The use of the River basin game as a tool for the implementation of the Waternet CP project in South Africa

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Abstract

In the Olifants river basin about 60% of water resource is used in agriculture (DWAF, 2004). Agriculture faces increasing competition from other water users, constraining its contribution to economic growth. Spatial and temporal water shortage for irrigation affects small scale farmers resulting in conflicts on sharing the little available water. This paper presents the River Basin Game (RBG) as a tool for equitable and sustainable water resource use in the Sofaya irrigation scheme in Sekororo, Olifants in South Africa. The area provides an ideal setup for investigative work described below as it lend itself to a mixture of large-scale and small-scale irrigation farmers sharing the same water resource.

The river basin game addresses irrigation water use efficiency and access between upstream and downstream users. It is applied with the development of new ideas on the ground, supported by lessons learnt at local, regional and international audiences. The RBG was first developed at University of Anglia, United Kingdom (UK) as a teaching tool and tested in Tanzania under the project Raising Irrigation Productivity And Releasing Water for Intersectoral Needs (RIPARWIN). The current version of the game incorporates a groundwater component.

The results reported are from two RBG workshops held in Sekororo. The first workshop consisted of small-scale farmers from different irrigation schemes and researchers, while the second consisted of farmers from Sofaya irrigation scheme.

Farmers were able to relate to the board game representation to their reality and accepted the schematic representation of their reality. Firstly, the RBG demonstrated that role-playing can benefit understanding of top-tail inequities of water supply. Secondly, that solutions lie with communities, particularly if given support by formal institutions such as universities, research institutions, government and nongovernmental organisations (NGOs) willing to respond to their needs. The game has proved to be an effective discussion support tool that should be up-scaled to the Olifants river basin.

Key words: community resolution; conflict; irrigation; river basin game; water shortage.

1. Introduction

Improving scientific insights on the complexity of natural and social systems' fundamental interaction is essential for increasing the calibre of decisions in a river catchment. Games and role-playing which belong to participatory action research are steadily being used to explore management strategies and policy making for natural resources such as water (Barreteau *et al.*,

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2000, 2001; Farolfi *et al*., 2004). Games have also found themselves used as tools for conflict resolution and negotiation (Etienne, 2003) in sylvopastoral management planning and for collective awareness of reedbed wise use (Mathevet *et al.*, in preparation). In Ngnith village, Senegal, role games were employed to resolve conflict between farmers and herders in which farmers cultivated crops along the riverside and cattle had to cross the fields to access the river for drinking water (http://emergent.brynmawr.edu/emergent). Several games have been devised for the management of irrigated systems (Burton, 1989; Barreteau *et al.*, 2001). The objective of the River Basin Game (RBG) described here, is to achieve a common representation of the issues and constraints of water management by all water users. This common representation can then serve as a knowledge basis for mutual understanding followed by negotiation. Reaching a common representation can be achieved by different ways: opinion surveys of all users, information systems and creation of dialogue platforms, multimedia tools, a centralised information centre, used in Ukraine, and role games used in Tanzania (Barreteau *et al.*, 2001; Daré and Barreteau, 2003).

This paper focuses on the application of the River Basin Game (RBG) in Sekororo, South Africa, as a tool for water management training, negotiation/discussion support and problem identification with consequent research needs. The study consists in setting up an environment/scenario, rules and observing the outcomes. Some collaborative methods use role-playing games in negotiation (Ostrom, 1994; Heathcote, 1998). Strategies from literature to avoid conflicts involve improving networks by integrating local requirements and knowledge, setting appropriate institutional framework, clarifying the source of conflict such as insufficient water, mapping a society's context, exploring management failure and using research to assist the analysis of tension and conflict resolution.

2. BACKGROUND TO THE RIVER BASIN GAME

The game in this study was first developed as a teaching tool for students in 2000 at the University of East Anglia by Bruce Lankford (Lankford *et al.*, 2004). The game was introduced into Usangu in 2002 in Tanzania and Nigeria, in sub-catchments with irrigation, domestic, livestock and environmental users and yielded positive results. The RBG is a role-playing tool for promoting dialogue and decision-making over water resources where irrigation is present (Lankford *et al.*, 2004). A board is used to represent a catchment with a gradient and glass marbles to show upstream-downstream flow of water. The RBG is actually a virtual river basin on which it is possible to conduct experiments according to scenarios defined by its user(s). Players call upon their own experiences to discuss issues and do not need prior training but are able to follow the rules of the game. The game thus offers a better understanding of the complex behaviour of ecosystems and gives the opportunity to test the sensitivity of the consequences of a given set of collective rules with respect to a set of assumptions on individual behaviours. The detailed game explanation is found in Lankford *et al*, (2004).

The RBG was developed to understand how people coordinate their actions in an irrigated area to manage water and crop production. Experience shows that the main contribution of role-playing games, which enhances discussion among game session participants, is the way in which problems encountered in the field and known by each individual separately are translated into a common and collective knowledge. It also enables action research to contribute to the practical concerns of people in an immediate problematic situation. Thus the RBG has a dual commitment in action research; to study a system and to concurrently collaborate with members of the system in changing it to what is jointly regarded as a desirable new state. Satisfying these goals requires the active collaboration of researchers and local communities, and hence stresses the importance of co-learning as a primary aspect of the research process. This aspect is one of the thrusts of the on going Waternet project CP (PN17 & CN 133) in the Olifants river catchment and Limpopo Basin under activity 2.5 on training of farmers. It focuses on transforming people involved into researchers, too, based on the viewpoint that people learn best, and are more willingly apply what they have learned when they do it themselves. The advantage of action research is the social dimension - the research takes place in real-world situations, and aims to solve real problems. Finally, the initiating researcher, unlike in other disciplines, does not attempt to remain objective, but openly acknowledges their bias to the other participants. The RBG offers many challenges like gaming as a form of safe environment for conflict resolution, and problem identification in a river catchment (Lankford, 2006b; Lankford *et al.*, 2004).

3. CASE STUDY - THE RIVER BASIN GAME IN SEKORORO, OLIFANTS

The Olifants river basin is located between 2.5^o & 26.5^o South Latitude, between 28.5^o & 24.8^o East Longitude and altitude (300 – 2300m). The catchment area is 54,475 km^2, with mean annual rainfall of 630mm (DWAF, 2004). The study was conducted in the quaternary catchment, B72A with an area of 534 km^2 and rural population of about 50 000 people. The pilot area, Sekororo is located in the lower Olifants. A number of wildlife conservancies are located downstream of the catchment. The area experiences high spatial and temporal rainfall variability that leads to seasonal dry spells. Population growth and agricultural changes are inevitable, exerting pressure and competition on water supplies which prompts changes in water management, allocation, and use. Under agriculture sector, commercial, emerging and subsistence farmers exist. More than half of the area falls under the former homelands, where subsistence farming and small scale irrigation schemes are the main livelihood strategies. More than 80% of the population relies on agriculture as a life strategy in the Sekororo and Olifants as a whole.

With the various water usages in the catchment (drinking water, fishery, crop irrigation, energy, conservancy, and the need to satisfy in-stream flow requirements into Mozambique), water has to be shared among various actors who do not have the same objectives and priorities. Thus water sharing creates tension or conflicts more so when addressing the past imbalances in South Africa.

There is currently tension between the rural community and the commercial farmers. The community is sometimes not allowed to use water for irrigation in the river because it is committed to commercial farmers downstream. The commercial farmers argue that they are more important as they provide jobs and food to the country. On the other hand, recent government policies on Black empowerment encourage and support the emerging small scale farmers to ensure food security in the country.

4. METHODOLOGY

Pre-game preparation is very important and in this study it involved a 2-day workshop on training of the trainers by one of the co-authors (Lankford), participant selection of actual stakeholders and preparation of a catchment model of the surface elevation (See Fig 1). The scale model was constructed for the farmers/community to easily identify the position of their irrigation schemes in the area and other areas of importance such as the conservancy areas.

The game was played with a cross-sampled group of 27 small-scale emerging farmers first from different irrigation schemes followed by a workshop involving 25 small-scale farmers from the same irrigation scheme. The farmers were divided into upper, middle and lower groups during the game. Although later in the game, swapping of the advantageous and disadvantageous positions was done for each group to give players alternative viewpoints of water security (what it is like not to have water).

The game board comprises a single channel with off-takes positioned at intervals from main channel to form a tree branch. The water channels are painted blue and the fields are painted green. Other land outside the river and fields is painted brown (see Fig.2). The glass marbles are used to represent units of water and holes in the field to denote irrigation water requirement. Each release of marbles from the top represented seasonal flow in the river. The groundwater component was represented as an off-take channel from the stream to a sink, later connected to the irrigated field. The rational for this representation is that in the catchment there is extensive use of boreholes by commercial farmers who appear to little appreciate that the groundwater they are using is connected the surface water. Over-pumping of groundwater, leads to stream flow reduction. In addition some farmers abstract surface water to satisfy their permit requirements and also in addition use boreholes for irrigation. This results in the farmers abstracting far more water than they are allowed by their permits. The water users considered were irrigation, municipality and environment at the downstream end of the catchment. A review of the history of the catchment was done, chronicling the different phases in its development.

The four stages in the game were tested: wet and dry seasons and an increasing number and capacity of intakes to irrigation fields along the river; individual water-seeking strategies; individual money-seeking strategies and community-based resolutions. Each stage involved the group discussions and feedback within an allocated time frame. This aspect is important in the successful facilitation of the game to ensure that participants have enough time to discuss their concerns and propose as much as possible their local solutions to issues found in the catchment.

The farmers were asked to list problems they face in their area and to rank them. They also proposed solutions to the problems according to resources available to them. The game workshop also involved a visit to Sofaya Irrigation Scheme (110 farmers on 200 ha) which has a committee consisting of five men and four women, elected every three years. An evaluation questionnaire of the impacts of the game was issued to all the participants at the end of the game to assess their understanding of the game and any improvements they would like to see in the future games.

For a detailed methodology see Lankford *et al*, (2004) and Lankford, (2006a, b). The Fig 1 shows the surface elevation model of the quaternary catchments (B72 E, F, G and A) in the Olifants. The white tags show the names of irrigation schemes found in the area. The lines on the model are rivers.

5. RESULTS AND DISCUSSIONS

Prior to playing the river basin game (RBG) the community members briefly described their water and farming situation. They use water for domestic purposes (cooking, washing, livestock, cleaning, beer brewing, drinking, build houses, for irrigation etc). They identified irrigation as the largest consumer of water. Most farmers in the small scale irrigation schemes usually farm small plots (1-2 ha) and the land is community owned. During the dry season it is not easy to find water for them (in some cases it is even difficult to find it during the wet season). This creates uncertainty about their future livelihoods.

Water quality issues were also present. Increasing population, limited water and land resources causes more competition for water and land. Regarding the quality of the water, there is only a water treatment facility for a nearby Sekororo Hospital. People mostly rely on the groundwater for the domestic supply. According to analyses conducted by the DWAF officers, the groundwater is safe even though in some areas people prefer taking water directly from the polluted rivers instead of from the existing boreholes because the groundwater is brackish. People wash their cars and clothes in the rivers. Animals drink, graze and defecate in/around the watercourses and the polluted runoff from the villages is discharged into the rivers without purification, causing a potential health hazard.

Demonstration stage (phase1).
The facilitator demonstrated how the game is played and the rules of the game. By the end of this phase, players knew what the glass marbles represented, understood the difference between wet and dry seasons and were able to choose differing locations and technologies for water abstraction.

Water seeking strategies (phase 2).
In this phase the players tried to obtain the best plot in the game board in order to satisfy their individual needs. They were asked to be selfish in abstracting water from the river resulting in less efficient use of water in their fields while those downstream ended with little or no water. The farmers understood the value of an upstream location, and all of them tried to get the plots upstream. The facilitator demonstrated the principle of productivity returns to water; that a single unit of water released from a wet upstream area has a high value to those short of water downstream, and yet those upstream might not even realise the absence of this one unit of water. All the farmers were in accord with this interesting observation.

Money seeking strategies (phase 3).
In this phase the players tried to obtain the best plot in the game board in order to better satisfy their individual needs (this time in terms of money). They also recognized the relationship between the access to water and the access to money or livelihoods. The identified alternatives for survival under water shortage were:

- Apply for loans to cover a financial shortfall or to invest
- Work for those who receive enough water as cash labours.
- Withdraw money from savings/food from the previous crops.
- Sell livestock for survival.
- Hawking and selling small goods
- Leasing land in wet areas
- Migrate to big cities for employment
- Receive government handouts (chickens, food parcels, milk cattle, grants,)
- Dagga (*cannabis sativa*) trafficking
- Stealing
- Gambling
- Picking firewood, sand and gravel for sale

The last four options in the list indicated how a community can engage in illegal activities for survival and how unfriendly such actions are to society, the environment and the ecosystem. This is supported in literature that the poor communities aggravate environmental degradation as their livelihoods depend much on natural resources (Adaman and Devine, 2001; Rockström and Falkenmark, 2001).

Community based resolutions (phase 4).

During this phase the players shared the available water fairly and were considerate to each other in order get the maximum benefit for the community. This was achieved by properly adjusting the intakes so that everyone had a fairish share of the water. This phase was seen as being a very positive to approach water and its equity of access in a catchment.

Discussions on the game and its value

After the 4th phase, generic questions on how water is managed in the catchment were explored. The participants were divided into discussion groups shown in Table 1 for identifying water related problems faced by the community. Feedback sessions were done after the discussions. The questions and answers are shown in the sections below.

How does the game relate to your community?

The main ideas and thoughts to this question were: the game was viewed as an imperative tool on consensus building on equitable sharing of water especially with the widespread water shortage and competition in the Sekororo quaternary catchment. Secondly, the game revealed that water is not shared equally and selfish water use creates mistrust leading to hatred and fights. Thirdly, it created a sense of awareness in water management, water productivity and need for a management committee to resolve conflicts should they arise.

What does the game mean to the community?

For the farmers sharing water meant more production, survival and peace in the community. There were no discernible examples of efficient use of water in the area from the farmers as they were not free to visit other irrigation schemes and share experiences. This resulted from the lack of information/transparency for sharing water. However, it was agreed that water use efficiency by tail end farmers is high because of the little water they receive. However, they acknowledged impacts of not managing water that include conflicts and trap in poverty cycle.

Community water related problems

A list of the water related problems that the community was facing was complied. Each group shared the three most important ones (because of a lack of time to discuss them all) (see Table 1). The most important problems shown in Table 2 were selected by voting, with each participant given three votes to select their most pressing problems.

Through discourses, solutions to overcome the ranked problems were identified. The female farmers and male farmers worked on separate groups to elicit problems as viewed by different gender. The rest of the groups worked on the remaining problems. Table 2 shows the main identified problems and proposed solutions.

The improvement of water productivity by communities is envisaged through forming groups rather than have small patches of irrigation plots scattered all over, by growing high efficient crops for sell at the market, using tested/hybrid seeds for their crops, supplying nutrients to the soil, crop rotation, supplementary irrigation and protecting crops from diseases. This could be done by marrying appropriate local (mulching, organic farming) and outside technology to maximize productivity of available water.

Future river basin games
The community agreed that all the stakeholders should be represented in future games. This includes commercial, small-scale and emerging farmers, municipal managers, water managers, tribal leaders, pastors, research institutions, Department of Water Affairs and Forestry (DWAF), Provincial Government and NGOs. They indicated that the workshop helps them to improve their water management skills and should be an activity done regularly until the whole Olifants river basin is covered.

The outputs from the two workshops were that different stakeholders should interact dynamically in negotiation for the limited water allocation. Farmers cannot always get the water they need. When a water crisis situation arises, stakeholders have to start negotiating on the basis of their stated fair principles. The 'coming together' of the community empowered them to speak with one voice and to specify management ideas compatible with the values of the community. The water supply structures were to be renewed and strengthened for transparent communication, with the community involvement in all steps of water management to ensure equitable sharing of the available water for effective development of agriculture and improved rural livelihoods.

Improvements to the River Basin Game
The farmers were able to relate the game to their scheme very well on the second workshop in Sofaya irrigation scheme. However they noted that the way their scheme operates is different from that of the River Basin Game. In their scheme the first one to have access to irrigation water is the one downstream and the sequence increases up to the last upstream user. They defended this arrangement as a means of saving water and always keeping water in their night storage dam.

One of the game improvements suggested was to have storage in the stream to capture excess water and release it slowly later on in dry part of the season. The other improvement was on finding an optimal slope of the board to avoid excessive velocity of the marbles. The advice to be improved in facilitating the RBG was the need for translations to be coordinated and synchronised well with the pace of the game.

Evaluation of the River Basin Game
The farmers demonstrated a good understanding of the game and that it was important in their schemes. They agreed to use the new knowledge and to spread it to other farmers who were not present. More interesting was their realisation that small problems that they face could be resolved by themselves if they come together and share information without government help. Government help would be reserved for bigger and complex projects. They requested for more games in future with other irrigation schemes in the catchment. These findings mirror very closely the outcomes of the game playing in Tanzania.

An interesting testimony from the farmers was raised during our recent follow up workshop was that there was evidence that people have improved operation and maintenance of their irrigation schemes since the RBG was played.

The results from the evaluation questionnaire showed that the game can act as a tool for reducing water use conflicts because it has the capacity for role reversal between head-enders and tail-enders, and vice-versa, making it easier for the parties to reach a compromise thereby reducing water conflicts. It makes the users understand how water is allocated between up and downstream users. Bringing farmers together helped them to plan together, encourage transparency, thereby reducing conflicts.

6. CONCLUSIONS

The farmers acknowledged that the problems they were facing were created upstream but could not discern that because their irrigation schemes are far from each other. Nonetheless, conflicts are addressed when stakeholders are open to each other, share information such as quantity of water one is abstracting, and come together regularly. The participation of farmers at lowest level coupled with optimal institutional organisations such as irrigation committees supported by policies for water management remain paramount in preventing conflicts. With the transformation of irrigation boards to water user associations under way in the Sekororo quaternary catchment, the new associations still fall short of justice water allocation principles, methods and resources to improve water productivity to address the poor technical quality of the irrigation service, which is the main factor of conflicts. Hence there is dire need to strengthen their knowledge and organisation through such tools as the river basin game.

Our aim was to bring the farmers together to realise their problems in a different way and to demonstrate that the solutions exist within the local communities rather than with researchers who might know little about the area and community desires. Integrating local requirements, advices and expertises are recipes for conflict prevention. The farmers discovered the importance of doing things by themselves before seeking assistance from the government. The RBG workshop emphasised pro-active communities that would only approach the government when their resources cannot match the required project.

The use of the RBG in the two workshops produced interesting results. Players understood the RBG reasonably well, found ways to initiate discussion of their real systems through its use and conceived of the possibility of upscaling to whole river basin. The farmers had fun, which is a precondition of its playability. It was shown that this sort of game may reveal social relationships to the researchers and can be used as a new tool to investigate social relationships. In the RBG, farmers/players were placed in a virtual world where roles were allotted and rules defined. In this approach, a question arises: did players adhere to the rules given by the game or did they bring in their own reality? Although the answer is likely to be both, there is need to focus on a methodology to link between play and reality in conflict resolution processes.

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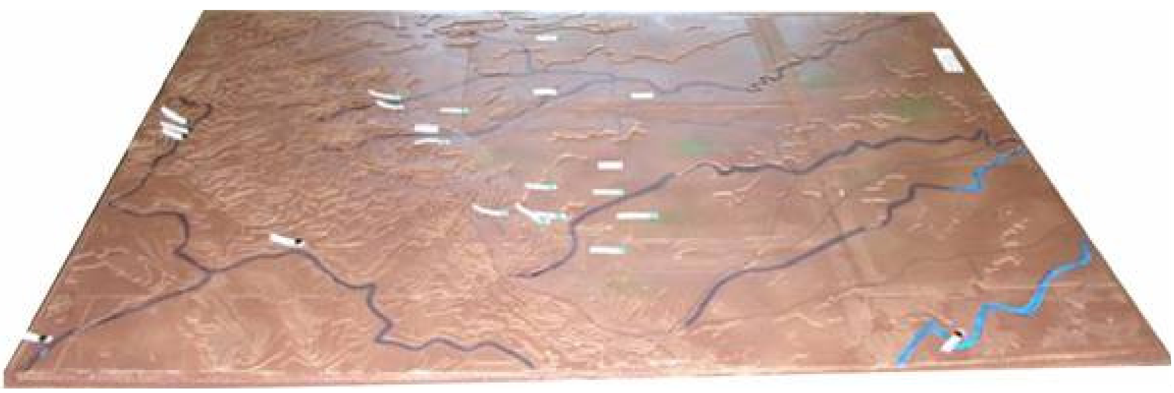

Figure 1. The surface elevation model for few quaternary catchments in Olifants.

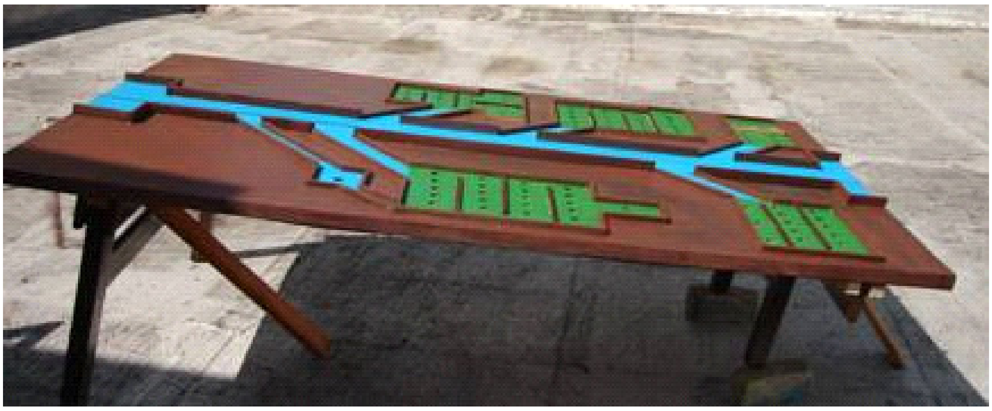

Figure 2. River Basin Game board model

Table 1. Water related problems from each group for the two workshops

Female farmers	• Pipes up in the mountain get washed away. • The Government provides pumps but not fuel to use those. • Some Government pipes are not functional. Rely on river resources.
Male farmers	• Lack of water – no job creation. • Diseases outbreaks. • Livestock mortality and low yields.
Community Leadership	• Committee skills, ownership and supervision. • Research with consultation – knowledge. • Unable to share water.
Student Group	• Lack of monitoring for domestic and irrigation use. • Lack of maintenance. • Lack of structure/authority for day to day water management
Senior Expert Group	• Lack of water for domestic use during the dry season. • Lack of planning for storage. • Lack of water and Land management institutions.
Other problems	• Perceptions of water quality (river vs. boreholes). • Rivalry between communities: sabotage and breakages of water pipes • Erosion and siltation: blocking pipes • Under utilized potential of land/water/people. • Building on agriculture based livelihoods.

Table 2. Solutions to the main identified problems in order of importance

Problems	Envisaged solutions
Some government pipes are not functional, people rely on river water resources	• Identify affected areas, families and costs. • Come together, contribute money for repairs. • Delegate a representative to speak to the government to carry out repairs. • Management and supervision of water supply system by a ward/village committee.
Committee skills, ownership and supervision.	• Training on how to manage water, finance and co-finance and supervision skills. • Awareness to target community ownership and responsibility.
Lack of planning for storage	• Task team elected (to plan flow from source, work with relevant consultants, where to build and size of storage, number of people supplied …) • Committee elected from all stakeholders to implement storage dams. Consult community for contribution and other aspects.
Lack of water, low crop yields, hence no job creation.	• Construct small dams/weirs in their plots. • Dams to be protected from livestock and children. • Local-level resource monitoring and evaluation with regular maintenance of infrastructures such as regular cleaning of furrows and irrigation intakes • Establish supervising committee and skills development. • Fair distribution through water user associations.
High livestock mortality	• Regular dipping, vaccination, and management of herd at pasture carrying capacity
Lack of land management institutions	• Strengthen existing water and land structures • Security of tenure and regulations that evolve and enforced locally (enforce the rights of community to manage their resources through granting legal recognition, can be changed by alterations in policy an institutional arrangements)
Rivalry between communities resulting in sabotage and breakages of water conveyances	• Encourage free discourse and transparency among water users, smallest social organisation above household. • Meet regularly to decide management issues • Conflict management arrangements in place
No markets to sell their produce	• Markets should be build in the village so that farmers can be able sell their produce.
Inputs suppliers are far away hence high transportation costs.	• Team up as a group to buy inputs • Have mobile input sale stations in the area towards rainy season
The extension officer is very busy and does not have time to organize training and workshops for them.	• Rely on NGOs and researchers in the area