

rice development and rainfed rice production



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FOREWORD

This publication contains the four background documents presented to the Fifteenth Session of the International Rice Commission held in Freetown, Sierra Leone, 11-15 October 1982. The first paper "Long-term Strategy of Rice Development" based on the FAO Study: Agriculture Toward 2000, dealt with the major rice production systems, analyzed the major constraints and potentials for development, and outlined the main elements of the strategy for increasing rice production to meet the projected demand on a global basis. The second paper "Regional Rice Development Programmes" reviewed rice development activities in Asia and the Pacific, Africa, the Near East and Latin America. The third paper "The Technology for Rainfed Rice Development in Africa" analyzed the constraints and potentials for rainfed rice development, the main components of production technology and also considered institutional and economic aspects such as extension, education and training, agricultural research, processing and marketing, input supply and rice production policies. The fourth and last paper "The Medium-Term Programmes for Rice Development in Africa" suggested medium-term policies and focussed on action programmes with a potentially high impact on rainfed rice production.

The Steering Committee of the International Rice Commission valued these papers as important reference documents and decided to publish these in book form. We strongly believe this publication will be useful to the planners, researchers and administrators dealing with rice development and production.

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LONG-TERM STRATEGY OF RICE DEVELOPMENT*

INTRODUCTION

1. Rice supplies a larger proportion of the world's dietary energy than any other food. It is of supreme importance in the food supplies, the agricultural production, and indeed the entire rural economy of a large number of developing countries, in particular some of the poorest and most heavily populated ones. In many of them its production has increased much too slowly in recent years, endangering their food security, and holding back the reduction of rural poverty and of hunger and malnutrition. Thus, although development strategy should usually be conceived at the level of national economies rather than individual commodities, there is some justification for singling out the long-term strategy of rice development for separate consideration.

2. In the world as a whole and in the Far East region, where most of the world's rice is produced and consumed, rice production has for many years grown much more slowly than wheat production. In many developing countries where rice is the staple food, its production has increased less than the growth of population. The Committee on World Food Security (CFS) therefore requested FAO to analyze the implications of these trends for the food security of the countries concerned, and this analysis was examined by the Twenty-First Session of the Intergovernmental Group on Rice in March 1978, and by the Third Session of the CFS in April of that year.

3. There has also recently been some regional strategy thinking about rice. In 1977 the Trilateral Commission studied the possibilities for increasing rice production in south and south east Asia^{2/}. The West African Rice Development Association (WARDA) held a seminar on future strategies in October 1979^{3/}. An FAO study of the rice production potential of Latin America^{4/} was considered by the Twenty-Third Session of the Intergovernmental Group on Rice in March 1980.

4. Regional, single commodity studies of this kind should be seen in relation to an overall framework. Such a framework is provided by FAO's study of Agriculture: Toward 2000^{5/}. The main findings of this study regarding rice are summarized below.

* A preliminary version of this document was summarized in FAO. International Rice Commission Newsletter, 19 (2), December 1980, p. 1-7.

1/ FAO. Implications of rice production trends for food security of developing countries, CCP: RI 78/9, Rome, January 1978

2/ Umberto Colombo, D. Gale Johnson and Toshio Shishido. Reducing malnutrition in developing countries: increasing rice production in south and south east Asia, Report of the Trilateral North-South Food Task Force to the Trilateral Commission, Triangle Papers: 16, New York/Tokyo/Paris, 1978.

3/ West African Rice Development Association. Strategies for development of the west African rice industry, CCP:RI 80/CRS 4, FAO, Rome, March 1980.

4/ FAO. Rice production potential in Latin America, CCP:RI 80/7, Rome, January 1980.

5/ The provisional results of this study were submitted to the Twentieth Session of the FAO Conference in November 1979 (FAO, Agriculture: Toward 2000, C79/24, Rome, July 1979). At the request of the Conference, the study is being revised, and most of the revised data shown here have yet to be published.

FUTURE PROSPECTS

5. Prospects to the year 2000 for rice demand, production and trade may be assessed on the basis of the revised "normative scenario"^{1/} of the FAO study. The main assumptions of this scenario are that the population growth of the developing countries^{2/} would slow down from 2.8% a year between 1961-65 and 1974-76 to 2.3% between 1980 and 2000, and that the growth of their gross domestic product (GDP) would accelerate from 6.0 to 7.0% a year. The growth of the GDP of the developed countries is assumed to fall from 4.5 to 3.9% a year.

6. The rapid growth of per caput incomes in the developing countries assumed in this scenario would generate a much faster increase than in the past in their demand for food and agricultural products. The production proposals of the scenario are designed to meet this demand to the fullest extent considered feasible, making each developing country as self-sufficient as possible, commodity by commodity, while bearing in mind the opportunities for international trade compatible with production possibilities and markets.

Demand and consumption

7. From 1961-65 to 1974-76 the world consumption of rice rose at an average annual rate of 2.6% (Table 1). According to FAO's normative projections, the increase in world demand would accelerate to 2.9% a year in the 1980s. In the 1990s, however, per caput demand would begin to be saturated in many countries, and the world increase would fall sharply to 2.1% a year. For the whole period from 1980 to 2000 it would average 2.5% a year, or close to the past rate. In the developing countries the rate of growth of demand would rise to 3.0% during the 1980s, and then drop back to 2.3% in the 1990s. The rate for 1980 to 2000 would average 2.7%, or a little more than the past increase in consumption of 2.6% a year. In the heavily populated Far East region the rate would be 3.0% a year in the 1980s, falling to 2.0% during the 1990s, and averaging 2.5% from 1980 to 2000, as against 2.4% from 1961-65 to 1974-76.

8. In the other developing regions, where rice has been growing rapidly in importance in the diet, and where the recent increases in consumption were much faster than elsewhere, the increase in the demand for rice would slow down except in Africa, where there would be a further acceleration. In China, as in the developing countries of the Far East, there would be a sharp drop in the rate of increase in the 1990s.

9. In contrast to the other cereals, the demand for rice would remain overwhelmingly for direct use as human food. With very few exceptions, only broken or spoiled rice is fed to livestock. Although the use of rice for livestock feeding is projected to rise by 9% a year to reach five million tons of paddy in 2000, this would represent less than 1% of the total world demand for rice. Again, unlike the other cereals, the feeding of rice to livestock is almost entirely in the developing countries.

10. However, rice bran is a more important feedstuff, although much of it is wasted at present by inefficient milling. In future, instead of being exported, more of the bran is likely to be retained in the developing countries for use in their own rapidly expanding livestock industries. Among other by-products, rice hulls or husks will probably find increasing use as a cheap fuel, especially within the rice industry itself for drying, milling and parboiling plants. Rice straw is likely to be increasingly used for paper manufacture in developing countries.

^{1/} A "normative scenario" is a selected alternative that is considered more desirable than the continuation of past trends, and indicates what could and should be accomplished in relation to certain objectives.

^{2/} The study concentrates on 90 developing countries, which account for 98% of the population of the developing world outside China. Other countries are covered in much less detail.

Table 1. Consumption of rice (paddy), 1961-65 and 1974-76 averages, and projected demand^{1/}
1990 and 2000, world and main regions

	<u>Total</u>				<u>Annual rate of increase</u>			
	<u>Average</u>							
	<u>1961-65</u>	<u>1974-76</u>	<u>1990</u>	<u>2000</u>	<u>1961-65</u>	<u>1980</u>	<u>1990</u>	<u>1980</u>
	.....	.....	.....	.....	<u>to 1974-76</u>	<u>to 1990</u>	<u>to 2000</u>	<u>to 2000</u>
	..... Million tons (paddy) .....				..... % per year			
Africa	4.1	6.4	13.2	20.8	3.8	4.1	4.6	4.4
Far East	127.8	170.4	265.2	323.0	2.4	3.0	2.0	2.5
Latin America	9.2	14.0	21.4	28.6	3.6	2.8	3.0	2.9
Near East	3.3	5.5	10.3	15.3	4.3	4.1	4.0	4.1
Developing countries	144.4	196.3	310.1	387.7	2.6	3.0	2.3	2.7
China	84.1	121.6	183.8	220.1	3.1	3.0	1.8	2.4
Developed countries	21.7	24.1	24.5	26.9	0.9	0.7	0.9	0.8
WORLD	250.2	342.0	518.4	634.7	2.6	2.9	2.1	2.5

NOTE: Based on revised normative scenario (unpublished) of FAO's study of Agriculture: Toward 2000.
 Data for developing countries refer to 90 countries accounting for 98% of population of developing world outside China; world total excludes remaining developing countries.

^{1/}Consumption and demand for food, industrial use, feed and seed, and including waste.

Production

11. In order to meet the projected increases in the demand for rice, world production would have to grow by almost 300 million tons of paddy (86%) between 1974-76 and the end of the century. This is already a formidable task, but it would be particularly difficult during the 1980s, when the world demand is projected to rise by 2.9% a year. However, the analyses of production possibilities in individual countries carried out for the FAO study indicate that it would be feasible, provided appropriate strategies and policies were followed, for world production to be increased in line with the projected expansion of demand (Table 2).

12. It should even be possible for the nearly 200 million tons (paddy) of additional demand for rice projected in the developing countries between 1974-76 and 2000 to be met from their own production. In Africa, where the production increase was already faster than in any other region, it would accelerate still further. In Latin America the high past growth rate would slacken slightly. In the Near East there would be a big rise in the rate of increase. In the crucial Far East, the increase in rice production would continue to be slower than in the other developing regions. However, it would climb steeply from only 2.3% a year (or less than the population growth of 2.5% a year) to 3.0% in the 1980s, before falling back again (in line with the slower expansion of demand) to 2.1% a year during the 1990s.

13. The rapid past increase in rice production in China would slacken only slightly during the 1980s, but (again in accordance with demand) it would slow down considerably in the 1990s. The already slow increase in the developed countries would decline further. Their production would be well below potential levels, and could be stepped up if necessary to meet the larger import demand that would result from lagging production performance in developing countries.

International Trade and National Self-Sufficiency

14. If past trends in demand and production continued, the gross import requirement of rice of the developing countries would rise from 8.3 million tons of paddy in 1974-76 to 33 million in 2000, and their net import requirement from 3.3 to 7.6 million tons. As in the past, a steep rise in their imports of wheat and other cereals would partly reflect the scarcity of rice. Their net imports of all cereals (including rice on a milled basis) would more than quadruple, going from about 30 to about 130 million tons, and those of the cereal deficit developing countries would increase from about 50 to about 175 million tons.

15. Although the developed countries would seem to be capable of producing a net cereal surplus of this size, such massive imports would represent an impossible situation for the developing countries. A principal objective of the long-term strategy of rice development is therefore greater self-sufficiency in rice in these countries.

16. Under the revised normative scenario of the FAO study, which embodies this objective, the developing countries' gross import requirements of rice in the year 2000 would be held down to 12.0 million tons (paddy), and they would even have a small net export (Table 3). Their self-sufficiency ratio (SSR), which was 1.00 in 1961-65, would recover from 0.98 in 1974-76 to 1.00 in 2000.

17. If the normative scenario materialized, the results would be particularly encouraging in the developing countries of the Far East, which would return from the net import position of the past decade to a substantial net export. Latin America would become a small net exporter. Although Africa's net import requirements of rice would double, the region's SSR would improve slightly. The net import requirements of the Near East would increase fivefold, and it would become by far the largest import market for rice; much of the demand in the oil-exporting countries would be for very high quality types of rice.

Table 2. Production of rice (paddy), 1961-65 and 1974-76 averages and projections for 1990 and 2000, world and main regions

	<u>Total</u>				<u>Annual rate of increase</u>			
	<u>Average</u>	<u>1974-76</u>	<u>1990</u>	<u>2000</u>	<u>1961-65</u> <u>to 1974-76</u>	<u>1980</u> <u>to 1990</u>	<u>1990</u> <u>to 2000</u>	<u>1980</u> <u>to 2000</u>
	..... million tons (paddy) .....				.....% per year			
Africa	3.4	5.4	10.3	18.8	4.0	5.9	6.2	6.0
Far East	128.7	169.2	267.4	330.5	2.3	3.0	2.1	2.6
Latin America	9.0	13.9	21.6	29.4	3.7	3.3	3.1	3.2
Near East	3.4	4.5	7.0	10.2	2.4	3.7	3.9	3.8
Developing Countries	144.5	193.0	306.3	388.9	2.4	3.1	2.4	2.8
China	85.3	125.0	187.3	222.1	3.2	2.9	1.7	2.4
Developed Countries	21.6	25.7	26.2	28.3	1.5	0.2	0.8	0.3
WORLD ^{1/}	251.4	343.7	519.8	639.3	2.6	3.0	2.1	2.5

NOTE: See note to Table 1.

^{1/} The excess of world production over the estimates of consumption and demand shown in Table 1 is partly accounted for by the net import demand of the remaining developing countries (mainly Hongkong and Singapore), which is projected as 1.4 million tons in 2000.

Table 3. International trade in rice (paddy), 1974-76 average, and projected export availabilities and import requirements, 2000, world and main regions

	<u>Gross exports</u>		<u>Gross imports</u>		<u>Net trade</u> ^{1/}		<u>SSR</u> ^{2/}	
	<u>Average</u>	<u>2000</u> ^{3/}	<u>Average</u>	<u>2000</u> ^{4/}	<u>Average</u>	<u>2000</u>	<u>Average</u>	<u>2000</u>
	..... Million tons (paddy)							
	..... Ratio							
Africa	-	0.6	1.1	2.6	-1.0	-2.0	0.84	0.91
Far East	4.0	10.3	5.2	2.9	-1.2	7.4	0.99	1.02
Latin America	0.7	1.8	0.8	0.9	-0.1	0.9	0.99	1.03
Near East	0.2	0.5	1.2	5.6	-1.0	-5.1	0.82	0.67
Developing countries	5.0	13.2	8.3	12.0	-3.3	1.2	0.98	1.00
China	3.0	2.0	-	-	3.0	2.0	1.02	1.01
Developed countries	4.2	3.9	2.5	2.5	1.7	1.4	1.07	1.05
WORLD ^{5/}	12.2	19.1	10.8	14.5	1.4	4.6	-	-

NOTE: See note to Table 1. World trade is almost entirely in milled rice, but the data are shown in terms of paddy or unhusked rice (of which the milled equivalent is about 65%) for greater comparability with those of production.

1/ Minus sign denotes net import.

2/ Self-sufficiency ratio (ratio of production to consumption).

3/ Projected export availabilities.

4/ Projected import requirements.

5/ The excess of world exports over imports partly reflects the net import requirements of the remaining developing countries (mainly Hongkong and Singapore), which are projected as 1.4 million tons in 2000.

18. China would continue to be one of the largest exporters of rice, but probably with a lower volume than in recent years. The net exports of the developed countries would show little change. In the developed exporting countries, and also some of the developing ones, exportable supplies of rice could probably be increased a good deal faster than in the normative scenario of the FAO study, in which the growth of exports is constrained by the envisaged success of some of the main developing importing countries in expanding their own production and thus limiting their import requirements. In spite of this constraint, however, the scenario still leads to an excess of export availabilities over import requirements.

19. This excess is partly in order to allow a safety margin for some shortfall in production in the developing importing countries. However, it also means that there could be some expansion in the carryover stocks of rice, which are very much less adequate in relation to consumption than those of wheat and coarse grains. Rice could also come to play a role in food aid that is more commensurate with its importance in the food consumption of the developing countries. Even with more abundant exportable supplies, however, rice prices in world markets would be unlikely to fall in relation to those of wheat and other cereals, in view of the higher production costs of rice.

MAIN STRATEGY CONSIDERATIONS

20. The scenario summarized above, as background for the discussion of the long-term strategy of rice development, is in no way a prediction of the future course of events. The demand projections indicate no more than what is likely to happen under certain assumptions about population and income. The production estimates represent what FAO considers to be a feasible set of proposals for meeting this projected demand in such a way as to make the individual rice-growing developing countries as self-sufficient as possible.

21. It remains now to discuss the strategies required for the production proposals of the normative scenario of the FAO study to come to pass. After examining the sources of the production increases in the developing countries proposed in this scenario, the main strategy considerations will be discussed, in relation first to the different production systems and then to different regional and country situations.

Sources of Future Production Increases in Developing Countries

22. Table 4 compares the harvested area, yield and production of rice in the developing countries in 1974-76 with those proposed for the year 2000 in the revised normative scenario. In view of the shortage of new land that could readily be added to the rice area, the proposed strategy relies heavily on increasing the productivity of the existing area in these countries by raising yields and cropping intensities.

23. It is proposed that during the quarter of a century between 1974-76 and the year 2000 rice production in the developing countries should more than double, rising by almost 200 million tons (paddy), or 102%. Reflecting greater cropping intensity and some additional land, the harvested area of rice would be expanded by 23 million ha (24%). By far the greatest emphasis, however, would be on raising yields, which would go up by 68%, (from 1.9 to 3.2 tons per ha), and would contribute about three-quarters of the total increase in production.

24. So large an increase in yields would entail a very rapid expansion in the use of such modern inputs as improved seeds, chemical fertilizers, pesticides, and farm machinery. For example, it is envisaged that fertilizer use for rice production would be raised more than ninefold, from 2.3 million tons of nutrients in 1974-76 to 20.9 million in 2000. The proposed contribution of irrigation is discussed below in connection with the different production systems.

Table 4. Area, yield and production of rice (paddy), 1974-76 average and projections for 2000, developing countries

	<u>Harvested area</u>		<u>Yield^{1/}</u>		<u>Production^{1/}</u>		<u>Contribution</u>
	<u>Average</u>	<u>2000</u>	<u>Average</u>	<u>2000</u>	<u>Average</u>	<u>2000</u>	
	Million ha		Tons per ha		Million tons		
Africa	3.8	8.6	1.4	2.2	5.4	18.8	37
Far East	66.7	98.5	2.0	3.4	169.2	330.5	80
Latin America	7.4	13.5	1.9	2.2	13.9	29.4	20
Near East	1.2	2.0	3.8	5.1	4.5	10.2	36
Developing countries	99.2	122.6	1.9	3.2	193.0	388.9	74

NOTE: See note to Table 1

^{1/} Paddy

Production Systems

25. Rice is grown in a wide range of different environments, for each of which there are specific strategy considerations. There is still some disagreement about the definition of the major production systems and the areas they occupy, but the most reasonable of the available estimates¹ is that irrigated rice is about half the world's harvested rice area, rainfed lowland rice about 35%, upland rice about 10%, and deepwater rice about 5%. Irrigated rice is taken to include partial² as well as full irrigation, and wet season supplemental as well as dry season irrigation. Rainfed lowland rice is where there is no artificial water supply³, soil saturation is aimed at and the water depth normally does not exceed 1 m. Upland (or dryland) rice is grown without bunding to impound water, on land that is prepared and seeded under dry conditions⁴. Deep-water rice is grown in water depths above 1 m. generally without bunding.

26. Partly based on the preliminary results of FAO's Agro-Ecological Zones Study, Agriculture: Toward 2000 places the land and water resources of the developing countries in six classes. Table 5 shows the proposed contribution of each of these classes to the increase in the harvested area, yield and production of rice in these countries between 1974-76 and 2000. Except for irrigated land, the classes (which are, of course, intended for all crops and not just rice) are different from the four main rice production systems, but they can readily be related to them. The naturally flooded land in the table includes deepwater rice and most of the lowland rainfed; the good rainfall land groups the rest of the lowland rainfed and part of the upland rice; and the problem areas consist of most of the upland rice.

¹/ R. Barker and R.W. Herdt. Rainfed lowland rice as a research priority - an economist's view. International Rice Research Institute. Rainfed lowland rice; selected papers from the 1978 International Rice Research Conference, Los Banos, Philippines, 1979, p. 4-7.

²/ Partially irrigated land is defined as equipped for irrigation but lacking drainage or reliable water supplies, or with low quality and reliability of distribution (see Table 5).

³/ The definition proposed by the Committee to Develop Future Research Strategies at the 1978 International Rice Research Conference includes artificial water supply where this is "undependable and limited to local impoundment" (IRRI, Rainfed lowland rice, Op. cit. p.329), mainly in order to accord better with the available statistics, the definition used here excludes all forms of irrigation.

⁴/ Surajit K. De Datta. Upland rice around the world. IRRI. Major research in upland rice, Los Baños, Philippines, 1975, p.2.

Table 5. Area, yield and production of rice (paddy), 1974-76 average and projections for 2000, developing countries, by six land and water classes

Land and water class	Harvested area		Yield		Production ^{1/}		Share of class in production increase
	Average 1974-76	2000	Average 1974-76	2000	Average 1974-76	Change ^{2/}	
	Million ha	Million ha	Tons per ha	2000	.... Million tons	....	%
Good rainfall	4.2	1.5	1.5	2.7	6.5	3.9	-2.6
Low rainfall	-	-	-	-	-	-	-
Naturally flooded	48.7	43.6	1.6	2.3	78.2	101.6	23.4
Problem areas	9.7	12.7	1.1	1.4	10.7	18.3	7.6
Total rainfed	62.6	57.8	1.5	2.1	95.4	123.8	28.4
Fully irrigated	19.5	53.4	3.1	4.2	59.6	226.5	166.9
Partially irrigated	17.0	11.4	2.2	3.4	38.0	38.4	0.4
Total irrigated	36.5	64.8	2.7	4.1	97.6	264.9	167.3
TOTAL	99.2	122.6	1.9	3.2	193.0	388.9	195.9
							100

NOTE: See note to Table 1. The land and water classes are defined using four suitability classes (very suitable, suitable, marginally suitable, and not suitable) from the FAO Agro-Ecological Zones Study which are related to the anticipated yield as a percentage of the maximum attainable under optimum agro-climatic and soil conditions. The six land and water classes are: good rainfall land (rainfall providing 120 to 270 growing days, soil quality very suitable or suitable), low rainfall land (rainfall providing 75 to 120 growing days, soil quality very suitable, suitable or marginally suitable), naturally flooded land (land under water for part of year, and lowland rainfed paddy fields), problem areas (soils of all qualities with rainfall providing more than 270 growing days, and marginally suitable soils with rainfall providing 120 to 270 growing days), fully irrigated land (equipped for irrigation and suitable drainage and not suffering from water shortages), and partially irrigated land (equipped for irrigation but lacking drainage or reliable water supplies, or with low quality and reliability of distribution).

^{1/} Paddy.

^{2/} Minus sign denotes decrease.