Rice self-sufficiency: Indonesia

ABSTRACT

Indonesia's ultimate goal is to provide sufficient food to ensure all its citizens a varied and healthy diet rich in carbohydrates, protein, vitamins and minerals. Programmes for increased food production have therefore received top priority in the development of the agricultural sector as an integral part of national development.

The broad strategy and policies for enhancing food output are aimed at:

- increasing farm accessibility and productivity;
- reducing risk in farming activities;
- developing modern farming practices and sustainable farming systems;
- increasing participation by farmers both in quality and numbers;
- enhancing equity in the distribution of income-earning opportunities and access to an adequate supply of food.

Implementation of the policies and programmes for increased food production is focused on four main efforts: intensification, expansion, diversification and rehabilitation of the nation's agricultural infrastructure.

Following independence in 1945, rice production in Indonesia lagged behind increasing domestic demand. This situation, coupled with the inability to expand production sufficiently, resulted in large-scale importation of grain and a serious drain on the economy. By the 1970s and early 1980s, Indonesia ranked among the world's largest purchasers of rice, with imports peaking at two million tonnes in 1980. After 1979, the government applied new measures and techniques, particularly the introduction of high-yielding varieties of rice, appropriate fertilizers, agricultural machinery and the application of integrated pest management (IPM), with the result that rice production rose considerably.

By 1984, Indonesia had achieved self-sufficiency in rice. Between then and 1996, the total production of rice in the country was higher than total domestic consumption. Reaching this goal of rice self-sufficiency entailed meeting challenges that confront many developing countries striving to expand food production. Among the obstacles Indonesia faced were lack of arable farmland, the ravages of crop-destroying pests, technological and infrastructure shortcomings and poor financial support, education and training. It was clear that the country had to bring about major advances in the technology and capacities of its

agricultural system. This required fundamental changes in farmers' attitudes and farming practices. An overriding challenge, therefore, was to motivate many millions of small farmers to participate actively in the national programme to increase rice production, since the focus on increasing output was from small farms rather than from large estates.

The country's success in attaining rice self-sufficiency has been made possible by several key factors. The Mass Guidance (BIMAS) Scheme – an integrated system designed to develop conditions where a large number of farmers can adopt new technology to increase their productivity and income – has been applied extensively. An integral part of BIMAS is organizing farmers into groups, which has proved an invaluable mechanism for disseminating information, technology, training and extension and implementation of new techniques.

Attention has been paid to local rice varieties through exploration, collection, evaluation and the documentation of germplasm. Improved varieties providing higher yield and early maturity have allowed farmers to increase cropping intensity. The resistance of these varieties to pests and diseases has minimized the use of pesticides, thus reducing costs and protecting the environment. Since one of the characteristics of improved modern rice varieties is high response to fertilizer application, the government has regularly released national recommendations on fertilizer rates based on research findings. The government has also supported the establishment of fertilizer industries in several locations in the country to ensure steady supply and distribution. Another boost to increased agricultural production has been the greater availability and use of agricultural machinery such as tractors and hand sprayers, which have had a considerable impact.

One of the most striking characteristics of Indonesia's progress towards rice self-sufficiency, however, has been the introduction of integrated pest management. IPM uses resistant varieties, natural enemies, appropriate cultivation practices and planting times, sanitation and monitoring to ensure steady and sustainable production. Indonesia became the first country to adopt the IPM system as a national agricultural policy and apply it on a broad scale, promoted widely through extension and farmers' field schools. The concept has since been adopted in other developing countries.

These achievements in Indonesia's rice programme have been complemented by development of institutions and structures at rural level to support production increases and establishment of an infrastructure to deliver farm outputs. The government has developed a favourable price policy for rice through setting floor and ceiling prices to protect farmers and consumers.

In the years since the achievement of self-sufficiency, Indonesia has sustained

rice production at levels capable of meeting domestic demand. A major contributor to the stabilization of self-sufficiency in this staple food has been the Super Intensification (SUPRA **INSUS)** system introduced in 1987, which has helped to boost rice production further, through its emphasis on enhanced cooperation among farmers' groups.

The innovative experience in Indonesia has demonstrated that self-sufficiency in rice can be achieved through a combination of interrelated factors:

- political will;
- a systems approach;
- continual technological efforts;
- a progressive rural structure;
- mass guidance;
- socio-economic engineering;
- a well-coordinated programme.

These valuable lessons provide other developing countries with exemplary models in their drive for self-sufficient and sustainable rice production.

INTRODUCTION

Indonesia, the world's largest archipelago country, comprises more than 17 000 tropical islands between the Pacific and Indian oceans stretching along the equator between the mainland of Southeast Asia and the northern part of Australia. This strategic position has always influenced the cultural, social, political and economic life of the country.

Extending 5 000 kilometres from east to west, Indonesia consists of five major islands – Sumatra, Kalimantan, Java, Sulawesi and Irian Jaya – and about 30 smaller island groups. Forest covers 72 percent of the total land, whereas its significant areas are mountainous and heavily forested. Total arable land currently amounts to some 14 million hectares (ha), of which 8 million ha are wetland suitable for rice production. Of the total arable land, 6 million ha are located on Java, the most fertile island and home to 60 percent **of** Indonesia's population.

Agriculture has long been the primary sector in the Indonesian economy, with a strategic, multi-purpose role closely integrated with wider objectives of national development. The success of Indonesia's agriculture is thus attributable to segments of both this sector and other related sectors.

As the main provider of food for the nation, Indonesia's agricultural sector has achieved a significant increase in production to meet the growing domestic demand resulting from an expanding population and rising per capita consumption.

Since the first five-year development plan was launched in 1968, the Government of Indonesia has worked consistently towards its objectives in the

agricultural sector, namely to:

- achieve and maintain food self-sufficiency;
- improve labour productivity, farmers' incomes and employment and business opportunities;
- increase non-oil exports;
- further speed up rural and regional economy;
- foster links with other sectors.

The effort to increase production to provide the people with enough food containing sufficient carbohydrates, proteins, vitamins and minerals has received top priority in agricultural development as an integral part of the national development programme.

The experience of rice self-sufficiency in Indonesia

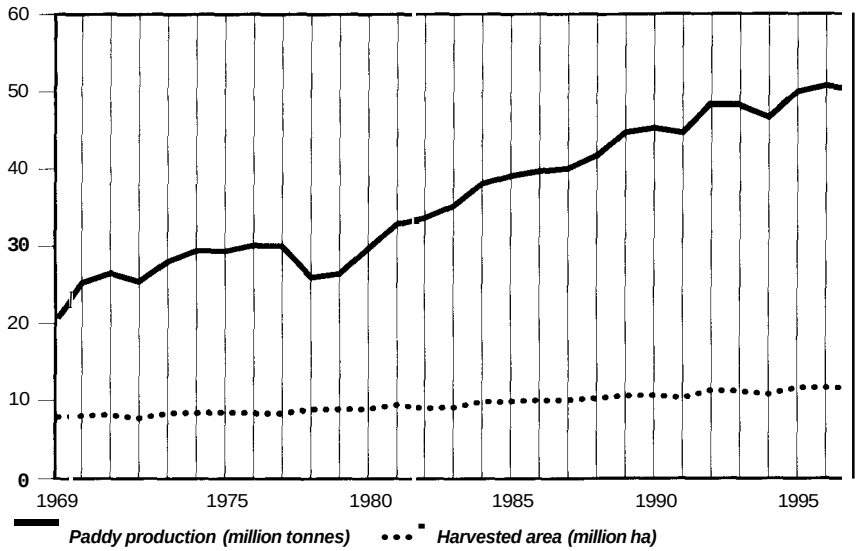
In order to realize self-sufficiency, Indonesia had to bring about major advances in agricultural technology and capacities. This required fundamental changes in farmers' attitudes and farming practices, many of which had been forgotten over decades through the interplay of cultural, social and economic forces. It was recognized that farmers would in general be unwilling and unable to change from traditional methods unless all the components of an improved farming system existed and functioned properly. **A** system was needed that was sensitive to cultural and social traditions, yet capable of combining and delivering all the components in a package **of** programmes to motivate, educate, assist and organize farmers to increase productivity and with it their incomes.

Reaching the goal of self-sufficiency in rice entailed meeting challenges that confront many other developing countries striving to expand food production. Among the obstacles Indonesia faced were lack of additional arable farmland, the ravages of crop-destroying pests, technological and infrastructural shortcomings and poor financial support, education and training. A sustained nationwide effort would be required to mobilize and harness technological, financial and human resources on a massive scale and with single-minded purpose. More specifically, the challenge was to motivate many millions of small farmers to participate actively in the national programme to increase rice production, since the focus on the effort would be on increasing output from small farms rather than larger estates.

The problems were formidable and called for:

- clear and consistent policies and programmes;
- accelerated research and the application of new technologies to improve rice production;
- improved delivery and receiving systems for technology transfer and other inputs to the farming community;

FIGURE 1
Total paddy production *(million tonnes)* and harvest area *(million ha)* in Indonesia, *1969-97*

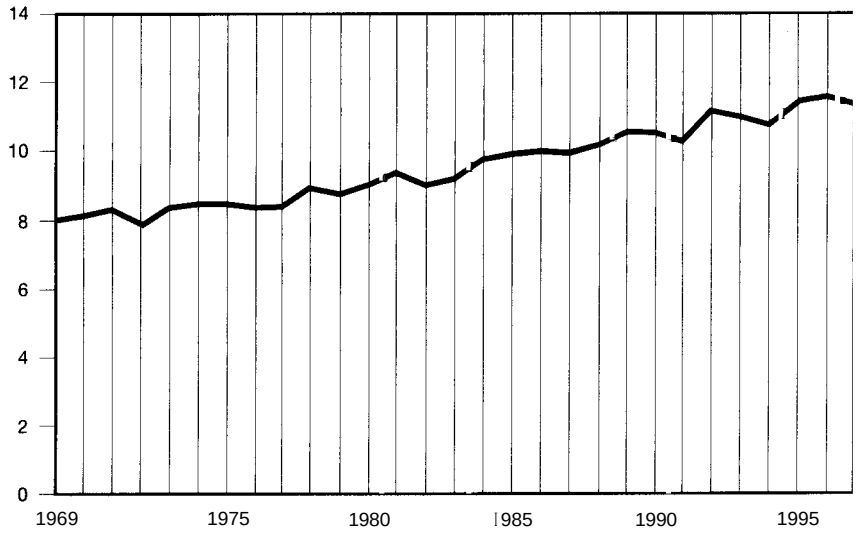


- financial and other incentives to heighten motivation among farmers to adopt new technologies and farming practices;
- expanded educational, training and other support services for farmers;
- new and improved infrastructures, such as irrigation schemes, roads, transportation and storage facilities to help raise the productivity of existing cultivated land, open up new areas for cultivation and facilitate access to markets ;
- adequate budgets at all levels to fund various programmes;
- institutional and organizational structures to oversee, guide and secure implementation of policies and programmes.

PRE-INNOVATION

For many years following independence in 1945, rice production lagged considerably behind expanding domestic demand. In the 1950s and **1960s,** the population was growing at a rate in excess of 3 percent annually and consuming more and more **rice per** capita. These factors. combined with an inability to expand production sufficiently, necessitated the large-scale importation of rice, thereby creating an enormous drain on the economy. In the 1970s and early 1980s, Indonesia ranked among the world's largest purchasers of rice, with imports peaking at 2 million tonnes in 1980.

FIGURE 2
Total harvest area *(millionha)* of paddy in Indonesia, 1969-97



The production of paddy before 1980, on the other hand, fluctuated considerably, with a steep decrease in 1977 (Figure 1). This resulted largely from the attack of brown plant hopper and the long dry season. The decrease was also influenced by some other factors:

- most farmers did not know how to develop and adopt the modern technology;
- most farmers did not use farm inputs correctly with regard to time, location, quantity and price;
- motivation, organization and training of farmers was not yet active.

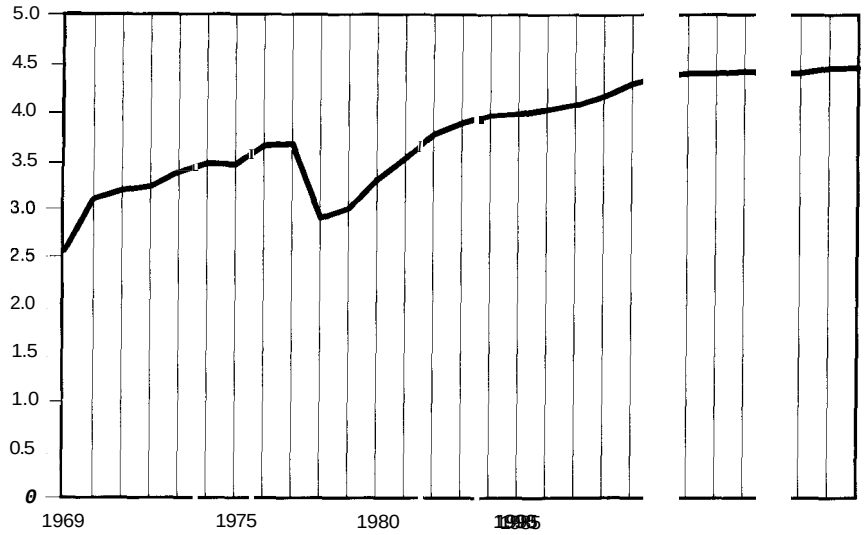
INTRODUCING INNOVATION

After 1979, the government applied a new innovation called Special Intensification (INSUS), which was followed by the Special Effort Programme (OPSUS) in the early 1980s and SUPRA INSUS in 1987. With these innovations, the production of rice increased dramatically, as shown in Figure 1.

Over these periods, the total harvested area increased considerably, especially through the development of new paddy field formations in irrigated, rainfed and swampy areas (Figure 2).

Figure 3 presents the productivity of paddy in Indonesia from 1967 to 1997. By comparing Figure 1 and Figure 3, it can be seen that the fluctuation of rice

FIGURE 3
Productivity *of* paddy *(tonnes/ha)* in Indonesia, 1969-97



production in Indonesia before 1979 was more influenced by variations of productivity.

After 1979, when the government started to apply new innovation, especially through the introduction of high-yield varieties of paddy, appropriate fertilizers, agricultural machinery and IPM, the productivity of paddy in Indonesia increased significantly.

The mass guidance (BIMAS) scheme

Political will is a prerequisite for the success of a food production programme and is reflected by the commitment of the government and community leaders. The mass guidance (BIMAS) scheme was designed to develop conditions under which a large number of fanners would adopt the new technology to increase their productivity and income. The system is focused on motivating the farm community to participate actively in the programme **for** increasing production, which is itself supported by an integrated programme and services from various **institutions in** a **coordinated structure.**

At the same time, it was recognized that learning new technologies would give rise to the need among farmers for other farm inputs such **as** seed, fertilizers and pesticides, with working capital to finance them. Post-harvest and marketing skills, procedures and facilities would have to be improved. These requirements

created the need to ensure close integration with infrastructural improvement, such as irrigation systems and roads, in order to support rice production and improve access to markets.

As an integrated system, BIMAS combines:

- a forum and focus for synchronizing and coordinating planning of programmes and services from agencies serving farming communities;
- a vehicle for popularizing and disseminating agrotechnology from the research stage to the farm and for integrating new technological extension activities with the provision of farm inputs, marketing and post-harvest handling;
- a means for achieving a more advanced and progressive agricultural system through development of delivery and receiving mechanisms for farm inputs and the application of policies embracing mixed farming, integrated territory and mixed commodity production;
- a force for motivating farmers to participate actively in the overall programme for increased rice production.

The organizational structure set up to direct the BIMAS scheme is an illustration of the political commitment and coordinated approach underpinning the drive towards self-sufficiency. At national level, the Minister of Agriculture, who reports directly to the President, chairs the Directing Board. At provincial and district levels, governors and district heads take the chair. With further application of this principle to sub-district and village heads, all levels of leadership are brought within the BIMAS organizational structure.

Since the BIMAS structure involves coordinated input from many different agencies, it facilitates an integrated approach by providing the opportunity for consensus at all levels and at all stages, from setting priorities, planning and implementation to supervision, monitoring, evaluation and control. This has been a key factor in the success of the BIMAS scheme.

Another important feature is the organization's adaptability to progress in farming society and in farm systems. This built-in flexibility is illustrated by the different approaches that have been progressively introduced in different areas at different times, in accordance with local farming communities' capabilities to absorb more intensive production techniques.

General Intensification (INMUM) involves the dissemination of technology and other farm inputs to individual farmers without any obligation **for** joint effort with others. Under INSUS, more intensive farming is implemented by farmers cooperating in groups, through which farm inputs are channelled.

At the highest level of SUPRA INSUS, dating from 1987, rice production is intensified through cooperation not only among farmers in one group but also

among farmers' groups covering a wider geographical area of between 5 000 and 25 000 ha.

In some areas, **a** programme of special efforts known as Operasi Khusus (OPSUS) is applied, in order to improve management and enhance the performance of various agencies.

Establishing a floor and ceiling price for rice

The government perceives agricultural development as a system comprising interdependent subsystems. Any failure in one or more subsystems will affect the other subsystems and the system as **a** whole. In the rice production programme, for example, there are several subsystems such as farm input delivery, farming systems, rice marketing and trade and consumption.

To protect farmers as both rice producers and consumers, the government has developed a favourable price policy through setting the floor and ceiling price, with the National Logistic Agency (BULOG) playing an important role. During harvest time, BULOG is ready to purchase rice from farmers whenever the price falls below the floor price. On the other hand, BULOG will intervene in the market by supplying rice when the price is above the ceiling price. The price is evaluated and adjusted annually.

Development of appropriate modern farming practices

High-yielding varieties. Improved varieties can be perceived as one of the salient technologies, playing a significant role in the rice production programme. These varieties provide higher yield, 5-9 tonnes/ha within 110-135 days, while local varieties yield only 3-4 tonnes/ha in 150-180 days. Early maturity allows farmers to increase their cropping intensity from one to two or three crops of rice per year. In addition, improved varieties are usually resistant to certain pests and diseases, thus minimizing the use of pesticides. Besides reducing the production cost, minimum use of pesticide is also important in relation to the quality of the environment.

Availability of high-quality seed is also a major contributor to the success of agricultural development. PT Sang Hyang Seri, a state-owned enterprise, is responsible for producing and marketing high-yield varieties. The production of high-yield variety seed increased dramatically from 485 tonnes in 1975 to an estimated 102 467 tonnes in 1997.

At present, more than 80 percent of the rice area is planted with improved varieties. In the meantime, more attention has been given to local varieties through exploration, collection, evaluation and the documentation **of** germplasm.

Fertilizer. One of the characteristics of improved modern varieties is their

TABLE 1
Type of agricultural machinery used for agricultural development, 1984-96

Item	1984	1986	1988	1990	1992	1994	1996
Two-wheel tractor	8881	11219	16804	23431	33845	50224	58174
Four-wheel tractor	4122	4175	3416	4524	4557	5384	7244
Hand sprayer	570039	724121	905062	1048096	1169106	1264198	1448249

Source: Central Bureau of Statistics.

high response to fertilizer application, especially nitrogen, phosphate and potassium. Based on research findings, a national recommendation on fertilizer rate is released, followed by regional recommendations. Recognizing the huge quantity of fertilizers needed for the programme and the resources available in the country, the government has supported establishment of fertilizer industries in several locations to assure continuous distribution of the products. Examples are PT PUSRI in South Sumatra, PT Kujang and Petrokimia in West and East Java and PT Pupuk Bontang in East Kalimantan.

In the food crops subsector, fertilizer use for paddy increased from 18 400 tonnes in 1984 to 4 174 000 tonnes in 1997. In 1997, nitrogen fertilizer consumption increased to 3 008 805 tonnes. Consumption of phosphates increased from 42 780 tonnes in 1969 to 678 100 tonnes in 1997 and that of potash from 13 700 tonnes in 1969 to 330 671 tonnes in 1997.

Agricultural machinery. Another input that makes a significant contribution to increasing agricultural production is the availability of agricultural machinery. Between 1984 and 1996, the use of agricultural machinery such as tractors and hand sprayers increased significantly, as shown in Table 1.

Integrated pest management

A significant contribution made by scientists of the Agency for Agricultural Research and Development (AARD) can also be seen in other programmes, such as the integrated pest management system. IPM encourages the integrated use of resistant varieties, natural enemies, appropriate cultivation practices and planting time, sanitation and monitoring. Pesticides are used only when necessary.

The adoption of IPM has been accelerated by various means, such as extension and farmers' field schools. The system requires skilled extension workers to train farmers in the rice field. In 1986, field comparisons based on pilot projects carried out by the first IPM-trained farmers showed that farmers practising the IPM method produced larger crop yields than those using pesticide-intensive methods. IPM had proved to be a viable alternative and was adopted by Presidential Decree in 1986 as the national pest control strategy for rice. In addition,

a ban was placed on the use of 57 brands of broad-spectrum pesticide, 20 of which had been widely used on Indonesian rice fields and substantially subsidized by the government.

Results from the IPM programme were evident almost immediately. After the first two seasons, the use **of** pesticide by IPM-trained farmers dropped by 90 percent. Production costs fell considerably through reduced pesticide use. A 60 percent drop in the use of highly toxic pesticide enhanced environmental protection.

A comprehensive training scheme has been put in place to establish IPM firmly as the predominant crop protection technology in Indonesia. The aim is to have some 2.5 million trained farmers by 1994, the last year of Indonesia's current Five-Year Plan.

Indonesia was the first nation to adopt IPM as a national agricultural policy and apply it on such a broad scale; the concept has since been adopted in several other countries.

Incentives for farm inputs

Part of Indonesia's success in developing agriculture, especially in expanding its rice production, is attributable to a combination **of** the provision of inputs and outputs and price policies that improved the profitability of rice cultivation.

The government also recognizes the limited resources of rice farmers, especially of land and capital. Credit in the form of subsidized inputs such as fertilizers, seeds and pesticides were therefore made available. The subsidy was then gradually reduced and finally discontinued. With the subsidy discontinued, it is expected that farmers will be more efficient in using agricultural inputs that may affect environmental quality. In the meantime, the subsidy can be used for other development efforts.

Development of a progressive rural structure

The achievement **of** rice self-sufficiency was critically dependent on the development of institutions and structures at the rural level to support increased rice production. Studies have shown that Indonesia's traditional rural communities are far from motivated by economic considerations alone. In addition to personal interests, the peer group's value system as well as an individual's role and position within the group are crucially important determinants of behaviour.

In addition to social structures, an effective infrastructure had to be put in place for the delivery of farm inputs. Four factors were perceived to be of particular importance to accelerating increases in rice output:

- guidance and training in new farming technologies and techniques;

- production materials such as seed, pesticides and fertilizers;
- working capital;
- retailing facilities.

Local leaders of farmers' groups have been closely involved in the programme for increased rice production, forming an integral part of the BIMAS system. The involvement of existing leaders, coupled with encouragement and training of potential leaders, has been a major factor in developing and enhancing community self-management in the intensification and extension of rice output.

Similarly, the organization of farmers into groups to cooperate in increasing rice production has provided a powerful force for motivating individual farmers. Development of such groups and operation through them have become basic features of BIMAS. In addition to stimulating and hastening the process of learning by doing, farmers' groups have proved a more efficient mechanism for receiving and disseminating technology and other farm inputs and for implementation of new farming techniques.

In order to secure more effective delivery of inputs to individual farmers and farmers' groups, Indonesia has committed itself since 1970 to the establishment of four key systems, which involve:

- agricultural extension services, based on rural extension centres staffed by trained field extension workers and agricultural subject matter specialists, who provide assistance to farmers in adopting technologies, farming techniques and systems;
- village unit banks to provide financial credit;
- village unit kiosks for stocking and retailing seed, pesticides, fertilizers and other inputs;
- village unit cooperatives responsible for distribution of farm inputs, credit, post-harvest handling, processing and marketing of rice.

The structure of delivery systems is based on the division of rice production areas into village units. The number of delivery institutions has grown progressively over the years. As of March 1997, there were 37 259 field extension workers operating in support of farmers and farmers' groups and 7 953 village unit cooperatives supporting local farm activities.

Training and extension

The dissemination and adoption of new agrotechnology lay at the heart of Indonesia's effort to achieve rice self-sufficiency. This meant forging a quiet revolution in the attitudes of the country's traditional farming communities. More specifically, it aimed to educate farmers to approach rice production as a total agricultural system, rather than the simple growing of a crop. This in turn involved the

TABLE 2
Harvest area, production and yields of paddy (GKG)" in Indonesia during Pre Pelita – Pelita VI

Year	Harvest area *(ha)*	Yield *(qu/ha)*	Production *(tonnes)*	Notes
1961-68	7 293 750	22.87	16 683 098	Pre Pelita
1969-73	8 152 474	24.14	19 677 292	Pelita I
1974-78	8 532 238	27.48	23 442 934	Pelita II
1979-83	9 068 278	34.76	31 519 032	Pelita III
1984-88	9 943 015	39.96	39 730 103	Pelita IV
1989-93	10 686 235	43.23	46 202 735	Pelita V
1994-97b	11 190554	43.91	49 137 880	Pelita VI

"Dry unhusked rice.
[b] 3rd forecasting.
Source: Central Bureau of Statistics (updated January 1998).

introduction of techniques suitable for different circumstances in different farming areas and the training of farmers in the use and application of what they learned.

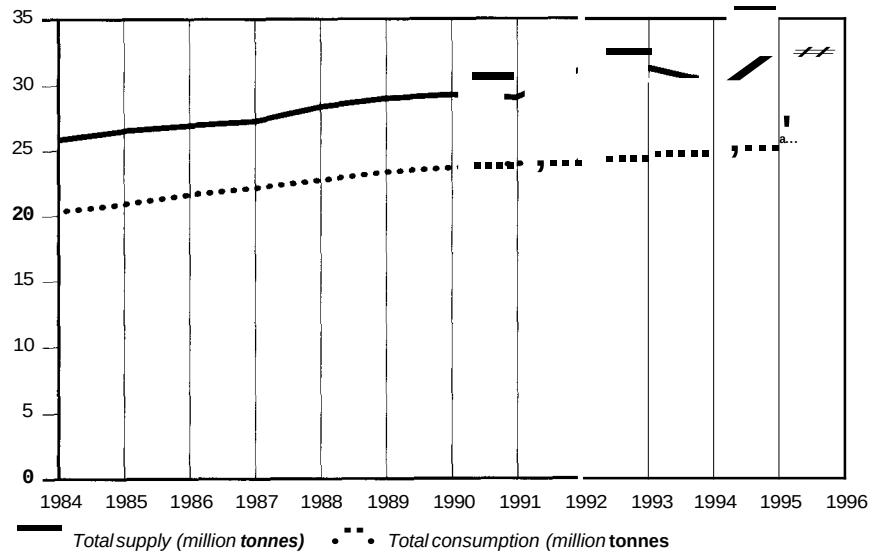
By focusing on farmers' groups, training and extension are brought more quickly to ever-wider numbers of individual farmers and the inherent dynamics of the groups themselves act as a powerful force stimulating learning. With the introduction in 1979 of the Training and Visit scheme as a part of agricultural extension activity, training was greatly strengthened by field extension workers being obliged to make periodic visits to farmers' groups. Under the scheme, each field extension worker is responsible for training 10-16 farmers in a group receiving intensive guidance in the field twice a month. Field extension workers themselves periodically receive training in such matters as production technologies, pest and disease control, soil preservation and water conservation.

Other agricultural extension methods are operated along with the Training and Visit scheme, including the use of radio, television and film, dissemination of printed material, shows, exhibitions and competitions with prizes. Indonesia's experience points to the synergetic use **of** a combination **of** methods to achieve the best training and extension results.

POST-INNOVATION

Supported by the strong commitment of the leaders and successfully implemented government policy and action programmes, food production has increased substantially, as shown in Table 2. Rice production increased remarkably during the Pre-Pelita to Pelita VI period. This was brought about by research that has played an important role in sustaining rice self-sufficiency. Information and technologies have been generated in relation to production and the economic and social aspects of rice production.

FIGURE 4
Total rice supply and consumption *(million tonnes)* in Indonesia, 1984-96



The total production of rice in Indonesia between 1984 and 1996 was higher than total domestic consumption (Figure 4), which means that over this period Indonesia was able to cover domestic consumption, in other words maintain self-sufficiency. Total consumption increased significantly because of an increase in the total population and per capita consumption. The consumption of rice per capita per year rose gradually to about 133.4 kg in 1997, resulting mainly from the increase of income per capita.

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