KALIKASAN planning their research activities for the coming season.

Presenting PTD to the community.

Participatory Technology Development

To introduce the PTD process, the Kadama and Kalikasan working groups conducted community orientations in their respective vilages. Social orientations were conducted by farmer leaders. This orientation familiarised the farmer members with PTD and its objectives. Farmers who attended the community orientations were also given historical perspective on how agriculture in the Philipinnes had evolved.

The process

KALIKASAN and KADAMA farmers who were interested in conducting PTD experiments were identified and selected according to criteria established by the group. These included a willingness to try organic farming and use 1000 m² of their farmland for experimental purposes;

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access to irrigation and a readiness to follow the research methodologies, activities and tasks required by the PTD process carefully.

Problem identification

The PTD process started with Participatory Appraisal Tools such as transect mapping, seasonal calendars and problem tree analysis in targeted KADAMA and KALIKASAN pilot sites. In cooperation with CLSU, PRRM and ILEIA, KADAMA and KALIKASAN members were encouraged to use resource flow diagrams and land-use maps developed from their own classification categories. This resulted in Agro-Ecological Resource Management (AERM) maps and descriptions of the prevailing farming systems in the Barangays Rajal Centro, Sta. Rosa and Triala, Guimba. A problem analysis was made, priorities set and the 'options' that could possibly resolve these problems was surveyed.

Training and planning

But first the research programme partners received PTD training. Concepts and principles were discussed and implementation plans prepared. Problems and issues affecting the management and implementation of the ILEIA-Philippine research agenda were identified.

Workshops were organised to operationalise the objectives, hypotheses and experimental designs. Methods of data collection, analysis, and the process of overall assessment to be used were established. Farmer cooperators determined the objectives and design of the experiments and decided which rice varieties to use, the type and amount of fertiliser to be applied, and the choice of planting method.

Standardised practices

The Bureau of Soil and Water Management (BSWM) carried out a soil analysis to determine the amount of fertiliser needed. Seedling establishment, land preparation and other cultural management practices followed the farmers' usual practice. Fields were ploughed and harrowed using hand tractors, harrows and carabao-drawn ploughs. Three days later they were harrowed again. When the land was clod free and had been well pulverised, rice seeds were put to soak in water for 24 to 36 hours. They were given another 12 hours in moist condition to germinate. Seeds were then sown broadcast on seedbeds. Transplantation using the straight planting method occurred 25 to 30 days later. A distance of 15x15cm was left between hills.

Chicken manure was applied before the last harrowing. Chemical fertiliser, however, was applied some 10 to 15 days after transplantation. Botanical pesticides and other traditional and innovative practices were the only pest management practices used (see Box 1).

Variable treatments

Research objectives were identified and formulated by each group. The KADAMA experiments were designed to find the best type of fertiliser (pure organic, pure chemical or mixed organic-chemical) for improved traditional rice varieties (ITRV). KALIKASAN experimenters wanted to determine how traditional and high yielding rice varieties (HYV), planted on two different types of soil, responded to pure organic, pure chemical and a mixture of organic and chemical fertilisers.

Banitan and Tayabo farmers' groups used different levels of organic fertiliser on ITRV and HYV. The PMK and UGNAYAN farmers used different levels of organic fertiliser to cultivate ITRs. These last experiments were only conducted during the wet cropping season of 1998.

Experimental design varied with the type of experiment chosen. Most farmers' groups laid out their experiment in 3 blocks (one block, one treatment) without replication. Scientists asked some groups to use replication (3 replications per treatment). Each type of experiment was repeated on at least six farms. Some 69, 21 and 69 cooperators from KADAMA and 57, 48 and 43 from KALIKASAN undertook experiments during the first, second and third experimental seasons.

Monitoring and data collection

Farmer cooperators were responsible for implementing the experiments. Area coordinators visited the farms regularly to help the farmer cooperators with implementation, monitoring and data collection. Area coordinators ensured that the research process was carefully followed and they provided orientation and guidance where necessary. A monitoring team composed of farmer, CLSU, and PRRM working group members ensured the process and experiments stayed on track and were responsible for facilitating meetings and workshops and writing programme reports. They noted those factors affecting experiments and discussed problems with area coordinators and farmer cooperators. KADAMA and KALIKASAN provided the CLSU-ILEIA Task Force with the schedules of farm visits. KALIKASAN research sites were monitored once every two weeks and KADAMA research sites were monitored during the first week of the month. Indicators for monitoring and evaluation of the experiments were selected (Box 1).

Informal meetings were held during or after monitoring to assess the results of field visits and suggestions and recommendations were made to farmers and area coordinators on what needed to be done. Institutional, working group and programme level meetings were also held to update each partner on the status of the experiments and, if problems had been reported the steps taken.

Members of the CLSU team were consulted when special problems arose and specialist knowledge was required. When pest or disease outbreaks occurred, for example, samples of the affected plants were brought to the CLSU laboratory and farmers were later given the results and advice.

Box 1 Farmer collaborators indicators for monitoring PTD experiments

- Growth: plant height, number of tillers, panicle length (30, 50 and 70 days after transplanting)
- Yield: fresh and dry (per m^2 and total field)
- Amount of external and internal inputs
- Amount of chemicals used
- Amount of organic fertiliser used
- Number of beneficial and harmful insects
- Available soil nutrients
- Organic matter content
- Soil pH
- Ease of land preparation
- Weed occurrence
- Extent of moss/algae growth
- Soil colour
- Resistance to natural calamities, typhoons, floods, droughts
- Types, amount and taste of food
- Income
- Frequency of income generation
- Reduction in expenses/need for capital
- Amount of production loans or savings
- Amount of free time
- Health
- Number of natural organisms, plants and animals returning to farmlands
- Depth of water table
- Number of farmers using organic fertiliser

Data processing

Data on plant height, number of tillers and panicle length were collected 30, 50, and 70 days after transplantation. The fresh and dry yield weights per sample m^2 and per plot were noted immediately after harvesting and two days after sun drying. Farmers, guided by the monitoring team, used 10kg weighing scales to record yield data. Scientists used a structured interview schedule to gather additional data. All information was then filed in a database using the Statistical Package for Social Sciences (SPSS) file. The CLSU-ILEIA Task Force analysed all statistical and economic data collected. Results were explained to the farmers in the assessment workshops.

Soil sampling for scientific analysis.

Laying out experimental fields.

Assessment workshops

After each cropping season, assessment workshops to discuss PTD results were held at village and working group level. Results were further evaluated in country research workshops. At the village level, primary evaluation of the quantitative and qualitative data derived from experiments took place during group discussions when farmers discussed the strengths and weaknesses of their own experiments. Farmers' interest in continuing the project was also assessed and the assessment workshops served as stepping-stones to further PTD experiments. In December 1998, at the end of the project and after three rounds of experimentation, there was a final farmer assessment of the PTD results and processes (see Basilio p 32).

Process documentation

Process documentors were responsible for monitoring the PTD process. Photos, videos and voice tapes were used to analyse the research processes and results and to assess the applicability of the research in general. The process documentation team consisted of members of the farmers' groups and staff from the University.

Transplanting.

The results of the PTD experiments

Data collected by the farmers were forwarded to CLSU partners for statistical and economic analyses. The IRRISTAT programme was used for statistical analysis and an analysis of variance (ANOVA) for experiments laid out in Completely Randomised Design (CRD). Treatment means were compared by the Least Significant Difference (LSD) test. For unreplicated treatments, the data per federation was pooled and analysed through ANOVA with farms serving as replicates. Treatment means were compared using the LSD test. Farmers were compared using the Duncan's Multiple Range Test (DMRT). Statistical significance was set at the 5% level.

Full statistical and economic analysis of experiment results from KADAMA and KALIKASAN farms for the three cropping seasons can be found in the research reports (Abon 1999; Mendoza 1999) and the Philippine's Country Report (Abon et al, 1999).

The statistical analysis lead to the following conclusions:

- Within the KADAMA research sites homogeneous results through time were obtained when the effects of the same treatments (pure organic, mixed and pure chemical fertilisers) were assessed for three consecutive seasons. The growth and yield parameters had insignificant differences across treatments. The organic, mixed and chemical fertilisers used in the experiments were statistically comparable in growth and yield when applied to improved traditional rice varieties (ITRV) Ag5 and Ag8.
- Two factor experiments for rice varieties Ag5 (ITRV) and RC28 (HYV) and fertiliser types (pure organic and pure chemical) were conducted in KALIKASAN. With the exception of experiments in Mangandingay during the wet season of 1997, insignificant results were established for the effect of these factors on rice growth and yield parameters implying that the three types of fertiliser used in the experiments were equally suitable for ITRV and HYV.
- Sites in the Mangandingay experiments had a history of organic farming. Pure organic fertiliser was most suitable for ITRVs (Ag5 and Ag8) in clayey and sandy loam soil, for HYVs C18 (planted in sandy loam soil) and C28 (planted in the clay soil). Pure chemical and pure organic fertiliser only gave statistically identical results in the case of Ag5 planted in clay soil.
- In farms exposed to organic farming before PTD experiments started in Triala and Guimba, pure organic treatment out-yielded pure chemical and mixed treatments for both ITRV and HYV varieties. These farms may have already reached a point where soil conditions had more or less stabilised to favour the use of organic fertiliser.
- Experiments in the 1998 wet cropping season compared quantities of pure organic fertiliser (chicken manure in 30, 60 and 90 bags of 50 kg) on land with an organic history. Yield and growth parameters showed no significant difference. This could mean that the minimum level of 30 bags/ha of pure organic fertiliser is enough to secure relatively high yields with ITRVs and HYVs. Padua (1979) reports similar results with the IR-42 rice cultivar confirming the experience of KALIKASAN organic farmers who found that after 5 to 7 seasons of applying organic fertiliser high yields can be maintained with as little as 10 bags/ha of chicken manure. However, there is the risk that soil nutrient depletion may occur because 30 bags/ha chicken manure would be insufficient to fulfill the nutrient requirements of a 5 ton rice yield even if considerable biological nitrogen fixation were to take place.

Given time, the ITRVs treated with pure organic fertiliser or mixed organic and chemical fertiliser could out-yield those treated with pure chemical fertilisers. Mhayamaguru (1998), who observed rice experiments conducted at Phil Rice where experimental fields were exposed to organic fertiliser for three years, supports this contention. He established that plants treated with mixed urea (U) and

photos: Kalkasan

Monitoring growth.

chicken manure (CM) (25:75 and 50:50 U:CM ratio) gave the best grain yield (8.5 and 9.1 t/ha). Pure urea yielded 8.8 t/ha. Raja & Garcia and Garcia et al. had similar results in comparable experiments with lowland rice. Such findings suggest the potential benefits of organic fertiliser and animal manure when applied continuously for several cropping seasons (Obien, et al., 1995).

Multiple Regression

To draw conclusions from PTD research rooted in a holistic perspective, multivariate techniques such as multiple regression and factor analysis are required. Data were measured at site level and, because of the amount of data, the Statistical Package for Social Sciences (SPSS 7.0 for Windows) was used.

The final step in the stepwise procedure for multiple regression revealed that significant predictors of rice yield were gender; farmer-cooperators' education level; extractable potassium and phosphorus; the number of tillers; supplementary and farm irrigation; total rice area; incidence of disease and pests, and the use of mixed fertiliser.

Gender and educational attainment were the two personal characteristics extracted as predictors of rice yield. Male farmers had better yield productivity. This could be explained by the fact that male farmers had more exposure to and direct involvement in farm activities than women. Farmers with a higher level of education produced better yields, had more scientific and practical knowledge and had better access to agricultural information. This, in turn, facilitated a better farming system and better yield.

Extractable potassium and phosphorus were found to contribute positively to yield and were the prime limiting factors in PTD farms. Although nitrogen is the usual element needed for growth and better rice yield, regression did not establish it as a primary yield indicator. This could be due to the fact that all PTD experimental sites were relatively rich and sufficient in extractable nitrogen, as the soil acidification studies confirm (Hipolito p 24).

Factor analysis of the same data showed that the principal component group of factors for yield prediction were farm irrigation; extractable potassium, nitrogen and phosphorus; pH; number of tillers; number of years of organic management; and the farmer organisation. These accounted for 22.1% of total variation.

Correlations were also established between pest and disease incidence and the use of indigenous pesticides. Exposure to organic farming practices was interrelated with soil and water characteristics and suggested that the organic farms studied could be on the road to ecological sustainability.

Factor analysis supports the regression results to a large extent and provides a strong argument for paying more attention to these factors in the next PTD series.

Table 1. Average productivity indicators by treatment in all experimental areas in Nueva Ecija: wet cropping season, July-December, 1997.

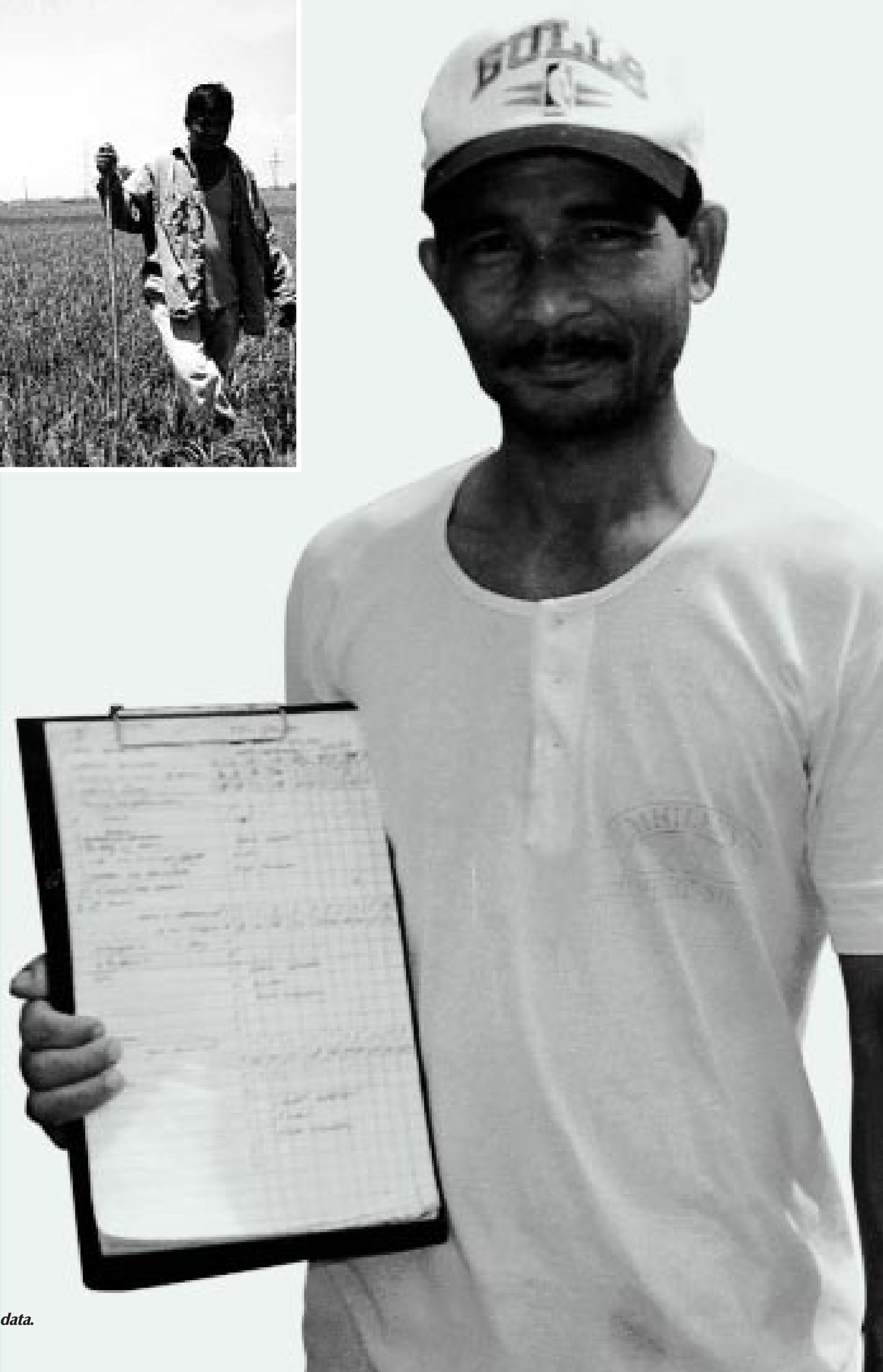
Item	Treatment		
	Organic	Inorganic	Mixed fertilizer
Land productivity (cav/ha)	117.82	127.17	135.20
Labour productivity (P/P)	3.54	3.62	3.78
Capital productivity (P/P)	1.85	2.04	2.02
Net income (P/ha)	21,715.31	25,303.00	26,630.11
Return to labour (P)	2.62	2.8	2.91
Return to capital/operating expenses (P)	0.85	1.04	1.02
Net profit margin	0.44	0.49	0.49

Table 2. Typical results for the experiments on fields with an organic history (from Guimba)

	Pure chicken manure 90 bags/ha	Pure chemical urea/16-20-0	Mixed fertilizer	
Total expenses	24,762.34	19,814.02	22,575.74	P/ha
Net profit	38,312.66	35,430.98	33,539.26	P/ha
Land productivity	145.00	127.00	129.00	Cavans /ha
Labour productivity	5.07	4.87	4.89	P/P
Capital productivity	2.55	2.79	2.49	P/P

Monitoring rice before harvest.

Sample plots are randomly selected for harvest.



Area coordinators collect data.

Economic Analysis

The economic analysis showed that in the first wet cropping season on farms beginning to make the transition from conventional to organic farming a combination of chicken manure and urea/16-20-0 is the best fertiliser to apply to ITRVs (Table 1). This is particularly so in irrigated areas with silty loam soil but appears to be more labour and capital productive. Moreover, earnings per peso revenue generated as well as earnings per peso spent on the production operation were equivalent to results obtained using pure chemical fertilisers. El Niño and La Niña made it impossible to substantiate the results of the second wet cropping season and the subsequent dry cropping season.

Experiments in fields with an organic history showed that chicken manure was most profitable (Table 2). This is certainly the case if the amount of organic fertiliser can be reduced after several seasons.

A series of natural disasters hit the experimental areas during the three-cropping seasons so more experiments are needed before definite economic conclusions can be drawn.

Nevertheless, results established during PTD experiments indicate the importance of improving soil fertility by applying organic matter. There is reason to believe that applying organic manure (OM) to rice fields helps secure sustainable high yields. The KADAMA and KALIKASAN experiments appear to provide an example of how this can be achieved. Liam (1993) presented data from a long-term Japanese experiment showing that in the first ten years yields from plots supplied with organic matter (manure in this case) were clearly lower each year than yields from plots treated with chemical fertiliser. However, during subsequent years, yields in OM plots reached yield levels similar to plots where chemical fertilisers were used. After 30 years, the yield from OM plots surpassed yields from chemical fertiliser plots.

In the Philippine case it may not take so long for organically treated farms to out-yield chemically treated farms. Despite their small scale PTD experiments have established consistent comparability trends.

■

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