International Rice Research Institute - Philippines

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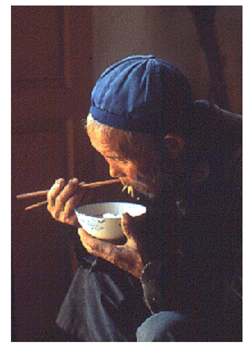

Rice is a grain that has shaped cultures, diets and economies of billions of people.

For them rice is more than food: RICE IS LIFE.

As we usher in a new millennium, scientist and governments are faced with the task of diminishing poverty and extinguishing hunger. The eye-opener of a population surpassing 6 billion brought into light the fact that there are more mouths to feed and lass land to do it on. The fact is a majority of the world's population depends on rice as a main staple in its diet. If we are to maintain the balance of agriculture, culture and society – we need to research rice that will provide higher yields, is drought resistant, and has the ability to adapt to the situations that mankind has provided. We also need to conserve the rice species that are already provided in order to help sustain and create new hybrids and GMO's. We must all make an effort to advance agriculture for nature will not be able to provide for what man has made.

One of every three persons on earth depends on rice for more than half of his or her daily food. Ninety percent of the world's rice is grown and consumed in Asia, where more than half the world's people and about two-thirds of the world's poor live. Rice is also an important staple in Latin America and Africa. The world's annual unmilled rice production, however, must increase by almost 70% from today's 520 million tons to keep up with population growth and income-induced demand for food over the next 30 years.

Rice surpluses and low prices in recent years have given an impression that the world's food production problems are solved. But population pressure in the rice-growing

countries is intense: about 80-100 million additional people must be fed each year. Prime rice lands are under pressure. Resource-poor farmers and the rural landless in Asia are being forced to till highly erodible and marginal lands, or to migrate to urban areas in search of livelihood, often leading to even more poverty. These people will spend ½ to ¾ of their income on rice alone – keeping stability in production is a necessity for social, economical, and political reasons. We must secure a prosperous future for rice by educational activities, cultural preservation, advocacy movements, and research.

Like many of the world's natural resources, rice is facing various problems with few solutions in site. Loss of interest in rice farming is on the incline as many farmers are finding it economically and physically straining to grow rice. Planting, transplanting, and harvesting are a major factor in lack of farming because almost all of them must be done by hand or machinery is inaccurate, unavailable, and costly. Many older farmers must stop because of physical stress, while many young farmers are working as fishers or moving into large cities to find work. This leads to more decrepit and disheveled fields and much less produce. Social problems are also leading to problems faced by farmers things such as smaller family size, and westernizing tradition have led to many farmers to abandon their land.

This abandonment of land to occupy larger cities is also creating a catch-22 for the production of rice. As more rural landowners move into the cities urbanization flourishes. As buildings are cropping up, cropland is being diminished. People in rural areas working to feed these urbanities are unable to keep up with a soaring demand from a skyrocketing population. The inverse effect is present – as population and urbanization increases, available cropland and production decreases.

Lack of government involvement is also detrimental to the rising necessity of rice production. Few governments provide subsides to encourage and assist farmers, nor do they provide education to teach the farmers about new technology and advancement in techniques for more efficiency. Funding for research centers and experiments has decreased dramatically as less and less of the budgets are being allotted for agriculture and science. A quandary stemming from deficiency of government intervention is the imbalance of distribution. Even as the production of rice increases poor transportation and communication leads to uneven distribution of food to the people and in turn creates unstable food security.

IRRI, the International Rice Research Institute, is playing a key role in helping provide solutions to some of the many problems faced by rice today. The goal of IRRI is to conserve, contribute and create rice species of the world. IRRI was established to help farmers in developing countries grow more rice on limited land with less water, less labor, and less chemical inputs, and to do so without harming the environment.

IRRI was established in 1960 as the prototype for a world network of 16 nonprofit international agricultural, forestry, and fishery research centers supported by the Consultative Group of International Agricultural Research (CGIAR). IRRI is located in Los Banos, Philippines (2 hours south of Manila) on the campus of the University of the PI. Though the faculties are not all impressive, the work done within it is extraordinary. IRRI houses many different departments including: plant breeding and genetics – researches GMO's and genetics, the social science department- studies anthropology and geography of people producing rice, training center – sends people to meet with farmers to teach new efficient and economical techniques, and entomology – which studies insects that harm or help rice.

Today, IRRI's research programs concentrate on the three major rice ecosystems: irrigated, rain fed lowland, and upland. A fourth, the cross-ecosystems research program, focuses on research that will generate knowledge applicable to all, or several, programs.

Current projects include developing new plant types for the major rice ecosystems, rice genome studies, sustainability and biodiversity in rice, soil and nutrient management in different rice-growing environments, integrated pest management, rice and global warming trends, and many others that hold the key to enough rice for the 21st century.

So how did a small town girl from Iowa get involved with an international institute? My name is Carolyn Persoon, and I am currently a biochemistry major and at the University of Iowa. In the fall of 1999 I represented Central Elkader at the World Food

Prize symposium and presented an essay on “Food Security and Logistics”. I also heard intricately woven stories of internships that WFP students had done in the summer. The experience sounded exciting and impressive and I was motivated to apply. After I discovered more information on rice such as: in several Asian nations the regional terms for rice and food, or rice and agriculture are synonymous. Once I understood the importance of the need to advance the study of rice, my drive and devotion to the internship became more deeply rooted. I feel that this made my experience more meaningful, educational, and enjoyable.

When I arrived in the Philippines, I was placed into the Genetic Resources center headed by D. Michael Jackson. He is germplasm Specialist and Head, Genetic Resources Center since 1991. The conservation, evaluation, and use of rice genetic resources, biosystematics, and database development are some of the many aspects of GRC that he has developed. Dr. Mike Jackson was associate taxonomist (1973-75) and regional representative (1976-81) for the International Potato Center (CIP), Lima, Peru; potato production specialist, Turrialba, Costa Rica (1976-81); lecturer, School of Biological Sciences, The University of Birmingham, UK (1981-91). He is honorary senior lecturer at The University of Birmingham; member of the editorial board, *Genetic Resources and Crop Evaluation*; author of more than 60 papers in refereed journals, two books, 12 book chapters and more than 80 other publications on genetic resources.

The goal of GRC is to utilize genetic resources of rice effectively to increase the productivity of rice crops. Traditional varieties and wild species of rice are being lost through genetic erosion (the loss of varieties due to excessive cross-breeding). Farmers adopt new varieties to create larger output, and cease growing the varieties that they have nurtured for generations eventually losing these varieties. Wild Species are threatened with extinction as their habitats are destroyed by human disturbance. Future crop improvements need the genetic variation from traditional varieties and wild species to cope with biotic and abotic (insects, drought, bacteria, etc.) stresses that are challenging rice today.

How is this so easily achieved? GRC contains a gene bank that receives, reproduces, and distributes seeds throughout the world. It contains 87,ooo accessions (identified rice species) and 39,ooo more potential accession that it stores for up to 100 years. The gene bank provides ways for researchers and farmers to communicate and receive seeds in order to advance the production of rice.

I was placed in GRC, specifically the molecular marker lab, because of my interest in biochemistry and working in a lab. However, the Genetic Resources Center is not limited to only lab or the gene bank. The center is composed of two screen houses used for cultivation of low viability or low seed stock in order to secure the seed crop and fertility, and also houses wild rice that are unable to be planted in the outside environment for fear of contamination or infestation. A conservation support lab studies cytogenetical research, tissue culture for embryo rescue, and propagation of low viability accessions. These are all used to secure the rice species we have in the world today. Seed testing and germplasm characteristics, as well as the seed health unit assure that incoming and outgoing seeds are disease free and uncontaminated.

One of the most important braches of the Genetics Resource Center is the data management that handles all of the information on approximately 120,000 different accession numbers, handling forms, any characteristical data, and requests from all over the world wanting seeds. The molecular biology/marker lab is employed to study genetic diversity using isozoymes, RAPD, ALF (electrophoresis) and microsatellites to research DNA differences between species of rice. The International Network for Genetic Evaluation of Rice (INGER), also part of GRC, provides breeding lines and varieties of rice developed in countries around the world have been exchanged and evaluated through crossing all political, religious, cultural, and philosophical boundaries. The results of the INGER evaluation are shared with participating countries, with the best-performing rice germplasm freely shared and used without copyright or patent considerations. INGER itself facilitates the distribution of seeds to cooperating countries, strictly adhering to safety and quarantine procedures.

Arriving at an internationally renowned research center and being giving a certain task whose results will be seriously utilized is extraordinarily intimidating. You are quite reluctant and have diminishing self-assurance; the more your project is glorified. The only thing I find you can do is work your hardest, put forth your best effort, and never underestimate your self - if you've done all that you are in the same dominion of any PhD. I did just that and decided that immediately when I arrived I would dig in…I had no idea it would be mud.

The first aspect of my work was to become familiar with the amazing diversity of the rice plant, and what better way to learn than to experience. Into the fields I marched. Tedious and monotonous are the best words to describe the physical stress that planting and transplanting rice is. All of the work is done by hand; initially you carefully place the seeds in dry-beds or semi-dry beds being sure not to drop any outside the planting well. Or if you are lucky, simply scattering the seeds across the bed while wading in shoulder deep water. Then a few weeks later pulling the plants and re-planting in another more spacious bed. I learned a great respect for the farmers who spend day in and day out tending the precious, particular plant. Growing-up in an agricultural background, I knew how difficult farming was, but to have to plant by hand and have no hybrid guarantee of a certain percentage yield – that is admirable. The farmers come to have a certain fondness and bond with the rice after devoting a lifetime to its production.

Next, I worked in the screen house recording vegetative characteristics of hybrids. This is done to correlate physical characteristics of the hybrid to that of the parent plant. It is necessary to have this data so in the future dominant and recessive characteristics will be know, and the researcher can create the desired hybrid. It was very hot and tiring work after 10 a.m., all the plants must be characterized within a weeks span in order to obtain correct results with a slight time variable.

Pollen counting was another project I worked on at this time. The name of the experiment is very descriptive, yes all I did was remove stigmas from rice seeds, dye them with KI (Potassium Iodide) and then count the cells under a microscope. This taught me that research is far from a glamorous job. Much of it is background data gathering and repetitive experiments, yet the finished product is one to be proud of. Every small step counts, no matter how seemingly insignificant. The pollen counting was studying the fertilization of hybrids; this was background information necessary for future referencing on crossbreeding accessions. This step also incorporated data management as I spent days entering data I had found into the main computer.

Experimenting began with breaking dormancy of rice plants. Dormancy is natural defense found in wild rice that is vital for survival in their natural environment, but detrimental to research. Seeds to prevent germination until a temperature use this tactic of dormancy or chemical change occurs, signaling that it is the appropriate time to germinate. This guarantees a chance of survival to the species of rice; however, in the lab it is necessary to break this instinct in order to study the species. I began by placing seeds in a moist petri dish and then attempting to break dormancy with different variables such as: changing cold to warm temperature, applying chemicals (HCL), or simply dehulling the rice. The short-term experiment lasted only a week. The analysis was after 7 day when I recorded a ratio of germinated to non-germinated seeds.

Looking at the DNA of 13 specific accessions or potential accessions to determine if they were repetitive and had exact replicated characteristics – this was my main experiment in the molecular marker lab. Initially, I gathered leaf samples and immediately ground them into a powder with liquid Nitrogen. The N (l) is used to preserve the leaf samples and also to maintain a clean workspace and avoid contamination. The leaf samples were kept in an –80 degrees Celsius freezer until further steps. It was then necessary to combine the chemical reagents/reactants I would be using throughout the experiment. I first found appropriate proportional ratios, combined the chemicals, and sanitized the solutions and any equipment I would be using in order to prevent DNA pollution.

Once all the chemicals were combined, I began extracting the DNA from the leaf cuttings. A small ball of DNA in the tube was all that was necessary once diluted with buffer. The diluted DNA was then mixed again with chemicals and placed in a gel for quantification. After the DNA had quantified, a UV light photo is taken of the samples to compare with a constant DNA ratio, we use this constant to base how much the DNA must be diluted again.

Mixing DNA once again with the prepared chemicals, we place it in a PCR (microsatellite protocol) to be magnified and amplified in order to be detected in the electrophoresis. This step must be repeated with all 13 accession number 20 times; each time with a different extractor that amplifies only specific patterns of strands in the DNA (i.e. ccgggtattaggg). Once amplified by the PCR, the DNA is placed in a gel and set into an ALF (electrophoresis) machine that is connected to a computer. The ALF uses a laser to detect certain time intervals of DNA particles passing through; this information is transferred to the computer, which then provides the information in a visible distinct graph, table, and chart.

With this information provided from the ALF, I was able to analyze the data, comparing the characteristics of each accession to find if there was indeed a repeated species. My results proved that the Caloro (wild rice) species was exact replicas and could be diminished to one accession. The Azucenas (domesticated rice) proved to have 2 pairs of identical accessions. However, my IR20 (hybrid rice) was inconclusive, teaching me the lesson that many experiments must be repeated several times to achieve accurate results.

The work I accomplished at IRRI benefited both the institute and individual scientist because it deleted the high likely hood of flaws in experiments conducted with repetitive accessions. It prevents false documentation of results and therefore promotes more positive aspects and results of agricultural experiments. It advocates more rapid results and correct results that will increase production of food and availability to food to people around the world. The constant availability and access to food will provide a stable food security around the globe.

While experiencing my internship I learned to remember your sunscreen, and to always apply to your feet. That not everyone speaks English, and not everyone wants to. When going into an unknown situation bring an open mind, and an open umbrella. Bring a journal. Remember to be polite even though it is chicken intestines. The hot know in the shower is not always warmer than the cold. Exchange addresses with everyone before leaving, and write constantly. Remember a good book; know that even though you leave Minneapolis at 11:15 and arrive in Osaka, Japan at 3:05 – it is not a 4-hour flight.

Most importantly however, I learned to extend my horizons past the cornfields I am surrounded by. The more I have come to understand about varying agriculture and culture, the more understanding I gain of my own. We cannot reverse some of the trends we see destroying rice farming. We cannot stop the expansion of urbanization or shrink what we have already constructed, but we can learn from these mistakes. In our own country we see the lack of interest in farming, high priced machinery, and lack of government involvement in the new monopolies in the farming business. To prevent what is happening to rice today from happening to our own crops we must stop the pattern of practices that has already begun. I can now look out to the skyline and see not only corn, but also wheat, tea,

and rice with all the nations, cultures, and people who produce them.