

**From strangler to nourisher:  
How rice farmers turned a challenge into an opportunity and the possible lessons  
for agricultural innovations researchers.**

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**Introduction:**

Research and development work on rice in Kenya was until 1999 mandated to the National Irrigation (NIB) board which was the government agency in charge of irrigation schemes in the country. The board provided services at a cost charged on the farmers produce at the end of the season. These services included land preparation, supply of production inputs, infrastructure maintenance, water abstraction regulation and research and extension services (Nguyo et al 2002). In year 2000, the board's authority was challenged after a farmers' protest demonstration in the Mwea Rice irrigation scheme of Kenya which led to loss of lives and property (Daily Nation, 14,Oct 2000, Nguyo et al 2002, Kabutha and Muteero 2002,). Consequently, NIB stopped providing services to the scheme farmers who took over control of their rice cultivation. This also led to the emergence of 'out of scheme' rice cultivation in stream and river valley bottoms which were formerly infested with reeds and papyrus vegetation. Prior to the farmer protests, rice growing outside the scheme was illegal as per NIB by laws (GOK irrigation act 1967,ch 347, The People Daily September 14, 2000). Growing of rice in these niches marked the beginning of '*jua kali*' or "informal" rice system.

Cultivation of rice in this new system started with little or no available rice technical information apart from the farmers' assumption that their fields were suitable for rice cultivation due to availability of water in the swamps. They had no, no prior experience of rice cultivation and neither had NIB whose work was specifically focused on the formal rice irrigation scheme whose context was markedly different from this new niche.. There was therefore very little that was available to this new group of farmers and they had to try out practices acquired from the MRIS farmers, through direct contacts or via casual labourers and offering themselves as labourers in the scheme to gain experience. These practices did not always work in the new environment owing to differences in soil type and other contexts that were markedly different from those in the scheme.

The farmers adapted what they learnt from the rice scheme to their new niche through trial and error, and their own experiences which resulted in a thriving rice cultivation system .Some of the innovations were seed pre-treatment, field management and post harvest and marketing practices and farmer organization. In the midst of these experiences, an invasion by a waterweed *azolla spp* in the year 2000/2001 almost brought the farmers rice cultivation efforts to a halt. This weed was a new invader as it was not existent in the area prior to 1999 as indicated in weed survey conducted in 1999. Efforts by the farmers to control the weed by physical/manual removal were rendered futile owing to its rapid multiplication rate and no sooner had the weed been physically removed than more weeds would be found floating in the same plots in a few days time. The floating weeds would suffocate any trans-planted rice plants and this would lead to spindly growth and eventual death. A futile effort by the farmers to remove the weeds and the spindly growth likened by the farmers to the symptoms of the human disease AID and hence the name small AIDS of rice was given to the weed.

This paper describes the farmers experiences with this weed covering their perceptions on the source of the weeds, their experiences and later without any extension or research services how they used their own adaptive and innovative capacity to deal with it and the other rice production constraints. This is juxtaposed to conventional research approach when the researchers encountered the weed . The paper argues for the need by researchers to recognize and utilize farmers' innovative capacity as the initial building blocks to relevant technologies. It advocates for the researchers input to be for feeding ' local technical innovations by linking farmers with sources of new ideas to explore and options to test (Loevinsohn 1990). Introduction of completely new technologies should be discouraged as this mostly leads to a distancing by the farmers owing to lack of compatibility with the existing socio-technical regimes in the farmers environment. Through this approach the resultant technologies are more likely to be pertinent and appropriate to farmers' circumstances.

This study was conducted in 2003/2004 as part of a study on researcher-farmers information exchange mechanisms in the Kenyan public research sector using various researcher and farmer led activities in two KARI research centres as case studies. The '*jua kali*' rice system was selected for study as an emerging agricultural production innovation system. It provided a chance to study how farmers' innovations arise, how they are shared, enriched and improved as they are exchanged between and within farmers, operating in different contexts.

### **Literature review:**

Rural development in Africa has been constrained because change agents or development agents have been transferring external knowledge, without recognising the local knowledge and development initiatives of the farmers (Mbithi 1994, Van Veldhuizen 1998). This view has its roots in the development from above paradigm grounded in neoclassical economic theory and its spatial manifestation in the growth centre concept (Walter and Taylor 1981). The hypothesis is that development from a few sectoral or geographical clusters would trickle down to the rest of the system. (ibid). This is the basis of the transfer of technology model and its assumed roles of actors in the technology dissemination process where technologies are assumed to have an intrinsic characteristic associated with their superiority and hence their popularity and subsequent adoption ((Leeuwis 2002, Mbithi 1994). The model assumes that rural change is exclusively technological and all that is required is an emphasis on farmers' technical mastery of the physical environment to ensure success. This approach assumed that as farmers improved their level of farming technology, they gained control over their physical environment. An advanced set of rural social institutions, and behavior patterns were expected to emerge and any rural group that resisted this change was assumed to be socially backward. Technology was expected to change the society while it remained unchanged but this view has been challenged by fact that technology is normally not applied in a vacuum. Farming activities have been shown to be social activities and that at times technology tends to increase social problems rather than solving them and rejection of a technology is often a rejection of its social implications (Mbithi, 1994)

It is therefore essential to recognize that for effectiveness, interaction between local knowledge and development initiatives, and the initiatives of formal agricultural research and extension, on the other hand need to be fostered. In this context, men and women farmer innovators who take their own initiative to change local agriculture should be taken as key allies in agricultural development. The "inventive self-reliance" of small-scale farmers who continuously experiment, adapt and innovate has been well documented by Richards (1985)", Chambers *et al.* (1989) and other authors (Van Veldhuizen *et al.* 1998). These findings seem to add support to the development from below paradigm that argues for development to be based primarily on

maximum mobilisation of each area's natural, human and institutional resources and use of appropriate technology rather than highest technology (Walter and Taylor 1981).

The above view renders support to the fact that people operating in a given agro-ecological setting have a good sense of local risks and possibilities. They are able to judge appropriateness of new ideas through informal experiments, generation of new ideas and practices and adaptation of ideas of others to their own conditions (Prain and Fujisaka, 1998). Besides the fact that farmers are keen on appropriate information to help them solve their problems, they especially value information from others working under similar conditions. This is evident especially when farmers undertake exchange visits to other farmers or where they observe and later adapt what they see to fit their local contexts. Change agents such as extension agents therefore need to become more aware of local creativity, to be able to take on a role of stimulating it and this applies to scientists who need exposure to be able to conduct research that is relevant to the real world of farmers. Policy-makers on the other hand need such exposure, and access to convincing information from farmers and scientists working with them. It is also true that conditions for land husbandry are constantly changing; and therefore, innovation and joint learning must be a continuing process where innovation in this context includes both technical and institutional change (Leeuwis and van den Ban, 2002).

The process of innovation involves various stakeholders who generate, adopt and adapt novel ideas, approaches technologies or ways of organizing and builds farmers' capacity (Biggs 2004, Kaaria et al, 2004). This creates a sustained, collective capacity focused on improving livelihoods and the management of natural resources. This enhanced capacity for innovation benefits rural people to develop new technologies, products and markets and ways of organizing, as well as policies and institutional arrangements, which catalyze and enable innovativeness. The interaction of systems in the farmers environment is therefore critical for the successful adoption of any innovation, and understanding the system as a whole is important in order to effect changes (Dillon and Hardaker, 1993; Goncalves, 1995; Anandajayasekeram, 1996). A versatile approach to working with communities hinges on several related elements, such as farmer experimentation, social and human capital formation, access to information, leadership and entrepreneurship Extension and researchers in this play the role of "feeding" local innovation by linking farmers with sources of new ideas to explore and options to test (Loevinsohn, 1990).

By so doing they facilitate communication between farmers, who examine local innovations, discuss the advantages and disadvantages, and consider who would like to try them out.

A major handicap to the innovation process is the attitude of extension and researchers who assume rigid role of development and extension of new technologies while farmers are assumed to passive users of the same. This is a view that limits the actors and hence curtails the innovativeness that is expected in the agricultural production system characterised by changing circumstances. In participatory research approaches, constant exchange is expected between in order to continually come up with relevant and appropriate innovations which should not be limited to technical innovations but to social and institutional innovations. As stated by Haverkort *et al.*, 1991, and Van Veldhuizen *et al.*, (1998) enhancing farmer experimentation could help to develop site appropriate technology more quickly and in turn strengthen local capacities to adapt to new conditions.

## **Methodology:**

*Location of study:*

The study was conducted in Ndia division of Kirinyaga administrative district of Central province of Kenya. It covered six villages spread out in four locations Kariti, Kiini, Mwirua and Kangai locations. The study area was divided into three clusters based on different land ownership categories, labour sources and information flow systems. The clusters were East Kagio, North East Baricho and South West Baricho.

East Kagio cluster consisted of farmers who hire land and others who own the land on which they grow the rice. The farmers in this cluster have frequent interaction with farmers from the neighbouring Mwea Division due to their proximity. They hire casual labourers from the Mwea irrigation scheme for tasks such as transplanting, weeding and threshing.

North East Baricho cluster consisted of farmers who own the land and their rice cultivation is informed by information from outside the cluster but also generate most of the knowledge from their own experiences.

South West Baricho cluster consisted of farmers who own the land and generate a lot of information from own experiments. Unlike in the previous two clusters, the farmers in this cluster do not use hired labour.

#### *Sample size and study approach*

A total of 92 farmers were interviewed in the three clusters through individual farmer interviews, key informant interviews, focus group discussions and observations.

##### *i) Individual farmer interviews*

Farmers in the three clusters were interviewed as they worked in their fields in order to discuss issues that were taking place at that particular time. This allowed the detailed examination of various issues and identification of farmers to be involved in focus group discussions.

##### *ii) Key informant interviews*

These involved individuals who were key players in rice cultivation. They included rice traders, agro-input suppliers, middlemen, group leaders, area extension agents, and researchers from the NIB rice research sub station.

##### *iii) Focus group discussions*

These involved six to eight farmers who were selected on the basis of their experience in certain aspects of the rice cultivation as mentioned by other farmers. To confirm such claims, their rice crop was observed in the field. Such farmers were convened and discussions were held using a checklist. Four focus group discussions were held involving 28 farmers.

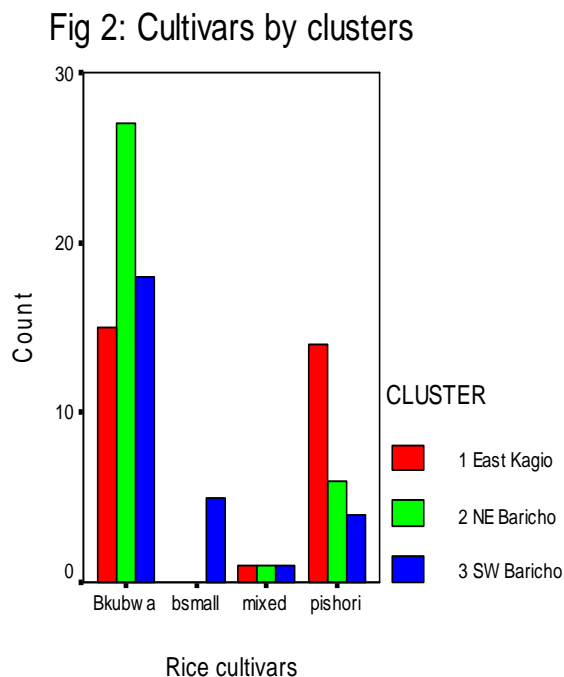
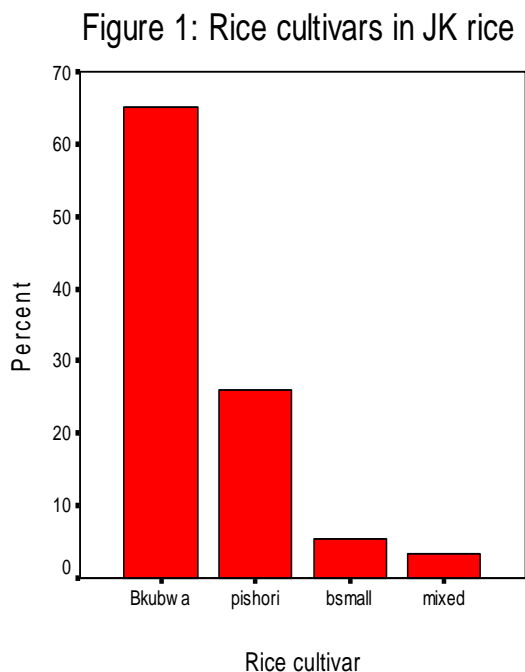
## **Findings and discussions**

### *Rice cultural practices:*

#### *Cultivars*

The main rice varieties grown in this area are IR 2793 commonly called 'small B' by the farmers, Sindano BW 196 commonly called *Bkubwa* (Big B). and Basmati popularly called '*pishori*'. A few of the interviewed farmers mixed the varieties (fig 1) The farmers started by growing variety IR 2793 or small B whose performance was initially good but deteriorated after a few seasons to an extent where at the time of this study, only a few farmers in one cluster were growing this

variety (fig 2). The deterioration was manifested in yellowing and blotching of the rice foliage and poor grain setting.. Based on these observations, farmers in all the clusters changed to variety *Bkubwa* (*big B*) and Basmati, which continued performing well on the low fertility soils.



*Land preparation*

Preparation of land for rice growing involves clearing of reeds and the other water loving plants from the identified spot in the valley. Following clearing, the land, hoe digging is done to remove all the reed and other vegetation roots. According to the farmers this is hard work because of the wet and muddy conditions. ‘Polder’ like structures called ‘*kipande*’ (piece) which measure ten by ten metres (fig i) are constructed by heaping soil clods on the sides of

*Fig i : Rice polders showing raised embankments*



demarcated pieces. The embankments serve as water reservoirs and as drainage structures. One corner of the field is identified for locating the nursery. This location is identifiable as a

yellow patch amidst green rice (fig ii ). In some cases the nursery is established outside the polder.

*Fig ii: Yellow spot showing nursery site*



#### *Nursery preparation*

The size of the nursery varies depending on the available land for transplanting and also on the amount of seed available. The identified nursery site is dug into a fine tilth and goat or chicken manure when available is mixed ashes. According to the farmers, these two manures are the most appropriate since cattle manure is too coarse for the ‘seedlings’. Fertilizers are also inappropriate at this stage because of a believe that *‘the fragile seedlings will be ‘burnt’* (scorched) by the fertilizer. The mixture is then incorporated into the nursery and pre-germinated seeds are spread out on the surface and covered with dry vegetation matter.

#### *Pre-germination and nursery planting*

Rice seeds are pre-germinated before seeding in nurseries where three methods are used. They include soaking seeds in water, packing them in a sisal bag and burying them in a hole on top of which a fire is lit to provide warmth. The hole is uncovered on the second day and the bag turned to allow for even germination. Burying of seeds in manure heaps is also practiced while covering of rice seeds in rice straw heaps. Farmers’ alternate between these practices based on their experiences with each. According to interviews with former rice extension agents, pre germination is supposed to be done by soaking seeds in water for 24 hours and then covering them in rice straw for 48 hours. The temperature in the rice straw is adequate for germination. According to one interviewed farmer using the hole method, *‘the method that I use gives me very good results and is faster due to the fire. I have also heard about burying in rice straw but temperatures in this area are very low at night and may interfere with the germination’* (farmer interviews 2004) After planting in the nursery the seeds take a month to be ready for transplanting in the polders described above.

#### *Fertilization and pest control:*

Diammonium fertilizer is applied after transplanting while some farmers apply Urea fertilizer. The quantities applied are based on the number of pieces. In every *‘kipande’* a kilogramme of fertilizer is applied. The farmers mentioned several pests that destroy the rice with the major ones being leaf cutting pests and stalk borers. The leaf cutters are very conspicuous due to pieces of leaves floating on the water surface which the farmers use to scout for damage. On

noticing this, they spray various pesticides. According to some farmers “*use of pesticides has also led to elimination of many water borne insects which we see floating on water after every spray. As a result we do not suffer insect bites when our legs are immersed in water like used to happen before*” (farmer interviews 2004)

The level of irrigation water at this stage is very crucial. This is due to the water weed ‘*azolla*’ whose origin is still a mystery to the farmers. The weed named by the farmers ‘rice AIDS’ stifles transplanted rice if the water level rises to the top of the seedlings. Initially the farmers used to spend endless efforts in trying to sweep the rice fields clean but the weed would resurface within a short time.

A weed scientist who observed the luxuriant *azolla* weed growth reported it in the weed science meeting following which an agro-chemical firms supplied some three herbicides for trial. This effort was rendered futile by the rapid weed re-growth besides the complexity of the herbicide technology to resource poor farmers who had already lost their support from the irrigation board (personal communication 2004). According to literature, *Azolla* doubles in biomass every 3 to 5 days under optimal conditions (Ventura and Watanabe, 1993) and completely crowds out any other vegetation by shading it out.

#### *Harvesting and marketing:*

Harvesting takes place three to four months after transplanting depending on the variety. The rice plants are slashed with a sickle and tied into bunches. These bunches are then threshed by hitting them on the ground and the paddy collected into bags. According to the farmers this is a tricky period for those who grow short varieties which requires sticks unlike tall varieties where sticks are unnecessary. The rice is either sold to middlemen or traders in the nearby Kagio shopping centre. Depending on the farmer’s financial position at the beginning of the season, sale of the crop may take place at the vegetative stage or earlier in a contract arrangement of some sorts. This is an arrangement where the farmer enters into an agreement with the broker. The broker advances the farmer money using the crop in the field as collateral. On harvesting, the broker collects rice worth his money and the farmer is left with the rest. Out of the interviewed farmers, 45% were found to have entered into agreement with brokers in the last three seasons while 35% sold their rice to traders in the market. 15% kept their rice and waited for the crop to appreciate in price.

#### *Rice fodder:*

In the course of exploring rice varieties, farmers encountered non booting types which they used these types for feeding their dairy cows resulting to increase in milk yields and improved body condition of the animals. According to 10% of farmers interviewed, rice in the vegetative stages is very good fodder for animals. After harvesting, there are times when the rice stubble is left in the field and ratoons develop and form good fodder for the animals. In one case, a farmer left his ready for drying off animal to graze on the ratooning crop and in his own words ‘*an increase of three bottles of milk left me undecided whether to dry it out or not.*’ (Farmer in/view 2004). This led to the discovery that green rice plants are good for dairy cows. Fodder and animal nutrition specialists explained that this is due to the abundant proteins and other nutrients at this stage of crop growth (researcher interview 2004). Farmers from out of the rice growing area have also been buying rice straw to use as fodder for their animals.

#### *Rice mulch:*

The farmers in this area grow French beans and various types of export vegetables. This was found to be the case with 80% of the farmers interviewed. Mulching using rice straw by 35% of these farmers reduced irrigation frequency of horticultural crops by 50% from four to two days per week.

*Azolla infestation:*

At the beginning of 2000 farmers noticed a waterweed in their rice plots floating on the water. The weed soon formed dense mats on the water surface and the new invader choked any rice that was submerged in the water. Farmers' efforts to remove it were thwarted by the rapid growth of the weed but soon noticed that weeds that remained below the rice plants did not interfere with the crop. This led to the discovery that by controlling the water level at transplanting time, the weed co-existed with the rice seedlings with no adverse effect on yields. The farmers soon also discovered that the weed makes rich compost for horticultural crops and also conserves moisture. This was through the farmers weed collection effort when they noticed healthy growth of plants growing where the decomposing weed was heaped. After this observation, the compost was utilized for mulching of kales with favourable results (fig iii). At weeding time, *azolla* buried in the rice plots was also found to result to vigorous rice crop.

*Fig iii: Composted Azolla applied in kales and mulched with rice stubble*



Fig 3: Weed source perception

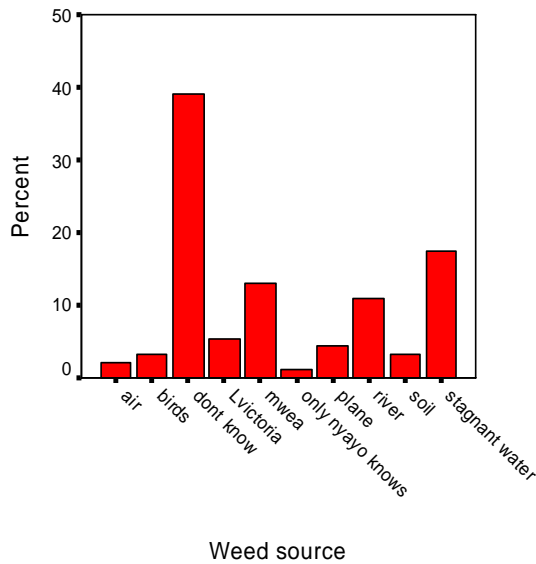
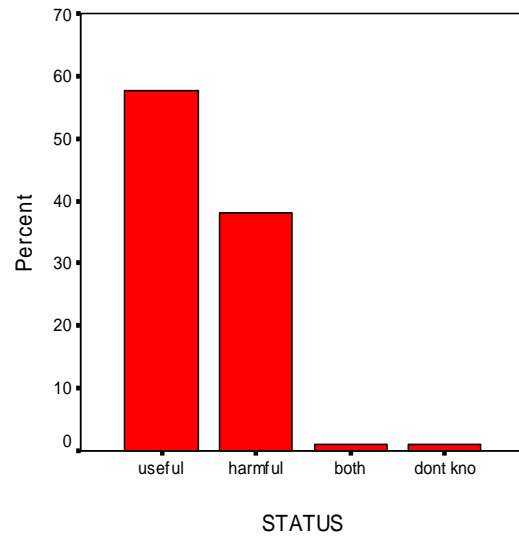


Fig 4: Weed status perception



*Information sources:*

Farmers gathered information from various sources. 30% of the interviewed farmers got their information from hired labourers. This was especially information on, nursery establishment, transplanting and threshing. 10% of the farmers got their information from offering their labour to experienced farmers while 15% got the information after trying and then comparing with their neighbours (fig 5 and 6). In all cases however, a lot of information used by the farmers came from their own experiences. Farmer to farmer information flow was a key mechanism of information flow using local rice growing support groups based on their social-cultural organizations. The elderly farmers played key moderating positions in the groups. The young and middle aged farmers in the groups scouted for new information from outside their immediate areas and were in most cases also the first ones to experiment with new ideas on their farms.

Figure 5: Rice information source

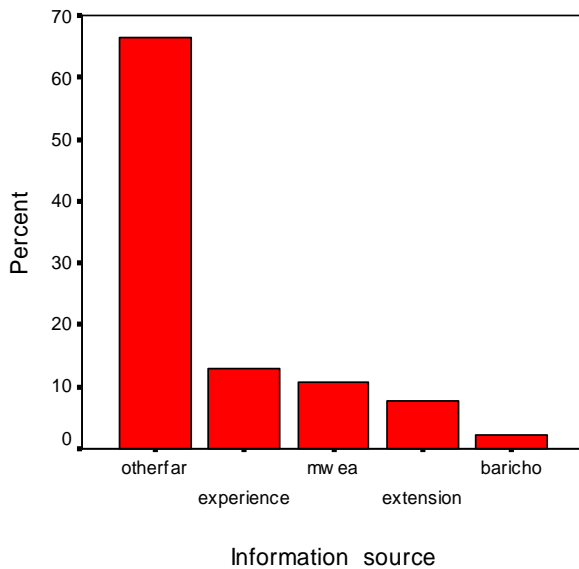
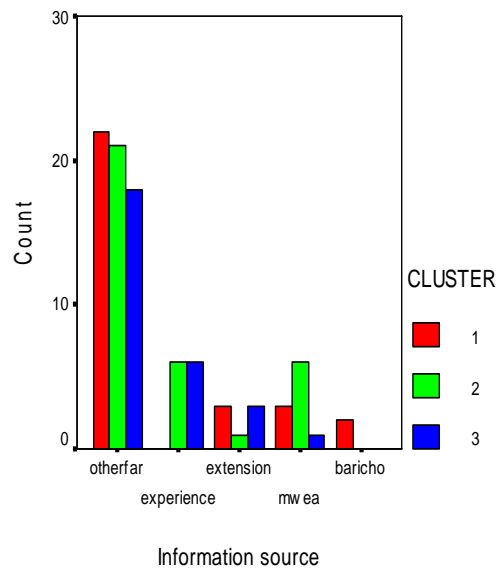


Fig 6: Info source by cluster



### Discussion

Biggs and Maetsart (2004) supported by Douthwaite (2002) hold the view that successful innovation systems are those where institutions facilitate flows of information in a bazaar approach and good partnership coalitions between key actors over time. In the system studied, a number of lessons that are ignored by participatory researchers are learnt. These have to do with the flow of information between the farmers leading to wide spread utilization of technical innovations that were not available at the beginning of this rice cultivation. This happens despite the researchers stereotype that farmers are ignorant and have to be trained for them to improve agricultural production. A lot of decisions that farmers make are based on many years of careful observations and farmer research as documented by Stolzenbach (1994), (1997). The research takes the form described as ‘adaptive performance’ by Richards (1993) or ‘move testing’ experiments whose research design shifts during experimentation depending on the farmers’ perception of his/her best options. This is clearly demonstrated by the ‘*jua kali*’ rice farmers’ observations and decision to switch varieties based on poor performance due to either to soil type, season or variety. Another example is the observation on *azolla* where farmers discovered the water level control technique. This agrees with Biggs and Clay (1981) and Reece and Sumberg (2003) who argue that farmers will innovate within the limits of their technical capacity to solve problems of simultaneous adaptation to fine-tune it in an attempt to fit it into their own physical and socioeconomic aspects of an environment. Interviews with a rice breeder condemned the farmers poor yields brought about by poor agronomic practices and poor variety selection. The farmers however have converted the poor yielding rice into fodder that improves their livestock. Another interview with a weed scientist revealed that herbicides were tried on the weed with dismal performance. Farmer experiments are clearly demonstrated in this activity where farmers associated vigorous plant growth with nourishing plant nutrients from the *azolla* confirming what Ventura and Watanabe (1993) and Galal (1997) have documented. At the end, the farmers acquired food and cash from areas that were otherwise unsuitable for crop growth. This is in agreement with Clay 1987 who state that technologies employed by resource poor farmers depend upon their

immediate environments and hence the technology is systemic in relation to physical environment. The synergy hypothesis advanced by Sumberg and Okali 1987 advocates for drawing on multiple sources of innovation model. This is due to the realization that farmers have an intimate knowledge of their local environment, conditions, problems priorities and criteria for evaluation. This knowledge is out of reach by outsiders and the same applies to results of formal agricultural research often inaccessible or inappropriate for poor farmers. This paper concurs with Bebbington *et al.*(1994) that investments have to be made in local farmers associations and innovation capacity if research organizations are intent on being client rather than research driven.. This is further emphasised by Collinson (2001) who states that traditional applied agricultural experimentation promotes allegiance to commodities and disciplines thus slowing progress in improving relevance of research output to smallholders. Using farmers' experiments as a basis for collegial relationship between farmers and researchers, may lead to accruing of benefits to both the farmers and the formal research system. This still remains a challenge as stated by Thiele et al (2001) that both conventional and participatory research are complementary should where good participatory research should improve the relevance of conventional research, and good participatory research without strong conventional research to back it up will not be effective (Thiele et al 2001). Organizational and managerial problems are often encountered in trying to operationalize end user participation with an emphasis on the identification and dissemination of 'successful' examples and 'best practice' (Van Veldhuizen et al. 1997, Sumberg et al, 2003). Other factors such as falling budgets have encouraged outmoded research paradigms and organisational forms while Western curricula based university education has failed to come to grips with the needs of professionals destined to work with small scale farmers (Pardey and Roseboom, (1989), Anandajayasekeram and Stilwell 1998). In spite of all these constraining factors for recognition of farmer innovation capacity, many researchers are determined to recognise participatory research where farmer innovation capacity is given place and experiences like the informal rice cultivation documented here provide examples of innovation systems that can form the spring boards of successful participatory research.

### **Conclusions and way forward**

With the changing farmer and research environment, it is important for both farmers and researchers to place emphasis should be on changing roles and attitudes aimed towards encouraging dialogue between them. There is need to move away from fragmented and more academic content towards a more logically compiled whole, and away from lecturing towards facilitating processes. As has been documented, farmers have been known to innovate because they have resources and can take risks, or because they do not have resources and are forced to look for new ways of doing things (Chambers et al 1989). They can be young with some formal education, or old without any formal education, or old without and include both men and women. Farmers may innovate if they were used to a certain way of doing things and circumstances have forced them to survive. In the context of this study, the innovating farmers were of mixed education levels and resource endowment. It is apparent that this did not prevent them from being innovative. It is necessary for any change agent to take these issues into consideration when introducing any new innovation into an area. It is also important to consider the uses that the information is put into. In the case of the rice innovation, farmers have put it into various and especially as food and cash income source. The valley bottoms have also become useful according to the farmers. Azolla is not only providing nutrients to the rice crop but also to other crops in the farmers cropping system.

Rice fodder is being used for livestock feed as well as a water reducing technology when used as mulch. All these added uses make the innovation more appealing.

Through the advent of this innovation, new systems of organizing have also been developed by the farmers and are used not only to discuss rice cultivation issues but other issues. Unlike what extensionists and researchers have always believed, farmers meet early in the mornings so that they may have time to attend to other issues in their wide repertoire of chores.

This paper argues that researchers in research organizations who are intent on improving or increasing the impact of their work with farmers have to recognize farmers' propensity for innovation. This arises out of the farmers' lived experience of situations that they encounter every day in their fields. The researchers have to understand the farmers' practices and their genesis before introducing new practices and assuming that they will work as may have happened elsewhere. Furthermore, researchers need to recognize farmers' social organizational innovations or any other innovations that may go a long way in supporting any new technical innovation introduced to them. Finally, it emerges from this account that the statistically analysable technical observations that researchers mostly focus on may not be the only data that should be collected. There is need to "make in-roads" or "poke holes" through the confines of the statistically analysable data. This is owing to the fact that a lot of what the farmers experience as they deal with the intractable farming problems may not only be solved by "stand alone technical innovations". These are issues that need to be embraced if participatory research efforts being made by many research organizations are to bear any fruit and may not happen without institutional changes in the management and policies governing formal sector research and development to encourage a paradigm shift, to build new partnerships and to avoid business-as-usual

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