SWAMINATHAN

MAJOR ADVANCES IN SCIENTIFIC KNOWLEDGE CONTRIBUTING TO CROP IMPROVEMENT

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Figure 1. We now live in the exciting age of genetic engineering and molecular biology. This figure shows how fast we have gained in our ability to manipulate the traits of crop plants. (Source: Goodman et al, 1987)

To be inserted in page 6.

THE YEAR THE UNITED STATES CANNOT FILL THE FOOD GAP (Source: Paddock and Paddock, 1967.

Figure 2.

Page 6.

PRODUCTION AND STOCKS OF CEREALS, 1975-1985 (Source: FAO)

Figure 3.

FOOD AND AGRICULTURAL PROGRESS (Source: FAO).

Figure 4. The relative importance of factors likely to influence agricultural development in developing countries, 1984-1990, was assigned by panelists who gave two points to each factor they rated extremely important and one point to each factor they rated moderately important.

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LAND USE AND RESERVES

Figure 7, Arable land in millions of hectares, as estimated by the Food and Agriculture Organisation. ~~We will have to produce more food from less lan~~

PAST ~~HISTORICAL~~ AND PROJECTED YIELD INCREASES FOR MAJOR CROPS

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Figure 8. [Adapted from F.A.O. 1987] Attaining the yield projected in Table 2 will require an increase of around 30 per cent. The potential for increase can be seen from the work done by the International center for Maize and Wheat Improvement, (CIMMYT), Mexico ~~CIMMYT~~ in raising wheat yields.

PROBLEM SOILS IN INDIA (Source: Central Soil Salinity Research Institute, Karnal

Figure 12.

PUSHING BACK THE ~~YIELD~~ BARRIER to Yield in Wheat

Insert in Page 12

Figure 20. Average yield of Mexican varieties under favorable management and in the absence of disease. The yield-potential trials were done at the CIANO Experiment Station, 1982-1984. (Source: CIMMYT)

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LANDRACES

Figure 21. The 73 parent strains include 20 landraces (blue).

(Source: IRRI)

POCKETS OF SUCCESSFUL PRODUCTION IN WORLD AGRICULTURE

Table 1. The examples of progress illustrate the power of coordinated action among scientists, extension workers, farmers, and political and development administrators (Wittwer 1986).

PAST AND PROJECTED YIELD INCREASES FOR MAJOR CROPS

Table 2. If the yields projected here are to be attained, present yields must increase by around 30 per cent. (Source: F.A.O. 1987 a,b)

IRRIGATION DEVELOPMENT

Tabel 3. If, over the 20-year period, the land under irrigation in South Asia increases by 36.6 per cent, then the rice harvest should increase by 13 per cent; if irrigated land in Southeast Asia increases by 6.4 per cent, then the rice harvest will increase by 1 per cent. (Asian Development Bank, Agriculture in Asia, 1985)

<u>AZOLLA</u> AND UREA AS NITROGEN SOURCES FOR RICE

Table 4. Fertilizer was applied at a rate of 69 kilograms of nitrogen per hectare (split application, basal and side-dressed at 42 DT). For the same amount of <u>Azolla</u> and urea applied, nitrogen uptake of the rice was a little higher for <u>Azolla</u> but fertilizer loss was far less than when urea was used.

SYMPHONIC AGRICULTURE MATRIX

Table 5. The basic characteristics of improved technologies for the future combine higher productivity, higher profitability,, greater acceptability, greater stability, and greater sustainability. To achieve these goals, an integrated approach is required.

RICE AREA AND YIELD IN CHINA, 1985

Table 6. The Chinese hybrid rice illustrates a technology that is appropriate to population-rich, land-hungry countries: The hybrid produces about ~~a third~~ 20 percent more rice per hectare, but the seed production techniques are labor intensive.

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BIOMASS PRODUCTION

Figure 24. Biomass production is plotted against the level of environmental factors (negative to positive).

define letters (L_B, L_A, U_A
Delete

ASIAN RICE-FISH FARMINING AREAS AND RICE PRODUCTION (Source: International Center for Living Aquatic Resources, Manila

Figure 34.

AFRICAN WOMEN"S LABOR SHARE IN FOOD SYSTEMS TASKS

Figure 35. (Source: UNDP)

delete?

SEPARATION OF A CEREAL CROP INTO ITS BOTANICAL CONSTITUENTS

Figure 36.

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Figure 9. ~~Table 1.~~ Pockets of successful production in world agriculture*

Projects	Accomplishments
Grain ~~Production~~ in India's Punjab	A three ~~3~~ fold increase in grain production in 10 years from 1965 to 1975
Rice ~~Production~~ in Colombia	Yields rose from 1.8 to 4.4 tons/hectare from 1965 to 1975
Wheat ~~Production~~ in Turkey	Increase in production from 7 to 17 million tons from 1961 to 1977
Hybrid Rice in China	20 to 30 percent yield increase (labor intensive high yielding technology
Hybrid Cotton in India	Yields doubled - (labor intensive high yielding technology)
The White (Milk) Revolution in the Gujarat	Daily cash income, improved nutrition, labor intensive technology for 300,000 small farms
The Puebla (Maize) Project in Mexico	Yields increased by 30 percent from 1968 to 1972
The Comilla Project of East Pakistan	Rice yields and incomes of farmers doubled from 1963 to 1970
The "Masagana 99" Project in the Philippines	Rice yields increased by 36 percent in 3 years from 1973 to 1976
Maize in Kenya	Hybrids and fertilizer and management increased yields 4.8 tons/hectare
Hybrid Maize in the ~~U.S.~~ United States	3.5 fold yield increase in yield from 1940 to 1979

*Wortman and Cummings, 1979

Table 2. Past ~~Historical~~ and projected yield increases for major crops

	1961–1963 ~~1961/63~~	1982–1984 ~~1982/84~~	2000
Wheat	1.0	1.7	2.3
Rice (paddy)	1.7	2.4	3.0
Maize	1.1	1.6	2.3
Sugar cane	46.0	57.0	69.0
Pulses	0.5	0.5	0.7
Groundnuts	0.8	0.9	1.0

Source: FAO. 1987a, b

Table 3. Irrigation development.

Region	Area in million ha		Percent of harvested rice	
	1980	2000	1980	2000
South Asia	55.3	91.9	29	42
South East Asia	12.6	19.0	28	29

Source: Asian Development Bank
Agriculture in Asia, 1985

Table 4. Azolla and Urea as ~~N~~ Nitrogen source of rice

Fertilizer	Grain Yield (t/ha)	Plant N Uptake (kg/ha)	Fertilizer in Loss (%)
Azolla	5.4	99	6.0
Urea	5.6	92	32.6
Control	3.9	63	

~~1/ 60 kg N/ha rate (split application, basal and side-dressed at 42 DT)~~

Source: IRRI

Table 6. Rice area and yield in China, 1985*

	Area $(ha \times 10^6)$	Production $(t \times 10^6)$	Yield (t/ha)
Total rice	31.8	166.9	5.2
Hybrid	8.4	54.6	6.5
Non-hybrid	23.4	112.3	4.8

*Statistics from the Ministry of Agriculture and Animal Husbandry and Fisheries