Moving Towards A New Research Paradigm for Myanmar: Community-based Natural Resource Management

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ABSTRACT

With agriculture as the prime mover of Myanmar's national economic development, agriculture intensification had affected the farm population and the natural resource base. For years, agricultural researches had been addressed through the traditional commodity and farming systems research approach. However, to answer a wider problems of environmental and resource degradation, new approaches that extend beyond the crop and the farmers' field have been employed. Hence, a new research paradigm focusing on a more collective, inter-disciplinary, community-level resource management was implemented in Myanmar.

A community-based natural resource management research was established in three pilot sites in Myanmar, each representing a different ecosystem. Initially, a team of researchers conducted a Participatory Rural Appraisal (PRA) to gather information on the natural resource issues and problems. Several research issues were identified and research studies were conducted through farmers' participatory trials and community activities. Research results and experiences are presented.

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I. INTRODUCTION

The agriculture sector is the backbone of the Myanmar's economy. In 1996, agricultural production accounted for 55% of its total GDP and employed 64% of the country's labor force. About 46% of the country's total exports were contributed by the agriculture sector.

Rice is the main staple food of the people and grown to more than 5 M hectares which is about 55% of the total cropped area. The Government of Myanmar (GOM) declared rice as the national crop and had taken concerted efforts to boost its production. Rice production accounts for 34% of the gross domestic product, 47% of the total agricultural export, employs 40% of the total labor force, utilizes 95% of the total available commercial fertilizers, and receives 85% of total farm credit.

Agriculture will continue to be the prime mover of Myanmar's national economic development. Since the shift of the Myanmar economy from socialism to market-oriented system in 1988, growths in many sectors of the economy exceeded government targets. Nevertheless, the agricultural sector will always play the most important role in achieving national objectives, i.e., domestic self-sufficiency in food requirements, adequate production of raw materials for local agro-based industries, and the generation of surplus production for exports.

The intensification of agriculture, on the other hand, has started to affect the farm population and the resource base on which it depends. For example, opening new land frontiers have caused extensive pressure on existing forest areas and swamplands, which threatens the environmental and ecological condition of the Shan uplands and the lowlands of the Dry Zone and the Ayeyarwardy Delta.

In developing the agriculture sector, the need to minimize the problems of environmental degradation had been increasingly recognized. Whereas, problems in the agriculture sector had always been addressed through traditional commodity and farming systems research techniques, new approaches have to be employed to address the wider problems of environmental and resource degradation. Hence, the research focus needs to be extended beyond the crop and the farmers' field towards a more collective, multi-disciplinary, participatory approach and a community-level resource management. Following this new research approach the International Development Research Center (IDRC), the Myanma Agriculture Service (MAS) and the International Rice Research Institute (IRRI) implemented a Community-Based Natural Resource Management (CBNRM) project from 1997-2000. It looked at the most important natural resource

problems and issues facing the rural communities in the country's different agroecosystems.

II. OBJECTIVES

Using the participatory and community-based natural resource management research approach, the objectives of the project were the following:

1. To characterize and analyze the important community-based natural resource management issues in the rainfed upland, rainfed lowland and irrigated lowland rice agroecosystems;
2. To test and evaluate farming systems innovations that increase income and/or yield on a sustainable basis;
3. Strengthen the capacity of local partners to undertake CBNRM research.

III. PROJECT IMPLEMENTATION

The implementation approach in this project is quite different from the former research activities. Traditionally, identification of research issues and design of experiments were solely decided by researchers and research administrators with very minimal participation, or none at all, from farmers or the community. With this new research paradigm, the project has the following features, namely: (a) it is a community-based activity, (b) participatory in nature where research issues and experimental designs were developed together with farmers or the community, and (c) a team approach in solving problems where researchers, extension workers and administrators actively participated.

A. Project Site Selection

Three pilot sites, each representing a different rice ecosystem, were identified to serve as field laboratories for applying CBNRM approaches to research and development. The three project sites were: (1) Myay Char village at Kalaw, Shan State representing the hilly upland rice ecosystems, (2) Ta Yet Pin village at Tatkon, Mandalay Division representing the low-rainfall rainfed lowland rice ecosystem, and (3) Ah Kyaw village at Danubyu, Ayeyarwardy Division representing the irrigated lowland rice ecosystems where intensive rice cultivation is practiced. These sites are the typical representatives of the different ecosystems in Myanmar.

For effective field implementation, the respective village tract managers (extension personnel) for each of the sites were selected to serve as site technicians for the project. They are part of the team that implements the project activities.

A team composed of researchers and extension workers was organized and conducted a Participatory Rural Appraisal in the three pilot sites. The primary objective of the PRA was to identify the production problems confronting the farmers and research

issues that can be addressed by on-farm trials. Researchers and extension workers discussed the identified problems and on-farm researches to be conducted. The PRA results also provided an initial picture of the major environmental, sustainability and CBNRM issues on each of the three rice ecosystems.

B. Training of researchers and extension workers

With CBNRM as a new concept and approach to agricultural research, there was an urgent need to familiarize the researchers and extension workers on this new paradigm. The men and women who shared the responsibilities in implementing the project underwent a 2-week training course Community-based Natural Resource Management before the start of project implementation. This ensures an effective implementation of the project.

The course focused on the biophysical, socio-cultural-insitutional, and economic concepts/issues governing CBNRM as well as the research methods of participatory rural appraisal (PRA) that are important in understanding these new concepts/issues. Topics covered were PRA techniques, farmers' participatory research, natural resource economic concepts, and institutional analysis and design principles. It also included a four-day field practicum at Ah Kyaw village (Danubyu township), which is one of the project sites.

C. On-Farm Farmers' Participatory Experiments

To address the specific research issues, farmers' participatory on-farm trials were conducted in the three pilot sites. The experiments were developed through a series of meetings and dialogue with farmers, researchers, and extension workers. Farmers were involved in identifying the major problem and in planning for the experiments. With the participatory approach, farmer's involvement in the design and implementation of the experiments played a vital role. The management of the experiments and data collection was done both by the farmers and extension worker. Data were analyzed using results from each farmer's field as replicates. Six to ten farmers participated in each experiment.

Furthermore, community activities in the villages were organized to address problems that can be better solved through group action. Some of these activities were community tree planting to address dwindling fuelwood supply and construction of mini-dams for irrigation and to solve flooding problems.

D. Planning Workshops and Farmers' Meeting

Regular workshop meetings before every season planting were conducted for proper planning of the detailed activities. It was participated by senior researchers and administrators from the Central Agricultural Research Institute (CARI) and extension workers from the Myanma Agriculture Service (MAS). Planned activities, which were initially discussed and consulted with farmers, were presented. In addition, research results of the previous season were presented in these meetings. These results were also presented in farmers' meetings to provide research result information and solicit their reaction.

IV. RESULTS AND DISCUSSIONS

A. Analysis of the Community-Managed Common-Property Resources in the Three Project Sites

The problem faced in many Common Property Resources was on how to coordinate the community of users so that the resource can be used efficiently and sustainably. These called for community management that required cooperation and collective action on the part of the users. Without coordination, the community of users tended to use the resource too much or too fast. Hence, collective consumption required some restraint among the users to assure that the resource base will be able to regenerate itself before it be extracted again.

There were four common-property resources utilized jointly in the three pilot village communities, namely: a) the common lands; b) grazing land; c) forest area for fuelwood; and d) water for irrigation.

1. Common Lands

a. Hilly Upland Site

The Common Lands (*Bon Myay)* in the upland are centuries-old common agricultural lands in the traditional Shan State villages. They originated as land gifts appropriated by Shan kings during the reign of the monarchs to the villagers. Cultivation of the common lands suggested an interesting common-property resource management in terms of land use since it possessed both private and communal features. For example, since common fields were highly divisible, management of parcels during crop production became entirely on a private basis. On the other hand, once the standing crops (upland rice potato, ginger, taro and niger) were harvested, the fields were utilized as communal pasture and grazing lands for the village draught animals hence it ceased to be a private holding.

The operational rules for managing the common fields of the *Bon Myay* governing seasonal decision-making of the co-owners were as follows:

a. The common lands can be accessed on a first-come-first-served basis.
b. Rotational use of the common land among cultivators.
c. After a cropping cycle, a co-owner request for the use of a parcel from the previous user which was purely bilateral in nature.
d. For a previous user who wished to continue to cultivate the same parcel for the next cropping cycle needed to demonstrate his intention to other users.
e. When rain comes and the previous user does not start work on his parcel immediately, another user can request for the use of that parcel given the permission of the previous user.

The effective management of the *Bon Myay* relied entirely on several factors namely: a) the community's mutual respect of access rights; b) strong community identity and social pressure from peers; and c) collective responsibility and concern on the welfare of the co-owners and the resource likewise. The observed reluctance

of the villagers to incur the disfavor of their peers, especially the members of the village SPDC, was usually enough to keep violations of the customary rules governing the common lands at a manageable level.

b. Rainfed Lowland Site

Common land (or "*Kobine*"as called in the rainfed lowland) originated from a secondary growth forest used as fuelwood source and was formerly used as common grazing land for the village animals. In the early 80's, farmers encroached upon the "*kobine*" with adjacent farms from nearby lowland. Farmers cut the trees and cleared the land to cultivate upland crops like chili and peanut during the wet season. At present, all the lands in the kobine are privatized and owned by approximately 20 farmers who also own lands downslope. The government granted the *Kobine* farmers legal titles to the lands they cleared and cropped.

Since the *Kobine* ceased to be a common property, the elder farmers in the village narrated the rules that existed when the *Kobine* was still used as a common property and how it evolved into a private property. *Kobine* lands were privatized through individual encroachment in the forest area. Although the State deemed that the *Kobine* lands were common property, the rule was enforced arbitrarily that lead to the privatization of the *Kobine*. Successful encroachment in the *Kobine* depended on the access position of the individual farmer. Although villagers of differing access positions encroached in the *Kobine*, most of them who successfully gained lands were farmers who owned adjacent farmlands in the nearby lowland. Since the forestland of the Kobine was very near to their farmlands, it was easy for them to extend the boundary of their fields. Farmers with small and large landholdings were observed to cultivate in the *Kobine*.

Competition rather than cooperation was the dominant relationship that took place in the clearing of the *kobine*. The intensity of competition among users depended on how fast an encroacher can clear the forest and crop the land. The rule for access is on a first-come-first-served basis. An individual farmer normally marked the area he wished to clear. However, due to the large number of farmers seeking access to the *Kobine* lands, the farmers were able to stake ownership from one acre to a maximum of 1.25 hectare per lot. Farmers with more facilities and equipment to clear the land were the ones that were able to get bigger share of the *Kobine* lands.

c. Irrigated Lowland Site

There is a 25-hectare common property area where the villagers cultivate the land on a first-come-first-served basis. These areas are topographically low lying and are submerged underwater during monsoon season. The traditional crop grown is "*muyin*" or deepwater rice. On the onset of the monsoon season (June to July), water starts to build up and flooding occurs until September. When the water recedes in October, "*muyin*" rice is planted and normally harvested in February or March. After *muyin* rice is harvested, all of the *Bon Myay* areas become grazing grounds for the village animals.

Since there are very few farmers involved in the cultivation of the *Bon Myay* and the *Kobine*, management of these lands was relatively easy. As a result, there were no explicit rules that evolved regarding use of these lands. Institutional arrangements among users were kept to a minimum involving only the borrowing of land by the landless from the *kobine* owners.

However, there is one important effect of the summer rice technology on the institutional arrangement in the *Kobine*. Before the adaption of the summer rice (dry season) technology in the area, landless households borrow the *kobine* lands from its owners and plant "*muyin*" or deepwater rice. Now, the *kobine* owners are using the lands to plant summer rice. This has a large implication on the access of the *kobine* lands to the landless households and on their income generating activities.

2. Grazing Lands

The agricultural production system heavily relies on animal power for land preparation such almost all farmers have cattle or bullocks. The presence of grazing lands and availability of animal feed is a very important component in crop production.

After most of the rainfed crops are harvested in December and January, large areas of rice stubbles and crop residues become available for grazing in the private lands and *Bon Myay* fields. During the summer months, the cattle herders exercised their customary right to graze their animals on these fallow lands. However, since the rice stubbles left in the fields were normally very short, the cattle herders seldom bring their herds in the fallow fields. Besides, fodder grasses are always available in the rangeland and open grazing land such that most of the grazing occurs in these two sources. The village grazing land, therefore, can be categorized into two types: a) year-round grazing in the rangeland along the hills, road verges and open grazing land; and b) the stubble area available after the crop harvest. During the crop-growing season when the animals grazed near standing crops, herding in the grazing lands or tethering in homelots prevents risk of crop damage.

A major problem for cattle herders is the decreasing area of the grazing land due to agricultural expansion and privatization of the traditional grazing grounds. The introduction of high-valued crops (i.e. potato, ginger, taro, beans) had reduced the open grazing lands due to the cultivation of the common lands. A possible solution to the fodder problem is to cultivate pasture grasses and other fodder trees that can be managed communally by the animal owners and herders. Initial discussions with the community indicated their willingness to participate in such activities that will be beneficial to the village animal husbandry system.

3. Common forest land

The common forest is the major source of fuelwood by the villagers. Residents from the different far away villages cut and collect fuelwoods from this forest. Peak collection is usually on December and January coinciding the off-farm season. About

80% of the fuelwood consumed by residents are collected from this forest. They collect the fuelwood using bullock cart. The remaining 20% of their fuelwood are collected near the village from the trees and bushes scattered in the field. Fuelwood collection is done all year round.

No written rules and regulations governed the use the fuel wood from the common forest area. The villagers, especially farmers, usually collect fuel wood during the dry season, which is an off-farm season. This allows tree regrowth during the rainy season. On the other hand, there are some rules regarding the cutting of trees in the timber forest which is enforced by the Forest Department. Hardwood can not be cut. However with the limited Forest Department field staff, some villagers break the law and sell logs illegally.

The source of fuel wood for the villagers is getting farther and the forest area becomes smaller due to over exploitation. About 30 years back, residents claimed tha the source is only 7 km from the village and that only 6 man-hours was required to gather one cart load of fuelwood.

4. Water Resources for crop production

Water is a very scarce resource in the hilly upland areas. Rainfall is the only source of water for crop production such that planting of major crops only occurs during monsoon season. Water scarcity is the biggest problem especially during the dry summer months. Large amount of effort and time were spent to fetch water from different sources for home consumption. The problem becomes more acute when the rains come late and the wells dry-up.

In the rainfed lowland, water from streams are topped as irrigation water during the monsoon. Along the streams are mini-dams built by farmers to divert irrigation water into their fields. The availability of the water to the next farm was depended upon the overflow of water from the preceding dam. When the water is high enough, the dam overflows downstream which enables the next farmer to trap enough water for irrigation. The farmers on the tail end of the stream had to wait until all the upstream farmers had enough water in their field. This arrangement for use of the stream water lead to the “adequately wetted rule” which ensured some fields to be saturated.

At Ah Kyaw village site where a river cuts across the village, two electric pumps are used to raise water for irrigation. This allows farmers to plant two-rice crop per year thus contributing to higher income. Furthrmore, the presence of an efficient water management committee coupled with the abundant supply of irrigation water have significantly reduce the risks of conflict and crop loss among farmers in Ah Kyaw village.

B. Major Concerns and Research Issues

Although each ecosystem has its own unique problem, there were two some common unique concerns identified across ecosystems. These were (a) poor soil fertility and (b) the need for improved rice varieties. The major specific concerns and research issues for each rice ecosystem were:

1. Hilly upland rice ecosystems

1. Low and erratic rainfall patterns resulting to low yields or crop losses.
2. Low soil fertility and farmers can not afford to purchase chemical fertilizer due to its high price and limited supply;
3. No suitable improve upland rice variety are grown. Only traditional upland rice varieties (long maturity and low yielding) were planted since upland farmers prefer the sticky rice variety. The improved upland varieties developed do not have the sticky rice characteristics.
4. Soil erosion, which is also associated to poor soil fertility.
5. Scarcity of fuelwood.
6. Limited livestock feed

2. Rainfed lowland rice ecosystems

1. Drought associated to erratic and low rainfall.
2. Poor soil fertility but do not apply the recommend fertilizer rate due to the high cost of chemical fertilizer.
3. Inefficient soil nutrient management
4. Low rice yield associated with the planting of low quality rice varieties.

3. Irrigated lowland rice ecosystems

1. Declining yield due to decreasing soil fertility as a consequence of continuous double rice cropping.
2. Rice varietal degeneration and need for new improved rice varieties.
3. Inefficient soil nutrient management
4. Poor crop establishment
5. Inefficient utilization of irrigation water during the dry season.

C. On-Farm Farmers' Participatory Researches

After identifying the major concerns and research issues, on-farm experiments were prioritized and planned to seek for possible solutions to these problems. As eries of experiments were conducted on farmers' field and both the management and data collection were done by the farmers and project site technicians. Data were analyzed using results from each farmer's field as replicates. Six to ten farmers participated in each experiment. After analyzing the results, these informations were presented to farmers and other members of the community.

1. On-farm trials

Several on-farm trials were conducted in cooperation with farmers. Only experiments during the monsoon season were conducted for the hilly upland and the

rainfed lowland ecosystem due to water availability. However, both monsoon and dry seasons experiments were conducted in the irrigated lowland ecosystem.

A summary of the different experiments conducted in the different sites is shown below:

Hilly Upland Rice Ecosystem	Rainfed Lowland Rice Ecosystem	Irrigated Lowland Rice Ecosystem
1. Rice Varietal Evaluation	1. Rice Varietal Evaluation	1. Rice Varietal Evaluation
2. Nutrient Management	2. Nutrient Management	2. Nutrient Management
3. Cropping Pattern trials	3. Crop establishment	3. Fertilizer Management
4. Multi-purpose tree species evaluation		4. Seeding rate and variety
5. Forage Evaluation		5. Cropping Pattern

2. Recommendations based on the results

a. Hilly upland ecosystems

1. With upland rice mostly receiving its nutrients from the residual soil fertility of the preceding crop, rotations with crops that replenish or improve soil fertility should be highly considered. Based on the results of the on-farm trials, soybean-rice or peanut-rice rotation was highly favorable to the upland rice crop (Fig 1).
2. Nutrient management of the whole cropping pattern (crop rotation) should be emphasized rather than on a crop basis. As commercial chemical fertilizers are unaffordable to upland rice farmers, technologies on the use of farmyard manure and other organic and locally produced fertilizers should be developed and evaluated.
3. There is an urgent need to develop upland rice varieties adapted to cold temperature and high elevation. In addition, the preference of upland subsistence rice farmers (i.e. sticky rice, more rice straw for animal feed) should be considered in the rice varietal program.

b. Rainfed lowland rice ecosystems

1. Under an environment where rainfall is limited and that rainfall is the major source of irrigation, short and early maturing rice varieties (100-110 days maturity) should be developed and evaluated.
2. Direct seeding of rice on the onset of the monsoon season, similar to that of upland rice planting, is a good alternative in avoiding drought on the later stage of rice growth. However, the reliability of the rainfall during the early growth stage is a risk to contend with.
3. Urea tablet should be used as fertilizer N to increase the N efficiency. This was one of the best alternatives in improving the low rice yields as a consequence of low fertilizer rates applied by farmers. One drawback, however, of the use of urea tablet was the laborious method of application. Although a urea tablet applicator was used, a less laborious and more efficient applicator should be developed.
4. Management of the irrigation system to provide supplemental irrigation water during monsoon should be improved. Some improvement should be focused on the proper

maintenance of irrigation canals and making of lateral canals so that irrigation water will not always pass from large fields to smaller fields.

c. Irrigated lowland rice ecosystems

1. Kyawzeya and Satmyo are the most promising improved rice varieties suited for wet season while Yezin-1, Yezin-2, Yezin-3, IR-13240 and IR-50 are the best improved varieties suited for dry season cropping. Kyawzeya, IR-13240, IR-50 and Yezin-3 are popular among the farmers.
2. Similar to the rainfed lowland ecosystems, urea tablet should be applied as fertilizer N to increase the N efficiency. Three to four split applications of broadcasted nitrogen fertilizer is also an alternative to increase N efficiency.
3. When farmers can only afford to apply low rates of chemical fertilizer, supplemental application of farmyard manure or liquid fertilizer (biosuper fertilizer) can increase rice yields.
4. Although a 200 kg/ha seeding rate is quite high, it resulted increased the rice grain yield compared to the recommended 50-100 kg/ha seeding rate. The high seeding rate is a strategy to reduce weed problems (Table 1a&1b). Since most farmers produce their own seed, it was observed to be less costly than hired labor for weeding.
5. Blackgram,or other legumious crops, should be rotated with lowland every two years to allow enough time for the fields to be aerated. A break in the continuous rice cropping may be advantageous in reducing the rice pest problem and in order to regenerate the soil fertility. Promising blackgram varieties were identified (Table 2) and adapted by farmers.
6. Although many farmers had already adapted the improved rice varieties, they should be trained on how to produce their own rice seeds for the next cropping season. Farmers do not differentiate grain from seed such that their seeds are taken from the grain harvest.

D. Community Organized Activities

Community action activities were organized to address major concerns raised in the different ecosystems. The community activities included community tree planting, maintenance and dredging of new lateral canals, and construction of mini-dams.

1. Community Tree Planting

Acknowledging the problem of dwindling fuelwood supply, the pilot village communities of Myay Char (Kalaw, Shan State), Ta Yet Pin (Tatkon, Mandalay Division), and Ah Kyaw (Danubyu, Ayeyarwardy Division) organized tree planting activities along the village roads and besides their homelots during the 1997 wet season. The Department of Forestry provided the seedlings of promising multi-purpose tree species.

At Myay Char village, approximately 300 seedlings each of *Pinsein* and *Acacia auriculiformis* were transplanted along the community road on 26 June 1997. Since *Pinsein* trees were indigineous to the area, some of the seedlings were taken from the farmers' field for transplanting. The village also set-up a nursery for *Pinsein* trees, which they used for replanting. The survival of *Pinsein* seedlings was much better than the *Acacia*.

In Ah Kyaw where about 200 villagers joined the tree planting, approximately 600 seedlings of Auratia, ma-U and Paukpanphyu were transplanted along the entrance road to the village on 14 August 1997.

Approximately 103 families from Ta Yet Pin village joined the planting of 182 seedlings *Cassia siamea* and 345 seedlings of *Acacia auricauliformis* in their homelots. Furthurmore, on 10 August 1997, the same number of families planting 350 seedlings of *Acacia auricauliformis* and 60 seedling of *Polyathia longifolia* along the entrance road to the village. Ten landless fishermen also planted 20 seedlings of *Acacia auricauliformis* along the dike of the Kan Hnya Sint Pond.

2. Irrigation canal maintenance and dredging of new lateral canals

The irrigation system in Ah Kyaw village (Danubyu, Ayeyarwardy Division) strongly supported the summer rice (dry season) program of the government. Due to siltation, the efficiency of irrigation water flowing through the irrigation canals had been decreasing. Through the assistance of CARI and advise from the Irrigation Department, a design to dredge and re-direct the irrigation water was done. Before the 1998 summer rice cropping, the village community was organized to dredge the canals. Furthermore, the community volunteer workers dug three lateral canals. With new lateral canals, farms that were formerly far from the irrigation canal had immediate water access.

3. Construction of Mini-dams

Due to low rainfall pattern at Ta Yet Pin Village, rainfed lowland rice during monsoon still has to depend partially on irrigation water. The presence of some free flowing streams in the village during monsoon makes it possible to build mini-dams to impound water for irrigation. The mini-dams also prevented the rapid flow of water frequently resulting to flooding of the rice fields in the lower portion.

With the project initiative, the community had organized the building of mini-dams before the start of the 1998 monsoon season. The village community provided the labor and local materials while the project provided the some materials that need to be bought. The Irrigation Department provided the mini-dam design.

As a benefit of the construction of mini-dams, farmers experienced increase rice yields due to adequate water supply and that flooding in the low lying rice fields were minimized. This showed that the collective action of farmers in the community yielded positive results.

V. General Observations

In line with this new research paradigm and approach (i.e. participatory, inter-disciplinary and community-based) used in the project implementation, there are several interesting observations that were noted:

1. There is a need for researchers to have a clear understanding of what "participatory research" really means. Initially, most researchers believed that having farmers as cooperators is enough to satisfy the concept of "participatory approach". Shifting the researchers attitude from the traditional approach to participatory approach (wherein farmers are involved in problem identification and in the research planning) is best achieved through training and actual participation.
2. The formation of an inter-disciplinary research team (which included extension workers and administrators) was very instrumental in fully addressing possible solutions through research. Furthermore, the regular workshop and planning meetings held before each season planting provided a good venue to present results from previous season and properly plan for the following season's research activities.
3. On-farm farmers' participatory researches ensured the fast dissemination of research results. Promising rice varieties identified during the rice evaluation trials were rapid adapted by farmers. However, farmers were reluctant to participate in research activities where they don't see immediate benefits (i.e. hedgerows as soil erosion control, use of different sources of organic fertilizers).
4. The communities were quite easily mobilized by the village leaders in undertaking community activities (i.e. tree planting, dredging of irrigation canals, construction of lateral canals and mini-dams). This is attributed to their form of governance.
5. The success of implementing community-based natural resource management researches heavily depends on capacity of local researchers. Their capacity should be strengthened through trainings, workshops and attendance to meetings and conferences.

Table 2. Grain yield and other agronomic characteristics of different blackgram varieties evaluated during the 1999 dry season at Danubyu Township, Ayeyarwardy Division.

Variety	Days to maturity	Plant Height (cm)	No. of pods/plant	No.of seeds/ pod	100-seed weight (gm)	Grain Yield (kg/ha)
LBG-17	107	43	8	5	61	747
Yezin-2	90	45	10	6	60	896
P11-30 (check)	110	53	7	6	55	532
s.e.		4.8	1.5	3.3	0.5	206
c.v. (%)		36.2	37.2	11.3	17.6	12.0
F-test		ns	*	ns	*	*