From the Lab to the Table…

Rice Production in the Philippines

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Introduction

The summer before my senior year of high school, I began seeking out articles concerning food security issues. I worked at a swimming pool as a lifeguard, and while my coworkers dug into *Cosmopolitan* during break, I got out 30-year-old issues of *National Geographic* containing articles about Norman Borlaug and the Green Revolution in Africa. My business teacher had approached me during the spring semester about taking part in something I had never heard of: the 2009 World Food Prize Youth Institute. She was really excited about it, and it sounded like a cool and unique opportunity, so there I was, spending my summer vacation writing an essay about the adversities facing the country of Haiti, located a mere 600 miles from the luxurious resorts of Miami. My teacher had also mentioned an internship opportunity associated with the Youth Institute, but I knew that of all the people applying for the internship, few were awarded it, so I stayed focused on my paper and decided to cross that bridge if I came to it.

I came to it. I had applied with nothing to lose, and everything to gain. A few months later I was congratulated and informed that I would be spending the summer of 2010 on the other side of the world, 8,000 miles away from my home in Rolfe, Iowa. I would be spending my summer in Los Baños, Philippines at the International Rice Research Institute (IRRI).

For a few years, I had really been set on pursuing a career in genetic research, so IRRI was a good fit for me. However, I also appreciate the less technical and more personal angle of science. Luckily, I was able to have a dual project, splitting my time at IRRI between two departments. My first project was purely scientific and all took place in a laboratory. My second project was on a more social, delving into the complexities of the relationship between research done in the lab and its impact on the rural farming villages.

Background of IRRI

IRRI is based in Los Baños, Philippines, but has fourteen additional branches in other Asian countries and in Africa. It is the oldest and largest agricultural research center in Asia (IRRI) and has a remarkable reputation as an international research center due to the prestige of the research conducted and the seminars held there. The mission of the institute is to "reduce poverty and hunger, improve the health of rice farmers and consumers, and ensure that rice production is environmentally sustainable" (IRRI). In keeping with this mission, IRRI has established relationships with other countries that both produce and consume rice and their respective agricultural research and extension programs. They have built partnerships with farming communities and a collection of organizations ranging from the local to international levels (IRRI). IRRI collaborates with these other organizations to further rice research, and, more broadly, agricultural research. By joining forces, the resources, experience, knowledge, and techniques of many institutes are shared. It cannot end with the cold science, however. To be effective and remain relevant, the knowledge gained in the labs at IRRI must be put into practical use. To facilitate the conversion of intelligence from lab to field, IRRI conducts training and educational sessions for those aiding rice farmers and circulates new information and technological innovations (IRRI).

The Ford and Rockefeller Foundations established IRRI in 1960 in cooperation with the Philippine government (IRRI). The establishment of such an institution was imperative, as almost half of the world's population relies upon rice as a chief source of nutrition (IRRI). Though most of the countries that produce and consume rice are in Asia, rice is also a crucial staple in Africa and South America. Many of these consumers and producers are among the world's poorest, which puts the production and distribution of rice in a place of high economic importance (IRRI). Also, because rice fields cover eleven percent of earth's arable land, the importance of research and technological innovation for environmental sustainability is emphasized (IRRI).

IRRI's first great agricultural research success came in the 1960s with the development of the variety recognized for sparking the Green Revolution in rice. This variety is accredited with saving millions of Asians from starvation and laid the foundation for Asia's ensuing economic maturation (IRRI). As a result of IRRI's years of research, production of rice has increased and price has decreased, which has been very good news to the world's poorest (IRRI). IRRI's research has had an immeasurable impact on an incalculable number of people.

Project I Premise

I spent the first month of my internship in the Gene Array & Molecular Marker Application Lab (GAMMA lab). I was in the Plant Breeding, Genetics, and Biotechnology (PBGB) Division under the supervision of Dr. Michael Thomson. Also helping me with my project were Erwin Tandayu, who recently obtained his B.S. in biology, and an assistant scientist, Mayee Reveche, who is a molecular biologist by training and has worked for IRRI since 1995.

Initially, the basic goal of my project was the identification of rice varieties. PBGB has a project planned for the future involving the development of a large database including all the known rice varieties and their respective names. One obstacle hindering the development of such a database is that the farmers share rice seeds amongst themselves and get seeds from sources other than seed companies. Because of this, the names of the varieties are often unknown or changed. The purpose of my project was to compare genotypes of known rice varieties to samples collected from local farmers' fields using marker data and to determine the authenticity of the varieties actually grown by the farmers.

The hypothesis was that there was some discrepancy between what the farmers said they were growing versus what was actually grown. To confirm this hypothesis, DNA fingerprinting had to be done on both the farmers' varieties and known varieties to show that the genotypes of the two samples were different. It is important for IRRI to know what varieties the farmers are growing so that IRRI can collaborate with the farmers and improve these varieties, instead of spending time on something irrelevant. What makes this difficult is that IRRI is not able to identify the varieties that the farmers are growing without doing DNA analysis.

Due to the lack of monitoring, the confusion regarding rice varieties has also been economically problematic. Because farmers don't know exactly what variety they are selling, they simply name their rice whatever variety is presently at the highest value.

By the end of my time in GAMMA lab, my project's goal had evolved and grown to include another objective: to determine if the seeds that the farmers were using were "pure" (of a single variety), or if within a single field the farmers were actually planting more than one variety unknowingly.

Project I Activities

Except one afternoon spent in farmers' fields to collect the samples, all of my work was done in the laboratory. After collecting almost ninety samples from a few different local fields, we began extracting the DNA. There are various protocols for extraction, but the basic concept is to break down the cell walls and use enzymes and extreme temperatures to separate the DNA from the other "junk" components of the cell. When extracting DNA from the field samples, we cut the rice leaves into small pieces, placed them in test tubes, and used a technology called a GenoGrinder to pulverize the pieces into a fine powder. When extracting from the control group (CG) samples, we ground the leaves by hand, using liquid nitrogen and a mortar and pestle. In both extractions, after the samples were in powder form, we went through a tedious process of adding buffers (see Appendix 1), centrifuging, incubating, and finally decanting the aqueous phase

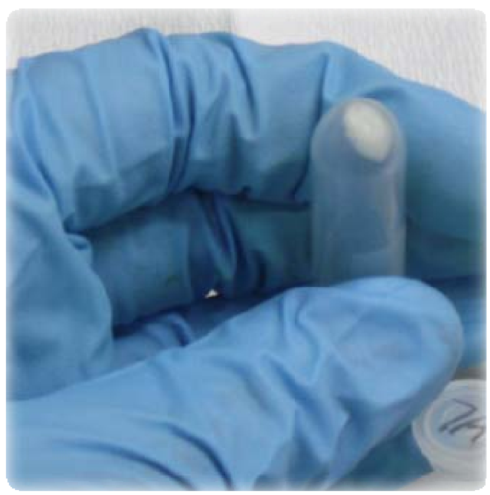

Image 3. Visible DNA pellet.

(the DNA) into a new test tube. We then precipitated the nucleic acids twice, once with isopropanol and then with sodium acetate. After precipitating, the DNA becomes a visible pellet, as seen in *Image 3*. Once in pellet form, the DNA is washed with 70% ethanol to reduce residual salt.

Next we utilized a technology called NanoDrop. Nano-dropping is used to determine the concentration and purity of the sample collected. An example of nano-dropping results can be found in Appendix 2. The columns labeled "ng/ul" and "260/280" indicate concentration and purity, respectively. A good sample will have around 1000 ng/ul and the number determining quality should be less than 2. The concentration was high enough for most of our field samples, but the results also indicated that our samples were impure and therefore contaminated. To improve purity we re-precipitated and re-washed the samples in 70% ethanol.

Once we had determined the concentrations, we were able to normalize the samples by diluting them with water. This makes the concentration of all samples the same so that the remainder of the process is more efficient. We also ran the samples through an agarose gel at this point, for the learning experience and for visualization. Following normalization, the samples must be amplified through polymerase chain reaction (PCR). PCR denatures the DNA, and through the use of primers and other components added to the sample, rebuilds and multiplies the initial amount. For my PCRs, we added 2 ul of the template DNA/controls and 13 ul of the cocktail, or the mixture of primers and other components (Appendix 3). After loading the PCR trays for amplification (see Appendix 4), we added a drop of mineral oil to each well to prevent evaporation of PCR product due to high temperatures. In simplest terms, the goal of PCR is to make more of what you already have. For my study, we multiplied the initial amount by thirty-five.

Following PCR, we had to do gel electrophoresis to be able to compare the genotypes of the samples. Electrophoresis is the transfer of a small amount of each DNA sample through a porous gel by electrical current. This works because DNA has a negative charge. We used polyacrylamide gels (PAGE gels, see Appendix 5). We ran the DNA samples through the gel for 1.5 hours at 100 volts. After electrophoresis, the gel is removed from the rigging and placed in a staining solution, Sybr Safe, which makes bands created by dye

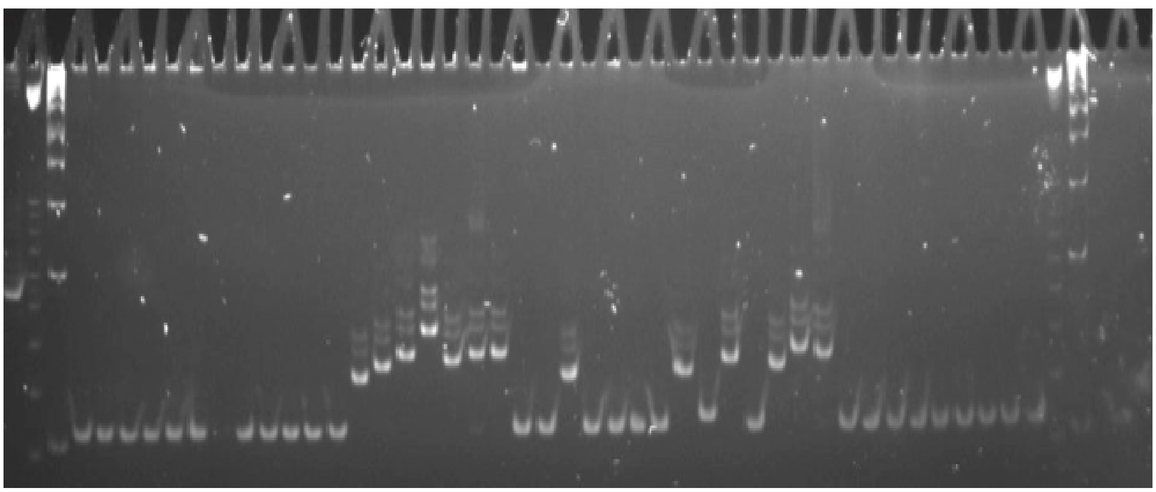

Image 2. PAGE gel, stained and viewed under UV radiation.

in the DNA visible under ultraviolet radiation. Different components in the sample DNA are different sizes and run through the gel at different speeds, creating the bands. Molecular markers, commonly called ladders, are also added to the gel and create bands during electrophoresis. Because we know the DNA sequence of the ladders, if any of the DNA sample bands run through the gel to the same depth as a ladder band, we can identify what component that part of the DNA is, creating a genotype of the previously unknown sample. In *Image 2*, you can see that the ladders were loaded on both ends of the gel and that the samples were loaded into the wells between the ladders. Ladders can also aid the scientist in identifying the start and end of a gel so that sample locations within the gel can be determined and there is less confusion.

We next scored the gel photographs for analysis using Microsoft Excel. In scoring, every band that ran the same distance (and therefore has the same size) is given the same number. We could then compare the sequence of numbers from the CG gels to the field sample gels to determine if any patterns were similar and therefore of a similar or identical variety.

Outcomes of Project I

PBGB is going to create the aforementioned database in the future. In a sense, I was "testing" this future project. The division wanted to observe whether DNA fingerprinting could achieve their goal and whether it would be effective and successful.

Due to few unforeseen events, errors, and time constraints, the outcomes of my project were slightly different from what had been expected. Identifying the field varieties was still a goal, but because the analysis for that is so much more difficult and much more time consuming, we were not able to complete it in the time that I was there. We also modified that goal to make it less specific and more general. Instead of determining which varieties were grown in the field, we were to determine which field samples clustered (related) to the control group varieties. By doing this, we would gain a better understanding of what varieties were grown in the field. Additionally, we examined the gels to discover discrepancies in what was supposed to be only one variety. For example, all the samples under the pink line in *Image 3* were from the same field and, according to the farmer from whom we collected, were of the same variety. However, when analyzing the gel shown in *Image 3*, we saw that two of the samples showed a different banding pattern (noted by arrows). This indicates that these samples are of a different variety. The

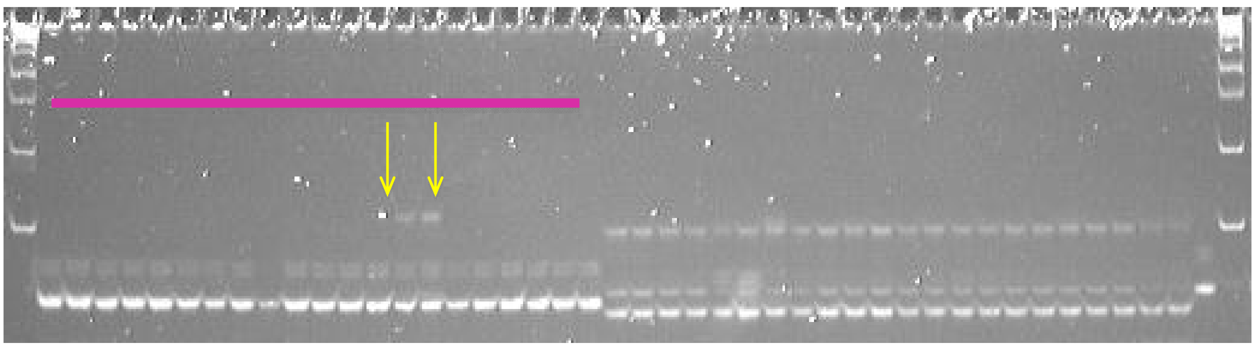

Image 3. PAGE gel, stained and viewed under UV radiation

difference in variety within a single field could be due to contaminated seeds or drop seeds from the previous season. It is also possible that the change in banding pattern is due to experimental error.

Although I was not able to obtain more substantive results before leaving IRRI, I still learned an immense amount in GAMMA lab, such as lab techniques; molecular marker technology; scientific concepts, such as the makeup of DNA; and the basic principles plant breeding and plant genetics.

Project II Premise

During my second month at IRRI, I worked in the Crop and Environmental Science Division (CESD) in Dr. Grant Singleton's group. Dr.

Singleton has worked in science since 1982 and has specialist expertise in the management and delivery of integrated technologies, in wildlife management (specifically in rodent biology and management), and in the management of research and extension projects in several countries. Within CESD, I was working with the Irrigated Rice Research Consortium (IRRC) group. The IRRC's goal is to ensure that Asian rice farmers reap the benefits of the technologies that result from scientific research through information dissemination (IRRI). While in the IRRC, I was mentored primarily by Rica Flor, an anthropologist who has done social science research in several Asian countries and has contributed to a multitude of publications.

On my first day in the IRRC, Rica said something that made me pause and think. She told me that the IRRC's work revolves around one question: How can IRRI take research from science to impact? Basically, why should we pour all this money and time into very technical and scientific work, if we don't also establish a link to the farmers so that the scientific discoveries can be used in the real world? Where my first project was strictly science and principles, my second project was about communication and building a bridge between two very different groups of people: the highly educated researchers and the common indigenous farmers.

My project with the IRRC revolved around women. Often times in agricultural research, women's roles and contributions are largely ignored (CGIAR). Success of agricultural research is measured by the rate of adoption of new technologies and the impact that those technologies have on food production and the livelihoods of the users and benefiters (CGIAR). This success depends on (1) understanding the “knowledge, systems, and priorities of farmers and users and (2) the use of gender analysis to ensure that the knowledge and views of all stakeholders is represented” (CGIAR). Women make up a large percent of the stakeholders. In Thailand, Indonesia, and the Philippines, women supply up to 50% of the total labor input in rice production. Women perform as much as 80% of the labor in India and Bangladesh (CGIAR). Women are responsible for transplanting and weeding. They help with the harvest. They manage most post-harvest activities as well as take responsibility for the threshing and milling of rice for family consumption. Many times, the women grow other crops and care for livestock. They manage cash flow and make decisions regarding pesticides and the adoption of new technologies (CGIAR). The role that women play is huge, and yet there have been few research projects that have made this crucial gender distinction (CGIAR).

My project focused on women and post harvest and the associated problems and strategies. The main concern of the IRRC is to facilitate the impact of research conducted here at IRRI in the labs and greenhouses, so my study was concentrated on how the research to impact conversion operates and its effect on women farmers specifically. I was to observe the process from the perspective of a social scientist.

Project II Activities

The goal of my project was to contribute documentation of this conversion process. For example, in the beginning, I was to observe how hermetic storage technology is disseminated to the farmers and the impact it has on their livelihoods. To do this, I spent my first few days with the IRRC at a workshop with people from IRRI, PhilRice, and other IRRI partners. The objective of the workshop was to create two mediums of communication to disseminate clear and useful information about hermetic storage concepts and hermetic storage devices to the end-users, namely, the farmers. By the end of the workshop we had developed a flipchart to be used during instruction and two fliers to be distributed at farmer training sessions. This workshop served as my introduction of the translation of research to impact.

Image 4. Message Design Workshop

A week after the workshop, I went with a group of other participants to Calauan to pre-test the communication materials with local farmers. The objective was to get input from the end-users on how the products were perceived and what improvements could be made. The farmers were very receptive to this activity. The researchers asked the farmers questions about the materials' aesthetics, the clarity of the messages, and the usefulness of the content and product. Following the pre-test, Rica and I stayed behind to talk with the farmers about their postharvest practices so that I could learn more about this aspect of rice production and also so that I could have practice interviewing. A report from this interview can be found in Appendix 6.

In my second to last week with the IRRC Rica and I traveled to Camarines Sur so that I would have the opportunity to speak with women rice farmers about postharvest. The first few days we were there, Rica conducted a training session for interviewers from an NGO that were to help the IRRC with a postproduction survey in the province. I observed the training session and was able to learn about interview technique and protocols. On the third day, I was given the chance to meet with women from Candato, a barangay of the town of Libmanan. The questionnaire used for discussion and a report from this interview can be found in Appendix 7. While interviewing the women I would ask the questions in English, Rica would translate to Tagalog, the women would respond in Tagalog, and Rica would translate back to English. It was a lengthy process, and the women know English, but it is ideal if they are able to use their first language so that they can fully express themselves.

Image 5. Women farmers from Candato, Libmanan, Camarines Sur

Projected Outcomes of the PRSSP and the ADB Postharvest Project

There are two projects that my study may contribute to in the future: the Philippine Rice Self-Sufficiency Project (PRSSP) and the Asian Development Bank (ADB) Postharvest Project.

The PRSSP is a plan that was formulated by the Philippine Department of Agriculture in an effort to increase rice production and reduce imports. Its goals include attaining rice self-sufficiency, improved productivity, and increased income of rice farmers. The IRRC is one of many organizations contributing to this project and mostly focuses on unified capability-building support. They work on developing and enhancing the capacity of farmer intermediaries through training and produce informational communication materials. They also monitor, assess, and document farmer adoption rates of new technologies and the resulting impact.

The goal of the ADB Postharvest Initiative is to disseminate new and effective technologies to decrease postharvest losses in three countries: Vietnam, Cambodia, and the Philippines. IRRI is involved only in the Philippine branch. To meet the objectives of the project, strong extension networks must be in place, primarily learning alliances. The learning alliances are expected to (1) increase diversity of technological options, (2) facilitate group reflection to increase interaction among stakeholders, and (3) improve the stakeholders' ability to identify and choose which innovation works best (Schuetz). IRRI is a member of the Philippine learning alliance. The IRRC coordination unit is involved in examining the adoption and impact of postharvest technologies.

Because my study was about women in postharvest and how new technology is affecting or would affect them, it is during the impact monitoring of these two projects that my findings will be most applicable.

Reflections

While I may not have been able to make a significant contribution to the advancement of IRRI's research, IRRI undoubtedly made its mark on me. My time there taught me things that I didn't expect to learn. I knew before I went that I would learn about rice farming, food scarcity, Filipino culture, lab techniques, and international relationships, but I didn't know what life lessons I would learn.

My experience taught me that the old adage is true: knowledge is power. One must know something if one is going to do something. While at IRRI I was surrounded by skilled technicians, graduate students, PhD students, post-doctorates, esteemed researchers, and world-renowned experts, all of whom were dedicated to rice research. I saw that even the highly accomplished experts strive to discover something new, with the hope that the unveiled knowledge might someday save a life. The old adage can also be applied at a more fundamental level: in the field. Without the proper training and understanding, we cannot expect the rice farmers to make progress. And with the exponentially increasing world population, progress *must* be made. The fight against hunger must have a unified front, involving people at every level of the operation. I learned that science is not enough. *Implementation* is the key. And implementation cannot come without communication. During my time at IRRI, I saw firsthand how important relationships and communication are, in transferring the scientific concepts from the lab to the soil.

Being at IRRI and seeing the passion that ignites the people there was truly inspiring. The scientists may have different tactics and methods, but they all have a common goal: to eliminate hunger. I learned that even if the war on hunger doesn't become my life's work, whatever my calling is, I must have that same enthusiasm and vigor. I learned that there are people in this world who work for more than just the paycheck. They work for the cause. And that is truly admirable.

APPENDIX 1

Buffers Used for DNA Extraction Miniprep Using Modified CTAB Method

- 1M Tris-HCL (pH 8.0) for 250 ml

- 0.5 M EDTA (pH 8.0) for 250 ml

- TE 1L
  - 2.5 ml 1M Tris HCL (pH 8.0)
  - 0.5 ml 0.5M EDTA (pH 8.0)
  - 247 ml distilled water

- 3M Sodium Acetate
  - 123.1g NaOAc dissolved in 400ml of distilled water
  - Adjust pH to 6.0 and volume up to 500 ml

- 2x CTAB Buffer for 200 ml
  - 172ml water
  - 20ml Tris (pH 8.0)
  - 8ml EDTA (pH 8.0)
  - 4g CTAB
  - 16.37g NaCl

APPENDIX 2

Example of Field Sample Nano-Drop Results

	Ng/ul*	A260	A280	260/280**	260/230
1	979.44	19.5	9.412	2.08	2.19
2	909.92	18	8.608	2.11	2.18
3	892.39	17	8.67	2.06	2.14
4	794	15.8	7.814	2.03	1.89
5	64.08	1.3	0.613	2.09	1.12
6	1050	21	10	2.08	2.15
7	714.6	14.29	7.058	2.03	1.88
8	968.88	19.378	9.735	1.99	1.76
9	19.36	0.387	0.181	2.14	0.5
10	1538.87	30.77	14.6	2.11	2.14
11	2350	47	25.7	1.83	1.29
12	761.66	15.233	7.4	2.05	1.98
13	508.79	10.176	4.99	2.04	1.99
14	677.94	13.559	6.59	2.06	1.86
15	7.84	0.157	0.071	2.21	0.23
16	400.08	8.002	3.854	2.08	1.97
17	1252.5	25.05	11.951	2.1	2.03
18	1070	21.4	10.3	2.08	1.98
19	1021	20.4	9.82	2.08	1.96
20	707.98	14.16	6.898	2.05	1.86
21	1899.94	37.999	17.879	2.13	1.95
22	2170.72	43.414	20.74	2.09	1.96
23	2092.3	41.845	19.814	2.11	2.1
24	1528.69	30.574	14.45	2.12	2.04

APPENDIX 3

PCR Cocktail Components

Reagent	Stock Concentration	Final Concentration	One Reaction (ul)
Sterile Water	---		8.5
PCR Buffer	10X	1X	1.5
dNTP	1 mM	0.1mM	1
Primer-Forward	5 uM	0.25 uM	0.5
Primer-Reverse	5 uM	0.25 uM	0.5
TAQ Polymerase	0.75U/ul	1 U/10ul	1

Primers Used for PCR

	PRIMER	PCR PRODUCT SIZE (Base Pairs)	ANNEALING TEMPERATURE (Celsius)
1	283	151	55
2	495	159	55
3	525	131	55
4	561	190	55
5	55	226	55
6	514	259	55
7	307	174	55
8	335	104	55
9	334	182	55
10	516	206	55
11	510	122	55
12	527	233	55
13	11	140	55
14	455	131	55
15	152	151	55
16	223	165	55
17	215	148	55
18	434	152	55
19	258	148	55
20	271	101	55
21	332	183	55
22	552	195	55
23	19	226	55
24	277	124	55

APPENDIX 4

Field Sample DNA Template Tray for PCR

	1	2	3	4	5	6	7	8	9	10	11	12
A	1	2	3	4	-----	6	7	8	-----	10	11	12
B	13	14	-----	16	17	18	19	20	21	22	23	24
C	25	26	27	28	29	30	-----	32	33	34	35	36
D	37	38	39	40	41	42	44	45	46	47	48	49
E	-----	-----	52	53	50	51	54	55	56	57	-----	58
F	59	60	61	62	63	64	65	66	67	68	69	70
G	71	72	73	74	75	76	-----	78	79	80	81	82
H*	83	84	198	198	198	198	198	218	218	218	218	218

Control Group Sample DNA Template Tray for PCR

	1	2	3	4	5	6	7	8	9	10	11	12
A	1C	2B	3A	4B	5B	6A	1C	2B	3A	4B	5B	6A
B	7C	8B	9C	10C	11A	12B	7C	8B	9C	10C	11A	12B
C	13A	14A	15C	16A	17A	18B	13A	14A	15C	16A	17A	18B
D	19B	20C	21C	22A	23B	24A	19B	20C	21C	22A	23B	24A
E	25C	26C	27D	28A	29C	30D	25C	26C	27D	28A	29C	30D
F	31D	32A	34D	35C	37D	-----	31D	32A	34D	35C	37D	-----
G	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
H*	198	198	198	218	218	218	198	198	198	218	218	218

**Row H contained controls*

***Spaces with dashes did not contain samples or controls*

APPENDIX 5

8% PAGE Gel Components:

- Sterile distilled water
- 10X TAE
- 40% Acrylamide
- APS (Ammonium persulfate)
- TEMED (Tetramethylethylenediamine)

APPENDIX 6

Postharvest Interview Report

Location: Calauan, Laguna

We spoke with a group of six farmers. Some of them had been farming for as many as nineteen years, and others only five. Most of them inherited their land and they said that it's as if they have farmed all their lives. All of them were tenant farmers. Government regulations mandate that the crop be shared between tenant farmer and landowner in a 70:30 ratio, respectively. Aside from farming their own land, many of them also work as laborers in others' fields. Other than rice, the farmers plant vegetables and fruits. They involve their children as little as possible in the farm work. They want their children to go to school and become something 'better' than a farmer. When children are used on the farm, they generally help with the weeding, harvesting, and re-planting.

The farmers use certified seeds only. One variety named was RC130 Angelika.

The farmers identified several common problems in postproduction. They named rain, climate, rats, other pests, and high moisture content, which damages the seeds.

Harvesting is done manually, but threshing is mechanical. When eighty percent of the panicle is a golden color the farmers know that it is time to harvest. Many people do harvesting. Each hectare is divided into plots, and one person is assigned to harvest one plot. Each laborer will receive ten percent as compensation. The same person harvests the same plot each season, and if they cannot or will not do the work, it is their responsibility to find a replacement. Each harvester is responsible for transporting the rice from his or her plot to a nearby shed. If the harvest is good, they might receive one-fourth a bag of rice for every ten bags they haul.

The gross amount harvested from one hectare is approximately 5 tons. After ten percent is given to each harvester, ten percent is given to the thresher. The farmers sell their seeds wet for 11-14 pesos/kilo. It is important that the seeds be white, clean, have a long panicle, and not be contaminated by mixed stalk or weed seed. For household consumption, they save one bag of rice for each person in the family. They use solar drying and usually women do the drying labor. Two bags per hectare are saved for the next season's seed. Seeds and grains are stored in their houses in bags. Farmers did not feel that their current postharvest activities incur significant losses in paddy.

The farmers have established an association. They have trouble gaining members and support however, because co-ops have a reputation for failing. They don't want to organize but see it as a need to address common problems. They would rather have one person invest in equipment and then pay to use it. They fear that no one would volunteer to maintain community-purchased equipment. The Department of Agriculture has offered to make a co-investment with the farmers to purchase a flatbed dryer and a warehouse to store seeds. The problem is that there is no land on which to put the dryer and warehouse; they need a donation. They fear that if someone donates the land, the donator would have a sense of ownership over the new equipment, and it would not be viewed as community-owned. The new equipment and warehouse would require around one thousand square meters.

In postproduction, women help with harvesting, sun-drying the rice for household consumption, and gleaning. Gleaning is the process of "re-harvesting" what was missed during the main harvest. The farmers felt that women wouldn't be affected if combine harvesters, dryers, or hermetic storage were introduced to the community. Because of the rate of migration and loss of labor force, the farmers felt that combine harvesters were needed.

APPENDIX 7

Questionnaire Used for Women in Postharvest Interview

Location: Candato, Libmanan, Camarines Sur

I. Getting comfortable

Introductions

Why we are here

Let the participants talk about themselves

- Names
- How long have they been involved in farming?
- Have they always lived in Camarines or are they migrants from other provinces?
- How much land is owned by the families
- When not helping on the farm, do they work elsewhere?

II. Activities

What are their main household responsibilities?

With which parts of rice production do they help with? Why?

How many times per month are they called to the field to work?

On which postharvest task do they spend the most time?

Do they think these tasks are strenuous/taxing? Which task is the most strenuous/taxing? If they could avoid these tasks and do other things instead, would that be better for them?

Do children help in any of these activities? Which activities do they help with? Do they have to spend time off school to help with these activities?

How do they balance their domestic responsibilities with working during postharvest?

If the labor they are required to do could be replaced by machinery, how might they spend that extra time? (with children/growing supplementary crops/livestock/etc)

III. Postharvest Technologies

What, if any, technology do they use in postharvest?
(just for follow-up in case they are quiet) Are they familiar with harvesters/combines, threshers, solar dryers, flat bed dryers, cocoon, or superbags?

How/where do they access the technology? (own it/rent it/etc)

How will they be affected if the community uses…combine harvesters?…a dryer? …hermetic storage? Do they feel that they would benefit?

IV. Decision Making
What role do they play in household decision-making? Are they the primary/secondary/co-decider?

Are they consulted when deciding when to plant/spray/harvest/sell?

Are they consulted when deciding to purchase machinery/insecticides/herbicides?

Are they consulted when deciding how to allocate funds?

For those who contribute income to the household, do they control where the money will be allocated?

Closing: (after summarizing) What is the best part of being a woman farmer?

Women in Postharvest Interview Report

Location: Candato, Libmanan, Camarines Sur

We spoke with a group of seven women farmers and three male leaders. Most said that they had been involved in the farming process since birth, that they had been "raised into" farming. Most had been involved in the planting for fifteen to thirty years. Only one of the interviewees had migrated to Camarines Sur; the rest were born there. Most of the families of the interviewees owned one or two hectares, but one family owned three hectares. The women's husbands owned the land that they worked on. When the women aren't helping with farming, they care for livestock: pigs, turkeys, ducks, and sows.

The women said that they are responsible for running the household. They do the laundry, cooking, cleaning, and caring of children and grandchildren.

In the field, the women help with planting (1 day), harvesting (1-2 days, up to 1 week), and weeding (done after the spraying of herbicides). After the planting, the women are generally only called to the field about twice a month to do light labor. During heavy work, the women are not involved, but bring food out to the field for the men.

During postharvest, women spend the most time on drying. They cannot lift the heavy bags of rice after drying so transport is hired. The women said that drying is a very taxing activity. They reported that they dry the rice on the streets (solar drying) and that one of the biggest problems they face in drying is the rain. Most of the rice they are responsible for drying is intended for household consumption, but it is often times later sold so that the family can pay off loans.

During postharvest time, the women are still responsible for all of the housework. Drying is an added chore during this time of the year. If they weren't required to do this form of labor, they would employ themselves with other farm labor.

Children 12 years old and older help with drying after they are dismissed from school. Usually, only the children of laborers miss school to help with farm work.

The women reported that the families own threshers and 4-wheel tractors that multifunction. The village has access to technologies through the agriculture office and the NGO (Caritas Diocese of Libmanan). The women themselves do not use technology, aside from solar drying. If new technologies were introduced into their villages, the women feared unemployment for the laborers. The lack of technology facilitates more jobs and if the manual labor were not in demand, men would have to migrate to find work. The women would not migrate, but would like to take up craft making. They indicated that they want to do business crafts, but would need a cottage industry set-up to be successful because they would have no way to market their products. The women did indicate that one technology they could benefit from without risking higher unemployment rates was safe storage devices.

When asked about household decision-making practices, the women replied that they were “co-deciders.” They were expected to make independent decisions regarding clothing, food, and children. Often when decisions are made about when to plant, spray, harvest, and sell the entire community is involved, and all the farmers act together. When these decisions are made there are barangay (village) meetings, and if one of the women’s husbands cannot attend, she will go in representation of their family. They indicated that women are strongly involved.

The women are also consulted in decisions regarding the purchasing of machinery, insecticides, and herbicides. Generally, the men decide what and when to purchase, and the women are responsible for purchasing or obtaining the credit to make the purchase.

Generally, household funds are pooled and women are consulted when deciding how to allocate these funds.

In closing, the women said that the best part of being a woman farmer is being able to provide food to their families and being able to keep them fed until the next harvest.

Works Cited

CGIAR Gender Program. “From Field to Lab and Back.” CGIAR, n.d. PDF file.

Difuntorum-Tambalo, Dinah Q. *Laboratory Protocols (Molecular).* N.p., n.d.

IRRI. *Irrigated Rice Research Consortium*. International Rice Research Institute, Jan. 2009. Web. 15 July 2010.

IRRI. *Laboratory Handbook on Molecular Marker Application for Rice Breeding*. International Rice Research Institute, 2010. Print.

IRRI. “What Impact Does IRRI Have on Rice Research?” International Rice Research Institute, 2007. Web. 14 July 2010.

IRRI. “What is IRRI?” International Rice Research Institute, 2007. Web. 14 July 2010.

IRRI. “Why an International Research Center for Rice?” International Rice Research Institute, 2007. Web. 14 July 2010.

Schuetz, Tonya, et al. *Participatory Impact Pathway Analysis (PIPA) Workshop Report Rice Postharvest Management in the Philippines.* 2009. PDF file.

Thomson, MJ. *DNA Extraction Miniprep Protocol for Rice Leaves*. N.p., n.d.