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AND

NATIONAL ACADEMY OF SCIENCES, USA,

WORKSHOP ON FOOD

A REPORT ON THE

LEMBAGA ILMU PENGETAHUAN INDONESIA -

NATIONAL ACADEMY OF SCIENCES, USA,

WORKSHOP ON FOOD HELD AT

DJAKARTA, INDONESIA

MAY - 1968

VOLUME - II

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LIPI-NAS WORKSHOP ON FOOD

VOLUME II

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FOREWORD

A week-long Workshop on Food was held in Djakarta 27 May - June 1, 1968, to formulate recommendations addressed to Indonesia's most crucial current problem: how to overcome calorie deficiencies and achieve a more nutritious diet for the country's 117 million people. A joint effort of the Indonesian Institute of Sciences (LIPI) and the National Academy of Sciences of the United States (NAS), the meeting sought to assist Indonesia's National Development Planning Board (BAPPENAS) with respect to the development of a national food policy and the identification of budget requirement priorities in connection with the Five-Year Development Plan (1969-1973). In the selection of subjects recommended for concentrated research, an effort was made to list topics for which the country's scientific and technological resources could be mobilized fully to support the top priority national goal of increased food production.

This compilation of eight working group reports is Volume II of a three volume report. Volume I contains the over-all findings and recommendations of the Workshop. Volume III includes keynote addresses, a list of participants, and other supporting material.

The report was submitted in preliminary form to BAPPENAS immediately following the Workshop. A summary of the conclusions and policy recommendations was presented to President Soeharto and to his cabinet ministers responsible for economic and agricultural development programs.

A basic guideline for the discussions was the 18-month White House report on world food problems conducted by the U. S. President's Science Advisory Committee and published in May, 1967. The Chairman, Executive Director, and several panel members of this comprehensive study participated in the Djakarta Workshop. In addition to the Academy's panel of 25 specialists, there were ten experts representing Australia, Japan, the Netherlands, as well as regional and international agencies. The 86 Indonesian panelists, resource specialists, and observers were drawn from several ministries, universities, and research institutes.

This report is published with the expectation that the observations, findings, and recommendations presented will be of interest and value to a wide audience in Indonesia and the United States, and among planners, agriculturalists, and

others in developing countries who are concerned with the increase of food resources, the organization of research, and the application of science and technology to economic and agricultural development. Additional copies of this report may be obtained free, upon request to either the Indonesian Institute of Sciences or the National Academy of Sciences, the addresses of which are given on the title page.

WORKING GROUP I

POPULATION

FOOD NEEDS

NUTRITION

Pages: 1 to 28

WORKING GROUP I: POPULATION, FOOD NEEDS AND NUTRITION

Poorwo Soedarmo, Chairman
Orville G. Bentley, Co-Chairman

INTRODUCTION

The Working Group came to some conclusions on the simply stated but intrinsically complex and vital problems of food in its relationship to maintaining the health of all Indonesians. Recommendations are made for present action and future plans.

The alarming frequency of deficiency diseases, and their obvious relation to inadequate quantity and quality of food (protein, calories and vitamin A activity) are impressive. We have presented the most reliable data available concerning food requirements in general and the specific requirements of vulnerable groups.

The only solution to the problem of feeding the Indonesian population is to increase food supply, reduce the rate of population growth, and raise the buying power of the population.

Calculation of food production targets for 1969 and subsequent years is recognized as essential, even if difficult to prepare with accuracy. Even though the data are inadequate for precise figures, it is clearly evident that integrated central and district programs of research and crop production promotion are needed. Keeping the rate of population growth in balance, with feasible increases in food availability, will be no easy task, but the tested means for bringing about family limitation are urged for widespread application.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The Working Group considered these major topics: national population problems, nutrient requirements, health parameters for determining nutritional adequacy of the diet, projected food needs based on recommended food allowances at a national level, national food policy, and applied nutrition programs.

Nutrition surveys show that protein-calorie malnutrition and vitamin A deficiency are common and are especially critical for preschool children (0 to 6 years of age), pregnant women, and nursing mothers. Although poor nutrition is a national problem afflicting all lower economic segments of the population, the likely permanent effect on the physical and

mental development in children is costly in terms of human misery and Indonesia's future human resource development. Consequently, Working Group I strongly recommends that a high priority be given to the production of protein-rich foods including vegetable protein sources and cereals, particularly rice. A national program for correcting vitamin A deficiency is also urgently needed.

The nutritional needs of Indonesian children are further confounded by widespread incidence of parasitic, gastro-intestinal infections, and other infections. These maladies interfere with food intake, and impair nutrient absorption from the intestinal tract, thus further depriving the child already existing on a nutritionally marginal diet.

The solution of nutritional problems requires concurrent improvement in public health programs designed to reduce sources of intestinal infectious agents in the environment. Public health programs needing attention include environmental sanitation, improved water supplies, and preventive medicine for the control of endemic and epidemic infectious diseases.

Working Group I has calculated and discussed a Food Balance Sheet and Food Allowances per capita and recommends that these figures be used by the Government in calculating food needs and planning food supplies in the year 1968-1969, and that the reliability of these data be checked for subsequent years. Taking figures from the Central Bureau of Statistics, Indonesia, for 1962-1967 (which do not take home production into account, and which may disguise uneven patterns of consumption within the population), an estimated average food supply per capita per day was calculated to be about 1700 calories. When compared to a recommended allowance of a national average per capita per day of 2100 calories, this indicated a shortage of about 400 calories. (Some observers have proposed a higher calorie requirement, but the Workshop has accepted the figure of 2100 as acceptable for present use in Indonesia when body weight and age distribution are considered.)

The continued imbalance between birth rates and death rates, if not corrected, will make it impossible ultimately to supply even a minimum level in quantity and quality of food. The current estimated population of 117 million, when projected to 1991, using growth rates by regions of 2.2, 2.4, and 2.6 percent and assuming a continuing decline in mortality through improvement in health, would give an expected population of 204, 223, and 235 million respectively. These projections clearly indicate the urgency of initiating a nation-wide program of family planning aimed at reducing the population growth rate.

The nation faces a critical food problem. To meet it, the Government should develop a national food policy and a functional national program to stimulate research, program building, and program implementation in all public and private agencies concerned. It should promote productive working relations among agencies in regional areas and between regional areas and the central Government.

LIPI, as the national institute of science, together with other appropriate agencies should promote the creation in Indonesia of a system for applying science and technology in food and nutrition programs. Such a system should be developed as quickly as possible with full understanding and appreciation that success depends on technically-adequate staff, valid and reliable recommendations, continuity and versatility in programs and productive working relations among all concerned. All these demand that programs become more scientifically oriented both as to materials and practices used and as to the social technology employed in getting the job done.

There is, therefore, a continued task for an organization such as LIPI to perform in the adequacy of programs and in stimulating their implementation.

Furthermore, it is apparent that stronger relations should be developed between the departments involved in food and nutrition programs and BAPPENAS (National Development Planning Board) and LIPI, at least by the appointment of liaison officers of sufficient rank and capability to assure effective representation of the respective programs.

SPECIFIC PROBLEMS

I. Assessment of Food Supply and Allowances

A. Food Balance Sheet

Statistical data for compiling a food balance sheet in Indonesia are not yet complete. The very small farm holdings make the gathering of such data very difficult. The Statistical Pocket Book of Indonesia (SPI), scheduled to be published every year (but not published since 1964), mentions only the availability of six kinds of food: rice, maize, cassava, sweet potato, soya, and peanuts (see Tables 1A and 1B, pp. 17 and 18). The foods not mentioned in the SPI, however, comprise only a small fraction of the total quantities of calories and proteins, probably not more than ten percent.

1. Foods for which Incomplete Figures are Given:

Sugar. Production figures are given for cane sugar (white) from plantations as well as from home industries (brown). No figures are given on brown sugar made from coconut and other palm juices.

Coconut. SPI mentions only production of copra from plantations. Production of small-farm copra can be obtained from the Directorate Aneka Tanaman. How much of this copra is used for human food is not mentioned. A large part of the coconut production is not used as copra but as coconut meat, but there are no figures.

Palm Oil. No figures are available on what part is used for food.

Fish. There are figures on fresh fish production from inland as well as sea fisheries, and on the import and export of preserved fish.

Meat, Eggs, and Milk. There are no figures on the production of meat and eggs, but there are data about number of animals, from which rough estimates were made. No figures are given for milk production, but there are figures on imports of milk.

2. Foods Not Mentioned in SPI:

These include other cereals, other roots, sago, other pulses, vegetables, and fruits.

3. Calculations into Calories and Proteins:

For the calculation of calories and proteins, the FAO Food Composition Tables were used. Where data were incomplete, estimates were made.

4. Consumption:

Calculation of consumption figures from data at the "production level" is not possible, because no estimate is available for wastage and spoilage before food reaches the consumer and for non-human food uses. FAO gives an estimate of about ten percent for the difference between the retail level and consumption. The Agricultural Extension Service estimate is that five percent is lost between the production level and the retail level, but the figure is almost certainly much higher.

Since before the war, nutrition surveys have been carried out in different areas, but mostly when there is hunger, or when the food situation is alarmingly bad, or when one or another kind of nutrition deficiency is suspected. These investigations are so small in number as to make generalizations about yearly average consumption impossible, but they provide an idea of the general food shortages.

In 1963 and 1964, the Central Bureau of Statistics compiled SUSENAS I and II (National Socio-economic Survey I and II; see Table 2, p.19), but the figures are not complete. Not mentioned are wheat and wheat products, other cereals, sweet potatoes and other roots, sago, pulses and fruits. But it mentioned vegetables and gave certain data on food from animal sources.

5. Some Conclusions from the Figures:

The rough estimates used for completing the figures for foods available are confirmed by different approaches, i.e., consumption and nutrition surveys carried out by the Nutrition Institute and the Academy of Nutrition, and consumption figures from the National Socio-economic Surveys. The conclusion can be made that the per capita consumption of food is dangerously low in Indonesia, not only in quantity but also in quality. Other events confirm this, like the yearly recurrence of food shortage and consequent hunger, even chronic hunger, and the increase in the number of areas compelled to use the protein-poor cassava as a staple food.

The critical deficiency is found in overpopulated Java, Madura, Bali, and Lombok, as well as in the other Lesser Sunda Islands. The outer islands are generally better fed, although still deficient, and, in some places, the situation is desperate. Efforts are required to arrive at a correct food balance sheet.

B. Nutrient and Food Allowances

1. Nutrient Requirements:

Satisfactory health of the Indonesian people can be achieved only if all required nutrients are supplied in the food consumed. A review of the current data on food production and consumption suggests that in the planning of national food supplies it is essential to give much greater consideration to nutritional well-being.

The Recommended Dietary Allowances (see Table 3, p. 20) have been designed for the maintenance of good health. They are intended for use in Indonesia as standards for the evaluation of food consumption, as the basis for planning of food supplies for groups of the Indonesian population, and to serve as a guide for public health and nutrition education.

The allowances of calories, proteins, vitamin A, thiamin, riboflavin, niacin, and calcium are based on the approach of the committees organized by FAO and WHO of the UN for the formulation of the requirements of calories and specific nutrients, for international application. Those of iron and ascorbic acid were based on the formulation made by the Food and Nutrition Board, National Academy of Sciences, U.S.A.

Important factors to be taken into account in using the dietary standards are body weights, physical activities, and the nature of the existing dietary patterns. The use of actual body-weight data is not justified, particularly in younger persons, because weights are low due to inadequate diet. The recommended figures for body weight are average figures which children and adolescents in Indonesia may attain, when the daily diet is well balanced during their whole period of growth (see Table 4, p. 22). To permit formulation of the allowances the Reference Man and Woman have been defined as follows:

> The reference man and woman are both 25 years of age, living in Indonesia at a mean annual temperature of 25° centigrade, weighing 55 kg. and 47 kg. respectively. Both are healthy and engage in an average annual activity which is not sedentary and does not involve more than occasional periods of hard labor.

It should be emphasized that adjustment must be made when groups of population differ from the specified characteristics of the "reference man and woman." The table should not be applied for individuals.

The protein allowances adjustment for the quality of dietary protein was made on the assumption that the existing average diet where rice is the staple food has a Net Protein Utilization (NPU) value of 60. It is important to note that in case the NPU value is higher than the mentioned value, the protein requirement will be lower. In areas where the staple food is other than rice, e.g., maize, cassava, sago, the NPU of the dietary protein is lower than 60, hence the provision of high quality protein foods needs special attention.

For the planning of the national food supply, the protein and calorie allowances recommended are expressed as per capita per day, i.e., the weighted average of the requirements for different sex and age groups. The distribution of population by age and sex has an important influence on the per capita requirements.

In estimating nutritional requirements, the additional needs for calories and proteins and other nutrients in pregnancy and during the period of nursing must be included.

Regarding the per capita allowance of protein for the population, attention should be given to the following factors: in many parts of Indonesia, protein of lower NPU values than 60 are consumed, meaning that the amount of protein required must be increased; high incidence of parasitic diseases, gastro-intestinal disorders and chronic illnesses may increase the need for proteins; and high incidence of protein-calorie malnutrition, particularly among preschool children, could cause permanent damage, and needs to be corrected for the welfare of the future generations.

It is essential that the calculated protein requirement be increased by ten percent to allow for the above-mentioned factors.

In order to increase the validity of the estimation of nutrition requirement of the population and the calculation of national calorie and protein requirements, more information is required. The methods of calculating calorie (2100 calories) and protein (55 grams) requirements per capita per day are summarized in Tables 6 and 7 (pp. 24 and 25).

More reliable data will be needed in the future particularly on the activity pattern of Indonesians of various groups (especially of the rural population), on the actual food intake and the nature of diets of various population groups (particularly children), on nursing, and on the effects of present low intake of nutrients on the nutritional values of the people.

For the estimation of the requirements at the regional level, adjustments should be made according to local data on population and health status as well as dietary patterns.

2. Translation of the Recommended Nutritional Allowance into Foodstuffs:

The recommended allowances of 2100 calories and 55

grams of protein were translated into foods.

Illustrations of food supplies from the food balance sheet do not show the actual consumption pattern. The latter comes from household dietary surveys. Such surveys have already been conducted in several parts of Indonesia, and some of them were presented to the Working Group.

The allowance figures are given at physiological level, meaning that they represent the amount of calories and proteins from foods actually consumed. Information on national food supplies is usually related to those at the retail level, taking into account only the losses of food between the first step of production and kitchen, and not those between kitchen and mouth. To avoid confusion, the Working Group preferred to express the allowances in terms of foods as purchased at the retail market. An addition of ten percent to the calories and proteins at retail level suggested by FAO was adopted bringing the totals up to 2300 calories and 60 grams of proteins.

The assumption that the present Indonesian diet has a NPU value of at least 60 was justified by the fact that the diet is predominantly based on rice.

The recommended food allowances at national level per capita per day and per year are represented in Tables 5 and 8 (pp. 23 and 26); its projection for the total population in the years of 1969 and 1973 are also presented. The Working Group recognized the need for regional adaptation, since dietary patterns and food availability vary from one region to another.

Among ten groups of food constituting the Indonesian diet, three have been given special attention. The first was rice. It provides more than two-thirds of the total calories and proteins in the diet. Its specific flavor and texture are highly acceptable. It has a high social value and fortunately, a relatively high quality of protein; NPU value of 57. The second was fish, which very often constitutes the single animal food in the diet, particularly in rural populations. It is widely distributed, and consumed mainly as dry-salted fish. Legumes represent the second vegetable protein source after rice. Since the total amount eaten is small, their protein contribution is not high; but their consumption is extremely important to increase the protein quality of the diet. They are used in a wide variety of recipes.

Allowance figures of all foodstuffs are presented in Table 5 (p. 23). These, in general, are the same as those recommended by the Nutrition Seminar in 1963. (It was emphasized that the allowance of five grams of milk per capita per day was intended primarily for infants who do not get breast milk.)

3. Problem of Protein-Calorie Malnutrition:

The problem of providing enough calories and proteins for the population is of the greatest urgency. It calls for immediate action.

The average per capita per day food supply at the national level during the years 1962-1967, as calculated from available data, showed that the available calories are in the range of 1696 to 1974, with an average of 1700 calories; the available protein is in the range of 32.3 to 37.7 grams, with an average of 35 grams of protein. The weighted average requirement per capita per day is calculated to be 2100 calories and 55 grams of protein at consumption level, or 2300 calories and 60 grams of protein at the retail level.

Figures on food consumption from the National Socioeconomic Survey for the year 1964 reveal that at the national level the per capita per day consumption is 1671 calories and 36.95 grams of protein. The breakdown of consumption figures showed that for the same year the densely populated islands of Java and Madura are worse off, with 1556 calories and 31.9 grams of protein, while the outer islands had 1931 calories and 45.9 grams of protein.

Scattered data in the medical literature and from reports of nutrition surveys showed the incidence of chronic, endemic hunger edema in certain parts of Java and, more seriously, the presence of protein-calorie malnutrition, in many instances coupled with vitamin A deficiency, primarily affecting the growing children of the age group below five years of age. Protein-calorie malnutrition may affect all groups of the population, but it may be especially significant in the physiologic age group with rapid growth, such as children and pregnant and nursing women.

The epidemiology of these nutritional deficiency diseases and their disastrous impact on the various aspects of development of the country and its population have been presented in the background papers. Lowered physical capacity of people, who are so necessary for the development of the country, impaired growth and development, and decreased

resistance to infectious diseases and stresses of life result from malnutrition.

Stress has been laid upon the harmful effect of protein-calorie malnutrition on the young age group, causing stunted growth and mental retardation. This may have serious repercussions for the country in the coming decades. The provision of sufficient food to meet the nutritional needs of the various age groups in the population has to be filled by locally available foodstuffs and by justified imports of commodities of high nutritional value.

Staple foods such as maize, cassava, sago and other tubers are the main contributors of calories and in the case of cereals also of protein in the average Indonesian diet. Soybeans, peanuts, and other legumes are the second contributors to the protein in the diet, followed by fish (mostly dried or salted fish), especially in Java.

Edible or cooking oil, an expensive commodity, is not liberally used in ordinary cooking practices of the population at large. The very low fat content of the diet, in the range of ten percent of the total calories of the diet, is serious. The inequitable distribution of food in the family will result in a very low intake of calories, protein and fat for the children, precipitating the onset of the full-blown kwashiorkor in the underfed marasmic children, worsened by the onset of vitamin A deficiency.

4. Vitamin A Problem:

Vitamin A deficiency in Indonesia leads to xerophthalmia and blindness. It is evident that xerophthalmia is one of the main causes of blindness related to vitamin A deficiency in Indonesia. The segment of the population most seriously affected by vitamin A deficiency is children of preschool age. The few isolated data collected to date suggest that the prevalence is increasing. Many children blinded by xerophthalmia fail to survive; the child with xerophthalmia is almost invariably suffering from protein-calorie malnutrition. Both reduce resistance to infectious diseases and have grave social consequences through their effects on growth and development.

Another socio-economic factor illustrating the behavior of the young child making it more vulnerable to the development of xerophthalmia is a passive attitude towards foods which contain rich provitamin A, i.e., green leafy vegetables are frequently refused. Sources of the vitamin

of animal origin are beyond the purchasing power of the family. The child with xerophthalmia is predominantly a poor man's child. The limited availability of food in general, particularly sources of vitamin A, protein and fat lies at the root of xerophthalmia and related problems. Vitamin A deficiency and protein-calorie malnutrition in young children are related to the general food shortage.

There are many carotenoid sources in this humid, green, tropical country which have a marked vitamin A activity. The carotenoids have to be converted to vitamin A in the intestinal wall, a function often impaired in the malnourished child. Furthermore, carotene is less absorbed in a low fat diet. (The practice of cooking in red palm oil in West and Central Africa makes a rich source of carotene available from an early age, with evident prophylactic value against xerophthalmia.)

The nature and magnitude of the vitamin A problem as described above demand immediate short and long-term planning at national and international levels for future action.

II. Family Planning

Working Group I concludes that the problems of food supply and food requirements, on the one hand, and of population growth, on the other, are inseparably intertwined. Working Group I recommends that the Workshop give the fullest possible consideration to the effect of alternate rates of national population growth upon potential food supplies.

At the present time, the figure of 2.6 percent is the best single estimate of the national population growth rate of Indonesia. Regional differences are recognized, however, and the rate of 2.35 percent per annum is suggested as the figure for the densely populated islands of Java, Bali, and Madûra, while the outer islands are considered to be growing at the rate of 2.8 percent per annum. If the birth rate continues at its present high level and if the death rate continues to fall as anticipated, the national growth rate may reach 3.1 percent by 1981 and 3.36 percent by 1991. The continued imbalance between birth rates and death rates, if not corrected, will make it impossible to supply even a minimum level in quantity and quality of food.

The current population of 117 million, when projected to 1991, using growth rates of 2.2, 2.4, and 2.6 percent and assuming a continuing decline in mortality through improvement in health, would give an expected population of 204, 223, and

235 million respectively. These projections clearly indicate the urgency of initiating a nationwide program of family planning aimed at reducing the population growth rate below the present 2.6 percent level (see Graph 1 p. 27).

The nation faces a critical food problem because of the continuing rapid population growth. It is strongly recommended that a national policy be formulated that would undertake to reduce this national growth rate, and that such a policy be incorporated in the Five-Year Development Plan as a priority project which has strong food as well as health implications. In the program designed to influence the birth rate, stress can continue to be laid upon the advantages of family planning for the health and welfare of the individual family. The adoption of this recommendation, it is believed, would give family planning activities an increased sense of urgency and a higher priority among competing activities.

While the long-term effects of a national family planning program cannot be guaranteed, scientists must draw the attention of LIPI and the Government to the fact that an uncontrolled growth rate could have disastrous implications on food policies and food programs developed without adequate consideration of population dynamics.

III. Food Policy and Applied Nutrition Programs

A. Food Policy

The philosophical aspects of what a food policy might be, and what might be expected from such a policy if it is adopted by the Government, were discussed. Food Policy was defined as: the programs and activities of the Government, which are legalized by the National Assembly and Parliament, to provide adequate food for the greater part of the population in order to obtain and maintain a desired level of health.

Analysis of the above definition reveals several principles, which are enumerated below:

That the Government have a clear program in the provision of food for the people;

That the program be legalized by the national representatives acquiring the status of an act;

That the food supplied be within reach of the economic capacity of the greater part of the population;

That the food provided be acceptable and adequate to maintain a desired level of health; and

That the program involve the active cooperation of all governmental agencies.

The principal change to be brought about by the adoption of a food policy is that producers, marketers, and consumers will all be guided by knowledge of what people "ought to eat" in order to have the desired level of health. With availability of good food and with education and promotion of its use, the supply and demand factors can meet in the market place and interact in such a way as to stimulate both production and use of food with enough calories, protein and vitamins. This is referred to as changing from a "tool-oriented production" to a "requirement-oriented" one.

Food production becomes the center of all activities of the various governmental agencies concerned; all activities are aimed toward facilitating the provision of food for the people at an adequate level in terms of quality as well as quantity. The production agencies have to adjust their capacity to meet the requirements of kind and amount of foodstuffs which must be produced and supplied for maintenance of the desired level of health of the population.

B. Applied Nutrition Programs

The definition and broad objectives of applied nutrition programs are quoted from the WHO Technical Report Series No. 340, 1966, as follows:

"Applied Nutrition Programs (ANP) constitute a comprehensive series of inter-related education activities, aimed at the improvement of local food production in favor of local communities, particularly mothers and children in rural areas, in which the guiding principles are coordination among different agencies and institutions and the active participation of the people themselves.

"The broad objectives are:

to establish dietary practices essential for sound growth and development of children and for the maintenance of health among all members of the family and the community to which they belong; concurrently, to improve levels of family living and local patterns of food production,

distribution, and consumption."

Coordinated action on nutrition improvement was started as early as 1954 in the Province of Central Java on the initiative of nutrition-minded health and agriculture officials, who established the Central Java Committee for People's Food Improvement (Panitia Perbaikan Makanan Rakjat Djawa Tengah). In 1957, the National Food Board recommended to the provincial governors the establishing of such a coordinating committee, but because of lack of guidance from the national level, only two or three provinces have complied.

The improvement of the nutritional state of the vulnerable groups of the Indonesian population can be effected by practical nutrition education for pregnant and nursing mothers. This means taking measures to make the community aware of the seriousness of the nutrition problems affecting physical and mental development of children, and concurrently showing the means for improvement within the community's reach. In essence, measures for nutrition improvement are based on principles of home economics or home life improvement, taking into account the various socio-economic factors. Expressed in simple words, it means: increase of production of nutritious food, especially protein-rich foods, in the backyard, and consuming them. Nutrition-mindedness of the community can be of great benefit in enhancing programs for increase of food production, and efficiently-coordinated efforts should be geared to spread it. But nutrition-mindedness should start from the top level of the government and go down to the regional, county, and village levels; it is of the utmost importance that executives, legislators, and policy makers at the national level be nutrition-minded.

RECOMMENDATIONS

I. Assessment of Food Supply and Allowances

It is recommended that:

1. The Government compile and publish a National Food Balance Sheet annually.

2. Food Balance Sheets also be prepared for geographic, economic units of the country.

3. For the present purposes, the 1963 figures of the available foodstuffs (Tables 1A and 1B; pp. 17, 18) be taken as estimates of the food supply in 1968.

4. Serious attention be given to increased availability of protein-rich foods, in addition to increasing the production of the main crops. Protein-calorie malnutrition and hunger edema are direct consequences of a general food shortage and inadequate nutrition knowledge. Protein-calorie malnutrition in the preschool age child is of special concern, since permanent damage can result in impaired physical and intellectual development, which has important consequences for the nation's future manpower.

5. The Government collect nutritional and food production data systematically at regular intervals through regional and group surveys in order to be kept aware of the results of the production efforts. If nutritional surveys are not feasible in a short period of time, food consumption surveys should be carried out in the near future, preferably incorporated into the Socio-economic Survey (SUSENAS).

6. Solution to the problems of vitamin A deficiency, widespread in the population of Indonesia, causing much blindness and increased susceptibility to infection, be achieved through several alternatives, any of which would be acceptable from the nutritional point of view, as stated below:

Improved utilization of plant carotene sources, especially green leafy vegetables, yellow fruits and red sweet potatoes; along with increased fat intake to increase the efficiency of carotene absorption;

Development of sources of, and utilization of, red palm oil and/or shark liver oil; and

The purchase of concentrated vitamin A preparations for oral use dosages.

7. Tables of dietary allowances and protein and calorie requirements be used by the planners in food production and supply; and that such data be reevaluated and adjusted periodically; also that the required national averages per capita per day be taken to be 2100 calories and 55 grams of protein.

8. Further studies be made to complete information on waste figures of food; energy expenditure of various groups of population.

9. Agencies concerned with food production be jointly involved with agencies responsible for the formulation of national policies and programs.

II. Family Planning

It is recommended that:

1. The fullest possible consideration be given to the effect of alternate rates of national growth on potential food supplies, because the problems of food supplies and food requirements, on the one hand, and of population growth, on the other, are inseparably intertwined. At the present time, the figure of 2.6 percent is recommended as the best single estimate of the national population growth rate of Indonesia.

2. A national family planning program be formulated to reduce the national growth rate, and that such a policy be incorporated in the Five-Year Development Plan as a priority project which has strong food as well as health implications.

3. Governmental support to family planning projects be undertaken which cover the whole nation, especially Java, Bali, and Madura.

III. Food Policy and Applied Nutrition Programs

It is recommended that:

1. A food and nutrition policy be established by law.

2. The scientific world be given more participation in the planning and follow-up of the food and nutrition policy.

3. The results of this Workshop on Food be given consideration in the formulation of the food and nutrition policy.

4. A Central Scientific Advisory Body be established for follow-up on the execution of the food and nutrition policy, preferably through LIPI.

Table 1A. Food Available Per Person Per Day
Calculated on Calories [1]

	1951	1952	1953	1954	1955	1956	1957	1958	1959
Rice	832	902	911	940	867	931	896	927	929
Maize	159	182	200	293	207	203	188	261	203
Cassava	262	284	327	338	314	316	340	378	402
Sweet Potatoes	45	77	71	68	60	81	80	89	83
Soya	28	28	28	37	31	31	29	36	36
Peanuts	25	27	28	36	31	33	33	33	36
	1351	1500	1565	1712	1510	1595	1566	1724	1689
Other Foods[2]	97	194	189	203	226	204	207	219	211
	1448	1694	1754	1915	1736	1799	1773	1943	1900

	1960	1961	1962	1963	1964	1965[3]	1966[3]	1967[3]
Rice	995	895	923	805	888	879	837	839
Maize	233	211	295	209	314	192	248	243
Cassava	354	342	346	339	330	292	370	349
Sweet Potatoes	75	68	99	81	102	69	56	52
Soya	36	34	30	26	29	25	24	24
Peanuts	36	31	34	30	33	24	36	28
	1729	1581	1727	1490	1696	1481	1571	1535
Other Foods[2]	217	210	247	211	179	205	200	195
	1946	1791	1974	1701	1875	1686	1771	1730

[1] Source: Statistical Pocket Book, Central Bureau of Statistics, Indonesia

[2] Wheat, sugar, coconut, fat, palm oil, fish, meat

[3] Preliminary Figures

Table 1B. Food Available Per Person Per Day
Calculated on Proteins[1]
(Grams)

	1951	1952	1953	1954	1955	1956	1957	1958	1959
Rice	16.5	17.8	18.0	18.6	17.1	18.4	17.6	18.2	18.4
Maize	4.1	4.7	5.2	7.6	5.4	5.2	4.9	6.8	5.2
Cassava	2.2	2.3	2.7	2.7	2.6	2.6	2.8	3.1	3.3
Sweet Potatoes	0.5	0.9	0.8	0.8	0.7	0.9	0.9	1.0	0.9
Soya	3.0	3.0	3.1	4.1	3.4	3.4	3.2	4.0	4.0
Peanuts	1.2	1.3	1.3	1.7	1.5	1.5	1.5	1.5	1.7
	27.5	30.0	31.1	35.5	30.7	32.0	30.9	34.6	33.5
Other Foods[2]	3.2	3.6	3.4	3.2	3.2	3.6	3.5	3.4	3.0
	30.7	33.6	34.5	38.7	33.9	35.6	34.4	38.0	36.5

	1960	1961	1962	1963	1964	1965[3]	1966[3]	1967[3]
Rice	19.7	17.7	18.2	15.9	17.6	17.4	16.6	16.6
Maize	6.0	5.5	7.6	5.4	8.1	5.0	6.4	6.3
Cassava	2.9	2.8	2.8	2.8	2.7	2.2	2.8	2.7
Sweet Potatoes	0.8	0.8	1.1	0.9	1.1	0.8	0.6	0.6
Soya	4.0	3.7	3.3	2.9	3.2	2.8	2.7	2.7
Peanuts	1.7	1.5	1.6	1.4	1.5	1.6	1.7	1.3
	35.1	32.0	34.6	29.3	34.2	29.8	30.8	30.2
Other Foods[2]	3.1	3.5	3.1	3.0	3.2	3.4	3.3	3.2
	38.2	35.5	37.7	32.3	37.4	33.2	34.1	33.4

[1] Source: Statistical Pocket Book, Central Bureau of Statistics, Indonesia

[2] Wheat, sugar, coconut, fat, palm oil, fish, meat

[3] Preliminary figures

Table 2. Consumption of Food Per Person in 1964
According to the National Socio-Economic Survey

Commodity	Calories Per Day			Proteins (Gr.) Per Day		
	Java & Madura	Outer Islands	Indonesia	Java & Madura	Outer Islands	Indonesia
Rice	853	1262	998	17.6	26.4	20.9
Maize	236	87	184	6.1	2.2	4.8
Cassava	131	104	121	1.1	0.9	1.0
Cassava Meal	57	21	44	0.2	0.1	0.1
Coconut	59	113	78	0.8	1.6	1.1
White Sugar	53	75	56	0.0	0.0	0.0
Brown Sugar	42	46	42	0.05	0.05	0.05
Coconut Oil	79	112	79	0.0	0.0	0.0
Vegetables	13	19	16	0.9	1.3	1.0
Fresh Fish	7	40	18	1.0	6.0	2.8
Salted Fish	13	23	16	2.9	4.8	3.6
Meat	8	15	10	0.9	1.7	1.1
Poultry	3	9	6	0.2	0.5	0.3
Eggs	1	4	2	0.1	0.3	0.15
Milk	1	1	1	0.05	0.05	0.05
TOTAL	1556	1931	1671	31.9	45.9	36.95

Commodity	Unit	Per Year		
		Java & Madura	Outer Islands	Indonesia
Rice	kg	85.80	126.88	100.30
Maize	kg	27.04	9.88	20.98
Cassava	kg	43.68	34.84	40.38
Cassava Meal	kg	5.72	2.08	4.43
Coconut	number	16.12	30.68	21.26
White Sugar	kg	4.16	6.76	5.08
Brown Sugar	kg	4.16	4.68	4.34
Coconut Oil	liter	2.60	4.68	3.33
Vegetables	kg	22.88	33.28	26.55
Fresh Fish	kg	2.60	16.12	7.30
Salted and Dried Fish	kg	3.12	5.20	3.85
Meat	kg	1.56	3.12	2.07
Poultry	number	0.52	1.50	0.89
Eggs	number	6.24	16.12	9.73
Milk	liter	0.52	0.52	0.52

Table 3. Recommended Dietary Allowances for Use in Indonesia Designed for the Maintenance of Good Health

	Age yrs.	Body Wt.kg.	Calo-[1] ries	Prot.[2] gm.	Ca. gm.	Fe mg.	Vita.A[3] micg.	Thiamin mg.	Ribo- flavin mg.	Niacin[4] Equiv.mg.	Ascorbic Acid mg.
Men	20-39	55	2600	65	0.5	10	4000	1.0	1.4	17	60
	40-59	55	2400	65	0.5	10	4000	1.0	1.3	16	60
	60 +	55	2400	65	0.5	10	4000	0.8	1.1	13	60
Women	20-39	47	2000	55	0.5	12	4000	0.8	1.1	13	60
	40-59	47	1900	55	0.5	12	4000	0.8	1.0	13	60
	60 +	47	1600	55	0.5	12	4000	0.6	0.9	9	60
Pregnant[5]	extra		+300	+10	+0.5	+5	+500	+0.2	+0.2	+2	+30
Nursing	extra		+800	+25	+0.5	+5	+2500	+0.4	+0.4	+5	+30
Boys	16-19	50	3000	65	0.6	12	4000	1.2	1.7	20	60
	13-15	42	2900	58	0.7	12	4000	1.1	1.6	19	60
	10-12	35	2300	50	0.7	12	3450	0.9	1.3	13	60
Girls	16-19	45	2100	57	0.6	12	4000	0.8	1.1	14	60
	13-15	42	2400	58	0.7	12	4000	1.0	1.3	16	60
	10-12	35	2300	50	0.7	12	3450	0.9	1.3	18	60
Children	7- 9	27	1900	42	0.5	10	2400	0.8	1.0	13	50
	4- 6	18	1600	30	0.5	10	1800	0.6	0.9	9	40
	1- 3	12	1200	25	0.5	8	1500	0.5	0.7	8	30
Infants[6]	6-12mos	8	900	20	0.6	8	1200	0.4	0.5	6	25

See p. 21 for notes.

Notes from Table 3

1. Calories: "net calories" means the energy available from food actually assimilated.

2. Protein: Assuming that dietary protein of the Indonesian diets has a Net Protein Utilization (N.P.U.) value of 60 in which rice is the staple food. In case the N.P.U. of dietary protein differs from 60, the figures should be adjusted accordingly.

3. Vitamin A: The figures presented in the table were calculated as 100% B-carotene. In the case of a mixture of carotenoids and preformed vitamin A (retinol) adjustments should be made according to FAO/WHO method (FAO Nut. Meeting Rep. Series, No. 41, Rome 1967). For the age group 6-12 months of age, 90% of vitamin A activity comes from B-carotene and 10% from preformed vitamin A.

   To convert micrograms into International Units of vitamin A activity: one I.U. is equivalent to 0.3 microgram retinol or to 0.8 microgram B-carotene.

4. One mg. of niacin equivalent is equal to either 1 mg. niacin or 60 mg. tryptophane.

5. Second and Third trimesters.

6. 0-6 months of age, assumed to be exclusively breast-fed.

Table 4. Recommended Weight by Years for Use in Planning National Food Supply

	Age Groups	Mid Point	FAO/WHO Protein Requirement 1965	Indonesian Nutrition Seminar 1963	Indonesian Recommended (this paper) 1968
			kg	kg	kg
Infants:	months	months			
	0- 1	½	-	-	4
	1- 6	4½	-	-	6
	7-12	9½	9	-	9
Children:	years	years			
	1- 3	2½	12	12	12
	4- 6	5½	18	17	18
	7- 9	·8½	27	21	27
	10-12	11½	35	28	35
Adolescent:					
Boys	13-15	14½	49	39	42
	16-19	17½	63	50	50
Girls	13-15	14½	46	41	42
	16-19	17½	54	45	45
Adults:	20 years and over				
	Man		65	55	55
	Woman		55	47	47

Table 5. Recommended Food Allowances Per Capita at National Level for Indonesia

Foodstuff	As Consumed g/cap/day	As Purchased g/cap/day	As Purchased kg/cap/yr.
Cereals: Rice	300	330	120.5
Other	50	62	22.6
Roots and Tubers	150	204	74.6
Legumes and Pulses	40	44	16.1
Meat and Poultry (bones not included).	20	22	8.1
Fish	60	82	29.5
Egg	5	6	2.2
Milk	5	6	2.2
Fruits and Vegetables	200	270	98.5
Sugar	25	28	10.2
Fats and Oils	20	22	8.1

Note:

1. These allowances provide 2100 calories and 55 grams protein per capita per day at consumption level and meet the recommended allowances for vitamin A and other nutrients.

2. Legumes and vegetable proteins may substitute parts of meat, poultry, fish, eggs, and milk proteins.

3. It is desirable to lower roots and tubers, while increasing cereals.

4. The figures at purchase level are calculated for targets of food provision.

Table 6. Average National Calorie Requirements Per Capita Per Day for Indonesia[1]

Age Group (yrs)	Population[2] (percent)		Calorie Requirement		Total Calorie Requirement	
	Male	Female	Male	Female	Male	Female
0- 1	3.3		1120[3]		3,696	
1- 3	9.2		1200		11,040	
4- 6	8.7		1570		13,659	
7- 9	8.7		1940		15,278	
10-12	4.4	4.4	2310	2310	9,932	10,164
13-15	3.9	4.0	2860	2400	10,994	9,600
16-19	4.3	4.1	2938	2080	12,599	8,528
20-29	6.0	6.1	2600	2040	21,600	12,444
30-39	5.8	7.2	2522	1980	14,616	14,256
40-49	5.0	4.8	2444	1920	12,200	9,216
50-59	2.9	2.9	2250	1770	6,515	5,132
60-69	1.5	1.5	2024	1620	3,036	2,430
70- +	0.7	0.7	1794	1420	1,253	994
TOTAL	100				209,183	

Average per capita per day: 2092 calories or
2100 calories

[1] Adult weight: Male 55 kg.; Female 47 kg.
Environmental Temperature 25° C.

[2] Data for 1969; Central Bureau of Statistics, Indonesia.

[3] Includes calorie allowance for pregnancy and lactation.

Table 7. Average National Protein Requirements per capita per day for Indonesia

Age Group (yrs.)	Population[1] (million)	Reference BWT(kg)	Requir. per kg BWT/day	Requir.[2] per capita (gm)	Total requir.
0- 1	1.3[3]	9	1.7	15.30	19,890
1- 3	10.8	12	1.06	12.72	137,376
4- 6	10.2	18	0.97	17.46	178,092
7- 9	10.2	27	0.92	24.84	253,368
10-12	10.2	35	0.86	30.10	307,020
Boys:					
13-15	4.6	42	0.84	35.28	162,288
16-19	5.0	50	0.77	38.50	192,500
Girls:					
13-15	4.6	42	0.84	35.28	162,288
16-19	4.6	45	0.77	34.65	159,390
Adults:					
men	25.7	55	0.71	39.05	1,003,585
women	27.3	47	0.71	33.37	911,001
pregnant	4.4.			+6.00	+13,200
lactation	4.8.			+15.00	+72,000
TOTAL	117.4				3,571,998

[1]Figures for 1969; Central Bureau of Statistics, Indonesia.
[2]In terms of reference proteins.
[3]One third of total infants 0-1 years of age.

Requirement for reference protein: 3,571,998/117.4= 30.04 gm/capita/day.
Requirement for protein of NPU 60: 30.04x100/60= 50. gm/capita/day.
Additional allowance (10%): 5gm/capita/day.
Recommended allowance of protein: 50+5=55 gm/capita/day.

Table 8. Allowance of Foodstuffs for Total Population Per Year in Tons

Foodstuff		1969 pop. 117.4 millions	1973 pop. 128.5 millions
Cereals:	Rice	14,140,830	15,477,825
	Other	2,656,782	2,907,955
Roots and Tubers		8,741,604	9,568,110
Legumes and Pulses		1,885,444	2,063,710
Meat and Poultry		942,722	1,031,855
Fish (Fresh)		3,533,782	4,646,005
Eggs		261,391	286,105
Milk (Fresh)		235,681	257,964
Fruits and Vegetables		11,569,770	12,663,765
Sugar		1,178,403	1,289,819
Fats and Oils		942,722	1,031,855

Note:

1. Allowance figures between the first step of production and the retail market level have not been included.

2. These include food imports and exports, food for animal feed, seed, and manufacture uses, food waste, and the extraction rate.

3. These figures are calculated at the retail market level (as purchased).

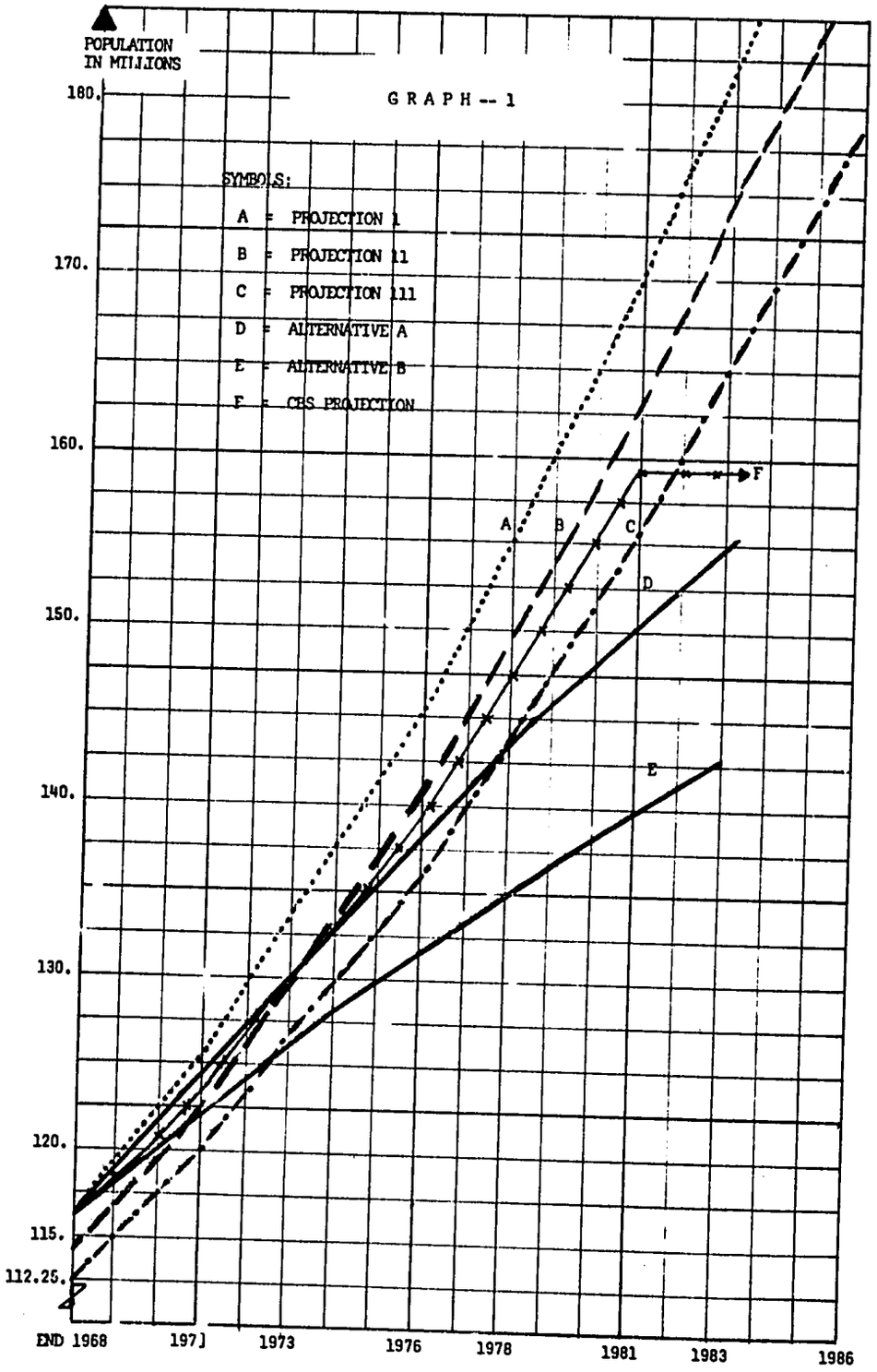
POPULATION
IN MILLIONS
GRAPH -- 1
SYMBOLS:
A = PROJECTION 1
B = PROJECTION 11
C = PROJECTION 111
D = ALTERNATIVE A
E = ALTERNATIVE B
F = CES PROJECTION
180.
170.
160.
150.
140.
130.
120.
115.
112.25.
END 1968
1971
1973
1976
1978
1981
1983
1986
A
B
C
D
E
F

Table 1

ALTERNATIVES OF POPULATION PROJECTION, INDONESIA

YEAR	PROJECTION I				PROJECTION II				PROJECTION III				CBS
	P	b	d	r	P	b	d	r	P	b	d	r	P8
1961	97.4	45.2	20.5	2.5	97.4	42.3	20.3	2.2	97.4	39.2	19.4	2.1	96.7
1966	110.2	43.7	10.0	2.6	108.9	41.5	17.5	2.4	107.5	38.8	17.2	2.2	109.6
1971	125.3	46.1	17.0	2.9	122.5	43.8	16.3	2.8	119.7	41.7	16.3	2.5	122.9
1976	144.9	46.9	15.7	3.1	140.6	44.7	15.6	2.9	135.8	42.3	15.4	2.7	138.5
1981	169.3	46.6	14.2	3.2	162.5	43.9	14.1	3.0	155.4	41.2	14.0	2.7	158.9
1986	199.1	46.6	13.0	3.4	190.6	46.1	13.2	3.3	178.0	40.9	12.9	2.8	-----
1991	235.5	----	----	---	222.4	----	----	---	204.8	----	----	---	-----

Notes: CBS = Central Bureau of Statistics
P = end year population
b = birth rate per 1000 population
d = death rate per 1000 population
r = b - d
P * = population on 31st October

Source: Institute of Demography, University of Indonesia

Table 2

PROPORTION OF MARRIED FEMALES (15-49) YEARS

N.S.S. II. 1964-1965

AREA	RURAL	URBAN	RURAL AND URBAN
JAVA-MADURA	43.9 (64.7)	39.5 (54.9)	44.1 (64.5)
INDONESIA	42.1 (63.4)	39.4 (52.7)	41.5 (61.2)
Source: Central Bureau of Statistics			
Note: 1) in brackets of 10+ year old population 2) urban population 14.8% of total			

Given: (1) Population projection as shown in Table 1.

(a) Projections I-III are prepared by the Institute of Demography, University of Indonesia.

(b) CBS is prepared by the Central Bureau of Statistics.

(2) Proportion of married females (15-49) years of age were obtained from the National Sample Survey II, end of 1964, as shown in Table 2.

(3) Birth interval of 22 months, or, 2.7 births per woman in 5 years.

(A) Then Family Planning aiming at a reduction of 3.5 million of births during 1969-1973, and an additional 2.0 million in following period implies:

Plan Period	Reduction of births by	Ever married females in urban areas		IUD insertion per year 1)	Proportion practicing family planning
		JAVA-MADURA	INDONESIA		
	(-------	----- in millions	----	--------)	
1969-1973	3.5	2.6	3.8	3.5	50%
1974-1978	+2.0	3.0	4.3	5.5	70%
(1) Assuming 5 IUD reduce 1 birth per year.					

(B) Then Family Planning aiming at a reduction of 7.0 million of births during 1969-1973 implies the following:

Plan Period	Reduction of births by	Ever married females in urban areas		IUD insertion per year	Proportion practicing family planning
		JAVA-MADURA	INDONESIA		
	(-------	----- in millions	----	--------)	
1969-1973	7.0	2.6	3.8	7.0	100%

Notes: (i) Calculation of IUD insertions per year if the target is a reduction of 3.5 million in 5 years, or, 0.7 million in one year.

(ii) Calculation of proportion of females practicing family planning in urban Java-Madura.

Assuming an average birth of 2.7 children per woman in 5 years the birth delivered in urban Java-Madura amounts (2.6) (2.7) = 7.02 babies. Then to avert 3.5 million of births at least 50% of the ever married females have to become continuous acceptors.

WORKING GROUP II

INTENSIFICATION OF PRODUCTION:

SOIL

WATER

FERTILIZER

&

AGRICULTURAL TOOLS

Pages: 29 to 50

WORKING GROUP II: INTENSIFICATION OF PRODUCTION: SOIL, WATER, FERTILIZER, AND IMPROVED AGRICULTURAL TOOLS

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INTRODUCTION

In Indonesia every day of the year is sufficiently warm for the growth of plants. This solar energy is a most important resource. It makes possible unparalleled production of food crops, if other factors of production can be combined so as to take full advantage of this energy.

Indonesia is also a well-watered land. Everywhere, rainfall is sufficient for producing at least one crop without irrigation; and in most places, more than one. With irrigation, limitation due to seasonal shortages of moisture in the soil is removed, although not without costs.

About 10 percent of Indonesia is now under cultivation; about 50 percent is potentially arable. The country, therefore, has the alternatives of increasing production on hectares already under cultivation, expanding production on to new lands, or of doing both.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

This Working Group gave careful consideration to the physical resources such as climate, important soil groups, water and fertilizers. In light of these existing resources, ways and means of increasing food production were discussed and evaluated. The potential for increasing food production is high in view of the abundance of solar energy, water and soil resources. However, problems of a highly significant nature in the utilization of these resources are present. The value of package programs was emphasized in attaining the maximum value of combinations of input factors, and this package approach should be applied in carefully selected geographic areas with concentration on the hectares already under cultivation. Areas which have the best irrigation and water control systems should be utilized to their maximum operating capacity.

It was noted that research and educational institutions should be strengthened and liaison be maintained with research in other countries so as to make use of research findings

applicable to Indonesia. Increased emphasis should be placed on educational and research programs designed to reduce serious food production losses from soil erosion, which has become a serious problem, particularly in Java.

Priority should be given to the improvement of existing irrigation systems which are in need of renovation. The use of power equipment offers such a great opportunity for increasing yields that the feasibility of using such equipment should be studied thoroughly. Research to determine the best crop sequences, including the possible use of power tools should also be undertaken.

Indonesia has large areas of potential arable soils that are not yet cultivated. Success in settlement and development of new lands necessitates careful planning, based on sound facts about the soils, climate, water and other relevant environmental factors. Therefore, it was recommended that soil surveys, which are basic to sound planning, use and conservation of land be continued; the feasibility of draining large, marshy areas be investigated by engineers and agronomists as to their long-range potentiality in food production; the possibility of using water from shallow wells for irrigation purposes be investigated; research to develop and test soil and water management systems adapted to local climatic and hydrologic conditions be continued and expanded; and, studies be initiated with the objective of seeking practical methods of flood control in areas where such problems exist.

The use of fertilizers offers one of the greatest opportunities in increasing food production. Great emphasis, therefore, should be given to the development of a fertilizer industry in Indonesia. Increased efforts should be made to determine indigenous resources for fertilizer and the economic and technical feasibility of their use. Importation of essential fertilizer materials should be made until adequate quantities of fertilizer material can be produced. Educational programs, with emphasis on greater usage of improved varieties of crops will substantially increase the need for additional fertilizers. Additional research is needed in order to improve fertilizer recommendations to farmers.[1/]

1/ During the preparation of this report, attention was called to the comprehensive study carried out by the International Bank for Reconstruction and Development/International Finance Corporation team. The results of this study should be carefully reviewed.

Concerning the expansion of livestock production, it was recommended that consideration be given to raising livestock in the outer islands where ample land exists and where such operations would not be competitive with food production for human use.

PHYSICAL RESOURCES

I. Climate

A. Temperature

Since Indonesia is located in the tropics, its temperature is characterized by small yearly variation. The variation of temperature is mainly due to the differences in elevation. Based on elevation differences, four belts can be distinguished, namely:

Tropical low lands with an elevation of 0 - 200 m and a temperature ranging between 25 - 27° C: hot climate;

Tropical foothills or lower mountains with an elevation of 200 - 1000 m and a temperature range of 19 - 24° C: warm climate;

Tropical mountains with an elevation of 1000 - 1900 m and a temperature variation of 13 - 18° C: temperate climate; and

Tropical high mountains with elevation ranging from 1900 - 4500 m, or above, having a temperature of 0 - 12° C: cold climate.

Frost, which can cause severe damage to crops, does occur, especially in the third and fourth belts; however, this condition does not occur often.

B. Precipitation

In general, precipitation in Indonesia is relatively high in comparison to other tropical areas of the world. The rainfall, however, varies according to the geographical location. Higher rainfall is generally found in the western and central part of the archipelago, and decreases toward the East (an exception is West Irian). The average annual precipitation in Sumatra, Kalimantan, West and Central Java, is about 2000 mm, while in the Nusa Tenggara it drops to about 1000 mm.

High precipitation (3000 mm) is found in the mountains of Java, Central Java, West Coast of Sumatra and South Sumatra. Highest precipitation (6829 mm) is found on the western slope of Mount Slamet in Central Java, while the lowest annual precipitation (530 mm) is found in Palu (South Sulawesi).

Beside geographical location, other factors such as altitude and location on the mountain slope (East or West slope) determine the amount of precipitation.

Before World War II, adequate data were collected from weather stations, especially in Java. Since then, however, many of the rain gauges were lost and have not been replaced. More recording stations are needed to adequately record weather data.

II. Soil (Figures on various soil groups and their distribution in Indonesia are given in Table 1, p. 50).

A. Podzolic Soils

The podzolic soils consist mainly of the red-yellow podzolic soils. They occupy about 51 million hectares (27 percent of Indonesia) which are in Sumatra, Kalimantan, and West Irian. Podzolic soils are quite acidic, very low in nutrient content, and subject to erosion. They are, however, very responsive to liming and fertilizer application. The greater part are now used for forest, shrubs, and alang-alang grass.

B. Organic and Alluvial Hydromorphic Soils

These soils are located mainly along the coastal plain of East Sumatra, South Kalimantan and South of West Irian. They occupy about 28 million hectares (15 percent of Indonesia). The soils are saturated with water and are very acid. Most of the soils are very low in nutrient content and only some parts near Bandjarmasin and in those parts which are influenced by the tide have high nutrient contents. The problem in the tidal-affected areas, however, is the presence of the so-called "cat clay." The control of water is probably the most crucial problem.

C. Latosols

This great soil group occupies about 17 million hectares (9 percent of Indonesia). Generally they are low to medium in nutrient level, the pH is about 4.5 or 6, and they are relatively resistant to erosion. The soil is deep ($\geq$ 1.5m) and

generally has good structure. These soils are found scattered throughout Indonesia on plains, hills, and mountain slopes.

D. Alluvial Soils

These soils cover about 17 million hectares (9 percent of Indonesia). The fertility varies according to the material from which they are derived. If they are derived from young volcanic material, such as that along the northern part of West Java, these soils are medium in fertility; but if they derived from tertiary formations which consist of silicious sediments, then they are quite poor. This is the case in many parts of Kalimantan.

E. Mediterranean Soils

They occupy about 7 million hectares (4 percent of Indonesia) and the pH is acid to medium. They are found mainly in areas which have a pronounced dry season.

F. Andosol

They are mountain soils which cover about 5 million hectares (2.5 percent of Indonesia). The nutrient levels are low to medium. They have a relatively high content of organic matter. In Java, most of these soils are utilized for the production of vegetable crops.

G. Podzol Soils

They are developed from acid parent material in areas with high rainfall. They cover about 5 million hectares (3 percent of Indonesia) and about half are found on the plains of Kalimantan. The fertility is very low.

H. Regosols

The regosols cover about 3.3 million hectares (1.8 percent of Indonesia). Most of them are found in Java, associated with the red-yellow Mediterranean soils. Regosols in Indonesia are mostly young volcanic ash soils. The nutrient level is medium, but organic matter content is generally low. The permeability is quite high, while the water holding capacity is relatively low.

I. Grumusols

Grumusols (the so-called "black-cotton" soils) are found mainly in areas with a pronounced dry season. They are physically very poor soils. The soil is not deep, cracks heavily in the dry season, and swells during the rainy season. These soils are found in the Eastern part of Indonesia. They occupy only about 1 million hectares.

J. Rendzina Soils

These are developed from calcareous parent material and are found generally in areas with a less pronounced dry season. The soil is shallow, but the physical properties are good, due probably to a relatively high content of organic matter. They occupy about 0.6 million hectares.

K. Other Soil Complexes

These soil complexes cover about 28 percent of the total area of Indonesia, or 55 million hectares. Most of these soils are found in mountain areas.

Since the most extensive soil groups consist of red-yellow podzolic and organic/alluvial hydromorphic soils, experiments on these soils should be carried out both in the laboratory and in the field, because sooner or later both groups of soils will have to be utilized in agricultural production.

III. Water

A. Surface Water

The biggest streams are in the large islands of Sumatra, Kalimantan, Java and West Irian, with discharges amounting to 2,000 or more cubic meters per second in the rainy season. During the dry season, however, the discharge may be a fraction of this, namely ten cubic meters. In general, the streams are navigable for some tens to some hundreds of km inland, except for those in Java which usually dry up during the dry season.

Large lakes are found in Sumatra, Sulawesi and West Irian. None of them, however, have as yet been exploited.

Extensive parts of the alluvial plains of Sumatra, Kalimantan, and West Irian are covered by swamps. In many places, the influence of tides affects large areas.

B. Subsurface Waters

The best aquifers in Indonesia are lava streams and limestones. The first mentioned are restricted to the vicinity of volcanoes; yields of over 2,000 liters per second have been recorded.

Most of the alluvial plains along coasts and rivers, and also those found in sites of subrecent lakes, may be regarded as good water-bearing formations, even though the quality of the water may vary. Many townships and thousands of villages depend entirely upon this kind of water-bearing formation for the supply of their domestic water.

Summarizing, it may be said that the quaternary deposits may be regarded as the best-to-fairly good water-bearing layers, whereas the older formations are poor-to-very poor.

C. Hydrological Problems

River water is heavily laden with silt, especially where cultivation of the land is very intensive and where the forests have been cleared.

Many drainage basins show denudation values of 1 mm per year. In one instance, namely, the Pengaron River basin in Central Java, an annual amount of 4 mm has been recorded.

The frequent floods that strike many low-lying areas each year are a constant menace. In Java, the areas often flooded are given below:

Region	River	Approximate Extent of Threatened Area(hectares)
Krawang, West Java	Tjitarum	15,000
Indramaju, West Java	Tjimanuk	19,000
Brebes, Central Java	Pemali	5,000
Demak, Central Java	Serang, Lusi	9,000
Lamongan, East Java	Sala	20,000
Kediri, East Java	Brantas	10,000

Volcanic eruptions may create problems in that the rivers have to carry much heavier loads than usual. This is the case, for example, with the Brantas river in East Java. Studies have been made to determine the feasibility of conveying the sand derived from the eruption to the Indian Ocean by means of a conveyance tunnel.

Reduction of flooding in the low-lying areas can still be accomplished by widening and dredging of the rivers, especially the estuaries.

Deforestation in certain areas severely affects the discharge of rivers and, in turn, the existing irrigation systems. The Sekampung River in South Sumatra serves as an example. Now that the forests in its head-waters have been cleared, the discharge of the river has dropped by nearly one half from its pre-World War II rate.

The inadequacy of hydrological data, especially for areas outside Java, makes planning difficult. It is often necessary to depend entirely on extrapolation, or comparison with similar situations elsewhere. An effort should be made to gather this important information for all areas of the nation.

D. Utilization of Water Potential

Irrigation - On the basis of the following data given Working Group II, there is still a great possibility to increase the area of irrigated land:

	Area Extent in Hectares		
Island	Already Surveyed	Not Yet Surveyed	Total
Sumatra	269,400	1,007,800	1,277,200
Kalimantan	8,000	135,000	143,000
Sulawesi	38,000	326,500	364,500
Others	24,000	5,000	29,000
TOTAL	339,400	1,474,300	1,813,700

Reclamation of Swamps - Under certain conditions, tidal irrigation can increase production substantially. If proper management of the hydrological conditions is instituted, the following figures indicate the possible future extension of reclaimed swamps:

Island	Estimated Area Extent in Hectares
Sumatra	680,000
Kalimantan	320,000
West Irian	No data available

IV. Potential Raw Material for Fertilizers

A. Natural Gas

Natural gas is available in every oil field, of which there are 41, according to present figures, spread throughout the country. Oil fields are situated in North Sumatra, Djambi, South Sumatra, West Java, Central Java, East Java, North East Kalimantan, South East Kalimantan and the western part of West Irian.

The urea production and natural gas consumption for the period of 1963 to 1966 was as follows:

Year	Urea Production (tons)	Gas Consumption (million standard cubic meters) Fuel	Feed Stock	Total
1963	9,720	10,439	4,572	10,001
1964	103,720	65,723	37,010	100,733
1965	94,120	66,415	32,935	99,350
1966	93,020	66,935	32,843	99,778

B. Phosphate Rocks

Phosphate rocks known to date are almost entirely of the cave type, being found in limestone caves, and originating from birds' waste. Up to now, only phosphate rocks from Java are well known.

Reliable figures resulting from the 1962 exploration show an amount of 20,200 tons of phosphate, averaging about 22 percent P_2O_5. Additional reserves are located in less important sites distributed throughout Java., Marine phosphate of economic importance has not been discovered. Prospecting for marine sedimentary phosphorites should be directed toward favorable sedimentary basins. For this purpose, studies on available materials should be carried out systematically.

Possibilities of finding insular phosphate of Christmas Island type should receive similar attention.

C. Potassium

No significant potassium deposits are known in Indonesia. Rocks containing minerals with a relatively high content of potassium, such as jarosite, alunite, leucite and nephelite do occur. Jarosite, which is present near Bandung, is

particularly interesting as a possible future source of potassium phosphate and sulfuric acid.

D. Limestone and Dolomite

Limestones are very widely distributed throughout the Indonesian archipelago and form one of the country's most abundant mineral resources. They are mostly formed as marine deposits, either as organic limestones or as chemical precipitation of $CaCO_3$. Small deposits of freshwater limestones are known to be in a few localities in West Java and other places. The younger limestones of the archipelago include subrecent upheaved coral reefs.

Dolomite limestones and dolomites are present in the north-eastern part of Java and Madura. A dolomite deposit of more than 100 million tons, containing 17 to 21 percent MgO was tapped in the Sekapuk region, East Java.

E. Sulphur

Sulphur deposits of volcanic origin occur in several volcanic regions in Indonesia. Of greater importance, however, are the deposits of sulphuric mud in crater lakes. The sulphur content of the mud may average up to 40 percent or higher.

Potential crater deposits of sulphur are located at Namora Ilangit and Sorik Merapi in Sumatra, Kawah Putih, Telaga Bodas and Dieng in Java, and at Mahawu and Kawah Masam in North Sulawesi.

There are numerous small deposits of high-grade sulphuric crusts in many craters and solfatar fields.

POTENTIAL FOR INCREASING FOOD PRODUCTION

I. Land, Water and Tools

A. Package Programs

The potential for increasing food production is high in view of the abundance of solar energy, water, and potentially arable soils. This does not mean it will be easy to increase production; because there are serious problems in making full use of the resources which Indonesia has in abundance.

It is of the utmost importance to recognize that high production requires the proper combination of input factors. To be sure, irrigation alone can increase crop production. So can improved varieties, fertilizers, or pesticides. The real payoff, however, comes from putting all these practices together in the right combination, and this is the solution for dramatically increasing production where the people are living now and already have soils under cultivation.

In view of the immediate need for increasing food production, it seems reasonable to concentrate on the hectares already under cultivation and begin to apply the complete "package" of improved inputs with appropriate adjustments according to kind of soil.

However, to apply the complete package at once to the entire area of cultivated soils would be impossible simply because of the logistics involved. The package approach should be applied in carefully selected geographic areas. This procedure has several advantages: it minimizes the logistical problem of providing the essential materials and advice; makes possible the establishment of training centers for expanding the technology to other areas as fertilizers, improved seed, etc. become available; offers the maximum increase in production from the limited quantities of fertilizers, seed, pesticides, insecticides; and sufficient advisors could be available at the start of a program of this nature.

Since adequate moisture supply is essential for maximum benefits from the better varieties, heavier fertilization, and appropriate application of insecticides and herbicides, the first areas selected should be served by good irrigation systems. The soils should be those deemed highly responsive to good management. The areas also ought to be strategically allocated for the expansion of the improved technology to other areas.

There must be good administration of a program such as this. Seeds, fertilizers, pesticides, insecticides, and advisors must be available for continuous assistance. Failure to have any one of these inputs available on time invites failure. Facilities and markets for handling the anticipated increased production must be planned for in advance and be available as crops are harvested.

While ample evidence indicates that applying combinations of practices is the most effective way to increase production, much is yet to be learned about what combinations are best. These need to be adjusted, not only as to kind of

crops, or sequence of crops, but also as to the kind of soil. The best combination on one soil may be less effective on another.

The interaction of factors--the reason that combinations of improved practices really pay off--is just as important in bringing new hectares into cultivation as it is in continuing cultivation on the old hectares. The combinations that will work on new hectares need to be determined before people move on to new lands, not after. Since the soils and hydrologic conditions in the potentially arable but not yet cultivated soils in the islands differ from the extensive soils on Java, research and testing should be done in new areas before migration to such areas is encouraged.

Much can be done to improve the combinations of practices on many soils already under cultivation even though the ideal combinations may not be attainable. On non-irrigated soils in areas with a dry season there is of course shortage of soil moisture for plant growth during this period. Perhaps parts of such areas, even if no more than a few individual fruit trees or a few square meters of vegetable gardens, could be watered enough to get food throughout all or most of the dry season. Furthermore, by planting crops on the contour, and by proper terracing, better use can be made of the limited rainfall that may occur during the dry season, and erosion, with the consequent siltation of streams and reservoirs, can be reduced.

B. Other Considerations

Accelerated soil erosion has become a serious problem. On Java, between one and one and one-half million hectares are badly eroded. Control of erosion will be a problem on sloping podzolic soils in the outer islands, when they are brought under cultivation. Erosion is related to water control. Much erosion apparently takes place at the onset of the rainy season, before cassava or other crops have attained much growth. Changes in practices acceptable to farmers need to be sought to control the water, reduce erosion, and avoid wastage of the precious soil resource.

In regard to irrigation, it is unfortunate that maintenance has been inadequate on 60 percent of the existing systems. Many hectares designed to receive irrigation are now without water. As a result, instead of sawahs, they become rain-fed padies subject to the vagaries of rainfall, with resultant lower yields and without full use of multiple-cropping. Repair of irrigation systems at least the parts that

are easiest to repair deserves high priority, and should be done even at the expense of delaying the building of new systems.

The use of power equipment offers so much hope of increasing yields that the feasibility of using such equipment ought to be studied thoroughly. If, by use of power tillage, the time between harvesting one crop and planting the next can be substantially reduced, the period during which a field is actually used for growing food crops can be increased, and more crops grown in one year. In Indonesia, about one month elapses between harvesting one crop and planting the next. If this time could be shortened to just a few days by use of power equipment, the annual total production from a field might conceivably be increased as much as 25 percent. If the use of power tools is feasible, and annual production per hectare is thereby increased substantially, there is an excellent probability that the economic return to the farmer will be increased enough to make the use of power equipment profitable.

Irrigation plus the use of power equipment at the International Rice Research Institute in the Philippines permits four crops to be grown in one year, providing some of them have shorter growing seasons than rice. Under such intensive management, with the net return calculated as return per day the soil is occupied by a given crop, rice is not always the most profitable crop in the rotation.

Indonesia has tremendous areas of potential arable soils that are not yet cultivated. Like the areas already under cultivation, the undeveloped areas are tropical and well-watered; and there is obviously great potential for food production.

Success in settlement and development of new lands, however, is not assured without careful planning based on sound facts about the soils, climate, water and other relevant environmental elements.

The soils in most of the undeveloped areas are different from the major soils on which most of the crop production is now taking place. For example, most of the soils in the outer islands are lower in fertility than the soils of Java, many of which have been enriched by deposits of volcanic ash. Also, many of these areas receive more rainfall than most soils now under cultivation. In lowlands along some coasts, especially in Kalimantan and Sumatra, there are tremendous areas of swampy and marshy soil. Off-hand they would appear to be easily

reclaimable, by merely providing drainage. However, soils in such locations often contain an excess of sulfides. Under presently known technology such soils are at best only moderately productive; but perhaps more important the risk of disastrous damage from over-draining imposes an exacting management requirement.

Surveys should be made to determine the nature and distribution of different kinds of soils, rainfall patterns, and hydrologic conditions before settlement of undeveloped areas. Research should be done to develop soil and water management systems that are adapted to local condition.

II. Fertilizers

A. Content

If Indonesia is to make headway in improving its food situation, much larger use of agricultural inputs, especially fertilizer, will be necessary. Population projections indicate that the population is increasing at about 2.5 percent per year and may increase by about 15 million people over the next five years. Fertilizer needs for such a population increase would be as shown below:

Year	Population Increase over 1967-1968 (millions)	Fertilizer Needs Over 1967-1968 Level of Consumption (tons)
1967-1968	-	-
1968-1969	2.9	145,000
1969-1970	5.8	290,000
1970-1971	8.8	440,000
1971-1972	11.9	595,000
1972-1973	15.0	750,000

This additional quantity of 750,000 tons of fertilizer is about five times the maximum amount that has ever been available for use in Indonesia in any one year, exclusive of plantation usage. Maximum fertilizer usage occurred in 1962, but decreased rapidly during the economic crisis of 1964-1965. As the following table indicates, fertilizer usage has not as yet returned to its former level.

Estimated Plant Nutrient
Imports and Local Production
(excluding imports for plantation use)

Source	1957/58	1958/59	1959/60	1960/61	1961/62
	(Tons Per Year)				
Import	52.0	85.0	76.1	115.8	148.9
Local Production	-	-	-	-	-
TOTAL	52.0	85.0	76.1	115.8	148.9
	1962/63	1963/64	1964/65	1965/66	1966/67
Import	125.1	94.6	32.6	24.1	23.9
Local Production	-	-	41.4	25.3	25.8
TOTAL	125.1	94.6	74.0	49.4	49.7

As can be seen from the above table, Indonesia has started indigenous fertilizer production in its ammonia urea complex located at Palembang, Sumatra. The rated capacity of this plant is about 50,000 tons of nitrogen per year.

Breaking down the estimated needs for the next five years would indicate that a 2:1:0 ratio would best fit the fertilizer needs for rice. Other crops may have some requirement for potash, but this will be minute compared to the nitrogen and P_2O_5 requirements. Using this analysis, two-thirds of the fertilizer needs will be nitrogen. By 1972, total nitrogen requirements will be in the neighborhood of 550,000 tons of N, exclusive of plantation use. With the Palembang plant capacity at only about 50,000 tons per annum of N, a deficit of 500,000 tons will exist. Thus, if these fertilizer needs are to be met by 1972, 2,000 tons per day additional ammonia production capacity could be justified. To conserve foreign exchange, and to utilize indigenous petrochemical resources, the planning for these plants should start immediately, since it normally takes from four to five years to complete such plants in developing countries.

Since phosphorous comprises one-third of total fertilizer needs, planning should also begin immediately for furnishing phosphatic materials. Possibilities for this are:

Import of phosphatic fertilizers, either bagged or bulk;

Import of fertilizer intermediates such as phosphoric acid or elemental phosphorous, that will then be made into finished fertilizers in Indonesia;

Import of phosphate rock, to be treated with sulphuric acid made from indigenous sulphur reported near Telaga Bodas;

Import of phosphate rock and sulphur for the production of phosphatic fertilizers.

Before any decision is made on phosphatic fertilizer, it will be necessary to make a complete analysis of the above alternatives and to evaluate them both from an economic and a foreign exchange aspect. This analysis should be made by a competent and impartial group.

In view of the problems of storage and transport, high-analysis materials should be given highest priority. Materials such as urea, diammonium phosphate, and urea-ammonium phosphates would best suit these requirements and serve the agronomic needs. Triple-superphosphate production and import should be discouraged if there is any chance for blending and mixing, since urea and triple superphosphate are not compatible in blends and mixes.

The cost of these production facilities will be great. The U.S. President's Science Advisory Committee report (Vol. 3, page 106) estimates about $500 per ton of plant nutrients on a "grass roots" basis. The foreign exchange requirement will probably be 50 to 60 percent of the total investment. The desirability of obtaining know-how in construction and operation as well as in distribution and marketing, along with the foreign exchange, might well be mentioned. Major companies with experience in these fields can contribute much to partnerships in the developing countries.

Even though the cost of these production facilities is great, this aspect of meeting the fertilizer needs may be the easiest to accomplish. Distribution and marketing, credit, and farmer education may be the larger bottlenecks to overcome.

Distribution and marketing per se are covered in another part of the Workshop Report, but it is important to recognize the desirability of having this function tied closely to the production aspects. Experience worldwide indicates that having these functions together tends to eliminate problems, and encourages more rapid fertilizer use.

B. Farmer Education

Indonesian farmers generally know the value of fertilizers in increasing rice yields as revealed in the BIMAS

program. Fertilizer use on other crops is less well understood. Generally, it seems that the Indonesian farmer seeks advice and guidance on all aspects of crop production, and especially on the use of fertilizers. But at present, the extension staff is inadequate in number and level of scientific training. For massive action programs such as those recommended, the extension staff must be greatly expanded, fully trained and qualified, and fully equipped for the job. It seems desirable that each extension worker contacting farmers have no more than 500 to 1,000 hectares to serve.

Response to fertilizers especially on the new improved varieties of rice is good, and should encourage rapid increase in fertilizer use. A combination of inputs, including not only better varieties, but also herbicides and insecticides, that may give 150 to 200 percent yield increase (rather than a 50 to 100 percent increase that would be expected from fertilizers alone) may be easier to accomplish and thus make better use of extension personnel and equipment. This suggests a package approach that gives the farmer not only his fertilizer requirements but also other inputs, and instruction on their use for maximum results.

C. Research

Although research results on fertilizers in Indonesia are limited, the "massive action programs" should not be held up pending more research results. Clear and concise recommendations should be immediately prepared for all massive action programs based on the limited experience in Indonesia, and on information available from other countries, especially IRRI-related experience.

Research in the immediate future should be strictly applied research, focused on refinement of recommendations for the massive action programs. Since it appears that as a general matter, varieties vary more than locations in response to fertilizers, it would appear that this research should be concentrated on a few well-chosen locations representing only major soil and climatic differences, for best return on the research effort.

Research on the fertilization of crops other than rice should be greatly increased, and wherever possible, this research should be based on full cycle of multiple cropping, giving consideration to full cycle economics of fertilizers.

To thoroughly service this program, additional well-qualified research personnel and facilities will be required.

As additional personnel are chosen and trained, future work with potassium, secondary and micro-nutrients and other problems related to fertilizer should be explored.

RECOMMENDATIONS

For immediate implementation of short-term increases in food production, the following recommendations were made:

1. Cultivation. In the light of the present food crisis, it is the unanimous opinion of Working Group II that, for the short run, a maximum effort should be placed upon improving production on soils already under cultivation. Further, due to the limited technical competence available and the obvious interaction among agricultural inputs, these efforts should be concentrated in selected geographical areas. Priority should be given to those areas which have the best irrigation and water control systems. Available seed of the new rice varieties should be concentrated in these areas. The best irrigated and water-controlled areas should also have first priority on fertilizers, pesticides, technical assistance personnel, equipment, and facilities. This approach should markedly increase yields. Storage, processing, transportation, and marketing facilities should be developed with respect to anticipated needs.

2. Irrigation. First priority should be given to improvement of existing irrigation systems, putting those systems into full operation that will be easiest to repair. Also, as these systems are renovated, all-out efforts should be made to stabilize the watershed areas that are contributing to the siltation problem, and to permanently improve the hydrology of the watershed.

3. Fertilizers. Due to the role that fertilizers must play if food needs are to be met, and the complexity of problems with respect to their production, import, distribution, marketing, and use, it is recommended that an in-depth survey of the broad scope of the fertilizer industry be carried out as soon as possible.[1/]

[1/] During the preparation of this report, attention was called to the comprehensive study carried out by the International Bank for Reconstruction and Development - International Finance Corporation team. The results of this study should be carefully reviewed.

4. Multiple Cropping. Further intensification could markedly increase yields. Consideration should be given to maximizing the use of radiant energy and available water. To do this, immediate research needs to be done to determine the best cropping sequences, including the possible use of power tools.

5. Power Tools. Most crop production today in Indonesia is done manually. About a month elapses between harvesting one crop and planting the next. If, by use of power equipment, this interval could be reduced to a few days, precious time would be gained for the growing of needed food plants, and more crops per year could be grown on the same field. A study should be made to determine the feasibility and practicability of using power equipment for increasing food production in Indonesia.

6. Groundwater. Irrigation from shallow wells using small pumps has resulted in increased yields in India and several other countries. Information on groundwater reserves in Indonesia looks favorable for this practice, and the possibility exists of irrigating many hectares of land at a minimum of investment. This possibility should be evaluated immediately.

For immediate implementation of long-term increases in food production, the following recommendations were made:

1. Fertilizer Raw Materials. Considering the large outlays of foreign currency that will be necessary if fertilizer needs are to be met by import, increased efforts should be made to determine indigenous resources for fertilizer, and the economic and technical feasibility of developing these resources.

2. Research. An expanding agriculture requires research to find solutions to many scientific and technical problems related to plants, soils, water, diseases, insects, marketing, storage, and other phases. It is important, therefore, that research and educational institutions be improved, and that liaison be maintained with research in other countries so as to make use of research findings that are applicable to Indonesia.

3. Water. Tests and demonstrations of soil management, involving the use of small quantities of water at strategic or critical times and locations, should be started. By this is meant the watering by hand of plots measured in terms of meters rather than hectares, and the growing of vegetables, primarily, rather than padi. By this is also meant the

shaping of seedbeds in such a way that water can be placed exactly where it is needed, and wastage thereby reduced to a minimum.

4. Marshy Lands. In the outer islands there are millions of hectares of marshy soils; drainage, presumably, could make vast areas suitable for cultivation. Studies ought to be started to determine not only the engineering feasibility of draining large areas but also the kinds of soils, and their suitability for cropping if they were to be drained.

5. Flooding. Damage to crops from flooding is substantial nearly every year. Control or prevention of flooding is difficult and expensive by presently-known methods. Studies should be started with the objective of seeking practical methods of control of flooding and reduction of crop damage from flooding.

6. Erosion. Soil erosion has become serious in some parts of Indonesia. Between one and one and one-half million hectares on Java are so badly eroded that they are no longer productive of crops. Soil erosion wastes a precious resource, and contributes to the siltation problem in streams and reservoirs. Where soil erosion is a problem, steps should be taken to bring about adjustment in use and management of soils so as to bring it under control. Growing crops, e.g., trees, that will permit the soil to always be covered with vegetation should be considered for such areas.

7. Livestock. Substantial areas of land in the outer islands are physically suitable for livestock production. These areas are Southern Celebes and both Southern and Northern Sumatra. Land preparation would be minimal. Liming and fertilization with nitrogen, phosphorous, and some potassium are likely to be necessary, along with the introduction of legumes and improved grasses. Feasibility of livestock production should be investigated in these areas.

8. Intensification and Extensification. Planning for the expansion of food production on to new lands should be continued, but implementation should take second priority to intensification on areas already in use for crop production. Soil surveys and collection of information on climatic and hydrologic conditions should be continued. Research to develop and test soil and water management systems adapted to local climatic and hydrologic conditions should also be continued. The Tidal Swamp System, especially its water control techniques, needs more study to determine the technical problems and feasibility of sustained rice production by this

method. The probability of tidal soils having unfavorable characteristics (such as high content of sulfides) is greater than on non-swamp soils, and the risk of failure is therefore greater. Priority in the development of new agricultural areas should be given to potentially arable soils with conventional irrigation means, rather than the reclamation of tidal and swamp lands by the Tidal Swamp System.

9. Soil Surveys. Since soil surveys are essential to the sound planning of use, management, and conservation of land, the making of soil surveys should be continued. It is especially important that such surveys be made in advance of settlement in those areas under consideration for expansion of cropping, so that soils unsuitable for sustained cropping can be avoided, and management of the suitable soils designed so as to make the best use of them. Survey of hydrologic conditions, including groundwater supplies, should also be continued, as well as exploration of minerals important to agriculture.

Table 1. Acreage of Indonesian Soil Groups (1000 ha.)

Soils	Java	Sumatra	Kalimantan	Sulawesi	Nusatengara	Maluku	West Irian	Total
				On Plains (0 - 8% slope)				
Organic/ Alluvial Hydromorphic	-	14,250.00	6,820.	-	-	-	6,657.	27,727.00
Alluvial	2,039.00	2,442.00	4,426.	761.	243.00	313.00	6,758.	16,982.00
Regosol	-	-	-	21.	-	-	-	21.00
Rendzina	-	-	-	31.	156.50	437.50	186.	811.00
Grumusol	512.00	-	-	219.	97.00	13.00	-	841.00
Mediterranean	26.00	-	-	769.	-	210.00	-	1,005.00
Latosol	271.00	531.50	-	-	-	-	-	802.50
Podzolic	371.00	9,612.09	10,935.	1,356.	156.50	253.00	5,117.	27,800.59
Podzol	-	812.50	2,513.	-	-	-	-	3,325.50
TOTAL	3,219.00	27,648.09	24,694.	3,157.	653.00	1,226.50	18,718.	79,315.59
				On Undulating Land (8 - 15% slope)				
Regosol	2,575.00	-	169.	21.	400.00	156.50	-	3,321.50
Grumusol	400.00	-	-	-	-	-	-	400.00
Mediterranean	2,123.41	-	-	831.	3,031.50	203.50	172.	6,361.41
Latosol	2,540.50	3,218.50	1,576.	830.	-	-	21.	8,186.00
Podzolic	-	11,000.00	5,201.	640.	-	2,000.00	4,508.	23,349.00
TOTAL	7,638.91	14,218.50	6,946.	2,322.	3,431.50	2,360.00	4,701.	41,617.91
				On Hilly to Mountainous (>15%)				
Latosol	109.50	469.00	907.	2,088.	382.00	800.00	3,426.	8,181.50
Andosol	950.00	2,000.00	1,500.	91.	172.00	-	16.	4,729.00
Podzol	-	484.50	1,660.	-	-	-	-	2,144.50
Complex	1,500.00	2,540.50	18,232.	11,145.	2,722.00	3,981.00	14,576.	54,696.50
TOTAL	2,559.50	5,494.00	22,299.	13,324.	3,276.00	4,781.00	18,018.	69,751.50
GRAND TOTAL	13,417.41	47,360.59	53,939.	18,803.	7,360.50	8,367.50	41,437.	190,685.00

WORKING GROUP III

INTENSIFICATION OF PRODUCTION:

FOOD CROPS

Pages: 51 to 65

WORKING GROUP III: INTENSIFICATION OF PRODUCTION: FOOD CROPS

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SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Current food production in Indonesia is insufficient to adequately supply local needs. This deficiency will progressively worsen unless provision is made for population control through family planning, and for a vigorous expansion of research and extension efforts.

Indonesia is blessed with a favorable climate, soils and water supply. The research technology now available, if fully utilized by farmers, could lead to a doubling of food production. The achievement of this degree of increase in production will require many modifications and adjustments in the existing pattern.

Indonesia should mount a massive action program to increase food production. This will require effective coordination among university, research, and extension personnel. It is imperative that information supplied to farmers represent the best combination of practices developed through research. The present BIMAS program does not fully satisfy this objective.

Increased emphasis must be devoted to research. Changing patterns of agricultural practices will require new varieties with greater insect and disease resistance and a greater potential to respond to improved practices such as increased quantities of fertilizer. Research must be a continuing activity to meet these ever-changing requirements.

One important component of an expanded research program is the need for a continuing up-grading of the technical competence of the research staff. Provision should be made for an increased emphasis on further graduate training of the existing staff and for the new research workers entering service. Expanded provisions for in-service training of the supporting staff (technicians) would increase the effectiveness of the entire research program.

It is suggested that the increased emphasis on both extension and research can best be met by the establishment of national programs for rice, maize, and the other crop groups. Such an effort should involve the trained manpower in the

universities, research institutes, and extension service. Joint planning would ensure that all available skills were focused on the solution of specific problems and that the recommendations given to the farmers represented the most complete information available.

Provision must also be made for the rapid increase and distribution of improved seed and plant materials. Other requirements for a major intensification of food production include adequate quantities of fertilizers, fungicides and pesticides to be locally available when needed; for improved storage, marketing, and handling facilities; and for the maintenance of adequate incentives to the farmers to encourage the adoption of new practices.

MAJOR FOOD CROPS

The present population of Indonesia and its rate of increase requires that greater emphasis be placed on the production of food crops. A list of the major food crops, together with their areas and average yields, are presented in Table 1 (p. 64).

Rice occupies the largest area and has received the major attention. It is the preferred food, but since production has not equalled need, the short-fall has had to be corrected by imports. These represent a heavy drain on the economy and efforts should be directed toward an increase in production. Rice will continue to receive major emphasis but attention must also be given to other crops, to develop and maintain a more balanced food supply, and to increase the availability of protein-rich foods. In the sections which follow, the current status of each of the groups of food crops is reviewed.

I. Rice

The production of padi rice has increased rather steadily through the period of 1960 to 1967. Due to the increase in population, however, per capita production has remained essentially stable. Rice production and population increase for this period are shown in Table 2 (p. 64).

Total rice production may be increased by either of two ways: by bringing new lands under cultivation; or through an improvement in all aspects of management of the area currently under cultivation. Opportunities exist for both alternatives, but this section of the report deals only with the more efficient utilization of lands now devoted to rice production. A general intensification of production will require increased

emphasis on development of improved varieties, utilization of increasing quantities of fertilizer, improved disease and insect control, and expansion of seed production.

A. Breeding

Breeding work on rice was initiated in 1905. Nine varieties developed by the Research Institute have been released. An estimated two million hectares are currently devoted to these varieties, which gave yield increases of 25 to 30 percent. The main emphasis during this period was adaptation to low fertility levels, traditional production methods, and satisfactory cooking qualities. These varieties are tall, tend to lodge, and have only limited capacity to respond to increased fertility levels. On the basis of the results obtained, it was believed that rice yields had reached a plateau, and that further major increases would be difficult to achieve.

This concept has been abandoned, as a result of experience with the new varieties, PB5 and PB8. It is now realized that to achieve maximum potential for yield, a rice variety should be short to minimize lodging, have erect leaves to more effectively trap sunlight, and have the capacity to respond to improved management practices, particularly nitrogenous fertilizers. Both PB5 and PB8 satisfy these requirements. Preliminary data from the 1967-1968 wet season indicate yields of approximately 7 tons per hectare of PB8, while the improved varieties Bengawan and Syntha produced yields of 4.2 and 4.5 tons, respectively. The supply of seeds of PB5 and PB8 is being increased, and it is expected that over 21,000 hectares will be grown under the new BIMAS project in the 1968 dry season.

There is a calculated risk involved in developing an extensive acreage devoted to one or two varieties. Such a system favors the development and spread of new strains of disease organisms. This risk must be accepted because of the potential for increased yield, however.

The next major objective of the breeding program should be to combine the desirable characteristics of types such as PB5 and PB8 with resistance or tolerance to the major disease and insect pests of the area. Screening of the World Rice Collection maintained at Los Banos has revealed varieties having resistance or tolerance to many of the important disease and insect pests. Maximum use should be made of the material, as well as the extensive research findings which have been accumulated at the International Rice Research Institute. It may be necessary to repeat screening of material already

identified as resistant under Indonesian conditions, to identify strains possessing maximum resistance to local races or biotypes of the diseases of local importance. When such resistance is found, its incorporation into agronomically acceptable varieties can be achieved in a short time period, through the use of three generations per year.

Experience has suggested that resistance may be inadequate for complete disease or insect control. Chemicals may be required under conditions of severe attack.

B. Fertilization and Management Practices

Fertilization and management practices appropriate to tall, late maturing varieties, which are grown on the bulk of the current rice acreage, are inappropriate to the new, high-yielding varieties now coming into use. With the tall varieties, Nitrogen application was limited to a maximum of 30 kg/ha. This situation has changed materially with the new varieties as shown by the data on effects of Nitrogen fertilization on grain yield in Table 3 (p. 64).

For each of these varieties, yields were essentially doubled by the use of 120 kg of Nitrogen. In no case was there an indication that maximum response had been attained. The difference between PB5 and PB8 is typical of that obtained during the wet season. The lower yield of PB8 is due to its lesser resistance to bacterial blight. In the 1967 dry season with 120 kg/ha of Nitrogen, these two varieties gave yields of 7600 and 7800 kg/ha.

Fertilizer-response data indicate that rice yields could be increased by at least 100 percent by proper fertilization and management. Data on yield responses at N levels greater than 120 kg/ha are not available. At current price levels to the farmer, 1 kg rice is essentially equal to 1 kg urea. Based on the response data in Table 3 the use of 120 kg N becomes highly profitable.

Other management practices must be revised to take full advantage of the yield potential of the new dwarf types. Part of the N should be incorporated into the soil prior to planting, to induce early tillering and rapid growth. Transplanting should be done at an earlier stage, i.e., 15 to 20 days as compared to 30 days.

C. Insect and Disease Control

Until such time as high levels of resistance are available, provision must be made for adequate stockpiling of the

necessary chemicals. Extensive tests have identified chemicals which provide satisfactory protection. Time of application is extremely critical, and may represent the difference between an adequate yield and serious damage. In addition to stockpiling of chemicals in the area of their possible use, surveys should be made to identify potential outbreaks before they become serious.

D. Regional Trials

It is desirable to maintain and extend the current system of regional trials. Such trials should be comprehensive, including comparisons of standard and new varieties, as well as fertilizer response. The fertilizer response trials should include a range of N applications to establish maximum response for each variety in the major production areas.

E. Control Measures

For some time, control of insects and diseases will depend heavily upon the wise use of chemicals. Bacterial blight and blast are serious in the wet seasons, but there is hope that these diseases can eventually be substantially controlled through the development of crop types with higher levels of resistance. Chemicals providing satisfactory control of major insect pests have been identified. A survey system is needed to identify potentially serious outbreaks of insects such as the white stem borer, so that effective control measures can be initiated before serious damage has occurred. The use of granular insecticides appears to offer the most promise. Application may be more rapid, thus minimizing loss, no specialized equipment is required, and is less subject to drift. Application can be made either by airplane to larger tracts, or on the ground by farmers to smaller tracts. In either event, the necessary chemicals must be maintained in stockpiles strategically located to permit their use when required, with a minimum of delay.

II. Maize

Maize is the second most important food crop in Indonesia. Approximately 3.6 million hectares are devoted to the culture of this crop, with an average yield of 9 to 10 quintals per hectare. In parts of east and central Java, maize becomes the primary food crop. Practically all of the present production is consumed as food, and exports amount to approximately 100,000 tons. The present price of maize - about half that of rice - does not permit the development of an export market.

A. Breeding

Earlier work established that local varieties had only a limited capacity to respond to improved fertility and management practices. Little effort has been directed toward the improvement of these types. However, extensive use has been made of types introduced from Latin American countries. The first use of this material resulted in the development of the varieties Perta and Metro, which produce substantially higher yields than the local types. The next development stage involved further introductions, and the formation of broad-based composites. Some of these, with adequate fertilization, have produced yields of 5.5 to 6.5 tons per hectare.

Through the use of simple recurrent selection techniques, the yields of these base-population composites have been increased by an additional 15 percent. The accomplishments of the breeding program can be summarized as follows:

Local varieties	2.0 - 3.0 T/ha
First exotic introductions	3.5 - 4.5 T/ha
Composites	5.5 - 6.5 T/ha
Improved composites	6.5 - 7.5 T/ha

Procedures for the rapid increase and distribution of this new material within the area of heaviest maize production have been suggested.

It is now possible to improve the quality of protein in any corn variety by introducing one of the genes opaque-2 or floury-2, and plans should be made to do this. The resulting doubling of protein quality will be helpful in improving the nutritional status of populations in the corn eating areas of Indonesia.

B. Fertilization and Management Practices

Varietal comparisons on all phases of the breeding program have been conducted at high levels of fertilization: N, 120 kg/ha; P_2O_5, 90 kg/ha; K_2O, 60 kg/ha. These rates of fertilizer application far exceed those in common use. Fertilizer response trials should be conducted to establish the limits of economic application. Population densities ranging from 40,000 to 80,000 plants per hectare have only limited effects on yield.

C. Disease Control

Both rusts and downy mildew can be serious. Since chemical control of these diseases is not feasible, the only

recourse is the isolation of resistant types. Selection against these diseases has been continued throughout the course of the breeding program.

III. Pulses

Soybeans, peanuts and green gram are covered in this section. These crops offer the major prospect for an adequate supply of vegetable protein. It has been estimated that the average daily need for protein is approximately 55 grams, of which three-fourths can be supplied as vegetable protein.

A. Soybeans

On a world-wide basis Indonesia ranks third in area devoted to soybeans. In the period 1964 through 1967, the acreage harvested has ranged from 571,000 to 661,000 hectares. Average yields, however, are low, averaging 6.9 quintals per hectare, indicating that the yield level has remained relatively stable. The low yield level is further complicated by the low price; a kilogram of soybeans commands essentially the same price as a kilogram of rice.

The low yield level arises from two factors: relatively little research effort has been devoted to either breeding or management; and farmers consider soybeans as a "catch crop"; it is planted without soil preparation, and little effort is expended on weed, disease and insect control. As long as this situation persists, soybeans cannot realistically be expected to contribute significantly to overcoming the protein deficit.

However, as indicated elsewhere in this report, soybeans hold great potential as a source of plant protein. In terms of the area now planted to this crop and the potential yields possible from support of research and educational efforts, this crop should receive immediate attention.

B. Peanuts

The picture with respect to peanuts is essentially the same. Yields average approximately 7 quintals per hectare, and the price per kilogram is roughly equivalent to that for rice. Peanuts receive better care, but yields remain low because of susceptibility to a number of insects and diseases, and because of the generally poor quality of seed available for planting.

C. Green Gram

The yield of green gram is even lower, averaging about 5 quintals per hectare. Harvest costs have been high, because

of irregular ripening. This last problem has been overcome by the development of a new variety which possesses the characteristic of uniform ripening.

D. Yield Levels

The low yield levels exhibited by these three crops is not characteristic of the species involved. Yields up to 20 quintals have been obtained in experimental plots, and even higher yield levels have been achieved in other areas of the world. The low yield levels are rather a reflection of the limited research which has been devoted to varietal improvement (including disease resistance); to a lack of adequate knowledge concerning the management practices required to produce high yields; and to the general low level of husbandry practiced by the farmers.

E. Increasing Production of Pulses

Working Group IV has concluded that this group of crops offers the greatest promise of the several alternatives considered, for satisfying the protein needs of young children. If this important requirement is to be met, it is obvious that a much higher research priority, including funds and trained personnel, must be assigned than has been true in the past. An expanded research program must include these objectives:

> Development of high-yielding varieties possessing the maximum degree of resistance or tolerance to the important disease and insect pests;
>
> Extensive studies on all aspects of management, soil preparation, fertilization, weed, insect, and disease control;
>
> Development of an effective seed-production and distribution scheme; and
>
> An expanded extension program to ensure maximum utilization of new materials and new methods as they become available from the research program.

Soybeans are attacked by several serious insect pests and plant diseases. Extensive research should be initiated among the world soybean germ plasm for sources of resistance to these pests. As rapidly as promising material can be identified, breeding procedures should be initiated to incorporate the resistance into the maturity and seed quality types preferred in Indonesia. To insure isolating types possessing the

maximum degree of resistance, segregating populations should be evaluated under conditions of heavy natural infection. By contrast, experiments designed to evaluate fertilizer response or management practice should be kept as nearly disease and insect free as possible, even though the spraying regime far exceeds the limits of economic feasibility. The procedures outlined should have equal validity for peanuts and green gram.

F. Storage and Preservation

Seeds having a high oil content pose special storage problems. Some degree of temperature and humidity control is required to maintain seed stocks in a viable condition for the periods required to develop and maintain an effective breeding program. Equipment to achieve proper environmental control is a sound investment; otherwise, too great a percentage of time and land has to be devoted to the necessary but non-productive task of regrowing stocks to maintain viability.

IV. Tuber Crops

The major tuber crops are cassava and sweet potatoes. In areas of poor soils and restricted rainfall, cassava becomes the primary food crop. Yields are high (Table 1), but the crop occupies the land for approximately ten months, while sweet potatoes require about four months for maturity. In addition, sweet potatoes provide large quantities of vitamin A and vitamin C. For these reasons, sweet potatoes should be emphasized in plans for increasing food production.

At the present time, production of both cassava and sweet potatoes are adequate for present consumption levels. An increasing population and the need for dietary improvement will require larger quantities of both crops.

A. Cassava

Several good varieties satisfactory for food are currently available. Additional varieties are available for the manufacture of cassava flour. The Central Agricultural Research Institute also maintains a clonal collection representing types from different areas of the country. Fertilizer response studies indicate that yields of 250 quintals per hectare are possible. Disease and insect problems are minimal.

B. Sweet Potato

Approximately 400,000 hectares are devoted to the production of sweet potatoes. Yields average about 55 quintals

per hectare, but yields up to 250 q/ha can be obtained with proper fertilization and management. Yellow or red varieties are acceptable, and their use should be encouraged because of the high level of vitamins A and C. More satisfactory and efficient methods of curing, storage, and marketing should be developed in order to increase the consumption of this crop.

V. Vegetable Production

Approximately three million hectares are devoted to the production of vegetables. Of this total, nearly 0.5 million hectares are devoted to commercial production, and the remainder is accounted for by home gardens. Vegetables contribute significantly to an improved diet, through their contribution to vitamins A and C and to increased protein intake.

The majority of the commercial vegetable production is centered in areas having an elevation 1000 meters and above. The crops of importance are Irish potato, cabbage, petsai, tomato, shallots, carrots, onions, peppers, cucumbers, eggplant, and pulses. Production has not kept pace with population increase due in part to deficiencies in transportation and storage facilities, leading to wide fluctuations in price.

A. Breeding

Relatively little breeding work has been done on these crops but extensive evaluations have been conducted with introductions from all areas of the world. As a result of this effort, satisfactory varieties are available for most of the crops. Some pose seed production problems and seed importation may be required for some time to come. The current yield levels of the more important vegetable crops are shown in Table 4 (p. 65).

B. Fertilizers and Management Practices

Research on production and management practices has been restricted due to limited facilities and personnel. For the crops studied most extensively, a 100 percent yield increase appears quite feasible through improved management. If the population projections for 1973 are realistic, an increase in production of this magnitude will be adequate. Several requirements must be satisfied if such yield increases are to be achieved. These include a greater supply of fertilizer (plus their timely availability) and of insecticides and pesticides; a better system of production and distribution, increased transportation facilities, and adequate provision for

storage. Transportation and storage facilities are particularly important to achieving stable prices, thus insuring the profitableness of the market garden enterprise. Obviously, research must be continued to find better varieties, to improve production practices, and maintain adequate control of disease and insect pests.

REQUIREMENTS FOR PROGRESS

I. Increasing Production

Realization of the potential for increased production for each of the crop groups considered depends upon several factors:

A full and rapid utilization of the improved types now on hand;

An adequate and timely supply of fertilizer so that each crop may be managed to achieve the greatest economic gains;

Adequate local supplies of insecticides to permit timely application when required;

A simple but effective seed multiplication and distribution scheme; and

A vigorous extension program to insure maximum utilization by farmers of the existing research information.

Pricing policies, incentives, adequate transportation and storage facilities, etc., obviously play an important role, but these problems are considered in the report of Working Group VI.

II. Action Program Using the Package Approach

If each of the above requirements is met, production of most of the crop groups could be doubled. It is unlikely that this degree of intensification can be achieved without a vigorous action program, however. Such a program will require the closest possible cooperation among all personnel and agencies involved. Furthermore, the approach to the farmers must represent a combination of practices of "package" approach. It is very difficult to convince farmers of the merit of a single new input, whether it be a new variety, an increased level of fertilization, or other practices. The package

approach uses all recommended practices simultaneously. Thus, the total effect of the combination of new practices becomes quite impressive and they are much more readily accepted.

III. Assistance from Private Enterprise

Such an action program will place heavy demands upon the limited personnel and financial resources. It appears desirable, therefore, to solicit and utilize to the fullest possible extent whatever help may be available from the private sector. One segment of the program to which private industry could perform a very useful service is that of the production and distribution of improved seeds. Cumulative experience throughout the world indicates that private seed production and distribution organizations are more efficient than government-operated and controlled systems. The same relationship undoubtedly exists for production and distribution of fertilizers and other agricultural chemicals. Even though such private enterprises are established, it will take time for them to become operative and to contribute significantly to the Indonesian economy.

IV. Research and Planning

Even with the combined effort, the full utilization of the accumulated research findings cannot be immediately achieved over the entire food crop acreage. Failure to make maximum use of the accumulated research findings will result in a continuation of the current inadequate food situation. The shortfall between production and needs will have to be met by imports, hard currency purchases, or from various types of aid programs, such as PL480.

The action program outlined should contribute to the solution of short-term needs. In the absence of an effective family planning program, however, the food situation will gradually become more acute. This unhappy conclusion arises from the fact that population growth is geometric, while increases in production are arithmetic. Thus, with population growth unchecked, the population and food production curves become increasingly divergent.

Even though an effective family planning program is adopted, it will be some years before its effect will be reflected in decreased demands for food. To meet the increasing demand for food, greater emphasis must be placed on research. Priorities must be established within the intensification of food production sector, and resources and personnel allocated to accomplish the task.

V. Training of Personnel

Emphasis on an action program, to achieve the maximum possible level of intensification, must not obscure long-term needs. Increased priority must be placed on development of greater competence of both the scientific and supporting staff. As a part of the program, provision should be made for graduate training for a larger segment of the scientific staff. In-service training facilities should be provided for the supporting technicians and field extension workers. Continued progress is dependent upon an increasing level of competence within a gradually expanding staff.

RECOMMENDATIONS

1. That a massive action program be undertaken to obtain utilization by the farmers of the research technology currently available. If this can be achieved, yields of such crops as rice and corn can be doubled. Such an action program will require the full cooperation of universities, research institutes, extension personnel, and community leaders.

2. Consideration should be given to the establishment of national programs for each of the several groups of crops: rice, maize, pulses, etc. Such national programs would include representatives from the universities, research institutes, and the Agricultural Extension Service, thus ensuring that the maximum degree of competence and skills were used in the establishment of a fully-coordinated and integrated program. Such an organizational pattern should ensure greater productivity at both the research and action levels.

3. High priority should be assigned to an expanded research program covering all aspects of crop production. It is further recommended that a team composed of Indonesian and foreign specialists be assembled to make a detailed study of organizational patterns and research procedures and priorities. This expanded research effort should include provision for a graduate study program to provide for gradual upgrading of the scientific staff and in-service training for the supporting research and extension staff.

Table 1. Harvested Area and Average Yield of Major Food Crops.[1]

Crop	Harvested Area (1,000,000 ha)	Average Yield q/ha
Rice	7.78	22.58
Maize	3.50	9.19
Cassava	1.52	87.61
Sweet Potatoes	.41	55.18
Peanuts	.40	6.50
Soybeans	.66	5.67

Table 2. Population Increase and Rice Production during period 1960 - 1967.[2]

Year	Population (1,000,000)	Padi Production (1,000,000 tons)	Padi Production per capita
1960	95.3	16.86	176.10
1961	97.4	15.90	163.18
1962	99.6	17.11	171.83
1963	102.0	15.28	149.75
1964	104.4	16.19	155.02
1965	107.0	17.00	183.26
1966	109.6	17.57	160.22
1967	112.3	17.93	189.71

Table 3. Effects of Nitrogen Fertilization on Grain Yield.[3]

Nitrogen Application Kg/ha	Variety			
	Syntha	Sukamandi	PB8	PB5
0	2134	1922	1906	2335
60	3879	3112	3193	4308
120	4371	3728	3542	5372

[1] Agricultural Extension Service.

[2] Central Bureau of Statistics and Agricultural Extension Service.

[3] Muara, 1966 wet season.

Table 4. Current Yield Levels of Vegetable Crops.

Crop	Area (hectares)	Yield (tons per hectare)
Irish Potato	9,102	9
Cabbage	18,023	11
Petsai	6,471	10
Tomato	3,191	3
Welsh Onion	3,778	4
Carrots	966	7
Turnips	1,221	10
Onions	37,000	6
Peppers	104,559	3
Cucumbers	13,845	8
Egg Plant	9,389	5
Pulses	155,840	0.6
Others	116,670	5

WORKING GROUP IV

HIGH PROTEIN FOODS,

ANIMAL FOOD

Pages: 67 to 91

WORKING GROUP IV: HIGH PROTEIN FOODS, ANIMAL FOOD

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INTRODUCTION

The problem of providing adequate protein for human consumption through utilization of various present or potential resources has been considered in detail. On the basis of present consumption levels, technical and equipment limitations, economic constraints, and market feasibility the relative importance of these protein sources for human diets in Indonesia has been assessed and specific action recommended.

Animal protein sources are discussed first, because of their quality. It should be recognized, however, that the principal sources of protein in the diets of the Indonesian people are cereals--principally rice--followed by soybeans, consumed mainly as tempe and tahu. The possible role of unconventional sources of protein such as solvent-extracted fish protein concentrate, food yeast, and other forms of single cell protein, algae and leaf protein, and of synthetic amino acids are also considered.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Since most protein in Indonesian diets comes from cereal grains, there is an urgent need to increase the availability of more concentrated sources of protein, especially for children. Soybeans are now most important for this purpose in rural areas. However, in view of present agronomic constraints (need for improved varieties and higher yields) on this crop, first priority should be given to increasing the production of inland fisheries, especially pond culture, with second priority given to the improvement of soybean varieties and management. Extension assistance for the subsistence production of poultry and eggs deserves third priority. For the growing urban populations, soybeans and fish are of first importance for supplementing the predominantly cereal diets of low-income groups. The demand for poultry, eggs, meat, and milk will gradually increase with economic growth, so their supply will need to be improved. Of these, poultry and eggs can most easily keep pace with demand, if dependable commercial sources of baby chicks, vaccine, and mixed feed are developed.

Marine fisheries and cattle raising should be promoted on the outer islands. The products will serve mainly for export, but some of the increased production will contribute to domestic supplies. A solvent-extracted fish protein concentrate is neither feasible nor desirable for Indonesia, but ground dried fish prepared at the village level for human consumption is recommended. In addition, methods under development in the Philippines, for preparing edible coconut protein concentrates, are promising. The development and promotion of protein-rich foods for infants and young children, using indigenous protein sources, requires priority attention. A program should be initiated at once to introduce one of the genes opaque-2 or floury-2 into high-yielding corn varieties adapted to Indonesia, as a means of raising the quality of corn protein. Wheat flour, which is largely imported, should be required to contain 0.2 percent of l-lysine, to improve its protein quality.

SPECIFIC FOODS

I. Fish and Fish Products

Fish contribute importantly to the protein nutrition of the entire Indonesian people, particularly in the rural areas. However, rapid population increase plus a deteriorating infrastructure (transportation, storage and distribution) have led to relative decreases in the per capita supply, with Java the most seriously affected.

Food fish in Indonesia are derived not only from the sea, but also from minimally-managed bodies of fresh water, and fresh and brackish water ponds. For the most part they are consumed salted and dried, fresh fish making up about one third of the fish consumption. Each of the sectors of supply can make further contributions to fish production and consumption. The fresh water fisheries are particularly important to the nutrition of the rural population.

A. Marine Fisheries

1. Marine Fisheries: Home Consumption

Broad estimates indicate that the over-all fisheries potential of Indonesian waters is substantial, but the present status of Indonesian fishing is highly labor-intensive, precluding tapping of more than a small segment of the available stocks. Moreover, only about 1.5 percent of the fishing fleet is motorized. To upgrade some of these boats, and also to

improve the infrastructure of marine coastal fisheries, through ice-making plants and facilities for docking, landing, transporting, and marketing, would require very substantial capital even if this were done for Java alone. This capital is not likely to be supplied by private sources. Much of the improvement would, therefore, have to be government supported. It is estimated that two levels of technical improvements (see Table 1, p. 90) could raise the per capita annual supply of fish by 0.2 kg. and 1.0 kg. respectively. It is assumed. that when operating under these improved technical conditions, fishing would still be profitable for the fisherman, and there would be a market for the fish.

Since the above assumptions are of uncertain validity, and since the massive capital required is not presently available, only a moderate increase in this sector can be expected. Whatever improvements in the fishing fleet and its infrastructure are planned, a rational program should be followed that can lead to optimum results in the region where it is applied. Furthermore, improvements in the home consumption marine fisheries sector hold promise only if tariffs on the essential materials are reduced.

2. Marine Fisheries: Export

Indonesian seas have stocks of interest to industrialized fishing enterprises, particularly shrimps and tuna Under Foreign Investment Bill No. 1 (1967) several companies are at present negotiating, or considering negotiating, for fisheries exploration ventures. Such ventures are highly desirable provided they do not compete with the operations of Indonesian fishermen for Indonesian consumption, and provided the joint companies are held strictly to the terms of their contracts, so that the Indonesian market sector is also benefited. The establishment of shore facilities by the enterprises for private and general use, including ice plants, repair shops, cold storage facilities, and landing and docking facilities, should also help domestic fishing operations.

B. Inland Fisheries

On the basis of present importance, inland fisheries in Indonesia can be divided into: swamp, river and lake fisheries; fresh water pond fisheries; brackish water pond fisheries; combined rice and fish culture; and small home fish ponds. Each is capable of improvement (see Table 2, p. 91) with potentials and contributions as follows:

1. Swamp, River and Lake Fisheries

These resources are almost exclusively found outside of Java. Less than 40 percent of the potential acreage is being utilized, yielding not more than two-thirds its estimated sustained yield. This is due to such infrastructural deficiencies as irregularity of ship arrivals, and the shortage of space in ships for fisheries products. An additional constraint is the low tonnage of these vessels, made necessary by the silting of navigation channels.

Improvements in the catch of river and lake fish depend less on altered management practices than on the improvement of transportation from production to the main consumption sites, especially in Java. Such improvements, which are also necessary for other commodities besides fish, will support an increase in fish production of at least 100,000 tons, and are therefore highly recommended.

2. Fresh Water Pond Fisheries

In the tropics, optimal management of fishponds involving use of superior species, fertilization of the pond, additional feeding, and manipulation of stocking can yield very high amounts of protein per unit of surface. Fish culture is already well-advanced in Indonesia, and can be expected to yield substantial further increases with relatively low investment in adaptive research and extension. Average yields of 1.2 tons of fish per hectare can be increased to 3.0 and 6.0 tons (see Table 2). These increases are likely to be consumed by the rural population. Therefore, assistance in and primary attention to this sector is highly recommended.

3. Brackish Water Fisheries

Management improvements at two levels of intensification (fertilization and manuring and feeding) can be expected to raise the production in this sector from 170 kg. of fish per hectare to 340 kg. and to 1000 kg. respectively (see Table 2).

However, improvement of brackish water fish culture, mainly milkfish, seems to be hampered by socio-cultural re straints, in part connected with existing tenure and ownership systems. The catch is shared so that 60 percent of the return from milkfish sales go to the owner and 40 percent to the tenants, while these percentages are reversed for the sale of species other than milkfish. Tenants may therefore favor milkfish less than other species. Also, feeder canals for

the ponds are badly silted and no fertilizer is being used. Land reform measures are now being applied to milkfish holdings, many of which are under absentee ownership. The potential of land reform for more intensive management is counteracted by the slow and haphazard manner in which the reform is executed, and by the lack of funds for upgrading the culture practices. Intensification of management, use of fertilizer, and selection of the most suitable species to be raised with milkfish (mullet, shrimp, mollusks) will bring about needed improvements in the brackish water fish culture sector. Adaptive research and much intensification of extension work will be required to facilitate the yield-increasing changes that have proved effective outside Indonesia.

4. Combined Rice and Fish Culture

Fish are grown in rice fields either simultaneously with rice or between plantings. At present, 80 to 100 thousand hectares of rice fields are being used for fish culture, with a production of more than 12,000 tons of food fish and seedlings.

About one million hectares of rice fields in Java are suitable for this culture and are capable of yielding at least 50 kg. per hectare, or more than 50,000 metric tons per year. Since sufficient water is available, from the week after transplantation until the flowering of the rice, and no special or complicated techniques are needed, the expansion of this kind of fish culture is highly recommended. The main constraints are high seasonal demand for stocking material, and the incompatibility of fish culture and insecticide treatments with chlorinated hydrocarbons such as endrin. Measures should be taken to guarantee the supply of stocking material by establishing new hatcheries, and by improving those now in existence.

Adaptive research executed jointly by rice and fish research units is highly recommended.

5. Small Home Fish Ponds

Most rural households can construct small home ponds to be stocked with the prolific, fast growing, easily manageable Tilapia mossambica, and utilizing kitchen and garden refuse as fish food. Initial costs are minimal, and benefits to be expected from the home ponds amount to 50 kg. per household per year. For these reasons the construction of home ponds is highly recommended, and it is also recommended that the Extension Service give priority to this

program and help to provide the households with sufficient male and female Tilapia mossambica for the initial stocking of their ponds.

C. Fish Protein Concentrate

It is not surprising that the recent publicity concerning a solvent-extracted deodorized fish flour (FPC) has generated interest as to its use in Indonesia, particularly for the feeding of infants and children. Establishment of an FPC production unit in Indonesia is strongly contraindicated, however, because:

There is no excess of fish, as required for the operation of such a plant;

Establishing a commercial fishing industry to supply this surplus would be expensive and time consuming;

There is no need to utilize an expensive process to remove the odor and flavor of fish for a population which likes both; it is uncertain whether a solvent-extracted FPC would even be acceptable in Indonesia; and

The cost of the product would be too high for a potential Indonesian market (30 to 40 U.S. cents per pound).

In contrast to the highly refined and therefore expensive product, there is an opportunity to produce a cheaper, non-deodorized, but highly sanitary product of the same high nutritive value. The feasibility of producing such an upgraded fish flour and introducing it for human consumption should be explored. As a first step in this venture, acceptability and market testing of such a product is recommended. Assistance could probably be obtained from UNICEF for this purpose.

There should also be a study of production techniques utilizing small-scale units to produce high-grade, edible fish flour through cooking, shredding, pressing, and drying. These units could be operated at the village or small industrial level and contribute to infant and child nutrition by producing a material much cheaper and more likely to be acceptable in Indonesia than solvent extracted FPC. Even these small production units would have to rely on some surplus. Since a relative fish surplus now exists only outside of Java,

the home industries producing this type of edible fish meal would most likely be located in Kalimantan and Sulawesi.

II. Poultry and Eggs

A. Chickens

At present, poultry and eggs are produced at the household level in rural areas (by allowing chickens to fend for themselves) and on a small commercial scale in the vicinity of the larger cities. Most of these poultry products are sold in the urban market. The urban markets are saturated at present because of the low purchasing power of the people. In rural areas, poultry and eggs are so seldom consumed that they contribute very little to the average diet. Dietary surveys in four rural areas during 1958-1960 indicated an average daily consumption per person of only 0 to 7 grams of poultry and other meat combined, and 0 to 1 grams of egg. In 1964, the estimated annual consumption of eggs in Java was 6.24 per person, with an average of 0.52 chickens per capita per year. For the outer islands, the corresponding figures were 6.12 eggs and 1.56 chickens. Consumption in the urban areas is greater, but very unequally distributed among the different income groups.

In 1962, the value of slaughtered poultry amounted to 16 billion rupiahs. Thus, the production and sale of poultry and eggs provide a useful cash income to the family located where these commodities find a ready market. Hence, the consumption of meat, poultry and eggs occurs principally in the cities.

Efforts to improve poultry production at the subsistence level are well worthwhile, because they represent a source of cash income for the household, and because some of the products will be consumed by the family. For one thing, at least 75 percent of rural families are raising chickens throughout the year. Furthermore, production at the family level does not use scarce grain or protein concentrates.

Although, at present, commercial poultry production makes only a small contribution to the protein supply of the diet of needy groups, it is a desirable and profitable industry which will expand slowly with the increase of the middle class in numbers and purchasing power. A large increase in the number of commercial poultry farms is questionable at present, not only because of the limited market, but also

because commercial poultry feed requires cereal grains, which are also in demand for direct human consumption, and protein concentrates.

While the poultry industry will not make an important contribution in the next five to ten years to meeting the needs of low income groups, its role will gradually increase. Over the long-term, flourishing poultry industries will contribute importantly to the protein supply of the nation. Production costs should be lowered by initiating production in rural areas where grains are grown and costs are less.

An adequate supply of high quality baby chicks, of dependably-mixed feed, and a source of reliable vaccines are required if the poultry industry is to flourish. Encouragement should be given to commercial entrepreneurs to establish poultry hatcheries, feed mills, equipment manufacture, and vaccine production. It is particularly important that vaccines against Newcastle disease be available for both commercial and subsistence producers, and that the agricultural extension service promote the routine use of this vaccine for all poultry.

Research designed to improve utilization of indigenous feedstuffs, including the by-product of cereal grains for the commercial production of poultry and eggs, should be continued. Research to adapt improved breeds of poultry for use by subsistence farmers is also badly needed, and could be very beneficial. Research and extension efforts could profitably be oriented to encourage poultry raising as part of the program to diversify the agriculture of the estates and increase their contribution to the food supply.

More attention must be given to the marketing of poultry and eggs, to facilitate their movement into urban centers at minimum loss. This would directly benefit both producers and consumers. Poor packaging and transportation arrangements at present result in high egg breakage, and there are no cold storage facilities. These factors contribute to the large spread between farm sale and consumer prices. A more efficient marketing system would increase quality, reduce costs to consumers, and increase the consumption of eggs in Indonesia.

B. Ducks

There exists a highly specialized duck industry which provides eggs and some meat for the urban market. There is also a good export market for duck eggs if production could be

increased and the eggs properly handled. Unfortunately, the supply of duck eggs is limited by the system employed for raising ducks in Indonesia, under which flocks travel from one harvested wet rice field to another, to feed on fallen grains and small animals such as snails, fish, frogs, worms, and insects. It is estimated that the maximum duck population which can be supported by this method now exists, and hence expansion will be entirely dependent on an increase in wet rice acreage, both from new land and from an increase in multiple cropping. Grain cannot be spared for feeding directly to ducks, although some grain by-products would be useful for this purpose. Some subsistence raising of ducks takes place, utilizing fish waste, particularly on the outer islands. This practice should be encouraged and supported by the agricultural extension service. An improvement in the marketing system for duck eggs is greatly needed.

III. Meat and Milk

A. Meat

1. Supply

Cattle, buffaloes, goats, sheep and swine are sources of meat in Indonesia. Of these, only swine are produced commercially on Java. Other animals are kept at a subsistence level, except for large-size herds of cattle and buffaloes on the Lesser Sunda Islands. New production centers planned for the outer islands are promising for this purpose, in view of their abundant land and lack of competition with food crops.

The estimated number of livestock in 1961 were as follows:

Type	Number in Millions	Percent in Java
Cattle	6.3	75
Buffaloes	2.9	55
Sheep and Goats	11.9	80
Swine	2.7	39

Except for the swine, most of this livestock was concentrated in Java, where the human population is dense, and the grazing and forage production possibilities are accordingly limited.

Data on fresh meat consumption in 1963 showed an annual per capita intake of 3.50 kg., far below the proposed

target of 5.5 kg. Consumption of meat in Java and Madura (1.56 kg.) and in the outer islands (3.12 kg.) showed a significant difference. The consumption of meat in Java is significantly higher among urban than rural people. These notable differences are accounted for mainly by differences in purchasing power.

West Java is supplied mainly by cattle from East and Central Java. Sumatra and Kalimantan are supplied by the production regions of the eastern islands. Cattle from the Lesser Sunda Islands are generally destined for export, particularly to Hong Kong. Considerable loss of weight during shipment occurs due to poor management and irregular shipping facilities.

The swine population in 1963-1964 was 2.7 million head, double the 1940 figures of 1.2 million. The consumption per capita per day dropped from 3.5 grams in 1940 to 2 grams in 1960; however, swine exports were 12 times higher in 1940 than in 1960. The export of swine to Singapore was blocked during the Confrontation, and recovery of this market is doubtful due to the large increase in swine production in Singapore and Malaysia. Even exports to Hong Kong now face heavy local competition.

For some regions, mostly on the outer islands, where swine raising and consumption are tolerated by the local people, pork is an important source of dietary protein. However, pork is consumed by only a very small part of the Indonesian population. Swine raising is generally at the family level, with inferior indigenous breeds fed on a meager ration of kitchen waste, cooked vegetables, and in rare cases, rice bran. Commercial swine production is concentrated in the vicinity of the large cities, with better imported breeds or cross breeds fed mainly on rice bran and coconut oil cake.

2. Production on Java and Madura

The improvement of the marketing system for cattle on Java could lower meat prices to within reach of more of the low income population. The production of sheep and goats on a subsistence basis by individual families could be assisted by agricultural extension activities. The swine industry around the larger cities could be encouraged, and opportunities for increasing exports to neighboring countries explored.

Improvement of the production level of all livestock requires better breeds, more efficient feeding and

management practices, as well as a more effective marketing system and disease control.

3. Production on the Outer Islands

The Bali cattle found mainly in Bali and Timor have proved satisfactory for beef production. Regular and well-planned exportation of these cattle would result in greater production, but this will require effective and efficient inter-island and overseas transportation. The local marketing system should help to increase swine production for export, and for local consumption.

Foreign capital investment for the large-scale production of beef cattle could be encouraged on the outer islands. Favorable market outlets exist, and abundant land is believed to be available on Sumatra and other outer islands. Such operations should utilize modern beef cattle breeds adapted to tropical conditions. Improvement of production requires better feeding and management, feed preservation and storage facilities, proper pasture and range management, forage production, provision of adequate drinking water by artificial wells, and effective disease control.

4. Research

Desirable research projects include studies on the productivity and economic returns of native cattle, sheep, goats, and swine; range pasture management in the various regions of Indonesia; marketing systems for livestock; adaptation of improved breeds of animals to local conditions; local means of transporting livestock with minimal losses and meat processing for domestic and foreign markets.

B. Milk

Educational efforts have made the nutritional value of milk more widely appreciated, but due to economic reasons consumption remains very low. In 1964, total annual milk consumption per person per year was only 0.52 kg.

Since so few of the population can afford to purchase milk, its contribution of protein will remain negligible for some years to come except among the small middle and upper income portions of the population located mainly in the urban areas.

The main milk production areas are near the large cities. These dairy regions are in West, Central and East

Java. Their estimated total milk yield is 35,000,000 liters annually (1965) while the number of dairy cattle is approximately 50,000 head. These figures clearly indicate a low average production per cow. This is due to various factors, such as poor breeding stock, inadequate feeding, and inefficient management. In certain areas, poor adaptation of imported stock leads to low yields. Storage of forage is a common problem particularly in the dry season since few dairies have adequate pasture land, and some have none at all. Part or all of the forage must be purchased from sources that are unreliable. The availability and quality of protein concentrates are also inadequate and subject to seasonal fluctuation.

As long as per capita income level does not improve appreciably, increases in milk production will make little significant contribution to fulfilling the need for protein. Nevertheless, dairying at either the subsistence level or on a commercial basis should be encouraged, and the efficiency of the dairy industry and the quality of milk and dairy products improved. Better sanitation and the introduction of simple cooling methods are necessary to maintain the marketable value and safety of milk. Proven bulls of dairy cattle adapted to lowland area, and artificial insemination can improve the production potential most effectively. Adaptive research will be necessary for this purpose. Better transportation and marketing facilities will encourage dairying, particularly in the more remote production areas.

Subsistence milk production from goats and buffaloes should be promoted. Better sanitation practices during milking are required. Crossing with better breeds such as the Saanan goat and the Murah buffaloes would increase milk production.

The availability of vaccines, medicines and feed additives would increase the general health of the herds of all types of dairy animals and would increase their production considerably. A study of the milk marketing system is a necessary prerequisite to improving the sanitary handling of milk, and the enforcement of public health regulations.

IV. Legumes and Coconuts

Legumes, particularly soybeans and peanuts, are the most important sources of plant protein in the Indonesian diet, with the exception of rice. The average intake approaches 40 grams per person per day. In September 1967, estimates of the 1967 production were 363,000 tons of soybeans and 242,000

tons of peanuts. They are usually consumed as tempe (fermented soybean), tahu (soybean curd) or ontjom (fermented peanut cake). The processing of these products leaves significant quantities of residues which currently are used mainly as feed. They too are potentially valuable as food. Legumes are also important potential protein sources for low-cost protein foods suitable for feeding infants and young children.

The contribution of coconut protein to the Indonesian diet is difficult to evaluate due to the absence of data on coconut production and consumption. That large quantities are available is indicated by the fact that well over a million tons of coconut are processed annually, about half of it being exported as copra. Much of the available coconut production is still not harvested.

A. Soybeans

In formulating recommendations for soybeans, concurrent consideration was given to peanuts, because of the practice of growing either one or the other on the same land. Though it can be argued that there is an economic advantage to growing peanuts, because of their oil content, it is strongly recommended that efforts be made to encourage the production of soybeans, for the following reasons:

> The high content (40 percent) and biological value of soybean protein, coupled with the history of acceptance of soybeans in the Indonesian diet, makes them a desirable indigenous protein resource. Moreover, they constitute almost the only protein food that the general population can afford at the present time.
>
> Soybeans can contribute up to twice as much protein as peanuts from the same acreage.
>
> Greater yields are reported in rice crops following soybean culture than in those following peanuts. Due to the way in which agriculture is locally practiced, soybeans improve the soil, but peanuts deplete it.

Increased soybean production could have a significant impact on alleviating the protein shortages for infants and young children, especially in the rural areas. Nutrition education is needed to encourage the feeding of soybeans as tempe and tahu to young children.

It is recognized that economic and agronomic factors will limit increased soybean production in the immediate future. As rice field irrigation is intensified, an additional crop of rice can be grown where only soybeans or peanuts are now possible. Thus, there will be a decrease in soybean production unless yields are improved, and unless growing is encouraged on the outer islands. On the other hand, as rice yields increase, prices are likely to decrease. If the differential in economic return between rice and soybeans decreases sufficiently, the production of soybeans may be stimulated.

Research work at the Central Research Institute for Agriculture has developed a new soybean variety for highland use. In testing programs incorporating intensive insecticide application, this variety has increased bean yields from 700 kg. to 2,200 kg. per hectare. Current Indonesian productivity is even nearly equivalent to that of Southern U.S. central states, if the yields are compared per month of growing time.

It is strongly recommended that an adapted testing program be undertaken to determine the productivity of this variety under the different highland and climatic conditions found in Java. If results are encouraging, extension work on seed production and distribution should then be given high priority. Improved management practices could increase lowland soybean yields, even with present varieties, but substantial yield increases will depend on finding higher-yielding varieties which are adapted to local conditions. Research for this purpose should receive a high priority.

Recently, a village-level process for producing full-fat soy flour was developed by the U.S. Department of Agriculture with UNICEF guidance. Cost of the equipment is approximately US$300. It is recommended that the Indonesian Government request UNICEF to initiate a pilot project to determine the feasibility of producing full-fat soy flour under Indonesian conditions. Even if the technology is adequate, the cost of the product and its acceptability in village diets will need careful examination.

Efforts to develop soybean foods for infants and children in urban areas should be stimulated. An increasing number of urban mothers are failing to breast-feed their babies, and a low-cost protein source for infant feeding is urgently needed, since milk is too expensive and in short supply. A commercially-produced low-cost high-protein beverage utilizing dried tempe could be particularly helpful.

It is emphasized that these foods should be designed for successful marketing. Free distribution programs alone are not feasible. Experience has shown that when these foods are initially distributed for relief purposes, they are not purchased to a sufficient degree when the charitable programs stop. Moreover, the Government cannot afford mass purchases for this purpose. The Nutrition Institute is currently testing food mixtures for urban children. For example, one proposed infant formula contains rice flour (30 percent), tempe flour (30 percent), "home made" fish flour (9 percent), sugar (27 percent), and peanut oil (4 percent). The Institute should be given food technology and food engineering assistance in developing such products and in evaluating their market feasibility.

Microbially-fermented soy foods such as tempe are primarily produced on a small scale as home industry. Due to the processing techniques employed, a considerable amount of potentially valuable food material is lost. For example, approximately 28 percent of the original dry material remains following the production of tempe. This situation is not confined to fermented foods. Nutrient-containing residues also result from soy and other oil seed-processing to obtain products such as tahu, a soy curd cake. These "waste" materials are generally utilized as feed ingr dients. Since the quantities involved are considerable, the possibility of their utilization in human foods should be investigated. In Bandung alone the daily residue from the production of tahu is estimated to be 20 tons.

B. Peanuts

In view of the considerations expressed in the preceding section, peanut production is less desirable than soybean production from the standpoint of human nutrition. Peanuts supply only minimal amounts of rather low-quality protein in Indonesian diets. Most of the crop is processed for oil content. There is some consumption of whole peanuts and of ontjom, a fermented peanut cake. In 1964, peanut cake residue was 449,000 kilograms, and was utilized principally for animal food. A considerable investment of capital and technological skills would be required if the residue of processing of either peanuts or soybeans for oil were to be used as human food. The technology for doing so is available, save that the tropical country problems of producing peanut meal free of alfatoxin have not been solved. Alfatoxin is produced by the mold _Aspergillus flavus_, which presents a special problem with peanuts because of their contact with the soil. The mold also

produces toxin on all other legumes, as well as on oil seeds and cereals, if they are stored long under humid conditions.

C. Coconuts

Evaluation of the protein contribution of coconut to the Indonesian diet is difficult because of lack of data. It is estimated that well over one million tons of coconuts are currently produced. Major amounts are processed domestically for oil, or exported. Because of the low return to the grower, much of the available coconut crop is not harvested, and there is little incentive to increase coconut production. Calculations have been made that, at present, coconuts supply an average of about one gram of protein per day in Indonesian diets. Whatever the precise figure, it is clear that for most of the population, coconuts are not contributing significant amounts of protein. Coconut flours contain over 20 percent protein of relatively high biological value. Demonstration of a feasible process for producing edible coconut flour could benefit the Indonesian situation in a few years.

Coconut flour has been produced experimentally, and a pilot plant is now under construction in the Philippines. Plans call for a plant that will be in operation by early 1969, producing 1000 tons of oil and 500 tons of flour per month. Three hundred tons of coconuts per day will be required to maintain profitable production capacity. If this commercial venture is successful, a feasibility project should be undertaken in Indonesia.

Coconuts are still a relatively untapped indigenous protein resource. If protein-containing edible coconut flours can be produced and utilized in the Indonesian diet, coconuts can become an important source of protein of high quality. Such a material would be particularly useful in the formulation of protein-rich foods for the feeding of young children, and the manufacture of protein containing beverages for all age groups in urban areas.

V. Cereals

Cereals are of primary importance in the Indonesian diet, supplying 80 percent of the protein and 75 percent of the calories. On a worldwide basis, cereals contribute about 50 percent of the dietary protein supply. Rice is the principal cereal crop, with an estimated consumption of 93.6 kg. per person in 1963 and 85.8 in 1964; annual consumption of corn is estimated at 17.9 kg. per person in 1963 and 43.7 kg. in

1964. Most of the remaining calories come from cassava, which contains essentially no usable protein.

A. Rice

The total annual rice production as dry stalk padi is approximately twenty million metric tons. About 80 percent of this rice is home-milled, whereas 14 percent is processed by small mechanical hullers. Only 6 percent is milled in central rice mills. Protein quality of rice is considerably better than that of maize or wheat, although the actual protein content is lower. While rice can probably satisfy the protein requirements of adults, in the quantities commonly consumed in Indonesia, this definitely is not the case with infants and very young children. The protein content of rice is too low to satisfy the minimal need, higher for children than for adults per unit of body weight. The best way to supplement a predominantly rice diet is with fish and soybean food such as tempe and tahu. Because of the scarcity of central processing facilities it does not appear feasible at present to fortify rice either with protein concentrates or with vitamins and amino acids.

B. Corn

Corn production in Indonesia was about 3.65 million metric tons in 1964. Its production and food use varies in different parts of the country. The protein content is somewhat higher than rice, but the quality is considerably inferior, with respect to the limiting amino acids lysine and tryptophane. Since it is not feasible to fortify corn with amino acids, due to the lack of central milling facilities and the present high cost of tryptophane, adequate supplementation of a corn diet with fish and soy food is recommended for that part of the population receiving a majority of their calories from corn.

As the best long-range solution to the improvement of the quality of corn protein, adaptive research should be started at once to introduce either of the genes opaque-2 or floury-2 into high yield corn varieites adapted to Indonesian conditions. These genes bring about an increase in the limiting amino acids lysine and tryptophane up to levels which make corn protein comparable to animal protein in quality.

C. Wheat

Wheat flour and some bulgur are currently imported to satisfy the growing cereal shortages of the cities. Wheat

foods appear to be well accepted by the urban population. It is recommended that the Government issue regulations requiring the enrichment of imported wheat flour with the standard B vitamin and mineral ingredients and with 0.2 percent l-lysine hydrochloride. Fortification with the latter ingredient almost doubles the nutritive value of the protein in wheat flour.

VI. Single Cell Protein

The possibilities of producing protein for human consumption by the growth of fungi, algae, or bacteria have received considerable publicity in recent years. The claims far exceed the realities, and Indonesia should not expect to produce protein from these sources within the foreseeable future.

Production of single-cell organisms for animal feeding, utilizing a crude paraffine fraction of petroleum for energy, and ammonia as a nitrogen source, has been initiated in France and the Soviet Union, and a pilot plant has been constructed in Taiwan. The material is not of a suitable quality for human consumption. Such a plant is feasible only as part of a petroleum refining industry, and requires considerable capital investment and technical skill to operate. The product can be used for animal feeding only when mixed with cereal grains which are now in short supply in Indonesia due to demands of the human population. Moreover, all available ammonia is needed for fertilizer production. No industrial production of single-cell protein for human consumption from such a substrate has yet been achieved by any company, and extensive animal and clinical testing will be required before any such production could be approved for human consumption. It should also be recognized that the material will of necessity be much more costly than protein from usual growing plant sources.

Yeast can be grown on molasses, but the cost of the product appears unfavorable and its acceptability uncertain. A dependable supply of molasses for this purpose is doubtful in Indonesia at the present time, since the sugar industry is declining in importance, and the available molasses is required for other purposes. At the very least, careful feasibility and acceptability trials would be required before yeast production on molasses could be recommended.

It has often been proposed that green leaves be processed to produce protein for human consumption. This is impractical, because land is not available for growing the required leaves, the product has a strong, objectionable flavor, and the cost

of production is so high that further processing to improve the flavor is not economically feasible. For somewhat similar reasons, the production of protein from single-cell algae such as chlorella, for human consumption, is wholly impractical at the present time.

In summary, there will be continuing developments in the field of single-cell and algal protein, based on the intensive research and development work mainly in industrialized countries; but Indonesia cannot presently look to these sources as practical possibilities, and should not use its scarce funds for research in this field.

CONCLUSIONS AND RECOMMENDATIONS

I. Fish and Fish Products

Fish contribute importantly to the protein nutrition of the entire Indonesian people, but with population growth the per capita supply is decreasing. Substantial capital will be required to increase the marine fish catch appreciably, but fresh water pond fisheries can yield very high amounts of protein per unit of surface, and growing fish in small home ponds is feasible.

It is recommended that:

1. Primary attention be given to increasing the production of inland fisheries, especially pond and combined rice and fish culture.

2. Joint research on insecticides by rice and fish experts be carried out to obtain types compatible with fish grown in rice fields either simultaneously with rice or between plantings.

3. Efforts be made to improve the brackish water sector by intensifying management, use of fertilizer, and selection of species most suitable to be raised with milkfish.

4. Home fish pond construction be encouraged, and that the Extension Service give priority to the home pond program, helping to provide the initial stocks of *Tilapia mossambica*.

5. The production of a non-deodorized, but highly sanitary product of the same high nutritive value as solvent-extracted deodorized fish flour be explored for human consumption.

6. Transportation facilities from production to main consumption sites be improved in order to support the estimated increase in fish production.

II. Poultry and Eggs

The present direct contribution of poultry and eggs to the nutrition of the rural populations is negligible--less than two grams of protein per person per day from poultry and livestock combined--and not likely to increase appreciably in the near future. Family poultry and egg production contribute to the cash income of rural families and to the dietary protein of urban populations, and the small poultry industry supplying urban centers will grow with an increase in middle-class purchasers.

It is recommended that:

1. Poultry and egg production be encouraged on a subsistence level; and adaptive research and extension work be undertaken on breeding, feeding, management, disease control, and marketing of these products.

2. Encouragement be given to commercial entrepreneurs to establish poultry hatcheries, feed mills, equipment manufacture, and vaccine production.

3. Research to improve utilization of indigenous feedstuffs, including the by-product of cereal grains, for the commercial production of poultry and eggs be continued.

4. A more efficient marketing system be implemented to increase quality, reduce costs to consumers, and increase the consumption of eggs in Indonesia.

5. Poultry production be encouraged as part of the program to diversify the agriculture of the estates and increase their contribution to the food supply.

III. Meat and Milk

Total meat consumption in 1964 was only 1.56 kg. per person in Java and Madura, and 3.12 kg. in the outer islands. Milk consumption is essentially zero in rural areas, and averages only about one-half a liter per person per year in the population as a whole.

It is recommended that:

1. Livestock production level be improved by introducing more efficient feeding and management practices, better breeds, disease control, and by the creation of local marketing system and more efficient inter-island and overseas transportation to aid both the export and local consumption trade.

2. Efforts be made to improve the quality of the present dairy animals and the milk supply.

IV. Legumes and Coconuts

Soybeans furnish a major supplement to cereal protein in rural areas, and at the village level processing into tempe, tahu, and other products results in protein-rich foods suitable for feeding to young children. Peanuts are much less desirable as a protein source because of their relatively lower protein content and quality, lack of indigenous processing procedures, and the hazard of the toxin produced by the mold *Aspergillus flavus*. Coconuts are still a relatively untapped indigenous protein resource.

It is recommended that:

1. Soybean production, which improves the soil, be stressed, as against peanut crops which deplete it.

2. Research to find higher-yield varieties of soybeans which are adapted to local conditions be given high priority.

3. A pilot project be initiated to determine the feasibility of producing full-fat soy flour under Indonesian conditions.

4. Efforts be made to develop soybean foods for infants and children in urban areas.

5. The feasibility of processing coconut as a source of protein for human feeding be explored.

V. Cereal Grains

Because of the large amounts consumed, rice and corn provide the bulk of the protein in the Indonesian diet, although both are low in protein concentration. Other more concentrated sources of protein are required for the normal growth and development of young children.

It is recommended that:

1. A breeding program for the purpose of introducing the genes opaque-2 or floury-2 into high-yielding corn be initiated immediately.

2. Wheat flour, which is largely imported, be fortified before shipment with 0.2 percent of l-lysine to improve its protein quality, and also with thiamine, riboflavin, niacin, calcium, and iron.

VI. Single Cell Protein

There is no prospect within the next five to ten years that single cell protein from yeast or bacteria will be practical for a country such as Indonesia. Not only is the capital investment high and the technology still uncertain, but the cost of the product would be prohibitive for the local market. This is also true for protein from green leaves or algae.

SUMMARY EVALUATION OF PROTEIN SOURCES
FOR HUMAN CONSUMPTION

Protein Source	Type of Production	
	Subsistence	Commercial
Fish; inland	Major importance	Major importance
Fish; marine	Minor importance	Large increase possible with sustained capital investment; important for export market
Poultry and Eggs	Important, but mainly for cash income	Increase possible, but limited by urban purchasing power
Meat	Relatively unimportant	Sizeable increase possible on outer islands mainly for export market
Milk	Negligible importance	Quality of present supply requires improvement, but limited market potential
Soy	Production very important	Cottage industry production of tempe and tahu very important
Peanut	Minor importance	Should not be emphasized
Coconut	Useful	An edible grade coconut protein may become technically feasible in the near future
Single Cell	Not pertinent	Not feasible at present

Table 1. Marine Fisheries (Java and Madura)
Mechanization of Medium Size Sailing Boats

No. of Medium Size Boats	Present Production per boat kg/year	Annual Production (kg) per Boat if Mechanized W/o Additional Facilities	With Facilities for Ice, Fish Storage, Preservation, Improved Marketing	Required Capital Investment per Boat for Mechanization x 1000	Required Capital Investment/ Boat/year x 1000	Present Total Production per year (tons)
14,000	1,000	2,000	6,000	Rp. 3000	Rp. 3750	14,000

Total Annual Production Increase if Mechanized (tons) W/o Additional Facil.	With Addi. Facil.	Total Expenditures per year for Mechanization: Capital Investment x 1000	Operation Costs w/o Facilities	Operation Costs with Facilities x 1000	Total w/o Facilities x 1000	Total with Facilities x 1000
14,000	70,000	Rp. 525,000	Rp. 1,400,000	Rp. 3,400,000	Rp. 1,925,000	Rp. 3,925,000

Income per kg of Increment: W/o additional facilities - Rp. 137; With facilities - Rp. 56.

Notes: Capital investment and operation cost figures are only for fishing boats and fishing operations.

Capital investment for additional ice plants (8 units) with a total capacity of 200 - 250 tons of ice per day is estimated at Rp. 650,000,000.

Training of fishermen in the operation and maintenance of engines is required.

By providing additional facilities the number of effective fishing days can be increased by approximately 50%.

Table 2. Inland Fisheries (Java and Madura)

Type Pond	Area (ha)	Present Production/ha kg	Fertilization and Manuring Area ha	Fertilization and Manuring Production/ha kg	Feeding Area ha	Feeding Production/ha kg
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Brackish Water	93,000	170	36,000	340	55,000	1,000
Fresh Water	54,000	1200	54,000	3000	54,000	6,000
Ricefield Fish Culture	1,000,000 (additional)	50				
Back-yard	1,000,000 households	50 kg/ household				

Type Pond	Total Present Production (tons)	Total Production if Fertilized and Fed (tons)	Additional Expenditures per yr/ha for (9) Rp x 1000	Total Expenditures per year in Rp x 1000
	(8)	(9)	(10)	(11)
Brackish Water	15,810	67,480	13 (Fertilizer) 9 (Motorpump) 5 (Labor) 14	468,000 770,000 1,238,000
Fresh Water	64,800	324,000	12 (Fertilizer) 50 (Feed) 62	3,348,000
Ricefield Fish Culture		50,000	1 (Stocking Material)	1,000,000
Back-yard		50,000 1/	2/	Almost nothing

Input per kg of increment Rp.: Brackish Water - 24; Fresh Water - 13; Ricefield - 20, private fishculturists should supply fingerlings; additional hatcheries necessary.
1/ Probably only 25,000 in first year. 2/ Almost nothing except for initial stocking.

WORKING GROUP V

PROCESSING, MARKETING

&

UTILIZATION OF FOOD

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WORKING GROUP V: PROCESSING, MARKETING AND UTILIZATION OF FOOD

Mubyarto, Chairman
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INTRODUCTION

Although reliable data on actual food storage losses are still lacking, it is conservatively estimated that in Indonesia the losses of food commodities from the time of harvesting to the time they reach the consumers in many cases exceed 25 percent. Clearly, the use of effective storage, and efficient methods of food preparation, offer the quickest method of increasing the food supply. As food production increases, and the country becomes more self-sufficient, the need for storage facilities will move from the main ports to inland production centers.

The report of this Working Group is divided into sections covering the following topics: storage and preservation; processing and utilization; distribution of food; recommended research projects; and some of the most important conclusions and recommendations.

Each section includes a brief description of the current situation, plus background information based upon several background papers prepared by members of the Working Group and by other resource people invited for discussion of a particular topic. After identifying the problems, recommendations for solving them are given for each topic, and in some cases for specific crops.

As a general conclusion, efforts to improve the preservation situation of all food commodities, and particularly rice, corn, cassava, fish, meat, eggs, and various oilseed crops should be intensified in order to improve production efficiency and to increase the nutritive value of these crops.

The introduction of modern processing practices is needed for all available foods, and especially in the rural areas of Indonesia, since this is where most of the food is produced and consumed.

This Working Group discussed at length the distribution problem, including transport, credit and pricing policies, and other government regulations. It is fully realized that political considerations will influence the acceptability and possibility of adoption of recommendations made in these areas.

There may be many people who gain from the continuation of the present situation, who will raise objections to the proposed changes. Nevertheless, the food situation is too serious, and the problems involved too severe to allow such considerations to interfere with plans for making changes that are in the interest of society as a whole.

SPECIFIC PROBLEMS

I. Storage and Preservation

In increasing the production and minimizing the losses in handling of food, the problems of efficient and sufficient methods of handling must be considered. Proper drying affects the possible period of storage and improves the quality of dried products (dried salted fish, dried spiced meat, etc.).

At the present time the method of drying is usually sun drying. It is time consuming, but inexpensive. The disadvantages of sun drying are that it is heavily influenced by weather conditions so its capacity is not sufficient; the drying condition is not easily controlled, which increases the percentage of losses due to deterioration by microorganisms or cracking due to the uneven rate of water evaporation; and the conditions are not properly hygienic.

The problem with using artificial dryers is generally lack of fuels. It is recommended that in order to increase drying capacity, artificial dryers be used more extensively and that charcoal, coal, and kerosene be used as fuels.

A. Animal Protein

Indonesia has not as yet produced protein of animal origin in adequate quantities. For this reason, storage, preservation, processing and utilization of these products has not been emphasized. Until now, meat has been consumed immediately, by the people in the cities. The present production of these products in Indonesia, according to available data, is as follows:

Meat (in number of animals slaughtered)	1,259,000
Milk (in liter tons)	35,000
Poultry and Eggs	No data

The average per capita consumption for Java and Madura per year is: Meat - 1.56 kg; milk - 0.52 liters; poultry - 0.52 kg; and eggs - 6.24 eggs.

There will be additional storage and preservation problems if more meat becomes available from the outer islands, which have a surplus of cattle.

There are not enough facilities for cold storage (such as chiller rooms) in the big cities; and there are no freezing facilities at all. The freezing facility which was built in Timor is not operating at this time. Furthermore, the existing facilities of storage are not operating in a satisfactory manner, because of lack of sanitary practices and of technical know-how to maintain and operate the plant.

In big cities like Djakarta, Bandung, Surabaja and Jogjakarta, there are small meat processing plants making sausage, ham, and other products to meet the demand in the cities; but these plants process only 5 to 10 animals daily. The canning of meat, especially beef, done in big cities and in cattle areas such as the Island of Bali, is of much more economic importance. However, because of the high prices of the products, this industry has not been growing. Due to a lack of skilled workers, these products vary in quality, and there is a loss approximating 50 percent throughout the entire process, from slaughterhouse through processing, because of inadequate methods of processing and the lack of effective sanitary measures.

1. Meat

It has been proposed that the production of cattle be increased, and that the meat be used primarily for export. While at present live cattle are being exported, this is not an efficient way of marketing this product. It has been estimated that the cattle shrink from 30 to 40 percent on the way to the market in Hong Kong. There is a considerable death loss, and there is a danger of markets being closed due to diseases of cattle.

It is recommended that the cattle be slaughtered on the islands and that the meat be exported as boned, frozen beef. A modern slaughterhouse which would meet sanitation methods necessary for the world market, equipped with refrigeration and freezing facilities, should be constructed at a port site such as on Timor Island. This would permit the export of frozen, boneless beef, and hides, and the by-products could be used as feedstuffs on the island.

2. Milk

In some milk centers there are cooling units for

temporary preservation and collection of milk from small dairy cattle owners. There is need for additional cooling units and for pasteurization facilities in other larger centers.

Milk processing to butter is done only in big cities, to meet local consumer demand. There is no processing of cheese.

3. Eggs

Chicken, duck, and turtle eggs are consumed. Such eggs are found mostly in preserved form, mainly as salted eggs, to meet the consumer demand for processed eggs.

With further development of the commercial egg industry, there will be two important needs in the fields of storage and preservation.

Refrigerated storage will be needed at terminal markets such as Djakarta in order to store eggs for limited periods of time to avoid gluts on the market. Refrigerated storage will be required to prevent complete loss of quality. These facilities should have the capability of maintaining temperatures of 1 - 5° C. Humidity control would also be required. Such storage should be operated in conjunction with plants manufacturing ice for human consumption and for the fishing industry.

The second major need involves the development of trays or flats, use of which would prevent breakage of eggs in transit to the market. Packing in rice hulls or other similar materials is suitable for short hauls, but eggs tend to settle out in longer hauls and breakage results. The paper industry of Java could well supply this need.

4. Fish

Fish is by far the most important animal protein in the diet of Indonesian people. The preservation of fish is particularly important because of the rapid rate of decomposition of the product.

Preservation by salting followed by drying is the method used in Indonesia to maintain a consumable state of the product at the time purchased by the consumer. Salting is rather heavy because the time between catching and consumption averages 2 to 3 months. Fish which are too salty deter consumption of adequate amounts and hence hamper attempts

to increase protein consumption from this source. Canning of fish is done on a minor scale in various places. Refrigerated facilities for temporary storage are not adequate. Smoking of fish is practiced in some places.

In the rural areas there is a kind of processed product called "pindang", but this product is not stable. This type of processing is used to produce desired flavor characteristics.

The salted dried fish contain from 20 to 26 percent salt. One of the problems seems to be less availability of salt, its quality, and the length of time required to accumulate enough fish to provide a cargo for the ship and/or the time required to obtain shipping space for the fish. Since salted fish is very hygroscopic (as much as 40 percent of the fish may be lost during the wet season) it should certainly be possible and in the interest of increasing the food supply to use air dryers to dry the fish to the desired moisture level. This will become even more important if the production of fish is increased. It is estimated that at least 10 to 15 percent of the fish are lost in exporter godowns, by decomposition; and there have been cases in which immense quantities had to be thrown away because of lack of salt. Much of this loss can be prevented by proper drying. However, attention must also be given to low moisture storage.

Fresh fish represent a much smaller percentage of the total, and suffers severe losses in quality due to decomposition before it can be marketed. Ice is badly needed to retain quality on the fishing vessels, at the dock, and in the markets. At present, ice is not available for this purpose because of high costs, and because the ice that is produced is used for direct consumption. The use of ice would certainly improve the quality of fresh fish, and increase the quantity which would be available for sale.

In the long run, when fish supplies reach a suitable volume at a central fish-landing point, consideration should be given to small-scale manufacture of sanitary fish protein concentrate of the non-defatted, non-deodorized type. This can be accomplished by available standardized fish reduction processes (cooking, pressing-out of stick water and final drying). This is feasible for Indonesia, since the population enjoys the flavor of fish. It is obviously unnecessary to sustain the expense and investment cost of providing defatted and deodorized FPC, using complex solvent technology. A protein concentrate of the simple type described, which is also high in available calcium and

phosphorous, would be an ideal supplement to infant diets, and will surely be popular in Indonesian cookery in the making of krupuk and similar foods.

Shrimp are finding an increasing market worldwide, usually at attractive prices. Surveys have indicated that there are important shrimp fisheries adjacent to the coast of Indonesia, and these should be developed for export. It is estimated that there would be a capacity of more than 2,000 tons annually of sustainable fishing in the shrimp areas. For this purpose freezing will be essential to maintain the quality that will be necessary to compete in the world market.

It is recommended that at least four ice plants be installed on the island of Java - two of 500 tons each at Djakarta and Surabaja, and two of 250 tons each at Tegal and Banjuwangi; that forced-air dryers be installed at the ports where the salted dried fish are processed; that freezing facilities be provided for shrimp for export, and that dependable sources of salt be made available at fish processing centers.

B. Oil Seeds

Soybeans and peanuts are harvested at the end of the dry season and sun drying is applied after threshing to reduce the moisture to 12 to 14 percent. The quality of soybeans is reduced by the presence of foreign materials such as small stones and soil. Grading is not a common practice.

Several typical foods made out of soybeans by fermenting whole soybeans after the removal of the seed coats, have a nutritive value; however, these products do not keep well. Protein content is about 25 percent.

Tahu is made from soybean curd. It is very popular, but spoilage occurs rapidly under conditions of moderate to high temperature and humidity. The protein content is about ten percent.

Soy sauce and tautjo are stored in glass containers, with the addition of preservatives such as salt, sugar, and other spices.

Peanut cake, after extraction of the oil, is used as cattle feed and as human food in the form of fermented product called "ontjom." The protein content of peanut cake is about 38 percent.

Expanded use of soybeans by conventional methods of preparation, i.e., tempe, tahu, and soy sauce, should be encouraged since this oilseed provides protein of excellent quality, making it particularly effective for supplementing cereal diets. It is proposed that at the village level, the feasibility of producing a full-fat soy flour (protein 40 percent, fat 20 percent) by the Peoria process should be explored. This would provide a stable, economical protein resource for infant and child feeding and for a variety of culinary uses. For urban needs, full-fat soy flour can be produced by means of the small industrial-scale cooking-extrusion equipment. With this machine it is also possible to produce cereal-oilseed mixtures in the form of noodles, snacks, and nutritionally-balanced high-protein weaning foods. The manufacture and distribution of such processed and packaged products should be introduced when it can be demonstrated that a self-sustaining market can be maintained.

Since peanuts are frequently processed industrially for oil, a study should be undertaken of the feasibility of upgrading the sanitary condition of oil-processing facilities to permit the production of food-grade peanut flour as a by-product.

C. Coconut

Coconut is produced in large quantities and may be preserved by drying. Copra is one of the most important export commodities. In storage, copra becomes moldy and rancid. The quality of the product should be improved.

Oil is extracted from copra by pressing, and is used as cooking oil. The coconut cake, which has a protein content of 28 percent, is used as food. Fermented copra cake is also prepared in Central Java, but this is not popular now as it may cause food poisoning due to toxins produced by *Pseudomona cocovenans*.

Research effort is justified to achieve stabilized home or village processes for fresh coconut meat for food use. The preservation techniques developed at the Food and Nutrition Institute of the Philippines, involving dipping in alkali and acetic acid, should be studied.

In the longer term, if current industrial methods being developed in the Philippines are successful in recovering edible protein concentrates and oil from fresh coconuts, the process should be examined for possible application to Indonesian conditions.

D. Fruit and Vegetables

Fruits and vegetables are produced on a continuous basis, near consuming areas, with very minor fluctuations in volume of production. Since they are consumed as fresh products, no attempt is made to follow preservation or canning practices. The primary problems in marketing are those of distribution and handling.

Early consideration should be given to stimulating village-scale preservation and proper handling of fruits and vegetables, including yellow sweet potatoes. Widespread use of such techniques would help to alleviate the vitamin A deficiency which prevails at the village level. The conservation of edible leaves such as those of cassava, in a manner which will retain vitamin values, should also be explored.

E. Rice

Rice padi, which is harvested as stalk padi, or which is harvested with sickles and threshed, is dried in the sun for a few days until the moisture content is about 14 percent.

Large stalk padi storage facilities are found near rice mills. The rice is stored either in godowns or outside on drying floors. Padi usually is stored in bags.

Rice processing is done by four important methods: hand pounding, hand operated husker, huller (Engelberg type), and commercial mills. Approximately 80 percent of the padi is home-pounded into half white rice which has an extraction of about 52 percent, while the extraction rate for full white rice is about 47 percent. The capacity of hand pounding per man per day is about 30 to 40 kg of rice. Due to the increasing numbers of hullers installed, hand operated huskers are developing very fast.

The milling output of the locally-made machine is 70 percent brown rice from padi or 56 percent from stalk padi. Milling capacity per man per day is 1 quintal of rice. Brown rice is reprocessed by hullers in the cities to produce half or fully milled rice.

The 7000 hullers operating outside of Java in remote regions, where communication is badly needed, are milling padi and polishing it into white rice. Milling capacity per day is 1½ tons of rice, and for polishing, 3 tons per machine.

This locally-made machine produces 51 percent extraction from stalk padi. Among the 700 commercial mills, 500 are operated in Java. They are between 30 - 35 years old with an average capacity of 7 tons of milled rice per day (7 working hours) and a milling output of 52 percent for stalk padi. The mill consists of a thresher, stone husker, aspirator, compartment separator, Engelberg huller or white ring cones. These machines are locally made but require import of motors and spare parts.

The increased production of rice will create a greater demand for storage space. This will be more than proportionate to the amount of increase in rice production, because it is anticipated that as rice production increases it will be processed by de-hullers in villages to a much greater extent than it is at present. This is desirable because of the greater efficiency of the commercial de-huller when compared with hand pounding. It is estimated that this will amount to at least a 10 percent increase in the amount of rice obtained.

As this shift progresses, greater amounts of rice will be accumulated in order to make the operation of the de-huller efficient. This will demand increased storage space. Head rice brought in from the field is resistant to damage because of the presence of the hull. Except in unusual cases, no insect treatment should be necessary as long as the rice is stored as padi rice. However, the rodent problem is serious at this point, and means must be taken to combat it. This can be done largely by chemical means. One of the problems in this type of storage, however, is the uneven degree of ripening of the rice as it is brought in. This again emphasizes the need for the use of artificial drying to reduce the rice to a uniform moisture content which will reduce the danger of mold. Artificial dryers, such as rotary, spouted bed, or tray dryers are recommended, and the fuels used may be charcoal, rice hulls, coal, kerosene, or wood. For the efficiency of drying, it is recommended that "gabah" be dried, and not stalk padi.

After cleaning, the rice is more susceptible to insect damage, and therefore storage should be provided which permits treatment and control of insects. As the production of rice increases and the country becomes self-sufficient, the need for storage of imported rice at ports will decrease and this space will become available for other commodities.

The better nutritional value of home-processed rice may be more than offset by losses in yield in comparison to rice processed by hullers or rice millers.

If the problem of high middleman charges can be reduced, village people would be encouraged to patronize central milling facilities, thus substantially increasing processed rice yields and enormously reducing the labor required for home processing. Repair and rehabilitation of existing commercial mills should be an important part of the program, as the production of rice increases.

Any system of milling should encourage food use of by-products. Rice polishings should be segregated from hulls, chaff and other debris, as it is an excellent vitamin and protein source; the bran provides excellent feed for poultry if utilized before rancidity appears.

In the licensing of equipment imports for hullers and rice mills, rigorous supervision should be maintained to insure that the most efficient equipment is purchased commensurate with cost. It is also recommended that there should be some supervision of rice mills and hullers in order to maintain yield and efficiency at the highest economic level.

For the long range, in relation to the needs of the urban population, the Riviana Company of Houston, Texas, U.S., should be questioned as to the possible increase in efficiency obtainable if their novel, large-scale, X-M solvent rice milling process were to be introduced into Indonesia. This new technology is claimed to provide a 10 percent increase in yield of polished rice over conventional systems. It permits recovery of the bran fraction as an edible concentrate and of the rice oil, as well, in edible form.

F. Corn

Because harvest time comes during the wet season, proper drying is necessary to reduce the moisture content to 14 percent; artificial drying is needed. Sometimes, to reduce losses, corn is stored in the ear near the stove, to get additional drying.

Usually corn is milled into grits, after soaking in water overnight, using hand-operated stone crushers or attrition mill-type machines.

One of the problems involved in the storage or export of corn is the high moisture content which prevails at certain times of the year. The production of "beras djagung" is a proper step as this product has longer storage life than unprocessed corn. This again points to the use of artificial dryers at the local level where corn may be accumulated from

the farms. In addition, corn is very subject to weevil and other insect damage and also severe loss due to rodents.

Villagers should be encouraged to use more corn as food. The feasibility of introducing the Irwin process into villages as well as simple corn milling and de-germinating equipment, to provide a clean, low-fiber corn meal, should be investigated. The possibility might be explored for producing and marketing to urban populations a precooked corn meal which can be provided at low cost with modern cooking-extrusion technology. This economical, quick-cooking product is a true convenience food and can be used in the home in the preparation of many foods. The possibility should also be studied of applying pasta technology to production of corn noodles and similar highly acceptable foods.

Other products important for child nutrition which can be produced by cooking-extrusion technology are high-protein weaning foods based on mixtures of corn and soybean, or rice and soybean, suitably supplemented with minerals and vitamins, including vitamin A. These can be made to yield thin-cooking gruels which have high caloric density required for feeding of young infants and weanlings, and which possess virtually the same nutritional quality as milk.

G. Cassava

Cassava, a third main staple food in Indonesia, is harvested throughout the year, but the main harvest is done in the dry season, to facilitate drying. Cassava is consumed either fresh or as dried sliced chips, which are prepared by cutting the cassava into small pieces and drying it in the sun for two or three days, until it reaches a moisture content of about 10 percent. If drying is not sufficient, spoilage may occur due to mold or insect infestations; discoloration occurs also.

The primary storage and preservation problems of cassava are concerned with proper drying and protection from insects when sorted as flour. The production of dried cassava is important.

It is recommended that appropriately-sized forced air dryers be installed in the village level and that these be used to reduce the moisture content of the corn, rice, and cassava to a safe storage level, which should be 14 percent.

The storage provided should be of the tight bin type for corn.

H. Sweet Potato

Yellow sweet potatoes should be an important source of vitamin A in the Indonesian diet which is chronically deficient in this vital nutrient. Simple methods of preservation in addition to improved drying methods need to be developed which will preserve the vitamins.

II. Processing and Utilization

It is clear that improvement in current processing at the home, village, and industry levels should provide increased quantities of a variety of safe and palatable foods from current production of food crops. It appears, for example, that the efficiency of production of edible rice from padi in Indonesia is about 10 percent lower than elsewhere.

The major effort to improve processing, conservation and utilization of food must be made at the farm and village level where most of the country's food is produced and consumed. Special effort will be needed to design and test simple mechanized processes to provide foods of improved palatability and stability; nevertheless, through appropriate technical inputs attention must also be given to the requirements of urban populations.

III. Distribution

An evaluation of the present condition of the distribution system in Indonesia must take into consideration the fact that in the 1960's it has operated essentially within an institutional framework, divorced from market forces.

The then-already poor transportation systems (both sea and land), due to physical and organizational deficiencies, deteriorated further because of lack of maintenance of vehicles and vessels, and because of variations in the trade patterns.

Preservation of a sound credit system was hampered by the galloping inflation. In relation to price formation, agricultural products had an unfavorable term of trade due to their seasonal character and also because of restrictions on import of necessary input factors.

Government regulations on prices were consumer-oriented. The movement of goods, especially rice, was governed by severe restrictions; e.g., the licensing of rice storage.

The new Government's awareness of the increasing weaknesses of the Indonesian economy led to reform in terms of a program of stabilization aimed at two difficult but related tasks: control of inflation, and re-introduction of the market forces. But a quick recovery is impossible.

Transportation is still inadequate. The balanced budget policy already shows a certain degree of success in reducing the rate of inflation and restoring the function of credit institutions to support marketing. A floor price for rice has been announced, the effects of which are still being observed. A decree was issued to abandon restrictions on movement of rice, and mills were freed for use by everyone.

In general, these steps have not all shown the expected results as yet, because there is still some reluctance to carry out modernizing measures at the regional level.

It would be hard to overemphasize the serious difficulties caused by the inefficiencies of the present system of distribution of agricultural products in Indonesia. In a sense, the country has not yet fully created its own common market. Specific marketing difficulties include the prospective inadequacy of transportation and storage facilities, governmental regulations for marketing, pricing policies, and a shortage of farm credit. The problems are numerous and complex, and involve the entire economy of the nation; furthermore, any important changes in the pattern of distribution will impinge on existing commercial practices and social mores as well. These matters, accordingly, deserve deep study and careful consideration before definite recommendations are made. It is important that the entire field of distribution be reviewed in the light of its potential interference with the carrying out of many of the recommendations of the Workshop. This review should be undertaken as soon as possible.

In fact, based on present information, it is evident that the shortcomings of the present system of distribution will offset many of the benefits of the application of modern technology. Furthermore, inadequacies of the system will greatly reduce the effectiveness of some of the proposals for the improvement of agricultural production. It is important that some steps be taken immediately to help induce the most clearly required changes in the existing pattern of distribution. This task should be undertaken simultaneously with efforts to carry out recommendations in other fields.

The report of the technical assistance mission sent to Indonesia by the Asian Development Bank recently contains

important information on marketing problems, as well as useful recommendations in that field. Equally important information is available in the background paper prepared by Dr. Mubyarto for the Workshop, on "Rice Price, Marketing and Food Policy." Based on these presently-available studies and on discussions that took place during the Workshop, it is possible to make certain broad recommendations at this time, but these must be followed by more detailed proposals that must await the deeper studies that are recommended.

It is important at this time to stress the fact that a continuation of the present pattern of distribution of food will postpone for many years the full realization of many of the benefits that would otherwise arise from technological improvements. Clearly, the effectiveness of the proposals of the Workshop will be greatly reduced unless the distribution system is modernized.

A. Internal Trade Regulations

Further "liberalization" of the internal trade regulations imposed on the private trading sector is needed. This liberalization should not be limited to the removal of some of the regulations. It should also include a simplification of the procedures under which the present system operates.

A specific example illustrating the need for a program of liberalization is the 100 percent markup in price that is sometimes required to induce the movement of rice from one area to another through private channels, even though the distances may be relatively short. Transportation costs may represent less than 10 percent of this markup. The balance consists of commissions, licensing fees, illegal "taxes", and large margins of profit added to the costs of persons handling these goods or providing services.

It is probable that a review of governmental procedures might indicate certain unnecessary regulations and suggest the nature of general simplification of the control of private transactions that would lessen the total amount of the uneconomic or improper charges now incurred in rice transactions, and in moving many other agricultural products from one area to another. It is not possible to be more specific on this subject without the benefit of more detailed information, but there seems to be a prima facie case for less restrictive policies and for devising a better set of procedures for whatever governmental supervision of trade is necessary.

B. Pilot Trading Units

The establishment of pilot trading units is recommended, to demonstrate the comparative efficiency of improved methods of marketing, including in particular the integration of credit, marketing, and extension services. These units could initially be affiliated with B.U.L., the governmental procurement agency for rice. Further details of this proposal are included in the section of this report on marketing.

C. Transportation

The substantial increase in the volume of food production that may be realized from an extensive application of more modern technology will place a heavy burden on Indonesia's transportation system. A rough indication of the extent of this impact is provided by the estimate that during the next five years an additional 750,000 tons of fertilizer will enter the seaports of Java and require transportation to various destinations throughout the island. During the same period, 7 million additional tons of grain must move from one point to another in Java. Both these tonnages are over and above the present volume of traffic.

Because of certain critical shortages or bottlenecks which arise with increasing frequency, there is some evidence of a decline in transportation capacity. Among the identifiable difficulties are the lack of spare parts for trucks and railroad equipment, and a growing shortage of railroad rolling stock. The preemption of railroad services for passenger traffic, at the expense of freight, is another problem. The heavy increase in the demand for transportation projected above will greatly augment these difficulties.

The Working Group calls for special attention to the transportation situation, and recommends that steps should be taken to coordinate the transportation programs of the Government with the basic recommendations of the Workshop.

D. Marketing

1. Agricultural Credit

A shortage of farm credit and a lack of adequate facilities for handling credit are important deficiencies of the present agricultural marketing situation. It is estimated that more than half of the agricultural credit now extended to Indonesian farmers comes from private money lenders. The terms of this credit are frequently such that they reduce

the incentives for the use of new technology. Several hundred thousand Indonesian fishermen face comparable difficulties.

The survey made by the Asian Development Bank contains useful information on this subject, as well as recommendations for steps to be taken. Additional facilities for handling farm credit and new methods of administering it are greatly needed. This will require a long-term program; but a start should be made as soon as possible.

One way of tackling the problem of getting started would be to establish demonstration or pilot units that would show how the handling of credit tied to marketing can effectively help in the introduction of new technology. For example, pilot organizations, which could initially be branches of B.U.L., could be established to handle rice processing in selected areas. These units could extend credit for approved inputs (high-yielding seeds, fertilizers, pesticides, etc.) to the farmers who supply the rice for processing. The units could subsequently market the rice through contractual arrangements with B.U.L. Such mechanisms would demonstrate the effectiveness of the integration of credit and marketing coupled with the elimination of the repayment problem. The same organizations should be the introducers of new processing equipment for rice, i.e., new drying and storage equipment and new hullers and polishers, when they become available for use. Pilot units of this type could provide training in the functions which the managers of multipurpose cooperatives must perform, i.e., the granting of farm credit, marketing of goods, and procurement and distribution of inputs, together with extension service advice.

The ultimate objective of such a program would be by demonstration and training to provide for the creation of multipurpose cooperatives along the lines that have proved to be successful in other areas. Initially, the units might be branches of B.U.L., but they should eventually evolve into cooperative organizations, when the time comes for such transformations.

2. Pricing Policies and Other Government Regulations

The Government's price control policy can accelerate or retard the introduction of new technology. The present policy adopted in Indonesia is favorable in respect to the relationships established between the cost of fertilizer and the price set for stalk padi. The Government should continue this practice, but must guard against altering it by inflation. Furthermore, the results of extensive use of new

seeds and other technological improvements will change the nature of price relationships of this kind. These new factors must be taken into consideration by the Food Board in formulating new policies and in altering present practices.

In one way or another, most governmental regulations now in effect will be influenced by the introduction of new technology. They should therefore be periodically reviewed in the light of the potential impact of whatever technological improvement projects are adopted.

SUGGESTED RESEARCH PROJECTS OF HIGH PRIORITY

It is believed that Indonesia has or will produce in the next five years enough food technologists to sustain a major program of research and development, but there is a serious shortage of supporting technical and engineering assistance. This should be corrected by instituting appropriate technical courses, e.g., for instrument technicians and laboratory assistants in chemistry, biology, and engineering.

Moreover, the total research effort in this field would be expedited by the consolidation of food technology research in a Food Technology Research Center.

It is important that all studies on food preservation and processing be related to the general technological level which is attainable in Indonesia at the present time, and particularly at the village level, where economies in fuel and power prices are essential.

There is little doubt that Indonesia must rely on drying as the primary method of food preservation during the next five years. Therefore, a major project should be the design of a small hot-air dryer suitable for village communities (natural draft; forced draft; kerosene fueled).

I. Calorie Staples

A. Rice

Studies of the comparative efficiency of different methods of milling, with the object of recovering the maximum yield of edible grain from straw padi.

Survey of losses of rice by spoilage and wastage at all stages of handling and marketing. Repeatedly throughout the Workshop, it was found that reliable data on this aspect

were lacking. The need for such a survey applies not only to rice but to all Indonesian foodstuffs.

B. Corn

Processing studies to develop foods equivalent to rice; the suggestion was made that such foods might be more acceptable if they look, cook, and taste like rice.

C. All Cereal Grains

Investigations of fumigant-grain protectant procedures to reduce insect and rodent spoilage of cereal grains in storage.

D. Cassava

Drying studies, which should investigate both the use of hot-air dryers and present sun-drying methods with a view to upgrading the out-turn of the dried products.

Processing studies to develop foods equivalent to rice from cassava with the addition of a proper supplement.

E. Sweet Potatoes

Drying studies, with the particular object of improving the retention of vitamin A in yellow varieties.

II. Protein Sources

A. Fish

Drying studies, with the particular object of decreasing the salt content while retaining good-keeping quality.

Development of fish foods for export, e.g., frozen or dried shrimp.

B. Meat

Investigation of procedures to permit export of Indonesian beef; remedies should be examined for correction of animal diseases. Importing countries require a heat treatment sufficient to destroy viruses, and since canning is impracticable, other procedures should be studied, e.g., frozen, boneless, cooked meat.

C. Eggs

Investigation of reduction of breakage during distribution with a view to developing a cheap tray or divider based on local raw materials, e.g., padi straw.

D. Soybeans

Development of improved procedures for microbal modification of soybeans. The special aims should be maximum retention of initial protein content and maximum stability against spoilage or rancidity, but the foods must also be highly acceptable or their nutritional purpose will be lost.

Development of simple mechanical methods for de-hulling soybeans, as a contribution to improved methods of making tempe.

Studies to prepare tahu of good-keeping quality, e.g., by drying.

Development of protein-rich soy food suitable for nursing mothers and infants.

E. Peanuts

New foods from whole peanuts.

New foods from peanut press-cake.

New foods by microbal modification with particular attention to the problem of mycotoxins.

F. Coconut

New foods derived from fresh coconut meat, including methods of microbal modification.

Improved methods of manufacture for copra with a view to utilization of the press-cake for human food.

III. Other Foods

A. Red Palm Oil

Investigation of red palm oil as a source of vitamin A, involving improved methods of manufacture to give a product of better acceptability and stability.

B. Fruit

Development of fruit products for export, based on distinctive Indonesian fruits - fresh fruit such as bananas, canned fruit products, and dried fruit products, involving application of sulfur dioxide, e.g., by burning of sulfur.

IV. Marketing

A study of trade patterns so as to rationalize the utilization of transport facilities in a more efficient way.

A study of physical and organizational deficiencies of transportation facilities such as harbors and railways, to indicate what extent volume could be increased by suggested improvements.

Market research for selected food products, particularly with respect to consumers' purchasing power.

CONCLUSIONS AND RECOMMENDATIONS

The use of effective storage and efficient methods of preparation is the quickest method of increasing the food supply. Reliable data on actual storage losses are lacking, but it is conservatively estimated that losses of food commodities from the time of harvesting to the time they reach the consumer may in many cases exceed 25 percent. Anything that can be done to reduce these losses will mean an immediate increase in the food supply, and this does not consider the loss of nutrients which may well be as serious or more serious than the physical loss of the food commodity.

Storage of food products serves the dual purpose of permitting the accumulation of sufficient quantities of the product so that it may be moved to market in an economical, orderly and efficient manner; and of protecting the product from deterioration during the time that it is held in storage prior to marketing. The immediate questions to be answered are: where is the storage capacity needed? how much storage space is needed? what type of storage is needed? how can storage facilities be provided at minimum cost?

The proposals that are being made to increase the production of food will necessitate a shift in the location of storage facilities. As the country becomes more self-sufficient in food production, the need for storage for imported goods will decrease, and the area of needs will

shift to productions areas. This would indicate a need for smaller capacity facilities in more numerous locations. It is imperative that plans be made for storage of crops as plans are made for the increase in production. All too commonly, production is increased and there is no way of handling the product efficiently, and hence serious losses result.

Tropical climates, with their periods of high rainfall, pose special problems with respect to proper storage of food products. Therefore, the provision of dry storage becomes imperative, to prevent the development of molds which render much of the product unfit for human consumption and sometimes even toxic. Well-drained areas must be selected for the storage sites, to prevent flooding and unusual moisture damage.

Insect damage is probably the largest single cause of loss of food products during storage. The most effective way of controlling this loss is the use of small storage units with a rapid turnover in products. Chemical methods of protection are now in use. When gases such as the bromides or organophosphates such as parathion and malathion are used, extreme caution must be exercised to insure that these chemicals are cleaned out of the product before it goes to the consumer.

Rodents, such as rats, destroy enormous amounts of food, and must be controlled by the use of proper construction such as concrete floors and buildings above ground level. They may also be controlled by the use of chemical poisons, but these must be kept away from children and animals.

Other types of preservation that might be suggested are drying, smoking, fermentation, refrigeration, canning, and ionizing irradiation at sometime in the future. Fruits may be preserved by the addition of sugar and in some cases pectin to form jellies and jams.

The increased production will require a tremendous increase in the amount of fertilizer that will have to be used. It is anticipated that for at least the next two years fertilizer will have to be imported. A study 1/ must be made of the potential savings in purchasing out-of-season fertilizer

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1/ During the preparation of this report, attention was called to the comprehensive study carried out by the International Bank for Reconstruction and Development/International Finance Corporation team. The results of this study should be carefully reviewed.

in order to determine whether a warehouse is needed at the port, or whether the fertilizer may be moved into distribution channels essentially as purchased. This also involves the study of the location of these storage facilities, whether they be closer to the use centers. These requirements will, of course, be in addition to those which are current.

It is recommended that:

1. A plan be developed for location of storage facilities, including the type of storage facilities which will be coordinated with the increased production of foodstuffs.

2. A study be made of the complete system of storage for the increased volume of fertilizers.

3. Appropriately-sized artificial dryers, such as rotary, spouted-bed or tray dryers be used. The fuels for these may be charcoal, rice hulls, coal, kerosene or wood. For efficiency of drying, it is recommended that gabah be dried and not stalk padi.

4. There be additional capacity for the manufacture of ice; suggested locations are Djakarta, Surabaja, Tegal, and Banjuangi.

5. Dependable sources of salt be made available at fish processing centers, and that forced air dryers be installed at the ports where the salted fish are processed.

6. Milling facilities be encouraged for the processing of rice at the village level. This will substantially increase the processed rice yield and reduce the labor for home processing.

7. Repair and rehabilitation of commercial mills be an important part of the program, as production of rice increases.

8. Steps to induce the most clearly required changes in the existing pattern of distribution, including transportation development, be undertaken in conjunction with the efforts to carry out recommendations in other fields.

9. There be further liberalization of internal trade, through removal of some of the regulations, as well as simplification of procedures under which the present system operates.

WORKING GROUP VI

PRODUCTION INCENTIVES

&

THE USE OF TECHNICAL INPUTS

Pages: 115 to 130

WORKING GROUP VI: PRODUCTION INCENTIVES AND THE USE OF TECHNICAL INPUTS

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INTRODUCTION

In modern industrial societies the notion that changes in economic incentives are important determinants of producer and consumer behavior is firmly grounded in economic logic and is confirmed by observation and analysis. In such societies, economic incentives play a leading role in guiding agricultural production decisions and in directing the flow of commodities through marketing channels.

It has frequently been held that peasant producers in traditional societies respond perversely to economic incentives, and that nationalistic and ideological appeals can effectively replace economic incentives in public administration and in the management of economic activities in such low income countries. There is increasing evidence, from studies in many countries, that peasant producers do respond to economic incentives. It also seems clear that efficient administration and management of public and private sector activities related to agricultural development is similarly facilitated by economic incentives.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Working Group VI emphasizes the importance of evolving a system of agricultural planning that places major reliance on the public sector for providing an effective system of incentives; and on the private sector for individual production decisions and logistical support.

In its deliberations, the Working Group has given major attention to the policies and programs which influence farmers' decisions to produce. The factors which influence farmers' incentive to produce can be grouped under three headings: (1) the general political, social, economic and cultural setting within which farmers must operate; (2) the technical alternatives available to farmers and to the institutions which serve agriculture; and (3) the policies and programs aimed specifically at influencing farmers' production and marketing decisions.

The first group of factors are particularly important in traditional agriculture. Since these factors respond slowly to the policy instruments available to Government, Working Group VI placed major attention on policies relating to the factors falling in the second and third groups.

In summary form, the recommendations are: (1) Major support should be given to research programs directed specifically to raising the yield potential of the basic food crops in each major agro-climatic zone of Indonesia; (2) the effectiveness of the urea/rice ratio of 1:1 adopted in the BIMAS program should be safeguarded by protection against inflation and imperfections in the marketing system; and similar considerations should be given to incentives to stimulate the production of other important food and export crops; (3) extension efforts should be directed toward the acceleration of the adoption of the technology necessary to increase food production; but the extension activities cannot be used as a substitute for the availability at the local level of adequate supplies of production inputs, adequate markets for farm products, and favorable price relationships; (4) studies should be made on ways of improving the technical efficiency and pricing efficiency of both input and product markets; (5) the use of scientific and technical manpower should be organized toward the application of its full potential to increase food production, with emphasis placed on in-service and formal academic training for professional workers; and (6) a national statistical system should be developed for agriculture; sources of output growth evaluated; land and resource development opportunities studied; and cultural diversity and the response to incentives reviewed by competent scholars.

BACKGROUND INFORMATION

In the past, a number of programs have been developed to increase food production in Indonesia. Some of them, like the Padi Centre, were almost complete failures. A more recent program designed to take advantage of the "package input approach," by the use of a set of complementary technical inputs, has achieved some promising results. These results were achieved primarily where farmers adopted the complete "package" of input and technology.

Several factors have contributed to program failures in the past. Some of them are inherent in the conditions which govern food production in Indonesia. The small size of farming units has been one very important factor. Intensification requires the use of technical input factors which have to be purchased. The scant resources possessed by the farmer give rise to limitations not easy to overcome. The limitations

take the form of inability to purchase the technical inputs, and lack of willingness to assume risk.

Other factors arise from the inefficiencies of both the product and the input markets. Because of these inefficiencies, the farmers are forced to purchase inputs at relatively high prices and to sell their products at relatively low prices. This condition does not provide the incentives necessary to induce farmers to purchase more technical inputs in the hope of producing an increase in their production and marketable surplus.

Reasons for past failures were to some extent inherent in the design of the programs themselves. While recognizing the fact that the farmers operate with very limited resources and therefore are acquiring very limited income, production incentives are essential to any program which would induce the farmers to participate in the program. In the past, some of the programs have even included mechanisms that would absorb production increments at prices lower than the going market price.

Development of fertilizer-responsive varieties of rice adapted to Indonesian conditions strengthens the belief that increases in the production of food can be achieved through intensification. These developments have, at the same time, provided improvement in the output-input ratios of such magnitude that economic production incentives can easily be designed and included in an intensification program.

The limited successes that BIMAS has already achieved indicates that by using the right approach, and with favorable economic and technical conditions, significant increases of yield can be achieved. (The low prices of early 1967 had a negative effect on the program.) Experience with the BIMAS program also indicates the importance of removing technical and institutional barriers which restrict production and marketing decisions.

Considering these conditions as background, Working Group VI reached a number of conclusions and recommendations with regard to production incentives and the use of technical inputs.

TECHNICAL CHANGE AND THE INCENTIVE TO PRODUCE

The technical aspects of production-incentive programs consist of measures that remove technical constraints which

limit farmers' decision-making, and measures that develop technical potential. Removal of the technical constraints is necessary in order that economic measures can be taken to induce farmers to increase their production through the adoption of new technology. These constraints include limited physical potentials, inadequate irrigation, unavailability of new technology, and the lack of access to technical factor inputs. Improvement of the technical capacity of crops and animals to respond to the variables that can be controlled by man--particularly the new biological and chemical inputs made available by modern science--represents the single most significant economic incentive that can be made available to farmers.

The specific issues with respect to technical change and the incentive to produce considered by Working Group VI were:

I. Soil and Climate

Physical potential is determined by soil and climatic conditions. Soil conditions can be improved to some extent through the development and use of fertilizers. Since climatic conditions are often given factors, it is necessary to classify geographic regions according to their physical potentials for further planning for production increase.

II. Irrigation and Water Control

The optimum response of crop production to the application of new technology can typically be achieved (as in the case of rice) only with effective irrigation and water control. Measures to increase the acreage of irrigated land--(1) by the construction of new irrigation systems; (2) by renovation of damaged systems; and (3) by proper maintenance of the existing systems--are essential if the production potential inherent in the new technology is to be achieved.

Regions with high physical potentials and presence of irrigation should be given priority in planning for production increases. These include the application of economic incentive programs as well as the introduction of new technology and availability of inputs.

III. Crop Technology

New technology, which in the case of rice consists of improved seed varieties, use of fertilizers, plant protection and better cultivating technique, improves physical input/output relationships. Technology is available to a farmer when

he has been exposed to it and when there is knowledge of what it will achieve on his farm. Crop production technology is highly location-specific. Adaptive research and the use of local testing and demonstration fields is a prerequisite to effective introduction of productive incentive programs such as the BIMAS and especially the BIMAS BARU programs.

IV. Factor Inputs

Measures should be taken to assure the farmers of the necessary factor inputs. These include securing the flow of fertilizers and pesticides/insecticides through public and private marketing systems, transportation development, storage facilities, supply and maintenance of tools including sprayers, etc. Packages of factor inputs and other facilities can be provided as in the BIMAS program by public and private sectors.

V. Scientific Manpower

A continuous flow of new output increasing production technology will become available to Indonesian farmers only if Indonesia is able to draw upon the full potential of its limited manpower in the agricultural sciences. It seems apparent that the present organization of scientific manpower in agriculture does not provide the economic incentives necessary to permit agricultural scientists to devote their full energy to the task of developing the technical basis for a modern agriculture. This waste of scientific manpower is a major limiting factor in Indonesian agricultural development. Appropriate action should be taken to correct this situation.

ECONOMIC INCENTIVES

The rate of adoption of output increasing technology by farmers is directly dependent on the relationship between product prices and the price of inputs. Cultural and institutional factors may dampen the response of farmers to production incentives. However, it is clear that farmers will not adopt new technology embodied in the form of biological and chemical inputs that must be purchased from the market unless it is profitable to do so. The policy of stabilizing the urea/rice price ratio at 1:1 adopted in the BIMAS program represents a relatively favorable production incentive. Its effectiveness could be eroded by either inflation or by imperfections in the marketing system. Similar consideration needs to be given to the incentives needed to stimulate the production of other important food and export crops.

Evolution of the effectiveness of price incentives must involve three major considerations: (1) area and yield response of individual crops; (2) impact on total farm output; and (3) impact on marketable surplus.

Experience in Indonesia and in other countries of South and Southeast Asia indicates that farmers are highly responsive to changes in relative prices in shifting hectarage from one crop to another. This means that decisions to increase production incentives for one crop should involve careful evaluation of the effect on the production of alternative crops.

Experience with respect to the effect of price incentives on yield is less conclusive. In the past, the impact of price incentives on yield has been limited by the lack of yield response of traditional crop varieties and lack of technical inputs and effective irrigation.

Thus the impact of changes in the overall terms of trade between the agricultural and non-agricultural sectors, on total output, is typically less dramatic than changes in price incentives for individual crops.

The impact of price incentives on the marketable surplus typically exceeds the impact on output. Higher product prices for a commodity such as rice tend to make it more expensive to the producer to consume his own rice. The effort is to induce the substitution in consumption of less expensive carbohydrates and to increase the marketable surplus of rice.

The specific issues with respect to economic incentives considered by Working Group VI, particularly those economic incentives operating through input and product prices, follow:

I. Rural Areas

There is growing evidence in Indonesia that a fairly high proportion of farmers do respond to economic incentives. Thus measures to increase food production through the utilization of new technical inputs should be accompanied by economic policies designed to take advantage of this positive response to both output and marketed surpluses by increases in prices of products related to prices of inputs. The Group agrees that the rate of absorption of new technology depends significantly on the price and risk structure facing the farmer-decision makers. As such, the Group recommends that major emphasis and support must be given to shifting the incentive structures in the rural areas to favor the producers.

II. Food Price Policies

Food price policies will have an impact on the economic activities of the non-agricultural sectors and on the non-food sector of agriculture (such as export crop production) through their impact on relative levels of agricultural products and the ratio of expected gains and cost of the use of new inputs. The Group recommends that in designing food price policies, these impacts should be considered seriously.

III. Market Institutions

Creating incentives through food price policies depends on effective market institutions. To be effective, use of price incentives should be accompanied by adequate infrastructures including warehousing, credit and communication facilities. The latter are needed to inform farmers of the policies adopted and to give them some degree of certainty with respect to price expectations at the time production decisions are made. It is the Group's impression that communication systems, as well as the infrastructure between urban centers and farmer-decision makers in Indonesia, are still in poor condition, although major improvements have been achieved in the last two years. This is one more reason to recommend massive improvement programs in this area. In addition, the Group feels that lack of standardization and grading among food crops is a major obstacle in implementing food price policies; it therefore recommends the establishment of a system of standardization and grading. Support of prices at the farm level through procurement by the Government at the rice-mill level depends on effective competition at different levels in the marketing system and among geographic areas.

IV. Price Policy: Subsidized Inputs

The desirability of a positive price policy to reduce the risk of the farmers in applying new technology in the production process is not disputed in the Group. However, there was considerable discussion with regard to the methods of implementing such a policy. It was argued that if the only objective of the policy is to increase the rate of adoption of new technology, it would be better to subsidize the inputs by lowering their prices than to guarantee minimum product prices. The argument was made that input subsidization prevents raising food prices, which is considered harmful for the growth of other sectors. This might be true if the introduction of new output-increasing technology succeeded rapidly enough. The policy of input subsidization was followed in Indonesia in the early sixties but failed to result in the

expected increased output. However, the Group was aware that other external factors, such as inflation and the consumers price protection-related policies of the Government, were also responsible for the failure. The major negative impact from a policy of subsidizing input is exerted through the losses that must be absorbed by the budget. Input subsidies compete with the use of public revenue for other development purposes. The Group is also aware that with inflation the terms of trade may turn against subsidized input policy. It may be desirable to develop a floor price formula which takes into account changes in the fertilizer/rice price ratio more frequently than twice each year (for the wet and dry season crops).

V. Price Policy: Floor Prices

The use of price policies to create incentives for the farmer to use new technology has real merit despite the disadvantages mentioned earlier. It is the Group's impression that farmers are particularly concerned about downward product price fluctuations. Indonesia has adopted a favorable floor price policy for rice. This ratio represents a substantial inducement to the farmer to use new technology. In other words, the floor price is currently high enough to result in a benefit/cost ratio which will induce the farmer to use the new inputs. Although there was not complete consensus in the Group that the present ratio is ideal, it is true that compared with ratios in many countries the one-to-one ratio used in Indonesia is relatively favorable. A major disadvantage of the floor price formula is the fact that not all cost factors are included in the formula. However, the Group feels that this floor price policy for rice is a good start--it has the advantage of directly linking the price of rice to world fertilizer prices, and it can be modified as a result of further experience.

VI. Common Markets

There is concern about the geographical dispersion of rice prices in Indonesia which reflects to a certain extent the imperfections of the market. Limiting this disparity will certainly create greater incentives for farmers to produce more in areas of low prices. The Group recommends that policies be adopted to create a "common market" for agricultural commodities, especially rice, for Indonesia. The market for input factors also needs to be modified in such a way that local prices reflect actual differences in distribution costs. The uniform price policy presently employed may result in

inefficient use of fertilizers and transportation resources, thus reducing the benefit/cost ratio and the total output from the use of available fertilizer.

VII. Food Price Ceilings

Although the Group agrees that raising, to some extent, the relative price of food is an inducement to increasing output, it does not overlook the importance of setting limits to increases in consumers' prices. The Group recognizes that if too low a ceiling for food prices is set, it may stimulate consumption increases and the demand for imports. The Group realizes the importance of achieving a balance between increases in the cost of living and production incentives operating through the price system. The Group agrees that the chosen food price policy should, to a certain extent, meet both needs. In other words, a policy of maintaining ceiling prices, to protect consumers, should be accompanied by a policy of maintaining a favorable floor price to stimulate production. The difference between the floor and ceiling prices should be consistent with the public resources available, if the price floor and ceilings are to be effective. Neither floor or ceiling prices are effective policy instruments unless farmers and consumers have confidence in the ability of the government to maintain the announced levels for a reasonable period of time.

INSTITUTIONS FOR THE DIFFUSION OF TECHNOLOGY

Extension services, credit agencies, and other institutions for the diffusion of technology are valuable primarily because of their ability to accelerate use of new technical inputs and improved production practices. Extension activities cannot be used as a substitute for the availability of adequate supplies of production inputs, adequate markets for farm products, and favorable price relationships at the local level. Where these essential factors are present, effective extension programs can assist farmers to recognize the opportunities available to them as a result of new technical knowledge, and to accelerate their utilization of such knowledge to increase production.

Working Group VI has given explicit attention to several institutional considerations that affect farmers' incentives to produce. These may be classified in four groups: (1) Organization and operation of the extension service; (2) Quality standards and other related measures; (3) Village institutions;

and (4) Coordinated, or "package" approaches to the conduct of extension activities.

In the past, the fragmentation of extension responsibilities among agencies has represented a major constraint on the effectiveness of extension programs. Lack of technical competence of extension personnel has also represented a serious limitation on the diffusion of new knowledge to farmers. The result has been frustration, and loss of credibility for extension activities by farmers.

The development of agricultural mass communications and village demonstration programs may provide and contribute to speeding up the rate of diffusion of new technologies and at the same time may reduce the farmers' risk significantly.

The possibility of crop yield insurance to minimize the uncertainties involved in the adoption of new technology should be studied, while the use of input subsidies could be used to encourage farmers' adoption of new technologies.

The communication of technical information is most effective when farmers have previously acquired a capacity to evaluate information. Investment in both general and specialized education in rural areas is necessary if the potential gains from new technology are to be realized. Fundamental general knowledge about agricultural and rural development should be given (as before World War II) to last-year students of the village elementary schools. In addition, vocational schools and adult education programs should be expanded and intensified. The expectation is that the farmers (and their sons) would be more receptive to innovations, and may respond more readily to economic incentives.

Extension agent staffing in the sub-districts (ketjamatan level) should be expanded. Agents should have a minimal educational background of the SPMA (Intermediate Agricultural High School). Further, periodic refresher and upgrading courses for the agents are necessary, if new technologies are to reach farmers effectively. If farmers are to have access to technically competent extension education, it will be necessary to provide adequate economic incentives to extension personnel. It will also be necessary to provide extension workers with more adequate resources and equipment.

Technical services available at the village level should be expanded. The role of seed and other inputs distributed should be such as to guarantee quality standards and availability at village levels. This means that commercially organized

businesses would be advisable in order to maintain the operational efficiency. When and where the supply of fertilizer and other modern inputs cannot be made available through private sector markets, the PN Pertani should function to stabilize prices and provide a source of effective competitors. If viable agricultural cooperatives are expected to develop, they should be instituted by the farmers themselves, based on the recognized needs and the possibility of profitable operation. The resumption of the well-known "Lumbung desa" (village granary) and "Bank Desa" (village bank) may also be advisable. They might be used, with little effort and help, to introduce new technologies at cost. A more commercial operation should be their goal in the future.

The BIMAS (package) approach should be tested for its effectiveness for other crops. Modifications that take into consideration the physical and socio-economic conditions and potentials of particular regions should be tested. Limited BIMAS programs (i.e., for one crop only) should be open to action-research by private foreign business, dealing with the package's new inputs. In such case there must be a requirement of an impartial extension service to the farmers, supervised by the local extension agents.

As new technical inputs become available, and technical constraints on output growth are removed, credit becomes an important facilitating factor in agricultural development. The demand for credit (1) to finance inventories of technical inputs and carryover of commodity stocks and (2) to cover the time lag between the purchase of inputs and the sale of products, places a heavy burden on the credit system once the rate of growth in output begins to accelerate. Because of the small size of the operating unit in much of Indonesian agriculture, it seems likely that a system which makes credit available through suppliers will be more viable than efforts to provide direct credit services to peasant farmers.

INPUT AND PRODUCT MARKET INSTITUTIONS

The effectiveness of production incentives depends on the local availability of the biological and chemical inputs embodying new technology, and on a marketing system which efficiently relates the prices at farm and market levels. It is the impression of the Working Group that both input markets and product markets fail to meet the test of technical efficiency or pricing efficiency at the present time, although a number of steps have already been taken to improve market performance. The next step that needs to be taken is the

removal of constraints on the movement of products and inputs among areas and the emergence of a system of "efficiency prices", that reflect the real transportation cost differentials. As long as artificial constraints on the movement of commodities are in force, it is not possible to separate the institutional element accounting for the lack of efficiency from the technical one, nor can rational policies be adopted to improve market performance.

NECESSARY LONG RANGE RESEARCH STUDIES

I. Development of a National Statistical System for Agriculture

The development of an effective national statistical system, including both census and sample survey components, is as essential for the economic analyses of agricultural production and marketing policy as is good experimental design for the conduct of research in the biological and agricultural sciences. If the data generated by census and sample surveys is to have maximum use for development planning and policy, it must be made available promptly at the national, regional, and local levels.

Group VI recommends that a careful review of the agricultural census and sample survey program of the Government be made by a study team drawing upon both Indonesian and external competence.

II. Marketing and Pricing Efficiency in Inputs and Product Markets

There appear to be important unresolved questions regarding both the technical efficiency of the markets for inputs and products, and the efficiency with which the market relates prices of factors and products over time, over space, and among different levels on the marketing system. The extent to which technical and pricing efficiency is influenced by trade barriers among regions, by the efficiency of the transportation system, and by the organization and structure of the marketing systems, is apparently not well known. Answers to these questions are relevant to decisions regarding the appropriate role of the public and private sectors in the input and product markets.

III. Sources of Output Growth

The rate of growth of output and of yield per hectare varies widely among commodities and regions. Although change in the area planted continues to account for a substantial share of increase in output, yields have risen sharply for some commodities and in some regions. For most commodities and regions, yields remain well below technical potentials. In some cases, the same factors that hold yields of existing varieties below yield potentials will also limit the yields that will be obtained when new varieties with higher yield potentials are introduced.

It is important to analyze the environmental, technical, and institutional factors which account for differences in the rate of growth of total output and of yield among areas, and to monitor these changes over time, as a guide to production policy. It is particularly important to determine the differential response of the several regions and commodities to price and technical incentives.

IV. Land and Resource Development

Working Group VI shares with other groups the perspective that major emphasis must be placed on the production of food crops, particularly rice, on Java and Madura over the next several years. At the same time, it would appear desirable to invest a limited amount of resources to explore the technical and economic feasibility of large-scale commercial agricultural development in some of the less-developed areas on the outer islands. Slow growth of export earnings may be as important as meeting domestic food needs, for the economic development of the Indonesian economy over the next several decades. The structuring of economic incentives to encourage land and water resource development by private capital could make an important contribution to both regional and national development. Research should be initiated to identify the feasibility of such developments and to analyze the economic considerations needed to make them commercially viable.

V. Economic Analysis of Experimental Data

Adaptive research in the biological and agricultural sciences is undertaken primarily because of the potential economic significance of the experimental results. Frequently, the design of such experiments is such that the results cannot be used to analyze the economic and farm management implications. Working Group VI recommends that adaptive research be

planned and administered in such a way that multi-disciplinary cooperation between agricultural scientists and economists in research design and analysis be encouraged.

VI. Cultural Diversity and the Response to Incentives

National efforts to promote economic development in Indonesia face a wide range of cultural and regional diversity which complicates the formulation of national policy. Various opinions are expressed about the need for flexibility in policy to accommodate these differences. One view is that policies should be phrased and administered uniformly, to promote national integration. An opposite view is that national policies should respond to the special features of regions, and that uniformity should be minimized. An intermediate position is that policies should be uniform as to objectives, but flexible in administration in response to regional needs. The extent to which regions in Indonesia have different development problems distinctive enough to require special policy and special administration, will require systematic study. Pending the availability of better information, a balance between national uniformity and regional diversity in policy and administration can only be approximated, and is subject to possible pressures and errors of judgment. Whether there are significant differences in developmental motivation, and whether these would require different policies to promote increased food production, requires systematic study. In order that these and other studies may be conducted, continuing effort is required to provide advanced study opportunitites to increase the number of social science scholars with research competence to develop national research programs, with declining reliance on scholars from other countries.

RECOMMENDATIONS

1. The single, most significant, economic incentive that can be made available to farmers lies in the improvement of the technical capacity of crops and animals to respond to the variables that can be controlled by man, particularly the new biological and chemical inputs made available by science. Recognizing that much of agricultural research is highly location specific, Working Group VI recommends giving major support to research programs directed specifically to raising the yield potentials of the basic food crops in each major agro-climatic zone of Indonesia.

2. The rate at which farmers adopt new yield-increasing technology depends on the relationship between product prices

and the cost of inputs. Cultural and institutional factors may inhibit the response of farmers to production incentives. It is clear, however, that farmers will not adopt new technology requiring biological and chemical inputs which must be purchased from the market, unless it is profitable to do so. The policy of establishing the urea/rice ratio of 1:1 adopted in the BIMAS program in Indonesia represents a relatively favorable production incentive. It is recommended that its effectiveness be safeguarded by protection against inflation and the imperfections of the marketing system. It is further recommended that similar consideration be given to incentives to stimulate the production of other important food and export crops.

3. Extension services and other institutions for the diffusion of technology are valuable primarily because of their ability to accelerate the adoption of new technical inputs and improved production practices. However, extension activities cannot be used as a substitute for the availability at the local level of adequate supplies of production inputs, adequate markets for farm products, and favorable price relationships. Where these essential factors are present, effective extension programs can assist farmers to recognize the opportunities available to them as a result of new technological knowledge, and to accelerate their utilization of such knowledge to increase production. In the past, fragmentation of responsibility, and lack of technical competence on the part of Indonesian extension personnel has been a serious limitation on the diffusion of new knowledge to farmers. It is recommended that extension efforts be directed toward the acceleration of the adoption of technology necessary to increase food production.

4. The effectiveness of production incentives also depends on the local availability of the biological and chemical inputs in which the new technology is incorporated, and on a marketing system which efficiently relates prices at farm and market levels. Working Group VI notes that both input markets and product markets fail to meet the test of technical efficiency and of pricing efficiency at the present time, although a number of steps have already been taken to improve market performance. It is recommended that the technical efficiency and pricing efficiency of markets be improved.

5. The institutions and agencies serving agriculture in Indonesia must be so organized as to enable Indonesia to draw upon the full potential of its limited manpower in the agricultural sciences, in order to stimulate and facilitate a continuous flow of new, output-increasing production technology

to farmers. It is recommended that the use of scientific and technical manpower be organized toward the application of its full potential to increase food production, and that emphasis be placed on in-service and formal academic training for professional workers.

6. In the interest of effective short- and long-range planning, it is recommended that: (1) a national statistical system be developed for agriculture; (2) marketing and pricing efficiency studies be made of input and product markets; (3) sources of output growth be evaluated; (4) land and resource development opportunities be studied; and (5) cultural diversity and the response to incentives be reviewed by competent scholars.

WORKING GROUP VII

BIOLOGY BASIC TO AGRICULTURE

Pages: 131 to 139

WORKING GROUP VII: BIOLOGY BASIC TO AGRICULTURE

Otto Soemarwoto, Chairman
John E. Bardach, Co-Chairman

INTRODUCTION

It is a widely accepted view that basic research in biology has a long-term effect and is, therefore, a long-term investment in the development of a productive agriculture. The importance of research for the improvement of food production is recognized in Indonesia through the establishment and support of agricultural research institutions, colleges, and universities. However, these institutions are not receiving sufficient financial support to enable them to carry on adequate programs. More and better trained scientists must be provided. They must be fully employed in research activities which are adequately supported. Such manpower and facilities are absolutely essential in order to provide a sound base upon which to build a progressive agriculture.

The preoccupation of the numerous agriculturally oriented research institutions vary from the practical (such as insecticide testing) to the very academic (such as those performed in the National Biological Institute). In view of this situation, it is appropriate that a panel of this Workshop on Food was asked to study the role of biology basic to agricultural development.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Adaptive research presently underway can yield applicable results within the next five years. Such research should receive priority at present, but because of the seriousness of the food problem in Indonesia, agriculturally related basic biological research, which takes a longer lead time must also be supported. Such research provides the base for applied or adaptive investigations.

Among the many research topics discussed, a few stood out for their potential, either because they would have very weighty long-term implications, or because their results would be known and could be included in management practices within two or three years.

By definition of the charge given to Group VII, a wide variety of topics were discussed. As improving agricultural

production, through basic research in biology usually takes considerable time priorities were uppermost in the minds of the panelists for research problems that would support the efforts in solving the pressing food problems.

By far, the most important recommendation to come from Working Group VII was that urgent attention must be given to erosion control. In fact, all efforts to increase food production, as recommended by the present Workshop on Food, will be seriously affected unless action is taken to conserve and reforest vulnerable areas in the watersheds of the principal rivers of Java, which provide water for essential irrigation.

The Working Group also placed emphasis on lack of coordination and poor communication in all scientific (as well as administrative) endeavors and strongly recommends simplification of organizational patterns.

Major attention was given to several specific research areas.

SPECIFIC PROBLEMS FOR RESEARCH AND RECOMMENDATIONS

I. Erosion Control

This ecologically oriented discipline was included in the discussion of Working Group II, but its importance justifies emphasis here. Evidence indicates that the majority of the soils in Java are in various critical stages of destruction by erosion. In fact, efforts to increase food production will be seriously limited if immediate action is not taken to conserve and reforest vulnerable areas in the watersheds of the principal rivers of Java.

It is, therefore, recommended that scientific surveys should be undertaken to establish land classification and that appropriate rezoning maps should be prepared as a basis for planning effective conservation measures. To prevent what has occurred, and is of increasing concern in Java, the Working Group also recommends that investigations and surveys should be initiated to mark areas where the clearing of forest lands outside of Java be regulated by an appropriate agency of the Government.

II. Breeding Research

A. Rice

To avoid costly duplications in rice breeding research,

the panel recommends that basic materials from the International Rice Research Institute be used extensively in developing improved varieties for local conditions in Indonesia. It is also recommended that the rice breeding program be conducted by the best trained scientists available in the fields of genetics, plant pathology, entomology, and soil fertility as a team.

B. Soybeans and Peanuts

In view of the recommendation of Working Groups I, III and IV that soybeans should be an important source of plant protein, and in view of the fact that further improvements of the existing varieties are needed, it is recommended that the existing breeding program for soybeans and peanuts be intensified. The Central Agricultural Research Institute should extend the collection of all available - indigenous as well as foreign - strains, or varieties, of soybeans for breeding purposes. A similar team approach of scientists, as suggested for the rice breeding program, should be established for this widely grown and nutritionally important crop.

Peanuts are an important source of plant protein and oil. Working Groups I, III, and IV gave attention to this crop. While it has some limitations in level and quality of protein, and its effect on the soil, as compared to soybeans, it will no doubt increase in importance in the future, as it has in other parts of the world. For this reason, it is recommended that research in breeding, cultural practices, disease and insect control, processing and nutritive values be supported at a lower level than the presently more important food crops.

C. Fish

Fish is the most important animal source of protein. Fresh and brackish water sources offer the greatest opportunity for fish production at present. As fish breeding on the one hand is still in its infancy, and on the other, Indonesia has a considerable tradition in fish culture, the Working Group recommends that fish breeding research be initiated in the Inland Fishery Research Institute with certain species of fish such as gurami and carp. They are omnivorous species that may be amenable to selection for faster growth, better food utilization, high flesh production, etc. Though these species are singled out here, there are other omnivorous and herbivorous species which should be investigated. In addition to breeding, it is recommended that management practices in all aspects of fish culture be investigated by competent marine scientists.

III. Plant Nutrition

Research on plant nutrition in its relation to agriculture in Indonesia has been mostly concentrated on plant response to the major elements such as N, P, and, to some extent, also K. Such studies have, for the most part, been confined to a few of the major crops in a relatively small number of locations. Considering the urgency of increasing food production, the Working Group felt that major effort should be directed to accelerating research on plant nutrition in obtaining basic and broad based data on crop response. Such work should be conducted under controlled and field conditions in adequate locations on the principal soil types in Java and the outer islands. A team of scientists, representing the fields of soil science, plant physiology, agricultural economics and crop production, should plan such a program.

IV. Plant Pests and Diseases

The Working Group discussed the adequacy of presently known facts on the insects and diseases affecting the important food crops in Indonesia. The basic biology of these pests is fairly well known. However, there is great need for additional research in the development of techniques and methods for more effective control measures on the important food crops, which are grown under the varying environmental conditions in Indonesia. The group suggests that major emphasis be given to research under field conditions on diseases and insects in the development of more effective control measures.

Basic studies should be conducted under controlled conditions in the identification of physiologic races of plant disease organisms and the reproductive physiology of insects. The development of more effective control procedures will necessitate the evaluation of crop production practices, the use of alternative chemicals, methods and time of application, equipment, and residual effects on subsequent crops and soils. Such research is essential to increasing crop production and the improvement in quality of food products. The Working Group suggests that competent entomologists and plant pathologists be engaged in this research and that they work with a team of scientists in appropriate disciplines in planning and conducting this greatly needed work in insect and disease control.

The group wishes to further emphasize the importance of this research by pointing out that losses in production and quality of food crops from these pests are not only of great

significance, but such losses reduce the gains which would otherwise be obtained from other production inputs, such as fertilizers, improved varieties, etc.

In addition to the plant diseases and insect pests, the rat is a serious pest. There are several species of rats in Indonesia which have been of serious economic importance. These rodents are destructive to economic plants, stored food products on the farm, and as vectors of diseases to human and animal life. Under present conditions of inadequate food supplies, the ravages of this pest become of critical importance.

There is considerable available knowledge on the rat in present-day scientific literature, but more information is needed in order to develop more effective control methods and procedures. The Working Group suggests that additional research be conducted on the prevalence of species, their habitats, reproduction, and food habits. It also recommends that, on the basis of such data, control measures be developed and evaluated in reducing the losses from rats.

V. Weed Control

Weeds are more important in crop production than has been generally recognized. It has been estimated that losses due to weeds in rice fields in Indonesia reduce yields as much as 30 percent. Since Working Group III discussed rice production, Working Group VII devoted major emphasis to upland cropping systems, rivers and lakes. Three weed species, *Imperata cylindrica*, *Cyperus rotundus* and *Eichornia crassipes*, were singled out as being the most important. In the first two species, chemical control has not been very successful. It is believed that this has been due to the lack of sufficient translocation of applied chemicals to the deeply covered rhizomes and tubers. After exploring the available information carefully, the Working Group came to the conclusion that the ineffectiveness in controlling weeds is due to the absence of adaptive research in applying the chemicals. It was also brought out that basic understanding of the biology of weeds is essential in increasing the efficiency and in insuring the success of chemical or other means of control. However, such biological studies of weeds have not received sufficient attention in Indonesia.

Working Group VII wishes to join the other working groups in emphasizing the importance of more effective weed control. It also recommends that studies be initiated on the economic effects of weeds on crop production and that research on weeds

be conducted by agronomists and plant physiologists under controlled and field conditions.

VI. Animal Diseases and Parasites

At the present time livestock and poultry products do not constitute major sources of protein in the diets of the Indonesian people. It is anticipated, however, that as food production increases and the economy advances, domestic consumer demand will increase, as well as greater opportunity for the export of these products. Therefore, this Working Group wishes to join Working Group IV in emphasizing long range plans for increased production of meat and poultry.

The incidence of animal diseases and parasites of livestock and poultry are significant under Indonesian conditions. For example, Newcastle disease is estimated to cause the loss of 50 percent of chickens annually. Also the occurrence of Coccidiosis, Trypanosoma and Rinderpest are prevalent in the archipelago. This Working Group recommends that plans be initiated to discover effective procedures and methods for the control of these diseases. Such plans should include research for the control of the important external and internal parasites of poultry and livestock.

Working Group VII also discussed other worthy problems in this field on which research is needed. However, under the conditions of limited resources, including adequately trained personnel, it would be unwise to spread such limited resources over too many projects which would not have an immediate impact on the current food situation.

VII. Biology of Shrimp

While this Working Group is cognizant of the domestic food situation, it also recognizes the importance of the production of export commodities to provide needed foreign exchange for Indonesia. Shrimp is currently harvested in substantial quantity in Indonesian waters, some of which is exported. The Working Group feels that additional research is needed on some of the fundamental problems of production. For example, considerable stocks are supposedly present, but very little is known about their reproduction, migration habits, size, time of maturity, etc. Such research will necessitate additional highly trained personnel, marine science equipment, and transportation. This will be expensive and competitive with the other needed research. Nevertheless, it should be established and constitute the basis for an industrial exploitation pattern for the shrimp industry in Indonesia.

VIII. Climate and Weather Forecasting

Indonesia is characterized as having a hot, tropical climate. Annual rainfall throughout the archipelago varies tremendously, depending upon location and altitude (see report of Working Group II).

Since World War II, a number of weather reporting stations have been discontinued. A careful study needs to be made of the number of weather reporting stations needed throughout the country in order to provide essential data. The amount of rainfall, as well as the time and duration of precipitation is of great importance in crop production. For example, there is a relationship between the amount of rainfall and the emergence of rice white borers. Furthermore, such data would be of great importance to farmers in adjusting the planting seasons of crops in such a way as to maximize the use of rainfall in production of crops, as well as to minimize damage from excessive rainfall during the harvesting season. Such data would also be of tremendous value in the operation of irrigation systems, so as to use these systems in the most effective manner.

In light of the important role played by water in agricultural production, this Working Group suggests that the existing weather reporting stations be placed in first class operational condition and that the additional weather reporting stations needed be established as quickly as possible. This Group also wishes to emphasize the importance of adequate and well trained personnel to manage these weather reporting stations and that the function of recording weather data be administratively structured so as to give appropriate recognition to the importance of this work, as well as to insure continuity of operation.

Food production from crop and animal sources is greatly influenced by weather conditions. Therefore, this Working Group wishes to emphasize the importance of short range and long range weather forecasts as an aid to food producers. With adequate reporting stations and with weather data over a sufficient period of time, it should be possible to establish predictions of weather hazards, such as extended drought periods, as well as length and intensity of monsoon seasons which would be a significant service to government planners and farmers.

IX. Human Ecology - Interdisciplinary Problems

Research in human biology is important because of its immediate relevance to agricultural production. Human ecological

studies comprise such areas as man-parasite-domestic animal relationships, environmental changes caused by man-made lakes (such as Djatiluhur project), problems of selectivity in transmigration, reactions of man to the introduction of new technology, the ecology of special groups of people living in special problem areas, such as the Tengger Plateau. These studies are interdisciplinary and deal with complex problems. They may, however, help the sociologists, the economists, the nutritionists, as well as agricultural production managers to influence people in socially desirable action. It is suspected that studies in human ecology would make significant contributions to the success of transmigration efforts.

Currently, Indonesian universities offer only limited and inadequate instruction and research in this area of knowledge, despite the fact that problems in this field may impose serious restraints on agricultural developments. This Working Group suggests that academic training in human ecology be strengthened in the institutions of higher education. Furthermore, the Group feels that with the limited trained manpower and facilities available for research in this field, it is important that such studies be well coordinated among the several research establishments closely associated with these problems (see also the report of Working Group VIII).

X. Manpower and Organization for Research

Indonesian trained manpower is limited and needs strengthening both through training at home and abroad. With regard to the latter, it is essential that information about research and training opportunities at foreign institutions should be made available to all potential applicants for such posts. It is well known that the quotas for Dutch and British fellowships, for example, have never been fully utilized, while Indonesian graduate schools are bursting at the seams. The bottleneck seems to be at various places in the highly complicated administrative machinery set up for such selection.

The Working Group recognizes that proper research training can not be separated from on-going research work. In fact, research training can best be given by scientists actively engaged in research. This requires close cooperation between universities and research institutes. The Indonesian universities offering instruction in the agricultural sciences need greater capability and resources for doing research. It is, therefore, recommended that coordination in research and training between universities and research institutes be widely extended and greatly improved. It is recommended too that university faculties be encouraged to conduct research by means

of financial incentives. This Group wishes to refer to the report of Working Group VIII, in which recommendations are made for productive research and training. It was agreed that judicious apportionment of meager research funds to a few capable scientists would likely accomplish more effective results than spreading the limited resources widely.

The prompt publication of research results is highly essential in getting timely information in the hands of educational leaders, who have responsibility for its application. Inasmuch as funds for publications are limited, the Group recommends that the number of existing journals be considerably reduced by combining related research reports. This requires a coordination between universities and research institutes, such as joint editorial boards, etc.

With regard to manpower and organization for research, the Group emphasizes a lack of coordination and poor communication in all scientific (as well as administrative) endeavors. It appears that simplified organizational patterns, including possible elimination of duplicate, or multiple, charges for the same affairs, would be helpful. However, more study and evaluation of existing patterns and needs should be made.

WORKING GROUP VIII

INSTITUTION BUILDING

&

RESOURCE DEVELOPMENT

Pages: 141 to 154

WORKING GROUP VIII: INSTITUTION BUILDING AND RESOURCE DEVELOPMENT

Kampto Utomo, Chairman
Egbert deVries. Co-Chairman

INTRODUCTION

In Indonesia, as in almost all other countries, many governmental services and institutions--including those devoted to research, education and extension--serve a widespread network of agricultural and industrial enterprises. The latter are engaged not only in production, but also in marketing, transportation, processing, and distribution. The Government itself provides an economic infrastructure through irrigation schemes, roads, railroads, etc. In a society rapidly developing into a market economy, this economic and institutional infrastructure is extremely important.

Many services and institutions perform reasonably well under conditions of slow growth. The accelerated development now possible for Indonesia, as shown convincingly in the Working Group reports, does not require numerical or quantitative additions to existing institutions, but does necessitate a certain amount of functional or organizational changes. These will be considered on the basis of a brief description of the recent situation in the light of the anticipated breakthrough in production.

It should be kept in mind that the total system of private (farmers, merchants, industrialists) and public action is or should be one cohesive whole. It is obviously of little avail to the farmers and the nation if additional products are forthcoming but cannot be moved to consumption centers; or if the credit is lacking to buy available fertilizer; or if purchasing power falls behind supplies of specific products; or if there is inordinate waste during storage and processing.

In the short span of two to five years, it would be impossible to provide the whole of Indonesia with all the technically-feasible inputs and promotional measures. The interdependency of factors of production (in the wide sense) necessitates a "package program" approach in selected areas.

This need for an integrated approach requires intensive programming on a regional and local basis within the framework of a national plan.

SPECIFIC PROBLEMS

There is a need for a well-organized flow of information from local authorities to the center, in order to keep the center abreast of progress, problems, and needs. Vice-versa, any new opportunity created at the center (in a department, in a research institute, or through international cooperation) should be put into action at the best location, by appropriate means. The specific services, aiming at agricultural improvement, should be constantly used in order that the system of institutions be a chain of communication throughout the whole field of production, through the stages of marketing, credit transport, processing, distribution, and consumption.

During the Workshop, problems of services of food production (research, education, and extension) were stressed, but the Workshop was also keenly aware of the interaction between all these elements, including nutritional status and population growth.

In recent years, the Government has initiated major programs in land settlement (transmigration), land reclamation (partly heavily mechanized), purchase and marketing of padi, and other operations, under a variety of managerial rules.

As will be seen from the following description, many departments operate in this field. Their activities should fit into an over-all national plan for food and agriculture.

Planning is done at the highest level on a supra-departmental level, where goals and means (external and internal) are matched and national priorities set. It works under directives, giving very high priority to food supplies and the balance-of-payments situation, which involves attention to agricultural exports. The Workshop concentrated upon production of food for domestic consumption. Stemming from the national plan, organizational and budgetary impulses flow through the totality of governmental activities, both at the center and in the field. Channeling of the flow of these impulses, and an understanding of their interaction requires great care with a view to the implementation of the food and agricultural programs. In the production field, these forces affect external and internal material resources, the availability of personnel of various types and levels of competence, and institutional relationships. The total system interacts with the farmers, providing support and inducement, information and supplies, incentives, and disincentives. The functional differentiation between governmental services hardly interests the farmer, but gaps (in timing and quantity)

greatly harm him, and work as a disincentive. Therefore, planning must move through channels if it is to lead to implementation and action in the villages.

Four levels are important in Indonesia in this channeling: the provinces - 25, the rural districts (kabupaten) - 225, the sub-districts (Ketjamatan) - 3,200, and the villages (desa, negeri, etc.) - 50,000. Major programs (such as multipurpose river development) must cut through district boundaries, and "package programs" may encourage inter-departmental effort; but the majority of action is within this administrative framework.

Mention should be made of a number of "emphasis programs" emanating generally from the central government, and executed sometimes in specific new organizations, or sometimes through rapidly enlarging existing organizations, or through the creation of new departments headed by a Minister of State. Given the dynamic situation of Indonesia over the last two decades and the need for expansion of food and agricultural production, many of these programs deal with problems facing the farmer - "transmigration" (land settlement), land reforms, cooperatives, and mechanization, to cite a few examples. Although centrally directed, these programs, together with the ongoing departmental activities generally operate through regional and local authorities. Thus, development programs and the functioning at provincial, district, and local levels should be clearly defined. They should serve as a two-way communication system: needs and feasibilities from the field; and objectives and resources from the center.

More detailed study is needed of requirements and procedures to obtain smooth functioning of this area of rural development administration. Though speed is necessary, haste in reorganization can be harmful and expensive

On the first level below central government are the 25 provinces. It may be assumed that all the departments and special program directorates have their representatives at the provincial level or have ready periodic access to it. Periodic consultation, under the leadership of the Governor, is needed to compare needs, objectives and programs in various fields to ensure close cooperation between the various services. It should be noted that the Government aims at having a state university in each province, but there is not always an agricultural or science faculty. Each of these universities should provide effective educational programs of instruction and research. They should be supported from national, provincial and local resources to the extent that,

in time, they become real centers of scientific leadership.

The second level comprises the districts, of which 80 are in Java and Madura (averaging a million inhabitants) and 150 are on the other islands, often larger in area but generally much less populated. The district officers should be a link between the province and the villages. They must translate plans into action programs, but should also convey needs and report programs in an organized fashion. They are the focal point of action to channel knowledge and resources (extension and supplies) to the farmers.

The third level is the village, with an average population of a few thousand. Under the demands of modern public administration the old communities have been and are increasingly being consolidated in "village municipalities" which have retained the elected village chief and council of elders. There are plans for further extending this form of administration; but for the moment an important administrative link between the village and the district remains in the ketjamatan (formerly "underdistrict"). The village is still the ultimate unit source of statistical information.

With the exception of the estates, there should be a constant reciprocal relation in the administrative and developmental process between the farmer, his village, the underdistrict, district, province and central services. Although for specialized services, one or more links in the chain may be omitted, one cannot count on direct links on a mass basis between the farmer and more central services. This means that, in the final analysis, agricultural development is closely linked with community and administrative action. The Agricultural Extension Service is a good example of such a link.

The Agricultural Extension Service must draw upon the science and technology derived from institutes of research and of higher learning, and must conduct its own ecologically-determined adaptive research and demonstrations. Set up organizationally with a "directorate" at the center, it is decentralized, with focal points in the provinces and districts. Its officers are in direct contact with farmers, to help and encourage them in the use of new technology. Extension workers must be able to explain (directly and through district and village organizations) government policy in the field of food and agriculture, but the Extension Service has traditionally had little regulatory authority. It can use and absorb services (advice, personnel) from universities, but it cannot by-pass administrative channels in supplies,

marketing, credit and other services to farmers. It can formulate and channel information at village and underdistrict level as to needs, problems, deficiencies, possibilities, performance, and success to higher levels. It can channel information and provide access to more central supplies to the underdistricts and village level, on to farmers groups ("rukun tani").

The links between information, supplies, and regulations (use of land and water, market requirements, pests and diseases including veterinary measures) should be reviewed in the light of needs of rapid expansion and experience in Indonesia and other developing countries.

INSTITUTIONAL GOVERNMENT SERVICES

In the time of this Workshop, it was not possible to prepare a comprehensive schedule of institutions working toward development of food production, marketing, processing, etc. This is in part due to the fact that some of these organizations are now undergoing change.

I. Department of Agriculture and Department of Plantations

The two main agencies are the Department of Agriculture and the Department of Plantations. Both have reorganized or are planning to undergo reorganization in the near future. The Workshop noted the commendable desire of these departments to streamline and simplify rather than proliferate their structures.

II. National Development Planning Board (BAPPENAS)

BAPPENAS needs and maintains close relationships with the various agricultural governmental and non-governmental agencies.

III. Central Bureau of Statistics

This Bureau, under the President's Office, collects, processes, and publishes the all-important data on the situation of food and agriculture, together with other economic and social data. It needs strengthening both at the center and in the field, so as to guarantee the reliability and accessibility of data that is needed for planning, is indispensable for action, and is useful in research.

IV. Department of the Interior

This department absorbed the former Department of Agrarian Affairs, including the Bureau of Land Use with its land-capability studies and related services. The Bureau was created for the benefit of agricultural development, and should have the closest cooperation with departments concerned with agriculture. The Department of the Interior also absorbed an agency (formerly a separate department) that assists and supervises cooperative societies, including those in rural areas with predominantly agricultural functions (credit, marketing). The proposed intensification program with the rapidly increasing need for credit and marketable surplus warrants a new look at the possibilities of rural cooperatives and the links with the Agricultural Extension Services, BIMAS projects of different structure, etc. The Directorate General of Community Development is also under the Department of the Interior. It deals with development programs at the village level, including village irrigation.

V. Social Services

Various social services are important for community action and rural life. The principal ones are:

Directorate General of Community Development;

Department of Social Affairs, with its program in the rural areas, called the Community Social Centers set up by the village communities on a voluntary basis to work in the field of social activities;

Directorate of Community Education in the Department of Education, which has a campagin against illiteracy and a program to improve family levels of living in the villages.

It was noted that an amalgamation of the above services, or at least cooperation at the village level, is being envisaged, and this might indeed strengthen their impact. For instance, the much needed nutrition education in villages might be channeled through these services, in close cooperation with schools (teachers' training, home economics schools, primary schools), agricultural extension services, and Department of Health agencies.

VI. Department of Education

This department plays such an important role that a separate section in the report is devoted to education and

training for rural development. Under this department is the Directorate General of Higher Education, supervising universities and institutes for higher learning. Those involved with agricultural education are listed below.

A. Professional Agricultural Training

In the field of professional training in agriculture, two centers have been designated as "mother" or "feeder" institutions: Bogor Agricultural University (IPB) and Gadjah Mada University in Jogjakarta. Under this arrangement, emphasis can be placed on strengthening a restricted number of universities in order that they may become national centers of excellence in the fields of agriculture, technology, basic sciences and medicine (and also in economics, teachers' training, etc.).

B. Vocational Agricultural Schools

These schools at the secondary level are of two types. Those organized and supervised by the Department of Agriculture train primarily for extension work or plantation employment. Agricultural schools under the supervision of the Department of Education/Directorate General of Basic Education were started only recently, and are to train in the broad field of "agricultural technology."

Two provinces (West Java is one) have started to organize their own agricultural schools, which is very encouraging. Unbalanced growth in secondary education in the past has meant that there have been too few such vocational schools, especially in agriculture, in relation to the growth of general secondary schools leading to college education. Coordination between the two types of agricultural vocational schools will be necessary now under two departments.

C. Village Community Programs

The role of the Directorate of Community Education, under the Department of Education, was previously mentioned in connection with the three approaches to village community programs other than by the agricultural extension service. Community education can be achieved through community leadership training by organizing community libraries and promoting local projects through village committees.

VII. Department of Light Industries and Department of Trade

These departments deal largely with food and agricultural products after leaving the farm, but also with off-farm inputs

needed in farming. Obviously, in researching, planning, financing, regulating, and operating the marketing and processing channels, these departments and their agencies should be in immediate touch with other institutions supporting food production. Planning for future needs must be done jointly.

VIII. Department of Public Works

The Department of Public Works has the responsibility for "basic irrigation" - dams, tanks and secondary canals, excluding tertiary canals in villages, which are to be taken care of by villagers. Two agencies at central government level assist with village irrigation but without personnel in the field, in contrast to public works: one agency under the Department of the Interior, and another in the Department of Agriculture. Both agencies ("directorates") have only recently started work.

IX. Department of Transmigration and Veterans Affairs

Transmigration is now under the Department of Transmigration and Veterans Affairs. In the past, services in this field have been under Social Affairs, Interior, or together with Cooperatives and Community Development in a separate department. Since a transmigration service has always been provided by the Government in opening new lands, its services apply to the total program of agricultural development. This is also the case with the Department of Transportation.

EDUCATION FOR TECHNICAL CHANGE AND AGRICULTURAL DEVELOPMENT

Although education is primarily the responsibility of the Department of Education, all departments in fact have their own schools and even colleges (academies, which are specific in their aim to fill the respective departmental needs for personnel). Elementary education (six years) is a joint operation of the Department of Education and the Department of the Interior. Secondary schools and universities are the concern of the Department of Education.

I. Primary and Secondary Education

In 1967, there were about 57,000 elementary schools, 80 percent of which were run by the Government, and the remainder by private organizations. The enrollment is over 12.5 million. At the secondary level, the junior and senior secondary schools each have three-year programs. At the

secondary level, there are four "streams": general; vocational; the technical; and teachers' education. The following are the number of schools and their enrollment in 1967 as reported by the Department of Education: 12,574,823 in 56,793 elementary schools; 888,745 in 1,294 general junior secondary schools; 95,178 in 604 vocational junior secondary schools; 259,757 in 397 general senior secondary schools; and 62,583 in 255 vocational senior secondary schools.

II. Higher Education

The number and enrollment of colleges and universities are as follows: in 40 state universities with general courses, and specialized ones in technology, agriculture, and teachers' training, 200 privately run institutions of higher learning, and nearly 90 academies, the enrollment is approximately 160,000, 80,000 and 40,000 students, respectively.

III. Training in Agriculture

While Indonesia is an agricultural country, with 72 percent of its work force in agriculture, contributing more than 50 percent of its national income, the enrollment in fields directly related to agriculture is low, except in higher education. In 1967 at the college level in fields directly related to agriculture, including forestry and fisheries, there were some 7,000 students. There are eleven senior agricultural high schools run by the Department of Agriculture, producing approximately 400 graduates annually. 24 new vocational agricultural schools are being built by local authorities and 20 by private organizations. The Department of Education has only recently begun setting up schools in agricultural technology.

At present, the number of extension field workers with specific extension training is negligible. Most of 400 graduates leaving school annually go to plantations or to administrative jobs in the Government at the central, provincial, or district level.

While the education of people in the rural areas is considered very important for the modernization of the country, facilities are still too limited. Schools are poorly equipped, and many of the teachers are not qualified. This applies to formal school education as well as adult education.

Education by mass-media, especially by radio (and by television at a later stage) warrants serious consideration. Broadcasts can be programmed at national and local levels according to the needs. At early stages broadcasts can be directed to schools which can serve the teaching of children and adults, and the upgrading of teachers. It would not appear

to be very costly to supply each of the 57,000 schools in the rural areas with a transistor radio set. (At present, the number of radio sets in the rural areas is growing because of low prices, plus the fact that a radio set has become a status symbol.)

If radio programming is properly directed to the various audience levels, and contains necessary as well as interesting information (the experience of other countries should be analyzed), results will be effective. Radio is a very effective channel for communicating the information on science and technology needed for rural modernization.

INDONESIA'S AGRICULTURAL RESEARCH CAPABILITY

Research and development for agriculture is done primarily by the Departments of Agriculture and Plantations, but is also scattered among other departments, so that research capability is fragmented in more than 30 centers.

There is limited support for adaptive research of the findings of the international teams of scientists, such as those in the International Rice Research Institute, Mexico, and India with respect to rice, wheat and corn.

There is an urgent need for improving the coordination of the activities of existing research institutes, and for more effective collaboration with institutions of higher learning, (especially with the agricultural colleges that have come into the picture since the mid-1950's), to insure effective use of the limited available research manpower.

The availability of new high-yield food grains permits the phasing of research in Indonesia into an immediate period of exploitation of these new resources through adaptive crop production research; and longer-range efforts, which will require greater attention to fundamental or background research and the building of a coordinated system of agricultural science and educational institutions, located in major agricultural regions and designed to serve total national requirements.

A survey by a joint team of carefully-selected Indonesian and foreign agricultural scientists with competence not only in research but also in its organization and management is urgently needed to study the organization and capabilities of research and related education, extension, library and documentation services. This joint team of six to eight members

should develop specific recommendations for the strengthening of research organizational structures, staff development for related educational and extension functions, and the role that universities should play in agricultural development.

RECOMMENDATIONS

Many institutions are in operation at present and a beginning has been made with "package programs," aimed at rapidly increasing production. The ultimate result of research, education, and extension services depends upon the cohesiveness of the total system of communications (knowledge, organization and materials).

Although the following remarks may have importance for the long-run as an on-going process, immediate attention should be given to the improvement of operations in the field and at provincial and national level in order to achieve an efficient organization in a two-year period. Concentration must be given to those areas listed below.

Personnel

1. Improvement of working conditions and salary scales.

2. Assess available personnel and skills, and accelerate the efforts to arrive at estimates of additional personnel required, by qualification and numbers, both at central and implementation levels, over a time horizon of 2, 5 and 10 years (manpower - cadre survey).

3. Where needed, organize professional up-grading courses in close cooperation with field services, research, and training institutes.

4. Use the capabilities of Indonesian specialists and foreign advisors and scientists with maximum efficiency.

Budget

5. Establish a firm budget for research institutes and extension services detailing specific programs.

6. Make the best use of foreign resources wherever feasible.

Communication among Policy-makers

7. Schedule periodic consultation and coordination meetings

of leaders of research in the total field of nutrition, food production, marketing and processing, regardless of their organizational structure in order to review progress, needs, and plans.

8. Strengthen existing agencies and enhance their close collaboration by providing needed maps for economic and planning purposes, reliable and timely series of statistical data, library and documentation services, and publishing channels for governmental and scientific reports.

Management of Programs

9. Initiate a study on present systems of action, prepare for and organize a few development-strategy symposia at control level, with participation from field services, research institutes, universities, and supporting (e.g. credit) institutions.

10. Prepare for and organize series of development-administration courses with participants from district and subdistrict levels, perhaps by province.

11. Prepare for and organize a series of development-management symposia and courses at provincial level, including participants from the various field services and central institutions (research, education).

12. Aim at the writing and distribution of a development-administration-management manual as early as possible.

The following short-term programs should be started as soon as feasible, since they will have long-range implications over a five-year period:

Research

13. Initiate a joint study by a team of Indonesian and international experts to prepare findings on strengthening research capabilities of the major universities and agricultural research institutes, their staff, equipment and collaboration.

14. Initiate and organize a multidisciplinary survey on areas presently under shifting cultivation, non-irrigated fields, and other areas of low productivity; and on tidal swamp areas.

Personnel

15. On the basis of an evaluation of needs and present availability, review and, if necessary, revise the educational system to meet the needed requirements for skills at all levels, especially middle-level technical personnel.

16. Attempt to mobilize and train "change agents" at the village level; consider the best form of farmers' organizations ("rukun tani", etc.).

Credit Institutions

17. Review, and where necessary note the measures necessary to expand the channels of credit to farmers, including a study of the links between credit and marketing of supplies and products (private and public), especially concerning institutions at village level.

Nutritional Situation

18. Strengthen, and where necessary expand the role of existing institutes, universities and laboratories in obtaining knowledge of nutritional needs and supplies, including consumer preferences, food habits, and nutritional education.

Marketing, Storage and Processing

19. Arrange for technical-economic studies on losses during storage and processing of major food crops, ways to avoid these losses, and new processing methods.

20. Promote small-scale industries to handle production and maintenance of implements, and/or processing of food crops.

Uses of Mass Media

21. Consider, test, and expand the use of mass media, particularly radio broadcasts and simple publications, as a means of communication to the schools and to farmers, so they may learn of and benefit from developments of science and technology in food production. Such a program should be part of a package program in coordination with education, health, nutrition, social welfare, etc., and through international agencies and foundations should take advantage of the technology now existing in the world.

Role of Universities

22. Strengthen the universities, especially in science and technology, with a core of leading national centers which maintain close relations with regional centers of learning, so that they become stronger partners in research (including adaptive research in many regions), in up-grading key personnel at central and regional levels, apart from formal professional training, and in public service (extension), especially regional planning and in action research through pilot projects.