pigeonpea

- Pigeonpea is the best option for our area having slopes and shallow soil with little moisture.
- The pigeonpea variety IPCL 871119 promoted through the project gives best yield with best quality grain as compared to local variety. A better market value is due to better grain quality, size and luster.
- In the coming year the local (*Desi*) pigeonpea will be replaced by IPCL 871119 in the entire village and also by the farmers of nearby 12 villages.

8. Benefits of intercropping

- Soybean and pigeonpea intercropping proved the best option for our area over the last 3 years; and we get the benefit of 2 cropping seasons.

9. Popularization of pigeonpea

- In last 3 years the pigeonpea seeds were distributed to about 60 farmers in 20 villages.
- Agriculture Department, Sagar officials along with farmers from other villages visited Shobhapur village to see the pigeonpea sowing on BBF system.
- Traders from Sagar are also coming to Shobhapur village for buying the seed.

10. Farmers' views

Asha tuar hamare liye vardan sabit huyi hai, iske pahale dus saal se hum tuar bo rahe the, na kabhi itna utpadan hua na kabhi eaisi quality mili. Hamari tuar ko krishi vibhag wale bhi dekhane aaye the, hamne mandi me sabse jyada bhav me tuar bechi aur aba to Sagar ke vyapari khud gaon me aakar poochhate hai ki tuar mandi mat lana hum ghar se hi le lenge. Hamne eak baar BBF se soybean tuar boyi, chana bhi boya aba kisi ke kahe bina bhi hum khud BBF banakar kheti karte hai saath hi apne sabhi milne walon ko Tuar-Asha aur BBF ke bare me batlate hai. Asha ka beej to hamne doosre jile me bhi panhucha diya hai. Pichhle saal Asha ne hame PALA ke prakop se ubar liya, hamne teen lakh se jyada ki tuar bechi.

Mahendra Yadav



Humne pahale saal mahendra Bhaiya ke yahan Tuar – asha ki fasal dekhi tab hamne faisla kiya ki agli baar mein jaroor SAsa variety lagaung. Aaj teen saal ho gaye, hamne Asha ko apna liya hai. Tata- ICRISAT project aane se hamare gaon me jo badlaw aaya hai yeh eak achchhi soch ka parinaam hai, isse pahale kabhi koi ham kisano ko Mitti, Beej aur Khad ka mahatva samjhane nahi aaya.

Devi Singh

Jab pichhle saal pala pada, hamare poore kshetra ki tuar ki phasal khade khade sookh gayi, eak dana bhi naseeb nahi hua, lekin hamne Asha variety lagayi thi, hamari phasal pala padne ke pahale hi kat gayi, Asha ne hame bacha liya varna ham kahi ke nahi rahate.

Mauji Lal



Hamare gaon me halki aur asamtal jameen hai, sichai ke liye pani ki kami hai, log aarthik roop se kafi kamjor hai, eaise me Tuar ki phasal bona hamere liye thik hai kintu jo desi beej hum log bote the vah kaam chalau upaj de deta hai. Asha Tuar ka beej upaj bhi jyada de raha hai aur dana bhi bahut achchha banta hai. Kisaan ko aur kya chahiye?

Bhagoni



Hum kisano ne ICRISAT me jaakar krishi taknik ke bare me sikha, kothapalli me bhi kisano dwara kiye gaye kaamo ko dekha. Hamare liye sikhne ko bahut kuchh mila, Humne poshak tatva, unnat kism, BBF, Kua recharge ko khud apna kar dekham, isse hamari aarthik sthiti behtar huyi hai.

Ram Sharan

BBF saved my crops in heavy rains: A story of an innovative farmer

Location: Ukawad, District: Vidisha, State: Madhya Pradesh

1. Introduction

Since 1998, in Malwa region of Madhya Pradesh, ICRISAT along with its partner BAIF is working on a watershed development program and promoting improved technologies to farmers. The concept of broad-bed and furrow (BBF) system was introduced in this area and farmers benefited in both dry season and monsoon with heavy rainfall.

With experiences of promoting BBF in this area, ICRISAT changed the implement to permit making BBF and sowing in the same field. The earlier implement was heavy and preparing BBF was time consuming so farmers were not much interested to adopt the technology even if they felt it beneficial for their crop. During discussion farmers confirmed that if they get a simpler implement they would practice BBF system in their field.

Considering suggestions of the farmers, ICRISAT designed a simple attachment and added it to the plow cum seed drill attached to the tractor. Now it is easier to make BBF and to sow in the field.

2. Concept of the case

BBF is a technology that conserves soil moisture and drains excess water from the field. Farmers felt that if they adopt this technology they have to lose some land and thus get less production. But they were proved wrong in practice in the farmers' fields. Actually water-use efficiency increases and helps in better use of the land. Farmers who have adopted BBF technology are better off than other farmers. In the village Ukawad, Mr Devendra Sharma adopted this technology and got the best production in heavy rains in the entire cluster of more than 20 villages. He says that it is only because of BBF.



3. The process

A team of scientists from ICRISAT made a visit before selecting the watershed in this area. During their visit they observed that most of the land is kept fallow by the farmers in this region. This was discussed with the local farmers. The reason for keeping land fallow was due to lack of proper technical knowledge of water management in the heavy soil and thus they could not take two crops.

To understand the fallow land pattern and total area under fallow, ICRISAT did a study using satellite data in this area. The study showed that nine districts of Madhya Pradesh had two million ha of fallow land and of course low production from this large area. Later on ICRISAT decided to work on this aspect by creating awareness and providing technological solutions. Technical guidance on including short-duration crops, soil testing, balanced application of nutrients, watershed treatment and preparing BBF in the field was provided.

Small interventions like seed rate, fertilizer application and soil testing were easily adopted by the farmers. They were little reluctant to adopt BBF although they knew the benefit of this technology. The reason was very simple. The implement introduced for making BBF was not farmer friendly. To use this implement they had to first make BBF and then sow which was time consuming. Also, most of the farmers hire the tractor for plowing and seed sowing. The moment they hire the tractor, the charges start. So they want to make efficient use of the machine; if they use this implement, the cost is more.

Based on feedback from the farmers, ICRISAT decided to make changes in the implement. A simple implement was prepared and was added to the tractor-drawn plow at local level which can help in making BBF in the field and also at the same time sowing can be done.

This technology was introduced in seven villages in 2010 rainy season under the Tata-ICRISAT productivity enhancement project. Demonstrations were undertaken on farmers' fields and results were satisfactory. Farmers saw how small changes in the same implement can strengthen their farming practices.

All demonstrations were supported with a balanced package of practices for the soybean crop. This was because land preparation only is not sufficient to get optimal production.

Demonstrations were successful as 2010 had low rainfall and by making BBF in their fields, farmers could conserve moisture and crops were saved in a critical period. Production was also good compared to non-demonstration plots.

4. Problems

- In heavy soil if rains are not sufficient then the crop gets damaged.
- In block cotton soil heavy rainfall damages crops.
- Moisture retention in the field is a big issue for farmers if rains get delayed or there is a long dry spell.
- During heavy rainfall, top productive soil gets eroded. It affects production every year and increases input cost.
- Poor growth of crop.
- Insect and pest attack.

Training and orientation

Village based training and discussions were organized by BAIF team.

5. Demonstration effects

The rainy season in 2011 was disastrous for most of the farmers due to heavy and continuous rains. Most of the farmers could not do proper sowing and some could not even do proper land preparation before the next sowing. Therefore making BBF in such a situation was a dream for them and they decided to adopt it in the next year positively.

In village Ukawad one progressive farmer who is also working with local Large Area Multipurpose Society (LAMP) took advantage of his resources and decided to prepare BBF in his 8 ha of land. He was lucky enough while preparing BBF and made proper BBF in his entire land and sowed soybean.

The rainy season of 2011 was very bad for most of the farmers with soybean in their fields. Excess rains damaged the crop or its growth was hampered.

In 2010 in the same village BBF demonstrations were undertaken in few farmers' fields. Rainfall was low. In those circumstances, farmers who were selected for demonstration got better results than other farmers.

Mr Sharma was one of the farmers who were selected for demonstration from their respective villages. In 2010 he got good results in his own plot. As a result he adopted BBF in the rainy season for soybean crop in 2011.

When he was asked why he did BBF again in his field when very few people are adopting it in the villages, he said: "I am not worried about others. I am more concerned about my own crop and I am fully convinced that if I can get better results with less rain then it will be beneficial during heavy rains also."



He was not aware that 2011 would be a disastrous year for crops and most of the soybean in the area would be damaged due to heavy rains. He adopted BBF because he learnt about its benefits and the results were good the previous year in his own plot.

When he made BBF he observed that he is the only farmer whose fields are much better than those of other farmers. Excess water is properly drained out from the field. BBF also helps to maintain moisture in the field.

6. Benefits of BBF he observed

- No waterlogging in the fields
- Proper drainage in heavy rains
- Better moisture condition for crops
- Assured crop in unfavorable situation
- Soil erosion controlled
- Can take second crop immediately after harvest of first crop.
- Less irrigation required for wheat and no irrigation required for chickpea.

7. Learning

He shared his view that BBF works better under any climate condition. His experience in a dry season in 2010 was very good and in the heavy rains of 2011 BBF supported his crop. Now, villagers also agreed with him that BBF is beneficial in any condition and even if there is a slope.

8. Future plans

He plans to increase the area under BBF next rainy season. He has also got one tractor from Large Area Multipurpose Society (LAMP) from government to rent for plowing and other agricultural operations.

9. What needs to be done?

An orientation program on postrainy season crops on BBF plots is required. Apart from that there is a need to organize experience-sharing camps at local level so that other farmers can also benefit from his learning.

Convergence approach helps in scaling-up best bets

Location: Sipringa, District: Gumla, State: Jharkhand

1. Introduction

Passing through dense forest as a visitor is always a thrilling experience and one wants to visit again and again. But the story starts when one lives there and understands how the forest makes your life difficult. This was the feeling when we visited remotely located villages of Gumla district of Jharkhand.

Village Sipringa is located around 18 km from the district headquarters. You start with a good road and end with a muddy road when you reach the village. Sometimes you need to try two-three routes to reach the village as one of them may be broken or some tree is fallen across the road. This is the reality and we will tell the story of the people who live here and proved their worth to win over their adverse situation.

PRADAN is working in the district for last 10 years on livelihood issues. Agriculture, as the basis for living for the local tribes, was identified as the core development arena by the team and interventions were started through self-help group (SHG) approach.



2. The journey

Villages	Number of farmers	Crops covered	Year
Teliya (Nucleus village)	50	Pigeonpea, black gram, groundnut, maize and green gram	2008–09
Springa and Tunjhtoli	120	Pigeonpea, black gram, groundnut, maize, green gram, tomato and cabbage	2009–10
15 villages	1000	Pigeonpea, black gram, groundnut, maize, green gram, tomato and cabbage.	2010–11

3. Steps

As the **first step**, soil testing was done as an essential component of the project. Boron was identified as deficient in the soil. Zinc and molybdenum deficiencies were also found. The soil was found to be acidic in nature with 4.5–5.0 pH.

Discussion with the farmers and explaining to them the concept and importance of soil testing and addressing its deficiency was most crucial. This was the **second step**.

The **third step** was to demonstrate application of micronutrients in crop production at village level. Two types of demonstration trials were planned. The first with the main cereal crops and the second with vegetables.

Scaling-up the learning from these demonstrations with other programs was the **fourth step** for the PRADAN team. This was in other interventions like orchard development in these villages with financial support of SGSY, NREGS and Tribal Welfare programs. Micronutrients were applied in fruit crops and results were really very good. Boron, an important micronutrient, was applied on fruit crops for better fruiting and quality production.

Another adoption of learning was in vegetable cultivation interventions which were promoted as an alternative approach with small holding farmers. Application of boron with balanced farmyard manure was demonstrated and the outcomes were discussed in meetings which helped in its replication.

4. Addressing the issue of input supply at local level

Initially it was the role of PRADAN to arrange inputs for the community, but it was a very hectic and time consuming task. In a meeting with the community it was decided to develop a simple participatory mechanism which addresses this issue. In the meeting it was also decided that PRADAN will provide necessary support to these local groups in linkages. To set up the mechanism a series of meetings was organized with numerous seed and fertilizer shops in the nearby area to ensure timely and quality inputs. The seed shops were ready to give support. The farmers started collecting money well in advance and made regular visits to the shops in groups or through community service provider (CSP). They jointly purchased the inputs and distributed among themselves. Sometimes they even give orders to Agri-horticulture co-operative (One of the PRADAN-promoted cooperatives) to supply them the inputs. Seeing the huge demands of seeds, fertilizers and micronutrients, the seed shops were convinced that there is a huge marketing scope for them. So they started keeping these inputs. Now the communities are independently doing this task.

5. Community service provider

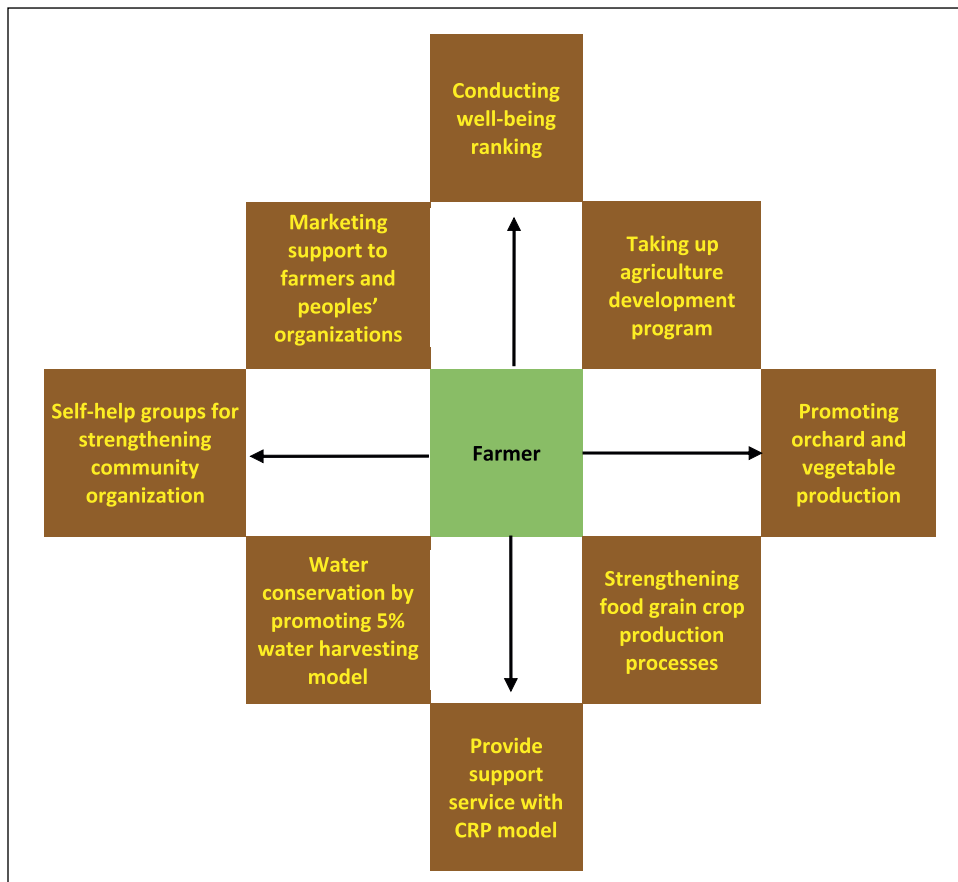
The community service provider (CSP) provides marketing support to the farming community of the village and is a person from the community itself. When the villagers started the common nursery, the production started coming at a single time, thus there was a glut in the local market and lower prices. Then PRADAN discussed with the community to find out ways to address this issue. The outcome of this meeting was the villagers selected a person to help them in marketing the produce. It was a charged or commission-based service provided by the CSP to the farmers. The CSP can charge 0.50 paisa per kg of marketed produce. This model not only addresses the issue of marketing but also helps to encourage more farmers to join this program.

6. Role of self-help groups

The SHGs are the basic platform which implements these interventions. Apart from these programs, SHGs play a different role in:

- Monitoring the quality of intervention.
- Helping other fellow farmers of the area.
- Motivating farmer to grow vegetable crops.
- Data keeping.
- Addressing issues such as free grazing, marketing and credit flow.

7. Multi intervention convergence approach



8. Outcome of inputs

In village Teliya overall irrigation was good but a few households had no irrigation in their field. Thus it was decided to address this issue with convergence approach. Farm concept was introduced in the village. Open wells were constructed and lift irrigation schemes were introduced in the village. Now the situation has improved and irrigation reaches up to 80% from 60% before. Better crop and financial support made it possible for 25 farmers to buy their own diesel pump sets and convert their land into irrigated category.



- Boron application is now scaled-up to 100 villages with 1000 farmers who are into vegetable production and orchards.
- Now the market also has micronutrients which were not available in large quantities.
- Interestingly hybrid maize was the biggest adoption by farmers after a few demonstrations of its benefit. Now a big area is being converted into hybrid maize cultivation resulting in better food security at household level.
- Summer fallow is reducing and an increasing number of farmers are adopting short-duration pulses like green gram. In one irrigation farmer gets good production (one kg seed gives 40 kg

production) and crop duration is just 65 days which provides opportunity to take better rainy crops. Green manuring also increases production of the paddy crop. Good market rate for summer pulses like green gram @ ` 40/kg is the forcing factor behind high rate of adoption of summer cropping.

- Increased knowledge of farmers about summer crop and green manuring.
- Formation of farmers' club to discuss about various crops and farming practices.
- One link person is trained from each village on crucial issues.
- Small steps led to a big gain for the villagers of Sipringa. Farming was not new to these villagers but the way they were doing farming was not giving them much return from their fields. Now the situation is changed with more gain from the same land.

9. Change in agriculture practices

The transition in agriculture started from 2000. The first major change was use of composite seed. But very few farmers adopted new technologies. Broadcasting seed was the most common practice. Demonstrating the use of quality seed in the ICRISAT supported project was useful for most of the farmers as they learnt the benefits of line sowing to get better production. Now most of the farmers follow line sowing for their hybrid maize crop. For traditional seeds, still broadcasting is practiced.

Overall production has increased and this has reduced the dependency on forest products and laboring. It took 6–7 years to understand the importance of seed and most of the farmers are now using quality seed.

Laharu Pahan, one of the farmers shared with us that now children are also going to school because there is a school within the village. The youth do not sell wood anymore. Inter-culture operation in crops has changed and farming practices have improved. Paddy production has increased from 0.4 t to 1.6 t. Now farmers have food security at household level and do not buy rice from outside.



10. Practices and knowledge support that increases tomato growing area

- Nursery raising at 15 days intervals to ensure a controlled supply of vegetables so that market does not crash.
- Prepare nursery beds of 3x7 feet each. Buy compost, DAP, Potash and Thimet and keep it for a day.
- Next day place 5 g of seeds. The quantity of seeds was reduced after training farmers who earlier used about 10 g of seed in the nursery.
- Cover the bed with mosquito net to protect the saplings from white fly and also apply Actara insecticide. Now they also see the expiry date of the pesticide before use. They also apply blue copper.
- Major shift in transplanting of sapling. Earlier they used to transplant after 21 days now they ensure that by 15 days sapling is transplanted.
- They carry out inter-culture operation after 5 days. Then apply Potash and DAP to the roots of the plant. Urea application is 15 days after transplanting.
- Farmers also know the names of chemicals, which they use for control of different diseases. This confirms their enhanced knowledge.
- Interestingly they applied boron and the production was doubled.
- Now the number of farmers who want to grow tomato is increasing year by year. The number of farmers has reached up to 100 from the earlier number of only 10–15. This shows adoption of improved practices and better return to the farmers.

11. Five points which brought change

- Seed treatment
- Use of improved seed
- Balanced use of pesticides
- Proper and timely use of fertilizers
- Regular discussion on package of practices and on the job training

12. Changes in major crop production

Particulars	Paddy	Maize	Tomato
Process promoted	<ul style="list-style-type: none"> • Concept of seeding meeting with the villagers • Introduction of high-yielding varieties of seed • Ensuring full package of practices • Disease and pest management 	Same as paddy	Same as paddy
Production analysis	Random sampling of 25% farmers.	Same as paddy	Same as paddy
Economics	₹ 3295 input cost per hectare	₹ 6900 input cost per hectare	₹ 20100 input cost per hectare
Learning	Need to introduce System of Rice Intensification method on large scale. As monsoon is not promising so there is a need to identify a variety which can yield even in less rain.	The crop is very promising so more families should grow this crop.	Identify varieties which are wilt tolerant and yield more. Ensure marketing support. Application of calcium and other micronutrients enhances yield. A campaign for micronutrient adoption is needed.
Scale of operation (Gumla project 2011)	We have covered 9000 families.	We have covered 3500 families.	We have covered 6000 families.

Economics of crops

Tomato-10 decimal

Inputs	Quantity	Rate (₹)	Expenditure (₹)
Seed – Namdhari	5 g	90	90.00
DAP	10 kg	18	180.00
Potash	6 kg	7	42.00
Urea	10 kg	7	70.00
Admire	4 g	21/2 g	42.00
Dunet	50 g	21/2 g	60.00
Blue Copper	100 g	400/kg	40.00
Croacean AG	6 g	25	25.00
Calcium	1 kg	70	70.00
Multinole	100 ml	40	40.00
Dhanuvet	100 ml	30	30.00
Themate	1 kg	60/kg	60.00
Bavistean	20 g	20/g	20.00
Metaco	20 g	35/g	35.00
Total			804.00

Tomato fields of farmers of Gumla villages with addition of zinc sulfate, Agribor and vermicompost and graded tomato for market:

Village	Area (acre)	No. of farmers	Tomato yield (kg ha ⁻¹)		Tomato income (₹ ha ⁻¹)	
			Improved ¹	Traditional	Improved ¹	Traditional
Sipringa	2.5	25	83809	53281	296381	133559
% increase over control			41.6		88.5	
LSD %			19072.3		6007.2	

1. Improved practices: Addition of 2.5kg of boron and 50kg of zinc sulfate along with DAP 500kg, MOP 250kg and urea 300kg per ha.

Maize-10 decimal

Inputs	Quantity	Rate (₹)	Expenditure (₹)
Seed Kaveri bioseed	500 g	80/kg	40.00
DAP	4 kg	18	72.00
Potash	3 kg	7	21.00
Urea	3 kg	7	21.00
Indosil	100 ml	42	42.00
Bavistean	20 g	400/kg	20.00
Themate	1 kg	60/kg	60.00
Total			276.00

Improved Paddy-50 decimal

Inputs	Quantity	Rate (₹)	Expenditure (₹)
Seed - Lalat, Khandgiri, Abhishek, and Sahbhagi)	4 kg	24	96.00
DAP	12 kg	18	216.00
Potash	15 kg	7	105.00
Urea	10 kg	7	70.00
Admire	4 g	21 for 2 g	42.00
Bavistean	20 g	20 for 20 g	20.00
Themate	1 kg	60	60.00
Agent Plus	100 ml	50	50.00
Total			659.00

13. Links with government program

The impact was also large because all these villages are in the interior and very difficult to access and are naxalite prone. So seeing such good agriculture work the district administration sanctioned some 11 nos. of sorting and grading house and 11,000 nos. of crates for the villagers across all the 4 blocks of Gumla. This support was given to SHGs. The district administration also sanctioned 36 nos. of lift irrigation to assure irrigation facilities to the villagers.

14. Changes

- Twelve households developed mango orchard
- 25 farmers now have Shreeram Honda kerosene pump
- There is one power tiller in the village
- Tomato farming area and number of farmers increased
- Improved seed is used by most of the farmers

15. Challenges

- Farmers, who have land less than one acre, are facing problem in meeting their round the year requirements from their land and therefore they either migrate or labor or depend on the forest. There is need to develop a special plan for such farmers.
- Conduct soil testing for villages.
- Farmers still need training on balanced application of fertilizer based on soil testing report.

A step toward productivity enhancement

Location: Gokulpura, District: Bundi, State: Rajasthan

1. Introduction

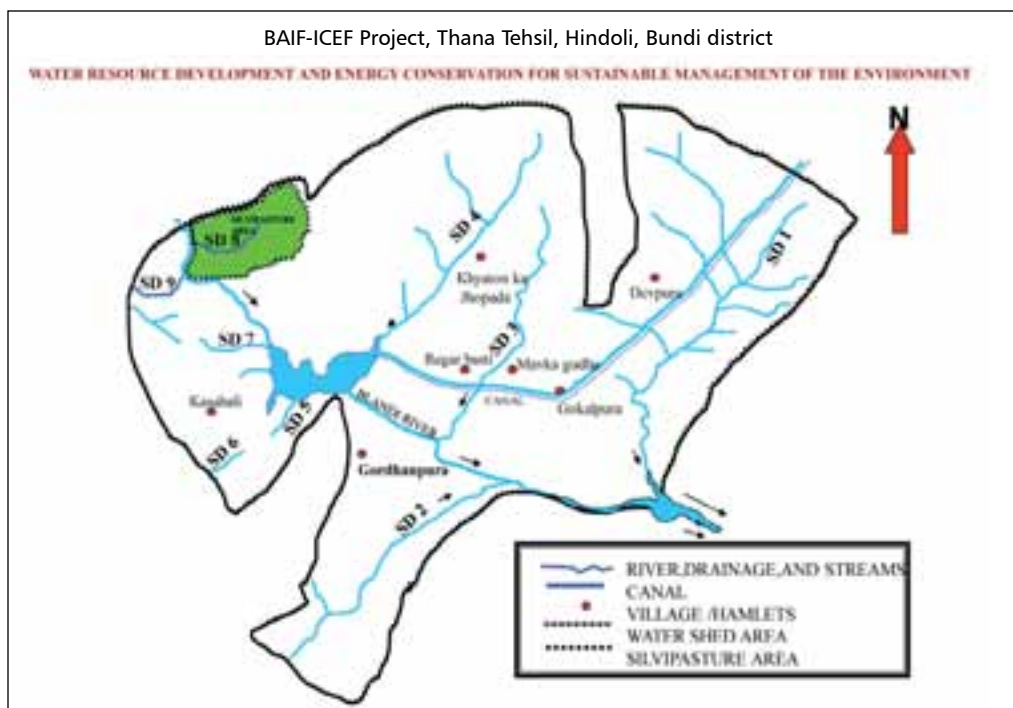
The story of productivity enhancement starts with better and healthy soil. This is a truth well known to us, but hardly is there any action on it apart from small efforts here and there. The history of various productivity enhancement programs shows that more focus was given on seed and not on soil and thus this issue never became important in the farming community. Thus no simple system was established to test the soil and provide information on soil requirements.

As in other states, in Rajasthan soil productivity enhancement is a big issue. Much effort is made in soil and water conservation but not on soil health improvement. Thus it will take more time to generate consciousness in rural areas. ICRISAT is taking needful steps in improving the soil health and increasing the crop productivity in the districts of Bundi, Banswara, Alwar, Jhalawar, Bhilwara, Tonk and Sawai Madhopur of eastern and southern Rajasthan.

The situation on the ground is not very good. People still follow old practices and are unwilling to adopt innovations. Application of chemical fertilizers, mostly urea and DAP, is adopted by the farmer because he can see the immediate outcomes of application. But the reason behind this is not clearly known to them. Therefore nutrient management is a key requirement. The market too is a big and crucial factor that can promote outcomes for new technologies and provide information for the farming community.

This case study will elaborate on the balanced use of nutrients for sustainable crop production and to improve the livelihoods of progressive farming communities in rural Rajasthan.





2. Concept of case documented

The process of building awareness about the use of balanced nutrition in another project location with a different farming community, to enhance soil capacity for better production is all discussed in this case. Here it is important to understand how different farmers in different locations respond to the same issues and approaches and what are their experiences.

3. The settlement

Bundi watershed is situated 40 km from Bundi District headquarter. It covers five revenue villages: Thana, Goverdhanpura, Gokulpura, Rosanda and Vijaygarh. Hindoli is the Block headquarters for these villages. The region is known as Hadoti in Rajasthan. The settlement of this area is very scattered and the majority of the community is schedule tribe – the Meena tribe. In total, there are five watersheds covering 1158 households. The total rainfall of the district is 760 mm and maximum temperature reaches 48° C in summer and minimum 8°C in winter.

Particulars	Area (ha)	Particulars	Nutrient status
Total area of the villages	4725.51	Soil testing report – pH	8.5
Agriculture land	1655.05	EC	0.21dS/m
Irrigated area	679.04	Organic carbon	0.59%
Un-irrigated	976.01	Available phosphorus	6.2 mg kg ⁻¹
Cultivable wasteland	779.73	Available potassium	91 mg kg ⁻¹
Un-cultivable wasteland	1567.73	Available sulfur	9.25 mg kg ⁻¹
Forest	723.18	Available zinc	0.65 mg kg ⁻¹
Average land holding per household	3.79	Available boron	0.45 mg kg ⁻¹

Rainfed farming is common in the area with more than 90% of the land cropped in the rainy season (*kharif*) and only 65% in postrainy season (*rabi*). There is no perennial river near the villages. Main crops are maize and soybean in rainy season and chickpea and wheat in postrainy season. Groundwater table in open well is 15 feet and in tube well it ranges from 30 to 35 feet.

4. Why micronutrients?

Soil deficiency of various nutrients is the major problem in the cluster of villages but low awareness and no direct links with the outcome of such deficiency on crop productivity make it of no general concern.

In Hadoti region, as per ICRISAT report, soils are deficient in sulfur, zinc and boron. Without addressing these deficiencies it is very difficult to improve production.

For each demonstration and action research, a carefully designed yield gap analysis (ie, existing farmers' crop yields and potential achievable yields) for major crops was prepared. To meet nutrient deficiency, an application plan was prepared based on soil analysis report recommendations.

5. Conducting representative soil analysis

'Healthy soil healthy crop'. This is the basic equation which is being promoted by the team working with the farmers. To understand the physiography, 60 soil samples were collected from the watershed area in 2002. Detailed analysis was carried out in ICRISAT soil testing laboratory. Steps followed for sample collection and sharing information with the farmers are as follows:

- Adoption of stratified soil sampling technique.
- One-day orientation cum training organized for farmers.
- Why and how to go about soil analysis was explained.
- Soil health cards were distributed to the farmers and findings discussed with them.

6. Status of the soil

- The soil analysis indicated that most of the farmers' fields were deficient in boron, zinc and sulfur.
- Phosphorus and carbon are represented in normal range.
- Potassium found to be in medium range.

The findings of soil analysis are as follows:

Soil Chemical Analysis Report, Sagar		
Soil health information	Normal	Average
Soil pH (1:2)	6.5–8.5	8.5
Electrical conductivity (dS m ⁻¹)	<0.8	0.21
Major nutrients		
Organic carbon (%)	0.5–0.75	0.59
Available phosphorus (mg kg ⁻¹)	5–10	6.2
Available potassium (mg kg ⁻¹)	50–125	91
Secondary nutrients		
Available sulfur (mg kg ⁻¹)	8–10	9.25
Trace nutrients		
Available zinc (mg kg ⁻¹)	0.75	0.65
Available boron (mg kg ⁻¹)	0.58	0.45

7. Trends in cultivation

- Most farmers apply DAP and urea in their field without proper recommendation.
- Wheat–maize is the major cropping system in the area. This uptakes a high nutrient amount from the soil.
- Lack of integrated approach in the area resulted in the poor fertility status in the soil.
- Inappropriate irrigation practices resulted in the loss of soil and nutrients.
- No difference seen between food grain and seed.

8. Defining balanced nutrient management

- Generally plants require a total of 16 nutrients in their life. All are taken up by the plant at different stages and from soil, water and air. If these nutrients are not available then it affects the overall growth and production process of the plant.
- Balanced application of nutrients for each crop is different and that has to be conveyed to everyone by proper demonstration. The application of macro and micronutrients without affecting the soil health for crop production is called Balanced Nutrient Management (BNM). Specific application of micronutrient as per requirement can be called Micronutrient Management.

9. The process of BNM demonstration

- The clusters of villages were supported with watershed program under financial support of India Canada Environment Facility (ICEF) with technical inputs from BAIF and ICEF. The watershed program supported by ICRISAT through the Asian Development Bank (ADB), Manila, Philippines started in 2002 but lacked a major aspect of productivity enhancement, which was later called watershed plus.
- Working with people and on natural resource management, the BAIF team felt that agriculture needs to be strengthened in this area. This was discussed with ICRISAT. After initial discussion with the team it was decided to start working on agriculture productivity enhancement. Deveji ka Thana and Goverdhanpura of the watershed cluster were selected as nucleus villages.

10. Steps adopted

- Soil testing and soil health card preparation.
- Training and orientation of farmers on balanced nutrient applications.
- Field demonstrations on improved seed plus balanced nutrient applications.
- Water-use efficiency.
- Exposure visit of farmers where such work is done and farmers are getting benefits.
- Community to community interaction.
- Study on residual effect on next seasonal crop.

Interaction with the farmers on their issues played a path-breaking role. When they were explained the entire crop production process and role of micronutrients, lot of questions were posed by them to the team. Those were answered through demonstration at village level which proved the points in the first season and so enhanced the confidence of the team and farmers.

The first milestone of this process was established when 708 farmers agreed to adopt crop demonstration following micronutrient application as suggested to them based on soil requirement in rainy season (*khari*) of 2002. The second step was introduction of Kaveri-235, an improved variety of maize. This has reduced the use of traditional seed with traditional practices.

The concept '*more input more production*' was deeply rooted in the area and therefore more application of urea and DAP was common. Thus shifting from maximum to balanced use of inputs was challenging. A few demonstrations and their positive outcomes created a favorable environment in the villages. Less economic burden with good production changed the mindset of the farmers in these villages. Now BAIF is working in nine districts of Rajasthan on crop productivity program for improvement of rural livelihood.

Year-wise crop demonstration program in Bundi district

Year	Crop	No. of demonstrations	Crop variety	Inputs used
2002–03	Maize	708	PMH-2201	Zinc, gypsum, boron, PSB, <i>Rhizobium</i> , Azotobacter
	Black gram		T-9	
	Green gram		MGG-219	
	Chickpea		ICCV 37, ICCV 10, KAK-2	
2003–04	Maize	761	PMH-2201, PHEM-1	Zinc, gypsum, boron, PSB, <i>Rhizobium</i> , Azotobacter
	Black gram		T-9, Barkha	
	Green gram		MGG-219	
	Chickpea		ICCV 37, ICCV 10, KAK-2	
	Sorghum		CSV 15	
	Wheat		PD, Raj-3077, Lok-1	
	Pigeonpea		ICPL 88039	

Continued

Continued

Year-wise crop demonstration program in Bundi district

Year	Crop	No. of demonstrations	Crop variety	Inputs used
2004-05	Maize	925	PMH-2201, PHEM-1, Ganga Kaveri	Zinc, gypsum, boron, PSB, <i>Rhizobium</i> , Azotobacter
	Black gram		T-9, Barkha	
	Green gram		MGG-219	
	Sorghum		CSV 15	
	Chickpea		ICCV 37, ICCV 10, KAK-2	
	Pigeonpea		ICPL 88039	
	Wheat		PD, Ajeet 105, Lok-1	
	Mustard		Pusa Jai Kisan, KD, Basanti	
2005-06	Maize	925	PMH-2201, PHEM1, Ganga Kaveri	Zinc, gypsum, boron, PSB, <i>Rhizobium</i> , Azotobacter
	Black gram		T-9, Barkha	
	Green gram		MGG-219	
	Chickpea		ICCV 37, ICCV 10, KAK-2	
	Sorghum		CSV 15	
	Wheat		PD, Ajeet 105, Raj-1027	
	Mustard		Jai Kisan, KD, Basanti	
	2006-07		Maize	
Black gram		T-9, Barkha		
Green gram		MGG219		
Chickpea		ICCV 37, ICCV 10, KAK-2		
Sorghum		CSV 15		
Wheat		PD, Ajeet 105, Raj-1027		
Mustard		Pusa Jai Kisan, KD, Basanti, Swati-501		
2007-08		Chickpea	255	ICCV 37, ICCV 10, KAK 2, JKG-1, JKG-2
	2008-09	Maize		100
Black gram		T-9, Barkha		
Wheat		Lok-1, Raj-3077, Raj-3765,		
Chickpea		ICCV 37, ICCV 10		
Mustard		Madhuri		
Sorghum		CSV 15		
Soybean		JS 335		

Continued

Continued

Year-wise crop demonstration program in Bundi district

Year	Crop	No. of demonstrations	Crop variety	Inputs used
2009–10	Maize	130	PMH-2201, PHEM-1, Kaveri-235, Mukta	Zinc, gypsum, boron
	Wheat		Lok-1, Raj-3077, Raj-3765	
	Chickpea		ICCV 37, ICCV 10	
	Mustard		Madhuri	
	Soybean		JS 335	
2010–11	Maize	298	PMH-2201, PHEM-1, Kaveri-235, Mukta	Zinc, gypsum, boron, FYM
	Wheat		Lok-1, Raj-3077, Raj-3765, Raj-1482, DBW-17	
	Chickpea		Dahod Yellow, C 235	
	Sorghum		PVK-8014	
	Soybean		JS 335, JS 9305	
Total		5386		

11. Experimental details

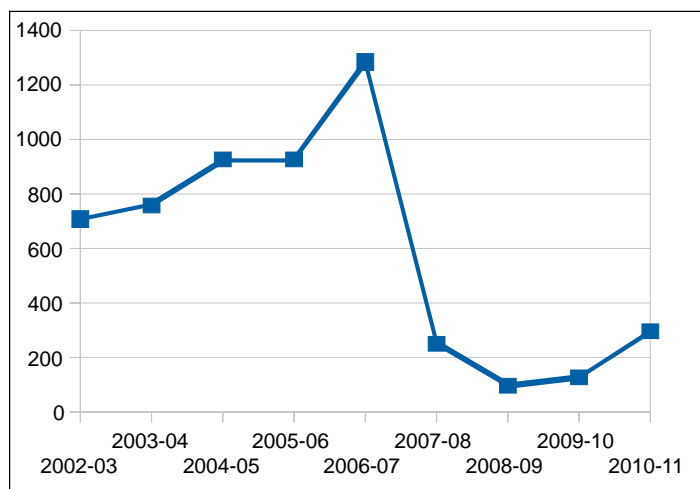
No. of treatments: 3

T1: Balanced nutrients as per status of soil + improved variety

T2: 50% FYM or vermicompost and 50% balanced nutrients + improved variety

T3: Farmer practices + improved variety

- The graph explains that initially more demonstrations were taken at field level to convince farmers about benefits of micronutrient application. But still there is need to convince more farmers to adopt better nutrient management practices in their fields.



Plot size: 1000 m² for each treatment

12. Output of the activity

Small is beautiful. Thus adoption of better nutrient management practices started with small numbers of farmers with strong acceptance in these villages. In the village, Deveji ka Thana most of the farmers started using seed of improved varieties of their staple crops. The *second* major shift observed was a shift from traditional farming to commercial farming in this village. Vegetable farming became first priority for some progressive farmers. The *third* big change in the region was the opening of shops that provide agricultural inputs including micronutrients, fertilizers and seed. In total eight shops are operational in this area which shows larger adoption of micronutrients and other inputs promoted by the projects. Out of these eight shops three already started selling micronutrients to the farmers and demand is in increasing trends. The last two years business data, especially for micronutrients, is as follows.

Shop name ¹	2001–02	2009–10	2010–11
Ms/ Naruka khad beej bhandar, Deveji ka Thana	0	2 q	3 q
Ms/ Shankar khad beej bhandar, Deveji ka Thana	0	2 q	3 q
Ms/ Charbhujia khad beej bhandar, Deveji ka Thana	0	1.5 q	2.5 q

1. Quantity of sold micronutrients from their shops in the season.

13. Kharif data 2008–11

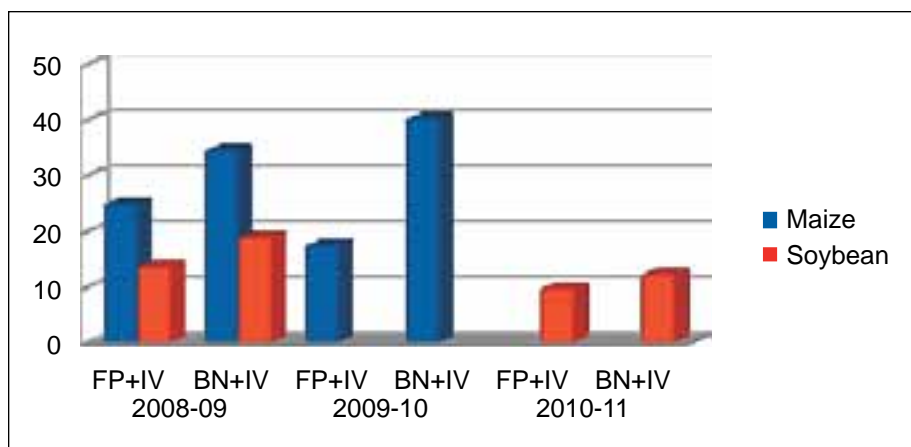
In Deveji ka Thana watershed BAIF and ICRISAT have introduced improved varieties of maize (Kaveri-235, Mukta and Star-1) and soybean (JS 335) and undertaken treatment with micronutrients. Data of the crop demonstration is as follows:

Crop	Yield (q ha ⁻¹)					
	2008–09		2009–10		2010–11	
	FP+IV	BN+IV	FP+IV	BN+IV	FP+IV	BN+IV
Maize	24.9	34.5	17.5	40.2	0.0	0.0
Soybean	13.7	18.9	0.0	0.0	9.8	12.3

FP+IV = Farmer practice and improved variety.

BN+IV = Balanced nutrients and improved variety.

- In 2009–10 the rainfall in Bundi district was very erratic and low compared to other years, but maize crop trial with micronutrients gave good yield (40.2 q ha⁻¹), almost double that obtained with farmers' practice.
- The soybean variety JS 335 gave highest production (12.3 q ha⁻¹) under drought conditions whereas the same variety under farmers' practice produced 9.8 q ha⁻¹ only.
- The seed quality (grain weight, color, luster) of JS 335 is very good as compared to traditional or local variety. Market rates of JS 335 were also higher (₹ 50–100) than other varieties.
- Now the farmers have seeds of both varieties – JS 9305 (short duration) and JS 335 (long duration). Both the varieties give good performance under local conditions.



14. Promotion of crop diversification

Rabi: 2010–11 – Wheat crops (variety DBW-17)

Wheat	Farmers' practice	Balanced nutrient	VC + 50% BN
Yield (q ha ⁻¹)	36–40	46–48	55–60
No. of tillers/plant	6–14	8–20	8–18
Plant height (cm)	42–88	45–83	51–103
No. of grains/plant	45–50	50–74	55–88

15. Farmers' perception about wheat – DBW-17

- The variety DBW-17 was introduced by the project in *rabi* 2010 while farmers used Lok-1 and Raj 3765.
- Growth of plant and length of ear head were observed to be very good in DBW-17. Therefore production as well as quality of grain were better than other varieties. The yield of DBW-17 was 36.6 q ha⁻¹.

16. Strategies to promote scientific approaches

- **Training:** A generic but important step to introduce new and improved technology and knowledge was part of broader strategy. To share knowledge, information and enhance the capacity of the farmers, training programs at regular intervals were organized. In the second year total 8 training programs were conducted with participation of 224 mandays.
- **Farmers' day:** This most effective step for sharing farmer's learning with other farmers was adopted in these villages. In 2009 Farmers' Day was organized in Shobhapur and in 2010 in Karaiya.
- **Exposure visit:** Exposure visits were also conducted every year for development of faith in the farmers about the new technology. Five farmers were taken for exposure visit to ICRISAT.

17. Output of the project activities in villages

Nutrient related

- Shops selling agricultural inputs now reached up to eight. These shops sold 85 q of micronutrients, which is a good indicator of adoption of micronutrients in this area.
- This enhanced production approximately by 20–50%.
- Per hectare return increased by ₹ 5000–10000 by using micronutrients. Generally farmers use macronutrients like DAP and urea mostly. Demonstration results make them realize the impact of micronutrients and cost reduction. They also experienced the residual effect for the next three years which was entirely new for them.

Seed related

- The demand of the high-yielding variety (HYV) is increasing day by day and more than 90 per cent farmers are using the HYV of maize in the watershed village. Moreover, the farmers are also using the new variety of wheat, chickpea and mustard in the area.
- The performance of short-duration varieties is very good. The demand for such varieties is increasing mainly for major crops like maize, wheat, soybean and pigeonpea.

Information and capacity building

- Simple and regular interface with the farming community helped in enhancing their knowledge base and understanding about new technologies and improved agricultural practices.
- Now the learning of the project is disseminating to other farmers in nearby villages of watershed through normal communication.

18. Farmers' views



Earlier I never used zinc, Agribor and gypsum in my field. Crop demonstration under the project in my field proved that yield increased with application of micronutrients. This boosted my confidence and now I am using micronutrients in my field.

Shri Mathuralal ji, Goverdhanpura



Earlier I did not know about micronutrients and we used only DAP and urea in my field. But after crop demonstration by BAIF in my field, I obtained wheat yield of 8–10 q per *bigha* and the soil in my field has pulverized by use of gypsum and increased the soil health.

Shri Nathu Lal ji, Vijyagar



Earlier I also did not know about the importance of gypsum, Agribor and zinc. But after the crop demonstration, I have obtained wheat yield of more than 40 q per ha by using this system and now I am using micronutrients by purchasing from the shop.

Shri Parbhu Lal ji, Thana

Variety that fulfilled farmers' demand

Location: Dharola, District: Tonk, State: Rajasthan

1. Introduction

Striking a balance between food and commercial crops is essential for small and marginal farmers to reduce their dependency on market for grains. In rainfed farming, improved varieties are adopted because they require less water, are of shorter duration, provide fodder and a better economic return.

Groundnut is grown in Tonk district of Rajasthan due to the favorable soils there. Most of the area grows a traditional variety of groundnut as it survives in harsh conditions, giving at least some production in poor rainfall, and bumper production when the rains are good. But the problem farmers face is its long duration to maturity, so they are unable to utilize soil moisture for a second crop.

A groundnut variety released from ICRISAT for rainfed areas was introduced in this region. The variety gave good results and was liked by farmers for its many qualities: seed quality, oil content, seed appearance, crop duration, resistance to diseases, flowering time, pod formation in a bunch compared to the traditional variety and fodder value. Learning from the farmers' perspective is discussed and shared in this case study.



2. Concept of case documented

This case study talks about the adoption of groundnut variety ICGV 91114 (short-duration, drought tolerant) for cultivation released by ICRISAT/ICAR. The core of the study is how a relationship was built up with the community; this was a new experience. The Jat and Meena communities are known for their hard work and for adopting advanced agricultural practices. Groundnut is one of the major crops of the *kharif* season in this village. The traditional variety gives a good return if the rains are good and last long. If the monsoon fails, then groundnut production goes down drastically. How the new variety addresses the problem is discussed here.

3. The settlement

This village was established by the forefathers of Dholya Jat. Hence the name Dharola. There are 30 families of Dholya Jat settled here out of 106 families in the village.

The village is surrounded by forests. From the hilly, undulating terrain, rain water drains into the fields and takes topsoil into the drainage channels. The base-line survey showed farmers were growing groundnut as 30% of their *kharif* crop. Generally a local groundnut is used which gives low yield. Farmers wanted an improved groundnut variety. From start of the project in April 2008 we introduced ICRISAT variety ICGV 91114 and micronutrients as per the soil-testing recommendation (boron, zinc and sulfur).

Caste	No. of households
Jat	30
Meena	30
Brahman	5
Nai	2
Kumhar	4
Hela	2
Balai	2
Bairwa	31
Total	106

Formation of seed-bed was by tropicultor, and the groundnut seed was sown by tropicultor on the bed. In *kharif* 2008, six families were selected for groundnut cultivation. Farmers had to pay 50% of the cost of the groundnut seed and materials, as per ICRISAT guidelines. Farmers use a sprinkler for irrigating groundnut.

Bio-physical characteristics		Land use pattern (ha)		Main crops	
Slope	Cultivated land (3-5%)	Forest land	623.28	<i>Kharif</i>	Maize, pearl millet, groundnut, sesame, black gram, green gram, sorghum
	Wasteland (10-15%)	Irrigated land	84.88		
Soil type	Loamy/Sandy loamy	Unirrigated land	296.88	<i>Rabi</i>	Mustard, wheat, chickpea, barley
pH	8.07 to 8.25 (alkaline)	Cultivable wasteland	117.86		
Soil depth	40 cm–130 cm	Area not available for cultivation	122.73	<i>Zayed</i>	Green fodder (lucerne, sorghum)
Rainfall	400–600 mm (erratic and intense)	Total area	1245.63		

4. Why technological inputs are required?

Shri Gopal Choudhari of village Dharolya was very excited when asked about the variety which he had adopted under this project. He brilliantly defined the village problems and all the farmers who were part of

the focused group discussion concurred with his views. He described how the village was predominantly rainfed and the crops mainly traditional. They atleast gave some yield, even in tough conditions. But they never really met the need and the village was just surviving. This situation was not acceptable but what to do?

When the project team interacted with us, we debated how to increase crop production and improve the productivity of our fields. The question was big to address but we decided to start with a small intervention which at the outset would address our main issue of enhancing production, but with a secure crop return.

The team of DEEP was there to do priority-ranking for all the crops and which one they should take for demonstration. A common decision was taken to first go for groundnut and soil nutrient deficiency as groundnut gives us fodder for our animals, a good economic return and also fixes nitrogen in the field. Crop variety selection was done using few criteria of which duration was the major one, due to erratic rainfall.

Major constraints

- Erratic rainfall
- Poor knowledge about basic and improved agriculture technology
- Timely availability of quality inputs was problem
- Wild life
- Soil erosion
- Poor understanding about marketing
- Traditional seed is being used
- Balanced use of nutrient is not in practice
- Soil testing is not common
- Poor availability of input

5. Addressing problems step by step

Problem analysis

This crucial task was handled very carefully as all outcomes of technological inputs are clearly linked with this process. Farmers of the area are progressive and ready for new inputs and knowledge if it meets their requirement. The entire exercise was done in a participatory manner. The outcome of this exercise is given in the box.

Farmers wanted a short-duration variety due to erratic rainfall. Their traditional variety gives good production only in good rainfall conditions. This was the basis for finalizing the variety for this area.

Awareness building

The most challenging task was executed by the philosophy of small steps with big outputs. The following interventions were carried out in the village to enhance knowledge and awareness.

- Regular informal village level meetings
- Focused group discussions
- Issue-based training organized on Improved Farming Practices, Transfer of Technologies, Integrated Nutrient Management, Integrated Pest Management and Water Management
- Organized Farmers' Day

Introducing quality inputs

- Use of improved seed variety from ICRISAT
- Use of macro and micronutrients (DAP, borax, zinc sulfate and gypsum)

Nutrient management

During discussion with the farmers, the field team learned about nutrient deficiency in the soil and proposed soil testing as essential before any treatment could be proposed. Based on the soil test report, a balanced fertilizer (micro and macronutrient) was suggested:

- DAP at 100 kg ha⁻¹;
- Gypsum application at 200 kg ha⁻¹;
- Zinc sulfate at 30 kg ha⁻¹;
- Boron at 2 kg ha⁻¹ was applied in all demonstrations at village level.

Introducing improved technologies

- Line sowing
- Use of sprinkler for irrigation
- Summer plowing
- Use of tractors for line sowing of groundnut
- Seed and fertilizer sowing separately
- Raised bed preparation

Comparative field demonstration of groundnut

Improved variety	Local variety
Early maturity	Late maturity
High production including grain and fodder	Low production of both grain and fodder
Heavy grain with thin seed coat (In 5 kg of groundnut we get 4 kg of grain and one kg of seed coat)	Light weight grain and heavy seed coat (In 5 kg of groundnut we get 3 kg of grain and 2 kg of seed coat)
Line sowing and proper seed rate	Earlier broadcasting of seed and heavy seed rate
First time applied micronutrients like zinc, gypsum, borax, etc	Only FYM no micronutrient
95–100 days crop	110–120 days crop
Only 5% seed are light weight	20% seeds are light weight
Probability of plant drying is less due to line sowing	Probability of plant drying is high due to broadcasting method
Easy inter-culture operations	Inter-culture operations are difficult
Pod formation in bunch	Pod formation not in bunch
Micronutrient reduces water requirements	Increases water requirement
Good market rate	Low market rate compared to ICRISAT variety

6. How seed promotion meets the requirement of agrarian community

Shri Hajari Lal Choudhari was very excited when he was asked about the outcome of varietal adoption in his field. He said – “My grain production enhanced and I got good fodder too.” In between, his wife was also talking and sharing her experiences about this variety. Though he was unable to tell the name of the variety, it being too difficult to remember, but later he read it on the seed bag which he had with him. Clearly, the outcome of this variety was really very good and he was happy with the production he received.

Hajari Lal is not the only farmer of the village who is happy with this variety. “There are lot of farmers who want to use this variety in the coming season and some farmers already experienced this variety and are very satisfied with the production in their field. This proves that this variety is successful in this climatic condition.”

Success indicators

Farmers learn about land preparation, proper seed rate and timely inter-culture operation

Increase in crop production of groundnut

Seed bank established at village level

Assured seed availability at village level

Increased awareness about use of balanced fertilizer along with micronutrients

Good market rate

Cost calculation

Types of inputs	Farmers' practice ¹	Demonstration
Plowing	1500	1500
Sowing	750	750
FYM	7200	7200
Fertilizer		
DAP	600	600
Urea	360	360
Borax	0	300
Zinc sulfate	0	1650
Gypsum	0	140
Seed	4800	4800
Weeding	4800	4800
Harvesting	1800	1800
Threshing	1800	1800
Market rate	2600 q ⁻¹	3000 q ⁻¹
Total production	6.5 q ha ⁻¹	9 q ha ⁻¹
Gross monetary return	6.5*2600 = 16900	9*3000 = 27,000

1. Seed distribution by Kisan Vikas Samiti is a priority of poor farmers.

7. Popularization and dissemination of seed of improved crop varieties

- Summer plowing
- Land preparation
- Line sowing by tractor
- Use of micronutrients
- Use of improved variety
- Increased crop yield
- Established Seed Bank
- Seed Bank operated by Kisan Vikas Samiti
- Seed distribution for poor farmers, so availability of seed is easy

8. Farmers' observations and knowledge

- Good production
- Early maturity
- Seed weight is better compared to traditional variety
- Crop rotation helps in termite control
- Groundnut should not be sown after mustard crop in the same field
- If rains fail then termite problem increases

9. Learnings

- Adaptability of any variety solely depends on the quality of the field demonstration.
- Step by step implementation increases farmers' participation.
- Participatory approaches are most beneficial for transfer of technology.
- Informal discussions in village meeting open up farmers to share their observations critically.
- Frequently Asked Questions (FAQ) prepared for technology transfer in advance helps in documentation of farmers' observations.
- Inter-personal relations are key for success

10. Impact

- Farmers have learnt about land preparation, proper seed rate, and timely inter-culture operation
- Increased production of groundnut
- Seed bank established at village level
- Assured seed availability at village level
- Increased awareness about use of balanced fertilizer along with micronutrients
- Good market rate in local market
- Technically sound demonstration makes good impact and increases adoption rate

11. How to scale it up?

- Proper diagnosis of any problem is the key for scale-up
- Establishment of seed bank helps in scaling-up of any variety
- Short-duration variety is in demand which ensures scaling-up
- Market tie-up is essential
- Availability of micronutrients

12. What did the farmers experience?



“Never ever used such a variety in my life. Good oil content, good color, better market price – all in one variety!”

Hajari Lal, Village Dharola



“Earlier I used to take only maize in my field. Last year I learnt about intercropping of maize along with groundnut. I did sowing of maize along with groundnut at a distance of 1 meter and I could get both the crops successfully. This was a dream for me earlier. This groundnut variety needs less water compared to our traditional variety.”

Gopal Choudhari, Village Dharola



"I never applied micronutrients in my life. This year I did line sowing of the new variety of groundnut provided by ICRISAT and got good production compared to my traditional variety."

Ramdayal, Village Dharola



"Best characteristic of ICRISAT groundnut variety is bumper flowering and good production. This variety is early maturing, which is our demand. It has good market rate. Seed formation in this variety is assured compared to our traditional variety."

Narayan Choudhari, Village Dharola

Variety brought change in the farming practices

Location: Tola, District: Bhilwara, State: Rajasthan

1. Introduction

Food security is the main concern in rural rainfed Rajasthan. There has been a sizable shift from food grain crops to commercial crops. Traditional crops are grown only for home consumption and particular food requirements.

Maize is the staple food of most of the rural families living in the rural southeast of Rajasthan. But its production is very traditional and quality seeds are not used.

In this write-up we discuss what made the shift from traditional variety to an improved variety with the balanced use of nutrients and an appropriate package of practices. Farmers were unaware of the concept of balanced nutrition to improve production and enrich the soil health. For a scientist, this can be a simple story, but for the farmers of village Tola it was entirely new. Something they had never heard about before. The results were amazing for them. The improved package of practices changed the village choice of variety, and created a demand for micronutrients in the market.

Characteristics of Mukta: Widely adapted maize hybrid suitable for rainfed condition with outstanding yield and stability. Stable yielder across many environments. Responsive to high input management. Excellent agronomics and consistency. Orange, semi flint with bold grains with excellent tip. Very uniform and appealing plant type of 85–90 days maturity.



2. Concept of case documented

This case study concerns balanced nutrient application based on soil testing applied on a new variety of maize. The work was done in a remote village of Rajasthan where such technology is usually a dream and farmers never get an opportunity to interact with scientists. How an essentially simple process can bring immense change to an area is elaborated.

3. The settlement

The Tata-ICRISAT project is working in a cluster of three villages: Dhod, Goga ka khera and Tola, of Jahajpur block in Bhilwara districts of Rajasthan. The village Tola and neighboring villages are predominated by the Meena community, known for its progressive nature in adopting new knowledge related to agriculture. But the biggest constraint was lack of information and availability of inputs on time. This is due to the remote location of these villages. Information reaches them, but very late. The progressive nature of the farming community presents a big opportunity to promote improved technology in these villages.

4. Village: Tola

Some brief demographic information of Dhod, Goga ka Khera and Tola, is given in the table. If we look at the average land holding size, we can see it is less than one hectare. Therefore the focus has to be on productivity enhancement. This will reduce migration of these farmers and strengthen their association with their own land. The female literacy rate is low but interestingly, girl education is increasing day by day in the village.

Most agricultural interventions are executed and managed by women farmers. Thus more capacity enhancement is required for the female members of each household than for the men. This is a big challenge. Interaction with the women of the village revealed that they have good knowledge about agricultural operations but lack knowledge about new technologies and methods. The major crops of the area are maize in the *kharif* and wheat in the *rabi*.

5. Production challenges

The problems in the village were almost common to other villages of the state. Interestingly the village does not have water shortage compared to other villages but there were no better water management practices. Major challenges in agriculture are listed in the box.



Population	2376
No. of households	487
Forest land (ha)	117
Cultivable land (ha)	199
Non-cultivable land (ha)	375
Irrigated land (ha)	239
Non-irrigated land (ha)	110
Total land (ha)	1040
Average land holding (ha)	0.77

Challenges

- Low production
- Lack of sustainable income source
- Poor rate of education hindered adoption of new technologies
- Poor quality of seed and other inputs
- Migration
- More inclined to traditional practices
- Women understanding about improved agriculture practices is low and they do most agriculture interventions
- Rainfed agriculture
- Market distance
- Black marketing of inputs

6. The process

BAIF has worked in this region for many years and results of their efforts are easily visible. Acceptance of BAIF as a developmental organization is great. When the project was started in Bhilwara district the village Tola was not the part of initial demonstrations of the project. The success of demonstration and the economic benefit spread the message to the neighboring villages. The villagers of Tola, who had some relationship with BAIF team for some other issues, requested the field team to start project intervention in this village as well. This was a good start and a good indicator for success of any intervention.

Demonstration started with the staple crop of the area. Maize is most commonly consumed rather than wheat in this region. Therefore if production of maize increases then it will strengthen the food security of the area. To understand the needs and issues, a detailed problem analysis was carried out in the village as part of the process.

The most crucial and tough task was selection of a lead farmer who can take up this varietal promotion initiative at scale in the village. As the farmers of this village had themselves invited BAIF, selecting the right farmer was not a big issue here. A few progressive farmers who themselves took up action-research in their fields, were part of this action-research on varietal promotion followed by up-scale adoption. These farmers were organized into a small informal village group in which they discussed outputs and outcomes of the participatory action research in their fields and how it might be scaled out in the villages. This is a two way system for transfer of technologies. Farmers communicated their own ground realities to the researcher and the researcher communicated modified technology to the farmers.

Farmer selection criteria

- Have progressive attitude and should not migrate.
- Agree to accept technical guidance of project team and ready to pay contribution.
- Own at least one ha land with irrigation facility.
- Easily accessible plot site with uniform slope and soil fertility.

The most crucial step which helps in deciding chemistry of action-research was soil testing. Explaining about nutrient deficiency to the farmers was very difficult as earlier they never heard about such deficiencies which affect crop production. This was a priority that at least the demonstration farmer must understand what nutrient deficiency is and can apply that nutrient in the soil against a soil test. Twenty farmers were selected for soil testing in the village and after analysis, ICRISAT prepared soil health cards for the farmers. This is an important tool for productivity enhancement and soil fertility improvement. Zinc, sulfur, boron, available phosphorus and available potassium are low and other nutrients are normal in the soil of this area.

Nutrient status in the soil

Soil pH (1:2)	Electrical conductivity (dS m ⁻¹)	Organic carbon (%)	Available phosphorus (mg kg ⁻¹)	Available potassium (mg kg ⁻¹)	Available sulfur (mg kg ⁻¹)	Available zinc (mg kg ⁻¹)	Available boron (mg kg ⁻¹)
8.5	0.21	0.74	3.80	38	5.0	0.54	0.56

The trials were mainly with maize variety Mukta released for this region. The outputs of this variety are good. Earlier they heard about this variety but had never used the seed. Based on recommendations of the soil test, inputs were defined and applied. Details of trials are given in the following table.

Year	Crop	Varieties	Participants
2008–09	Maize	Mukta, Kaveri-235	30
	Wheat	Lok-1, Raj-3077, Raj-3765	30
	Mustard	Madhuri	30
2009–10	Maize	Mukta, Kaveri-235	30
	Wheat	Lok-1, Raj-3077, Raj-3765	30
2010	Maize	Mukta, Kaveri-235, Bio 9220	240

Treatments were based on soil nutrient status and crop requirements. The control plot size was equal to the treatment plot, ie, 2000 m². In the treatment plot the following inputs were used:

- Recommended seed rate
- Rhizobium and PSB/*Trichoderma*
- DAP 11 kg
- Urea 21 kg (maize)
- Gypsum 32 kg
- Zinc sulfate 5 kg
- Agribor 250 g

7. Treatment results

To make the treatment successful various observations were taken at various stages. A total of 19 different types of observations were taken at each treatment plot. This not only helped in assessing the outputs at each stage but also trained the farmers to do the same in their own field with their own seed. It assisted in building awareness amongst the farmers and created a good environment.

Field observation shows that average grain yield is 3820 kg ha⁻¹ in treatment plot and 2100 kg ha⁻¹ in the control plot. The treatment plot yield was 82% higher than the control due to improved variety and



balanced fertilizer application. These are encouraging results, which will boost the adoption of Mukta variety at scale.

8. The findings

Technical

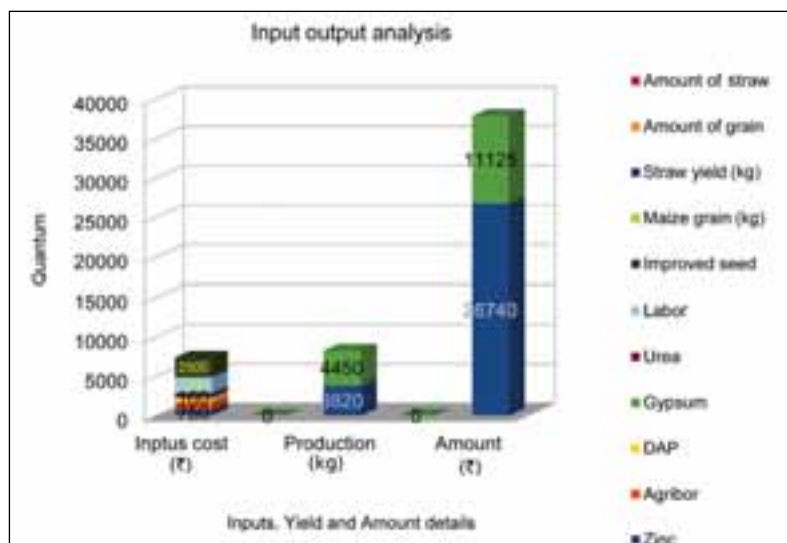
- An 82% additional yield can be obtained by BNM and improved seed.
- Plant protection is possible by using micronutrient and also reduces cost of production.
- Critical irrigation increases production by 0.2–0.5 t ha⁻¹.

Economic

- As per cost-benefit ratio we can get 3 to 4 times additional output with ratio of 1:4 in case of hybrid maize.
- Farmers get returns for up to three years against the one time investment (₹ 2835 per ha) on micronutrients in the *kharif* crop.
- Economic relief in plant protection due to addressing deficiencies with micronutrients.
- Better market prices due to a desirable shiny grain (an outcome of sulfur application).
- Minimized seed cost through certified/foundation seed role plan.
- Reduced irrigation cost through short-duration variety and moisture management.
- During discussion with the farmers most of them were yet to confirm that they will again apply after three years but few of them were confident and saying they will apply it after every third year if it is available in the local market.
- When discussed about the difference between traditional variety and hybrid variety the villagers were of clear view that hybrid gives more return compared to their traditional variety. Thus it is more beneficial to go for hybrid. But here we need to see how the traditional genotype is also conserved and if there is any possibility to strengthen the traditional variety with balanced application of inputs for seed sustainability. The economics of sustainability is crucial here.

Social

- We can maintain soil health.
- We can make women and local youth aware with live demonstrations.



- Farmers get new skills and updated knowledge.
- Change in mindset through eco-club and other social mobilization tools.
- We can involve the community through need-based participatory research.

Forage production

- Apart from the maize grain crop, a fodder crop of sorghum using a new variety and balanced nutrient application was taken up by 80 farmers in the area. Thus fodder was available for 3 to 4 months more than with local practice using local seed.
- They got economic relief through milch animal with amount of ` 4000 per year due to additional income from dairy.
- Total 16 ha area is covered under forage production.

Vermicompost

- Production and use of vermicompost has not been successful due to various reasons. High temperature is one of the reasons for lack of adoption by the farmer.
- In total, 20 participants benefited, but some did not continue after the first round of production.

Summer plowing

- Farmers realized that weed control and moisture management were good.

9. Scaling-up

- Assured seed availability is key for scaling-up of any variety.
- Rigorous training and capacity enhancement is essential.
- Improved farm implements for plowing and seed sowing in particular, are required.
- Easy availability of micronutrients in local market.
- There is a need to develop a mechanism to involve small, marginal and resource-poor farmers. The existing selection criteria do not attend to these categories of the farmer.
- More efforts are required to develop better understanding of the residual effect of micronutrient application.
- Better market links for easy availability of micronutrients and other quality agriculture inputs.

10. Lessons

- The timely application of any method and technology is crucial.
- For adoption of any technology, a proper demonstration of a package of practices is crucial.
- The farmer also needs additional outputs like fodder otherwise adoption rate goes down.
- Boron application was useful.
- Crop rotation needs to be adopted.
- Use of micronutrients like zinc, sulfur and gypsum increases moisture retention and disease resistance.
- Women farmers believe that hybrid seeds need more care and high inputs compared to traditional seeds. This needs to be clarified.

- The team does not address poor and marginal farmers due to crises of funds and local dynamics.
- In case of vermicompost, the rate of adoption is not good when compared with other locations where the same was promoted and well adopted by vegetable-growing farmers due to immediate results of enhanced production and quality of their vegetables.
- Staff orientation on research methodology is a must before implementation.
- For adoption of any technology, a proper demonstration of package of practices is crucial.

11. Impact

- Short duration of crops was the reason to make the variety popular amongst the farmers.
- The maize variety Mukta is well received by the farmer.
- Grain quality improved after use of micronutrients.

12. Farmers' views

“Application of micronutrient increases seed shining. It also reduces water requirement of the crop.”



Mrs Kalidevi w/o Udailal Meena, Village Tola



“My production cost got reduced drastically.”
Arjun Singh Man Singh Meena, Village Tola



“Application of Agribor reduced the cost of DAP and I obtained good production.”

Ramesh Sevalal Meena, Village Tola

Market forced farmers to adopt new varieties

Location: Saherbera, District: Jamshedpur, State: Jharkhand

1. Introduction

Development is always a priority for Tata. Under its social responsibility Tata Steel Rural Development Society (TSRDS) is working in Jharkhand with tribes since 1979. Based on the learning from its interventions in the villages, the organization decided to work to strengthen agricultural practices of these families under Tata-ICRISAT project. The project is mainly focusing on crop productivity enhancement.

Jagannath, a young farmer, confidently tells the story of positive changes in his village Saharbeda. While talking to him, he was thinking about his past, how things shifted from dry to green and low to high production in his own land and village. The way he explained his entire experience is a treat to listen to again and again. “Three crops, one farmer, too much work load”, that is what he said! But knowledge and better practices makes it easier.

During discussion with Jagannath it clearly came out that the market is the biggest force behind scaling-up the technology and varieties promoted by the TSRDS of any crop in their area. And for Jagannath and other farmers of village Saharbeda it is a true story which starts from selling green gram and green maize cobs. A new variety of chickpea was introduced as a second crop to utilize fallow land in the village.

2. The case study

This is an interesting story about a village where the organization promoted one short-duration crop variety with an integrated package to change the cropping pattern. Its adoption tells of the success of the approach in the remotest villages.



3. Process of implementation

As with other villages, project implementation was started with soil testing, farmers' training, orientation, exposure visits and demonstrations at village level with sound technical support by the ICRISAT team. In each village a few progressive farmers cum volunteers were identified and given training to collect information and to distribute project inputs.

The village is remotely located from district headquarters (the poor connectivity puts it in the remote category) and surrounded with dense forest. Interface with wild animals is part of daily life. Sometimes the quantum and quality of agricultural production depends on the damage by elephants and other wild animals. Elephants are the biggest enemy for these farmers. They try their best to keep elephants away from their fields but it is next to impossible.

Interface meetings, focused group discussions with the farmers and prioritization of their demands in agriculture revealed that if they are provided with short-duration crops they would be very happy. This was mainly to protect their crops from wild animals. Also short-duration crops fit better in the area with reference to weather and resources to ensure better production.

Seed of a high-yielding variety of maize was provided to them. The crop was very healthy. Crop growth was good due to balanced application of nutrients and better intercultural operations as suggested by the scientist. Meanwhile farmers observed that damage to this variety by elephants was increasing. It was not possible for them to save the crop.

The fields of the farmers are located along the link road that connects to other villages of the area. People from these villages also work in the industrial area and there is inflow and outflow of people. When these people saw the crop they asked for green cobs. A few farmers sold green cobs and due to a better taste demand soared. Initially farmers were not interested to sell their crop green but when there was attack from elephants then they decided and sold it green and in this way a market emerged at village-level itself.

A few days after farmers saw elephants damaging their crops they realized it would be good if they sell green cobs. Small sales of green cobs got a better response from the people and gradually it picked up very fast. Taste of this variety was also good and was liked by the people. Farmers who have sown this variety earned good profit compared to grain.

In this village farmers also keep fallow land due to heavy rains and lack of improved knowledge of cultivation. Introducing short-duration, improved varieties helped them to plan for taking two crops from the same field.

In the postrainy season, ICRISAT along with TSRDS team, planned planting of short-duration kabuli chickpea variety Kak 2 in the rice-fallow land of the village. This was a good experience. Farmers were happy as they tested the benefit of a new variety with good production and better returns by selling green pods. This was done with 16 farmers and the local variety JG 11 with 15 farmers. Yield details are given in the following table.

Chickpea yield with seed priming technique in rice-fallow fields during winter 2008

Chickpea variety	No. of farmers	Area covered (ha)	Grain yield (kg ha ⁻¹)
Kak 2 (Kabuli)	16	3.20	1614
JG 11 (Desi)	15	3.10	1165

Demonstration of Kak 2 gave better results compared to the traditional and other local varieties of chickpea. With improved practices, plant growth was good and grain size was also bigger than the local one. When people from other villages saw the crop they asked about the variety and some of them tested it also. The same problem of elephants occurred and people then asked about selling the green crop only due to better taste and big size of grain.

Farmers were very happy with the crop and they were not interested to sell it. When they refused then some people started stealing the crop while passing from the field and it became difficult to control this. Then it was decided by farmers to sell it as green pods (seeds) and get better prices.

TSRDS and ICRISAT were very happy when they heard about these results of the crop but at the same time they were worried about their data which they required for their own record. Somehow data from some sample plots were gathered and analysis was carried out and shared with the farmers.

4. Constraints faced during implementation

- **Remoteness:** Villages selected for the project are located remotely and connectivity of these villages is also not good. In rainy season it is really difficult to approach these villages.
- **Poor infrastructure:** There are few basic amenities within the village. All are dependent on the nearest town which is 20 km away.
- **Low awareness:** People still follow traditional practices in agriculture. There is no proper operational system which shares updated information with the villagers. Most depend on the market for new information and knowledge. This way one cannot ensure that whatever knowledge they are getting is good and beneficial to them.
- **High expectations of community:** After getting regular support from TSRDS on various issues people held high expectation from the project team. Meeting all the expectations is not possible for any agency.
- **Industrialization:** Shift from farming to a job in factories is a big trend in this region. This is due to low or sometimes no returns from agriculture.
- **Low return from agriculture:** Traditional practices, lack of knowledge about improved practices and limited resources are the main causes of poor returns from the field.

5. Role of TSRDS

The process of change is mainly facilitated by the team of TSRDS. It was a long journey over a couple of decades when work started in this region by Tata and later on development work also started through TSRDS.

Facilitation is not an easy task; it has its own principles and takes time. When it comes to bring change in agriculture systems it becomes much tougher. The reason? It is understood that agriculture is a traditional practice; thus every farmer knows it very well and therefore we need to do very little. But in reality it is not true. The young generation is far away from agriculture practices, both traditional and improved. What they do is just sow seeds and want a good harvest. That's all. They are not interested to know more than that. In such circumstances it was difficult to introduce technical agriculture practices to change the scenario.

6. SRDS and ICRISAT focus

- Soil test-based nutrient management, micronutrients usage for rice and other crops
- Chickpea crop after rice-fallow
- *Kharif* maize introduced in upland
- Land management (plowing techniques)
- Low-cost drip systems
- Vermicompost pits
- Nursery development (*Gliricidia*)
- Seed bank

7. Major crops promoted and their data

Effect of micronutrient (MN) application by spray and basal methods on paddy yields, rainy season 2009

Treatment	No. of farmers	Area (acre)	Grain yield (kg ha ⁻¹)	% increase
FYM + DAP + Urea (Control)	10	9.3	2850	
Control + MN spray	5	10.3	3230	13.3
Control + MN basal	6	10.3	3498	22.7

Chickpea grain yield in rice-fallow fields sown with seed priming technique, postrainy season 2009

Chickpea variety	Sherabida and 8 villages of Sariekela-kharsaw district			
	No. of villages	No. of farmers	Area covered (ha)	Grain yield (kg ha ⁻¹)
Kak 2 (Kabuli)	6	21	3.15	630
JG 11 (Desi)	9	36	2.80	590
ICCV 2 (Kabuli)	3	13	2.20	410

8. Benefits of micronutrients

- At least 25% production increase in vegetables like tomato and brinjal and crops like paddy and maize
- Good color of grain gives better price in the market
- Vegetable sold on priority basis
- Plant growth is good, production enhanced, good quality fodder, disease resistance and healthy plants.

9. Key success factors

- Roadside village
- Wildlife attack: we are taking this as success because it forced the farmers to change the crop and take care of the crop till it reaches the market.
- Better price for green produce like chickpea pods and maize cobs
- Short-duration crop

10. Outcome

- Use of micronutrients increased
- Paddy production increased from 0.75 tons/acre to 1.8 tons/acre by 2008.
- Paddy fallow land used for chickpea production.
- About 20 percent farmers are now taking three crops in the village.

Paddy

Paddy variety	Sowing method	Before intervention		After intervention	
		Area (q/acre)	Yield (q/acre)	Area (acre)	Yield (q/acre)
Local	Broadcasting	16	7	16	8.5
	Transplanting	Nil	-	1	10.5
HYV	Transplanting	Nil	-	16	14.5

Changes in the postrainy season crops

Crop	Before intervention		After intervention	
	Area (acre)	Yield (q/acre)	Area (acre)	Yield (q/acre)
Oilseeds	-	-	5.2	3
Pulses	14	6	6.5	4
Vegetables	0.9	6	2.5	35
Wheat	-	-	4.0	7
Potato	-	-	2.0	25

11. Future challenges

- Sustainable availability of micronutrients at local level with good quality.
- How to shift young generation from working in industries to agriculture.
- Still only a few farmers are using micronutrients in some villages.
- Wildlife: wolves eat the groundnut crop and elephants destroy the pigeonpea crop.

12. Village – Saherbera

- Panchayat: Raidih; Block Kharsawan
- Total population 204 (Male – 108, Female – 96)
- No. of households 32 (ST – 100%)
- Total area 22.5 acres
- Forest land 37.75 acres
- Non-cultivable land 6 acres
- Plantation 5 acres
- Cultivable land 16 acres (Primary source)
- Area cropped more than once 10 acres
- Gross cropped area 6 acres

Sources of livelihood –

- Agriculture 31 households
- Service/Business 69 households

Improved goat breeding program in Bundi watershed area of Rajasthan

Location: Thana, Govardhanpura, District: Bundi, State: Rajasthan

1. Introduction

The goat, known as the poor man's cow, is a lifeline for many poor families in Rajasthan. With a small investment, goats can give a good return. This characteristic keeps it in high demand in poor households. Breed improvement can help increase productivity where genetic quality is poor. Farming and animal rearing are complementary to each other. For farmers who have good quality land, animal rearing may be secondary, but in arid and semi-arid regions, where rainfall is low and uncertain and assured crop production is not possible, then animal rearing becomes important.

Goat keeping is mainly carried out as subsidiary enterprise to supplement incomes from crops. For the very poor, often women, they may be the main source of income. Goat keeping is usually free-range grazing in open fields and wastelands plus some crop by-products, which would otherwise go waste. There are 102 breeds of goat in the world; twenty of them are in India. Goats are reared for two purposes, ie, meat and milk.

Jamnapari and Sirohi are two good Indian breeds known for their good quality meat and milk. They have been introduced to other countries to improve local stocks.

2. Concept of case documented

Social and economic inclusion is the main theme of this case study. The project is mainly focused on enhancement of agricultural productivity but when the project team learned that some landless farmers



were not covered a decision was taken to work on their priorities. These families were completely dependent for their survival on local (*deshi*) goats. Most of these have slow physical growth but are locally adapted. The main objective was to improve the *deshi* breed with a Sirohi buck and change the livelihood of the herd-dependent community. The Sirohi breed has a much faster weight gain than the *deshi*.

3. The settlement

The villages Thana, Goverdhanpura and Salaviya are part of Bundi watershed which is located 35 km from Bundi District headquarters. This region is commonly known as the Hadoti region of Rajasthan. Habitations are scattered and most people belong to Meena tribe and the Gurjar community (60%). The total population of the watershed village is 4034 in 685 households.

The villages cover 3031 ha, of which 1409 ha are under agriculture with 477 ha completely irrigated, 731 ha un-irrigated and 201 ha of cultivable waste. An additional area of 1187 ha is un-cultivable wasteland which may be upland or lowland. Another 435 ha is forest. Average land holdings are 3.79 ha per household. The depth to water is 20 feet in an open well. Soils are red to brown. Soil testing revealed: pH 8.5; EC 0.21dS/m; OC 0.59%; available phosphorus 6.2 mg/kg; available potassium 91mg kg⁻¹; available sulfur 9.25 mg kg⁻¹; available zinc 0.65 mg kg⁻¹; and available boron 0.45 mg kg⁻¹.

How to improve rainfed farming is the biggest challenge. Over 90% of land is used in the *kharif*, and 65% in the *rabi* season. With good rains and water available in the wells and tube wells, then *rabi* cropping may increase. There is no perennial river near the village. The main crops are maize, soybean, chickpea, mustard and wheat in both seasons. The farmers are industrious. Despite water scarcity they try hard to get maximum output from agriculture.

4. The process

There are stories about the shepherd community of Rajasthan who are renowned for their rearing of large-sized goat herds. But in Bundi district they are hardly to be found; there are but a few large-scale goat keepers. Mostly people keep goats to meet basic consumption needs of the family, so breed and quality were never big issues for them.

Small farmers depend on goats to supplement their crop output. BAIF had selected some poor farming families which already kept goats around the house and suggested using improved bucks to improve the *deshi* breed. After a few days, ten farmers agreed to take the Sirohi buck for their flocks. The project provided the funds on repayment basis from the revolving fund created under the project.

BAIF staff and few selected committee members formed a team to purchase the Sirohi bucks for the project area and visited Ramsar near Ajmer to buy them and to learn from the vendors about the habits of the buck and their maintenance. Insurance was also arranged at the same time.

Adult *deshi* bucks were separated from the herd and one Sirohi buck introduced. One buck can serve 40 goats.

Challenges

- Goat keeper and goat both are in poor category
- Reducing area of common land
- Degraded pasture land
- More dependency on natural breeding services
- Small land holding and lack of fast growing species
- Limitation of herd size
- Social and economic status of goat owners in the community
- Lack of organized market
- To use as liquid asset, mortality in initial stages due to poor management and keeping

The buck was fed about 250 g of barley grains and other fodder. After a few months the new kids arrived and the BAIF team provided training about how to maintain good health of the buck. From time to time BAIF staff supported the groups and gave vaccinations and health checks. Only 12% of the buck had been affected by diseases and pests.

The new kids in the herd were healthy. Nine members of the group returned their loan within two years by selling the new kids, and one farmer returned the money after insurance claims. These ten Sirohi bucks were used for ten families in the three villages through a revolving fund. The ten families in turn provided a breeding service to other families with a small charge to cover maintaining the buck health.

Particulars	Quantum
Buying the Sirohi breeding bucks (No.)	1643
Total money spent on the bucks including all charges (₹)	40,000
Benefited the family (No.)	205
Sirohi kids born (No.)	1069
Net income by selling the goats (₹) in three years	1643060

5. Community response to Sirohi

Breed improvement in a new area is not easy because of the cost of improved stock. But in the case of goats it is easier because the risk of one improved animal is not great compared to a large ruminant. BAIF, a well-known agency in the livestock sector, took up this assignment in 2003 after an analysis of the area under the ICRISAT supported project. The initiative was started with only a few families who were ready to adopt the change. The efforts were completely funded under the project; therefore risk for the participants was low.

At an early stage the adoption rate was low. But when people saw the new generation and the rapid growth of the kids, a demand for service from the Sirohi bucks gradually grew. A payment system, formulated to charge for services, got accepted, and the system got established. Now it has spread across the region and Sirohi progeny can be seen in every herd of goat-keeping families. The number of Sirohi progeny born and surviving are recorded, as are the amounts received after sale in the market. A summary of outputs from 2003 to 2010 is given in the following table.

Outputs of the breeding buck from 2003–2010

Name of beneficiary	Micro-watershed	Families benefited	Goat kids			Amount (₹)
			Male	Female	Sold	
Shyoji/Sawala	Thana	23	83	87	100	262000
Shivraj Singh/Sarar Singh	Thana	20	90	91	134	306000
Bansi/Lodikya	Gordhanpura	28	95	99	160	390000
Durgalal/Gendilal	Thana	30	38	33	57	150750
Kailash/Prabhu	Salavalya	20	34	36	53	132500
Prabhu/Deva Gurjar	Salvalya	23	50	51	54	142360
Bhawarlal/Ramdev	Gordhanpura	28	51	49	41	11425
Gopal/Ghasi	Thana	13	9	10	10	24700
Ramesh/Ratan	Thana	20	85	78	52	121000
Ghasi/Lal	Salvalya	0	0	0	0	Buck died
Total		105	463	475	564	1344060



The data clearly explains the story of change in this area, how the community responded to this initiative and the results. This small action brought big changes in the life of people.

6. Popularization and dissemination of improved breed

BAIF and ICRISAT organized a farmers' day every year and every crop season to popularize and disseminate their activities. Farmers from the nearest villages, the Institute and the beneficiaries,

all share project activities with one another and to those not directly involved, and discuss how to benefit from the project. The Line Department also tells of its departmental activities in this program. The Krishi Vigyan Kendra is also helpful to inform other farmers about what is going on. ICRISAT provided exposure visits to other areas where farmers had excellent benefit from the project. On these visits the interaction is of farmer to farmer sharing the actual benefit of the project (as given below).

Name of beneficiary	Village	Number of goats born	District	Produced kids	Amount (₹)
Shyoji/Sawala	Thana	3 female goats	Bhilawara (D), Boi (V)	Sold 15 kids	45000
Shivraj Singh/ Saras Singh	Thana	No	No	No	0
Bansi/Lodikya	Gordhanpura	16 female goats	Distributed amongst brothers by father	Sold 25 kids	75000
Durgalal/Gendilal	Thana	4 female goats	Given in kinship and in village, district Bundi	Sold 25 kids	50000
Kailash/Prabhu	Salavalya	No	No	No	0
Prabhu/Deva Gurjar	Salavalya	No	No	No	0
Bhawarlal/Ramdev	Gordhanpura	No	No	No	0
Gopal/Ghasi	Thana	1 female goat	Thikarda (V), Bundi (D)	Sold 11 kids	33000
Ramesh/Ratan	Thana	2 female goats	Thikarda (V), Bundi (D)	Sold 13 kids	39000

7. Learning

- Market planning as per the market
- Herd size 10+1 is acceptable and manageable in this region
- An advanced pregnant or with-kid goat is the best option while promoting this breed with the farmer for an early start of income
- Goat rearing should not affect the education of children and it should be shared by other family members as per their school time
- Increased awareness about feeding of goats

- First-rain water is the biggest problem in rural areas.
- More focus is required on basic health care like de-worming, etc.

8. Outcomes

Change in breed rearing in the area

- Sirohi breed was not commonly reared in this area. It was not accepted due to lack of knowledge about its characteristics and growth amongst the rearing community.
- With proper backup support, an initial introduction of Sirohi breed brought change in breed.
- Now the number of Sirohi bucks and goats is increasing in this area.

Demand of improved breed in the local market

- Difference in growth of kids is around 10 kg more than the local breed
- Healthy, fit and active nature of breed
- Resources availability

Knowledge and capacity of the rearing community

- Additional feeding to kids as per market need
- After three years in 2006 every herd owner sold the previous Sirohi bucks and introduced a new buck in his herd to control inbreeding

Other families also liked the improved progeny of bucks, and at this time we can see the Sirohi breed in every herd of goats around the area. The outcome is summarized below.

Particular	Number	Duration	Amount
Families motivated and joined breed improvement program	105	2003–10	
Kids born from Sirohi bucks by natural service	938		
Earning by selling of new progeny of the Sirohi breeds			1,344,060

9. Farmers' views



“The new progeny of Sirohi breed give 1.5 liters of milk per day. I provide 250 g of grain as feed. The milk yield is two or three times that of the *deshi*. The Sirohi goat gives two kids in 14–15 months. The health of the Sirohi kids is better than the *deshi* and the insurance of bucks has been very fruitful for me.”

Durgalal, herd owner



“I bought one Sirohi buck with the help of BAIF institute for three thousand rupees and after two years I got 75 kids in my herd and another 25 families in my village had 55 new kids. After three years I sold the breeding buck for ₹ 7000 and also 70 new he- and she-goats from the herd, earning ₹ 75000 in net profit. At present 15 Sirohi breed goats are in my herd. Other families of my village also have breeding bucks in their herds. This business is better than agriculture for our area.

Ramesh s/o Sri Ratan Lal



I have provided Acacia leaves and pods to she-goats which come on heat very quickly. The Sirohi animals are rarely affected by diseases and pests. When the rains start, we give vaccine to the goats and kids, otherwise they can suffer from diarrhea. By protecting the kids from cold, their mortality rate is reduced. In total, 35 kids were born in my herd and only one died. During famine domestication of goats is better than any other business in rural area. The maintenance costs are very low and everywhere you can sell without problems and the benefits of Sirohi breed are higher than the *Deshi* breed.

Bansi Lal s/o Sri Lodakiya, Village Goverdhanpura

Small support made vegetable farming profitable

Location: Mawairaiyat, District: Mandla, State: Madhya Pradesh

1. Introduction

Backyard vegetable production is commonly practiced in the villages by most farmers. But very few take up vegetable farming as their main enterprise in remote villages due to poor market demand, and sometimes the food habits of the area.

In general, the Gond region of Madhya Pradesh receives good precipitation every year and has good forest cover. Water is available for much of the year. Unfortunately, Niwas block has a different story altogether with low rainfall, wastelands and poor soil health. The case which is shared here is from this region of Mandla district of Madhya Pradesh. The intervention discussed is implemented under SRTT-ICRISAT project and it was started on a pilot basis in six villages of Katangsivni Panchayat namely Mavaimaal, Mavairaiyat, Padarpani, Katangsivni, Bhardwara maal and Bhardwara raiyat of Niwas block.

This case study has focused upon Chain Singh, a vegetable grower who benefited from the program through varietal change and change in package of practices, as well as use of bio-fertilizers and locally made treatments.



2. Concept of case documented

This is the story of a farmer who wanted to scale-up the returns from his field and was supported once he showed his commitment by taking water from a very small but perennial water source close to his farm. He was doing vegetable cultivation for home consumption. When he saw one of the farmers of his village named Mr Halku Singh doing vegetable cultivation and earning good money out of it, he also dreamed to become a vegetable grower and earn good money. But he was sure that he would go for more organically grown vegetables rather than applying chemicals. He got support from the Foundation for Ecological Security (FES) project and proved himself by producing quality vegetables and making a profit. He told us that his primary objective was to have good vegetables for own consumption, and to earn money was secondary. He could achieve both successfully.

3. The settlement

Niwas block of Mandla district is a predominantly tribal block: almost 70% of the population are tribals. Mandla, in the Chattisgarh Hill Region, receives an average rainfall of 1400 mm, though Niwas receives much less, only about 400–500 mm. Agriculture in Niwas block and in the rest of Mandla district has largely been traditional with very low productivity. The dependence upon rainfed cropping restricts farm productivity. There are stony uplands (Bharra lands), and an underlying basalt rock leads to high surface runoff. The availability of groundwater is low, limiting the opportunities for using groundwater for irrigation.

The project area has high to moderate recharge potential. Using surface water in recharge structures would make sense in such an area for improving the availability of water. Besides this, small-scale vegetable production where the farmer has a perennial source of water, the introduction of high value crops which can be grown in residual moisture after monsoon (like gram), and an improved package of practices have all been introduced to improve crop productivity and reduce input costs.

Mawairaiyat is situated 650 to 700 m above sea level in Katangsivni Panchayat of Niwas block in Mandla District. The slope of the area varies from 5% to 40% which encourages soil erosion during heavy showers. The village is spread over in 260.04 ha. The village is divided into three hamlets with a total population of 267 people. The average literacy is low, especially amongst the females. The land is mostly undulating in nature with a massive spread of basalt rocks which allows only moderate recharge. Mawairaiyat is comprised of 77 households with 267 members with a scheduled tribe population of 240 and OBC population of 27 people.

Location: The village is located in Niwas block and is about 8 km from the main bus stand of Niwas. The village is well connected with concrete roads (done in PMGSY). The nearest weekly market of the village is Pipariya (Saturday) and Niwas (Friday).

4. Resources

Land: The total population is spread over an area of 1.29 ha. Private land covers 89.82 ha, reserve forest covers 33.24 ha and revenue forest 3.30 ha. The area under water is 4.90 ha. The total area is 260.04 ha.

Forest: Previously the village had good forest cover but now degradation has spread to such an extent that the villagers have to go more than 3 to 4 km to obtain their fuel wood. The village is now a part of a federation (Sailani Sanyukt Manch), which is basically engaged to protect the forest area comprising seven villages.

Water: The village has two wells and one handpump for drinking water, and 3 streams and one pond for bathing and washing. There is a stop-dam which is basically used for irrigation.

Agriculture crop details and dependence: The farmers cultivate paddy, wheat, maize, mustard, pigeonpea, *batra*, *masoor* and chickpea during *kharif* and *rabi*. Paddy, maize and wheat are the most important crops.

Fodder: The village had proper forest surrounding with ample fodder which was favorable for domestic animal rearing. The current situation has changed to a great extent as external influence on the forests has led to great degradation of forests.

Fuel wood: The villagers obtain fuel wood from forest but from more than 4 km away.

Migration: With the passage of time, population increase and resources getting scarce, people started migrating to other places in search of work to satisfy their basic necessities in life.

Institutions: An executive body of the Gram Sabha Prakritik Sansadan Prabandhan Samiti had been formed in the village so as to regulate and monitor the ongoing activities undertaken in the village.

5. Fresh vegetables from my field

Vegetables were promoted to improve the nutritional status of people in the project area as well as to develop an alternative source of livelihood. The food habit in this area rarely includes vegetables so the individual rarely has a nutritional diet. Vegetable cultivation on a small scale was seen as an important intervention to make better use of available water resources in homestead lands as well as small patches of irrigated lands. The sowing of vegetables coincides with the time when farmers start moving to the cities for employment. In view of these issues, nine farmers were selected for vegetable cultivation. Chain Singh was one of them in 2009.

Chain Singh is a vegetable grower from Mawai Rayyat. The village falls in high recharge zone, with low availability of groundwater. He is a small farmer with five acres; most of the land is un-irrigated. He had a dream to ensure that his family could eat healthy and good quality vegetables. By producing vegetables in his own farm he proved that he is not only a visionary but a strong implementer too. The year 2009–10 was the year when he could say in his neighborhood and to his relatives: "See these are fresh vegetables from my own farm. Please take some and eat healthy food like my family is eating."

6. Perfect selection

The implementation of any activity and identification of farmers is usually done by the Village Institution, the Gram Sabha. Organizing the Gram Sabha for every decision is not possible;

What motivated Chain Singh

- Green vegetable fields of Halku Singh of his village motivated him to grow vegetables in his field too.
- He felt that his family should eat healthy and fresh vegetables from his own field.
- Earn some money by selling vegetables in local market.

Challenges for Chain Singh

The major challenge before Chain Singh was to find water for irrigating his crop. He arranged for water by diverting some water from a perennial stream and prepared a pit in his land where he would store that water. He has dug drains to water the plot. Controlling pest attacks have been a challenge for him. Changing climatic conditions also pose a challenge for Chain Singh. Erratic rainfall or frost in winter can potentially harm the plot.

so an Executive Committee was appointed by the Gram Sabha, consisting of some elderly village men and women. This Executive Committee named as “Prakritik Sansadan Prabandhan Samiti” would take decisions on behalf of the Gram Sabha.

Chain Singh has been innovative enough to use the perennial stream in the area as the source of water. He was not selected for vegetable cultivation at first. However, his effort to divert water towards his barren land through a perennial narrow stream convinced the implementing team of his success.

He not only diverted the water but also collected it in a pit until it filled up. Then he would take his bucket to water the plants.

Chain Singh was identified by the Executive Committee which considered him hard working and interested in taking up new initiatives, and believed that he would learn new techniques and methods, implement them and then work towards motivating other farmers to adopt the same.

7. Choosing the vegetables

The market is crucial for any economic intervention. Both promoter and entrepreneur must have a basic understanding of the market at the outset. This of course is most important for vegetables as a highly perishable commodity, as with fruits. In this case, the market analysis was first done by Chain Singh as he wanted to start vegetable production with support from the project. In a way it was good for the sustainability of the intervention.

His assessment of the market was very good with respect to selecting the vegetables to be grown in his field. He identified brinjal, tomato and potatoes as vegetables with a good demand in the local market. And he asked for technical support to produce these vegetables only. Cultivating these vegetables has developed his self-confidence. According to him, this was the first time he was consuming vegetables that he had produced by himself. Besides using them at home their production also earned enough income for him. Thus the initial result was very good and motivating.

8. The way implementation took place

- Formation of village committee for proper farmer identification, to provide support, monitor the plots and verify whether the support provided has been used properly.
- Soil testing was done. The report showed the soil of the area lacked zinc.
- Improved manure preparation techniques. Notably, the production of vermicompost has spread swiftly in the area after initial successes like Chain Singh.
- Technical support to obtain the right quantity of improved varieties of seed.
- Introducing bio-fertilizers, better manure application practices and hand-holding support for implementation.
- Good quality training and capacity building about vegetable production and the use of non-pesticide techniques.
- Regular monitoring.

Steps	Support provided
Seed replacement in tomato and brinjal	Improved varieties of seeds provided
Seed treatment	Training on seed treatment with <i>Trichoderma</i>
Preparing seedbed	Training on developing a raised seedbed of 15 cm height
Soil treatment	Material support in the form of vermicompost, <i>Trichoderma</i> and PSB for treatment of soil before plowing
Root treatment of saplings	Training on root treatment with <i>Trichoderma</i> to avoid fungal infection
Transplantation	Training on planting in line at a distance of 60 cm between two saplings
Mulching, weeding and watering	Mulching with vermicompost
Flowering and fruiting: vulnerable stage of pest attack	Training on preparing <i>Matka khaad</i> (the decoction of cow urine, dung, jaggery, leaves of plants with pesticidal properties like <i>besharam</i> , <i>ramphool</i>)

9. Crop management practices and non-pesticide management

Vegetable cultivation requires diverse skills compared to the common food grain crops. Deeper understanding about the production of different vegetables is essential when they are grown as a commercial crop. They require more time and labor than food grain crops. This was the first thing Chain Singh learnt.

Therefore he was oriented on crop management and production in detail. He was given knowledge and input support during cultivation. As he had never sown vegetables before, he was trained on-field and off-field before he started with his cultivation.

Step-wise training

- Preparation of seedbed
- Transplantation
- Preparation and application of bio-pesticide
- Weeding
- Fruiting
- Market linkage

10. Input cost

Name of the item provided	Name of the variety/quantity	Amount (₹)
Seeds		
Tomato	Anand (10 g)	240
Brinjal	JK–kanhaiya (50 g)	100
Fertilizers		
Zinc sulfate	5 kg	165
EFYM (enriched farmyard manure)	200 kg	600
		(farmers' contribution)
Vermicompost	150 kg	600
PSB, Azotobacter and <i>Trichoderma</i>	2 kg	120
Total cost (excluding labor)		1925
Total cost (including labor)	100 x 15 human days (farmers' contribution)	1500 + 1925 = 3425
Total farmers' contribution	1500 + 600	2100
Contribution from FES	3425 – 2100	1325

Month	Interventions	Vegetables (brinjal and tomato)
October	Seed treatment	Seed treatment with 5 g of <i>Trichoderma</i>
	Seedbed preparation	1m x 1m
	Soil treatment	Soil treated with 250 g PSB, 50 g <i>Trichoderma</i> and 50 kg of vermicompost at the time of plowing
November	Seed germination	Germination in first ten days of November
	Root treatment	With <i>Trichoderma</i> after keeping the sapling in shade for 15 minutes before transplanting
	Transplantation	Began while maintaining a distance of 60x45 cm
December	Transplantation and irrigation	Transplantation of both the crops completed and watering was done regularly
January	Mulching and watering	Mulching and watering
	Weeding	Weeding operation continued. Flowering began in January
February	Flowering	Brinjal: About 50% of flowering by mid-February and fruiting by 25th February Tomato: Growth in mid-February; flowering begins in February
	Pest attack	Treatment of pests by a decoction developed from locally available bio-pesticides, cow urine, cow dung and jaggery.
March	Production and sale	Brinjal: 7 quintals partially sold for ₹ 7,000, the rest for self-consumption Tomato: 10 quintals of which quantity sold was worth ₹ 10,000 and rest for self-consumption

11. “My capacities enhanced this way”

With lots of physical exercise exerted in his vegetable production, Chain Singh has received two most crucial outputs in return. The first is nutrient security and income. The second is knowledge and capacity enhancement about vegetable farming.

Process	What he used to do before	Capacity enhancement after this intervention
Seed treatment	Not aware of seed treatment for vegetable crops	He learnt how to do seed treatment using <i>Trichoderma</i> but still follow-up training and handholding support for at least two to three seasons would be required
Root treatment	Completely unaware about such practices	Transplantation of saplings was done by dipping them into <i>Trichoderma</i> solution
Soil treatment	Earlier he used to apply only compost in the field before transplanting saplings	After training he applied 50 kg of vermiculture along with 250 g of PSB culture and small quantity of <i>Trichoderma</i>
Intercultural operations	Earlier he used to apply compost along with ash	He applied 50 kg of vermiculture and 250 g of PSB along with <i>Trichoderma</i>
Pesticides	Never used any pesticide	Used twice <i>matka khad</i> locally made by him after training.
Production	Brinjal 7.8 quintals, 1.5 quintals of tomato, 20 kg potato and 50 kg of onion	10 quintals brinjal, 7 quintals tomato, 50 kg ladyfinger
Income	₹ 8300 (domestic consumption)	₹ 8500 excluding domestic consumption

12. Outcome

- Chain Singh observes the success of vegetable production in many ways.
- One is income enhancement from adopting improved farming practices. The income of Chain Singh has risen in that particular year, as he earned about ₹ 17,000 from the vegetables. However, the major contribution of vegetables for Chain Singh has been for home-consumption and hence improvement in nutritional status.
- Chain Singh also identified his increased knowledge about the vegetable cultivation as important. For example: use of new types of fertilizers like vermicompost, PSB and pesticides prepared by locally available materials like *matka khad*, etc.
- He also realizes the importance of root treatment and seed treatment. Chain Singh has not been able to continue with vegetable production this year because of health problems in the family. Yet, he is confident of continuing next season with the improved practices that he has learnt.
- Chain Singh’s efforts for vegetable cultivation have been exemplary. Many people from his village have even brought vegetables from his farm in exchange for *mahua*. His efforts are demonstrably visible in the village as well as outside although one may not be sure exactly how many have learnt from him and applied their learning.

13. Learning

Chain Singh learnt that without utilizing existing resources at an optimal level it is not possible to grow vegetables successfully. He was trying not only to scale-up vegetable output but also to enhance nutrition and the taste of vegetables which are grown by using natural inputs. The biggest learning was that business should be controlled and monitored by one person and he or she should be aware and knowledgeable about market. Summer vegetables are the most challenging due to high probability of grazing damage from the open grazing concept in the region. Free produce for relatives also reduces overall profit and is unavoidable due to social system and culture. Producing vegetables is round-the-clock work and needs rigorous monitoring. He says that *palak* is the vegetable most easy to produce while *lauki* is the toughest – because of frequent disease attacks and the need to protect against them. Applying chemical inputs is good for production enhancement but it reduces quality, especially taste. Chain Singh desires more training on the appropriate use of pesticides and other inputs in vegetable production. Now Chain Singh is confident about vegetable farming. He is aware about all stages of cultivation.

FES learnt that optimal utilization of resources is possible, provided we understand all the factors that motivate the farmer and all his needs. Both income enhancement and sustainability in terms of knowledge built about the particular intervention are necessary.

Worms changed thinking of tribal farmers

Location: Gundipara & Manpura, District: Jhabua, State: Madhya Pradesh

1. Introduction

Composting is commonly not taken seriously in agriculture in the rural areas. Farmers look askance at it because of its long biological process and non-economically measurable outputs. Inappropriate composting of agricultural waste and cow dung leads to other problems in the field, most commonly, termites and these can be addressed by a composting method which has major benefits on crop growth and quality and on soil health. The issue is one of attitude rather than technology.



Vermicomposting is one of the most popular methods of composting and was introduced to villages in Jhabua District as one of the project interventions. A well tried and tested method of vermicompost making was also reintroduced ensuring that the design and the technology was well demonstrated and well executed in the field. A follow-up plan was prepared to know about the outputs of vermicompost application and its returns in field were discussed in the village.

The four-pit-model of vermicompost was devised by ICRISAT after lots of research to make the method farmer-friendly. We learn in this case study how this technology was promoted. The turning point which made this intervention successful is described.

2. Concept of case documented

How proper follow-up made the four-pit model of vermicompost a successful intervention is the base of this case study. The concept of vermicompost had been introduced to Jhabua by various agencies but was not widely adopted by the tribal farmers. The one and the only reason was lack of follow-up at field level after introducing the methodology. Construction of the pits, time taken to fill them and apply the compost in the field are the most commonly cited difficulties for farmers in adopting the technology.

3. The settlement

Gundipara and Manpura are no different than any other tribal-dominant villages typical of Jhabua District. Agriculture is the base of livelihoods. The education status is now changing, with more school-going children to be seen, especially girls. But still, the very low literacy rate in these villages is a cause of concern. Migration is also an issue; but there may be a positive side to migration in exposure to new technologies and awareness about better living conditions. But, whatever the reason, there seems to be a new learning attitude in the villages, to try out new technologies, and to adopt new and improved methods in agriculture.

Demographic information about these villages is given in the following table:

Village	No. of families	Literacy (%)		Category of family		Land holding (ha)		Landless families	Total area of horticultural crops (ha)
		Male	Female	BPL	APL	<1 ha	1–2 ha		
Gundipada	183	26.89	13.7	82	101	19	164	0	7
Manpur	113	17.5	8.3	52	61	11	102	0	5

The land use pattern of these villages is similar as all of them have a lot of wasteland. But only Gundipada has forest land, albeit with degrading forest cover. Gundipada has different types of soils at different elevations. A combination of red and black soil can be found mostly in the upper level, whereas clay-loam and silt are found in level areas and sand in the valleys. The same soil structure is found in Manpura village also.

Village	Total area (ha)	Cultivated land (ha)	Cultivable waste (ha)	Waste land (ha)	Orchard & Veg. (ha)	Forest land (ha)	Irrigated land (ha)
Gundipada	430.44	295.91	21.7	58.61	9	45.22	9.55
Manpur	154.18	125.33	10.36	12.49	6	0	5.83

Agriculture in these villages is mainly rainfed. The crops are maize, pigeonpea, upland paddy, wheat and gram (chickpea). No commercial crop was grown. Very few farmers grew vegetables, and only for home-consumption. Following the project interventions some farmers started commercial vegetable cultivation.

4. The process

Ramala s/o Puniya of village Gundipada took part in discussion at the village meeting. He was excited to share his learning and experiences. Two years ago when he was told about the four-pit model of vermicompost then he was reluctant to adopt this method of composting in his field. The reason was simple. “Who will maintain it and what additional benefit will I get if I construct one vermi pit?” Genuine questions from a farmer of a remote village! Answering these questions was not easy for the field team. They patiently answered his queries and explained to him the four-pit model of vermicompost making. This was the start of the battle in the field for the GVT team.

The initial interface with Ramala was to explain about the vermicomposting process. Because he had never heard that worms can convert cow dung and agri-waste to compost, the entire biological process was explained to him. Interestingly he agreed to construct this four-pit model in his field. But he asked for financial support to construct the structure. This was the first success towards the adoption of the four-pit model in this area.

Along with Ramala, Project vermicomposting started in these villages. For proper orientation and knowledge building, technical training on verimicompost methodology was organized in collaboration with Krishi Vigyan Kendra–Jhabua, GVT–Jhabua, ICRISAT–Hyderabad.

Two years ago Ramala made his first vermicompost after receiving training and other support. Following him, five more farmers adopted it and in Manpura ten farmers adopted this method of composting with the project support.

The hand holding support was for making the vermicompost and using it on the crops. Since farmers had never seen such compost, using it was a like a dream for them.

The second big issue was to train masons of the village so that quality of the four-pit model can be maintained. These masons were also taken for exposure to a nearby village named Hatyadeli of Meghnagar block of Jhabua district.

After an initial struggle with the community, efforts started giving results when the first compost structure was filled with worms and farmers could see the vermicompost after 45 days, and it was applied in the field. Now farmers of this village are selling worms and compost to nearby villages: worms at ₹ 200 per kg and compost at ₹ 4 per kg. Now there are 16 vermicompost operations in the two villages, six pits at Gundipada and ten pits at Manpura.

The four-pit model

- Dimension of pit is 1.5 m width, 4.5 m length and 0.9 m height.
- Partition walls with small holes to facilitate easy movement of earthworms from one chamber to another.
- An outlet at one corner of each chamber with a slight slope facilitates collection of excess water, which is reused later or used as earthworm leachate on the crop.
- The first chamber and then second chamber is filled layer by layer along with cow dung and then earthworms are released.
- Once the contents in the first chamber are processed the earthworms move to chamber 2, which is already filled and ready for earthworms.
- This model reduces labor cost and saves water as well as time.

5. Understanding the concept of vermicomposting

Poorly composted manure is generally applied by most of the farmers of this area. This is the main source of creating favorable conditions for weeds, termites and other pests and insects on the farm.

Environment degradation is a major threat confronting the world. The rampant use of chemical fertilizer contributes largely to the deterioration of the environment through depletion of fossil fuels, generation of carbon dioxide (CO₂) and contamination of water. It leads to loss of soil fertility due to imbalanced use of fertilizer and that adversely impacts on agricultural productivity and causes soil degradation. Now there is a growing realization that only the adoption of ecological and sustainable farming practices can reverse the declining trend in global productivity and protect the environment.

The large quantity of organic waste generated in India, nearly 700 million t yr⁻¹, is either burned or land filled posing a problem of safe disposal. To mitigate this problem, waste can be converted into highly valuable nutrient-rich compost in an environment friendly manner. Vermicompost is one of the best methods of composting any kind of organic matter, and provides a 'win-win' solution to tackle the problem of safe disposal of waste and provide most needed plant nutrients for sustainable productivity. Vermicompost improves growth, quality and yield in different field crops, and in vegetables, flowers and fruit.



6. We build our knowledge

Knowledge building started with the first meeting with the villagers. Follow-up meetings, on the job training and exposure visits continued the capacity building. Most crucial were regular field visits and explaining at every step about vermiculture and its application. An exposure visit cum training program at ICRISAT, Hyderabad for two days in January 2011 was a big confidence booster. Farmers learnt about various methods, technologies and management practices apart from vermiculture and were highly motivated.

7. Impact of using vermicompost

“Due to the use of vermicompost, the size of onion has increased in Gundipada” expressed one farmer named Chuniya Vesta. He has sold 1 kg worms to Buriiji Basna and 2 kg worms at Opalpura, a nearby village. Ramala Puniya sold 1 kg worms to Ramchand Mangaliya. Farmers are using vermicompost in their vegetable crops such as onion, cabbage, cauliflower, tomato, okra, *methi* (fenugreek), *dhaniya* (coriander), *goarphali* (cluster bean), cucumber, bean etc.

The farming communities of these villages are now producing vermicompost themselves and using it in their crops, vegetables and fruit plants. The key impact of the compost as perceived by the community is:

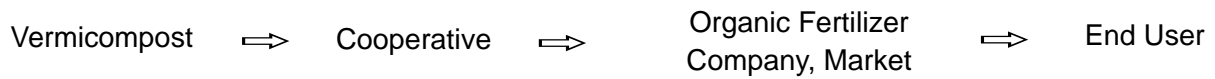
- The moisture retention capacity of the soil increases
- The productivity of crop increased by 15 to 25%
- The productivity in vegetable crops increased up to 25 to 30%

- No. of irrigation reduced or water saved
- Very good vegetative growth in mango and sapota plants
- Income generation due to sale of worms and vermicompost
- Soil becomes loose and porous

8. Future plan

As there are SHGs, it has been planned to sell the vermicompost through cooperative directly in the market, to the organic fertilizer industry such as KRIBHCO, and in organic WADI project villages.

The end users are farmers, parks, gardeners, restaurants, guest houses and offices where gardening is done. Through proper packing, bagging and tagging it will be sold to the end user.



9. Farmers' statements



Ramala s/o Puniya, Village Gundipada

(Chili, Cotton and Mango grower)

- Single irrigation saved but productivity not affected.
- Insect attack reduced.
- Flower dropping reduced in chili. Shape and luster was good compared to regular practice.
- Good growth in mango and sapota plants.
- Income increased due to sale of worms.

Khushal s/o Kasana, Village Manpura

(Brinjal, Chili, Tomato and Mango grower)

- The larger size of brinjal increased production.
- Income increased due to sale of vermicompost.
- Neat and clean atmosphere.

Punjya s/o Nanji, Village Manpura

(Chili, Tomato and Mango grower)

- Irrigation requirement reduced.
- Expenditure on purchase of chemical fertilizer reduced.
- Due to good size and luster of chili the market price of chili increased (₹ 0.50 to 1.0 per kg).
- The size of tomato increased.
- Due to good luster of tomato the market price increased (₹ 0.50 to 1.0 per kg).
- Good growth in mango and sapota plants.

Shambhu s/o Maniya, Village Gundipada

(Chili, Onion and Mango grower)

- The size of bulb in onion increased by 20 to 25%; yield increased by 20 to 25%.
- Expenditure reduced.
- Fast growth in mango and sapota plants.
- Less insects in chili.
- Crop duration increased in chili and no. of picking was increased (1 to 2 more picking).

Babu s/o Chainiya, Village Manpura

(Chili and Mango grower)

- Expenditure on purchase of chemical fertilizer reduced.
- Less attack of insects.
- Fast vegetative growth in chili saplings.
- Irrigation water saved and income increased due to sale of worms.

About the organizations

From Madhya Pradesh

1. Bhopal Yuwa Paryavaran Shikshan & Samajik Sansthan (BYPASS), Bhopal

BYPASS is an acronym for “Bhopal Yuwa Paryavaran Shikshan & Samajik Sansthan”. The core philosophy of the organization contained in five words of ‘Yuwa Paryavaran Shikshan & Samajik Sansthan’. The organization is keen to bring in young, well-educated and committed people for undertaking ‘Paryavaran Shikshan’ which actually meant hands-on learning through implementation of community led natural resource management and environmental education.

The organization also intended to accelerate the universalization of primary education of comparable quality by concentrating on mainstream primary education of rural children, in particular. The latter part of BYPASS stands for ‘Samajik Sansthan’, or a socially responsible and answerable organization. BYPASS envisioned mobilizing the disadvantaged community groups through effective and responsible grassroots institutions or CBOs by engaging them in NRM based activities, value addition of NTFP, self-help, and skill upgradation and livelihoods promotion. BYPASS exists to facilitate creation of opportunities of gainful development for the community especially vulnerable sections, ensuring enriched environment, sustainable livelihood, improved quality of life and good human values.

2. Centre for Advanced Research and Development (CARD), Bhopal

The Centre for Advanced Research and Development (CARD) is a non-government agency established in India, in the state of Madhya Pradesh. CARD has been established to promote action research and to apply its findings for the protection and development of the society and its environment. Centre for Advanced Research & Development believes in Community-based Natural Resource Management approach to reduce rural poverty. The sustainability of this approach largely depends on the empowerment of the communities for not only sharing the costs and benefits at all levels, but also by demanding their entitlements. CARD has a strong grassroots presence in three distinct regions of Central India, namely, Gond predominant eastern tribal region, agriculturally rich Feudal Malwa region and Bhil predominant western tribal region. These are the fields of experimentation for future strategy formulation and learning lessons for designing improved strategies and policies. Participation being its core value, CARD acts as a facilitator rather than an implementer of development process.

3. Society for Promotion of Eco-friendly Sustainable Development (SPESD), BAIF Foundation, Bhopal

BAIF Development Research Foundation is a professionally managed non-profit Public Trust, established by a noted Gandhian, Late Dr Manibhai Desai in 1967 to promote sustainable livelihood in rural India.

Vision

Building a self-reliant rural society assured of food security, safe drinking water, good health, gender equity, low child mortality, literacy, high moral values and clean environment.

Mission

BAIF's Mission is to create opportunities of gainful self-employment for the rural families, especially disadvantaged sections, ensuring sustainable livelihood, enriched environment, improved quality of life and good human values. This is being achieved through development research, effective use of local resources, extension of appropriate technologies and upgradation of skills and capabilities with community participation. BAIF is a non-political, secular and professionally managed organization.

4. Foundation for Ecological Security (FES), Mandla

Registered under the Societies Registration Act XXI 1860, the Foundation for Ecological Security (FES) was set up in 2001 to reinforce the massive and critical task of ecological restoration in the country. The Foundation strives for a future that is based on a holistic understanding of the principles that govern the interrelationships of various life forms and natural systems. The essence of these efforts lies in intertwining principles of nature conservation and local self-governance in order to accelerate ecological restoration, as well as improve the living conditions of the poor.

FES presently works with 2208 village institutions in 27 districts across six states, and assists the village communities in protecting the 130,000 hectares of revenue wastelands, degraded forest lands and Panchayat grazing lands (Charagah lands). FES supports Panchayats and their subcommittees, Village Forest Committees, Gramya Jungle Committees, Water Users Associations and Watershed Committees in order to improve the governance of natural resources. Regardless of the form of the institution FES strives for universal membership and an equal access of women and poor in decision making.

5. Grameen Vikas Trust (GVT), Jhabua

Gramin Vikas Trust (GVT), a not for profit development organization promoted by Krishak Bharati Cooperative Ltd (KRIBHCO), Department of Fertilizer, Government of India (GoI) and Department for International Development (DFID)-UK aim to develop effective policies and programs addressing emergent contemporary issues especially addressing Natural Resource Management, Agriculture Research and Development in a system based approach, livelihood both in farm and non-farm sector touching cross-cutting themes of poverty, equity, gender replicability and sustainability in rainfed areas of India.

GVT commits itself to radiant self-reliant rural community by "Improving Poverty Reduction Strategies, Policies and Practices". GVT aspires to act as catalyst to help socially and economically disadvantaged rural people to improve their livelihood on sustainable basis.

From Rajasthan

6. DEEP Development Research Foundation, Tonk

7. Rajasthan Rural Institute of Development Management (RRIDMA), Bundi

Rajasthan Rural Institute of Development Management (RRIDMA) is an associate organization of BAIF established in 1993 under the Societies Registration Act, 1950. The head office is located at Udaipur. The divisional office is located in Bundi.

RRIDMA is implementing a multidisciplinary program covering Livestock Development, Community Pasture Development, Tribal Development, Water and Energy Conservation Project, Transfer of Technologies for Sustainable Development Project, and Women Health and Empowerment.

From Jharkhand

8. Professional Assistance for Development Action (PRADAN), Gumla

PRADAN is a voluntary organization registered under the Societies Registration Act of India. Established in Delhi in 1983, PRADAN was pioneered by a group of young professionals, all of whom were inspired by the conviction that individuals with knowledge resources and empathy for the marginalized must work with communities at the grassroots in order to help them overcome poverty.

PRADAN believes that the path towards conquering economic poverty is through enhancing the livelihood capabilities of the poor and giving them access to sustainable income earning opportunities. In the process, the poor must be enabled to break free from their past, develop an alternative vision of their future and set achievable goals. They must be equipped with the technical, organizational, negotiating, and networking skills that will facilitate the fulfillment of their goals.

Today, some 268 highly motivated and skilled professionals under PRADAN's fold are working in the remote villages of India, immersing themselves directly with target communities. These young professionals are recruited from universities and hold specialized degrees in subjects like management, engineering, agriculture and the social sciences.

PRADAN professionals, divided into 41 teams, work with over 206,298 families in 4,138 villages across eight of the poorest states in the country. A majority of the families that PRADAN works with belong to the Schedule Tribes and Schedule Castes.

9. Tata Steel Rural Development Society (TSRDS), Jamshedpur

Established in 1979, the Tata Steel Rural Development Society (TSRDS) is involved in various social development programs aimed at helping the rural communities living around Tata Steel's operational units.

Prior to the setting up of TSRDS, Tata Steel's community initiatives were conducted through its rural and community services division. However, the fundamental differences between the imperatives of rural and urban development prompted the company to reclassify its community initiatives programs under three units: Community Development and Social Welfare, TSRDS and Adivasi and Harijan Welfare Cell, now known as the Tribal Cultural Society.

TSRDS covered 32 villages around Jamshedpur (in the state of Jharkhand in eastern India) in its first year of operation. Today, the Society has seven separate units, six in Tata Steel's operational areas, and covers 600 villages in the states of Jharkhand and Orissa (also in eastern India). TSRDS is actively involved in the spheres of livelihood generation, health and hygiene, and people empowerment.

TSRDS has expanded its agenda and identified the advancement of education, sports and self-reliance as tools to ensure a better quality of life for the people it works with.

Address of the contributory organization for communication

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International Crops Research Institute for the Semi-Arid Tropics

The **International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)** is a non-profit, non-political organization that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics have over 2 billion people, of whom 644 million are the poorest of the poor. ICRISAT innovations help the dryland poor move from poverty to prosperity by harnessing markets while managing risks – a strategy called Inclusive Market-Oriented Development (IMOD).

ICRISAT is headquartered in Patancheru near Hyderabad, Andhra Pradesh, India, with two regional hubs and five country offices in sub-Saharan Africa. It is a member of the CGIAR Consortium. CGIAR is a global research partnership for a food secure future.

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