Most Significant Change Stories from the Challenge Program on Water and Food (CPWF)

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CPWF Impact Project

May, 2007

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Introduction

The following stories were collected from CPWF project and theme leaders in January 2007 based on the following two questions:

1) What has been the most significant technical development/advance made by your CPWF project / theme / basin since the start?
2) What has been the most significant partnership change (significant in terms of making scientific progress and/or developmental impact more likely) that has taken place since the start of your CPWF project (or theme or basin)?

The stories were organized by the CPWF's five themes and according to first call projects, basin focal projects and small grants projects. They show the broad range of outcomes and impacts that the CPWF is beginning to have. The stories are not a comprehensive audit of CPWF impact, but rather what people felt motivated to write about. The stories provide gateways to evidence of change and are not to be interpreted as definitive but as iterative.

The Most Significant Change (MSC) method was used to collect and analyze the stories[1]. MSC is part of a repertoire of iterative learning-based approaches that are employed by projects and CPWF as projects evolve in response to emergent change. The authors of the stories were principally the Theme Leaders, Project Leaders and Principle Investigators. In writing the stories they were able to give their interpretation of the emerging issues and changes that most mattered to the leadership in these projects.

Theme leaders selected the story or stories they thought most significant and gave their reasons. The selection decisions and criteria are given as feedback to the projects as a way for the CPWF to focus innovation towards explicitly-valued directions and away from less-valued ones.

First Call Projects

The CPWF placed the first competitive call in the last quarter of 2002 and 33 projects have received average funding of USD 1.1 million for a mean of 4 years research. Projects were chosen according to their compatibility with the CPWF development objectives, scientific merit of proposed research, strategic relevance to CPWF research agenda and priorities, quality and institutional mix of the research team and degree of stakeholder participation, likely impact on beneficiaries, and value for money. The projects are variable and many are cross cutting across both basins and research themes. Some of the stories presented here are part of projects with impacts on a global level—others are more location-specific and are catalyzing changes on a smaller level.

[1] See http://en.wikipedia.org/wiki/Most_significant_change

Theme 1 Crop Water Productivity Improvement

Identifying options for growing more food and saving water

Classification: Technical
Name of persons reporting: Liz Humphreys and Bas Bouman
Date when the change occurred: 2005-2006
Place where the change occurred: Theme 1 Office, IRRI

The Story:
The challenge to produce more food with decreasing water availability has led to the notion that crop water productivity (WP) needs to increase. However, the debate on how to increase WP is confounded by different definitions and spatial and temporal scales of analysis, and poor understanding of what constitutes a "real" water saving. For example, water savings at the field level (such as reduced runoff and reduced percolation beyond the rootzone) do not always translate into water savings at a regional level (where the losses at the field level can be captured and reused elsewhere in the system). Furthermore, merely increasing water productivity may not solve the dual challenges of increasing food production (it may even decrease it) and saving water. Bas Bouman (CPWF Theme 1 leader 2004-2006) saw the need to develop a means of analyzing WP in a systematic way to identify interventions with the potential to increase food production and save water.

Why is the story significant?
The framework provides a systematic means of identifying potential interventions that can increase food production while saving water, at a range of scales from the plants to region. The framework is based on generic principles that can be readily applied across cropping systems, environments and spatial scales. It will assist CPWF projects that aim at improving crop water productivity.

What were the critical factors that led to the change?
- Perceived lack of understanding of water flows and true water savings generated by presumed 'water-saving technologies' in a number of CPWF and non-CPWF projects.
- Lack of a suitable framework–there was need for a methodology to assist scientists and practitioners who are trying to develop sound water management technologies and improve crop water productivity.
- The framework was developed through interaction with many scientists/professionals from different disciplinary backgrounds.

What were the constraints?
The framework helps understand conceptually the effects of the very wide range of interventions (such as breeding, agronomic management, irrigation management, recycling, etc.) on water productivity, food production, water use, and true water savings. To move from the conceptual to the analytical stage, (simulation) models need to be applied and/or empirical field data need to be collected. These activities are constrained by lack of skills, capacity, and equipment (e.g. for monitoring water flows) in many of the current CPWF projects. These constraints could be alleviated by new partnerships (adding the right skills) and capacity building (training).

What are the future implications for actions (e.g., future research), if any?
The framework needs to move from a conceptual stage to an analytical stage and then needs to be tested and applied in a range of applications–-a logical place to start is with themes 1 and 4 CPWF projects.

- Capacity building (skills in using equipment to measure water flows, skills in modeling)
- Link the Crop Productivity framework with the framework of Water Accounting at the landscape-watershed/basin scale.
- The framework is most useful for examining potential interventions for increasing crop water productivity at a range of spatial scales. However, it needs further development to better take temporal scales into account, and financial measures of crop water productivity.

Ecosystem services of rice landscapes

Classification: Technical
Name of person reporting: B.A.M. Bouman
Date when the change occurred: June 2005
Place where the change occurred: CA/CPWF Workshop at IRRI, Los Banos, Philippines

The Story:
CPWF Theme 1 and the Comprehensive Assessment of Water Management in Agriculture (CA) joined forces in 2005 in developing an assessment of "Rice and Water". A workshop was held in June 2005 with a variety of specialists working on the interface rice-water from different angles: food security, water management, climate change, gender equity, poverty alleviation, etc. Participants came from different disciplines and geographical locations. Most of the assessment centred on "conventional" topics of water use, mitigating water scarcity, food security, poverty alleviation. However, during discussions and through background material prepared, it was realized that rice production was only one of the many ecosystem services provided by rice landscapes. Rice fields seem to provide very unique, but often unrecognized, ecosystem services such as providing a habitat for birds, fish and other animals, recharging groundwater, mitigating floods, controlling erosion (through terraces), flushing salts from the soil, providing water filtration, sequestering carbon, and regulating temperature/climate.

Why is the story significant?
To date, most research and development work to mitigate water scarcity has focused on the food production component of ecosystem services, such as the development of water-saving technologies and modernization of irrigation systems. However, there is little understanding on how water scarcity (or other major hydrological changes such as increased flooding and salinization) will affect the other ecosystem services from rice landscapes and what options exist to safeguard valuable ecosystem services and minimize damage to the environment with major hydrological changes.

What were the critical factors that led to the change?
The key factor was the decision to develop a special CA chapter on "rice and water". Irrigated rice worldwide receives around a quarter to a third of all tapped freshwater resources, and provides the staple food for 3 billion people. The chapter would not have been possible without the CA and the CPWF linking up.

What were the constraints?
Broadening our thinking; getting people from different backgrounds together.
What are the future implications for action (e.g., future research), if any?
New research is needed on the various ecosystem services of rice landscapes, and how they are affected by major hydrological changes (water scarcity, flooding, etc) and potential response options such as a shift to nonflooded cropping systems. What are the downstream and offside effects of rice production and such changes; who benefits and who loses? Can there be mechanisms for payment for ecosystem services?

Proof of concept of the aerobic rice technology

Classification: Technical
Name of person reporting the story: B.A.M. Bouman
Project / Theme / Basin: PN16 / Theme1 / Yellow River Basin
Date when the change occurred: Throughout 2005-2006
Place where the change occurred: Yellow River Basin, North China Plain

The Story:
Since the early 2000's, reports came out of China about farmers pioneering aerobic rice (that is, rice grown under nonflooded and nonpuddled conditions just like wheat or maize), under water-scarce conditions and realizing "high" yields. However, no information was available on actual yield levels and water (irrigation, rainfall, groundwater) requirements, and it was suspected that shallow groundwater tables made high aerobic rice yields possible. Using a combination of well-designed field experiments, monitoring farmers' performances, and crop growth simulation modeling, we confirmed that aerobic rice yields of 3.8-5.6 t ha^{-1} are obtainable with groundwater tables deeper than 2 meters, with only 2 to 3 supplemental irrigations (150-225 mm) and rainfall of 115-670 mm. For comparison, lowland rice in the same environments produced 6-9 t ha^{-1}, but required 900-1,300 mm of combined rainfall and irrigation water with groundwater tables of 20 to 30 cm depth. Moreover, it was experimentally demonstrated that aerobic rice can withstand prolonged flooding.

Why is the story significant?
With the concept well proven, aerobic rice can become an alternative crop for increased livelihood and food security under conditions of water scarcity:

- In rainfed areas where maize is the current dominant grain crop, farmers are testing aerobic rice for crop diversification (reduced market dependence on maize, rice security for home consumption).
- In irrigated areas where water shortages make the growing of lowland rice impossible, aerobic rice can be introduced alongside upland crops such as maize or cotton for a diversified cropping system (again, rice security for home consumption).
- Especially in areas with water shortage and risk of flooding, aerobic rice is the preferred crop because of risk of failure of upland crops such as maize or cotton.

What were the critical factors that led to the change?

- Development of special "aerobic rice" varieties that combine drought resistance of upland rice with high yield characteristics (lodging resistance, input-responsiveness) of modern high-yielding lowland rice.
- Combination of field experiments, farmer participatory R&D, and simulation modeling demonstrated the potentials of aerobic rice and guided the development of appropriate

management practices
- A multidisciplinary research team that combines breeding, agro-climatology, plant nutrition, agronomy, water management, and economics, and works with a combination of approaches
- Strong local champions who "speak the farmers' language", and involvement of local governments.

What were the constraints?
- In terms of the project team: forming a coherent multidisciplinary research team where individual scientists break down disciplinary boundaries

- In terms of involvement and adoption of aerobic rice by farmers: gaining trust by repeated presence of scientists; getting local government support; extension support; availability of aerobic rice seed (distribution system); and market boundary conditions, i.e. relative price of outputs (rice versus maize, cotton, etc) and inputs (seed price, water price, etc), labor availability and costs.

What are the future implications for action (e.g., future research), if any?
With increasing water shortage in traditional rice-based cropping systems, field conditions will become more aerobic (less flooded conditions) with adoption of alternate wetting and drying, aerobic rice, and upland crops. This will have major implications for sustainability, environmental impact, and ecosystem services that are still very poorly understood. Research is needed to develop response options for farmers to maintain crop production capacity while safeguarding critical ecosystem services.

Aerobic Rice Partnership Development in Asia

Classification: Partnership
Name of person reporting the story: B.A.M. Bouman
Project / Theme / Basin: PN16 System of Tropical Aerobic Rice / Theme1 / IGP
Date when the change occurred: April, 2006
Place where the change occurred: At IRRI HQ, but affecting countries in South Asia and the IGP

The Story:
Based on the promising developments of the aerobic rice technology by PN16 (STAR), the Irrigated Rice Research Consortium (IRRC), and the Consortium for Unfavorable Rice Environments (CURE), the Asian Development Bank requested IRRI to head a project to develop and disseminate aerobic rice in South Asia. The work under this project in India, Pakistan, Bangladesh, and Nepal, complements geographically the work carried out in China, India, Laos, Thailand, and the Philippines under STAR. The achievements and work plans of the STAR and ADB projects were discussed in a combined meeting in April 2006. Research priorities and strategies were discussed and jointly agreed upon, following a similar format as combined STAR-IRRC meetings in 2004 and 2005.

Why is the story significant?
The partnership and collaboration between STAR and the ADB project (and the two above-mentioned Consortia) ensures that no work gets unnecessarily duplicated, that resources are optimally utilized, and that results and ideas get shared in early stages of development. The ADB project could make a 'flying start' and benefit from STAR's experiences. Now that the concept of aerobic rice was proven by STAR, they could now move on to "second-generation issues" such as long-term sustainability and soil health issues.

What were the critical factors that led to the change?
It may take years to develop good partnerships, which depend on mutual trust and confidence. In the case of the STAR and ADB projects, collaboration among STAR, IRRC, and CURE partners paved the way for extension with the ADB project. Also critical is the attitude of donors who realize that partnerships add value to their own funded projects/Consortia and who do not want to 'claim' sole ownership of results or achievements.

What were the constraints?
- Sharing of data and resources (such as finances among institutes)
- Agreeing 'who does what' (task division)

What are the future implications for action (e.g., future research), if any?
- Issues of yield sustainability and soil health under aerobic soil conditions
- Effect on ecosystem services from the change from flooded to nonflooded aerobic rice.

The following story was chosen as a favourite because it is a good example of the tremendous potential to increase food production and water productivity in salt affected areas by the development and adoption of salt tolerant varieties of both rice and non-rice crops. Approximately 21m ha of agricultural land in Asia are salt-affected. Salinity problems undermine food security and livelihoods for an enormous number of poor people.

The development of salt tolerant varieties adapted to different environments is the outcome of a large, collaborative research effort. This includes the following: collection and preservation of germplasm from many diverse locations; screening of tens of thousands of lines for salt tolerance; physiological studies to understand the mechanisms of salt tolerance; genetic studies leading to the identification of molecular markers for the main genes responsible for salt tolerance; and traditional breeding to incorporate salt tolerance into locally adapted varieties with the desired quality (for eating preference and marketability).

Adoption of salt tolerant modern rice varieties in the wet season and non-rice crops in the dry season significantly enhances farmers' food security and income in Orissa, India

Classification: Technical
Name of Persons Reporting: Thelma Paris and Steve Zolvinski on behalf of Dr. Abdel Ismail (Principal investigator) and Dr. DP Singh, Dr. Sanjoy Saha, Dr. K.R. Mahata of Central Rice Research Institute (CRRI), Cuttack
Project / Theme / Basin: PN7 / Theme 1 / Indo-Gangetic Basin
Date when the change occurred: 2003-2006
Place where the change occurred: Kamilio and Chaulia villages, Ersama block, Jagatsinghpur, Orissa

The Story:
The villages where the work was done have problems of soil salinity due to ingression of seawater during high tides through surface channel, creeks and river during the wet season while the rice of shallow saline groundwater creates salinity problem during the dry season.

Although the average annual rainfall is around 1558 mm, the distribution of monsoon rain during the crop growing season is highly erratic. The problems of initial or terminal drought, submergence or water logging, flash flood and cyclonic disturbances are more frequent.

Farmers are poor, with small land holdings and food (rice) insecurity. The rice they produce is enough only for four to nine months. Thus they have to buy during the lean months. Farmers grow TVs namely Rashpunjar, Bhaluki, Bhundi which have low yields at 1.0 ton per ha. During the dry season, farmers grow varieties such as Khadagiri, Parijat, Lahat, etc which yields 2.5 to 3 tons/ha. However during the dry season, these varieties are susceptible to salinity and any increase in salinity level damage the crop severely.

The low productivity of summer rice is due to unavailability of suitable rice varieties and lack of technical knowledge about management of rice crop under this stress situation. Under the project CPWF PN #7, these severely stressed rice environments became the laboratory for farmer participatory experiments for saline tolerant rice varieties and crop diversification

Why is the story significant?
- With the introduction of new varieties namely SR26B, Pankaj, and Lunishree, rice yields increased and additional/expanded dry season rice crop allowed farm households to grow enough rice for the year. Farmers said “we no longer think about whether we will have enough to eat the next day”.
- Introduced varieties at least doubled the yields compared with the TVs. Farmers reported yields of varieties between 2.5 to 4 tons per ha compared to yields of TVs at 1.5 tons per ha.
- Sunflower, a crop which has tolerance to salinity, was introduced after rice. Farmers used to leave the fields fallow after rice. Now, farmers would like to double the area planted to sunflower. They like the fact that sunflower can be pressed for cooking oil which saves them money from having to purchase an essential household commodity. The residue or “cake” from the pressing process can be used for livestock/fish feed and as cooking fuel.

What were the constraints?
- The new varieties are more susceptible to stem borer that damaged 10-20 percent of the crop, whereas TV are tolerant to pests. They also complain of grain shattering which was specific to Lunishree.
- Lack of access to pure seeds of the new varieties. Instead of 2 kg from the project they want this to be increased to 5 kg.
- One constraint in increasing income out of sunflower is the lack of efficient seed extraction facilities and the high cost for pressing. Farmers would like to learn how to prepare seeds for pressing i.e. drying and storage.
- Lack of information about varieties and production practices as agricultural centres tend to work on other crops. The research team has introduced only KBSH1 which is grown in other areas of Orissa. Another constraint is a fungal disease.

What are the future implications for action (e.g., future research), if any?

- This project demonstrated the importance of conducting farmer/community participatory experiments to enable immediate feedback on technologies introduced. "Learning by doing" enabled farmers to conduct experiments on their own by growing the new varieties using their level of management. Plant breeders should consider farmers' criteria in varietal selection.
- Farmers, both men and women, should be involved in evaluating the popular varieties with Saltol gene.
- Expand sunflower production as a crop suitable for saline areas, after rice.
- Evaluate additional crops that grow well in these saline areas and which have high market value

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The next story was chosen as a favorite partnership story because it is an excellent example of the impact that can be achieved by identifying and truly involving the key stakeholders and end users–farmers, fishers, R&D organizations including top management, district and provincial extension, NGO, local government, government resource managers, government planning and development institutions.

The vital roles of NGOs, local governments and development agencies in a research project on Coastal Resources Management

Classification: Partnership
Name of Person Reporting: Dr. TP Tuong on behalf of PN10 team members
Project / Theme / Basin: PN10, Themes 1 and 3 / Mekong and Indo-Gangetic Basin
Date when the change occurred: 2002 to date
Place where the change occurred: Bac Lieu Province of Vietnam and the Southwest coastal sub districts (Batiaghata, Dumuria and Paikgacha) of Bangladesh

The Story:
Usually researches are carried out by research institutes and universities and are often divided by sectors, e.g. agriculture, aquaculture etc. The uptake of research results is often considered a separate step, to be carried out by development agencies. Interventions by different development agencies are often also carried out independently.

Sustainable natural resource management in the coastal zones, where fresh and saline water interface, must take into account diverse stakeholder interests (e.g. agriculture, aquaculture, capture fishery) and complex multi scale interactions among different resources (e.g. water, soil, land use).

Among PN10 partners are institutions in charge of various resources important to coastal management (water, land use, agriculture, aquaculture, and fishery). They include research and development institutions, national, provincial and local governments, NGOs and farmers. The project creates a forum for these institutions to discuss their diverse views on the possible impact of proposed resource use interventions. Of particular importance is the collaboration/dialogues between institutions in charge of research in agriculture (BRRI in Bangladesh, CTU in Vietnam), research in aquaculture (BRFI in BD and RIA2 in Vietnam), land resource management (LGED in BD, IMRC in VN), and water management institutions (BWDB in BD, SIWRP in VN).

The inclusion of an NGO (HEED) in BD and local governments and extension services (at district and provincial levels) in Vietnam are pivotal in the speedy dissemination of on-farm technologies of the project. They participated in on-farm research, and organized field visits and farmer training, using existing farmer networks.

The planning and development institutions (BWDB, LGED in BD; SIWRP, IRMC, BL DARD) are both research partners and clients of the project. They supplied the project with important secondary data; gave feedbacks on research findings, and incorporated the appropriate research findings in their development activities/workplan. Top management employees of these national development and research agencies were involved in the national advisory committee (NAC) of the project.

Why is the story significant?

- The involvement of local government and NGO ensures demand-driven research and the relevance of research outputs. They also facilitate rapid uptake of technologies.
- In BD, research results encouraged BWDB to implement a project on Integrated Planning for Sustainable Water Management (IPSWAM) involving farmer groups in polder 30 at Batiaghata, Khulna. LGED extended its supports to determine water table elevation in Tala upazila of Satkhira district.
- Realizing the importance of and farmers' interest in HYV, the Department of Agricultural Extension (DAE) and BWDB have taken up development interventions to reduce the flood depth in polders 22, 29 and 30 (in Khulna district) so that HYV can be grown in the wet (commonly known as *aman*) season
- In Vietnam, the research findings were incorporated in the provincial land use and water management schemes.
- National agencies are sharing secondary data for developing resource management domains (RMD), hydraulic and salinity modeling.

What were the critical factors that led to the change?

- Built on partnership developed from previous projects
- A clear understanding of roles and responsibilities of different organisations in each country and how they work/interact
- A good ex ante analysis of uptake and impact pathway of the project findings

What were the constraints?

- Infrastructural development requires time and resources; there is considerable time lag between planning and implementation.
- Adoption of new technologies by farmers takes a few years, therefore impacts of improved production systems may not be seen during the project period.

What are the future implications for actions (e.g., future research), if any?

- Improving coordination among the GOs, NGOs, and research and development agencies
- Implementing an impact monitoring program and impact assessment when the project ends

Deploying Genotypes Resistant to Yellow Rust in Eritrea

Classification: Technical
Person reporting The Story: M.E.H. Maatougui
Project / Theme / Basin: PN2 / Theme 1 / Nile Basin
Date when the change occurred: 2006
Place where the change occurred: Highlands of Eritrea

The Story:
Yellow rust (Puccinia striiformis), besides terminal drought, is a serious threat to wheat production in the highlands of Eritrea. Every year, outbreaks of the disease cause serious yield losses that can range from over 50% to total crop failure. Most cultivars in most wheat growing areas of the highland are highly susceptible to this disease, especially if rainfall is favorable. Although farmers are familiar with the disease, they are not aware that genetic resistance exists and can be the most reliable solution.

PN2, for the past two years, has been exposing farmers to resistant material, introduced from ICARDA. New germplasm was planted in farmer's initial trials (FIT) in 4 villages (Tera Emni, Weki, Wekerti and Tekonda) representative of 4 important sub districts of the highlands (Dubarwa, Serejeka, Dekamhare and Adi Keyh). Farmers selected for resistance against the disease, plus other agronomic characters such as earliness, plant height, spike length, spike density, grain size, and grain yield.

In 2006, twenty resistant genotypes with attractive agronomic attributes were selected by a total of 131 farmers (51 females and 80 males) from 8 villages in 4 locations.

Farmers started to accept the existence of genetic resistance to rust and to consider the deployment of resistant germplasm. And they requested seeds of the selected genotypes. One kilogram of foundation seed was provided for multiplication for each of the 20 lines. These will be distributed to farmers at the next cropping season (June-November, 2007).

Why is the story significant?
- Food insecurity is a major problem in Eritrea and officials of the Ministry of Agriculture are strongly pushing for a strategy to increase wheat production.
- The use of genetic resistance to rust is a long term, low-input intervention.
- Increased awareness of farmers on the use of resistant varieties

What were the critical factors that led to the change?
- Farmers have seen and selected resistant, locally adapted and productive genotypes that can be used safely in their prevailing cropping conditions.
- Prices of wheat are always higher than those of barley, the dominant staple food in rural areas.
- Local demand for wheat is rising steadily as relief provisions are getting lower.

What were the constraints?
- Occurrence of the disease is natural and its severity is increasing causing recurrent crop failures.
- Local cultivars are all susceptible.
- No incentives were previously set to encourage wheat production.

What are the future implications for action?

- Identify cultivars with resistant genes and cross them with genotypes preferred by farmers.
- Organize seed multiplication of adopted genotypes in each village
- Assist in setting up a pilot village based wheat seed enterprise

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New, high yielding lentil variety identified through collaboration with farmers

Classification: Technical
Person reporting The Story: Salvatore Ceccarelli
Project / Theme / Basin: PN2 / Theme 1 / Nile Basin
When the event happened: 2006
Location where it happened: Adi Logo, Wokerti and Tekonda (Eritrea)

The Story:
Lentil is an important cash crop in Eritrea but production is seriously limited by biotic stresses, the most important being fusarium wilt, rust and weeds. In 2005 a high-yielding lentil line (ILL 7978) that can contribute to sustainable farming in the highlands of Eritrea without drawing from the limited water available was identified. It yielded, under rainfed conditions and without additional inputs, nearly three times more than the local check. It was not affected by wilt and rust unlike the majority of the lines tested, and being small seeded, was the most preferred by farmers.

In 2006 the line was added as check in the initial participatory lentil trials planted in three villages--Adi Logo, Wokerti and Tekonda--under prevailing agronomic practices. At the same time the line was multiplied at ICARDA for distribution and for foundation seeds. Later that year, the line's superiority was confirmed when it ranked first in Adi Logo and Tekonda and sixth in Wokerti. During farmers' selection, the line received the highest or amongst the highest score by both men and women.

Twenty kg of foundation seeds were produced from the 3 trials and about 100 kg are expected to be produced at ICARDA. The entire lot will be distributed to representative farmers of the village stakeholder committees for multiplication during the next cropping season. At least two fields in each of the three villages will be planted for demonstration and seed multiplication. The expected output of 10 quintals will benefit the village farming community.

Why is the story significant?

- The new cultivar was identified in a dry year (2005) and remained superior in 2006, when rainfall was higher. Therefore, it is likely that we identified a stable variety with higher water use efficiency;
- To meet local demand expensive imports from India and Canada have to be made, and these types of lentils are often large seeded and are not well appreciated by consumers. Price of local lentil ranged from 2 to 2.5 US$ per kilo in 2006.

What were the critical factors that led to the change?

- Local demand for domestic consumption of the crop;
- Testing of the line in farmers fields with farmers' participation in evaluation and selection;
- High income opportunity: a 0.5 ha field of productive, wilt-resistant cultivar can easily produce 500 kg under rainfed conditions and without any external inputs, ensuring a higher income for the farmer.

What were the constraints?

- Unavailability of productive cultivars
- Lack of organized seed production

What are the future implications for action (e.g., future research), if any?

- Extend the work to more villages and provide farmers a larger number of wilt- resistant, early to medium maturity lentil lines.
- Help contact farmers of the village stakeholder committees to organize village based seed enterprises to multiply and distribute seed of the improved variety.
- Organize several large-scale demonstrations and field days in collaboration with contact farmers, local administrators, research leaders, extension agents, and NGOs.
- Participation of farmers in the selection process will ensure interest in seed multiplication, rapid adoption of varieties suitable to specific local conditions of different villages, and rapid impact.
- It is possible with the methodology used by the project to identify other crops which can use available water efficiently to produce good yields and boost farmers' income.

Theme 2 Water and People in Catchments

Theme 2 conceptual framework, especially the concept of reverse flows

Classification: Technical
Person reporting the story: Nancy Johnson
Theme: Theme 2
Date when the change occurred: May 2003 Framework was first developed
Place where the change occurred: IFPRI, Washington DC

The Story:
The framework was a true collaborative effort between CIAT, IFPRI and ICRAF on behalf of Theme 2. The framework has been successful in communicating not only the upstream-downstream relationships within catchments but also that these one way flows can become two way flows. The reverse flows can take many forms and people interpret them in a range of ways from a direct financial flow such as PES or an indirect flow of labor from lower to upper in search of income earning opportunities. The framework gets people thinking about the catchment as a system that is based upon but more complex than water flowing downstream.

Why is the story significant?
The framework and the concepts in it are being taken up and cited by others, mainly in workshops where it is presented.

What were the critical factors that led to the change?
Ability to bring several scientists who all had experience working on watershed issues in different contexts (one in Asia, one in Africa, one LAC) together for one day to focus just on this. Costs were low because it was an add-on to other trips for all concerned, but the payoffs were high.

What were the constraints?
None

What are the future implications for action (e.g., future research), if any? Framework will be published in an international journal very soon so its potential impact should grow.

Payment of analytical services

Classification: Partnership
Name of Person Reporting: Theme 2 coordination
Date when the change occurred: June 2006
Place where the change occurred: Nairobi Kenya

The Story:
Theme 2 hosted a project inception workshop for payment for environmental services (PES) approaches to contribute to equitable and sustainable management of soil and water in upper catchments in Nairobi, Kenya from 27 to 28 June 2006. The workshop was assisted by Theme 2 project leaders, members of MSEC, MIS and AfNet (a consortia of soil scientists working in Asia, Latin América and Africa), and experts of PES in Australia, North América and Africa.

They discussed how to integrate water and soil management thinking in the landscape scale, and how the technologies being developed by the projects have the potential to produce ES at the watershed level. As a consequence, several soil scientists became interested in the socio-economical concept of PES and how they will be able to apply it to their projects. The participants have also been motivated to write joint proposals for PES case studies.

Why is the story significant?
It is significant, because CPWF Theme 2 project leaders and the scientists of the soil research consortia got together to discuss and understand better how to tackle the problem of water and soil nutrient management in a landscape scale perspective. They are working together on how to integrate biophysical science with socio economic science in new ways.

What were the critical factors that led to the change?
The opportunity to get together to discuss new ideas and concepts

What were the constraints?
For some soil scientists it has been difficult to understand what PES is all about. But they are working on it, and the project has an important component of capacity building that will fill this gap of knowledge.

What are the future implications for action (e.g., future research), if any?
Improved work in soil and water science.

Deeper understanding of water-poverty relationship

Classification: Technical
Name of Person Reporting: Nancy Johnson
Project / Theme / Basin: PN20 / Theme 2 and Theme 5 / Andes
Date when the change occurred: Summer 2005
Place where the change occurred: Fuquene watershed

The Story:
The prevailing perception in this watershed was that wealthy cattle farmers were contaminating the water in Lake Fuquene and hurting both the environment and the livelihood of the poor that depend on it. After using poverty analysis methodology that characterizes current poverty and explains changes in poverty over time, it became clear that dairy farms also had significant positive impacts on poverty alleviation: dairy farmers hire workers on good long terms contracts, from female heads of household for milking to more skilled people for administration. The results of the poverty analysis were later presented to the relevant communities.

Why is the story significant?
This was important because it has changed the way the other stakeholders viewed the dairy farmers. Appreciation of their role in poverty alleviation is one factor in shifting focus of interventions further upstream. It also affected the kinds of regulatory scenarios that might be considered welfare enhancing for the watershed.

What were the critical factors that led to the change?
Looking at poverty in a dynamic rather than a static way was critical to change. By looking at who was poor 20 years ago and who is poor now, changes in poverty status--and the causes behind them--was better understood.

What were the constraints?
We didn't have as much participation of biophysical scientists as we would have liked

What are the future implications for action (e.g., future research), if any?
Results were already used in design of subsequent work in the site, and have been presented and will be published in other places to share the lessons.

The following story was selected as a favorite because it is an example of the kind of cross-scale work that is so needed and that shows the possibilities of research linking with national policy.

Linking the lake and the páramo, at multiple scales

Classification: Partnership
Name of Person Reporting: Nancy Johnson
Project / Theme / Basin: PN20 / Theme 2 / Andes
Date when the change occurred: 2006
Place where the change occurred: Andes basin

The Story:
The main intervention we are doing in the 2 sites in Colombia is the "*conversatorio*", which is a legal mechanism through which communities hold authorities accountable. Its success depends on the extent to which the community is united, technically prepared, and capable of interacting with representatives of the institutions. The project is adapting a process for preparation of local communities on all of these fronts in order to address watershed issues.

The process is led in each of 2 sites by local NGOs, supported by a national NGO and the research organisations. In one watershed, the NGO was mainly focused on the lake at the bottom of the watershed, while in the other it was an NGO from the "*páramos*" of the uppermost part. Bringing these two together, through the support of the national NGO, has led to a strong collaboration and to new perspectives on the importance of linking upper and lower parts of watersheds. In addition to their links with each other, the wetland NGO now works in upper areas and the "*páramo*" NGO now has contacts with the irrigation districts of the lower part of its watershed.

At least in Fúquene, this is also reflected in changes in the way that communities see things. In a prioritization exercise to determine what topics would be addressed in the "*conversatorio*", fisher communities gave priority to problems faced by upstream communities because they recognized that by working with those communities to solve their problems of unsustainable agricultural expansion, they would indirectly be solving their own problems of water contamination. This in spite of the fact that a fisheries biologist with whom they worked closely was pushing them to give priority to a downstream fish and water quality monitoring systems!

The realization that upstream issues were important also spurred the downstream NGO to try and influence policy makers to take action in upstream areas. One area is land use regulations in *paramos*. The NGO is supporting the idea of environmental service payments for adopting

sustainable practices in appropriate areas. Another area is water treatment. None of the water treatment plants in the rural communities is working and this is a major source of pollution downstream.

In another site in Coello, Tolima, there was very little contact between the upper and the lower parts. Through this project and the intervention of CIAT's rice project, a contact was made. Someone from the rice growers' association participated in a "watershed expedition" that involved about 30 people from different parts of the watershed visiting it together. As a result they became aware of the threats to their water supply due to upstream land use practices, and are now active participants in the basin dialogues coordinated by the NGO.

Why is the story significant?
It shows new relationships and changes in attitudes that should continue beyond the life of the project.

What were the critical factors that led to the change?
Opportunity to focus on something beyond their original geographical and technical areas of expertise

What were the constraints?
The 2 local NGOs competed for time and attention from the national one. In some ways this brought them closer since but the national NGO does favor one over the other which is always a problem.

What are the future implications for action (e.g., future research), if any?
Presumably both will continue to use a watershed perspective within their work. One thing I wonder about is how the communities will feel about the linkages they discovered. For example, the fishers see that their problems will be solved upstream. But will they support drastic upstream solutions like banning all agriculture at the expense of upstream welfare? How the alliances among stakeholder groups play out over time will be interesting to watch.

Multiple use water services

Classification: Technical
Name of Person Reporting: Barbara van Koppen
Project / Theme / Basin: PN28 / Theme 2 / Andes, Indus Ganges, Limpopo, Mekong, Nile
Date when the change occurred: Since inception phase of the project
Place where the change occurred: Governments of Colombia, South Africa, Zimbabwe, and Thailand

The Story: Conventional water development was sector based (either domestic or irrigation) but water users normally use schemes for multiple purposes and multi-faceted livelihoods.

PN 28 showed evidence of community-level cases of multiple use water services. It was clear that planning and design of water services for multiple needs of the poor can improve wellbeing. Women's participation in planning also enhances institutional and financial sustainability of multiple use water services, and improves water efficiency and equity at low incremental cost.

The governments of Colombia, South Africa, Zimbabwe, and Thailand have taken up recommendations of PN28 and have adapted a national policy towards planning and implementation of multiple water uses. The government of South Africa has drafted national guidelines for multiple water use services and is testing these in pilot-projects with local governments. In Zimbabwe there is a proposed law incorporating MUS.

Dialogue with global water sector leaders in both domestic and productive sectors and with national and local partners has led to uptake or strengthening of multiple-use approaches (World Water Forum IV, WSP, IFAD, global NGOS, Winrock, GWP, ICID, Stockholm Water Week, Gates Foundation, etc).

Other impacts are implicit and not necessarily documented, but not less effective, such as:

- The allocation by WWF4 of a topic Session on MUS in a highly competitive process
- Joint policy briefs e.g. GWP reports how MUS is now more widely seen as IWRM
- There are high-level discussions in Colombia (with Ines Restrepo) on water quantity norms for 'domestic' schemes. However, changing laws can last longer than the duration of the project.
- In Nepal, high-level irrigation engineering officials said in meetings that they will “close their eyes” if an irrigation scheme is used for domestic purposes. This is an informal commitment that is not easy to document, but may be much more effective than a change in the Zimbabwean water law!
- The Thai government has embraced the multiple-use water tanks and other investments for homestead production by the Farmer Wisdom Network, (which is supported by the MUS project) for the national economic sufficiency policy. We are documenting this process, but, in general, governments do not like to be told by others what they have to do, so any documentation of change has to be much more subtle. In fact, our approach with 'Learning Alliances' is exactly to create ownership and fully adapt according to national stakeholders' commitments
- The project has been invited to the Collaborative Council on ('domestic') Water Supply--another key player taking up the concept, and IFAD is also showing more interest in the project.

Why is the story significant?

- Implementation of multiple-use water services approaches alleviates rural and peri-urban poverty more effectively.
- It highlights the extent of collaborative efforts pertaining to MUS. To date there are many written advocacy papers and joint publications on MUS approaches.

What were the critical factors that led to the change?

- Strategic partnership between domestic and productive water sectors to jointly identify obstacles to sector-based planning and untapped synergy of cross-sectoral collaboration
- The common CPWF action-research framework shared among projects for cross-basin comparisons across eight countries

What were the constraints?

Limited capacity and institutional space to implement participatory planning for identification of local-specific water needs, building ownership, and upscaling

What are the future implications for action (e.g., future research), if any?
Further action research from local to global level to corroborate advocacy and develop upscalable participatory water planning and design approaches.

Selected as a favourite by the management team member responsible for gender, institutions and participation because it shows how proponents negotiated and struggled to seek solutions to earlier problems in order to effect change. It demonstrates an iterative approach in action.

The Long Road for Participatory Technology Development (PTD) in Iran

Classification: Technical and Partnership
Name of person reporting: Juergen Anthofer, Seyed Babak Moosavi, Yagyoub Norouzi & Francis Turkelboom
Project / Theme / Basin: PN 24 Livelihood Resilience / Theme 2 / Karkheh River Basin
Date when the change occurred: Sep 2004 until now
Place where the change occurred: Iran

The Story:
Introduction of participatory technology development (PTD) approaches for land and water management was one of the main goals of the project since its onset. In preparatory discussions, this need was felt because, despite excellent research expertise available in Iran, integrated solutions which directly benefit farmers are often lacking. At first, training courses about participatory approaches were organized ('Participatory diagnosis', 'Building on local innovations', 'PTD'). While this created a lot of interest and enthusiasm, it appeared to be difficult for many researchers to apply these new approaches without intensive backstopping and institutional support. Involved research institutes were testing their own technologies on-farm, but identified local innovations were hardly considered in the trials. Moreover, the trials were fully researcher-designed, and interaction between farmers and researchers were largely restricted to those farmers hosting the trials. Furthermore, the Extension Department and other stakeholders were not involved. Thus, it was felt that a more institutional approach was needed.

In mid 2006, a special project activity on 'Participatory Technology Development' (PTD) was launched to increase farmer participation and to enhance inter-institutional linkages. The PTD approach was meant to overcome the above shortcomings through intensified farmer participation and increased inter-disciplinary collaboration during the trials. A new research partner, the Rural Research Centre (RRC) was invited to lead the PTD activity, with assistance of ICARDA. This was a timely move, as RRC had recently received the national mandate to stimulate the use of participatory approaches in Iran. The PTD team has been building linkages between the different Iranian agricultural research institutes, and has been collaborating with extension and a local NGO (CENESTA). Links with other ICARDA-managed projects have also been established: some activities of the water productivity project (PN 8) and the participatory plant breeding project (PPB) have been incorporated into the PTD framework.

A one-week planning workshop was conducted at RRC, using problem and objective trees and transforming the results to a project planning matrix for the whole project period. Monitoring criteria were developed and a national and two provincial PTD teams for the two project sites were formed, comprising of RRC staff and additional experts from different disciplines. To begin with, existing 'best-bet' options were introduced in four PTD pilot villages and explained by a team of researchers and extension staff. The teams were supported by farmers who had hosted

experiments of these technologies in the previous year to share their experience with the other farmers. During long discussions with farmers, it was explained that farmers were not asked to participate to work *for* the project, but that they were invited to participate *based on their own* interest and benefit. Hence, all financial and material incentives were reduced to the absolute minimum. After clarifying the approach, farmers chose those technologies they were interested in. A few weeks later, follow-up meetings were conducted in the villages to explain the field layout and the procedure of implementation. Trials were simplified to make monitoring by farmers possible. The provincial PTD teams are now following up the trials and have intensive contacts with farmers collecting their views. Technologies which are now being tested are: 1) wheat or barley inoculated with *Azotobacter* and 2) wheat varieties (with PPB ICARDA and CENESTA). Existing researcher-managed on-farm trials on chickpea varieties and supplementary irrigation (by PN8) will be included in next season's farmer-to-farmer cross visits and modified towards a more farmer-managed setup. For all these experiments, water use efficiency will be proposed as one of the criteria to participatory evaluate the technologies in this water-scarce environment. This will enable us to compare all the tested interventions on basis of water use efficiency.

In an additional step, the provincial PTD teams plan to work on community related issues in the four PTD villages. Starting in April 2007, the teams will develop venn-diagrams to identify local institutions and stakeholders, which are important for agricultural development and natural resources management. Furthermore, water and nutrient resources and their flows will be mapped jointly with gender specific user groups in the communities. These activities are expected to provide the basis for guidelines towards better utilization of water and other natural resources on the community level, and will be one of the building blocks for the watershed management plans.

Why is the story significant?
It shows that institutional collaboration is important to overcome constraints to the introduction of participatory approaches. It is hoped that this activity will lead to a more increased demand-driven, inter-disciplinary research agenda for the dry mountains of Iran.

What were the critical factors that led to the change?
- Realization that training workshops had hardly changed the work approach of the researchers.
- Realization that farmers had not perceived ownership over the researcher-designed field trials.
- Involvement of one Iranian project partner with the national mandate for PTD.
- Collaboration with Extension, CENESTA and other ICARDA projects.
- The full-time involvement of an ICARDA staff on this work.

What were the constraints?
- Researchers in Iran are used to work mainly within their discipline and direct interaction with farmers is rather limited.
- The fear of many researchers not to produce sufficient data for publications. Presentations and discussions with researchers by ICARDA and the PTD teams were important to clarify ways how PTD could be incorporated in the regular research agenda.
- Farmers are used to receive incentives for cooperation and do normally not perceive researchers' experiments as their own.

What are the future implications for action (e.g., future research), if any?

- The next step is a follow-up workshop on PTD with special emphasis on participatory experimentation, monitoring and evaluation and on community approaches.
- The PTD teams will go through participatory community assessments of the four pilot villages.
- Field days and farmer cross-visits, not only to explain technologies, but also to facilitate a critical discussion between farmers, extension staff and researchers of various disciplines about possible options.
- Change from complex researcher-managed trials to adaptive simplified trials which are increasingly managed by the farmers.

Mainstreaming capacity building in food and water research in the Limpopo Basin

Classification: Technical
Name of person reporting the story: Bekithemba Gumbo / Washington Nyabeze / David Love
Project / Theme / Basin: PN17 / Theme 2 / Limpopo
Date when the change occurred: throughout the duration of the project
Place where the change occurred: Integral to all field sites in Mozambique (Chókwè), South Africa (Olifants B72A) and Zimbabwe (Mzingwane).

The Story:
Too often capacity-building is seen as add-on to research: a follow-up activity in which the main researchers are uninvolved or uninterested. As an alternative, WaterNet's approach is to integrate capacity building into research activities from planning stage onwards. WaterNet's mission is to strengthen regional capacity in integrated water resources management through education, training, research and outreach by drawing from the complementary strengths of its 52 member institutions. PN17, from its inception, has integrated WaterNet's capacity building programmes in Southern Africa in its own work.

Key research in PN17 is undertaken by six Ph.D. fellows, registered at WaterNet member institutions and supervised by scientists from member universities and CGIAR centres within PN17. Each Ph.D. fellow is linked to Masters' students who undertake their dissertation projects within PN17. Many of these students come from the WaterNet regional masters programme in Integrated Water Resources Management core hosted by the Universities of Dar-es-Salaam and Zimbabwe, supported by four other regional universities hosting the specialisation modules of the programme. Others come from programmes at other WaterNet member institutions, namely Eduardo Mondlane University, Mozambique and the University of the Witwatersrand, South Africa. They are supervised by Ph.D. fellows and scientists from these universities and CGIAR centres in PN17. To date, 15 Masters students have graduated and 11 are currently working on their dissertations.

A particular benefit is the development of trans-disciplinary scientific teams for the supervision of students and the guiding of community training. This is made possible by the broad nature of the PN17 partnership, backed up by the wider WaterNet membership. The involvement of scientists in the supervision of research and capacity building projects at different scales, from farmer's fields to river basins, helps develop core capacity with an appreciation of the challenges and linkages at the different scales within the basin.

Why is the story significant?
WaterNet's core mission is capacity building. By building partnerships with CGIAR centres (through CPW&F) this capacity building effort benefits as follows:

a) Capacity building is aided by access to senior scientists: Many universities in southern Africa are facing chronic shortages of senior academic staff, so the involvement of CGIAR scientists in supervision of masters and PhD students benefits these departments. In practical terms, it means (i) a sharing of the supervision load for university departments which are short-staffed and (ii) input is made available to students from more senior staff. Beyond this immediate practical consideration, all participating departments (students and supervisors) are enriched by the interactions with CGIAR scientists who come with a different approach and often from different backgrounds. This enrichment works in both directions.

   The following are examples of this type of partnership in supervision:

Student	**University**	**CGIAR scientists who are co-supervisors**	**Difference made (value added)**
Walter Mupangwa (PhD)	University of the Free State, South Africa	Steve Twomlow, ICRISAT	Expertise in soil/water management techniques
Manuel Magombeyi (PhD)	University of the Witwatersrand	Dominique Rollin, IWMI (Replaced by Christian Cheron) Sylvie Morardet, IWMI	Expertise in agronomy and socio-economics
Brenda Chibulu (MSc)	University of Zimbabwe	Steve Twomlow, ICRISAT	Expertise in soil/water management techniques
Clever Dhliwayo (MSc)	University of Zimbabwe	Steve Twomlow, ICRISAT	Expertise in soil/water management techniques
Jean-Marc Mwenge Kahinda (MSc)	University of Zimbabwe	John Dimes, ICRISAT	Modelling expertise which student did not have access to
Osten Ntsheme (MSc)	University of Zimbabwe	Dominique Rollin, IWMI	Expertise in agronomy
Lucky Nyalungu (MSc)	University of Limpopo, South Africa	Dominique Rollin, IWMI	Expertise in agronomy

b) Capacity building contributes to integrated water and food research. Linkages between WaterNet-member NARES institutes and CGIAR centres are also promoted, as well as linkages between WaterNet and key government departments.
c) A better understanding of capacity building needs in Integrated Water Resources Management is being developed.

What were the critical factors that led to the change?
The PN17 project brought together a large number of partners that had previously not worked together. The capacity building strategy was developed in order to (i) roll out the capacity building component of PN17, (ii) direct that effort towards integrated food, land and water research capacities, (iii) ensure the collaboration of NARES and CGIAR centres in the capacity building effort and (iv) assist in data collection for PN17.

What were the constraints?
Different organisational and disciplinary cultures can be a constraining factor to collaboration between scientists in the co-supervision/mentorship of juniors. At a strategic level, it is not always easy to merge capacity building objectives and research objectives, and degree project and overall research project time lines are not fully compatible. Furthermore, impact of capacity building on livelihood require more time than the normal time scale of conventional project planning.

What are the future implications for action (e.g., future research), if any?
The capacity building strategy and partnership is being further developed to improve communication and co-supervision between project partners. Efforts under consideration for the future include:

- Mentoring of students in writing scientific articles
- Ensuring all PhD students are linked every year with a number of MSc students
- Involving researchers in training on editing and reviewing scientific articles
- Engagement of senior specialists in synthesis activities
- Repackaging research outputs to inform a broader stakeholder platform i.e. beyond the scientists

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Evaluation of low head drip irrigation kits and their distribution by NGO programmes

Classification: Technical
Name of Person Reporting: Bekithemba Gumbo / Washington Nyabeze / David Love
Project / Theme / Basin: PN17 / Theme 2 / Limpopo
Date when the change occurred: Study covered 2004-5 and 2005-6
Place where the change occurred: Mzingwane Catchment, Zimbabwe

The Story:
The studies featured in this story are part of PN17's wide-scale programme to address water resource management at the catchment and basin scales. This project, focusing on two studies on low head drip irrigation, is among the various graduate student studies of agricultural practices, water, and nutrient use.

The first study was an on-farm comparative investigation of water efficiencies and crop productivity at Zhulube irrigation scheme, upper Mzingwane Subcatchment, Zimbabwe, and showed water saving of more than 50% under drip compared to surface irrigation, but no significant differences in vegetable yield or labour.

The second study was a survey of 114 households in Mzingwane Catchment, Zimbabwe, which were beneficiaries of drip kit distribution by NGOs (under other projects). It was determined that only 2 % of the beneficiaries had used the kit to produce the expected 5 harvests over 2 years, owing to problems related to water shortage, access to water and also pests and diseases. About 51 % of the respondents had produced at least 3 harvests and 86 % produced at least 2 harvests. Due to water shortages during the dry season 61% of crops produced with the drip kit occurred during the wet season. This suggests that most households use the drip kits as a means of supplemental irrigation. Conflicts between beneficiaries and water point committees or other water users developed in some areas especially during the dry season.

Why is the story significant?
The results show that although drip kit distribution programmes in the study area have achieved some of their objectives and save around 50 % on water use, drip kits are under-performing due primarily to poor access to water. Many of the poorest farmers share water resources with other irrigators and with other, higher priority uses, such as livestock watering and domestic use. It is therefore not suitable to offer drip kits to the poorest of the community without improving their access to water at the same time. Poor monitoring and lack of back up, such as spares, was also a problem. This could reflect the manner in which the distribution programmes were carried out by many of the implementing agencies, seeing drip kit distribution as a relief effort and not as a development programme.

What were the critical factors that led to the change?
This research effort was designed to evaluate drip kit distribution and usage, in order to improve (i) drip kit usage by farmers and (ii) drip kit distribution by NGOs. It forms part of PN17's output 1 (Constraints and Opportunities of Current Agricultural Practice).

What were the constraints?
Poor access to water, insufficient materials (spares), and problems with pests and diseases

What are the future implications for action (e.g., future research), if any?
A protocol for sustainable drip kit distribution programmes for use by NGOs has been developed. This protocol has been adopted by a number of NGOs in Zimbabwe. Additionally, two of the PN17 project partners are extending these studies to regions outside the Limpopo Basin (under another project).

Theme 3 Aquatic Ecosystem and Fisheries

Using an impact pathways approach to identify priority interventions at Center, Discipline and CP levels

Classification: Management and Coordination
Name of Person Reporting: Malcolm Beveridge (Theme 3 Management Team)
Project / Theme / Basin: CPWF Theme 3
Date when the change occurred: September 2006
Place where the change occurred: Throughout all areas of work related to aquaculture

The Story:
The WorldFish Center promotes the use of aquaculture to tackle poverty. Specifically, it uses aquaculture to directly and indirectly make substantial contributions to the development of sustainable, resilient livelihoods, create employment and stimulate economic growth and improve the nutrition of many millions of poor people. However, while aquaculture has fulfilled its promise in many parts of Asia, in sub-Saharan Africa its successes, like those of attempts to increase agricultural output, were mixed. As a result of our experiences working with the CP on Water and Food, we decided that using an Impact Pathways approach to identify priority interventions could prove useful in showing where we should focus our research efforts and on how we build partnerships to scale up and out impacts from research projects.

The Problem Tree for aquaculture asserts that the key problem is that aquaculture cannot substantially help poor people escape from poverty, and employs an IP approach to tease out the causal links. By stating the reverse–i.e. by asserting that aquaculture substantially helps poor people escape from poverty--and by mapping the causal links we can identify the types of broad, high impact interventions required to effect the uptake of aquaculture as a cost-effective means of addressing poverty. The Problem Tree helped identify four key thematic areas:

- **Aquaculture as an engine for rural economic development**. Poor people often have the resources and skills to use aquaculture to help lift themselves out of poverty. However, there can also be barriers to the adoption of aquaculture by the poor, including poor education and health, access to resources and input and output markets, technological knowledge and management skills, a poor enabling environment and political and social constraints.

- **Development and dissemination of sustainable aquaculture technologies**. Aquaculture is still in its infancy. Many emergent new technologies promote better use of resources and reduced demands on environmental services, increased productivity and production, and result in cheaper products. Efforts are needed to ensure greater access to these technologies, especially quality seed and feeds, constraints to aquaculture fulfilling its potential to help people escape from poverty, that we believe are as much the result of inefficient and ineffective private/public sector interactions as technological impediments.

- **Protection and enhancement of environmental quality**. Aquaculture must be implemented in as environmentally sound a manner as possible. Adoption of aquaculture technologies can lead to better use of resources (increased water productivity, recycling of on-farm materials). However, over-expansion of aquaculture makes unsustainable demands on environmental goods and services, with the poor proving to be most vulnerable. To substantially contribute to reducing poverty, aquaculture must be incorporated into

watershed and coastal management plans. Greater understanding of the risks associated with intensification (disease, self-pollution), translocation of species and genetically improved strains, in adoption of cage aquaculture and in exploitation of environments vulnerable to climate change, is needed.

- **Development of human and institutional capacity.** The successful and sustained adoption of aquaculture to impact on poverty reduction requires development of capacity among policy makers and national research and extension institutions and staff. This empowerment requires identification of skills needs, training requirements and professional development support, opportunities to strengthen the capacity of institutions to deliver training and continuing professional development through a range of models, including distance learning, and identification of opportunities for scientific mentorship among institutions (e.g. networks).

Why is the story significant?
We believe that this type of analysis clearly presents a comprehensive view of the intervention logic, explains how project activities and outputs will contribute to a sequence of outcomes and impacts and facilitates constructive discussion among project team leaders. The importance of most significant change stories, in helping clarify and communicate the research for development processes out of which impact emerges, also became clear (see Douthwaite *et al.* 2003, http://impactpathways.pbwiki.com). For me, as a member of the CPWF T3 Management Team, it also helped ensure that the right priority research areas had been identified and that complementary issues were being pursued within our Center.

What were the critical factors that led to the change?
It was my engagement with the CPWF some six months after joining the WorldFish Center that opened my eyes to this exciting way of analayzing problems that went far beyond the more widely used logistical framework approach in trying to ensure development impact. The IFWF in Vientiane later that year provided further oppportunities to develop my thinking and to work with others to try to use the impact pathway and most siginficiant change story approach to achieving development impact.

What were the constraints?
Lack of time.

What are the future implications for actions (e.g., future research), if any?
Within the Center, we intend to use models as a starting point for discussions with staff and partners at a regional level, allowing further refinement and crystallisation of priority interventions. A process of strategising is then needed to decide specifically in which arenas WorldFish might lead, where it might partner and where it will merely champion actions.

The following story was selected as a favourite because the project has demonstrated its capacity to trigger various changes at a wide range of scales:

- **At farm level:** improved rice and shrimp farmers' livelihood (especially increased income)
- **At local management level**: increased awareness of the value of brackish water for food production (in this case, shrimp) and thus the need to include brackish water in the management of water resources in coastal areas; strong partnership involving local institutions (especially NGOs): contribution to the production and dissemination of research outputs
- **At national planning level**: understanding of the need to shift from a rice-based production system to a diversified production system in order to enhance the productivity and the ecological and social sustainability of the coastal area; reciprocal benefits of project partnership especially integration of research findings in national planning
- **At scientific level**: potential for producing International Public Goods on the management of fresh and saline water interface for the production of rice and shrimp in coastal areas

INRM research supports livelihood in fresh – saline water interface environments

Classification: Technical
Name of Person Reporting: TP Tuong on behalf of PN10 members in Vietnam
Project / Theme / Basin: PN10 / Themes 1 and 3 / Mekong and Indo-Gangetic Basin
Date when the change occurred: 2001 to date
Place where the change occurred: Bac Lieu Province, Mekong Delta, Vietnam

The Story:
Prior to 2000, with the aim of boosting rice production for export, the Vietnamese government invested in water management infrastructure (embankments and sluices) to protect Bac Lieu Province from salinity intrusion. The intervention adversely affected the livelihood of people in the west of the protected area who needed brackish water to raise shrimp.

In 2001 demand of aqua-products for export increased significantly, and conflicts between shrimp culture and rice culture became serious due to different water quality requirement: saline water for shrimp and fresh water for rice. A DfID-funded project analyzed the pros and cons of the salinity control measures and the land use policy that favored rice intensification. The project proposed a land zoning scheme and the associated sluice operation procedures that would accommodate both rice intensification in the eastern part and shrimp culture in the western part of the area and the shrimp (dry season) – rice (rainy season) systems in the transitional area. Change in water quality due to sluice operation predicted by hydraulic and salinity model were analyzed to identify the most suitable option.

From 2002 to 2003, the local government adapted the land use zoning in the revised land use plan. Sluice operation procedures were adopted and a water quality monitoring network was established. Farmers adjusted their production systems according to the zoning.

PN10 work, which started in 2004 involved refining the hydraulic and salinity models which they used to compare different water development scenarios (e.g. excavation of new canals and dredging old ones) proposed by the local government and to find the impact of sluice operations of the surrounding province on Bac Lieu and vice versa. It also improved production systems in each of the "land use zones" by implementing agricultural and aquaculture experiments with farmers, which have very much stabilized due to the preliminary land zoning.

The local water management offices now have the capacity to manage the water quality network and to refine the sluice operations through data monitoring to ensure suitable water quality for different zones. Farmers have adapted newly improved production systems and farming technologies to reduce production risks and increase income (e.g. maintaining Scirpus littoralis Schrab in the shrimp fields to regulate pond temperature, reducing shrimp diseases and getting extra income, multi culture with shrimp and crab instead of shrimp mono culture, planting upland crops after two rice crops instead of 3 in fresh water zones, using new rice varieties etc).

Why is the story significant?

- National planners accepted the diversification in production systems instead of mono-culture with rice as the most dominant crop.
- The local government accepted the concept that brackish water is also a resource instead of always labelling it a “constraint to production”
- The project helped boost farm income and improve farmers’ livelihoods
- The hydraulic model helped Bac Lieu and surrounding provinces to understand the interaction among water management systems in their own territory. Based on the suggestion from the project, MARD has established the “river basin organisation” to coordinate water management in neighboring provinces.
- The impacts of research were multi scale: from regional (land use and water management) to field level (farming technologies).
- The concept and methodology can be applicable in other coastal zones.

What were the critical factors that led to the change?

- Built on the success of previous projects
- A multi scale approach to resource management and quantification of upstream–downstream interactions among different zones
- Participatory research with farmers and on farm tests facilitated the dissemination of technologies.
- Good communication with local government and development institutions

What were the constraints?

- There were a lot of data requirement for hydraulic and salinity modeling; in many cases governments do not invest systematically nor do they sustain data acquisition.
- Local governments have limited human resource capacity for technology transfer, e.g. hydraulic and salinity model, and GIS applications.
- Limited resources and time for testing the improved production systems with farmers given that research projects are often time bound and do not include “extension and development” costs .

What are the future implications for actions (e.g., future research), if any?

- Continue the tests of improved production systems with farmers.
- Include other water quality components (e.g. DO, acidity) in the water model and use it as decision support tools for production planning.
- Expand the study on land use zoning and water management to the surrounding provinces that are sharing the same water control system with Bac Lieu.

Significant rise in fish production from the floodplains is boosting farmers' income

Classification: Technical
Person reporting the story: Dr. Benoy Barman
Project / Theme / Basin: PN35 / Theme 3 / IGB
When the event happened: 2006 - present
Location where it happened: Beel Mail at Mohanpur, Rajshahi in Bangladesh

The story:

- Pen culture was developed at Mohanpur, Rajshahi by fixing bamboo fencing (*bana*) around 100ha of floodplains to contain stocked fish. The area under pen culture was established at the beginning of the rainy season (June-July).
- Fingerlings were stocked in the area including : 3387 kg (catla 550 kg, bighead 1567 kg, rohu 523 kg, mrigal 294 kg, common carp 453 kg). Regular harvests of fish have been taking place since October 2006, and will continue until January 2007.
- The development of pen culture in the area has led to increases in fish yield with implications for fish consumption and improved livelihoods for local people. Fishers have been empowered and their rights have been improved

Why is the story significant?

- The productivity of stocked fish as well as non-stocked fish in the floodplains increased significantly from 103.7kg/ha in 2005 to 242.1kg/ha the following year.
- By January 2007, total fish harvested were: 24213 kg which consists of 18416kg of stocked fish and 5797 kg of non-stocked fish.
- Total income generated from selling fish in 2006 is almost three times higher as compared to the previous year; and total amount of fish consumption by the beneficiaries has increased from 1800 to 3326 kg.
- With permission from the community directly involved with the project, poor people from the surrounding villages are able to benefit from the PN35's pen culture using local gears to harvest small fish.
- Total fish consumption amongst project beneficiaries has doubled since the project began.

What were the critical factors that led to the change?

- Successful management of water levels by stakeholders to maintain optimum levels for fish production
- Stakeholders (beneficiaries) worked together to ensure the security of the fish.
- Harvesting was carried out by 8 groups of beneficiaries using a well-planned method, using 16 non-motorized boats, which has increased the overall harvest.
- During low water level periods, villagers are still able to harvest fish by using small scale fishing gears (push net, polo and harpoon).
- Contribution and support from DoF officials in improving the system has increased the confidence of villagers in their ability to manage the system.

What are the future implications for action (e.g., future research), if any?

- The local DoF officials gained confidence from the success they have achieved in managing such a large body of water in a complex socio-economic system. Their knowledge and understanding of what research is and its value has increased. They have also developed skills in conflict resolution. Capacity in understanding the relevance of this type of research to development and the role of livelihoods issues has also been improved.

- The increased confidence of DoF officials will ensure the sustainability of the project and the eventual scaling out of the project beyond the project site.
- The approach used in Mohanpur has the potential to be disseminated widely in Bangladesh and beyond, increasing benefits for poor and landless fishers.

Adoption of novel water management and High Yielding Varieties (HYV) of Rice in the Coastal Saline Environments

Classification: Technical
Name of Person Reporting: Dr. M. Mondal and PN10 members in Bangladesh
Project / Theme / Basin: PN10 / Themes 1 and 3 / Mekong and Indo-Gangetic Basins
Date when the change occurred: 2003 to date
Place where the change occurred: Polder #30 of Batiaghata upazila in Khulna district, Bangladesh

The Story:
About 1 million ha of coastal saline soils have been monocropped with low-yielding (about 2.5 t/ha/yr) traditional rice during the wet season (*aman* season) from July to December. Most of these lands remain fallow in the dry season from January to June (*boro* season) because the lack of enough good quality irrigation water as river water becomes saline after January.
The DfID-IRRI project PETTRA tested growing HYV rice during *aman* and a novel water management that allows cultivation of HYV *boro* rice with irrigation from non saline river water during November to January and water stored in field channels from February to April. PN10 further developed and refined the said technologies, selected suitable HYVs for each season, while investigating technologies to produce "more rice with less water" during *boro* season. It also provided training on coastal water management and HYV rice production, seed production and preservation to male and female farmers of Polder 30. About 30% farmers grew HYV rice in *aman* season and 10% farmers of polder 30 adopted *aman-boro* cropping pattern in 2006. These farmers increased yearly rice production by 3 to 4 folds more than the traditional practice

Why is the story significant?
- Food production increased and food security improved among resource-poor farmers
- There was a rise in farm income and farmer's livelihood, especially among resource- poor farmers who were trained in seed production and produced and marketed seeds of HYVs.
- The project demonstrated that water productivity in the coastal zone can be increased (increasing production without further diversion of fresh water).
- The concept and methodology can be applicable in other coastal zones.

What were the critical factors that led to the change?
- Built on the work of previous projects
- Quantitative understanding of the dynamic of soil and water quality
- Participatory research with farmers facilitated the dissemination of technologies.
- Providing seed production and storage training to on-site male and female farmers, making HYV seeds available in the area
- An NGO organized the training of women farmers on production and preservation of quality rice seeds
- Good communication with local government and development institutions and the Department of Agricultural Extension

What were the constraints?

- Storage capacity of the canals is limited, which means that only a limited area can be used for *boro* rice.
- Availability of HYV rice seed
- Poor drainage facilities and management resulted to a high water depth in the field, which affected the yield of the short-stature HYV during the *aman* season.

What are the future implications for actions (e.g., future research), if any?

- Development of on-farm infrastructure for appropriate utilization of water and land resources of the coastal region
- Research is needed to forecast availability of fresh/non-saline river water under conditions affected by climate change and salt-water intrusion in coastal aquifers.
- Training on water management and improved rice production is needed for farmers and extension providers.
- Development of HYV with short duration and submergence tolerance for the *aman* season and cold-tolerant varieties for the *boro* season.
- Studies comparing *boro* rice and non-rice crop cultivation in the dry season

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Theme 4 Integrated Basin Water Management System

This story was chosen as a favourite because it highlights the importance of capacity building in addressing groundwater overexploitation, as well as the role of knowledge sharing in enabling people to better understand a common problem.

Interdisciplinary capacity building cum knowledge sharing within groundwater governance in Asia

Classification: Partnership
Name of Person Reporting: Karen Villholth
Project / Theme / Basin: PN42 Groundwater Governance in Asia: Capacity Building through Action Research in the Indo-Gangetic (IGB) and Yellow River (YRB) Basins / Theme 4 & 5 / YRB and IGB
Date when the change occurred: October 2006 to March 2007
Place where the change occurred: India, China, Bangladesh, Pakistan and Nepal

The Story:
Groundwater overexploitation and degradation and their associated socio-economic impacts are widespread phenomena in many parts of the world today, including Asia and the need to address this problem is increasingly recognized at many different levels of society. At the same time it is clear that devising lasting solutions requires substantial efforts and capacity, often beyond the capability of existing systems.

One of the key constraints to proper groundwater management, and to water management in general, is the lack of inter-disciplinary capacity within existing structures for developing, utilizing, allocating and safeguarding water resources. Typically, the development of groundwater is within the hands of technical staff, with little knowledge of environmental and socio-economic impacts. Allocation of groundwater, either through formal licensing, or through indirect methods may be controlled by politicians, legal advisors, with the help of economists or simply driven by open market mechanisms. Safeguarding of the resources and the associated health and livelihood benefits (in the lack of pro-active and institutionalized controlling mechanisms), is driven by environmentalists, self-driven activists, NGO's with support from international donors and local to global coverage media.

However, in order to make a change on the ground level and move towards more informed and sustainable groundwater management the various parties need to come together to embrace the problem complex in an integrated manner and devise solutions built on a comprehensive understanding of the driving mechanisms and potential combination of interventions that may work under given circumstances.

Another striking feature of present day groundwater problems is that they are prevalent in developing as well as developed countries. There is no blue print or master plan for guiding less advanced nations, simply because the problems are complex, partly unique to the settings, and continuously evolving.

However, it is also clear that similarity of issues across national borders and within larger international river basins may foster incentives for collaboration, knowledge sharing and continued dialogue on possible management approaches.

On this background, successful approaches to groundwater management will have to emerge from practical experiences on the ground, in a 'live laboratory' subjected to different trial-and-error efforts, assuming that the business-as-usual or 'laissez-faire' model does not work.

In order to support these self-learning mechanisms of developing sustainable groundwater management, IWMI in collaboration with a vast number of associated partners in the Indo-Gangetic and Yellow River Basins as well as from nations outside the South and South East Asia region is developing and implementing an innovative and unique concept of inter-disciplinary capacity building cum knowledge sharing, action research, policy dialogue and awareness raising through media coverage within groundwater governance.

The program consisted of a 5-week intensive residential training course for 24 junior fellows and media participants. The first four weeks covered basic theory of groundwater hydrogeology, chemistry and environmental science, socio-economic aspects, policy and institutional aspects and communication/awareness/media/knowledge sharing topics. The last week was devoted to case studies of groundwater governance in various parts of the world, involving 9 senior professionals from groundwater research and management from the region. After the course, fellows were exposed to the realities of groundwater use and management in their own countries through applied action research in the field (junior and media fellows) or in third part countries, e.g. the USA and Australia, through intensive study tours (senior fellows). The whole program culminated with a Summary Workshop where all the participants, including the project researchers and resource persons, share and discuss research outcomes, program evaluation and policy recommendations.

The program enabled the participants to gain a broader, integrated understanding of the issues and equipped them with concrete tools to assess groundwater conditions and discuss/evaluate various policy options and approaches to GW Governance in the Asian context.

Some specific outcomes:

- About 20 scientific papers on contemporary conditions for groundwater use and management in the 5 basin countries, papers that will be published in international scientific publication outlets.
- A CD with all the course material
- A film on GW conditions in Nepal
- Partnerships were forged among the participants to develop various joint projects. One research project has already been granted to one of the participants in Pakistan

Why is the story significant? It has established an innovative and unique concept for inter-disciplinary capacity building based on traditional learning methods as well as new, interactive, action research methodologies and knowledge sharing.

What were the critical factors that led to the change? High profile of the program through wide distribution of program brochures, application material and a web page with continuously updated information

- stringent planning and management of the program
- a pre-developed network of relevant institutions and partners within the region
- an expressed demand for such a training/research program
- recruitment of/collaboration between key program members with widely different disciplinary backgrounds related to groundwater

What were the constraints? Cumbersome procedures for ensuring relevant visa formalities for the participants of the program

What are the future implications for action (e.g., future research), if any? ·

- A strong platform has been established for setting up inter-disciplinary research teams and alliances among organisations for developing groundwater governance related research and mechanism.
- The research findings of the program provide a solid basis for the future direction of research on groundwater related problem areas within the two focal basins.

Below is one of the favourite MSC stories in terms of impact and networking. It was chosen because it showed the ability to build researchers' capacity to target the right policy circles, demonstrating that networks are indeed influential vehicles that potentially bring about change.

The opportunistic presentation that may change urban agriculture in Ghana

Classification: Partnership
Name of Person Reporting: Philip Amoah
Project / Theme / Basin: PN38/51 Theme 4 / Volta Basin
Date when the change occurred: March 2006
Place where the change occurred: Accra, Ghana

The Story:
The Accra Metropolitan Assembly (AMA) has a bylaw on "Growing and Safety of Crops" which states that: "No crops shall be watered or irrigated by the effluent of a drain which is fed by water from a street drainage. Any person who contravenes these bylaw commits an offence, and is liable on summary conviction to a fine not exceeding 100,000 Cedis, or in default of the payment of the fine, to a term of imprisonment not exceeding 3 three months, or both"(Local Government Bulletin 1, 1995: 190)

AMA has no systematic way and insufficient resources to enforce the bylaw. In the first place, the bylaw is largely impractical as AMA doesn't provide alternative irrigation water sources. AMA also did not consider the benefits that can be gained from making the bylaw partial. Part of the problem is AMA's inability to properly manage wastewater in the city.

During the Akosombo Impact Pathways Workshop PN 38/51 identified the Ministry of Food and Agriculture (MoFA) from their impact pathway maps as the most important stakeholder in terms of scaling out/up[2] of the project outputs and policy formulation.

Shortly after the Impact Pathways workshop, MoFA organized its own multistakeholder and policy workshop on UA. PN 38/51 seized the opportunity to present to the Ministry ways to minimize health risks without outright banning wastewater use for agriculture as well as potential benefits of using wastewater.

[2] Scaling out is the horizontal spread of knowledge and technologies from farmer to farmer, NGO to NGO, within the same stakeholder groups. Scaling up is the vertical spread between institutional levels that provides political support to adoption.

Why is the story significant?
It is significant in that the project realized the importance of lobbying for political support from the network mapping done in the Akosombo Impact Pathways workshop, and this led to the presentation they made to the MoFA.

The presentation was well received to the extent that the greater part of the meeting afterward was spent discussing the presentation. A declaration for political support for the UPA was made by the Ministry and they concluded that the PN38/51 outputs should be used by the Ministry and the Metropolitan Assembly in the formulation of more appropriate policies on UA in the future.

Although policy changes take time, as they do in Ghana, the work done by the CPWF Project helped catalyzed a number of developments. For one, CPWF complemented the work of IWMI and RUAF in policy change on wastewater use. Through the efforts of the said institutions, and the knowledge gained from the CPWF work, urban and peri-urban irrigated agriculture has been recognized in the city planning of Accra and became part of “informal irrigation” in the national irrigation policy awaiting cabinet approval. Informal irrigation in this policy shares the same status and support as formal irrigation.

Another recent success is that WHO and FAO have given funds to continue the current work with stronger focus on the WHO wastewater use guidelines. This project aims at implementing the guidelines where MoFA will be a key partner.

What were the critical factors that led to the change?
Knowledge sharing--you do not have always to invite stakeholders to your project meetings, you can use their forums.

What were the constraints?
None

What are the future implications for action (e.g., future research), if any?
The Importance of stakeholders in project planning and implementation will be taken more into account. Recently the project did this with the help of the Knowledge Sharing in Research Project of IWMI-CPWF. They organized 5 open fora for their target groups of farmers and food caterers to seek feedback on the project outputs, and what steps are needed to make them as useful as possible. This feedback from stakeholders was then also used to prepare dissemination materials, such as a participatory video on safe practices made with the catering community. The project plans to use the same process in farmer training.

Theme 5: The Global and National Food and Water System

The next story was chosen as a favourite because of the clear creation of an International Public Good—the database of African Water Treaties—that is influencing or at least being considered in the creation of national policies.

The World's Largest Collection of African Water Treaties

Classification: Technical
Name of Person Reporting: Mark Giordano
Project / Theme / Basin: PN47 / Theme 5 / African basins including Limpopo, Nile and Volta
Date when the change occurred: Completed June, 2005
Place where the change occurred: Coordinated from Colombo but assembled from real and virtual archives around the world. Housed for global access at IWMI Headquarters in Colombo, Sri Lanka.

The Story:
Africa is a land of transboundary river basins. With the exception of island states, every African country has a territory in at least one transboundary river basin. Transboundary basins cover 62 percent of Africa's total land area, and virtually every basin greater than 50,000 km2 crosses at least one national boundary. Because of the transboundary nature of most of the continent's waters, most African water management is also, by definition, transboundary water management.

Why is the story significant?
While transboundary basins are important to Africa, the African experience in transboundary water management is also unique in many aspects due in part to the role and legacy of colonialism and the continuing influence of donors. Developing a firm understanding of Africa's past transboundary governance experience--how and why it has changed and varied across the continent--is critical if leaders are to have the best chance of managing the future of these critical basins.

The database has been influential in a few ways. The Council on Foreign Relations, one of the most prominent foreign policy think tanks in the US, used the results to draw conclusions on their policy brief on transboundary waters in Africa. From that, the Asia Society (another foreign policy organisation) sought ideas from the project in setting up a water program. The South African government commissioned a study on the extent of their transboundary water agreements, and the database (and related papers) was used to supply quite a bit of the information. Same for the institutional section of a UNEP book on the Hydropolitics of Africa. A World Bank employee used one of the related papers for something they were doing on transboundary waters. Two of the papers based on the database have provided input to the IUCN book SHARE, a guide for negotiators and others involved in creating transboundary water law.

The database and related journal articles and book chapters are clearly being used and have changed thinking on the extent, nature and driving forces behind transboundary water law and its content in Africa. The extent to which they have been used is pretty impressive given the very short time frame--none of the papers have even been in print for a year.

What were the critical factors that led to the change?
CP 47 provided the opportunity and resources to create what is believed to be the largest and most comprehensive collection of African transboundary agreements in existence. The collection significantly increased the known volume of African transboundary law and includes more than 150 agreements, treaties, protocols and amendments spanning over 140 years and involving more than 20 African basins. A catalog of the treaty collection is available on-line at www.africanwaterlaws.org. A general analysis of its content has been published in Natural Resources Journal.

What were the constraints?
One major obstacle to developing such an understanding has been the lack of a complete or near complete collection of African transboundary water law.

What are the future implications for action (e.g., future research), if any?
The treaty collection serves as a global public good available to all. It has already sparked a series of additional research projects related to the management of African transboundary waters. These include analysis of the inter-relationship between international policy and basin level agreements, the drivers of transboundary water law formation in Africa and lessons for African leaders and donors, and the impact of transboundary agreements on dam construction in Africa.

Moving beyond Africa, the development of the treaty collection has led to a cooperative venture with an Advanced Research Institute already working in the field to update and improve a global collection of similar documents. Completion of this collection, and expected methodological improvements in agreement analysis, will provide the global public goods needed as the foundation needed to fill a range of critical knowledge gaps. Key research topics already identified to fill some of these gaps include mechanisms for the management of flow variability, both “natural” and as a result of climate change; methods for cost, benefit and risk sharing to improve management outcomes in transboundary waters; and how consideration of environmental services can better be included within transboundary agreements, especially in developing country contexts.

Importance of Complementary Policies in Farm-Level Climate Change Adaptation Strategies

Classification: Technical
Name of Person Reporting: Temesgen Deressa, Glwadys Aymone Gbetibouoe, Puja Jawahar, Claudia Ringler
Project / Theme / Basin: PN53 / Theme 5 / Nile/Ethiopia and Limpopo/South African Basins
Date when the change occurred: October, 2006 - these are very preliminary results
Place where the change occurred: Looking at preliminary survey results, Washington DC

The Story:
Based on two large-scale household surveys implemented in parts of South Africa and Ethiopia, it was perceived that majority of farmers in the Limpopo (90%, SouthAfrica) and the Nile Basin (60%, Ethiopia) are aware of long-term changes in precipitation and temperature. In response to higher temperatures and decreased rainfall, farmers have developed different adaptation strategies to mitigate some of the negative impacts of climate change. They range from irrigating more, changing crop varieties or crops, shifting planting dates, to stopping farming as

an activity and instead investing in livestock. Farmers adopt different adaptation strategies in response to changes in rainfall and temperature changes. While adoption of a new crop variety is the main strategy used to adapt to rising temperatures, water harvesting schemes and increasing irrigation is the primary adaptation strategy to decreased precipitation.

However, about 40% of farmers do not change farming practices. Why aren't there more farmers adapting? The preliminary results of the survey suggest that there are two distinct constraints to adaptation in the case study sites: In the Limpopo Basin, lack of credit was the main factor that was cited by almost half the farmers. Other reasons included lack of access to water (18%), no property rights (9.5%), and lack of market access (4.3%). It is striking that only 1.7% of respondents cited lack of information as a constraint to adapting in South Africa/Limpopo.

We find a very different picture in Ethiopia, where a majority of farmers cited lack of information and knowledge as the primary factor preventing them from adapting to long-term changes in temperature and rainfall (20%). Like in South Africa, access to credit and money (20%) is also an impediment to adaptation. These results suggest that although climate change adaptation strategies need to focus on the provision of improved access to water, and enhanced crop varieties, in order to be effective, policies must also address market imperfections such as access to information, credit and markets in order to help small-scale subsistence farmers to adapt to climate change.

Why is the story significant?
Little is known on farmer perceptions of climate change in rural Africa and even less on their barriers to adaptation to climate change.

What were the critical factors that led to the change?
We are reporting information based on new research findings--a significant advance made by the project.

What were the constraints?
None

What are the future implications for action (e.g., future research), if any?
More research on policies to complement climate change adaptation strategies.

Enhancing Social Science Research Capacity in the Limpopo and Volta River Basins

Classification: Partnership
Name of Person Reporting: Amy Sullivan
Project / Theme / Basin: PN47 / Theme 5 / The Global and National Food and Water System; Integrated Basin Water Management Systems; Limpopo; Volta
Date when the change occurred: Ongoing since June 2005
Place where the change occurred: Among select students in the Limpopo and Volta Basins

The Story:
During the planning phases of PN47 (African Models of Transboundary Governance), project partners, including NARES representatives, identified local capacity for high quality social

science research as an existing need. Thus, we built a significant capacity strengthening component into the project plan and devoted the necessary resources to see it through. Twenty promising students from across the basins were screened, selected, trained, and funded to do field research on local aspects of water governance. Our work was monitored by project staff who augmented classroom learning with practical training in the field.

Why is the story significant?
This story is significant because the project has invested in strengthening the capacity of local researchers to undertake institutional research in the future. It filled a need that was identified by national partners as a worthwhile investment. With local capacity for designing and undertaking this kind of research, there should be less need for continually employing 'outside experts' to assess local systems.

What were the critical factors that led to the change?
Identification by national partners of this gap drove the change. Willingness of project planners to devote resources to this initiative was obviously critical as well.

What were the constraints?
Among the constraints were identifying students with a background and interest in becoming stronger social science researchers. Once the students were assembled, their diverse educational and subject matter training proved a bit challenging for trainers.

What are the future implications for action (e.g., future research), if any?
Future implications are the existence of an interested cadre of young researchers well versed on issues of water governance who are well placed to contribute to their countries' research agenda and development.

Basin Focal Projects

The BFPs define 'blueprints' for each of the CPWF basins. They translate the global goals of the CPWF into specific research objectives for each basin, while maintaining coherence of the program through common methodologies. Through whole-basin analysis of hydrology and poverty, coupled with more detailed analysis of livelihood support systems, each research project defines specific problems of water and agriculture, the people they affect, the areas over which they occur. Further analysis identifies potential opportunities for impact through research from both existing and future projects. An essential part of the BFP effort is to identify the pathways to impact from projects, in collaboration with the institutions that will deliver it.

Currently BFPs operate in Volta, Mekong, Karkheh and Sao Francisco Basins.

Improvement of strategic planning of water resource management in basins

Classification: Technical
Name of Person Reporting: Simon Cook
Project / Theme / Basin: Basin Focal Project
Date when the change occurred: 2006. On-going
Place where the change occurred: Mekong, Karkheh, Sao Francisco and Volta basins

The Story: (Note: the BFPs are still in their first year, thus the following are in progress)
Sao Francisco:

- A realization by the Water Resources Secretariat (ANA) of the linkage between rural poverty within the basin and agricultural water use.
- Irrigation water pricing policies that reflect the need for environmental flows below the Sobredinho Dam.

Volta:

- A realization of the depth of poverty and benefits derived from agricultural water use in northern Ghana.
- A realization of the underdevelopment and poor integration of irrigated agriculture in agricultural development.
- Quantificaton of the water available

Mekong:

- Estimates of exploitable limits for agricultural water in the upper Mekong Basin included in water allocation negotiations.
- Local governance bodies in NE Thailand, Vietnam, Laos and Cambodia access critical information on sensitivity to loss of water.

Karkheh:

- Clarification of the effect of government food price support on land use change,

Why is the story significant?
Prior to this, policies and instruments applied by Ministries and International River Basin Organizations lacked accurate data that coupled water management with land use impacts. Before, the CPWF and other investors had little factual basis on which to estimate the effects of investment.

What were the critical factors that led to the change?

- Conceptualising the linkages between water, agriculture and livelihood support
- Quantifying these linkages with data from the basins

What were the constraints?
Lack of information; insufficient time for in-depth stakeholder engagement

What are the future implications for action (e.g., future research), if any?
Use these estimates to target and promote best-bet innovations within basins.

The impact of the Impact Pathways and the Scaling Workshops organized in the basin on projects of the Volta basin

Classification: Technical and Partnership
Name of Person Reporting: Winston Andah and Boru Douthwaite
Project /Basin: BFP-Impact Project/Volta Basin
Date when the change occurred: January and October 2006
Place where the change occurred: Volta Basin

The Story:
The Volta Impact Pathway Workshop was organized at Akosombo, Ghana in January 2006 for eight projects in the basin. It was attended by two project leaders/principle investigators of each project. The projects were introduced to concepts like problem tree, objective tree, project timelines and visions and network maps and matrices. The Most Significant Change concept was also introduced at this workshop. In October of the same year, the Volta Scaling Workshop was organized in Accra, Ghana with the following objectives: (1) sharing and peer-review of project progress and impact pathways to date; (2) identification of next steps to achieve scaling at the project, basin and global scale; and (3) development of project and basin level action plans to achieve scaling out and scaling up.

Why is the story significant?
- Inspired by the knowledge gained at the workshop PN 40 has developed a methodology for "Influence Network Mapping".
- PN 38/51 had understood the relative importance of Ministry of Food and Agriculture (MOFA) and Accra Metropolitan Assembly (AMA) in the network mapping and that had helped them realize the importance of lobbying for political support.
- PN 34 had successfully organized a Capacity Building Needs Consultation Workshop with Primary Stakeholders for clarification and crystallization of project outputs. The project attributed this success from their project Problem Tree and Objective Trees developed from the impact pathway study.
- It was the first time the projects of the basin were together to peer review each other and this led to identifying synergies not only amongst the projects but also in the scaling processes.

What were the critical factors that led to the change?
- Practical exercises at the workshop that linked the various concepts with their projects.
- Energy and commitment of the participants.

What were the constraints?
That not all the PLs were able to attend

Small Grants Program

The CWPF Small Grants Program was conceived for projects that would enhance the adoption of promising interventions for better agricultural water productivity. The emphasis was to develop innovative ways to follow through research on water productivity to achieve developmental impact, bridging the gap between research and development. The assumption is that there exist innovative strategies for managing agricultural water that may influence or inspire the creation of policy for improving agricultural water productivity. In August 2005 a call for small grants projects were made, with a budget of from $40,000 to $70,000 per project. As of April 2007 there are about 14 small grant projects in operation.

Creating an oasis in the dessert

Classification: Technical and Partnership
Project/Basin: SG505 / Andes
Name of Person Reporting: Ross Borja and Stephen Sherwood
When the event happened: 19 July 2006
Location: Lavanderos, Ambuqui, Valle de Chota, Ecuador

The story:
They used to be impoverished and downtrodden farmers, but now Alfonso and Olga Juma regularly receive visitors from all over the world. They have become an inspiration for others--and it all started the day they decided to capture water.

Alfonso and Olga could not produce enough to feed their family on their one-hectare farm. The region where they lived was semi-arid, with about 600mm of intense rainfall during three months, followed by nine months of draught. Alfonso migrated to the city to earn money as a menial labourer, while Olga took care of their children. He considered looking for work in the U.S. or Spain.

After visiting farmers who made innovations with water harvesting and micro-irrigation under similar conditions, Alfonso proposed to two neighbours that they tap a water source high up in the mountainside, some two kilometres from their farms. A year later, on 19 July 2006, some 35 representatives from a “Community of Practice” composed of seven projects supported by the McKnight Foundation in Bolivia, Peru, and Ecuador as well as visitors from the U.S. and Europe participated in a field day at Alfonso and Olga’s farm to learn about their experience. The participants arrived in a bus that climbed through the barren, desert landscape of the Chota Valley, crossing river beds and meandering up a dusty road through the sand, rock and cactus laden landscape. The bus stopped at what, over the last year, had become a green oasis: Alfonso and Olga’s farm.

Alfonso began his story by pointing to the surrounding barren hillside and a neighbour’s dry, sun-baked fields. “A year ago, our farm was just like that. I was so poor,” he confided, “that I was embarrassed when my children looked at me.” He went on to explain how his neighbours and he worked endless weekends, and they invested about $600 in hoses and assorted materials. Most recently, they had dug storage ponds of about 10,000 litres each that they lined with clay. Now, they were experimenting with micro-irrigation. “We’ve learned that by using tubes (rather than open canals) you can (effectively) double and even quadruple your rainfall.” Alfonso went on to explain how they had transformed their farm and lives.

> “Once I had water, I could grow that small plot of alfalfa. With the alfalfa, I could have cuy (guinea pig). The cuy produced manure for my soil. We still have a long way to go, but with just the cuyes, we have already paid back our $200 investment in materials. When I started we had no cuy. Today we have 300 cuyes, that are worth about $5.00 each or $1,500 in all. That is much more than I used to earn in the city. Now I can stay home with my family. With the manure, I’ve planted 75 mango and avocado trees. My farm has become an oasis. Every year it will grow greener and greener. My farm used to be barren of plants. My biggest problem today is that I’ve run out of land to plant.”
>
> “I never dreamed that people from so many countries would come to visit us. I used to be ashamed when my children looked at me...it has just changed my kids’ lives, and, it has changed mine. I no longer feel embarrassed to be a father.”

Recently Alfonso and Olga planted mango and avocado trees. They can now survive the growing dry periods between rainfalls, perhaps an effect of climate change. Further, they have extended their wet season so that they now can produce throughout the year. They have more than doubled their family income, which means Alfonso no longer needs to migrate to look for work, and he can stay at home with his family.

Water harvesting is a very new concept for many Andean farmers, particularly those who grew up in areas where water was once plentiful. Due to the effects of resource degradation, increased demands for water, and possible climate change, rural families, such as that of Alfonso and Olga, are facing new challenges. They must quickly innovate if they are to survive.

This CPWF project has supported learning on how to enable such change. The potential that increased access to water for improving farm production was well established. Nevertheless, we were less clear on the specific social learning and water harvesting practices that could enable rural innovation in this area. Previously, the investigators had worked with groups of farmer innovators to address soil fertility and pest management concerns. As a result, we had gained new appreciation for ‘peoples’ science’, i.e., innovations that spontaneously emerge from local socio-environmental contexts, as viable opportunities for development. Nevertheless, we are yet to apply such approaches to water harvesting and micro-irrigation. Another question is: what role should 'outsiders' (i.e., development practitioners, researchers, and their institutes) play in promoting (rather than squashing) local learning and initiative on more intensive and sustainable water management for improving farm production and livelihoods?

Our project hypothesized that farmers who faced similar challenges spontaneously innovated in ways that could be mutually useful. Further, we believed that the diversity of social and environmental contexts in rural areas produced to an equally rich diversity of novelties – i.e., opportunities or 'seeds' of change that could catalyze transitions towards new ways of managing water for food and economy.

In our search for how to enable such catalysis, we consulted an established group of farmer innovators and invested project resources in their ideas. The project financed initial encounters in the form of cross-visits among farmers who were facing similar challenges with water scarcity. The goal of those exchanges was to identify novelties that could represent a catalytic force of change. The project then financed visioning workshops in localities, during which participants discussed field trips and produced "dream maps" of the future. We then collectively supported the implementation of those dreams, which involved the creation of revolving investment funds and *mingas* (Kichwa for “group work parties”) during which participants worked together to

install and test different innovations–e.g., catchment designs, materials for tanks, and filtering and distribution means--on different farms. This usually involved a training visit from a farmer who had generated a relevant novelty elsewhere as well as backstopping from a technical expert who planted generative and challenging questions along the way. The project then supported follow-up visits across farms to document and discuss further innovations, such as the utilization of water and biological resources as a means to "capturing energy and wealth". This included project participants as well as a growing array of interested parties from other organisations and areas.

The project has utilized photography, mapping, and economic studies to capture outcomes. Most recently, the project has financed the integration of such "endogenous" approaches to water innovation with Farmer Field School methodology as a means to helping farmers fill knowledge gaps associated with water-farmer interactions and thereby improving abilities to manage water more purposefully. Presently, we are testing learning exercises and will be implementing pilot FFS in the project areas as well as with new partner agencies in Bolivia, Peru, and Ecuador.

Why is the story significant?
The story is significant because we have learned several key lessons from it:

- Informal social processes of learning and exchange among farmers can be a powerful catalytic source of change.
- Farmers often have the material and biological resources at hand for mobilizing substantial change. As such, overcoming present barriers often depends on knowledge-based or conceptual development.
- Strategic combining of water with biological resources enabled intensification of an on-farm energy sink, which in turn provided a means to improved nutrition and income. We called this interactive process a “greening” of the farm.

What were the critical factors that led to the change?

- Broadening encounters: informal visits and exchanges with farmers who had transformed their farms under similar conditions provided inspiration and a new vision of what is possible.
- Leveraging biology: Alfonso and Olga combined water with biology (alfalfa, cuy, manures and green manures and trees) as means of harvesting sunlight and converting it to other forms of energy on their farm, effectively creating an “energy sink” and greening effect.
- Self-financing: while the project supported exchanges, Alfonso and his neighbours mobilized their own material and human resources. The relatively quick return on water and biological resources was substantial, enabling them to pay back their investment in a relatively short period of time.

What were the constraints?

- Most people living in arid to semi-arid conditions do not have access to a water source throughout the year. For them, it is essential to harvest rainwater during the wet season and store it. This is particularly true in marginalized areas, where population is growing and the resource base is being degraded.
- Even though farmers often can pay back water harvesting and micro-irrigation investments, access to fair credit can help accelerate transformations. It may be useful to explore farmer-generated and -managed credit systems as a means to catalyzing further innovations with water.

- Highly innovative families, such as that of Alfonso and Olga, are often social "outliers". Their examples do not automatically lead to diffusion of broader change. Linking them with broader processes of change would likely demand unique attention.

Alfonso explains how water transformed his one-hectare farm, which used to be dry and desolate like the one next door. In the distance is the property of Don Jorge, another emerging oasis in the desert.

Alfonso disappeared into his house and returned with an accordion. He said, "*Primero me vino la lagrimas, pero despues me llegó la alegria*" (First came the tears, but later I found happiness). He began to play music, and the visitors surrounded him with dance.

Recommendations (if any) for future research

- Now that farmers such as Alfonso and Olga have largely exploited their ideas, we need to help them deepen their experience in ways that can lead to further innovation with water and biological resources for improving their livelihoods. How can this be facilitated and encouraged, particularly across large populations of marginalized farmers?
- It would be useful to explore more thoroughly the key events and processes behind such success stories, what we sometimes call the "positive deviants" (borrowing from a health/nutrition approach), perhaps through deeper social and economic analysis. What can be achieved through linking up positive deviants into unique networks of innovators? How can the positive deviants contribute to enabling re-directions of present water management regimes across broader social groupings?

Knowledge Sharing and Communication Strategy in Agricultural Water Innovation Systems

Classification: Technical
Name of Person Reporting: Kenneth Masuki and Mary Shetto
Project/Basin: SG503 Enhancing adoption of High Potential Interventions for increasing Agricultural Water Productivity / Nile Basin
Date when the change occurred: March 2006 to date
Place where the change occurred: Makanya Catchment in Same District, Tanzania

The Story:
SG503 is enhancing adoption of innovations to wider communities in the Makanya catchment with the aim of scaling up novel innovations in the Nile Basin. Past studies indicated that one of the constraints to adoption of Water and Moisture Systems Innovations (WMSIs) has been limited knowledge of innovations and their benefits.

Historically, upland farmers in Makanya Catchment have been growing bananas in mixture with coffee. So banana was mostly used as a food crop. For a long time now farmers are experiencing marketing problems with coffee, so these fields were not well attended. Recent drought rendered production to be almost negligible. Farmers were left with no alternative cash crops and production of vegetables was also not well organised.

A knowledge sharing and communication strategy was developed in collaboration with partner institutions, farmers, district authorities and the Civil Society Organisation to promote WMSIs. Analysis of the current knowledge, attitudes and practices (KAP) of different partners were carried out as a basis for overcoming barriers to adoption and provision of enabling environment to enhance adoption of WMSIs.

Knowledge sharing and learning was carried out through focus group discussions, dialogue, participation of farmers in Agricultural Show Nanenane (40 farmers), and exchange visits in areas where WMSIs are successfully practiced, i.e. Lushoto (10 farmers) and Babati (15 farmers).

Farmers were encouraged to grow high value crops in the terraces so that they increase return to land and labour. Farmers were not given free seeds. However, during exchange visits (out of their own initiatives) some farmers brought back banana suckers from Lushoto. Farmers requested improved banana seedlings so that they can expand their fields. The two partners CSOs we are collaborating with (ALERT AND SAIPRO), have shown interest to help a small group of farmers obtain banana seedlings from the Selian Agricultural Research Institute and they in turn can reproduce and distribute seedlings to neighbouring farmers. We also have planned to conduct limited demonstration on Conservation Tillage with seven farmers groups using farmer field school approach in season starting March. This is in response to farmers' request to practice CA as they learned from fellow farmers in Babati district. This will be done in collaboration with the District Extension Team and Village Extension officer. The district will support farmers with basic inputs required for establishing these demo plots in terms of seeds, pesticides and implements (rippers).

Within project activities to promote WMSIs we are encouraging farmers to link, for example, terracing with planting of high value crops like vegetables so that to give farmers alternative cash crop in order to improve their incomes. Exchange visits can help achieve this and visits were arranged in areas where farmers have succeeded to link WMSI with markets. After

preliminary discussions farmers showed interest to try these innovations and when they got opportunity to witness fellow farmers benefiting from WMSIs where bananas and other vegetables are produced with limited supplemental irrigation, a lot of enthusiasm to improve their banana fields was generated.

In the lowlands, we are taking advantage of the fact that farmers are already producing *lablab* (*Dolichos* spp) which is also a cash crop. *Lablab* is also a recommended legume for Conservation Agriculture as we saw in Babati when we visited with farmers. Therefore, using *lablab* as a cover crop will held us introduce CA while using a crop of their choice which is already grown in the area. Therefore, our interventions are mostly in providing implements and inputs to establish demonstration plots.

Farmers are not setting trials as such, but are improving soil and water management practices using different innovations like terracing, contouring and CA to produce crops that can increase production of crops as well as livestock since along the contours they also plant fodder tree.

Preliminary observations indicate that in less than six months there has been rapid adoption of WMSIs such as terraces and contours in the five villages whereby more than 144 farmers have constructed 1118 terraces. Production of high-value crops (such as bananas, tomatoes, and onions) will increase productivity of scarce water resources. Land area covered and cost-benefit analysis will be carried out as part of the ongoing monitoring and documentation process.

Why is the story significant?

- Farmers have shown enthusiasm to adopt technologies that have been there for more than 50 years as a result of participatory processes in knowledge sharing and learning.
- WMSIs is contributing to rainfed agriculture as a measure to address challenges posed by climate change and has the potential to benefit about 10,000 farm families in the Makanya Catchment.

Among the key lessons learned are:

- Adoption of water system innovations depends much on a combination of different promotion methods.
- Farmers always learn by seeing and doing–experiential learning.
- Interactive methods, complemented by other methods and media of communication like exchange visits, audio-visual and printed materials, are more effective than non-interactive methods.
- Linking farmers with marketing institutions is the key to motivating farmers to invest in WMSIs.

What were the critical factors that led to the change?

- Involvement of farmers and other partner institutions in planning the knowledge sharing and communication strategy brought a sense of ownership amongst stakeholders.
- Targeting of village, ward and district leaders as champions of promoting the technologies
- Recognition of gender participation in enhancing adoption of WMSIs
- Combination of various forms of information sharing and learning through discussions and provision of basket of choices in terms of technologies to be adopted by farmers
- Promotion of high value, crop-based enterprises added value to the adoption of WMSI and encouraged farmers to invest in these innovations.
- Partnership with CSOs who are assisting farmers to link with markets and to procure resources

- Presence of researchers in the knowledge sharing and learning processes enabled them to address problems associated with 'lack-of-fit' with farmers in the field such as choice of innovations according to soil types and farmers resources.

What were the constraints?
- Absence of farmers organisations in agricultural marketing
- Poor infrastructure such as water storage facilities and roads

What are the future implications for action (e.g., future research), if any?
- Increasing capacity for farmer-to-farmer knowledge sharing and learning
- Increasing capacity of researchers in knowledge sharing and communication strategy development
- Changing mind-sets of researchers towards promotion of research products through knowledge sharing and communication.

Water and Soil management led to food security

Classification: Technical
Name of Person Reporting: Josephine Kizza
Project: SG513 Food Security in Southern Uganda
Date when change occurred: 2006 - 2007
Place where the change occurred: Masaka and Rakai districts – Southern Uganda

The Story:
Subsistence farmers formed three cohesive groups of thirty members each with functional leadership. They trained in soil and water conservation with a prime aim of attaining food security using integrated water management approach as a key element.

We provided practical demonstration in water harvest, soil moisture retention and soil erosion reduction efforts. We also helped established communal plant nurseries for each group. We provided "on farm advice", responding to individual needs and addressing the interests of even the most timid participants. We also introduced the use of polythene to line water storage pits fed from surface run off, covered with wood logs and soil spread over to allow growing of vegetables with shallow roots

Why is the story significant?
- The story is significant because it shows how we can link environmental awareness with economic development. Participants have adopted integrated organic farming practices that are ecologically friendly and further embraced agro-forest practices as part of efforts to improve the depleted soils.
- The project helpled 90 families meet their basic needs and combat chronic food shortages.
- Water harvest and improved soil moisture retention was introduced to solve the increasingly unpredictable rainy seasons.
- The holistic approach is enabling subsistence farmers to conserve the soil and trees and maximize the use of natural precipitation.
- Replication of technologies by the neighbouring communities was made possible.

What were the critical factors that led to the change?
- Training of participants in organic farming and subsequent adoption
- Farmers' control over planting materials
- Promotion of fruit trees that are linked directly to household food and income needs
- Skills of group leaders
- Water harvest and control of soil erosion

What were the constraints?
- Training of non-literates alongside those who can write
- Continued reliance to firewood as a source of energy
- Lack of animal manure, a key component in compost making
- Participants not used to sharing of experiences and innovations

What are the future implications for action (e.g., future research), if any?
Assess the effects of tapping surface run-off water to neighbouring communities downstream.

Reducing pest incidence and water usage in cotton with ladies finger as a trap crop

Classification: Technical
Name of Person Reporting: Bharat Dayal
Project / Theme / Basin: SG508 Selecting and scaling up water-efficient farming and groundwater recharge systems among 3,000 small scale farmers, Rajasthan / Themes 1 and 2 / Indo-Gangetic Basin
Date when the change occurred: July-September 2006
Place where the change occurred: Village Gunti, District Alwar, Rajasthan, India

The Story:
Decreasing yields over the years has discouraged Mangeram, a farmer from the village of Gunti. He was growing cotton in his field which had a high incidence of sucking pests like aphids, red cotton bug and pink boll worm, which led to decrease of crop yield. He tried to solve the problem by increasing pesticide application, but it just made things worse. He then assumed that land fertility was the problem but soil testing showed that all the nutrients needed were available in the right quantities. He was desperate for a solution.

Moreover, he has been applying excessive water because he thought that the yellowing of leaves and apical buds was due to water stress. It was actually due to pest attack and this was explained to him in his interaction with SG508 scientists.

Now, Mangera is one of 50 progressive farmers in the district. His field is now a model field under the CPWF project. A crop combination of cotton and ladies finger was recommended to the farmer, with the cotton field surrounded by two rows of ladies finger. This model was designed to reduce water usage and at the same time increase productivity.

A similar neighbouring plot of cotton grown conventionally was taken as the control. The logic was that since the pests which attack cotton and ladies' finger are the same, the introduction of a trap crop will reduce the attack of sucking pests. The farmer used two irrigations in the model plot, whereas the control plot had three irrigations. The model and the control fields were then put under CESA observations taken weekly for different indicators and significant changes were observed with respect to the number of fruiting bodies. There was increased dropping of fruiting

bodies in the control plot which was the result of excess water and fertilizer application. Thus, the control plot had reduced yield compared to the model plot.

Why is the story significant?

The story is significant because the research has shown how to increase productivity with less water and pesticides. This one example has the potential to influence entire villages of farmers and boost their yields.

What were the critical factors that led to the change?

- The farmer was convinced of the benefits of mixed cropping and its reduced risk. He was doubtful at first if the model could work as he argued that if pesticides could not stop pest attacks the introduction of a trap crop would be of little help over the years. He participated in the trial when he realized that the ladies finger could serve as a security crop in case the main crop fails, and that it can be used both for domestic and commercial purposes.
- Farmers' acceptance of the need to use water judiciously in the wake of depleting ground water tables
- Farmers' active participation in meetings and orientations with agricultural researchers
- Farmers' confidence in the project

What were the constraints?

- Farmers has been discouraged by previous interventions by government and non-government organisations who started water- and soil-management related work but never followed them up
- Normal resistance to change in rural areas
- The project initially being mistaken as a government scheme with lots of free inputs
- Farmer-led research is rare in India and poses a challenge to the project.
- Farmers believe in results when they see them, and it is difficult to convince farmers to participate based on projected results.
- Top down approach is normally followed in India where policies made by the State are imposed on the community. A project where farmers are completely involved in the research and takes responsibility for it requires that the farmers have to change their habits and in rural areas this takes time, energy and a lot of motivation.

What are the future implications for action (e.g., future research), if any?

- Reduced pest attacks will lead to reduced pesticide use, resulting in better quality cotton and better profits for the farmers
- The model has been accepted by a number of farmers who will adopt it next year.
- Reduced production risks--farmers have seen that two crops can be grown from the same land at the same time
- Improved food and water security
- Within one year, this research has convinced the farmers of the need to save water and this will be scaled up to many more farmers in the operational area. Through this model, farmers can realize that they can efficiently use their land while saving water and preserving soil health, while at the same time ensuring their livelihood.