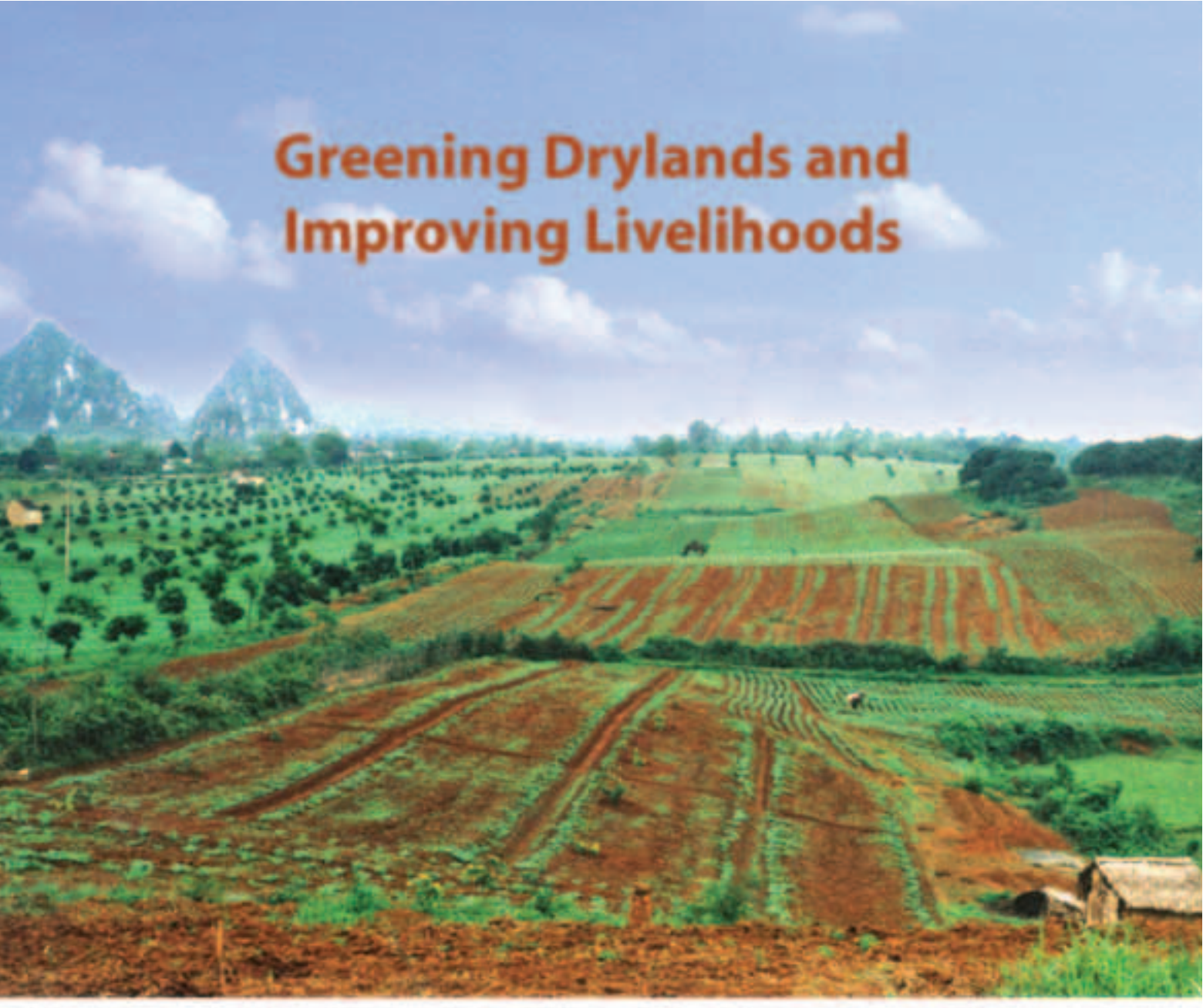
Greening Drylands and Improving Livelihoods



International Crops Research Institute for the Semi-Arid Tropics

ICRISAT's focus area: the dry tropics

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) conducts research in the semi-arid or dry tropics of Asia and sub-Saharan Africa, where agriculture is the backbone of economies. Encompassing 48 countries, the dry tropics is home to the poorest of the poor, about 300 million, with a very fragile ecosystem and extreme climatic variations. ICRISAT addresses these critical challenges by developing problem-based and impact-driven research.

Our vision

The improved well-being of the poor of the semi-arid tropics.

Contributors

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Putting poor people first

Three thousand years ago, precursors of the Aztecs of Mexico built large-scale water management systems. The canal network in southern Mexico's Tehuacan Valley is the largest known prehistoric water management system in the New World. But that was at a time when water and food scarcity were relatively unknown. However, the 600 million poor inhabiting the semi-arid tropics today have to grapple with poverty and parched lands; degraded natural resources and burgeoning populations; besides a single rainy-season crop grown on degraded lands, and not forgetting the abysmal state of infrastructure and the moneylender giving chase.

Over the last half-century, water management in both rainfed and irrigated agriculture has been instrumental in achieving significant productivity gains in agriculture. ICRISAT has enhanced its water management work through its community watersheds in the semi-arid tropics of Asia and sub-Saharan Africa. The Institute enabled the up-scaling and out-scaling of its on-station watershed management experiences to community watersheds in order to enhance impacts. Besides greening the landscape and improving the livelihoods of the poor, the watersheds have linked people and water resources through science, planning, and education to achieve the goals of sustainability. Private-public partnerships have provided the means for increased investment not just to enhance productivity but also for building institutions as engines for people-led natural resource management.

The four Es and Cs of our approach

ICRISAT's approach to community watershed management brings together 25 years of expertise. It espouses the Integrated Genetic Natural Resources Management (IGNRM) approach where Research for Development (R4D) activities are implemented at landscape level at benchmark sites representing different SAT agroecoregions. The entire process revolves around the four Es – **Empowerment, Equity, Efficiency** and **Environment**, which are addressed by adopting specific strategies prescribed by the four Cs – **Consortium, Convergence, Cooperation** and **Capacity building.**

Better tools, better harvests, better lives

The ICRISAT community watershed management initiative has vastly improved the livelihoods of 250,000 poor people in watersheds in 368 villages across Asia, spanning India, Thailand, China, and Vietnam, where farm households are trapped in a vicious cycle of poverty, with no employment opportunities and seasonal migration in search of jobs. Harnessing a watershed's potential through a consortium approach has involved engaging a wide plethora of actors – national agricultural research systems (NARS), non-government organizations (NGOs), agricultural universities, private interest groups,

and farm households as key decision makers. Convergence of initiatives and endeavors has facilitated this people-centered development effort supplemented with decentralization of decision making. The primary stakeholders who were brought into the picture from the word go and their capacities to stir the program towards a sustainable initiative have been gradually honed.

Getting everyone around the same table meant considering how the group envisioned future generations using the natural resources within the watershed. A consensus of all parties who have a stake in the community watershed and establishing a sense of need and direction were paramount. As a leader, ICRISAT had to get people to voluntarily commit to goals and accept responsibilities. Today, we have a partnership that has led to greater local initiative, responsiveness, and control.

External factors such as public expectations have motivated this partnership. Scientists and leaders now recognize that the best way to protect vital natural resources is to understand and manage them on a watershed basis. ICRISAT is now involved in developing and strengthening the skills, instincts, abilities, processes and resources that communities in the rainfed areas need to survive, adapt, and thrive.

This approach has led to cost effectiveness, win-win solutions through empowerment of partners, synergies, swifter scaling-up, change in organizational behavior, and public-private partnerships with multiplier effects.

Gateway to sustainability

China

Vietnam

India

Thailand

Neighbors help neighbors

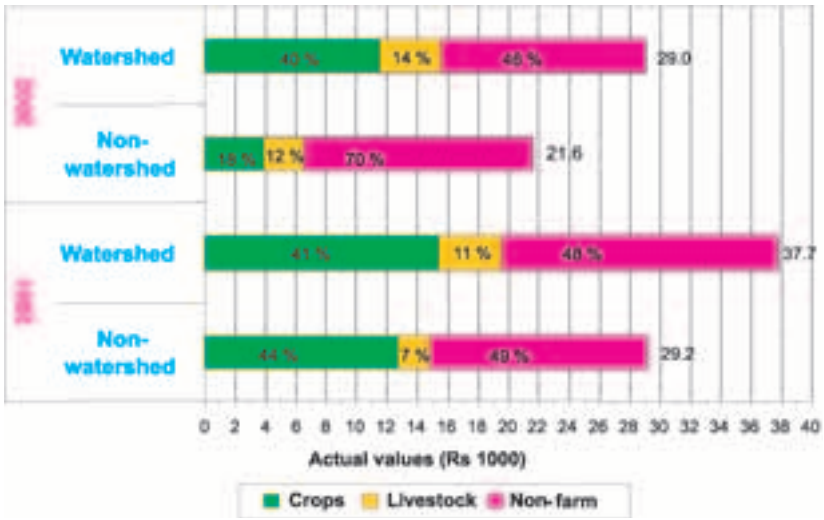
In India, Thailand, Vietnam and China, ICRISAT's community watershed interventions have taken the form of knowledge-based entry points such as soil and water conservation activities, *in-situ* conservation, building rainwater harvesting structures, crop diversification and intensification, crop-livestock integration, integrated pest and nutrient management, conserving biodiversity, enterprise development, gender integration, capacity building, and the use of new science tools.

Community watershed management model

Crop-livestock integration

Reducing rural poverty

ICRISAT's community watershed management model addresses the issue of rural poverty by ensuring improved productivity with the adoption of cost-efficient water harvesting structures as an entry point, crop intensification and diversification with high-value crops, improving the capacity of farm households through training and networking and building on social capital, among many other measures. A case in point is the Adarsha watershed in Kothapally village in Andhra Pradesh, India. Today, it is a prosperous village on the path of long-term sustainability and a beacon for science-led rural development. *Ex-ante* impact assessments in 5 districts of Andhra Pradesh in India have revealed an aggregate income of US$ 608 million from major crops in 10 years through watershed interventions. In Thailand, Vietnam and India, the adoption of interventions led soybean growers to benefit by US$ 781 million in 10 years.



Income stability and resilience effects during a drought year (2002) in Adarsha watershed.

Passport to a better world

Eight years ago, women from the Banjara Hub (nomad) community in Madhusudhangarh in Guna district of Madhya Pradesh never grew vegetables. With funds from the Sir Dorabji Tata Trust and help from ICRISAT-BAIF Development Research Foundation, the villagers now grow vegetables for their own needs and even manage a small income by their sale. "Our health and that of our families has improved since we started growing and consuming vegetables," says a delighted Samanta Bai. "We use the money to start thrift savings with our self-help group," adds Nandita Bai.

Conserving biodiversity

Participatory biodiversity conservation has enabled the poor to manage their natural resources better. In Govardhanpura and Gokulpura villages in Bundi district in eastern Rajasthan, India, a participatory community initiative under the Tata-ICRISAT-ICAR project and funded by the Sir Dorabji Tata Trust regenerated half of the degraded common pool resources (CPRs) or grazing area by adopting appropriate social and biophysical interventions. This ensured the availability of fodder for all households and an income of US$ 1670 annually for the self-help group (SHG) through the sale of grass to surrounding villages. In Thanh Ha watershed, Vietnam, the introduction of legumes saw a jump in crop diversity factor from 0.25 in 1998 to 0.6 in 2002. In Kothapally watershed in Andhra Pradesh, farmers now grow 22 crops in a season with a shift in cropping pattern from cotton to a maize/pigeonpea intercrop system. More legumes are now grown in Vietnam and Thailand, reducing the need for fertilizer N.

Improved crops and cropping systems

Maize-pigeonpea intercrop in Kothapally watershed.

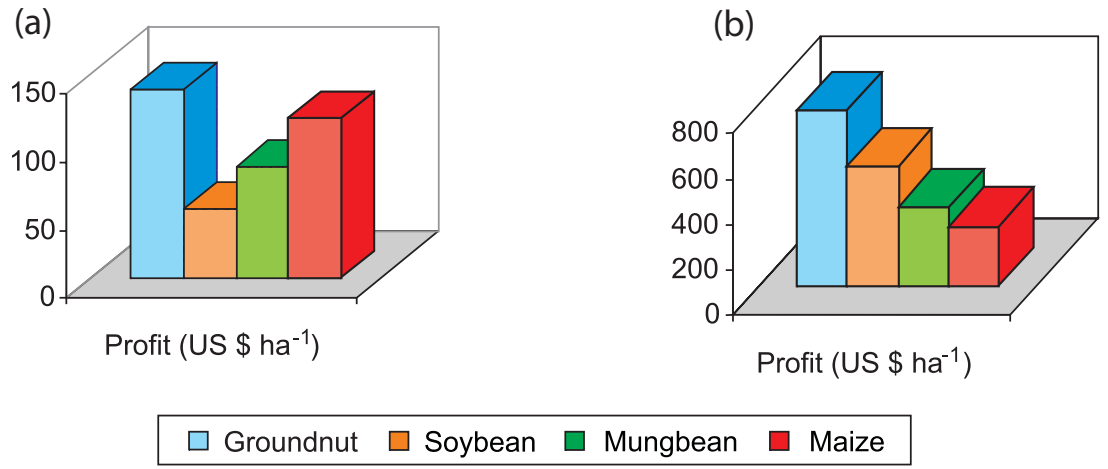
Pigeonpea in Bundi watershed.

The adoption of improved crop varieties of groundnut (ICGV 91114 and ICGS 44), chickpea (KAK 2), pigeonpea (ICPL 87119) and sorghum (CSV 15) increased yields by 20 to 43% and also enhanced the economic profitability of other soil and water conservation investments, which might otherwise have been commercially unattractive to farmers.

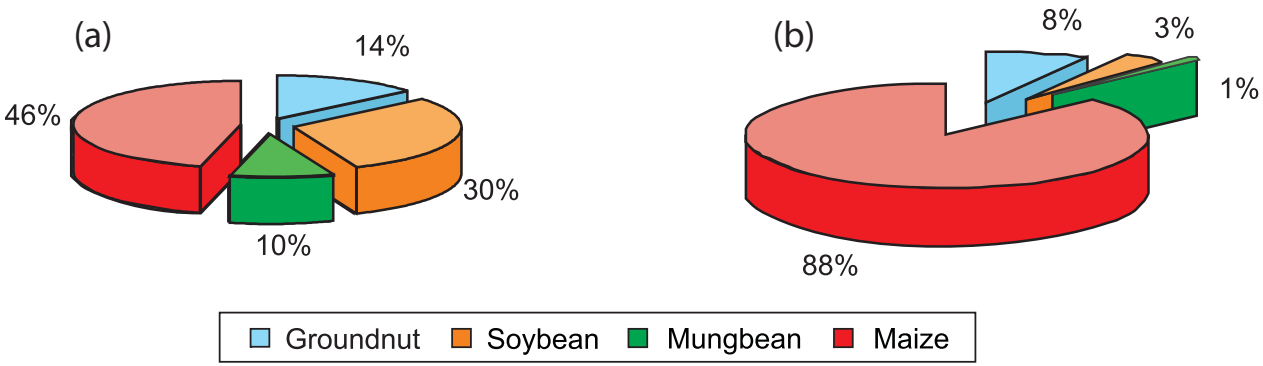
Crop	1998 Baseline	Yield (kg ha-1)						
		1999	2000	2001	2002	2003	2004	2005
Sole maize	1500	3250	3750	3300	3480	3920	3420	3920
Intercropped maize	-	2700 700	2790 1600	2800 1600	3080 1800	3130 1950	2950 2025	3360 2275
Intercropped pigeonpea	190	640	940	800	720	950	680	925
Sole sorghum	1070	3050	3170	2600	2425	2290	2325	2250
Intercropped sorghum	-	1770	1940	2200	-	2110	1980	1960

Average crop yields with improved technologies in Adarsha watershed, Kothapally, Andhra Pradesh, India.

Farmers prosper in Vietnam



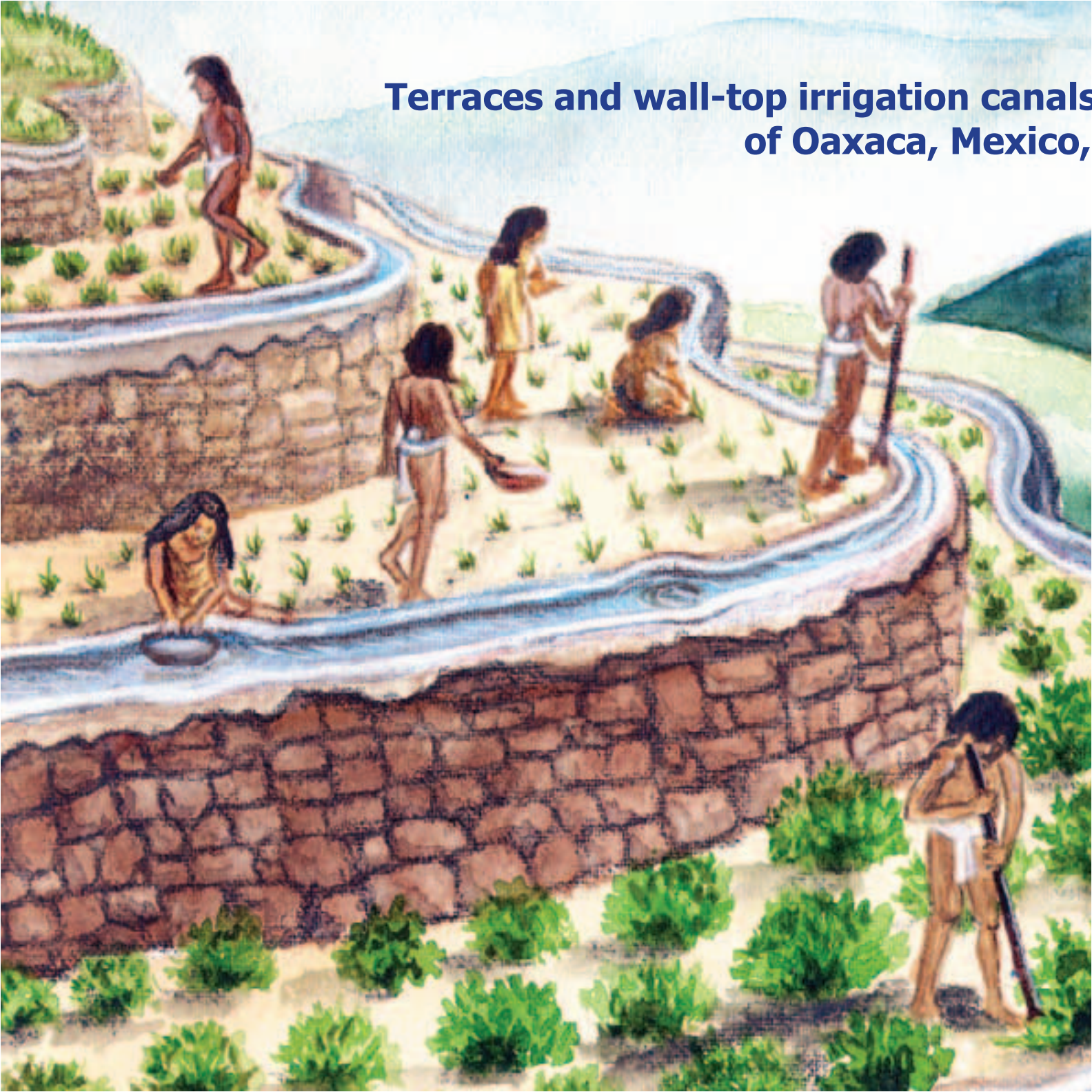
Profits from legume crops in (a) autumn-winter 2003 and (b) spring 2004, Thanh Ha watershed, Vietnam.

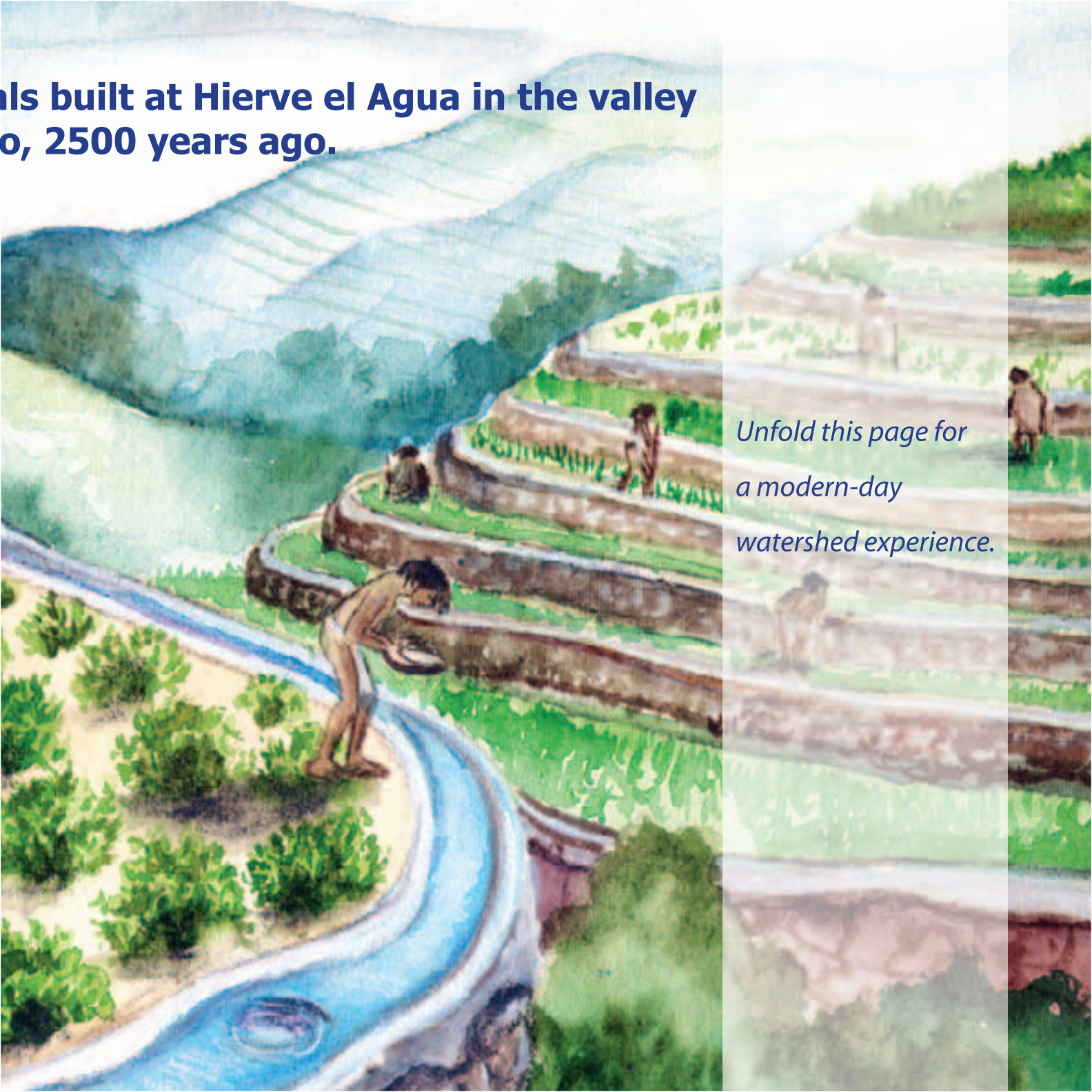


Area expansion of legume crops in (a) autumn-winter 2003 and (b) spring 2004, Thanh Ha watershed, Vietnam.

Thanh Ha watershed in Vietnam.

Terraces and wall-top irrigation canals of Oaxaca, Mexico,





ls built at Hierve el Agua in the valley
o, 2500 years ago.

Unfold this page for a modern-day watershed experience.

Improving water availability

Among the community- and farmer-based soil and water conservation interventions undertaken to enhance productivity and income were the building of efficient water storage structures such as check dams, gabion and gully control structures, field bunding and percolation pits. Findings in most of the watershed sites revealed that open wells located near water harvesting structures (WHS) had significantly higher water levels compared to those away from WHS.

In Lucheba watershed in China, the farming community jointly contributed to a drinking water project with a water storage tank and pipelines connected to farm households, solving the drinking water problem of 62 households and more than 300 livestock, and saving people the drudgery of spending hours fetching it.

In Thanh Ha watershed, collective pumping of well water and setting up an efficient water distribution system enabled farmer groups to earn more income by growing watermelons in the watershed.

Collective water management benefits Thanh Ha farmers.

Water harvesting pits in Vietnam.

Underground tanks/cisterns for harvesting run-off in Xiaoxingcun watershed, China.

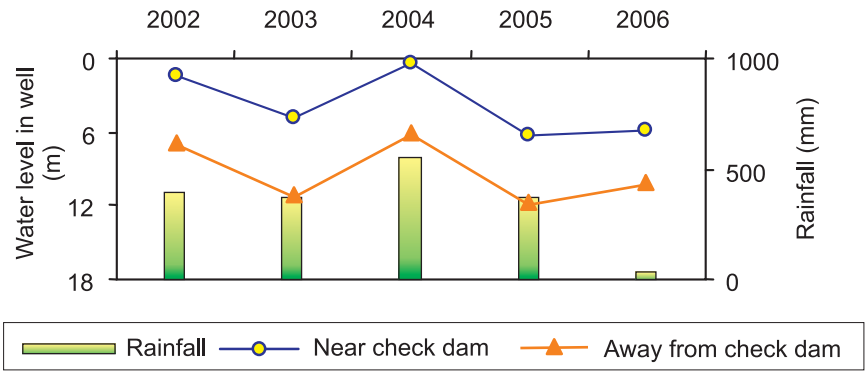
Well recharging with runoff water.

Water pond in Thailand.

The effectiveness of our community watershed management was evident in the reduced run-off volume, peak run-off rate and soil loss and improved groundwater recharge in all the sites in the four countries.

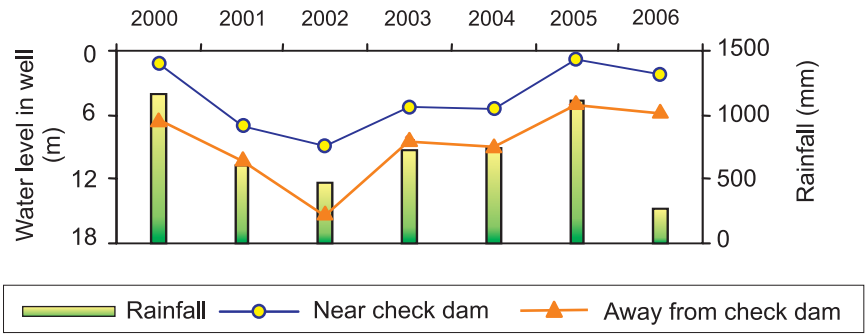
The impact of community watershed management on groundwater levels in India

Bundi watershed, Rajasthan



Estimated additional groundwater recharge was 6,75,000 m^3 per year.

Adarsha watershed, Andhra Pradesh



Estimated additional groundwater recharge was 4,27,800 m^3 per year.

Women drive development

Poverty is what drives women in the watershed villages to surmount all odds to manage household consumption and production. A nudge can often lead to a big push in development. Watershed projects provided the platform for creativity and innovations without trampling on social norms. They provided targeted activities for women, leading to benefits such as building of institutions, developing social capital, improved health awareness and more importantly, greater incomes.

Lakshmi of Kothapally village was a farm laborer till she was introduced to vermicomposting; converting degradable garbage, weeds, and crop residues into valuable organic manure using worms. Today, she earns US$ 36 a month doing this and has inspired and trained 300 peers in 50 villages of Andhra Pradesh!

Powerguda, a sleepy tribal hamlet in Adilabad district of Andhra Pradesh in India would have remained the repository of problems but for one lady's persistence. **Subhadrabai** pioneered a community watershed management approach and biodiesel enterprise, specifically *Pongamia*. With this, her women's group sold carbon credits to the World Bank and gained accolades worldwide.

Sa-gnad Lhuangkham in Wang Chai watershed, Thailand, had the chance to be part of a cross-visit sponsored by the watershed project from which she derived insights into cooperative work. As a result, new self-help groups have sprung up, and making fish sauce, fish feed, soap and shampoo has become a full-time activity for women.

In Addakal mandal, a group of 500 women from 17 villages got together to form the ***Mahila Samaikhya*** (women's federation). They now run a bank, a resource center for training and a knowledge hub. Empowerment is like a magnet, you are drawn to it willy-nilly, women in the neighboring village have learnt from the Addakal example.

The lowly earthworm brings in money

Ramesh Puri is a medium-scale farmer in Piplund village in Rajasthan, India with a 5 hectare farm. He started vermicomposting when the ICRISAT and BAIF Development Research Foundation team started the 'watershed plus' activities in his village in 2005.

He has a vermicompost pit with four compartments under a shed. He says with the compost he has been able to harvest 1 ton of wheat from 0.25 ha, a figure hitherto unthinkable for him. "Not only have I got improved yields, the wheat also tastes better," says Puri. "I have already started using vermicompost for all my grain, vegetable and fodder crops."

Sustaining development and protecting the environment

Farmer-based measures such as the implementation of the broadbed and furrow (BBF) landform, contour planting to conserve *in-situ* soil and water, use of the tropicultor for planting, fertilizer application and weeding, and planting *Gliricidia* to strengthen field bunds, conserve rainwater and supply nitrogen-rich organic matter, have been included in the watersheds.

In Tad Fa watershed in Thailand, interventions such as contour cultivation at midslopes, vegetative bunds planted with *Vetiver* and fruit trees on steep slopes and relay cropping with rice bean reduced seasonal run-off by half to 194 mm and soil loss to less than 1/7th compared to the conventional system.

Integrated Pest Management (IPM)

In order to optimize crop productivity, farmers in the community watersheds adopted several crop protection measures such as the monitoring of *Helicoverpa* using pheromone traps, the use of pest-tolerant varieties, indigenous methods of manually shaking pod borers from pigeonpea, and biological control measures such as *Helicoverpa* nuclear polyhedrosis virus (HNPV). The interventions meant less use of pesticides.

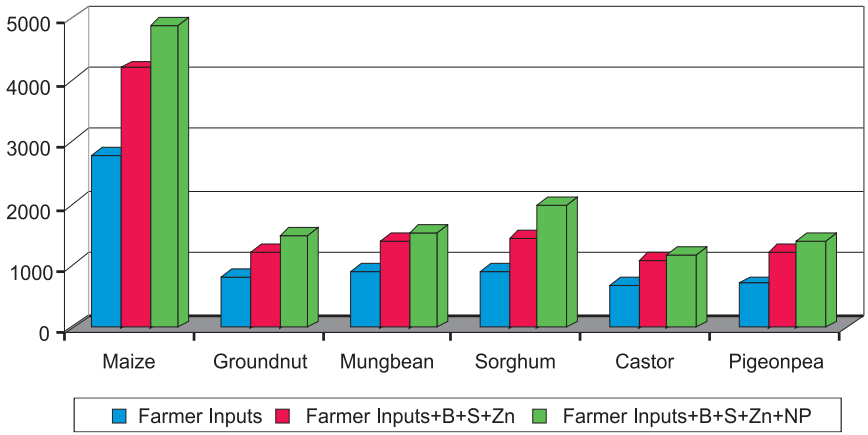
Crop rotation using legumes in Wang Chai watershed substantially reduced N requirement for rainfed sugarcane. IPM practices such as the use of mechanical shaking, HNPV, plant-based bioextracts, insect traps of molasses, light traps and tobacco waste led to extensive crop/vegetable

production in several benchmark sites in India, Xiaoingcun (China) and Wang Chai (Thailand) watersheds.

Integrated Nutrient Management

Improved land and water management practices along with integrated nutrient management (INM) comprising applications of inorganic fertilizers and organic amendments such as crop residues, vermicompost, farm manures, *Gliricidia* loppings as well as crop diversification with legumes not only enhanced productivity but also improved soil quality. Increased carbon sequestration of 7.4 t ha^{-1} in 24 years was observed with improved management options in a long-term watershed experiment at ICRISAT.

INM increased crop yields by 30 to 120 % in Andhra Pradesh, Madhya Pradesh, Rajasthan and Gujarat in India, North Vietnam and China.



Yields of various crops with micronutrients and other inputs in the Andhra Pradesh Rural Livelihoods Project watersheds, Andhra Pradesh, India, 2003 rainy season.

More high-value crops with more water

Cabbages grown at Lucheba watershed, China.

Greenpea at Bundi watershed.

Radish cultivation at Ringnodia watershed.

Enhancing partnerships

The community watershed management approach has contributed to scaling out and up through nucleus satellite schemes and building productive alliances for further research and technical backstopping. Apart from extending its benchmark watershed model to Thailand, Vietnam and China, ICRISAT also shares its innovations with the Philippines.

South-south collaboration

The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) and the Indian Council of Agricultural Research (ICAR), Government of India, are focusing on capacity building and collaborative projects in Africa, drawing from the Asian experiences. A recent partnership fortifying Asia-Africa ties is the "Lake Kivu Pilot Learning Site" where Rwanda, the Congo, and Uganda meet under the Africa Challenge program.

Influencing policy reforms

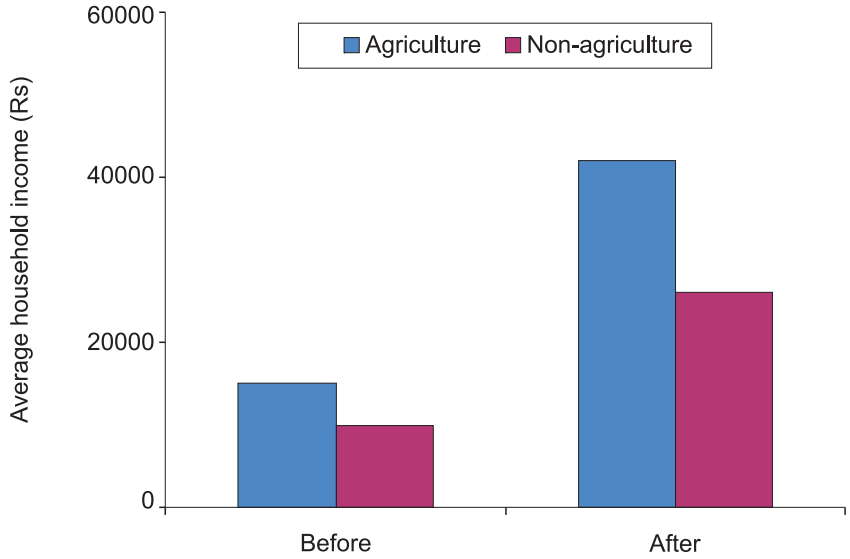
In India, the state governments of Karnataka, Tamil Nadu, Rajasthan, and Andhra Pradesh have sought ICRISAT's assistance in establishing model watersheds and identifying policy inputs like groundwater usage to improve rainfed agriculture. In Thailand, the model contributed to a strong policy statement where every farm household in Northeastern Thailand should have a farm pond, while policy makers in Vietnam, China, and India have shown its impact through a number of R&D projects being scaled out in rainfed areas.

Promoting NRM at landscape level

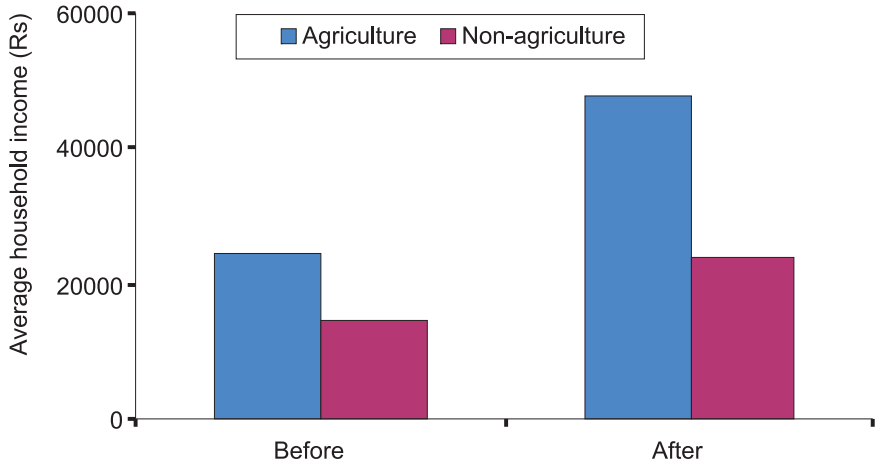
Promoting NRM at landscape level enabled the attainment of wider research impact. Satellite imagery of Kothapally watershed showed 35% increase in vegetative cover after four years. In Thailand and Vietnam, ICRISAT's collaboration with the International Water Management Institute (IWMI) on integrated catchment management substantially reduced soil and nutrient losses and minimized siltation and eutrofication of downstream water bodies.

Community watershed management in Rajasamadhiyala benefited downstream villages and increased productivity, production and incomes for the farmers.

Off-site impacts



Average income of households in the off-site village (Aniyala).



Average income of households in the off-site village (Kasturba Dham).

The benefits

- The community watershed management model which brought together scientists, farmers, government and NGOs, enabled convergence of ideas and cooperation in harnessing the power of collective action
- Developed farmer participatory evaluation methods
- Standardized economical representative soil sampling methods for a micro-watershed
- Identified carbon sequestering systems
- Established a collective action mechanism
- Enhanced community participation
- Developed methods for the safe and useful disposal of obnoxious weeds
- Village seed bank mechanisms served as livelihood options for self-help groups
- Developed SALUS-TERRAE, a digital terrain model with a spatial water model along with Michigan State University
- Enhanced the capability of crop simulation models in collaboration with the University of Georgia.

Our partners

Agricultural Research Institutes: Stockholm Environment Institute (SEI), University of Georgia, University of Reading, International Institute for Applied Systems Analysis (IIASA), University of Michigan and the National Remote Sensing Agency (NRSA).

National Agricultural Research Systems: Central Research Institute for Dryland Agriculture (CRIDA), Indian Council of Agricultural Research (ICAR) institutions, State Agricultural Universities (SAUs) in India; O/o Agricultural Research and Development (OARD), Department of Land Development (DLD) and Khon Kaen University (KKU) in Thailand; Vietnam Academy of Agricultural Sciences (VAAS) in Vietnam; Yunnan Academy of Agricultural Sciences (YAAS) and Guizhou Academy of Agricultural Sciences (GAAS) in the People's Republic of China; and Bureau of Agricultural Research (BAR) and Bureau of Soils and Water Management (BSWM) in the Philippines.

Governments: District Water Management Agency (DWMA), Department of Rural Development, Government of Andhra Pradesh; Sujala Watershed, Government of Karnataka; Government of Rajasthan and Government of Madhya Pradesh; and Provincial Governments of Yunnan and Guizhou, the People's Republic of China.

Non-government organizations: Bharatiya Agro-Industries Foundation (BAIF), M Venkatarangaiah Foundation (MVF), World Wide Fund for Nature (WWF,) Samaj Pragati Sahayog (SPS), Mysore Resettlement and Development Agency (MYRADA), and Rural Education and Agriculture Development (READ).

CBOs: Watershed Committees, User groups and Watershed Associations.

Private: Mak Royale, Southern Biotechnologies Ltd., Online (SBT) and Confederation of Indian Industry (CII).

About ICRISAT®

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 600 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Centers of the Consultative Group on International Agricultural Research (CGIAR).

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