REPORT OF THE MEETING
OF THE
ADVISORY GROUP FOR RESEARCH
ON CROPPING SYSTEMS
IN SOUTH AND SOUTHEAST ASIA

IRRI - 10, 11, 12 April 1973

Participants

From IRRI - Dr. D.S. Athwal
Mr. G.R. Banta
Dr. R.R. Harwood
Dr. M.R. Vega

THAILAND - Dr. Bhakdi Lusanandana (Ministry of Agriculture)

TAIWAN - Dr. R.F. Chandler, Jr. (Asian Vegetable Research
       and Development Center)

HYDERABAD - Dr. J.S. Kanwar (ICRISAT)

PHILIPPINES - Dr. A.A. Gomez (UPCA).

THAILAND - Mr. D.C. Finfrock
       Dr. A.R. Thodey (Ford Foundation, Chiang Mai University)

IRAN - Dr. D. Leeuwrik (ALAD Project)

SAMARU - Dr. D. Norman (Ahmadu Bello University)

NEW YORK - Dr. D. Hathaway (Ford Foundation)

SINGAPORE - Dr. E.V. Araullo (IDRC)

OTTAWA - Mr. G.R. Bourrier
       " Mr. J.H. Hulse
This will be a brief report since copies of almost all the papers presented are available in the AFNS Division.

D.S. Athwal opened the meeting by stating what he considered were the three objectives of the meeting.

1. To spell out the approach to research and expansion of multiple cropping systems in Southeast Asia;

2. To suggest IRRI's role in cropping systems and its relationship with country programs in South and Southeast Asia;

3. To discuss IRRI's cooperation with other international centres.

Athwal pointed out that while multiple cropping has been a feature of Asian farming since pre-historic times, the recent history shows the following trends.

Up to 1960, increased production was achieved largely through increased acreage. After 1960 improved varieties and better agronomic practices began a slow but significant increase in yield (i.e. weight of harvested crop per unit area per year). Most of this increased yield was related to monocrop cultures and in particular to rice. Now there is a rapidly growing interest in and emphasis upon intensive cropping systems. Consequently, IRRI is now prepared to expand the cropping systems' research program, which so far has been supported by IDRC. Athwal emphasized however that the Board of Governors of IRRI have directed that the cropping systems' research must not be undertaken at the expense of rice research and must be built around rice as the main crop. Though facilities for irrigation during the dry season are expanding, it was his belief that IRRI's main emphasis should be upon non-irrigated cropping systems. He believes IRRI's function is to do the basic studies, to achieve results which will demonstrate the increased productivity and increased income which can result from multiple cropping and to stimulate and support regional
and national cropping systems' research programs. By way of growing interest he cited a program which is now starting in Indonesia, and the very urgent request from USAID for IRRI support for a multiple cropping program in Vietnam. In this latter instance, he stated that until they had more data from IRRI's research and a stronger team, they could not respond to the USAID request. He therefore emphasized the urgent need to expand and strengthen the IRRI program in order to be able to provide the service which the nations of the region are now asking for.

He welcomed IDRC's interest in giving continued support but recognized that any recommendations made either in or outside this meeting required eventual sanction of Dr. Brady, the newly appointed Director-General of IRRI who is expected to take up his post later in the year.

Richard Harwood the head of the IRRI multiple cropping program then gave a very good paper prepared by himself and Gordon Banta. It started with some interesting statistics, pointing out that 83% of the farms in Southeast Asia are less than 3 hectares in size and 51% of the 21 million small farms produces at least one crop of rice each year. Their small size restricts per capita income and is a primary factor in the low standard of living suffered by much of the Southeast Asian population. Of these small farms, 5½ million have no source of power, only hand labour and 67% use animal power for land tillage. Irrigation water is available to a land area equivalent to 38% of the rice growing area, but most of the region is rain-fed.

Harwood presented a series of definitions which, though they appear in the printed version of his paper, are worth repeating here since they are definitions to which IRRI will adhere in the future.
Multiple Cropping: The growing of more than one crop on the same land in one year.

Maximum Cropping: The attainment of the highest possible production per unit area per unit time without regard to cost or net return.

Mixed Cropping: Two or more crops grown simultaneously in alternate rows in the same area.

Relay planting: the maturing annual crop interplanted with seedlings or seeds of the following crop, thus involving an overlapping of growing cycles.

Cropping Pattern: the yearly sequence and spatial arrangement of crops or of crops and fallow on a given area.

Cropping System: the cropping patterns utilized on a given farm and their interaction with farm resources and the available technology which determines their makeup.

Finally, Harwood explained that in the IRRI philosophy a cropping system is a farm based system and extends only as far as the nearest market.

Harwood then went on to deal with land utilization throughout Southeast Asia and the contribution which multiple cropping can play to increased productivity and increased income. He related this both to shifting cultivation and permanent settled cropping.

He stated IRRI's primary focus as upon permanent settled cropping systems on both puddled soil which is partially irrigated or rain-fed and upon unpuddled soil which is only rain-fed. In the first case, one is dealing with puddled rice, followed by intensive uplands crops and in the second, intensive intercropping plus relay cropping of upland rice and other crops.
Harwood made the point that evidence to date suggests that the primary limiting factor in these systems is soil fertility and seldom does one find systems which make full use of drought tolerance crops in order to utilize fully the moisture available from rainfall or irrigation. This emphasizes the need for a close working relation between IRRI and ICRISAT when the latter's semi-arid cropping systems' research gets underway. It was pointed that as cropping becomes more intensive, the uneven demand for labour over the season becomes a limiting factor and seasonal peak demands coupled with temporary labour shortages restrict the level of cropping intensity in many instances. The IRRI program evaluates each of its cropping patterns in terms of its labour profile and staggered plantings, relay planting, and intercropping are all used as devices to produce a more uniform profile. They also recognized that credit is, throughout Southeast Asia, a limiting constraint. In this regard, the experience at UPCA, described later, is worthy of note.

Harwood stated there was still some diversity of view as to whether the cropping pattern should be adapted to the available power source or whether farmers should be encouraged to apply the power source best suited to the most efficient cropping system. It did not seem to me that this was a case of either or but rather a progression from one to the other as economic facilities so permitted. It did serve however to emphasize the complexity of the IRRI program since such factors as bed configuration, row spacing, weed management and degree of intensification are all considerably influenced by the power source and the optimum system for hand power is significantly different to that for machine power.

Harwood then presented a herring bone diagram by which to illustrate all of the inputs which feed into the development of a cropping system. On the left side of the backbone he arranged the resources: labour, credit, markets, power source, solar radiation, land, water. And on the right side the technologies:
determines the nature of the chosen cropping system.

Though in his definitions Harwood stated that the IRRI system stops at the nearest market, they propose to give some significant attention to present and future market demands in Southeast Asia in order to select those crop mixes which will offer greatest return to the farmers. Harwood discussed varietal selection and pointed out that some of the varieties best suited for monocrop culture are not ideal for intercropping. Hence the multiple cropping program requires its own varietal selection. By way of example, Harwood cited the cowpea. Most of the varieties used in Asia are tall indeterminates which require to be staked. On the other hand, determinate upright types produce a high yield and an earlier harvest.

Harwood dealt at some length with weed and insect control and repeated some of the data presented in the IRRI annual report. They are making a particular study of plant interrelations and crop competition as a means of controlling weeds. For example, they have classified all of the common weeds according to their ability to tolerate shading by leafy varieties included in the cropping mix. This indeed a novel approach since most other Centres work on weed control as almost entirely devoted to herbicides. They are however exploring certain specific herbicides in comparison with hand weeding in both monocrop and intercropping systems. They have demonstrated a significantly higher total yield from a mung plus maize intercrop, over each grown as a monoculture, largely in consequence of improved weed control.

They have also shown the distinct benefit of certain plants in insect control. Peanuts are generally regarded as a "dirty crop" since they attract a wide variety of insects. However, among these are included several species of predatory spiders which dramatically reduce the populations of corn borer. Harwood warned therefore against the excessive use of broad spectrum chemical pesticides which destroy indiscriminately both nuisances and allies. This matter of plant-insect interaction is to be
studied more intensively and the first additional scientist proposed for the team is an entomologist. They are also exploring disease plant interactions in a variety of model systems.

A particular high priority will be improved utilization of water by developing cropping systems which take greatest advantage of the highly variable, both annually and seasonally, rainfall patterns. To this end they are developing a statistical system of rainfall probability rather than relying upon average rainfall data which in many instances are more misleading than illuminating. Outside the meeting, Harwood expressed considerable interest in and support for our emphasis on drought resistance and would like to get a copy of the recommendations from the Saskatchewan workshop.**

They are particularly interested in such drought tolerant crops as mung bean, cowpea, peanuts, pigeon pea, sorghum, millet and even cassava, their particular attention being directed to early maturing varieties. Harwood dealt at some length on the importance of tillage for seed preparation and weed control in the wide variety of Asian soils which range from sandy loams to very heavy clays. Particularly perplexing are problems of tillage following puddled rice on heavy soil where mechanical power sources are frequently unavailable. The lack of power for tillage increases the turn around time between crops, particularly where upland crops follow puddled rice. Legumes following rice on puddled soil with inadequate tillage invariably results in a low productivity. Soil fertility is of great preoccupation and a soil scientist will be added to the team probably during phase II of the IDRC project. Of particular concern is the maintenance of optimum pH on light textured or old heavily weathered soils which further emphasizes that the cropping systems proposed must be not only productive but manageable by the small Asian farmers.

**GB and WH please note
Of particular interest also is interplant relations. The crop x crop interaction is assuming increasing importance as cropping patterns become more intensive. The main areas of interest are:

(a) plant interactions of plants growing together in an intercrop or interplant pattern and;
(b) residual effects of one crop on another.

Harwood cited several references (see Appendix A) which testify to the higher productivity of several intercropping systems compared with monocultures. Several adverse residual effects, the fundamental mechanisms of which are not understood, were referred to. The deleterious effect of mung bean, cowpea, and sweet potatoes, when followed by rice, soya beans or maize, has been widely observed. IRRI has started a few bioassays for allelochemical substances in the soil following crops of mung bean and sweet potatoes. I suggested to Harwood, outside the meeting, that since IRRI is not likely to develop the depth of biochemical facilities necessary to make a comprehensive study of allelochemical plant interactions, we might consider developing one or two projects with Canadian universities to study these phenomena in greater depth. Harwood agreed that appropriate research could be undertaken with mung, cowpeas and sweet potatoes grown in pots in Canadian greenhouses. We should probably start with a comparatively modest project to determine if the interactions observed in Asia can be reproduced in pots in Canada. If not, it would suggest some location's specific phenomena, possibly involving the soil microflora. However, since, apparently, Asian farmers over a wide region have traditionally avoided growing sweet potatoes in advance of the other crops mentioned, it is not improbable that the interaction is biochemical in origin.
Finally, Harwood described the detailed survey they are making of the allocation of available resources in a variety of traditional and acquired cropping systems in various parts of Southeast Asia. He also gave a brief review of the training programs they are offering and developing.

It was evident from Harwood's paper and a subsequent visit to the IRRI multiple cropping plots, that a tremendous amount of progress, both in philosophy and practice, has taken place since Harwood took over the project less than a year ago. In addition to being a very competent scientist, as evidenced by his academic record, Harwood is obviously a very practical down-to-earth person who has no illusions about the difficulty of the job he has taken on. He emphasized several times, both privately and in the meeting, his concern to separate, as far as is possible, those problems which are location specific and therefore must be undertaken in national programs, and those which by the elucidation of fundamental principles are widely transferable. An added benefit which he did not mention is the confidence in multiple cropping research which a person of his obvious competence and dedication inspires. I would rate the IRRI program under Harwood’s direction as a very good risk.

The UPCA component of the IRRI project was described by Arturo Gomez. Since his summary is comparatively brief, a copy is attached as Appendix B. Of the three tables presented at the end of Gomez' paper, table 1 relates to baseline data obtained before the project started, tables 2 and 3 are data obtained very recently. Unfortunately, the before and after tables do not present comparable data but Gomez has promised to provide data from which ready comparisons and indications of progress can be made.

I believe everyone was greatly impressed by the capability and obvious sincerity of Gomez. He emphasized that nothing is given to the farmers free of charge. They pay for all seed, fertilizers, and transportation. Only the advice of Gomez' technical advisers and colleagues is given without charge.
They have been making a careful assessment of the cost of providing the advisory services to the barrios and estimate the cost as roughly $3,000 per barrio per year. Gomez emphasized that this is a much higher cost than could be borne by the Government of the Philippines but he is convinced that this cost can be substantially reduced in the future by assigning several barrios to each technical adviser. Gomez is maintaining a rigid standard of discipline among his advisers and has already fired one of them who, though well qualified technically, did not maintain the kind of strict relations with the farmers which had been prescribed.

Gomez referred to the bitter-sweet experience of the heavy floods experienced in the barrios last year. Though the farmers suffered severe crop damage, the UPCA technician advisers were thrown into a close working relation with the farmers in clearing up the post-deluvial mess which served to establish a very good rapport between the farmers and UPCA. Gomez also referred to the slow but gradual increase in credit financing which had resulted from the IDRC revolving funds.

In the second phase of the project it is proposed to increase the size of the revolving fund in order to permit the project to expand over a much wider geographical area. Following Gomez' paper, Banta and Harwood presented their general proposals for phase II of the project. Banta emphasized that they will pursue a systems approach and as in phase I the system will extend as far as the nearest market. It is interesting that the UPCA regards its systems unit as a complete barrio which is the smallest community organization in the Philippines with its own government.
Banta stated that in their opinion the farmers of Southeast Asia are ahead of the scientists in multiple cropping systems. However, since little has been done to understand the crop x crop and the crop x environment interactions, this would form a significant portion of IRRI's Phase II project. Banta also emphasized the need to improve the efficiency of communication both between IRRI and other research groups in Southeast Asia and between the various farming communities who are already practicing one or another form of multiple cropping. The specific research problems which Banta proposed would be studied were:

1. The selection and improvement of varieties,
2. Plant interaction and plant environment interactions,
3. Risk,
4. Labour and power,
5. Water use efficiency,
6. Improved methods of communication and information transfer,
7. The methodology of evaluation and,
8. The methodology of training.

Harwood stated that the project will also include a classification of the region by soil, climate and environment; particular attention being given to the computation of reliable probabilities rather than the use of average meteorological statistics. They will also take a closer look at the relation between IRRI's program and the various national programs since IRRI's function is to provide a service to the national programs through (a) the development of new technologies and (b) the transfer and implementation and adaptation of these new technologies in the countries of the region.

Again, Harwood emphasized the need to improve IRRI's information network and it was suggested that there is perhaps room for discussion between IRRI and the IDRC Information Sciences Division. It is their intention to organize more frequent regional workshops of scientists and practitioners of multiple cropping throughout the Southeast Asian region.
For their training program Harwood stated that they proposed to be extremely selective in their choice of trainees. In addition they plan to hold sub-regional workshops in a number of Southeast Asian countries. Though it will not be an exclusive feature of the project, particular emphasis will be placed upon non-perishable crops in the multiple cropping systems. In addition to the other series of papers, copies of which are available for anyone who wishes to read them, there was a fairly lengthy discussion throughout the three days of the meeting. This discussion was summarized by a small group of reporters under the chairmanship of Dr. Robert Chandler who is now Director-General of the Asian Vegetable Research and Development Centre. The general discussion made particular emphasis upon improved productivity at minimum risk. The subject of risk was discussed at some length and it was considered that his assessment of the risk involved will probably be one of the greatest determinants in the small farmers' attitude to and adoption of proposed multiple cropping systems.

Dr. Kanwar, the Associate Director of ICRISAT, stated that the Indian Government had decided that multiple cropping is essential to increasing the productivity of Indian agricultural and that a target of 15 million hectares under multiple cropping systems has been proposed.

The discussion of IRRI's future role laid emphasis first upon increasing the efficiency of utilization of land, water, and labour resources, the development of multiple cropping principles of wide adaptability. There was some discussion as to whether IRRI should focus primarily upon irrigated or rain-fed rice and it was agreed that both should be included in the program and that perhaps greater attention should be given to partially irrigated conditions than IRRI had originally proposed. The meeting strongly endorsed IRRI's proposal to explore interplant reactions together with reactions between plants and insects, microorganisms, weeds and environmental factors. They urged that particular attention be given to improved water management and that IRRI develop principles
of multiple cropping research designed for the benefit of multiple cropping research workers in the various national programs.

As indicated above, substantial emphasis was placed upon a more comprehensive and effective information service to cover both past and present multiple cropping research and cropping systems practice. The meeting suggested that the training program should be of two principal kinds: (a) training and research techniques, (b) training in the adaptation and evaluation of specific systems. The meeting also urged that IRRI concentrate more upon fundamental principles of wide adaptability rather than upon a wide range of crop mixtures, many of which might turn out to be highly location specific. There was some discussion concerning the size and composition of the ideal multiple cropping research team at IRRI but this was not resolved. Outside the meeting there seemed to be a consensus that the program should evolve rather than expanding very rapidly as has been proposed by Dr. Athwal in the document he prepared for Centers’ Week last year.

In its discussion of national programs, the meeting proposed a general strengthening of multiple cropping throughout South and Southeast Asia and the need for effective backstopping of national programs by the IRRI team. The representative from the Government of Thailand urged that IRRI should become a germ plasm bank for all of the major crops likely to be included in multiple cropping systems throughout the region. Harwood however emphasized that IRRI could only undertake to examine and select from existing varieties and could not launch a varietal improvement plant breeding program, such as it carries on for rice, for all of the other possible crops which might be grown.

As might have been expected, if IRRI were to adopt all of the suggestions advanced it would need an enormous research and training facility. However, I think we can be confident that Dick Harwood is sufficiently hard-headed and pragmatic to select from the various alternatives those research and training activities
which he believes will provide greatest benefit.

A written summary of the discussions and recommendations is being prepared by Bob Chandler and will be circulated through the AFNS Division as soon as it is received.**

A copy of the complete program appears as Appendix C.

**GB, SB and WH please note
APPENDIX A

Literature Cited


APPENDIX B

THE ADOPTION OF MULTIPLE CROPPING IN THE SELECTED
COMMUNITIES IN THE PHILIPPINES\footnote{1/}\n
I. Introduction

The present paper will be based primarily on our experience
with six pilot barrios in Laguna and Batangas where we have
attempted to introduce or improve multiple cropping systems
in the farmers' fields. This project started on March 1972
and we expect it to continue for a period of five years. The
primary objective of the project is to evolve a procedure for
encouraging selected farm villages to adopt the technology of
multiple cropping. In the process, it is expected that the
problems and benefits of such a technology can be identified
to serve as a basis for similar projects later on.

The present paper covers the first year of operation of
the project and will deal primarily on the accomplishments,
lessons learned, and their implications to future work in
multiple cropping.

II. The Pilot Barrios

The following criteria were used in selecting the six pilot
barrios for this project.

\footnote{1/ Paper presented by Dr. A. A. Gomez in a conference on
multiple cropping at IRRI, Los Baños, Laguna, April 11, 1973.}
1. Rainfed-rice must be a major crop,

2. The barrios must be accessible and not too far from market outlets,

3. The barrio people must express their willingness to participate in the program.

Based on the above criteria the names and description of the six barrios selected are given in Table 1 and 2.

III. The Barrio Technicians

The minimum requirement for prospective barrio technician is a Bachelor of Science in Agriculture. Out of 15 applicants, 7 were selected for a 6-week training course on rice production, vegetable production, multiple cropping and extension approaches. At the end of the course, 6 were selected and one technician was assigned to each of the 6 barrios selected.

To help the technicians accomplish their job in the barrio, the following were required or provided:

1. Each technician was required to reside in the barrio.

2. A motorcycle was provided for each technician.

3. A guarantee deposit of a little more than P10,000 was deposited at the Rural Bank near each barrio to be used as guarantee for loans of farmers in the barrio.
4. A small pick-up was purchased to help in hauling initial produce in the barrio.

5. Possible market outlets for barrio products were explored for the technicians.

IV. Accomplishments in the Barrio

A. Production

Table 3 indicates the crops planted together with the labor requirement and net income for each crop.

B. Use of credit facilities

The amount of loans and repayment of farmers in the pilot barrio are shown in Table 2.

C. Marketing and farmers' organization

The technicians are at present servicing the farmers in terms of procuring seeds, fertilizers, insecticides and other inputs of production and at the same time help in locating markets for farm produce. At all opportunity, each technician stresses to the farmers the benefit of forming their own organization that will take care of these services. Because of this visible motivation it is expected that the barrio association can be organized before July, 1973.
V. Some General Comments and Conclusions

A. On production technology (lowland paddy rice)

The production technology for planting other crops after rice can be arbitrarily classified into two categories, namely:

1. Cropping in puddled soils.
2. Cropping in unpuddled soils.

The first category requires almost no modifications of the present cropping technology in rice. The second category can be achieved only by drastic changes in the cultural management of rice and the use of expensive machineries for cultivation. By virtue of the minimum requirement for the first type, our experiences indicate very clearly that this type of technology is more readily accepted. This technology can be briefly described as follows:

Holes of about 1 cu. ft. are dug right after the rice is harvested. These holes are filled with unpuddled soil into which seeds of succeeding crops are planted. The crops most suitable for this culture are those that occupy a large area per hill, obviously to minimize the number of holes to be dug. Thus, the most popular crops used after rice in our pilot barrios are watermelon, cucumber and other vine crops.

It is felt that research geared toward improving this technology will go a long way in improving multiple cropping techniques in the rural community, at least in the initial stages.

Many of crops being sold to local processors.
B. On the consequences of barrio resources to the technology most favorable for adoption - The resources of most communities are very limited to small tools and some animals. It would be too expensive and quite impossible to expect these resources to improve dramatically to adopt to certain types of technology in multiple cropping. Instead it is proposed that the technology to be introduced must be workable with the existing barrio resources. Our research efforts must necessarily take this into consideration.

C. On the minimum requirements for a successful adoption of multiple cropping.

At the moment, there are at least two requirements for a barrio to go into multiple cropping, namely:

1. Ready profitable market.

2. Readily available advice on technology.

In many of our barrios these two requirements are not too difficult to satisfy. Thus, it is our feeling that the accomplishments in the six barrios presently described have a good chance of being repeated in many others.

D. On problems to be tackled next - We have definitely shown that multiple cropping can be accepted quite quickly in some barrios. As you can see, however, the resources we have
used are quite expensive. Our next task will be on how to reduce this expense to a level that local government can afford them.

E. On the possibility of duplicating this project in other countries of Southeast Asia. — We maintain that similar projects can be very useful to neighboring countries. The conditions and problems would have many similarities. As a consequence, some kind of centralization of control maybe necessary in order to maximize the transfer of experience among countries.

**Total project cost: $3000 /harrio /year.**

About 1/3 of expense is technical salary.
<table>
<thead>
<tr>
<th>Crop</th>
<th>Crop Ha</th>
<th>Crop Income</th>
<th>Crop</th>
<th>Crop Ha</th>
<th>Crop Income</th>
<th>Crop</th>
<th>Crop Ha</th>
<th>Crop Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>1.101</td>
<td>53.09</td>
<td>Rice</td>
<td>1.010</td>
<td>53.06</td>
<td>Rice</td>
<td>1.013</td>
<td>53.05</td>
</tr>
<tr>
<td>Rice</td>
<td>2.011</td>
<td>53.07</td>
<td>Rice</td>
<td>1.019</td>
<td>53.08</td>
<td>Rice</td>
<td>1.017</td>
<td>53.06</td>
</tr>
<tr>
<td>Rice</td>
<td>2.011</td>
<td>53.07</td>
<td>Rice</td>
<td>1.019</td>
<td>53.08</td>
<td>Rice</td>
<td>1.017</td>
<td>53.06</td>
</tr>
<tr>
<td>Rice</td>
<td>2.011</td>
<td>53.07</td>
<td>Rice</td>
<td>1.019</td>
<td>53.08</td>
<td>Rice</td>
<td>1.017</td>
<td>53.06</td>
</tr>
<tr>
<td>Rice</td>
<td>2.011</td>
<td>53.07</td>
<td>Rice</td>
<td>1.019</td>
<td>53.08</td>
<td>Rice</td>
<td>1.017</td>
<td>53.06</td>
</tr>
<tr>
<td>Rice</td>
<td>2.011</td>
<td>53.07</td>
<td>Rice</td>
<td>1.019</td>
<td>53.08</td>
<td>Rice</td>
<td>1.017</td>
<td>53.06</td>
</tr>
<tr>
<td>Rice</td>
<td>2.011</td>
<td>53.07</td>
<td>Rice</td>
<td>1.019</td>
<td>53.08</td>
<td>Rice</td>
<td>1.017</td>
<td>53.06</td>
</tr>
<tr>
<td>Rice</td>
<td>2.011</td>
<td>53.07</td>
<td>Rice</td>
<td>1.019</td>
<td>53.08</td>
<td>Rice</td>
<td>1.017</td>
<td>53.06</td>
</tr>
</tbody>
</table>

*Table 1: Description of the six parishes selected as pilot communities for the multiple cropping extension program.*
<table>
<thead>
<tr>
<th>Farm Tools</th>
<th>Bilog-Bilog</th>
<th>Marinin</th>
<th>Baclaran-Gulod</th>
<th>Bagong-Fook</th>
<th>Bagumbayan</th>
<th>Cailos</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>plow</td>
<td>200</td>
<td>72</td>
<td>26</td>
<td>23</td>
<td>10</td>
<td>17</td>
<td>353</td>
</tr>
<tr>
<td>harrow (peg tooth)</td>
<td>89</td>
<td>13</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>110</td>
</tr>
<tr>
<td>harrow (guyod)</td>
<td>24</td>
<td>46</td>
<td>25</td>
<td>23</td>
<td>14</td>
<td>22</td>
<td>154</td>
</tr>
<tr>
<td>lithao</td>
<td>102</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>108</td>
</tr>
<tr>
<td>sprayer</td>
<td>55</td>
<td>17</td>
<td>42</td>
<td>4</td>
<td>3</td>
<td>13</td>
<td>134</td>
</tr>
<tr>
<td>shovel</td>
<td>94</td>
<td>65</td>
<td>146</td>
<td>69</td>
<td>104</td>
<td>38</td>
<td>516</td>
</tr>
<tr>
<td>bolo</td>
<td>440</td>
<td>134</td>
<td>655</td>
<td>174</td>
<td>403</td>
<td>355</td>
<td>2161</td>
</tr>
<tr>
<td>(MA(t)E) hoe</td>
<td>63</td>
<td>35</td>
<td>76</td>
<td>2</td>
<td>30</td>
<td>17</td>
<td>223</td>
</tr>
<tr>
<td>blower</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>hand tractor</td>
<td>-</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>power sprayer</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>carabao (WATER BUFFALO) cow</td>
<td>23</td>
<td>117</td>
<td>140</td>
<td>38</td>
<td>26</td>
<td>13</td>
<td>357</td>
</tr>
<tr>
<td>lilk (Culina)</td>
<td>28</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>28</td>
</tr>
<tr>
<td>horse</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td>halabas (Culina)</td>
<td>-</td>
<td>31</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>31</td>
</tr>
<tr>
<td>caret</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>43</td>
<td>-</td>
<td>46</td>
</tr>
<tr>
<td>weeder</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>65</td>
<td>-</td>
<td>69</td>
</tr>
<tr>
<td>coconut motor</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>kalaykay</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>water pump</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crops</th>
<th>Area:</th>
<th>No. of</th>
<th>Total:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Labor requirements and income of some crops planted by farmer cooperatives.
<table>
<thead>
<tr>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>180</td>
<td>1</td>
<td>865.00</td>
<td>3</td>
<td>29</td>
<td>12.065.00</td>
<td>66</td>
</tr>
<tr>
<td>0</td>
<td>130</td>
<td>1</td>
<td>3330.00</td>
<td>6</td>
<td>3.409.00</td>
<td>11.437.00</td>
<td>27</td>
</tr>
<tr>
<td>0</td>
<td>130</td>
<td>3</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table 4:** Growth of farm income in the six pilot bancos
Program

April 10 (Tuesday)

0830 - 0900  Opening remarks and consideration of agenda  Athwal

Chairman: Chandler

0900 - 1020  IRRI source paper on cropping systems research  Harwood

1020 - 1040  Coffee Break

1040 - 1120  Research approaches to cropping systems in West Africa  Norman

1120 - 1200  The multiple cropping approach in India  Kanwar

Afternoon session

Chairman: Hathaway

1330 - 1415  The multiple cropping approach in Thailand  Finfrock

1415 - 1500  The socio-economic aspect of multiple cropping research in Thailand  Thodey

1500 - 1520  Coffee Break

1520 - 1650  Tour of multiple cropping plots
April 11 (Wednesday)

Chairman: Athwal

0830 - 0915  Cooperation between IRRI and other international centers on inputs to cropping systems research  Chandler

0915 - 1000  Field evaluation of cropping systems in the Philippines  Gomez

1000 - 1020  Coffee break

1020 - 1040  Need for expanding research on cropping systems in South and Southeast Asia  Discussant: Banta

1040 - 1100  IRRI's role in research, training, and extension of cropping systems in the Southeast Asian network  Harwood

1100 - 1230  Discussion on future directions

1500  Concluding session