REVIEW

Rice Crisis and Climate Risk Management: The CURE Approach

Gelia T. Castillo
International Rice Research Institute, Philippines
Email: c/o s.arellano@cgiar.org

The global food crisis, as manifested locally in soaring rice prices and long queues of would-be buyers, has generated panic, blame-passing, and various forms of social unrest in many countries all over the world. Inevitably, in the wake of these tumultuous developments, there has surfaced a renewed interest in agriculture and its role in human existence. Hopefully, this comes with a resolve to reinvest on the part of those who had thought that "we're done with agriculture". The slogan "RICE IS LIFE" has never been so dramatically played out as it has been in the months of April to July 2008. The alarming mood has been quite a contrast to the relatively sedate celebration of the International Year of Rice in 2004. As we "**rush to rice**", the focus will likely be on producing more and more rice in irrigated, favorable, large, and accessible farms. Furthermore, the policies of "old" will acquire a new refrain ─ subsidies on inputs and outputs; corporate farming; more land into cultivation; irrigation; credit; and post-harvest facilities, among others. The "hoarding" of rice, which in the past would have been regarded as simply an effort to ensure a buffer stock, has been criminalized. There has been a marked shift in the action arena from rice paddies to rice warehouses, and, of course, the centers of rice trade. In such a shift one can only surmise how the unfavorable areas (meaning, the rainfed; the upland; the drought-prone; the flooded and submerged; the saline soils and other problematic areas) would bear up. It would be unfortunate if people would forget the significance of these areas, which had only recently been recognized, to wit: These areas are in an annual chronic rice crisis, albeit a SILENT ONE, because their rice fields are not the noted source of rice for the hungry towns and cities, but they are the life of those who depend on them for their unpredictable and meager harvests.

This paper is an attempt to remind us that the maxim "RICE IS LIFE" does not show itself only in irrigated rice paddies but also in topographically, ecologically, and climatically challenged rice-growing places, where rice probably should not be but it is. This paper describes briefly the "harvests" from the investments of CURE (or the Consortium for Unfavorable Rice Environments) in these less valued rice lands.

CURE has ten member countries, namely: Bangladesh, Cambodia, India, Indonesia, Lao PDR, Myanmar, Nepal, the Philippines, Thailand and Vietnam. It fosters cooperation in research and development between the NARES (or the National Agricultural Research and Extension Systems) and the International Rice Research Institute (IRRI). CURE provides a framework within which researchers, extension workers, policymakers, and farmers can tackle key problems in their respective ecosystems. The Project Goal is to achieve better "food security for poor farmers in the marginal and diverse rainfed environments in monsoon South and Southeast Asia, through more sustainable and resilient rice-based production systems."

Low and unstable yields are a common feature of rice farming in rainfed environments. These environments are not only unfavorable and fragile but are also very diverse; hence, research on-site with partners and a multidisciplinary approach constitute the usual strategy employed. Where farmers are dependent on rain and rains are unpredictable, the challenge to research and development is great indeed!

To illustrate, one report describes the situation as follows:

> "For an environment that can expect mild to moderate drought every year, and a severe drought every four years, Chhattisgarh State, India, 2007 growing season was an anomaly. Rains were sufficient and well-distributed".

This description is a left-handed way of saying that in drought-prone rice areas, normal rainfall is an *anomaly* and it is the annual occurrence of drought which is the usual weather expected.

CURE has shown that the unfavorable, the diverse, and the unpredictable are not necessarily impossible to address in rice science. Stephen Zolvinski, an anthropologist who did a qualitative assessment of impact in research sites (in India, Lao PDR, Bangladesh, Thailand, Indonesia and the Philippines) reports on the changes in different aspects of rice farming associated with CURE's R&D activities. The ecosystems in the key research sites include: the drought-prone plateau uplands; the drought-prone lowlands; the salt-affected lowlands in eastern India; the sloping rotational upland systems in Luang Prabang, Laos; the submergence-prone environment in Rangpur, Bangladesh; and the intensive upland systems with long growing season in North Cotabato, Philippines. What is worth noting is the fact that there is a common approach used to address generic themes across these diverse sites but the resulting technologies are specific to the particularities of each ecosystem. The themes which embody the technologies and relevant social, cultural, and economic circumstances are:

- Germplasm improvement;
- Rice varietal diversity;
- Seed and seedling management;
- Crop establishment methods;
- Cropping system enhancement;
- Upscaling activities;
- Patterns of labor utilization; and
- Food security.

From the qualitative impact assessment done in 2007 by Stephen Zolvinski who was Assistant Network Coordinator of CURE, innovations were evidently taking place in rice farming practices. Zolvinski, an anthropologist, observed these new practices through intensive on-site and on-farm visits; focus group discussions; interviews with farmers, both male and female; and interaction with the Work Group members from CURE, extension workers, representatives from NGOs and local government units, and research partners from national and local research institutions.

THE COMMON APPROACHES

Zolvinski (2007) observed that whatever innovations resulted from the Project were a product of "upstream" work at IRRI and the national research institution, and CURE's activities as a "downstream" platform for testing/scaling out new varieties and new practices using farmer- participatory methods. CURE followed an ecosystem paradigm in order to develop technologies suitable for the complex social and natural environmental conditions at the key research sites. When researchers got "on-the-ground" to improve system productivity for such diverse ecologies, some commonalities emerged from the six Working Groups of CURE with each group focused on a specific ecosystem. This suggests that even diversity and uncertainty has its common denominators — in rice, in nature, and in science — as evident in these common approaches:

1. Continuous "upstream" work at IRRI and the national research institutions to unravel the physiological bases of stress tolerance in the rice plant, which can be useful in identifying gene markers for breeding tolerant traits into farmers' popular varieties.
2. Using multiple methods such as varietal screenings, observational nurseries, and preliminary yield trials, to identify the germplasm suitable for marginal environments, and employing farmer-participatory evaluations in researcher-managed "mother trials" and farmer-managed "baby trials" to select entries that match men and women farmers' performance criteria.
3. Developing nursery management practices that produce healthier, robust seedlings better able to survive and recover from stress after transplanting into the main field and produce above-average yields. Such practices involve seeding density in the nursery nutrient management and seedling handling.
4. Developing site-specific tools for weed and weed management and new establishment practices that farmers can adapt based on their socioeconomic situations, access to resources, and positions of their fields on the toposequence, taking into account hydrology, soil type, and nutrient status.
5. Developing improved crop establishment practices which, combined with improved early-duration varieties, allow for earlier rice establishment and earlier harvest that, in turn, allows for the timely sowing of a non-rice crop to intensify system productivity, thereby enhancing food security or generating income as a cash crop.
6. Developing combinations of weed and nutrient management practices which, combined with new establishment methods and better germplasm, can result in significant increases in rice production in fragile ecosystems.

What stands out in these common approaches is the judicious and "experimental" blending of scientist's science and farmer-participation (both male and female) in technology development. In this process, the indigenous and local plays its part in shaping the "goodness of fit" between "LAB, LAND and CLIMATIC RISKS". Furthermore, through on-farm trials, pathways to the connectedness and synergy between the individual components are observed in order to determine which combinations are likely to increase productivity and promote food security. This connectedness is illustrated in the fifth approach above with underscoring. Time and timing are essential in the synergy so that the total effect will be more than the sum of the individual components.

THE TECHNOLOGY PRODUCTS: SOME EXAMPLES

The workings of the process described above can be illustrated in the resulting technological output as discussed below:

Germplasm Improvement

Swarna-Sub I, which is a submergence-tolerant variety, is the result of considerable "upstream work" using molecular tools to identify the tolerant gene *Sub IA* and to transfer it to *Swarna*, a popular variety in South Asia using marker-assisted breeding. This process has reduced the time to bring new varieties to farmers from the normal 6 to 10 years to about 2.5–3 years. In the years 2006–2007, tests on-station and in farmers' fields showed that *Swarna Sub I* had realized its full yield potential with proper nursery nutrient management. This variety has been further tested by farmers and researchers in other submergence-prone sites and is now ready for release. The different components and stakeholders in the seed systems of three countries in South Asia have been mobilized for seed production, demonstration, and distribution to farmers.

The development of this variety is an example of how modern scientific tools combine with what is already locally popular in order to arrive at an improved product which is stress- tolerant and also locally acceptable. Because of this approach, the *SUB-1* gene can now be found also in *Samba Mahsuri-sub I* and in *IR64 sub I,* besides *Swarna-sub I*.

- Farmer-participatory varietal selection enables researchers to identify the germplasm that meets farmers' criteria for the Eastern India drought-prone ecology. A key farmer-preferred criterion is short-to-medium duration varieties for earlier harvest.
- In the drought-prone plateau uplands like Hazaribag in the Jharkand State in India, two new short-duration (90-95 days) varieties, namely, *Anjali* and *Vandana*, are finding favor among farmers. There is evidence that farmers are saving seeds for planting in the next season, and seed exchanges are taking place with other farmers.

Rice Varietal Diversity

Through CURE and participatory varietal selection, farmers can choose from different varieties whose visible performance in the field they may use to compare with traditional varieties. Given a number of choices, they are able to take home with them several good-performing varieties for further validation in their own fields, thus increasing varietal diversity. The exchanges which take place among farmers through field days also contribute to this. However, Zolvinski reports that farmers say it might take them several years before totally adopting the improved varieties because they still rely on traditional varieties which, although low-yielding, are capable of withstanding different stresses. At any rate, farmers now have access to improved varieties which they did not have before.

As far as rice varietal diversity is concerned, Laotian farmers in Luang Prabang present an iconic example. They grow as many as 15 glutinous traditional varieties in their sloping fields and as many as seven varieties in the available lowland fields. Diversity is a key to understanding the farm household's deployment of rice varieties. Numerous traditional varieties are planted to coincide the harvest with the peculiarities of the weather , and to have a wide range of yield possibilities. For instance, although early-duration varieties in sloping uplands are low-yielders, they are available for consumption as soon as rice is harvestable. On the other hand, longer-duration varieties are valued for higher productivity. What is worth noting is that farmers would like to try medium-duration varieties to avoid bird and rat damage which happens to early-duration types. Furthermore, although villagers largely favor and consume glutinous rice, they are interested in non-glutinous varieties as potential export and for making noodles for marketing. Provided they can acquire the grinding technology required, women can certainly find an additional source of income in processing rice noodles.

Seed and Seedling Management

Because farmers use seeds from their own harvest and continue to do so from one cropping season to the next, the quality of these seeds affect the quality and quantity of the harvest. Along with improved varieties to choose from, CURE has introduced the concept and practice of clean and healthy seeds; lower seeding rates; and raising quality seedlings.

In the drought-prone villages of Hazaribag in Jharkhand State, India, researchers found adequate the indigenous seed storage method using a woven bamboo basket sealed in mud-cow dung mixture. The low humidity in the area enhances seed storage. Panicle-harvested seed can maintain seed purity and grain yield better than bulk-harvested seed. Training on seed health has been conducted in all participating countries; and women were the intended targets for they are the usual custodians of seeds. The introduction of improved varieties is always accompanied by training on seed health, and farmers tend to be more diligent about following these practices because they want to maintain seed quality so they can sell the new seeds especially as the demand for them grows.

In Rangpur, Bangladesh, the farmers' group approach is based on the experiments conducted in the farmers' field schools which showed that proper seed health management practices can improve rice yields by 9 percent. This is evident in the better performance of transplanted seedlings from panicle-selected seeds compared to farmers' usual selection practices of using seed mixtures. Farmers' feedback reveals this practice could produce a reliable source of quality seeds, saving them the expense of purchasing new stocks from traders.

The researchers recommended low seeding rates for raising quality seedlings but farmers explained that the high seeding rates were due to the shortage of available space in the highlands for the nursery. A low seeding rate in the seedling nursery would not produce enough volume needed to plant the main field.

Farmers in the submergence-prone environment of Rangpur practice *bolan* or the double-transplanting system in which the seedlings are raised in a highland nursery, then transplanted to a highland field 30 days later, and finally transplanted in the main field 60 days later. Farmers prefer to use the *bolan* for lowland fields, because it allows a better timing of transplanting after the waters recede. Despite the labor savings and better yield from quality seedlings with lower seeding rates and a nutrient regime, farmers perceive that such a practice would be good for the single transplanting system in the medium lowlands. The double transplanting system (bolan) allows for the coordination of transplanting relative to flood water levels. Farmers use the second bolan plot as a sort of holding area for seedlings, until floodwaters recede, before making the final transplant in the lowlands.

Crop Establishment Methods

In the drought-prone area of eastern India, farmers are convinced that the dry-direct line seeding is proven to be effective, and that in years of favorable rainfall, wet-direct seeding can raise productivity for the range of climatic conditions in Chattisgarh State.

These direct-seeding technologies have numerous advantages compared to the traditional *beushenring*_system. These include earlier rice establishment and harvest; better growth and higher yield; better weed control and less labor, hence less cost; better utilization of seeds and fertilizers when the crop is sown in a line; and the opportunity for sowing a post-rice chickpea crop, if late season soil moisture is available.

In the salt-affected lowlands of Cuttack, India, women say that the improved varieties' taste is better for cooked rice but the traditional varieties are better suited for making their traditional breakfast dish, *pokhal*. They are satisfied with the Sesbania green manuring and Azolla biofertilizer to improve yields. Although they prefer farm yard mature (FYM) compost over chemical fertilizer, the amount of FYM is limited. They are concerned about wild rice infestations in wet-season fields. In rice storage, they use certain leaves for biopesticide and apply other practices they learned in seed health training.

Cropping System Enhancement

In food-insecure and disadvantaged ecosystems, cropping system enhancement is highly desirable and is very much part of the CURE approach. With shorter-duration varieties and time-saving crop establishment, it becomes possible to grow non-rice crops which bring cash and employment.

One such combination in drought-prone villages in India is to use a shorter-duration variety, followed by a chickpea variety, pigeon pea, or maize. On the other hand, in the salt-affected lowlands, sunflower is the main non-rice crop as it allows them to extract cooking oil which is an essential commodity in the household. However, one problem is the lack of sunflower oil-extraction presses in the area.

An unusual livelihood enhancement which is practiced in Laos includes rice, pigeon pea, and sticklac, a type of resin adhesive extracted from pigeon pea which has been produced with the use of a certain inoculum (*Laccifer lacca* parasite).

Crop diversification is made possible through clever timing and sequencing of the crops which have food and market value.

Upscaling Activities

The early evidence of CURE activities' impact has mobilized many strategies for upscaling in order to reach more places, more farmers, more quickly. Because the technology development and testing process is always participatory, there is a built-in extension effect. Among the strategies employed are: the training of trainers; farmer-to-farmer exchange; field days; farmers' field schools; techno-demo plots; cross-visits; participatory varietal selection; on-farm research; farmer-participatory experiments; adaptation of farmer's usual practice; publication of extension materials in the local language for extension workers and farmers using print and electronic media; community seed bank; and "mother" and "baby" trials (researcher-managed and farmer-managed field trials). The aim is always to give farmers a variety of options to choose from.

A multitude of stakeholders at the local, provincial, or regional levels are engaged through policy dialogues and field visits. These include the researchers, extension workers, government officials, traders, NGOs, and other parties involved. It is always important to have "something to show" instead of "mere talk". NGOs and local officials are most important for upscaling "star" technologies which are promising. Each stakeholder has a role to play in this task.

Patterns of Labor Utilization

Contrary to popular belief, it is labor, not fertilizer, which has the largest input share in rice production. The labor requirement of a particular management practice is a major factor in farmer adoption. For example, dry seeding and wet-line seeding save 15 to 20 days of labor compared to the traditional system which takes 152 to 154 laboring days in drought-prone areas. With wet-line seeding, labor is saved, nutrients are better managed, and weeds better controlled, giving higher economic returns from line sowing. In this ecosystem, weeds are a major problem, which is why indigenous and improved practices such as the careful application of herbicides are being tried. Even in the low-fertility uplands of Ubon, Thailand, the traditional farming practice of rice-cutting shows higher yield from the cut than the uncut ones. Apparently, rice-cutting reduces weed pressure.

Taking advantage of the post-rice residual moisture is important for the non-rice crop to succeed. Whether it is pigeon pea, chickpea, maize, potato, sweet potato, mungbean or sunflower, these non-rice crops ,which are of special interest to women, provide additional food, income and employment. In Raipur, Chhattisgarh State (characterized by drought-prone lowlands), food security is not much of an issue as are the labor shortages for critical tasks in the field operations for traditional rice establishment systems. Better-paying jobs draw male laborers away from these critical labor-intensive tasks required under the traditional systems. Farmers perceive the new direct-seeding practices can save them labor and costs of production in establishing a crop. Further developments in the industrializing state can result in higher labor wages in the farm, thus making labor-saving farm practices more attractive to farmers.

In Lao PDR, a study by Shrestha, Borysha and Kamphoukeo (2006) on the socioeconomic impact of the Lao-IRRI Rice Research and Training Project reports that drought, weeds, insects, and labor shortage are regarded by farmers as the most important constraints to their rice production. Weeds are mentioned by almost 90 percent of farmer-respondents, whether for the wet or the dry season. Labor shortage is mentioned to be more of a problem during the dry than the wet season. There is not much use of herbicides, as shown by the low usage (13.3 percent) of households in Central Region and Northern Region (12.5 percent), as well as the non-use of herbicide in the Southern Region. Weed control options are being investigated to deal with an invasive weed variety which takes over hilly plots.

Food Security

Since the end-goal of CURE is food security for households in these less favorable rice areas, the strategy includes the following: early-duration higher-yielding varieties; improved labor-saving practices; earlier rice crop establishment; and earlier harvest that allows for the timely sowing of a non-rice crop to intensify system productivity and enhance food security or generate income as a cash crop to purchase rice.

Achieving food security in the research sites turns out to be a tremendous challenge since practically all the villages suffer from "hungry months" that can last from two to eight months depending on the size of landholdings and the rice produced. Having to purchase rice to make up for annual shortages is a real burden, because the cash income is rather limited. In most of the CURE villages, only about 10 percent of households are truly rice-secure. Even those who are able to grow enough rice for consumption also become rice-insecure if they have to sell rice to pay for debts, inputs, and other household needs.

In Bangladesh, this period of hunger called MONGA occurs before the harvest of the wet season crop *(T.aman)* in the months October to November, and before the harvest of the dry-season crop (boro) in April and May. This is a time when there is no employment; rice prices are high; and there is no food in the house. As food shortages increase, so do rice prices.

How do these households cope with the rice shortage?

- In the Indian research sites, the males out-migrate during the January-May off-season. Streams of migrants troop to major population centers like Kolkata where they work as rickshaw drivers and general laborers. In addition, farm households grow vegetables such as potato, onion, and garlic, to market for cash to buy rice. Farmers have said they are interested in adopting new varieties to improve rice production, which would ease the pressure to migrate. As one farmer argued: "If we can grow enough rice to fill our bellies, why would we need to leave the village?"

- In Bangladesh, when prices are low, farmers take out loans at 15 to 18 percent interest from NGOs or banks, or get advance payments from traders or local money lenders; these are paid back at harvest time.

  Men and women farmers say they can improve their overall livelihood by improving staple crop production in the uplands, which would allow them to divert household resources from food purchases to investments on children's education. Increased upland production would provide seasonal field work although unskilled laboring jobs in town pay higher wages. At any rate, increased productivity which would reduce rice purchases would enable them to spend more for their children's education.
- In Lao-PDR, some farm households borrow rice and repay this in kind with a 10 percent interest. In other words, the household pays back 12 kg of rice for every 10 kg borrowed.

It is clear from the farmers' interviews that they rely on sloping uplands for household food security. However, production has been declining due to short fallows that they associate with population pressure. In terms of household rice self-sufficiency, Shrestha, et al. (2006) report improvements in yields resulting from the adoption of modern varieties. Data show that in the Northern Region which has more of the rainfed uplands, 57 percent of households adopt modern varieties but devote only 46 percent of their rice area. In other words, although they have experimented with the new varieties, they still continued to use traditional varieties in the major portion of their rice lands. A higher proportion of rice self-sufficiency among households is reported for modern variety adopters than for non-adopters. For the Northern Region, the percentages are 82 and 67 percent, respectively. For households that are rice-deficient, the deficiency lasting 1–3 months was most frequent. Some 10 percent of adopters have a deficit of more than 7 months. It is a well-established fact that the incidence of poverty is negatively correlated with household rice availability. Households that have a rice deficit are almost always poor.

Quite interesting is the finding that male- and female-headed households in the Northern Region are only marginally different with respect to such factors as: the adoption of new varieties; rice area under varieties; rice self-sufficiency; overall income; general health; consumption of meat and eggs, etc. The big difference lies in the adoption of farm machinery wherein more males than females have the advantage. In terms of ethnicity, different ethnic groups have responded differently to modern varieties, with one group showing the lowest level of adoption. But what is interesting is that all ethnic groups retain the use of traditional varieties even if they adopt modern ones. In this way, genetic diversity helps preserve cultural diversity.

THE PRIMACY OF SEEDS

Seeds lie at the heart of agriculture and, particularly, of rice farming. As reported in Shrestha, et al. (2006 p. 34): "Lao-PDR has one of the highest amounts of biodiversity of rice in the world. It appears to be the center of biodiversity for glutinous rice. To preserve this, the Lao-IRRI Project started a program to collect traditional varieties throughout the country. These resources are conserved in the national gene bank in the country and in the International Gene Bank at IRRI. As a matter of fact, Lao PDR's contribution to this International Gene Bank ranks the second highest, next only to India". In addition to seeds, indigenous knowledge about traditional rice varieties has been documented.

As Rod Lefroy, the representative of the International Center for Tropical Aquaculture

(CIAT) in Vientiane said: "The presence and documentation of rice genetic diversity is of enormous pride to Lao people and this is one aspect of the Lao-IRRI Project that is going to be remembered long after the project has been completed" (Shrestha, et al. 2006). This unique contribution is also an excellent example of how a small country can share its wealth in rice genetic resources with the rest of humanity in an immeasurable way.

In the CURE villages, seeds play a central role in the R&D program. It is as if, without seeds, there is no "magnet" to reinforce the message of improving rice production. The significant roles played by SEEDS are manifested variously in the following:

- the evaluation of advanced lines and landraces in different ecosystems;
- participatory varietal selection;
- the farmers' field days which almost always feature varietal performance (without seeds for field trials, the message does not prosper);
- the demand for seed multiplication after a variety is deemed desirable;
- the collection and identification of landraces, lines, and varieties of tolerant genotypes, which can be used directly by farmers or as donors for future breeding;
- the keeping of newly introduced seeds for sowing next season, a practice which indicates positive response to the introduction;
- the use of national varietal testing and release procedures to determine how soon the use of particular seeds can be legitimized;
- dissemination in the area of seeds of promising lines, regardless of formal approval, through farmer-to-farmer exchange; and
- the greater value acquired by seeds of rice plants that survive under drought conditions.

Seeds must be kept clean and healthy in order to improve their performance. Among non-rice crops like potatoes, chickpea, mungbean, sunflower, and vegetables, good quality seeds are essential if crop diversification is to happen. Finally, seeds have a cost and in some instances this factor becomes a drawback to adoption until somebody decides to subsidize or give them away free, at least for trial purposes.

The experience of Arakan Valley in North Cotabato, Philippines exemplifies how achieving rice seed security may be equated to pursuing food security. For 30 years, farmers in this upland area grew a traditional variety called *Dinorado*. Identified by its pinkish grain, aroma, and flavorful taste, Dinorado fetches a good price in the market due to its high demand for weddings, fiestas, and other special occasions, and as a staple in specialty restaurants. In the ten years prior to CURE activities in Arakan, the upland rice area declined from 2,753 ha. to 377 ha. Contributing to this decline was the erosion of the genetic purity of *Dinorado*; the unavailability of higher-yielding modern varieties; the decreasing soil fertility; and perennial weed problems. As an alternative, farmer grew maize due to the scarcity of rice seeds. Furthermore, food-insecure households ate their stored seeds during the food-deficient months. To address the seed problem, CURE obtained new lines of the traditional varieties *Dinorado* and *Azucena* and six improved varieties from IRRI's Genetic Resources Center (the gene bank). These new accessions which were introduced produced higher yields while meeting the households' preferences for agronomic, eating and cooking quality characteristics. The local officials' vision of recapturing Arakan's reputation as a producer of high-quality *Dinorado* slowly became a reality. The hungry months have been reduced to two (June and July) and the upland rice area has been restored to its mid-1990s level (about 3,000 ha). Futhermore, non-rice crops intercropped in the same field have helped to improve food security and/or provide the option for each crop. Mungbean was particularly attractive because farmers could harvest right before rice, thus easing the food shortages that occurred before the rice harvest season. Mixed-crop combinations have also enabled the farmers to grow a food crop while waiting for plantation species, like rubber. to mature.

One indicator that the rice seed supply has improved is that farmer-to-farmer seed exchange and seed-sharing with relatives, friends and neighbors are taking place because there is more than enough for their own needs. Farmers prize the *Dinorado* and it is sold to meet the demand of niche markets. It also performs a "savings" function, in that it is set aside for buying food in the lean months. As one farmer has put it: "It is easier to save palay (unmilled rice) than to save money". These stored stocks of the *Dinorado* variety can be sold later on to buy cheaper rice.

Having realized their goal of reviving *Dinorado* and increasing productivity through other improved varieties and seed health management practices, the Working Group sought to establish a network of seed producers who will be a continuing reliable source of quality seeds even after the Project ends. This network has been formalized as the Arakan Community Seed Bank Organization which has been linked with the local government and with CURE for technical assistance. This idea of maintaining a community seed bank has been extended to a Manobo indigenous community where members store seeds in a common bank which can be accessed only during planting time. The Arakan Valley model has also been exported to Lampung Indonesia in order to instill proper seed health practices and ensure seed availability of good quality.

Seeds as products of science and of the genetic resource heritage of humankind are eloquent bearers not only of life's continuity, but also of a people's cultural identity and of the differential capacity to survive climatic variabilities. Given their potential to improve human well-being, the continuing work on seeds must be an integral part of overall efforts in climate risk management.

CONCLUDING STATEMENTS

For a long time, the unfavorable rice-growing environments have not been favored with rice science investments. They were too diverse; too complicated; too difficult; and after all, they provided only a small proportion of total rice supply. The current rice crisis, however, produced a great deal of political and media hype. Inevitably, this has made us face a reality unknown to most of us, namely, that households in unfavorable areas suffer a rice crisis yearly over a period of several months. Despite droughts, floods, salinity, sloping uplands, submergence , and other problems, households who depend on these areas for food practice coping mechanisms based on tradition and farmers' own "experimentations" to produce rice, albeit at great risk.

The Consortium on Unfavorable Rice Environments has attempted, in a major way, to use science, in combination with local knowledge and practice, to address the diversities through a common approach: They found that the uniqueness and the diversities have common denominators. By way of generic research themes, they produced location specificities that worked. These have begun to make a difference. Farmers have also exhibited their own capacities to innovate further on the seeds and management practices developed and introduced to them. A participatory mode of implementation has enabled science and practice to mitigate the negatives of unfavorable environments.

As the International Research Institute for Climate and Society (IRI) said in its 2007 Report entitled: *Climate Risk Management in Africa: Learning from Practice*:

"Poor people manage risks, including climate-related risks, regularly as part of their everyday lives. Using as much information as they can get, farmers make decisions that aim to minimize risks and exploit climate opportunities, for example they try to time the planting of their crops to coincide with the onset of rains. *Climate risk management is therefore already being practiced at various levels and with varying effectiveness*…"

Medium and long-term adaptation must begin today with efforts to improve current risk management and adaptation. Lessons from current practices, along with the notion that learning comes from doing, are of critical importance.

CURE is a prelude to the big story of Climate Risk Management.

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