# Tying-up Loose Ends-
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***Correct citation:***
Jürgen Hagmann, Edward Chuma (2000) *"Tying-up Loose Ends-Integrating soft and hard methodologies in NRM research and extension*", in I. Guijt, J.A. Berdegué, M. Loevinsohn, F. Hall (eds.) Deepening the Basic of Rural Resource Management, Proceedings of a Workshop, ISNAR and RIMISP

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## Integrating soft and hard methodologies in NRM research and extension

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## 1. Introduction

The common goal of all engaged in rural development is to make an impact that improves rural livelihoods and enhances sustainable NRM. This is a trivial statement, but its implications are profound. A 'fight' between schools of thought over 'soft' or 'hard' perspectives or how much participation is required is rather irrelevant, because in the end, the reality and decisions of the local actors (and not the interventionists) determines whether or not they will change the way they manage their resources. Any approach geared towards sustainable NRM and development can only be effective if it influences people's management behaviour, which means their decisions and capacities for NRM. Clearly, this can only work within the complex realities of rural livelihoods.

Dealing with complexity is a strength of soft systems approaches. They bring about social learning processes to enhance individual and collective capacity to manage natural resources, to adapt to change and to solve problems. However, such processes are often grounded in the development of 'hard' technologies. Problem-solving skills and empowerment cannot be taught in a vacuum, but can be enhanced through the learning that occurs during joint technology development, for example, by improving a plough design or developing a soil management technique. Through such processes, people's personal capacities and self-esteem grow, with 'the plough' as the vehicle for the process. In most cases soft issues are grounded in or emerge out of 'hard' innovations. For example, the new plough might require more or less draft power and thus touches on resource-sharing arrangements which need to be negotiated in the social context. Thus, for such processes to be effective, both 'hard' and 'soft' knowledge and skills are integrally needed.

Integrating soft and hard approaches may sound easy, but presents major difficulties in both theory and practice, as NRM research and development generally lack the integrated and interdisciplinary frameworks required. This often leads to poorly integrated approaches and activities, rarely with satisfactory outcomes. In this paper we aim to address this gap by providing a conceptual framework for integrating these approaches. We also describe a practical case of its use in Zimbabwe. Finally, we discuss scaling-up of the approach in Zimbabwe.

## 2. A conceptual framework for NRM research and development

The framework presented here is a synthesis of recent trends and a variety of different theories and concepts related to NRM and innovation management (see Hagmann, 1999 for more detail). All recent successful experiences in NRM have one common denominator: a focus on human development. Based on this perspective, there are several basic assumptions within our conceptual synthesis:

- sustainable NRM and even development in general is a social learning process, in which the goal is increasing human capacity to solve problems and manage resources effectively and efficiently
- sustainability is not value-free, but is a function of the value/culture system of local actors, thus sustainability needs to be defined and agreed upon by 'insiders'
- sustainable NRM is decided less by technical expertise than through learning and negotiation among stakeholders
- technology and knowledge are not value-free and culture-neutral and therefore not directly transferable from any given situation (culture, organisation etc.) to another, but have to be constructed socially in a collective learning process.

Sustainable NRM needs to be seen within the broader development context. Therefore, in the following section we briefly summarise the development paradigm which has given birth to this process.

### 2.1 The development paradigm

At the macro level, development as a state-controlled activity, where modernistic models and technologies are transferred to less industrialised countries, has largely failed and has marginalised many of the target societies. Furthermore, tighter economic conditions have reduced state services and decreased state capacity to care for people and for natural resources or control their use. This increases pressure on people at a local level to take greater responsibility for, and control over, their resources and their lives.

State withdrawal has meant an acceptance of decentralisation policies and empowerment strategies, resulting in a shift of decision-making power to lower levels. In such a context, development is not a progression in a single direction towards one goal, but a process of continuous adaptation, problem-solving and opportunity. It is the basis for local people to take responsibility for setting development goals and activities. It becomes a people-centred social learning process of which the result is a growing capacity for problem-solving and self-governance, rather than direct economic growth.

As the use of natural resources is decided less by technical expertise than by negotiations amongst the various stakeholders, new ways of negotiating such use (including rules and regulations) are needed (Röling, 1996). The different interests and powers which these stakeholders represent make it likely that this will be a conflict-laden process. Therefore, local capacity for conflict management is an important determinant of success. Sustainability in development and in NRM is thus a continual value-dependent, political and social negotiation process which cannot be defined by outsiders (Checkland and Scholes, 1990).

Within this context, social and technical innovations are essential to manage on-going change, but their development and spread is only effective if part of a collective learning process. Technology and knowledge are neither value-free nor culture-neutral, and therefore not transferable across organisations and cultures. For example, a technology which works well in South America might not work in a different social context in Africa, despite similar soils and climate. The same might be true of different areas in one province or even in neighbouring villages, when power and socio-cultural conditions differ. Technologies are constructed and shaped within this socio-technical context and are products of this negotiation and learning process (Law and Callon, 1992; Latour, 1993). Agricultural extension in this context has to be understood as a joint learning process between insiders and outsiders based on experiential learning (Kolb, 1984; Röling and de Jong, 1998).

In such situations, 'soft system' perspectives can accommodate different realities in a learning process. These perspectives are the backbone of our synthesised conceptual framework. Based on the theoretical analysis we identified three main strategy elements underlying the conceptual framework, discussed in turn below:

1. to create conducive conditions for a process of social learning and collective action by sharing knowledge;
2. to strengthen the capacity of local groups, institutions and organisations for negotiation and conflict management;
3. to develop innovative, resource-conserving technologies and to spread them through interactive learning.

## 2.2 Social learning and collective action through sharing knowledge

Some of the key objectives of social learning and collective action in our analysis are:

- to increase collective capacity for self-organisation and governance;
- to increase self-confidence;
- to increase the collective bargaining power of cohesive local entities through their institutions and organisations.

This process aims to create an environment in which the multiple, complex objectives of individuals are recognised and freedom for diversity and situation-specific solutions is inherent. Collective accountability for natural resources is built through generating a common vision and through environmental learning and analysis which builds on stakeholders' values. Existing local institutions and organisations should, ideally, be the basis for building this process (see 2.3 below).

As a shared problem provides a forum for collective action, the first step in generating social learning involves an exploratory analysis of the problem and the complex networks of players involved. All stakeholder groups must be well represented to allow for an expression of diverse interests, especially marginalised groups. The process has to be facilitated by external or internal facilitators, and cannot be limited to the grassroots level alone. In most cases, it must also promote change at the policy and institutional levels, especially negotiation and conflict management capacities.

## 2.3 Strengthening capacity for negotiation and conflict management

One element of strengthening local capacities is devolution of power and decision-making to local institutions and organisations. However, this alone is often not enough. For several decades, the state 'cared' for people by taking over many responsibilities and decisions which local communities had traditionally handled themselves. This has disempowered many communities by undermining their management capacity. Previously negotiation and conflict were easily avoided by referring to government decisions and policies. But handing back responsibilities in a time of rapid social change without any support to leadership development could increase, and has done so, the power of certain groups and leaders, leading to extremely tense conflicts, inequitable development and social disorder. Hence there is a need to build negotiation and conflict management capacities and organisational capabilities to deal with these new responsibilities.

This capacity-building needs to take place at two levels: at a local level within stakeholder forums, and at the level of government bureaucracies, which should be supportive of the local process. Negotiation and conflict management capacities need especially to be strengthened at the interface between local, bottom-up decision-making systems and the normally top-down decision-making systems of central government. The link between the different levels of decision-making from individual to central government is a key focus.

## 2.4 Developing and spreading resource-conserving technologies

Indigenous knowledge and indigenous resource management systems are the foundation of much innovation development in sustainable NRM. Such innovations need to be developed by integrating indigenous knowledge and technologies with external ideas and technologies through farmer experimentation. To promote sustainability, technologies should ideally be based on the principles of sustainable agriculture (Pretty, 1995). However, this does not exclude high external input technologies if the stakeholders can afford them and are willing to invest in them, and if they support sustainability. New ideas can be shared and negotiated through a stakeholder forum which includes researchers. Resource stabilisation requires an agro-ecosystems perspective, where any new technology has to be negotiated in terms of productivity, stability, sustainability and equity. Technology development and spread cannot be strictly divided as both are part of the learning process.

## 2.5 Implementation

The question now is how to put these theoretical concepts into practice? To implement the framework described above, a strategy has to be developed. However, it should not be implemented as a blueprint as the strategy depends on the specific context, and needs to remain flexible in order to seize and build upon opportunities which arise. Therefore only some basic elements are described here (Figure 1):

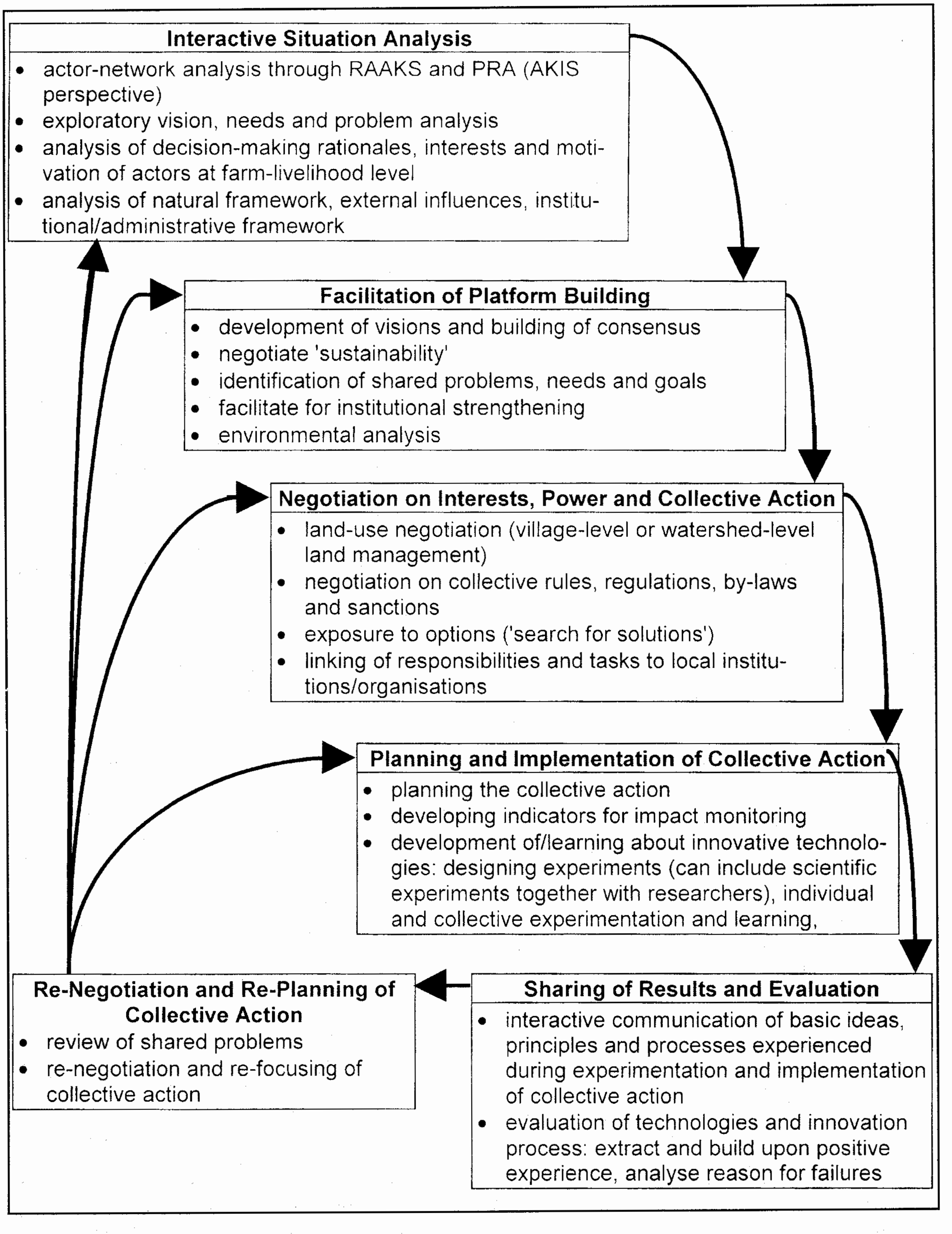
- Implementation at the local level normally starts with a detailed analysis of the local situation. AKIS, RAAKS (Rapid Appraisal of Agricultural Knowledge Systems) and PRA (Participatory Rural Appraisal) methods can be used to explore the types of groups and local institutions and organisations present, as well as the environmental context, external influences and the administrative framework. A needs and problem analysis should aim to identify problems and issues shared by the majority of the local people. Besides the social framework, the situation analysis should also embrace the natural framework, external influences and the institutional/administrative framework. Local decision-making strategies should be analysed at the farm level. This process is not an extractive process implemented by outsiders, but serves both to inform the outsiders and to trigger self-analysis within local stakeholders.
- The next step is to build platforms or forums involving all stakeholder groups. These stakeholders should not be represented by group leaders only, who often represent their own interests rather than the interests of groups and communities. A facilitator needs to be aware of this issue and work with other individuals as well. Through continuous negotiations in these forums over common visions, goals, needs and problems, decisions about collective action can emerge.
- NRM actions need to be geared towards environmental analysis, negotiations over land use and village land management (here the technical information from a land evaluation might be required in addition to the knowledge of farmers). This reveals problems and areas where innovations are required. Responsibilities for co-ordinating these activities should be with the respective local institutions/organisations. The implementation of agreed by-laws for NRM may be included in the tasks.
- When the time is right for technical innovation development, this needs to be approached through farmer experimentation. This will include starting with 'looking for things to try', designing joint experiments, trying things out, and sharing the results with others within the forum.
- At the end of a season or year, the most important part of the learning process is to self-evaluate the activities in light of the goals initially set by the stakeholders themselves. Then activities can be adapted for the coming year. The identification and analysis of shared problems and needs involves continual negotiation, and the planning cycle is therefore short.

The methodological sequence can be viewed as a cyclical spiral of collective action and reflection and self-evaluation (Figure 1). Each cycle brings new learning experiences on which the next cycle can build. Not even the situation analysis is static, but will provide more insights during implementation which might require new actions. This action learning is an iterative process, ensuring that the goals pursued are determined by the local people.

### 2.5.1 *The role of outsiders*

External support is mainly methodological. All the above steps are carried out by local people, in most cases initially facilitated by outsiders, and later facilitation is taken over by insiders. The external facilitation is often very important to trigger the process of self-analysis which is difficult if this should come from inside and be done by stakeholders who are involved and have interests themselves. The situation analysis is the only step which might have to be carried out by an outside agent. Local training in facilitation skills (Box 1) is therefore an integral part of the learning process, as the outsiders' facilitation role will be taken over by the local people during the process. Researchers and extensionists have a pivotal role to play in

***Figure 1. Sequence for implementation of the theoretical concept for innovation development and extension in natural resource management.***



***Box 1. Good facilitation – the foundation of learning processes***

The core of any learning process, whether implemented by outsiders or insiders, is process facilitation and management. Development workers' facilitation skills are the biggest challenge of all. Our experience has clearly shown that good facilitaton skills are more important than any particular tool or learning aid, and also more difficult to learn than any other skill needed for implementing the learning process.

The core of facilitation is about asking the 'right' questions at the 'right' time in order to enhance people's self-reflectionand self-discovery without pre-empting the responses or pushing in a preconceived direction. These questions are to mirror back to people the consequences of their behaviour and possible solutions in the long run and thus lead to a deep self-reflection and ownership of the problems they express. The main difficulty is 'steering' the facilitation process, which requires several skills and conditions:

- *A clear vision and the values of the process goal.* This vision needs to be built upon values like development based on participation, ownership, inclusiveness, people's self-development, openness, transparency and accountability. With this vision as a guiding light, the facilitator is able to handle situations flexibly and to pose the 'right' questions to enhance learning. Thus the facilitator needs to be a step ahead and lead the process, rather than its outcome. Often, this vision can be enhanced through exposure to successful cases which provide a real and concrete example of such a vision.
- *Empathy and the 'culture of inquiry'.* The facilitator needs to be able to empathise with the group members so that he/she can react appropriately. Empathy goes beyond knowledge about group dynamics, as it is a skill that depends on personality. Another skill is the 'culture of inquiry' which is the ability to question apparently simple things and to get down to details. Often the real problems lie in the details, which need to be disclosed before a solution can be developed.
- *A clear understanding of the process design and steps.* In our experience, unless the process design is clear, facilitators have major problems guiding the process. Beginners in process facilitation especially need a clear 'operational framework' as a 'rail' to guide them (Figure 2). Such a framework defines the objectives, key questions and issues, core methodologies and partners for each process step. Only after thorough training and experience in these process steps are facilitators able to understand and implement them confidently and modify them according to their own experience, empathy and common sense. Understanding the process with its usual ups and downs also helps to reduce the frustrations often experienced when things do not go in the desired direction. Once having gone through a whole process cycle, facilitators know that these are part of any non-linear learning process and they can handle these situations by putting them in context.

These are some core skills and conditions required for facilitation of any learning process. Facilitating learning in NRM also requires knowledge about ecological principles and practices, where specific learning tools play a crucial role.

supporting increasing self-governance. The innovation process includes them as equal partners with farmers. However, research can only be directly useful for farmers if it focuses on shared problems and if it intervenes at the relevant level and supports farmers' experimentation. Transfer of material resources can play an important role, but only to support people's projects. It should not be used as an incentive for people to 'participate' as this will undermine their interest and the ownership of the whole process will be with the outsiders – the classic dilemma in development.

The framework is clearly geared towards learning, optimisation and efficiency in NRM. Although associated with Western societies, any society in historical terms must be effective at coping with change. Modern and indigenous resource management systems alike are the result of such a learning, adaptation and optimisation process; the main difference being the time frame. Therefore this is not a Euro-centric vision but a necessity for the survival of any society. It would become Euro-centric if the rationale within the process was dominated by outsiders. However, as the 'how' and 'what' in the learning process are negotiated and determined by the local actors themselves, their rationales, cultural and social contexts are the driving forces.

This theoretical concept sounds highly complex and demanding, especially as it is not a blueprint approach, but creates room for creativity and adaptation. Its success depends mainly on the practical strategy and tools developed for each specific context, and on the attitudes of the actors. In the next section, we describe how the concept was developed and applied in Zimbabwe.

## 3. A Case Study on Learning from Zimbabwe

The work on participatory research and extension in Zimbabwe referred to here was part of a collaborative project between the Zimbabwean national extension service, the German development co-operation, and strategic partners like the Food Security Project of Intermediate Technology Zimbabwe (ITZ). It took place in the semi-arid areas in Southern Zimbabwe (Masvingo Province), where soil and water conservation are key issues facing the smallholder farming sector of the communal lands.

The work in Zimbabwe was characterised by constant learning and evolution both on our part and the part of the farmers, guided by a vision of improving rural livelihoods and the state of resource degradation. We started in 1988 with a conventional on-station research project looking at a single technology (conservation tillage). The project was initially not consciously constructed as a learning process. After two years it began to shift towards adaptive on-farm research, then evolved towards farmer participatory research and eventually into participatory technology development and extension (this evolution is described in detail in Hagmann *et al.,* 1997). This evolution was mainly driven by intuition, common sense and empathy, all led by a strong desire to improve rural life. This goal, and the vision of rural people who are able to develop and use their own potential, were the 'guiding stars' which steered the learning process. Without this local vision, our intuition and empathy would have had no direction.

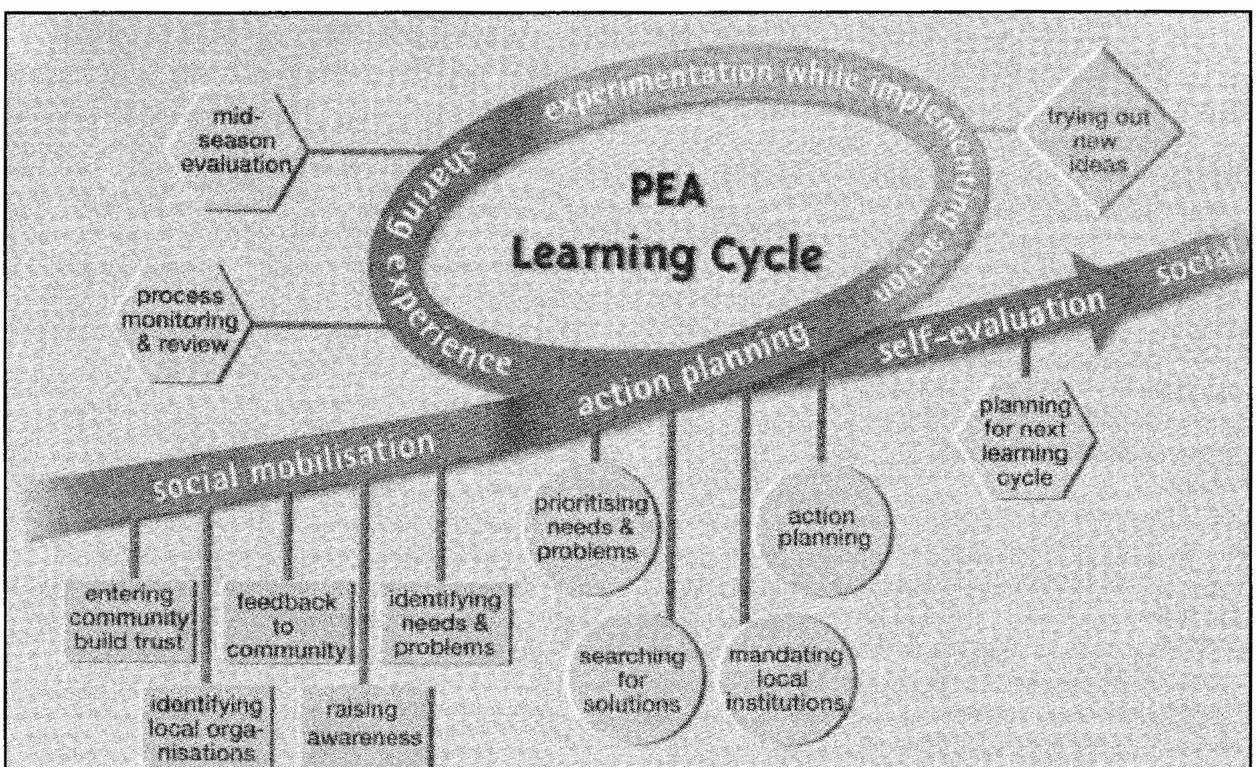
In our work with farmers we tried to react to events as they occurred, rather than anticipate and prescribe, and by reviewing our successes and failures we continually adapted our intervention design. Thus our technological focus became much broader, looking at soil and water management and NRM in general, and we moved from technology development to facilitating innovation in technology development and in extension.

Our core lesson was that the social environment needs to be highly conducive if innovations (social and technical) are to spread, be it in NRM or any other part of the livelihood system. Therefore, we never tried to separate the NRM learning process from the complex livelihood context. Our aim was to facilitate social, economical, ecological and organisational innovations through experiential learning which would enable people to manage their environment adaptively (de Boef, 2000). This explains why a broader social context than just a farmer group needs to be addressed and motivated to engage in collective action and reflection.

### 3.1 Conceptualising the learning process

We found it increasingly difficult to explain to outsiders exactly what we were doing, and needed to clarify the process for ourselves, thus we decided to systematise our learning. We conceptualised 'process steps' within the learning cycle. Creating a 'model' to serve as a guiding framework

***Figure 2. The cycle of action and reflection in participatory extension (PEA)***



for others, while avoiding it being treated as a blueprint and implemented in a mechanical way, proved to be a challenge.

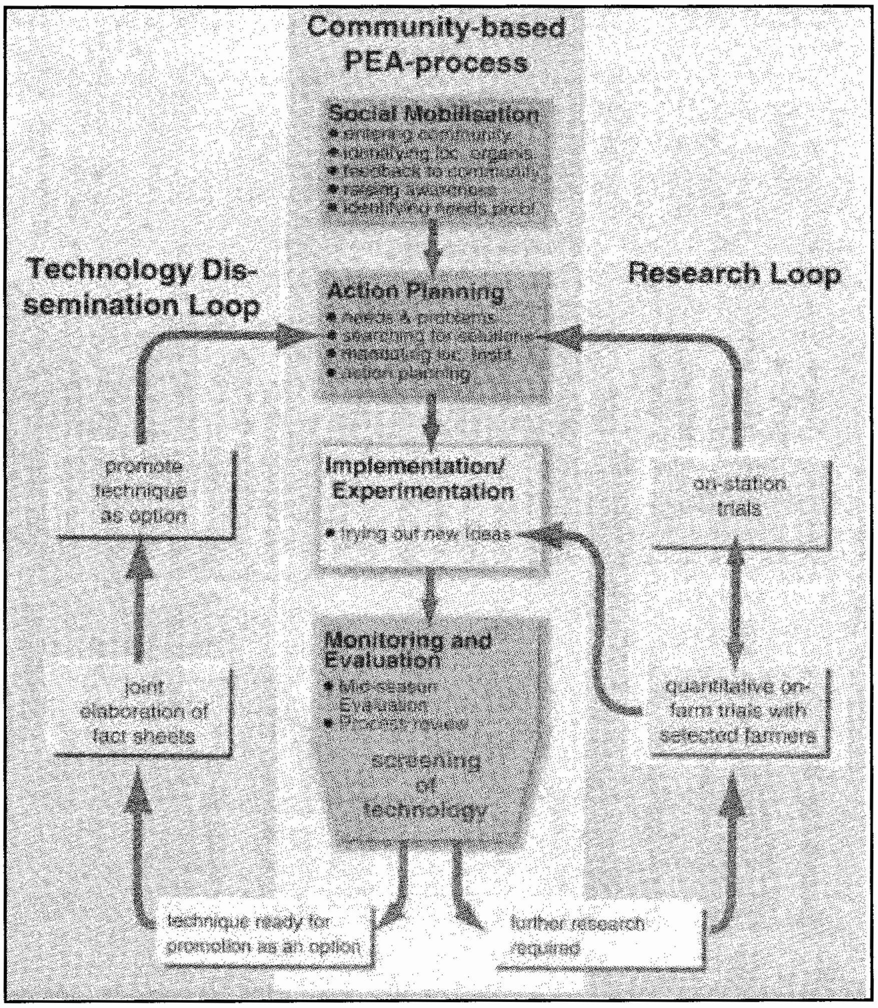
We call the model the 'Participatory Extension Approach' (PEA). The core of the approach is strengthening social organisation on the one hand, and farmer learning through experimentation and discovery on the other. This learning process consists of four main 'phases' (Figure 2; Hagmann *et. al* 1999): social mobilisation, action planning, experimentation/implementation, sharing experiences and self-evaluation. Each phase contains concrete steps and takes place within a negotiation process similar to the one described earlier in Figure 1.

### 3.1.1 *Integrating hard and soft sciences*

As described above, we started off with a rather 'hard' technological and research perspective which evolved to a strong 'soft' focus as this was the only way of making a difference to farmers. Although this project had no social scientists, we started to learn about social negotiation processes in practice, developed a methodology for facilitation and turned to the theory in order to understand more clearly what we were doing. Ultimately we developed the theoretical framework described earlier which integrates soft and hard science in an action learning process. An important role of research is to develop tools and aids to make 'hard' science visible for 'soft' processes. Researchers essentially play a back-stopping role in the experimentation process. Their involvement is through developing and testing new technologies, providing explanations which are not easily seen and need detailed scientific research, and advising the actors on technological options. The research agenda emerges from farmers' experimentation and learning. Researchers take these learnings and questions further and feed back their own insights into the next learning cycle. In this mode, the NRM research becomes 'grounded' in actual problems. Researchers also monitor the trials closely (discussed below). Figure 3 illustrates the way in which we integrated soft and hard approaches.

Our approach is far more than a methodology to enhance farmer learning about technologies. It differs considerably from farmer field schools because it facilitates social processes and also encourages large scale experimentation by farmers themselves in their own fields. Rather than promoting ready made solutions, it tries to enhance farmers' technical and social understanding of, and capacity for, innovation.

***Figure 3. Linking 'hard' research with 'soft' extension / learning process***

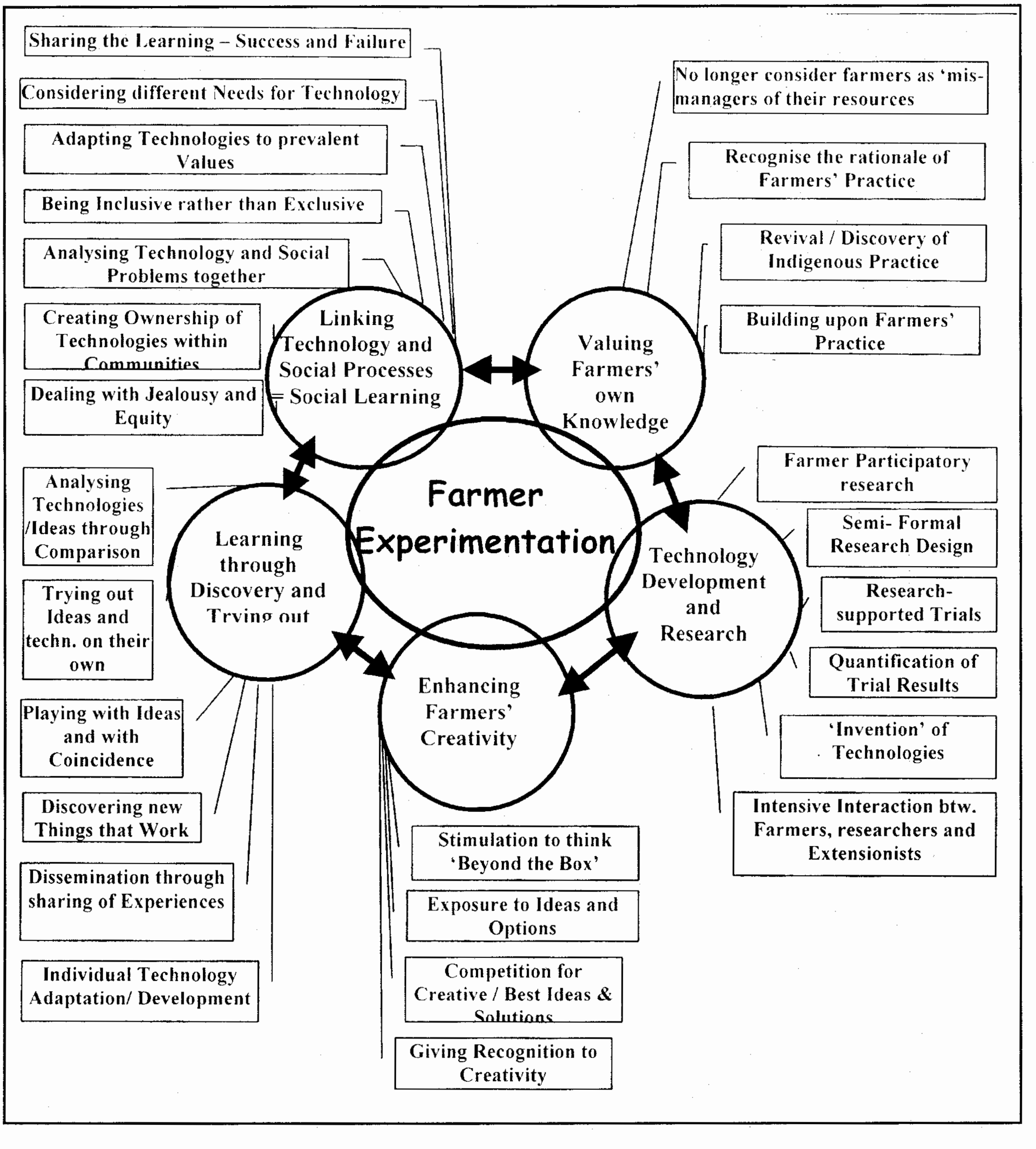


### 3.1.2 Role of farmer experimentation in the learning process

Farmer experimentation has been central to our learning process. Although we started with 'adaptive trials', we soon learned that experimentation is about much more than testing a certain technology. We found that farmer experimentation relates to several other, often rather invisible but important areas which turned out to be key for success or failure (Figure 4):

1. *A methodology for discovery and experiential learning*. It creates curiosity and a spirit of trying and discovering.
2. *A way to value farmers' own knowledge*. It improves the understanding of biophysical processes by farmers (land literacy), it reveals the interrelation between farmers' knowledge and scientific knowledge and so contributes to a better mutual understanding, and raises the status of farmers' knowledge which in turn raises confidence in their own solutions.
3. *A way to enhance farmers' creativity*. The curiosity and the confidence which is created generally triggers creativity in finding solutions. People develop their own solutions rather than waiting for answers from outside.
4. *A methodology which links technical and social processes and generates social learning*. A collective experimentation process automatically raises technical and social issues. Any technology will be adapted to social conditions if farmers are trying them out and sharing their experiences with others.

***Figure 4. Key elements of farmer experimentation within an innovation process***



5. *A methodology for research and technology development.* It helps researchers and farmers to work effectively together and develop technologies. In this way, research has a major role to play.

Our experience in training and scaling-up shows that in most cases farmer experimentation is understood simply as a tool for research and technology development, while its other strengths are overlooked. To demonstrate its wider value to people with no experience of this way of working, we found exposure visits to experimenting farmers to be very effective. These allowed people to see that, in terms of land literacy and NRM in general, farmer experimentation is the core methodology for enhancing their understanding of the resource system and for generating creative solutions to the challenges faced. The operationalisation of farmer experimentation required a number of practical methods and tools to enhance farmers understanding of their ecosystem. We called those 'learning tools' and developed a range of different tools during the projects.

## 3.2 The learning tools

Learning tools are central in facilitating and implementing farmer learning and experimentation. We used a variety of methods to stimulate group exploration, discovery and learning, some of which are described below. In this paper we limit the description to methods for promoting land literacy.

Many of the tools described here emerged out of a 'hard' science focus. For example, we initially carried out rainfall simulation experiments on the research station. Similar to Hamilton (1995) we found this set-up very interesting for research purposes, but when we wanted to explain the erosion processes clearly to farmers, we felt that a more simple design would be better. So, we decided to use simple trays which Elwell (1986) used for simulation purposes and a watering can to demonstrate the effects of different soil management practices to farmers (see below). Another example was our shift from measuring and communicating tons/ha of soil erosion which the farmers never understood, to a focus on facilitating farmers' understanding of the process of erosion through observation and experiential learning. Even the research design on-farm (the paired design described below) changed from a 'hard' statistical method to a 'soft' analytical comparison tool that could be implemented by farmers while still leaving the opportunity for researchers to carry out detailed 'hard' measurements.

Despite our shift towards 'soft' issues, we continued to conduct both 'hard' and 'soft' quantitative and qualitative experiments until the end of the project. We used hard science and farmers' perspectives together to explain biophysical processes and to convince people of the value of 'soft' approaches. For example, we once carried out a scientific study on soil erosion in a catchment which proved that standardised soil protection measures were not effective and that adaptive and situation-specific management approaches were required (Hagmann, 1996).

The use of symbols, proverbs and songs, as well as building on farmers' own metaphors (Box 2), helped in the learning process, and more importantly, created new social norms and tapped values which probably played a big part in generating farmers' enthusiasm and motivation to understand and do things differently.

**Box 2. Metaphors and codes**

In the discussions the use of farmers' imaginative language is encouraged. For example, a farmer compared the dynamics of water in the soil to the workings of blood in the body; a gully becomes a wound which allows blood to drain away. This is related to the drying up of wetlands through gullies. Such metaphors, together with songs, stories, proverbs and dances are used to relate environmental processes to the farmers' everyday reality. Pictures of a degraded landscape, for example, with people struggling to get firewood are also useful tools. Role plays help rural people analyse their own situation from a distance. These codes provide an entry for a debate about farmers' perceptions. The type of facilitation that takes place, however, is extremely important. First, questions on the situation depicted in the picture/game/role play are asked and these are then developed into questions that create links with real life. The farmers then discuss the various answers generated by the group. The facilitator's role is to challenge farmers' perceptions through questions, to summarise the discussions and to guide the process.

In community workshops we initiated the learning process by stimulating debates about people's visions of development. Questions like *"If you came back as a spirit in 100 years time, what would you like to see in your village?"* stimulated people to think about non-material values. The subsequent discussions often reflected farmers' concerns about environmental issues. These debates explored the reasons for environmental and social change, which helped motivate people to work towards joint visions to reverse these changes. Generally we have the impression that facilitating farmers' own exploration of core values of themselves and communities created a lot of energy. Values became a driving force for dealing with social and environmental problems. Economic benefits from land husbandry were not as important as often assumed.

### 3.2.1 *Building Land Literacy*

Below are some examples of how we built land literacy with farmers.

*Comparing soils*

Two simulated soil profiles are compared with farmers. The profiles are contained in glass boxes with an outlet at the bottom (Figure 5). One profile simulates an eroded soil and has a shallow topsoil, while the other simulates well managed, non-eroded soil. An equal amount of water is poured into the two soil columns. The shallow, eroded soil has a lower water retention capacity and half of the water immediately flows away. The non-eroded profile is able to hold water. Having observed this simple experiment, farmers' learning is facilitated by such questions as *"What happened?", "Why did it happen?", "What effect has this on plants growing on these soils?", "Have you seen this happen in your fields?", "What is the effect in your field and has this changed over the last few decades?"*. In this way farmers discover and analyse biophysical principles and relate them to their situation. The analysis reveals the link between the (man made) drought and soil erosion.

*The rainfall simulator*

Three simulated fields - one ploughed, one ridged and one mulched - are compared during a 'rainstorm' induced by a watering can (Figure 6). In reality these fields are boxes (see Elwell, 1986), measuring 0.3 x 0.5 x 0.1 m with an outlet in the bottom and a chute in the top. Runoff, soil loss and groundwater outflow are collected in glass beakers from the three 'fields'. High runoff and soil loss occurs on the ploughed field, whereas on the mulched and ridged fields runoff and soil losses were low and groundwater outflow was high. Questions similar to those mentioned above were asked to encourage farmers to analyse these observations and relate them to their own environment and practices.

*'Think tanks'*

Think tanks are areas where numerous technical options are shown in the field. They can be used to display a range of land husbandry practices. In the Zimbabwe case the sources of these innovations were creative farmers, training centres and research stations. Visits to 'think tanks' have become so popular that farmers, on their own initiative, hire and pay for buses to visit these locations themselves. Feedback to the community after such excursions is an extremely important step in encouraging other community members to experiment with new ideas. Farmers' feedback also encourages researchers to test and demonstrate farmer generated technologies on-station. Later we tried to develop such think tanks in a more decentralised form as 'village or area experiment stations' in more accessible places, such as along roads etc. It was important that these were not implemented like the well-known 'demonstration plots' where 'proven technologies' were demonstrated and farmers were taught to practise these in the same way. The context and spirit of experimentation and adaptation had to be created first so that farmers could decide for themselves whether and how to adopt the ideas, rather than adopting them wholesale as blueprints.

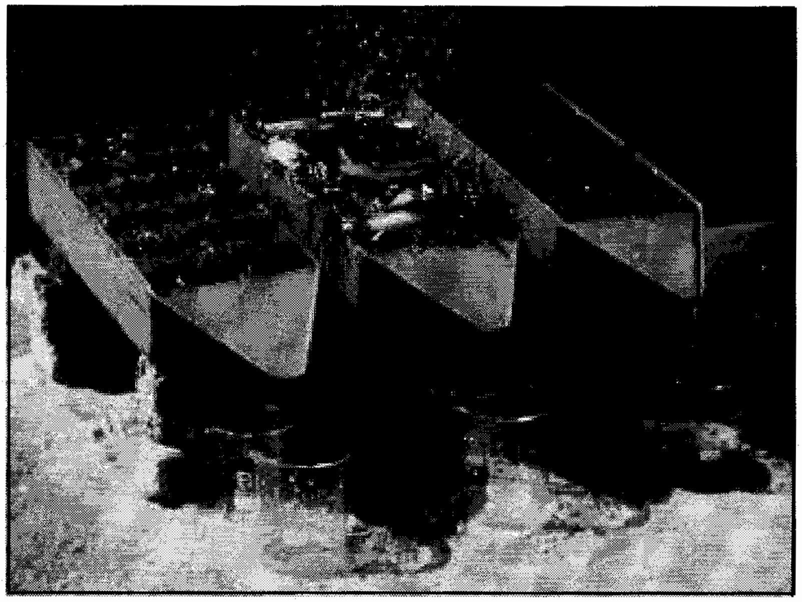
*Competitions for the best ideas*

Farmers' experimentation was further encouraged in competitions for the best ideas (not for the best crops!). The ideas generated were pooled and revisited every season. About half of the innovative ideas were farmers' adaptations and modifications of externally introduced ideas and options. The other half originated entirely from farmers. In several cases, ideas from outside were brought in, farmers modified the techniques and then the innovation was further developed jointly to a stage where it could be promoted. In other cases, researchers were inspired by farmers' practices and ideas and then further developed the innovation together with farmers.

To avoid innovators being victimised by jealous fellow villagers, a two-way competition was introduced: individuals in a community compete, but different communities

***Figure 5. Comparing Soils***

***Figure 6. The Rainfall Simulator***



also compete against each other for the number of innovators and good ideas. Thus innovators are accorded more respect by their community, whilst it is also in their interest, if they are to win, that as many 'ordinary' farmers as possible copy their ideas. Criteria for judging the competitions are set by farmers in co-operation with extension workers.

Such competitions helped revive farmers' knowledge and ideas and generated a willingness to try new things. The presentation of a farmer's own ideas to others strengthened his or her confidence and pride. In many communities, experimenting has become a new, positive social norm and the fear of failure has been minimised. This spirit has replaced the tendency to wait for outsiders' solutions and has re-valued farmers' knowledge.

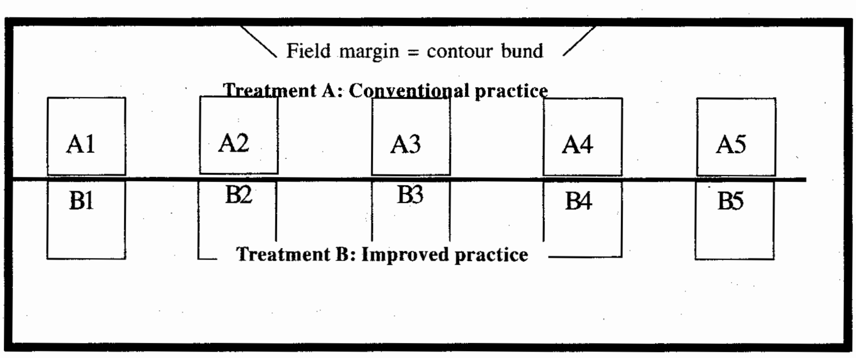
### 3.2.2 Comparing 'hard' and 'soft' research through paired plots

Quantitative data were collected during the research process by both farmers and researchers. Conventional practices and new ideas were compared by placing them side by side in one field, allowing farmers continually to monitor and analyse what they saw, leading to an understanding of the processes and factors that influence the performance of technologies.

The following methods were used to test new techniques:

- The core method for the researcher-driven quantitative technical evaluation is a simple paired treatment design where the traditional practice (the control plot) is put next to the improved technique in the same field (Figure 7). After explaining the basic principles of comparison (eg. for tillage: same planting date, same planting density, same fertilisation rates) farmers manage their trial field and observe the performance of the two treatments. The paired treatment design with only one variable proved appropriate and not only enabled farmers to compare the performance of new techniques, but also enabled researchers to obtain quantitative data. Variability in soil and fertility was so high that reasonable results were obtainable only when closely spaced, paired check plots were used.

***Figure 7. Paired treatment design with 5 plot pairs within one field. The two plots of one pair (each 5x5m) are closely spaced to avoid high variability in soils and soil fertility. Slope positions of the treatments (sited upslope or downslope) are randomised over different fields. Slopes are between 1 and 5%.***



These check plots are used for further quantitative measurements and allow for more control by the researcher without interfering in farmers' management or sacrificing practicability of implementation, which is the case in completely randomised block designs. The results are analysed by comparing the performance of the improved technique relative to the traditional technique. For statistical analysis each farmer's field is treated as a randomised block with five replicates.

- Qualitative observations and informal discussions with farmers during weekly visits have proved to be the most successful method to monitor farmers' trial management and adaptations. The continuous, long-term interaction with individual farming families revealed that farmers' attitudes towards technologies are influenced by their livelihood coping strategies. It also revealed that farmers' circumstances are highly diverse and variable, both between and within families.
- Joint evaluation tours and group discussions explore farmers' understanding of the techniques and the processes and provide additional information on the implementation.
- Formal questionnaire surveys identify the attitudes of participating and non-participating farmers towards certain techniques.

All these tools were used at different stages and some of them were used again after a year to review the learning process.

The quality of the data improved as farmers' experimental capacities improved. Provided farmers had fully understood the basics of small scale experimentation, and provided researchers made enough observations during critical times (eg. planting, harvest), check plots can generate high quality data. However, data quality in farmer managed/implemented trials without frequent contact with researchers proved to be highly questionable. The same applied to farmers' records, which were only of good quality (for researchers) if the researcher showed strong interest and requested them on a weekly basis.

The analysis of the quantitative research data showed that the performance of a certain technique significantly depended on the farmer and his/her management (Chuma and Hagmann, 1998). This proved to us that the development of a single extension message cannot work. Recommendations would have to be extremely site- and situation-specific; a requirement which no extension service can provide. This experience supported our rethinking of the conventional extension approach.

### 3.2.3 The impact of the learning tools

The learning tools had a major impact on deepening farmers' understanding and analysis of the environment. The simulations became a reference point for farmers. For example, when talking about soil erosion in their fields in a mid-season evaluation, farmers often referred back to the model situation as a way to explain what happened in their own fields. During rainstorms farmers went out in their fields to observe whether similar processes happen in their fields. They observed where the water was flowing and identified the points where they needed to put checkdams or close rills. This curiosity was mainly triggered by the learning tools which provided a technical and analytical understanding but also peer pressure to conserve resources. This pressure resulted in a kind of new 'social norm' in resource management.

For example, phrases like 'no drop of water should leave your field' or the 'spirit of experimentation', which became widely used amongst farmers, set the tone for trying out as many techniques as possible. The competitions have triggered a community-wide experimentation process and, according to our observations and farmers' comments, improved resource management as a whole. It is, however, difficult to collect quantitative data on a large scale to substantiate this statement. However, we were able to measure an enormous increase in farmer experimentation: both the number of experiments per farmer, as well as the numbers of experimenting farmers per community, and the spread of certain technologies. Increases in productivity have also been assessed (Hagmann *et al.,* 1997).

## 3.3 Scaling-up

The next step, having started with small groups of experimenting farmers, was to scale-up the process to whole communities. The main strategy for scaling-up was to institutionalise PEA within the extension department as they are the most important agents in the rural areas. The aim of institutionalisation was to transform the extension workers from teachers of technologies to facilitators of innovation processes. Since 1996, therefore, we have been training extension agents to implement the PEA approach without our direct support. Our emphasis remained on enhancing farmers' learning and understanding, rather than on technologies. Only through this process will farmers be able to practise effective adaptive management in this semi-arid complex, diverse and risk prone area.

Institutionalising the approach within the extension organisation has been, and still is, a highly complex process (Hagmann *et al.*, 1998). Most of the learning tools are still being used by the extension workers who are exposed to them during iterative, on-site/off-site training in PEA. Some have developed new ones on their own, which is the ultimate aim in the competence development of extension staff. However, it has proved difficult to maintain an equal focus on the technical issues and on the social and facilitation skills. Initially more training and support in process facilitation is required, as this is what technically-oriented extension agents struggle with.

Our monitoring and evaluation consists mainly of community reviews. At present we are carrying out an intensive impact evaluation at farmer, extension worker and extension management level to explore the elements of self-sustaining processes in areas where extension workers are implementing the approach as part of their regular work, without any donor support.

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