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PARTICIPATORY ON-FARM RESEARCH IN INDIA'S SEMI-ARID TROPICS – A PROCESS FOR CO-LEARNING AND PRACTICE CHANGE

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ABSTRACT

Farming systems in India's semi-arid tropics are complex, diverse and risk-prone. One of the major challenges to farming systems improvement in India is the development of environmentally sustainable farming practices, which are profitable to small farmers and can be implemented within these farmers' severe resource constraints. Solutions to India's farming problems cannot be solved by technological solutions alone due to the complex socio-economic and socio-cultural issues relating to caste, gender, farm size, farm ownership and labour.

This paper firstly provides an outline of an innovative participatory action research methodology developed and implemented through an India – Australia co-learning partnership to try to address this challenge. Secondly, the paper reports on the practice change facilitated by the use of this methodology and explores the potential for this methodology to facilitate further change in agricultural practice, including agricultural research and extension.

The Australian Centre for International Agricultural Research (ACIAR) funded project - Tools and Indicators for Planning Sustainable Soil Management on Semi-Arid Farms and Watersheds, aimed to improve long-term sustainability and productivity of rainfed lands in the semi-arid tropics. A "negotiated learning and action system" methodology was developed to meet the challenges presented by this complex inter-disciplinary cross-cultural project. This methodology was based on the principles of negotiated learning, action research and systems thinking. Participatory on-farm research formed an integral part of this methodology and was one of the project's key learning, extension and biophysical research tools. Participatory on-farm research enabled project staff to strengthen rapport with village farmers leading to farmer directed research, co-learning between project staff and farmers and research results that were more relevant to the farmers' situation.

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The strengths, weaknesses and challenges to the further use of participatory on-farm research in the Indian semi-arid tropics, identified through the project, provide valuable information, which can be used to enhance and extend this approach in India and Australia.

Introduction

One of the major challenges facing farmers in the semi-arid tropics throughout the world is to manage their lands to produce food economically and without degradation of the natural resources on which production is based, particularly soil and water resources. Farming systems in India's semi-arid tropics are complex, diverse and risk prone. Cultivation in these areas is largely rainfed with many areas experiencing problems associated with variable rainfall, poor soils and land degradation. Land degradation in the semi-arid tropics of India affects some 166 million ha or 50 per cent of the total geographical area (Sehgal and Abrol 1992). Erosion by water is the single most important mechanism affecting an area of 86.9 million hectares.

An added concern in India is the need to increase food production to keep pace with population growth. Available land is often marginal for agricultural production and much of the land is managed in smallholdings with farmers experiencing severe economic constraints. Efficient use of incident rainfall is the key to maximising production in the semi-arid tropics. Large increases in production (up to 10 times) are possible using optimum management practices (El-Swaify, et al 1985).

Considerable research and development efforts have gone into improving farming practices and technologies, however the rate of change to more environmentally sustainable is generally considered to be slow in both India and Australia (Queensland Department of Primary Industries 1998). In India, where traditionally agricultural extension has been based on a technology transfer or adoption/diffusion model, it has been recognised that solutions to farming and natural resource management problems cannot be solved through technological solutions alone (Dixit, et al 2000, Shah 1998, Sharma 1992, Singh 1998). These problems are embedded in complex socio-economic and socio-cultural situations. The average farm size is just over one hectare per capita and there is a large population of landless poor who depend on the wage earnings from agriculture and related enterprises. The issues of caste and gender add another layer of complexity. The minority higher castes control most of the land and related resources while the majority lower castes work as wage earners on these farms.

Farming by smallholders in the semi-arid India is getting more challenging in the post-WTO era owing to rising input and labour costs, more or less stagnant prices of the agricultural produce, especially of coarse cereals, pulses and oilseeds-important produce from drylands. This has led to a new crisis of widespread distress among

farm families leading to a large number of suicides reported from the semi-arid part of the country.

In Australia the limited success of traditional extension practices (based on the adoption/diffusion model) in increasing rates of adoption of environmentally sound land management practices is also well documented (Barr and Cary 2000, Vanclay 1992, Vanclay and Lawrence 1995). Vanclay and Lawrence 1995 outline the deficiencies of traditional extension, which are relevant to the development, and implementation of more environmentally sustainable agricultural practices. Traditional extension is based on a paradigm where farming problems can be overcome by continued application of conventional science. It does not consider many important social issues such as the unequal distribution of impacts and benefits of technology. Traditional extension activities focus on the promotion of discrete technologies, rather than new ways of thinking and management of whole systems and they do not readily integrate farmers' indigenous technical knowledge. The social, political and cultural contexts of agriculture and adoption behaviour are not considered in the traditional adoption/ diffusion model.

The severity of the issues facing farming in India and Australia and the inadequate level of impact resulting from past research and extension efforts set the stage for innovative approaches and methodologies for farming systems research to be developed. It was in this context that a partnership was developed between agricultural and natural resource management agencies in Queensland Australia and India, through the ACIAR project 9435 - *Tools and Indicators for Planning Sustainable Soil Management on Semi-Arid Farms and Watersheds.*

This project, through a co-learning partnership, aimed to develop and apply a methodology that could be used to improve long-term sustainability and productivity of rainfed lands in the semi-arid tropics by providing tools to increase the implementation of practices that maintain production, improve water use efficiency, reduce soil erosion and maintain soil organic matter. This project aimed to both explore the scope for new technologies to improve systems and by using a participative learning approach, to build broad understanding and ongoing learning networks among scientists and farmers, so that the research and its results were more relevant to the farmers and the socio-economic constraints they were experiencing.

The aims of this paper are three-fold: (a) to provide an outline of the innovative approach developed and implemented through the partnership, (b) to explore the impact of one of the key tools in this approach - participatory on-farm research – in facilitating co-learning and practice change and (c) to discuss the opportunities and constraints for the further use of the project's style of participatory on-farm research in India's semi-arid tropics.

The Project and its Emergent Methodology

ACIAR 9435 - *Tools and Indicators for Planning Sustainable Soil Management on Semi-Arid Farms and Watersheds* was a complex inter-disciplinary systems project implemented at several locations in India and Australia between 1996 and 2002. Collaborating agencies included the Department of Natural Resources (DNR) and the Department of Primary Industries (DPI) in Queensland, Australia and the Central Research Institute for Dryland Agriculture (CRIDA) in India. The project was an initiative of the Australian Centre for International Agricultural Research (ACIAR) and the Indian Council for Agricultural Research (ICAR). In India research was conducted in three villages – Nallavelli (near Hyderabad), Mudabhavi (Bijapur district) and Pampanur (Anantapur district) and at CRIDA centres at Hyderabad, Bijapur and Anantapur.

ACIAR 9435 developed and applied a *"negotiated learning and action system"* for agricultural research and extension. This was dubbed the *"learning cycles"* methodology by the project team as action research/action learning cycles were embedded into all aspects of the project's planning and implementation. King, et al (1999) describe the process used for development and initial facilitation of this negotiated learning and action system in India. The system is based on three key principles:

Negotiated Learning as a form of interactive participation recognising that:

- Both farmer knowledge and scientific knowledge are valid in the research process
- Participants will view reality differently
- Participation in decision making is seen as a right for anyone who may be affected by that decision
- The process facilitated will need to embody the above points to seek multiple perspectives, enable shared learning and participation in joint planning, analysis and capacity building.

Systems' Thinking : The systems approach takes a holistic view of complex situations and allows for interactions to be discovered. Through systems' thinking participants in research projects endeavour to understand the interconnectedness of parts of the system and interactions within the system compared to the more reductionist approaches where the focus is on exploring various parts of the system in isolation (Roling and Jiggins, 1998).

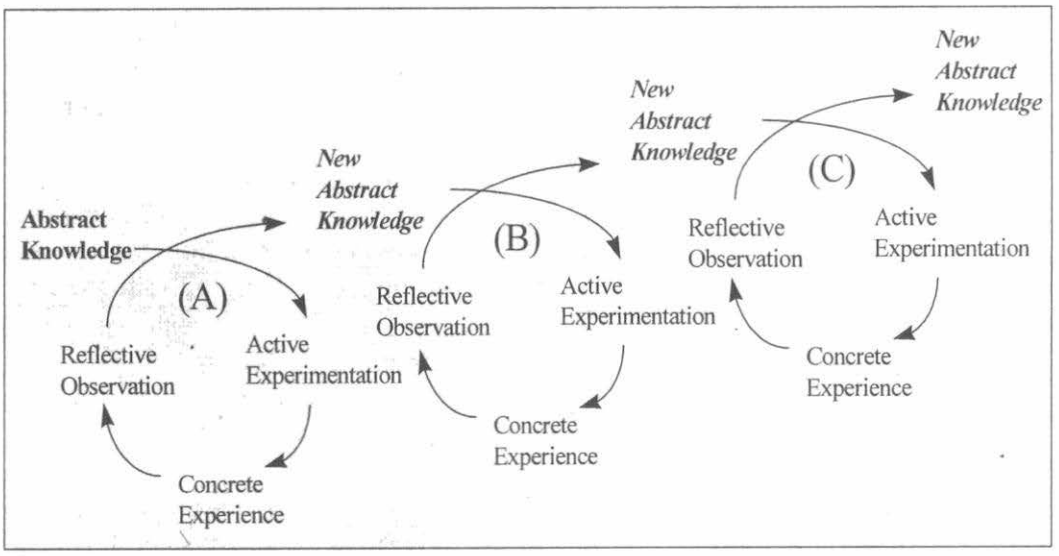
Action Research : Action research principles and processes were imbedded in the system. Action research as described by Dick 2001 pp21, *"pursues both action (change) and research (understanding) outcomes. It achieves change through its participative approach, often in conjunction with other change processes. The research is achieved by being responsive to the situation and by searching strenuously for disconfirming evidence".* Action research represents a spiral of action and critical reflection, which

embodies Kolb's "Experiential Learning Cycle" (Kolb 1984). This cycle consists of four phases as represented in Figure 1. Action research was selected as a core principle along side negotiated learning as it:

- Investigates real solutions and instigates change to real problems in real life situations
- Facilitates change within the villages and the organisations involved
- Improves the understanding of participants about more sustainable soil management practices

Project participants included farmers, extension officers, economists, biophysical research scientists and support staff. The challenge of coordinating and integrating social, economic and biophysical research across sites and countries was addressed through the use of 'learning cycles' to facilitate regular observation, reflection and planning leading to further action. Using the "plan, act, observe, reflect" cycle became a norm of the project team. 'Learning cycles' were also used to allow for the growth in knowledge and learning among team members and other participants, to be recognised and incorporated into the project. The learning cycles engendered a continuous improvement framework for delivery of project objectives. Participative negotiated action was used to maximise the prospects that the results would be context specific and applied by intended end users.

Figure 1: A series of experiential learning cycles which form a spiral of increasing knowledge (Source: King, et al.,1999 adapted from Kolb 1984)



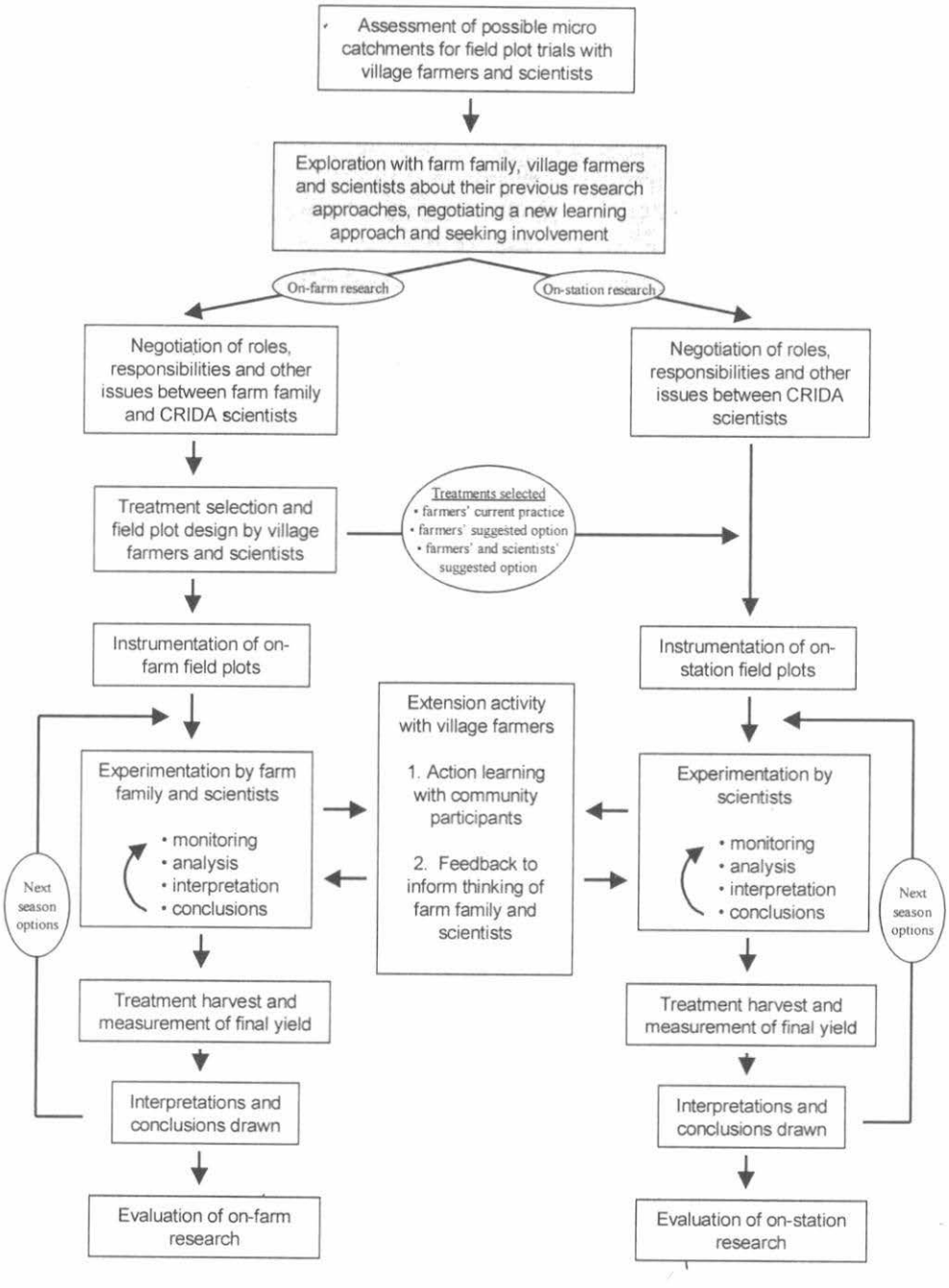
Participative Processes Used

Participatory on-farm research was one of the key research, extension and learning tools used within the project. Biophysical research was conducted on farmers' fields and on research stations with farmers' involvement. Farmer participation in the selection and evaluation of research treatments was facilitated using focus groups (Krueger 1988), the portable rainfall simulator and farmer discussion groups. These participative processes were also used to facilitate co-learning between farmers and scientists, and between different disciplines eg. soil scientists, economists and social scientists. Annual cycles were used to plan, implement and review research results with farmers leading to joint planning of the following year's research trials. Farmers and scientists made joint decisions and learnt from each other's observations and reflections on research results. The social aspects of village farming were incorporated into treatment selection through farmer participation and the social and economic implications of research results were assessed with farmers through discussion groups and individual interviews. Table 1 outlines the participatory processes used to negotiate and learn from on-farm and on-station research. Figure 2 represents the research cycle that was implemented at Nallavelli village, Andhra Pradesh.

Table 1: Processes used to facilitate participation in action research on-farms

Participatory process	Types of participation and learning facilitated
Focus group interactions	❖ Develop a shared understanding of farmers' perceptions of sustainable farming systems' and traditional soil management practices
Portable rainfall simulator used in an action learning framework	❖ Develop a shared understanding of farmers' perceptions relating to traditional practice ❖ Further develop farmers' understanding of soil and water interactions and conservation ❖ Evaluate treatment performance during cropping season with farmers ❖ Allow comparison of farmers' traditional practice to practices developed from farmers' wisdom in real time and in a group situation
Farmer and scientist discussion groups	❖ Agreement on treatment selection for on-farm and on-station research sites ❖ Assess the performance of treatments ❖ Farmer economic evaluation of biophysical results ❖ Evaluation of new action learning tools
Other action learning tools	❖ Further develop farmers' understanding of soil and water interactions and conservation ❖ Facilitate discussion between farmers and scientists for co-learning

Figure 2 : The participatory on-farm research approach implemented in Nallavelli Village, Andhra Pradesh (Source: King, et al 1999)



Learnings and Impact in India: Capacity Building, Practice Change and Co-learning

An evaluation of the use of the "learning cycles" methodology and the outcomes of action learning and social assessment elements of the project in India was conducted in March 2001 and is reported in detail in the project's final report (Orlando 2002).

Evaluation data were collected through interviews of project staff, farmer discussion meetings and from information gathered through group reflection exercises at the project final review workshop. Qualitative data from these sources were analysed to provide evidence of changes to project staff's and farmers' knowledge, attitudes, skills, aspiration and practice over the life of the project and to capture learnings about the project's approach to extension and research, including the use of participatory on-farm research.

Through the evaluation process project staff highlighted the importance of the participatory on-farm research process in developing their own skills and knowledge as well as those of the farmer participants. Staff developed an enhanced knowledge and understanding of the usefulness of using participatory techniques to negotiate and implement on-farm research with farmers and across disciplines. The following quotes extracted from evaluation interviews illustrate some of the changes in knowledge and understanding facilitated by the project.

A group of 8 visited Australia. We were exposed to action learning tools such as the rainfall simulator and focus groups and how these were organised in Australia. We saw how you could facilitate more participation of farmers and how you could seek their wisdom– this was a major learning for the whole group and me personally. We also saw soil and water workshop and saw how simple tools could increase farmer knowledge.

Before the project the farmers had an understanding of soil erosion but not infiltration. They could see that soil was running off some areas and depositing in others. They could see rills and gullies. However, they did not understand the impact of certain practices on soil erosion and links to infiltration. .....From the rainfall simulator farmers have clearly observed how much infiltration has occurred, the amount of runoff and the colour of runoff. They could see the differences clearly.

Yes, they already had some knowledge about soil erosion and runoff but the rainfall simulator and the on-farm experiments have helped them understand why soil erosion is occurring and what management options are available. It helps farmers to make a comparison between the effects of their present practice and new options.

By implementing the participatory techniques imbedded in the participatory on-farm research approach, co-learning occurred between project staff and farmers as well as across disciplines as evidenced by the following statements. Participatory processes enabled farmers and project staff to value each other's knowledge and opinions and learn from each other and together. Participatory on-farm research laid a foundation of trust between village farmers and project staff, which was essential for co-learning to occur.

Through focus groups we have a very good understanding of farmers' 'perceptions of soil quality and sustainable farming indicators. To them soil quality and sustainable farming means they lead a better way of life, that all components of the farming system are looked after, including livestock, water and soils.... that they can continue their social responsibilities and maximise benefits for unit invested.

Over three years of on-farm research and other activities we have built up a common understanding with farmers. We are clearer about each other's roles and responsibilities and how to share our experiences with farmers and how to understand their experiences.

There has been a change in attitude towards working with farmers – now we see the value of building understanding with them..... Scientists have been given the opportunity to learn with and from farmers and they value this.

We [the scientists] used to dominate any farmer discussions. But now through the focus group method we facilitate and the farmers dominate the discussion so we can learn from them.

Project staff developed skills and confidence in how to plan and implement on-farm research and facilitate the participatory techniques imbedded in the process.

We came back to India [from visiting Australia] and carried out focus groups with farmers at Nallavelli, Anantapur and Bijapur. We found we had to redesign the methodology to suit India's conditions and to conduct focus groups in local languages. We then tried to compare results across countries.

Learning about the principles and processes of action learning has enabled us to facilitate farmer participation.

The implementation of participatory on-farm research in villages was reported

Frequent visits on-farm to do on-farm research, focus group sessions and use the rainfall simulator has helped to develop trust within the farmers, towards the scientists because they know we are going to come back.

I have realised this project has facilitated farmer participation well. Earlier farmers were scared of us and would not express information freely because

they thought we may take their land or cause them some problems. Now trust has been built and farmers participate freely – even challenge us with new ideas.

Previously most scientists or extension officers would only visit an area two or three times and not be seen again, so farmers did not build up confidence in these people. Because we visit often, confidence and rapport has been built and scientists are being asked to help facilitate the resolution of other problems and conflicts. The farmers are able to discuss other problems informally and this spins off into other projects for the community. If there was no instrumentation at these sites [on-farm] we would probably only visit two or three times a year.

by project staff to have affected the attitudes of farmers towards scientists. One of the important aspects of on-farm research had been building the confidence of farmers in scientists and government officials. Because they had put permanent instrumentation on-farms and were visiting frequently, farmers became confident that these scientists would return. Through frequent visits trust and rapport was built.

The project influenced changes in the practice of project staff and farmers. Staff reported changes in the way they interact with farmers and other team members and the way they conduct research.

Previous to this project I had not worked with women farmers – now we work with women with the rainfall simulator and focus groups and now they are more involved in the project.

Other benefits of on-farm research have been the ability to interact with farmers to see what they think about treatments and options in their own field. They now ask us all sorts of other questions about agriculture….. Through the rainfall simulator the farmers have been able to have influence over the treatments placed on-farm research and on the research station.

In relation to working with farmers – before the project scientists were like 'dictators' telling farmers…. and now they treat farmers with respect, share experiences…they value farmers' knowledge.

We used to take our own ideas and implement them on-farm…… Now we give the farmers all the freedom to recommend practices, then we [scientists] will discuss with the farmers any limitations we see with their recommendations and we will come up with a combined choice.

We will now be using this participative approach in our watershed projects. Before the ACIAR project we just demonstrated our recommendations and provided monetary support for farmers to implement practices

> *and structures. But after we left the watershed few of the structures have been maintained....Farmers gained little scientific knowledge or ownership by doing it that way. But in the ACIAR project we have involved farmers and used their knowledge, information and considered social and gender issues in treatment selection. They have ownership and will maintain structures and practices.*

Changes occurred in the way farmers participated in research, interacted with scientists and carried out on-farm practices. Many examples were reported of how farmers have changed the way they are involved in research as a result of the projects. Changes included:

- Willingness to test their ideas on-farm and challenge scientists with new ideas
- Increased participation in discussion of farmers not seen as the "lead farmer"
- Increased participation across caste, gender and ethnicity
- Greater openness and willingness to share information

> *Focus groups [and discussion groups] have worked out well. Now women and men farmers across castes will participate together in discussions. Earlier men of higher caste dominated focus group discussions but over 3-4 cycles of focus groups confidence has been built and all are taking part equally in discussions.*
>
> *Farmers are coming forward now wanting to try new ideas on their fields. They are even challenging us [scientists]. One farmer has challenged me by saying, "I will put on more FYM than you (he has bench terracing) and we'll see who gets the best yield"*
>
> *The rainfall simulator and on-farm research has also enabled farmers to test their own options – they have new ideas they think are good but are not practising these ideas. This process has given farmers the opportunity to test their ideas and now he knows whether they are good or not.*

Project staff reported many examples of how farmers have changed their on-farm practices as a result of the use of participatory on-farm research. The practice changes observed include implementation of conservation furrows, changes in crop layout and crop type as well as retention of cover and residue incorporation.

> *Through doing research on-farms the farmers' perceptions have changed, they are now using conservation furrows – this practice has been implemented the most. The farmers involved are telling other farmers about the project and the research and the rainfall simulator. I have seen other farmers in neighbouring villages implementing conservation furrows.*

Three new farmers are interested in adopting the green gram practice provided they can have available the rotary implement to incorporate green gram residue. Two farmers have bought the implement and will incorporate residue for other farmers at a cost. Farmers believe the benefits will outweigh the costs.....Farmers have also implemented their own methods on farms. Before the project, during the Kharif most farmers will leave the land fallow because of low and erratic rainfall. Now farmers are growing cucumber, ridge gourd, bitter gourd, coriander and green gram in the Kharif. In 1997 one farmer decided to try a cover cash crop of cucumber in the Kharif, now 35-40 farmers are doing it. They are doing this because they understand that the cover crop helps harvest water into the soil effectively for Rabi planting and gives them returns as well. They would incorporate the residue into the ground also if they had access to the rotary implement but are not doing this at the moment.

Ongoing use of participatory project planning and implementation techniques by project staff with farmers and the project team throughout the project is evidence of the usefulness of these techniques to sustainable resource management projects in India. These techniques have also been implemented by project staff in other projects as a result of the ACIAR 9435. Case study 1 outlines one previous staff member's experiences in extending the learning cycles methodology and participatory on-farm research to the Andhra Pradesh Rural Livelihoo ' Project. The "learning cycles" methodology incorporating participatory on-farm re search has also been recommended for use in India at the National level in Nationa Agricultural Technology Project and Institute Village Linkage Project.

Participatory On-farm Research - Strengths, Weaknesses and Challenges

The project also provides some insights int › the perceived strengths and weaknesses of using participatory on-farm research in ndia and the challenges institutions and scientists need to overcome if participatory ›n-farm research is to be extended more widely into farming systems research in Inc a (Orlando 2002).

Through the use of participatory on-farm research in the ACIAR project, project staff recognised the strengths of involving farmers in action research cycles and in conducting research on village farms. Participatory on-farm research was reported by staff to be more relevant to the farmers and built stronger working relationships and partnerships between farmers and scientists. Greater relevance and participation led to greater implementation of new practices by village farmers. Weaknesses were mainly related to the practical difficulties of implementing and documenting participatory on-farm research and the training required to develop skills in facilitating participatory methods.

Case Study 1 – Extending the learning beyond ACIAR 9435

This case study outlines one former ACIAR 9435 project team member's experiences in extending skills, knowledge and understanding developed during ACIAR 9435 into the recently initiated Andhra Pradesh Rural Livelihood Project (APRLP).

APRLP is one of the largest development initiatives of the Department For International Development (UK) in India. The project aims to improve livelihood opportunities of the rural poor in drought-prone areas of Andhra Pradesh by working in 2000 watersheds between 2002 and 2007. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is involved in APRLP projects aimed at enhancing livelihood opportunities through sustainable natural resource management (NRM). ICRISAT has been one of the pioneering institutions in NRM research. Its intercontinental (Africa and Asia) experience in integrated watershed management is a valuable source of knowledge to research and development agencies across the semi-arid tropics. As many of the past single institution-led natural resource management projects had failed to deliver the expected outcome, a consortium of several research and development organisations was formed to implement the ICRISAT-APLRP project. This is the first time such a multi-institutional and multi-disciplinary team is converging at catchment level in Andhra Pradesh to upscale the benefits. Therefore, it was a challenge for the consortium to develop a common vision of the project goals and grow into a team. ICRISAT; the convener of the consortium, initially found it hard to be in the "driver's seat". Due to the varied backgrounds and training, the project team was disparate and not able to articulate on a common ground. There was a need to develop an understanding of the importance of other's expertise and knowledge and appreciation for each other's viewpoints. Essentially there was a need for building trust and confidence among consortium partners before on ground actions could be effectively planned and implemented.

Taking the lead from the processes developed and implemented in ACIAR 9435 and experiences from ICRISAT's involvement in integrated watershed management projects, the importance of developing an effective inter-disciplinary team approach that sought out and internalised the farmers' perspective was impressed on the project leadership. Using the skills, knowledge and experience developed through ACIAR 9435 and other watershed projects the principles of inter-disciplinarity, action research/ action learning and farmer participation are being integrated into ICRISAT's APRLP through:

- *A series of team building exercises facilitated using the action learning / action research cycle*
- *A series of adult and action learning workshops for field staff to train them in the action learning concept and participatory techniques*
- *Documenting parts of the project and process using the action learning cycles framework for reporting*

The ICRISAT – APRLP project is essentially an on-farm programme in its early stages of development. There is much confidence that action research/action learning incorporating participatory on-farm research will be integrated throughout the project.

The Agro-Ecosystem Directorate for Rainfed Areas (AED-RF) for the World Bank funded National Agricultural Technology Project (NATP) that operated from CRIDA between 1999-2005 adopted a new culture of working with NGOs, farmer organisations and women's self-help groups. Most of the 105 that operated under AED-RF followed on-farm approach. CRIDA's capacity to work in on-farm action research mode was also recognised by the Natural Resource Systems Programme (NRSP) of the DFID, UK. The project aimed to improve rural livelihoods through better natural resource management had an outlay of Rs 16 million (1US $= Rs 45) and was implemented completely in an on-farm action research mode. As a follow-up of NATP, under the World Bank funded National Agricultural Innovation Project CRIDA has been awarded another project with a funding to the tune of nearly Rs 200 million for developing modules for livelihood enhancement in 8 of the poorest districts of Andhra Pradesh. The project is yet to be grounded and is implemented by consortium of international, national and regional research institutes supported by private sector players and NGOs. This project too will follow action research mode.

Thus, CRIDA's has traversed a long way after imbibing learning from the ACIAR 9435.

(Source: Pers note by S Dixit CRIDA/ICRISAT)

Project staff also recognised that for participatory on-farm research methods to be extended into other projects and institutions in India then a number of key challenges would need to be overcome. These challenges relate to scientists' mobility, the greater time commitment required to implement participatory on-farm research, ability to publish research results, field working conditions and perceived loss of power from scientists to farmers. To overcome these challenges practical measures and incentives that could be introduced by managers and institutions include changed car pool arrangements, improved travel allowance, access to example publications and recognition awards for participatory research.

Conclusions

The use of participatory on- farm research within a *negotiated learning and action system* has been a powerful tool to facilitate learning between Indian village farmers and scientists (from a range of disciplines and across two countries) about sustainable cropping systems and soil management. It also led to practice change in farmers as well as practice and organisational change in project staff and partner institutions. Indian scientists involved in ACIAR project 9435 *Tools and Indicators for Planning Sustainable Soil Management on Semi-Arid Farms and Watersheds* have embraced the participatory action research process eventhough it has presented them with many working challenges. Their ongoing support for and implementation of this innovative research practice is linked to their belief that research results are more relevant and useful to the village farmers and are more likely to result in ongoing implementation of changed practice on village farms.

The authors suggest that the research process developed could be used in a wide variety of situations involving complex issues relating to people and the way they interact with their natural and social environments. Such situations include the development of sustainable agriculture systems in a range of cultures and environments.

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