Asia CSR Leadership Awards
Best Environment Friendly project- ICRISAT Development Center

Background
Degradation of agroecosystems and declining sustainability are major concerns for agricultural development in many poor regions of India, where rural livelihoods depend directly on management of land and water resources. Sustainable use of natural resources has significant links to human well-being and poverty reduction. The rural livelihood system mostly depends on natural resources and has reached saturation due to declining stock of resources. Concerns over the sustainability of natural resource use are not new, however, the last decade has seen significant changes in the approach to access to resources and its links to poverty. Rapid deforestation and biodiversity losses are depriving people of valuable forest resources, such as fuel wood, food and medicine. Soil degradation is a major threat to the livelihoods of 1 billion people, mostly poor, who are more likely to live in degraded or fragile environments. Projections of rural population growth, agricultural expansion and intensification, and poverty in the next few decades suggest a potentially serious conflict between natural resource sustainability and poverty in rural areas.

Together with partners, ICRISAT has developed a number of technologies to deal with the above challenges for sustainable intensification. These technologies were extensively tested at research and farmers’ fields and further scaled up through support from companies practicing Corporate Social Responsibility (CSR) and development agencies like state, national and international organizations. Sites of learning at micro to meso scale community watersheds (500 to 5,000 ha scale) were established in different rainfall and ecological regions demonstrating the potential of various agriculture water management interventions. This initiative was initially supported by the Asian Development Bank for pilots in India, Thailand, Vietnam and China. Later, development investors such as the Indian Ministry of Rural Development, the World Bank through the Sujala Watershed Program in Karnataka, the Department for International Development through the Andhra Pradesh Rural Livelihoods Program, and private corporate partners like Tata Trust [Sir Dorabji Tata Trust (SDTT) and Sir Ratan Tata Trust (SRTT)], SAB-Miller, Coca-Cola India Foundation, JSW foundation, Asian Paints, Rural Electrification, etc, supported scaling-up initiatives in India. With the support of the above agencies, ICRISAT Development Center made conscious efforts to rejuvenate degraded resources by improving water resources availability (surface and groundwater), increase use efficiency and consequently strengthen various ecosystem services.

Land and water management
In drylands, poor distribution of rainfall in terms of amount and its variability generates dry spells almost every year resulting in water stress and poor productivity. Various in-situ and ex-situ water harvesting practices were developed to enhance green (residual soil moisture) and blue water (surface and groundwater) availability and reduce non-productive evaporation. In-situ interventions such as contour and graded bunds in the fields minimized the velocity of generated runoff and allowed more water to percolate into the fields. This practice created an opportunity to accumulate surface runoff along the contour line, and also protect soils from erosion. Low cost water harvesting structures reduced peak discharge and harvested substantial amount of runoff, which increased groundwater recharge. At the same time, these structures trapped sediments which protected the river ecosystems further downstream.

As water is the limiting factor in most of the drylands, water conservation and management play an important role. The Parasai-Sindh watershed supported by Coca-Cola India Foundation, comprises three
villages covering nearly 1,250 ha in Jhansi district of Bundelkhand region. Bundelkhand region of central India is a hot spot of water scarcity, land degradation, poverty and is extremely vulnerable to climate change. This watershed receives nearly 850 mm of rainfall with about 85% from June to September. Frequent drought and floods are common during monsoon. Due to hard-rock geology, groundwater recharge mainly takes place in shallow and unconfined aquifers characterized by poor specific yield. Water level in open/dug wells depletes quickly after the monsoon and communities suffer from water scarcity especially in summer.

The in-situ and ex-situ water and soil and conservation efforts have been made through check dams and gully control structures. Ex-situ water harvesting structures together developed 125,000 m³ of storage capacity and it was estimated that these structures harvested nearly 250,000 m³ of surface runoff and facilitated groundwater recharge in the monsoon season. Groundwater table on an average increased by 2.5 meters, varying from 2.0 - 4.0 meter as per toposquence compared to non-intervention stage. This has increased cropping intensity by 50% especially post-monsoon. Productivity of post-monsoon crops, especially wheat, has doubled after watershed interventions. Wheat yield before watershed interventions was in the range of 1,500-1,800 kg ha⁻¹. Before watershed interventions, despite the good establishment of crop, there was a high chance of crop failure due to depleted water resources by end of January-February which used to coincide with flowering or milking stages and lack of supplemental irrigation due to dried-up wells. After implementing the watershed program, farmers had wheat yields ranging from 3,000-4,000 kg ha⁻¹ which significantly improved their income and livelihood. Farmers further have shifted their cropping pattern from low water requiring crops (chickpea and mustard) to high value crops (vegetables and wheat). Fodder availability has increased significantly due to which milch animal
population has increased by 30% (nearly from 900 to 1,200 buffaloes) within four years of project implementation.

Agroforestry was strengthened by promoting tree plantation on farm bunds and wasteland with community participation. Improved varieties of chickpea and wheat were introduced and crop yield increased by 30-50%. In addition, various income generating activities such as vermicomposting, nursery raising and other microenterprise activities further helped farmers to earn additional income. Steps to enhance farmers’ capacity such as exposure visits and field days were organized. Watershed interventions enhanced average annual family income from `50,000 INR (US$ 830) to `125,000 (US$ 2,080) in a short span of three to four years clearly indicating the potential of science-led interventions to address food security and rural livelihood issues in the drylands.

Similarly, the ICRISAT-SABMiller initiative through different soil and water conservation measures and water harvesting structures, created additional storage capacity of more than 60,000 m$^3$ in project villages. This resulted in an estimated groundwater recharge of 150,000 m$^3$ of water every year due to multiple refilling of rainwater harvesting structures. Another watershed, an ICRISAT-JSW initiative, created additional capacity of 6,000 m$^3$ for recharging groundwater in villages surrounding the JSW factory in Bellary district, Karnataka. The water harvesting structures together developed 7,000 m$^3$ of storage capacity. It is estimated that these structures have harvested nearly 20,000 m$^3$ of surface runoff and facilitated groundwater recharge.

**Soil fertility management**
Emphasis was laid not only on water resource development and management but also on other important components such as soil fertility management. Over the years, continuous farming and indiscriminate use of fertilizers resulted in declining organic carbon and essential micro and secondary nutrients. Soil degradation negatively affected yield sustainability. Together with partners, ICRISAT undertook large-scale soil analysis in different agroecological regions of India. Soil test results revealed that most Indian soils are deficient in essential micro and secondary nutrients such as sulfur (S), boron (B) and zinc (Zn). To address such problems, application of soil test based fertilizer along with green manure was promoted as an entry point activity in watersheds. This has enhanced crop yields by 20-70% depending on the crops, soil types, rainfall and other management practices.

**Carbon sequestration**

Large-scale conversion in land use from forest to agriculture and grasslands resulted in loss of organic carbon. Furthermore, deep ploughing and crop intensification further degraded land resources. To rejuvenate degraded land, use of organic fertilizer and green manure through gliricidia plantations and vermicomposting was promoted at pilot sites. Special emphasis was given to rejuvenating wastelands by cultivating biofuel crops like Jatropha and Pongamia. Agroforestry has been promoted in a number of watersheds to enable farmers to get a consistent income as well as strengthen land resources. Crop diversification by adopting legume-cereal rotation was encouraged which resulted in enhanced soil health besides increased carbon sequestration. For example, long-term data collected from ICRISAT Heritage watersheds shows increased soil organic carbon (335 kg ha$^{-1}$yr$^{-1}$). In these areas, sorghum was intercropped with pigeonpea or rotated with chickpea/green gram/black gram/soybean.
Water use efficiency (WUE)

The current water use efficiency in rainfed agriculture varies from 35 to 45% and huge amounts of fresh water harvested as soil moisture during the monsoon period is lost through non-productive evaporation resulting in poor water use efficiency. To obtain more crop per drop various water management practices were adopted. For example, improved land configuration (Broad Beds and Furrows) in vertisols and introducing short-duration soybean varieties enhanced cropping intensity in Guna, Vidisha and Indore districts of Madhya Pradesh with the support of SDTT and SRTT. This has increased crop yields (40% - 200%) and incomes (up to 100%) significantly. Similarly, introducing a short duration legume crop with simple seed priming and micronutrient amendments, growing of early maturing chickpea in rice fallows with best bet management practices were promoted. An economic analysis has shown that growing legumes in rice fallows is profitable for farmers with a benefit-cost (B:C) ratio exceeding 3:1 for many legumes. Other improved in-situ interventions such as supplemental irrigation, improved land form treatment, protected cultivation of high-value crops, soil test based integrated nutrient management, improved crop management practices, efficient irrigation methods, need based irrigation application, proper crop rotations and intercropping enhanced water use efficiency by 50-200% in different watersheds.

Income generating activities
Breed improvement of cattle is being promoted in targeted villages of different watersheds. Improving cattle breeds through artificial insemination is an important component. This activity helped in developing cross breeds, increasing milk yield, improving livelihoods and incomes of the farmers and nutrition of the village people. The works were undertaken in collaboration with BAIF Institute for Rural Development (BIRD).

Similarly, spent malt as an alternate source of feed is being promoted in ICRISAT-SABMiller watershed and Adarsha watershed, Kothapally, Telangana. Spent malt is a by-product of the brewing industry, comprising malt and grain residues which contain carbohydrates, proteins and lignin. Spent grain is considered to be a good source of protein and water-soluble vitamins for animals. It is palatable and is readily consumed by animals.

- ICRISAT, in consultation with SABMiller and consortium partners, has initiated supply of spent malt from SKOL Breweries to villagers with the aim of strengthening livelihood opportunities and financial security of women through Self-Help Groups (SHGs) as they can get higher milk yield with greater fat content for sale.
- The Priyadarshini women SHG has undertaken the responsibility of transportation and distribution of spent malt in the village.
- Training on care, handling and maintenance of spent malt was given to women SHGs; and training on precautions to be taken for feeding the animals to beneficiary farmers.
- Fifty-eight beneficiary farmers are utilizing the spent malt (1,437 kg/day) and feeding 391 milch animals
- Total milk production in the village is about 1,562 liter/day and with use of spent malt as animal feed, farmers have observed increased milk production of 1 liter/animal /per day with improved fat content.

- Increased gross income on milk production is about `12,565 per day with a net income of `8,973 per day in the village. In total, the village is getting increased net income of `269,175 per month with an average net income of `4,640 per family.

- Till March 2015, Priyadarshini women's SHG sold 1,570,318 kg of spent malt making a net profit of `72,014 during a period of 40 months after meeting the expenses of transportation, handling and rent for storage and labor charges incurred for distribution.
Environment friendly initiatives such as soil test based fertilizer application not only improved soil health but also crop yield and income. Economics of Zn, B and S application was calculated for all the crops by considering the cost of additional inputs used, additional income generated due to yield enhancement, and benefit cost ratio for each rupee of additional investment made. In case of chickpea, the additional income due to the adoption of soil test based fertilizer application ranged between 9,430 to 19,090 during 2009-10, and between 6,210 to 8,280 during 2010-11. The returns per rupee invested were quite high as evident from B:C ratios of 4.2 to 8.5:1 during 2009-10 and 2.8 to 3.7:1 during 2010-11. The benefit cost ratio of cotton crop was 4.4:1 with the additional income of 10,000 during the rainy season 2010-11 whereas the B:C ratio was 2.6:1 with the additional income of 6,400 during the rainy season 2011-12. Similarly, the B:C ratio for rice grain yield was 2.7:1 with the additional income of 6,030 during the rainy season 2010-11 whereas the B:C ratio of rice grain yield ranged from 2.3 to 2.9:1 with the additional income in the range of 5,670 to 7,200 during the rainy season 2011-12. The B:C ratio of sugarcane was 11.4:1 with the additional income of 25,620 during the year 2010-11 whereas the additional income from sugarcane crop was 17,850 with the B:C ratio of 7.1:1 during the year 2011-12. Significant increase in additional income due to small additional investment made in balanced nutrition and favorable B:C ratios indicates that application of Zn, B and S were economical and this practice can be recommended for large-scale adoption in soils that are deficient in the said nutrients.

**Way forward**
Integrated watershed management is an important strategy for sustainable intensification that is eco-friendly. Soil and water conservation practices resulted in higher groundwater recharge which enabled supplementary irrigation during dry spells in the monsoon season and increased the scope of irrigation for a second dry season crop. Moreover, in situ water harvesting resulted in enhanced green water use efficiency in rainfed agriculture. Productivity enhancement, crop intensification and diversification further contributed to farmers utilizing available resources effectively and earning more. Watershed interventions were also helpful in strengthening various ecosystem services such as reduced nutrient and soil loss, which is expected to have positive impacts on environment. With increasing population pressure and declining fresh water availability, watershed development programs are increasingly important for securing agricultural yields in upland areas to achieve food security and at the same time protect the environment.
CSR investors/partners in IDC currently include:

Other IDC investors/partners