# eraction of Agriculture with Food Science

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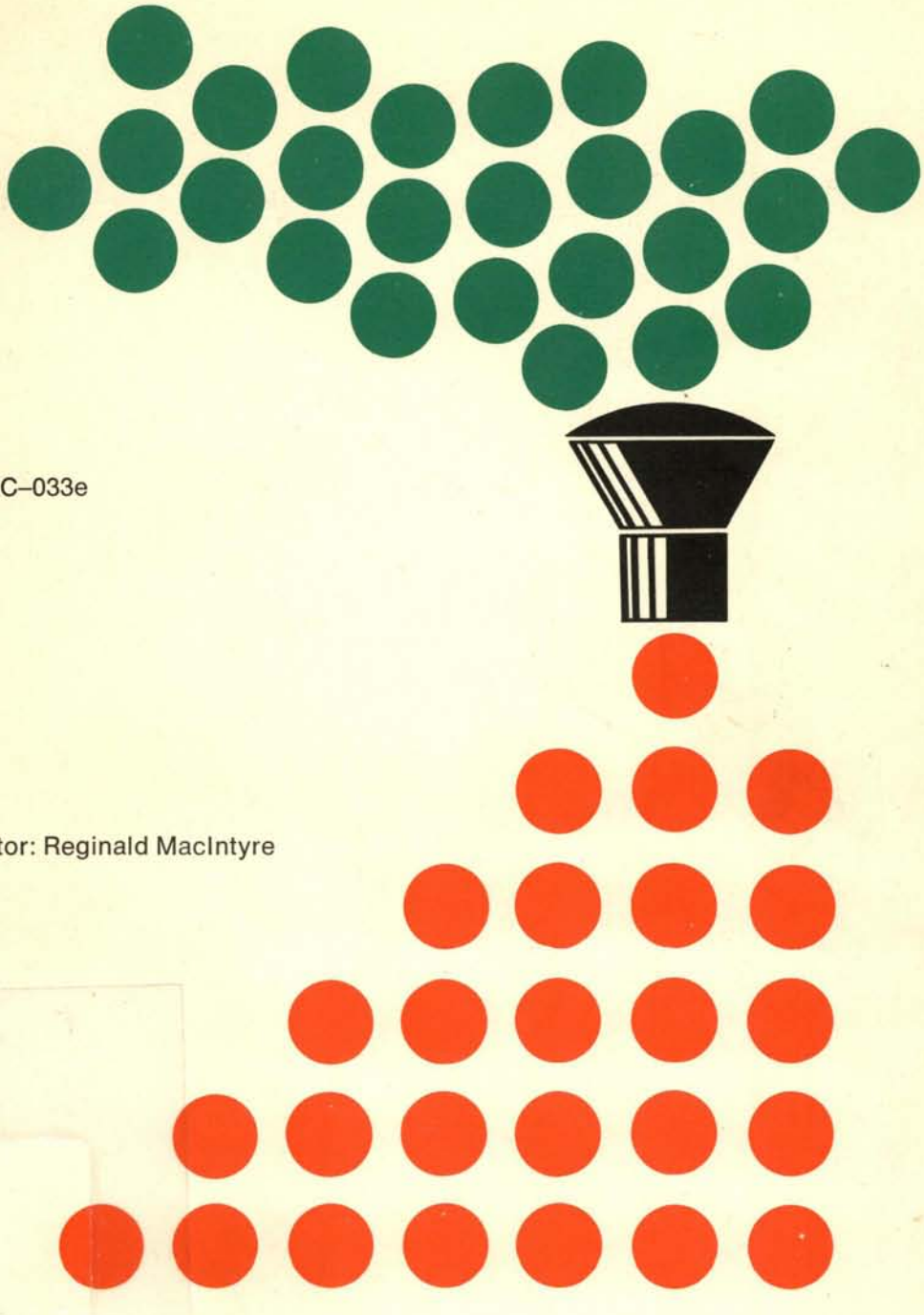
Singapore, 22-24 February 1974



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Editor: Reginald MacIntyre

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*Editor:* REGINALD MACINTYRE



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# *Contents*

# Intensification of Cropping Systems in Asia

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**Abstract** The intensification of land and labour utilization through improved cropping systems is a promising alternative for increasing food production and employment in rural Asia, the sector where the problems of low income and malnutrition are most acute. While various types of cropping patterns are practiced in the region, however, the intensity of land use in most cultivated areas remains low.

Experience in the Philippines, where the adoption of improved cropping is being accelerated in several pilot communities, indicate that the majority of small rural farmers are willing to take the risk of added cash and labour inputs provided credit is available and markets for their products are assured. Unfortunately, these requirements are not easy to satisfy. It would seem, therefore, that a major task for the successful adoption of intensive cropping in Asia is the establishment of socioeconomic structures that would improve credit and marketing facilities in the rural sector.

**Résumé** L'intensification de l'utilisation de la terre et de la main-d'oeuvre, grâce à l'amélioration des systèmes de culture, constitue une possibilité prometteuse d'accroissement de la production alimentaire et d'élargissement du marché de l'emploi dans le monde rural asiatique. Ce secteur est celui où les problèmes de malnutrition et d'insuffisance des revenus sont les plus aigus. Bien que de nombreux types de modes de culture soient mis en oeuvre dans cette région, la terre y est encore cultivée en de nombreux endroits d'une manière peu intensive.

Selon l'expérience tentée aux Philippines, où l'on s'efforce d'accélérer, dans un certain nombre de collectivités pilotes, l'adoption de techniques culturales meilleures, il semble que la majorité des petits agriculteurs acceptent le risque d'augmenter leurs apports en espèces ou en main-d'oeuvre, à condition de trouver du crédit et de bénéficier de garanties pour l'écoulement de leurs produits. Il n'est malheureusement pas facile de répondre à de telles exigences. Il semblerait par conséquent que l'un des facteurs essentiels de la réussite en Asie de l'adoption de méthodes de culture intensive soit la mise en place de structures socio-économiques améliorant le crédit et les circuits de commercialisation du secteur rural.

## Introduction

A major alternative for increasing crop production in Asia is the intensification of land and labour utilization on areas that are presently under cultivation. This can be achieved by increasing the number of crops or the number of days in which an area is put to pro-

ductive use through any of the following techniques: *Multiple Cropping* — the growing of more than one crop in the same land in one year (Harwood and Banta 1973) where only pure stands are sown at any one time (Dalrymple 1972); *Intercropping* — the growing of two or more crops simultaneously in the same area; and *Relay Planting* — the interplanting of seeds or seedlings in between plants of a maturing annual crop.

In this paper, I shall try to look at the potentials of improved cropping systems in Asia, the extent of their adoption in the region, and our experience in introducing multiple cropping in selected communities in the Philippines.

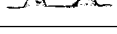
## Prospects of Intensifying Cropping Systems in Asia

Most of the developing countries of Asia have a tropical or subtropical climate and can grow crops at any time of the year provided water is available. Experiments by Bradfield (1970) at the International Rice Research Institute (IRRI) shows that five crops including a crop of rice can be harvested from the same area in 1 year (Table 1). Luh (1969) reports that as many as nine crops a year are raised by vegetable growers in Hong Kong and Vietnam. Harwood and his group have shown that weeds and insect incidence can be reduced by intercropping. The combination of corn and mung, for example, not only gives high yield but has a distinct advantage for weed control. The combination of peanut and corn markedly decreased borer damage in corn.

A major limiting factor for intensive cropping in Asia is water. More than 50% of arable lands grown to annual crops depend on rainfall. Since precipitation is not distributed evenly throughout the year, many farmers grow rice during the monsoon season and leave the land idle during the dry months. Experiments at IRRI and UPLB have consistently shown that, in areas with 6–8 months of rainfall, another crop after rice can be grown without additional irrigation. The technique is to prepare the land before the rain comes instead of the usual procedure of waiting for the land to be submerged in water before plowing. This technique allows for the planting of rice right after the first rain instead of 45–60 days later. This time saving is enough to mature a crop of rice so that corn, vegetable or even rice can be grown before the dry months come.

Considering the fact that land is a very scarce resource, that farm labour is abundant, and that the majority of the low-income group is in the rural sector, the intensification of cropping systems in Asia is very attractive. The labour absorption of a unit area of land can easily double by the addition of another crop where only one was planted before. Furthermore, the benefits from intensive land use do not discriminate against, and may even favour, the small landowners. Indeed, the prospects of improved cropping systems are so bright that it has been referred to as a means toward a more successful utilization of the Green Revolution, the labour intensive technology that could bring most subsistence farmers into the stream of market-oriented economy, and the technology that could solve the serious nutrition problems among the rural poor.

TABLE 1. A one-year cropping sequence for rice and four other crops (Bradfield 1970).

| Crops | Days to harvest | Tillage operation |
|---|---|---|
| Rice | 102 |  |
| Sweet potato | 100 |  |
| Soybeans | 85 |  |
| Sweet corn | 66 |  |
| Soybeans (green) | 60 |  |

## Cropping Systems in Southeast Asia

While the practice of growing several crops in the same area has an ancient history in Asia, the extent of its practice has been far from impressive. In a review of country data, Dalrymple (1973) shows that many countries in the region, especially in Southeast Asia, have a low cropping index (Table 2). Aside

TABLE 2. Intensity of cropping systems of Asia (Dalrymple 1973).

| Country | Period | Multi-cropped area (*1000 acres*) | Cropping index |
|---|---|---|---|
| Burma | 1965–66 | 2,162 | 111.1 |
| Bangladesh | 1968–69 | 8,479 | 119.2 |
| India | 1966–67 | 48,456 | 114.4 |
| Indonesia | 1964 | 5,248 | 126.2 |
| Japan | 1967 | 3,672 | 126.0 |
| South Korea | 1969 | 3,074 | 153.4 |
| Pakistan | 1967–68 | 3,046 | 108.5 |
| Philippines | 1960 | 4,982 | 136.0 |
| Taiwan | 1969 | 1,905 | 184.3 |
| South Vietnam | 1960 | 621 | 112.5 |

from traditional social barriers two major reasons can be cited: 1) difficulty in transmitting the technology, and 2) lack of socio-economic structures to support the technology.

While the technology for the culture of a single crop may be easy to transmit to farmers, the techniques for intensifying cropping systems involve not only changes in managing familiar crops, but also new crops which may be totally unfamiliar to a farmer. Furthermore, intensive cropping systems require more labour, more capital and a better marketing system. Inadequacy in any of these could easily lead to the failure of the whole system. Many farming communities in Asia lack many of the social infrastructures that promote a market-oriented economy. Transportation from farm to market is difficult. Credit is non-existent in many cases. As a consequence, if several crops are grown on one farm the motivation is for consumption within the family or small community instead of the market outside.

In spite of the low level of adoption, a wide range of cropping systems is practiced in the region. Three common systems are reviewed.

### Systems built around rice

Rice is the most important staple crop of Asia and occupies the largest area devoted to any one crop. When water is readily available, the most common system of cropping is the monoculture of rice. Two to three crops are grown within a 12-month period with the highest yield usually obtained during the dry months. This system is competitive since rice is a prestige crop and the grain is the most salable commodity on the farm. Furthermore, since rice is usually grown under flooded conditions, such areas are not easy to cultivate for other crops within short intervals.

Only a small portion of farms in Southeast Asia, however, have sufficient water to satisfy the requirement of flooded rice year round. In fact, more than 50% of the rice-growing areas depend primarily on rain for water. In these areas rice is grown during the monsoon months when rain is most abundant and the land is either planted to other crops or left idle after the rice crop. Some of the major crops grown after rice are corn, sorghum, pulses and vegetables. The major problems with these systems are: 1) Although rice takes only 4 months to mature, it takes 2–3 months of rain before enough water is accumulated in the paddy for traditional rice culture; 2) Puddled soils are not easy to convert to upland crop culture; 3) Crops other than rice are not as easily marketed; and 4) Difficulties in water management.

### Systems involving annual crops other than rice

The system of cropping in these areas differs from those with rice primarily in terms of cultivation. The land is prepared dry and at no time is the land submerged in water. This management practice is common to many crops and consequently a wide range of cropping systems are practiced. The major factors affecting the choice of crops are market opportunities, storability of a crop, and tolerance to water stress.

As a general rule, the high-profit crops such as tomatoes, eggplant and other vegetables, which are also high-risk and labour-intensive, are grown in areas near market and population centres. In contrast the grain crops such as corn, sorghum and pulses are grown in less accessible areas.

### Systems involving perennial tree crops

One of the most important perennial crops in the Philippines is coconut. Plantations of this crop extend from areas near metropolitan Manila to as far south as Mindanao. Because of the morphology of coconut many plantations near populations centres utilize the area between the rows for other crops. One of the most intensive is the cultivation of papaya and pineapple, a system that increases the profits from the land by more than 100%. Bananas, lanzones and such root crops as gabi and sweet potatoes are also used extensively.

## Introduction of Multiple Cropping in Selected Communities

With the wealth of information on cropping systems from the experiment stations and commercial farms, the UPLB in cooperation with IRRI and IDRC started a project in 1973 whose primary objective is to improve the cropping systems in selected communities in the Philippines. By working on pilot communities, instead of with individual farmers, we hope to: 1) develop workable patterns of introducing intensive cropping to rural farmers; 2) identify the social and economic problems in the adoption of the technology; and 3) assess the social and economic impact of the technology.

### The pilot communities

The smallest unit of formal government in the Philippines is called a barrio. It is formally headed by a barrio captain and a council of about 5–7 barrio leaders. A typical barrio is about 200 ha in area with about 150 households. This is the type of community which was used as a unit for the present project.

Since the project covers only six barrios, it was necessary to limit the types of communities that we should work with. We therefore decided to limit our choice to those that satisfy two features: first that rice is a major crop and adequate water for rice irrigation is available only during the monsoon months (about 60% of our rice farms belong in this category); secondly, the barrios must be accessible by road and not too far from market outlets. We felt that this feature was necessary for a market-oriented cropping system. The specific features of the six barrios selected are shown in Table 3. Some of the general features are as follows: 1) source of water for the rice paddy comes from rain or irrigation canals which supply adequate water during the monsoon months but not during the dry months; 2) the barrios are near the population centres and market outlets; 3) population density is high and landholding is small; 4) average income per household is small and food intake of young children is below the normal requirement; 5) alternative job opportunities aside from farming are available; and 6) farm equipment consists primarily of farm animals and hand tools.

### Introduction of multiple cropping in the barrios

Since the ultimate objective of the project is to introduce multiple cropping in the barrios, to the extent that the technology will continually be adopted even after the project is phased out, our strategy was based on the following guidelines: 1) that only technical advice will be given free. All material inputs will have to be paid by the farmers at cost; 2) that our entrance activities should try to

TABLE 3. Some characteristics of the pilot communities (average of six).

| | |
|---|---|
| No. of households | 418 |
| Size of household | 6.4 |
| Income per household (*$/year*) | 395 |
| Education (*years in school*) | 4.7 |
| Nutritional status (*% of normal*) | |
| Children's height | 90 |
| Children's weight | 79 |
| Food consumption (*kg/day*) | 4.2(2.2) |
| Land area (*ha*) | 292 |
| Farm size | 1.9 |
| Percent owned | 23 |
| Farm animals and implements | |
| Work animals | 112 |
| Animal-drawn cultivators | 119 |
| Hand tools | 508 |
| Hand sprayer | 22 |
| Power machinery | 2 |

use and strengthen existing barrio organization and services where they exist; and 3) that the project should provide other additional inputs and services at the start, with the intention that they be taken over by the local residents as soon as possible.

Each barrio is assigned one technician who is a BSA graduate with training in multiple cropping. The technicians reside and work full-time in the barrio. The technicians were fielded in their respective barrios in June 1972. At this time, the rice field is being prepared for planting. The first task of the technician was to assist the farmer in rice culture and at the same time encourage farm families to plant other crops in their backyard areas. The backyard planting was very effective in illustrating the technology and profitability of growing other crops as well as rice. When rice was ready for harvest many of the backyard crops were also being harvested and the farmers had a good basis for deciding whether they will try the same crops in larger areas utilizing the rice field which would otherwise be idle. By the end of the first year at least 5% of the rice paddy was already planted with a second crop.

In most cases during the initial planting of other crops, the farmers were not ready to cope with the additional needs of the more capital-intensive and more perishable nature of the new crops. In many cases our technicians helped in facilitating bank loans, procurement of seeds, fertilizers and other inputs, and later in locating and transporting their produce to market outlets. All these services, however, were paid by the farmers. At the same time these activities gave the technicians a good opportunity to illustrate to the farmers the problems, the expertise and the services that they will have to contend with in the new cropping system.

By the end of the first year, many farmers were convinced of the profit potential of growing other crops after rice. They were also aware of the need for services that were initially provided by the technicians. This awareness was the source of motivation for the farmers to organize themselves into groups that can share the needed services At this time, it became necessary to organize the skeletal structure of a barrio farmers organization. It is our intention to strengthen these organizations and make them functional before the end of 1973. The area to be devoted to multiple cropping is expected to increase threefold in 1973 and, consequently, more supporting services will be needed. This barrio organization will be put to the test in 1973. Although the technician will continue to play a key role, we hope that this leadership can be eventually transferred to the local leaders of the newly formed organization.

## Impact of Multiple Cropping

### Cost and returns

Our objective during the first year was to reach a few strategic farmers in the barrio with the hope that these few would succeed and serve as example to others. In terms of area, this initial target is less than 5% of the whole pilot barrio, so I will not attempt to evaluate its impact on the whole barrio.

Among the initial target farmers, we keep records of their daily activities in terms of cash, labour and other inputs together with the cash and non-cash farm income (Table 4). The data show that: 1) some crops such as tomato, eggplant, cabbage and watermelon, aside from having high profit potential, need intensive labour per unit area resulting in a good potential for absorbing excess labour in the farm; 2) a wide variety of crops can be grown after rice with good profit potential as long as adequate water is provided. For many crops included in Table 4 water was provided from shallow wells and manually hauled to the field. We are now looking at small manual pumps that may be used to simplify this task; 3) the success of most of the initial farmers has shown that profit and labour absorption per unit area per year can be easily doubled by planting another crop after rice. Present indications are that these attractive possibilities will at least increase the area participating in double cropping to at least four times that of last year; and 4) together with the planting of an additional crop after rice is the introduc-

TABLE 4. Cost and returns per hectare for some selected crops.

| Crop | No. of farmers | Area planted (*ha*) | Man-days per crop | Total expenses (P) | Net Income (P) |
|---|---|---|---|---|---|
| Rice | 35 | 51.40 | 123 | 1714 | 92[a] |
| Corn | 16 | 8.93 | 48 | 589 | 184 |
| Watermelon | 26 | 4.90 | 180 | 1901 | 1616 |
| Tomato | 32 | 4.36 | 308 | 2574 | 5402 |
| Cucumber | 21 | 2.75 | 202 | 1636 | 438 |
| Beans | 27 | 2.66 | 136 | 1439 | 520 |
| Mung bean | 8 | 0.92 | 235 | 1917 | 559 |
| Eggplant | 10 | 0.66 | 269 | 1490 | 5036 |
| Cabbage | 8 | 0.30 | 292 | 2685 | 4687 |

[a]About 60% of the area was heavily infested by tungro, hopper burns and/or grass stunt. The average income in the healthy areas is P831.

tion of improved varieties for many kinds of crop species such as watermelon, cucumber, beans, tomato, cabbage, eggplant, and sweet potato.

### Use of credit facilities

As mentioned previously, credit to the pilot communities was liberalized through the use of added collateral provided by the project to the nearby rural banks. By early 1973, 186 farmers had used this facilitiy with total loans of a little less than $10,000. As expected many farmers participated but, more important, the number of defaulting borrowers is small. Our observation is that when the crop succeeds the farmers are very willing to repay their loans.

### Establishment of supportive socioeconomic institution

After 1 year of demonstrating the profitability of multiple cropping and discussing with individuals and groups enthusiasts the problems involved in establishing an on-going multiple cropping enterprise in their community, some cooperators and assisted farmers decided to organize themselves into a multiple cropping farmer association (MCFA). The membership of the association is Bilogbilog 30, Marinig 38, Baclaran-Gulod 34, Bagong Pook 22, Bagumbayan 35, and Callos 20.

These associations are newly organized and their activities will centre on cooperative borrowing, procurement and marketing of farm inputs and products.

## Future Plans

*1* We are expanding our record-keeping activities from the 10–ha area reported here to approximately 120 ha involving about 200 farmers.

*2* We have now encouraged some farmers to plant and harvest from the same area three times in one year.

*3* We are increasing our pilot areas from 6 to 12 with the new areas located in provinces that are less populated and less accessible than those presently described. These new pilot areas are more typical of farmlands farther away from metropolitan Manila.

*4* In all these pilot areas we project a 4–5-year stay in each barrio. Within this period we expect the barrio to have had enough experience in multiple cropping to continue on without the help of the project.

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