13. References

Barah BC and Betne, R. 2001, Analysis of the status of rice production system in Assam. In: Barah, B.C. (ed) proceedings of the Workshop on Prioritization of Strategies for Agricultural Development of northeast India, NCAP/NEC/AAU. New Delhi. 18 p.

Barah BC and S. Pandey 2005, Rainfed rice production system in eastern India: An on-farm diagnosis and policy alternatives, Indian Jr. of Agri. Economics, vol 60(1) Jan-MArch, pp110-136.

Bhalla GS. 1997. Structural adjustment and the agricultural sector in India. In: Chadha GK and AN Sharma, editor. *Growth, employment and poverty: change and continuity in rural India.*. New Delhi: Vikas Publishing House Pvt Ltd. p 21-41.

Calpe C, 2004, Rice Market Outlook, FAO Rice conference, Rome Italy, February 12-13.

Jha Dayanatha, 2001, Agricultural Research and small farms, presidential address at the 60th annual conference of the Indian society of agricultural economics, Kalyani, West Bengal.

Jha Dayanatha and S K Pandey, 2005, Resource allocation for agricultural research; An empirical description, draft report, National Professor project, NCAP, New Delhi.

Hossain M and Laborte A. 1996. Differential growth in rice production in Eastern India: Agroecological and socio-economic constraints. In: Singh VP, et. al., editors. Proceedings of the International Conference on Stress Physiology of Rice, 28 Feb – 5 Mar 1994, Lucknow, U.P., India, p 221-239.

Maclean J.L, et al. (ed), 2002, Rice Almanac, Third Edition, IRRI, Philippines

Pal S, Pandey S, and Abedullah. 2000. Growth and variability in agriculture revisited: district-level evidence of rice production in eastern India. In: Pandey S, Barah BC, Villano RA and Pal S, (ed), Risk Analysis and Management in Rainfed Rice Systems,Manila (Philippines): International Rice Research Institute. p 97-114.

Pandey S, Barah BC and L Velasco, 2000; Pattern of Rice Productivity growth in eastern India; Implications for Research and Policy, Working paper 2, NCAP, New Delhi

Pandey S, Barah BC, Villano RA and Pal S, (ed) 2001, Risk Analysis and Management in Rainfed Rice Systems. Manila (Philippines): International Rice Research Institute. p 97-114.

Pandey S and Pal S. 2000. The nature and causes of changes in variability of rice production in eastern India: a district -level analysis. In: Pandey S, Barah BC, Villano RA and Pal S, (ed), Risk Analysis and Management in Rainfed Rice Systems. Manila (Philippines): International Rice Research Institute. p 73-96.

Planning Commission of India, 2002, Tenth Five Year Plan, Approach paper, Chapter 6, New Delhi.

Rai, Mangala, 2004, International Year of Rice-An overview, Indian Farming vol 54 (8), pp 3-6.

Rao C.H.H. 1985, Report of study group on agricultural strategies for eastern region of India. New Delhi, Government of India Planning Commission. 45 p.

Singh V. P. and R. K. Singh (ed) 2000; Rainfed Rice: A sourcebook of Best Practices and Strategies in India, IRRI, Philippines

Appendix Tables

Appendix Table 1 : Quenqunnial average Area under rice in India

Area

Zones	State	1967-1969	1975-1980	1985-1990	1995-2000
East Zone	Assam	2141.0	2229.9	2364.4	2503.0
	Bihar	5341.6	5366.8	5279.4	5043.4
	Orissa	4317.5	4391.4	4304.5	4508.1
	West Bengal	4776.5	5145.2	5433.5	5946.8
East Zone Total		**16576.6**	**17133.2**	**17381.8**	**18001.2**
North Zone	Haryana	220.0	394.4	579.0	948.2
	Himachal Pradesh	96.7	92.4	90.1	82.2
	Jammu & Kashmir	233.0	260.2	266.7	269.7
	Punjab	326.0	858.2	1785.8	2344.2
	Uttar Pradesh	4459.5	4868.2	5343.0	5726.9
North Zone Total		**5115.2**	**6079.0**	**7485.6**	**8423.0**
South Zone	Andhra Pradesh	3226.4	3714.1	3708.4	3834.4
	Karnataka	1164.0	1105.0	1146.3	1368.4
	Kerala	866.5	834.2	620.2	400.5
	Tamil Nadu	2620.5	2658.4	2016.0	2233.8
South Zone Total		**7877.4**	**8311.7**	**7491.0**	**7837.1**
West Zone	Gujarat	501.6	465.3	497.2	632.4
	Madhya Pradesh	4280.5	4709.4	4996.6	5339.2
	Maharashtra	1369.5	1476.4	1500.3	1492.9
	Rajasthan	112.0	179.0	124.4	143.3
West Zone Total		**6263.6**	**6830.1**	**7118.5**	**7607.8**
India Total		**36702.0**	**39632.8**	**41002.6**	**43821.9**

Appendix Table 2 :
Quinqunniel average Production of rice in India

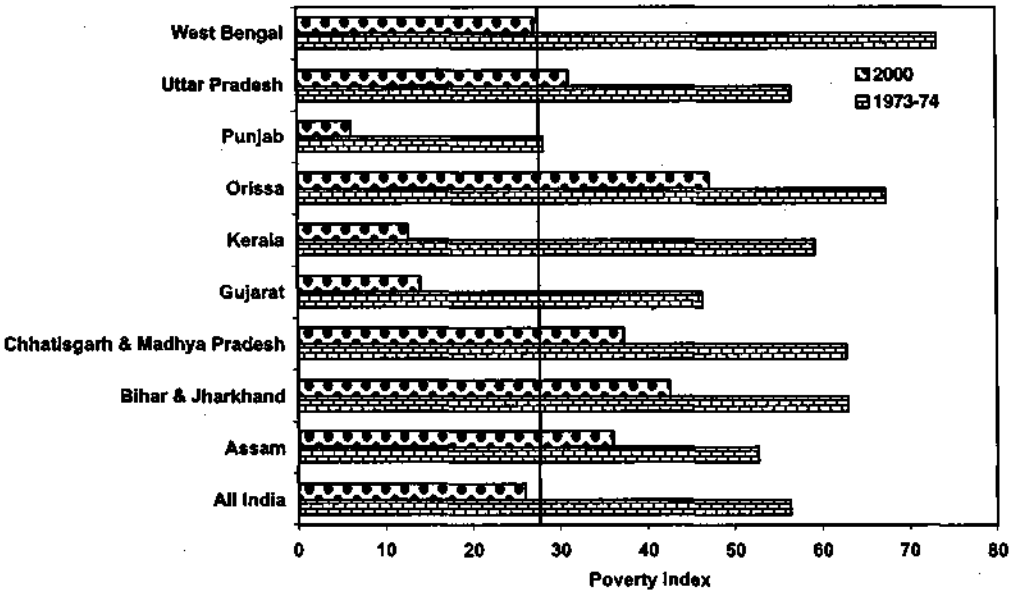
Production

Zones	State	1967-1969	1975-1980	1985-1990	1995-2000
East Zone	Assam	2115.3	2157.5	2636.3	3441.6
	Bihar	4964.5	4837.3	5887.0	7003.3
	Orissa	4227.0	3878.4	5022.4	5476.3
	West Bengal	5729.0	6574.8	9441.9	13006.8
East Zone Total		**17035.8**	**17448.0**	**22987.7**	**28928.0**
North Zone	Haryana	276.0	915.0	1477.4	2376.6
	Himachal Pradesh	104.4	107.9	97.9	109.9
	Jammu & Kashmir	383.5	464.8	545.6	494.0
	Punjab	437.5	2362.8	5707.0	7733.2
	Uttar Pradesh	3092.0	4461.0	8212.8	11767.2
North Zone Total		**4017.4**	**7396.5**	**14563.3**	**20104.3**
South Zone	Andhra Pradesh	4507.2	6145.0	8374.4	9868.9
	Karnataka	1899.0	2113.2	2207.4	3348.4
	Kerala	1262.0	1294.4	1084.9	776.2
	Tamil Nadu	4028.0	5296.4	5592.3	6770.2
South Zone Total		**11696.2**	**14849.0**	**17259.0**	**20763.6**
West Zone	Gujarat	346.8	556.1	572.5	962.5
	Madhya Pradesh	3099.0	3293.0	4604.3	5656.0
	Maharashtra	1403.0	2126.4	2113.6	2515.4
	Rajasthan	76.0	201.6	126.4	145.9
West Zone Total		**4924.8**	**6177.1**	**7416.8**	**9279.9**
India Total		**38686.5**	**47886.2**	**65061.1**	**83297.1**

Appendix Table 3 : Quinqunniel average Productivity of rice in India

Zones	State	Yield			
		1967-1969	1975-1980	1985-1990	1995-2000
East Zone	Assam	987.0	966.8	1113.8	1374.6
	Bihar	928.9	898.1	1113.6	1400.6
	Orissa	979.5	879.8	1162.3	1214.0
	West Bengal	1198.2	1278.3	1733.0	2187.4
East Zone Total		**1023.4**	**1005.8**	**1280.7**	**1544.2**
North Zone	Haryana	1255.5	2331.7	2541.9	2524.4
	Himachal Pradesh	1079.2	1166.1	1085.5	1340.0
	Jammu & Kashmir	1635.6	1782.7	2045.2	1832.2
	Punjab	1341.3	2736.1	3190.4	3298.6
	Uttar Pradesh	694.0	916.9	1534.2	2052.4
North Zone Total		**1201.1**	**1786.7**	**2079.4**	**2328.1**
South Zone	Andhra Pradesh	1398.2	1651.1	2241.4	2565.8
	Karnataka	1630.3	1902.1	1920.0	2438.0
	Kerala	1452.2	1553.2	1751.4	1937.4
	Tamil Nadu	1537.0	1987.7	2787.6	3017.6
South Zone Total		**1504.4**	**1773.5**	**2175.1**	**2489.7**
West Zone	Gujarat	686.0	1193.1	1115.6	1517.6
	Madhya Pradesh	725.0	700.0	921.2	1059.0
	Maharashtra	1024.5	1441.3	1404.9	1685.4
	Rajasthan	720.9	1143.9	995.1	1010.0
West Zone Total		**789.1**	**1119.6**	**1109.2**	**1372.3**
India Total		**1053.9**	**1206.6**	**1584.3**	**1898.6**

Appendix Figure 1 : Incidence of poverty in India.



Appendix Table 4 : Compound Growth Rates of Area, Production and productivity of rice in India (%)

State	Zone	Area			PRODUCTION			Yield		
		1970s	1980s	1990s	1970s	1980s	1990s	1970s	1980s	1990s
Assam	East	0.68	0.79	0.02	0.81	2.20	2.37	0.13	1.40	-1.03
Bihar	East	0.23	0.26	0.34	1.26	4.80	4.92	1.03	4.52	4.61
Orissa	East	0.07	0.46	0.16	-0.40	4.97	-1.32	-0.47	4.49	-1.47
West Bengal	East	0.85	0.75	1.19	3.14	1.59	6.52	2.27	0.83	5.27
East Zone Total		**0.17**	**0.59**	**0.32**	**0.11**	**4.77**	**2.01**	**-0.15**	**3.59**	**1.53**
Haryana	North	5.55	2.08	6.12	12.58	3.43	4.38	6.66	1.32	-1.64
Himachal Pradesh	North	-0.69	-1.05	-0.44	0.56	-0.39	0.82	1.26	0.66	1.30
Jammu & Kashmir	North	1.37	-0.02	-0.43	2.47	0.10	-1.76	1.08	0.13	-1.30
Punjab	North	10.28	5.41	2.48	19.00	7.24	2.50	7.91	1.74	0.02
Uttar Pradesh	North	0.89	0.26	0.85	4.98	9.18	3.14	4.05	8.89	2.27
North Zone Total		**2.23**	**1.21**	**1.57**	**6.53**	**5.41**	**2.85**	**3.52**	**0.94**	**-1.72**
Andhra Pradesh	South	1.77	0.71	0.12	3.58	2.94	1.31	1.78	2.21	1.17
Karnataka	South	-0.59	0.18	1.70	0.35	-0.10	3.52	0.94	-0.28	1.76
Kerala	South	-0.37	-3.72	-5.48	0.33	-2.64	-5.58	0.71	1.12	-0.12
Tamil Nadu	South	-0.33	-2.88	1.58	1.71	2.23	1.86	2.05	5.26	0.27
South Zone Total		**0.55**	**-0.59**	**0.44**	**2.22**	**2.22**	**1.51**	**1.46**	**2.46**	**0.78**
Gujarat	West	-0.98	0.70	1.91	3.77	1.18	3.71	4.79	0.48	1.74
Madhya Pradesh	West	1.05	0.44	0.55	1.00	5.51	0.19	-0.05	5.05	-0.36
Maharashtra	West	0.87	-0.01	-0.73	5.10	0.22	1.37	4.20	0.23	2.12
Rajasthan	West	5.56	-3.76	46.53	10.92	-0.16	54.36	5.08	3.74	5.33
West Zone Total		**0.95**	**0.22**	**0.16**	**1.16**	**1.01**	**0.67**	**2.18**	**0.32**	**-1.77**
All-India Total		0.76	0.41	0.62	1.95	3.62	2.00	1.17	3.19	1.35

Source; Estimated from disaggregate time series data

Appendix Box 1 : Global Rice Outlook 2004

The Food and Agricultural Organisation of the United Nations (FAO)'s first forecast of paddy production in 2004 shows a 4 percent increase from the previous season, to 613 million tonnes, which would be the highest level on record. However, initial results from on-going harvests in countries in the southern hemisphere already point to a 3 million tonne increase from the previous season, to 81 million tonnes. Along the south of the equator, prospects are positive so far in Indonesia as well as Malaysia where some 400 000 hectares of new land have been opened for rice cultivation.

- By contrast, drought at planting time has limited the production potential in Sri Lanka. In Africa, the season is well advanced in Madagascar, Mozambique and Tanzania. In Madagascar, production might fall this year, reflecting a poor start of the season and the impact of two cyclones that hit the country at a critical stage of crop development. A recovery from last year's shortfall is anticipated in Tanzania.
- High prices last year bolstered plantings in most of South America. Favourable growing conditions have further boosted the outlook for Argentina, Brazil and Uruguay. By contrast, drought conditions are expected to impair production in Ecuador and Peru.
- Low water allocations to producers in Australia constrained plantings again this year, but were sufficient to sustain a 54 percent increase in production from the dismal outcome of last season.
- The early forecasts of 2004 paddy production in northern hemisphere countries are mainly based on the prevailing government policies, expectations of favourable producer prices and "normal" growing conditions.
- In Asia, China and India are expected to account for much of the anticipated increase in world output. In the first country, rising domestic prices have raised concern of an imminent tightness, which has prompted the government to launch several initiatives to boost production.
- Sizeable production gains are anticipated in Bangladesh, Indonesia, Philippines and the Islamic Republic of Iran,

consistent with the expansionary policies pursued by those countries.

- Production should recover in Japan and the Republic of Korea where adverse weather conditions hampered crops last season. Strong price incentives should also boost the sector in Thailand and Pakistan. By contrast, Viet Nam has set a smaller production target this season, reflecting a 10 percent loss of its winter-spring crop because of drought.

- In Myanmar, the disruption caused by sudden changes in policies and the resulting slump in domestic prices is also anticipated to depress output. Production in Africa is set to grow modestly, although government efforts to promote the sector could give rise to some increases in Ghana, Mali and Nigeria. High prices should also sustain growth in Egypt. High import prices should also boost output in Costa Rica, Nicaragua and Panama. In the rest of the world, the United States has forecast a record output in 2004, since producers are expected to respond to high prices by increasing plantings. Little change in production is currently foreseen for the EU, although the implementation of the new policy regime as of September, introduces some elements of uncertainty.

Contraction in international trade in rice 2004

- FAO's forecast of world trade in rice in 2004, which is largely determined by the outcome of production in 2003, has been reduced by some 0.8 million tonnes from the previous report to some 25.5 million tonnes, which is 2.5 million tonnes lower than the estimate for 2003. The lowering of the 2004 forecast mainly reflects a worsening of export prospects for China and India, which more than offset some upward revisions for Thailand, Cambodia, Egypt, the United States and Uruguay.

- According to the present outlook, China is anticipated to export 1.5 million tonnes during 2004, down from 2.6 million tonnes last year. In recent months the country has witnessed sharp increases in market prices that are likely to prompt the government, which holds a monopoly on rice exports, to restrict sales abroad. In India, steps have already been taken by the Food Corporation of India (FCI) to temporarily suspend sales for exports, pending an assessment of FCI buffer stocks, which were heavily depleted in the past two years.

- The ban coincided with the passing of new regulations, which will allow exporters to purchase rice directly from farmers rather than exclusively through the FCI. Sales from the country are currently prospected to hover around 2.5 million tonnes, down from 4.4 million tonnes in 2003. In January, Myanmar also prohibited exports for six months. As a result, the country's exports are forecast at 500 000 tonnes, little changed from last year but well below the country's potential.

- United States' shipments are expected to drop from 3.8 million tonnes to 3.2 million tonnes, constrained by high domestic prices and falling availabilities. Limited supply should also restrain sales from Australia to 200 000 tonnes, or about one-third of "normal" levels. Similarly, exports from Japan and the Republic of Korea, most of which are made in the form of food aid, are anticipated to be smaller following last season's production shortfalls and dwindling stocks.

- By contrast, shipments from Pakistan should remain of the order of 2 million tonnes, especially if the government maintains transportation subsidies, while sales by Thailand and Viet Nam, the two major rice exporters, are officially foreseen to increase to 8.5 million tonnes and 4.0 million tonnes, respectively. Viet Nam's export performance, however, will depend critically on the size of the winter/spring crop currently at the harvest stage.

- Scarcity of supplies already prompted the Government to advise exporters to refrain from signing new contracts requiring deliveries before the next harvest in June. In the rest of the world, favourable crops and higher international prices should boost shipments by Argentina, Uruguay and Egypt.

- The reduction in the 2004 global import forecast reflects a number of adjustments that take into account the prospects of higher prices and freight rates and the reduced availabilities in China and India.

- For instance, the forecast of aggregate imports by African countries, part of which were sourced in those two countries, has been cut. At the same time, the forecast of imports by China was raised, following news of an intensification of trans-border movements of rice into the country.

- Compared with 2003, imports by Asian countries are now anticipated to fall, mainly on account of weaker demand by Bangladesh and the Philippines following excellent harvests in 2003, and by Indonesia, where imports have been banned from 20 January to 30 June.

- Despite the recent announcement of the liberalization of rice imports by the Islamic Republic of Iran, the imposition of high tariffs (100 percent ad-valorem tariff plus a discretionary duty of some US$190 per tonne this year) and improved domestic availability should also result in reduced shipments to the country. Smaller flows of food aid are likely to cut overall rice deliveries to the Democratic Republic of Korea.

- By contrast, Iraq, where the control over food grain procurement passed from the World Food Programme to the country's Ministry of Trade in April, is anticipated to import 1 million tonnes, up from 700 000 tonnes last year. China (mainland) is foreseen to purchase about 1.2 million tonnes, the highest level since 1995. In Africa, overall rice imports are likely to fall again this year, especially if world prices and freight rates keep rising, with the Cote d'Ivoire, Nigeria and Senegal accounting for much of the contraction.

- However, deliveries to Ghana and Madagascar are forecast to increase, to compensate for the latest season production shortfalls. In Latin America and the Caribbean, Brazil cut the official import forecast to 550 000 tonnes, down from over 1 million tonnes in 2003, in anticipation of a good 2004 paddy harvest. However, deliveries to both the Dominican Republic and Peru are foreseen to increase substantially, to compensate for smaller domestic supplies.

- Among the other major rice markets, deliveries to the United States are anticipated to be larger, attracted by high domestic prices.

- The Russian Federation is also foreseen to step up its purchases, especially since, unless extended, the 10 percent tariff would no longer be subject to a minimum value of €30 per tonne as of 20 March. Imports to the EU are provisionally forecast to remain of the order of 700 000 tonnes, although the halving of intervention prices as of September 2004 might result in much lower variable import duties.

Stable overall rice consumption

- World rice utilization is forecast to reach some 415 million tonnes, in milled equivalent, little changed from the previous year. Most will be used for human consumption, with food utilization estimated to fluctuate around 368 million tonnes. On a per capita basis, rice food consumption is forecast at 58.6 kg in 2004, down slightly from 58.7 kg last year. Consumers are likely to face price rises this year, which will be compounded in the major importing countries by sharp increases in freight rates.

Global carry over stocks to fall for the fourth consecutive year

- Since global rice utilization is again anticipated to outstrip production, global rice stocks are forecast to fall to 102 million tonnes at the close of the marketing season ending in 2004, down from 120 million tonnes a season earlier. As in the previous years, China is likely to account for much of the contraction, as the country end-of-season inventories could shrink from 78 million tonnes to 62 million tonnes.

- Among major exporters, a decline is anticipated in Australia, Egypt, Thailand and the United States. Rice reserves should also diminish in some major importing countries, including the Islamic Republic of Iran and the Philippines, in part due to reduced imports prospects, as well as in Japan, the Republic of Korea, following last season production shortfalls.

- By contrast, carry-over stocks might increase somewhat in India, though remaining well below historical levels, and in Myanmar, but would change little in Viet Nam.

Rising International rice prices

- Rice prices recovered strongly over most of 2003, as reflected in the FAO all Rice Price Index (1998-2000=100), which averaged 82 for the whole year, up from 72 in 2002. The strength persisted in the first few months of 2004 as supplies tightened in major exporting countries. In March 2004, the index reached 109, the highest level since February 1999, and 20 points above the value in October.

- Although the past five months coincided with the harvesting of the main paddy crops in major exporting countries, prices of all the various types and qualities of rice have followed a rising trend since October.

- For instance, within the high quality Indica rice segment, the price of Thai 100%B rice rose from US$199 per tonne last October to US$253 per tonne in March, with an even stronger increase reported for rice from Pakistan. As for the lower quality Indica, the Thai A1 Super quotations passed from US$158 to US$213 over the period, sustained by the withdrawal of Myanmar and Indian exporters from the market.

- Particularly strong price increases also affected medium grain rice, with the Japonica rice price sub- index surging 21 points between October and March. The rise was less pronounced for aromatic rice prices, the index of which rose by 6 points in the same period.

- International rice prices are expected to increase further in the coming months, especially if China, which will not harvest its early rice crop before June, intensifies its purchases. However, the pressure would be mitigated, should Myanmar or India lift their restrictions on rice exports.

Source : Derived from the FAO reports on rice April, 2004

Appendix Box 2 :
Rice Science perspectives :
Views on cause and effect relationship in rice

A quote from a presentation by Ronald Cantrell, former Director-General, IRRI 2004.

- Asia's rice industry is in crisis due to inadequate support, driving farmers into penury and spurring mass migration with potential adverse implications on regional security.
- Not only is the rice industry in Asia facing a crisis in the supply of such essential resources as land, labor and water, but — most importantly of all — many nations are finding it difficult to develop sustainable ways to provide decent livelihoods for rice farmers and consumers.
- The stability in Asia including the troubled nations of Indonesia and the Philippines, is threatened by the continuing lack of development in its most important cereal crop.
- Rice farming remains a poverty trap in many Asian nations, mainly because of very small farm size and compounded by declining support for public rice research.
- Asia's rice producers enjoyed annual yield increases of 2.5 percent and production gains of more than three percent between the early years of the Green Revolution and up to the early 1980s. However, from the late 1980s until the late 1990s, the rate of annual yield increase was nearly halved, and the rate of production increase fell even further.
- As stagnating yields push them deeper into poverty, many rural rice communities in Asia are growing increasingly restless.
- Poverty and a lack of opportunity foster instability in socio economic and geo-politico sphere. A lack of opportunity in heavily agricultural Tenggulun has forced 20 percent of its working-age population to leave in search of employment — a story repeated time and again throughout rural Asia."
- At the same time the international support for public rice research has been collapsing, with mainly Western donor

nations taking aid money elsewhere, including to Africa after having achieved "visible success" in Asia.

- Moreover, new rice technologies have not reached ordinary farmers in many countries because the extension systems for delivering them are chronically underfunded.

- Assuming there are 200 million rice farmers in Asia, an investment of just 40 cents per farmer for each of the next 20 years would go a long way toward ensuring that they can earn a decent living sustainably supplying poor rice consumers with plentiful supplies of affordable, nutritious rice.

- Rice is so central to the lives of most Asians that any solution to global poverty and hunger must include research that helps poor Asian farmers reduce their risks and earn a decent profit while growing rice that is still affordable to poor consumers.

- It is thus essential to renew focus on the development of sustainable strategies to feed half of the world's population that depends on rice.

- Recognizing its importance, the United Nations declared the United Nations International Year of Rice 2004 for focusing on the food security of three billion rice eaters. Rice, covering about 150m hectares world-wide, has a profound impact on the environment and natural resources. It also threw a big challenge facing Asia, to meet national and household food security needs with an ever-declining natural resource base, especially water and land.

- Current annual rice production of 545m tonnes needs to be increased to 700m tonnes to feed an additional 650m rice consumers by 2025, using less water and less land, which is a big challenge. In addition, rice is seen as crucial in meeting a prominent UN Millennium Development Goal — the eradication of extreme poverty and hunger.

- Seven "key challenges" were mentioned to producing enough rice for the world and doing it sustainably. These are poverty and the environment, farm chemicals and residues, land use and degradation, water use and quality, biodiversity, climate change and the use of biotechnology. Each of these issues is crucial to rice production and efforts to ensure that the 800m rice consumers who have been trapped in poverty in Asia can get access to the rice they need to feed themselves and their families

- The fluctuating production and price of rice has been notable. As international rice prices jumped in the year 2004 by a surprising 40% because of shortages in some countries, we are reminded that we cannot take Asia's ability to feed itself for granted. If we do, millions will suffer because of our complacency.

- Since the start of the Green Revolution — which began in Asia with the IRRI's release in 1966 of IR8, the first modern, high-yielding semi dwarf rice variety — supporters of this technology-based drive say global rice harvest has more than doubled, racing slightly ahead of population growth.

- Farmers have also benefited as improved efficiency has lowered unit cost and increased profit, they say.

Source: Rice Reporter, November 2004

Appendix Box 3:
A lesson from PUNJAB model of Agriculture

Punjab agriculture as it stands today manifests a model of overall holistic approach to development. The growth has been induced by systematic planning and designing the development of the entire range of infrastructure affecting and supporting the sustainable agricultural production.

- Punjab scaled the vertex of developmental pyramid from almost an ordinary level in the 1950s to a proud stage of a "little-big" status in the present years. It claims little as Punjab occupies only 1.5 per cent geographical area in the country, and big because it contributes bulk to the central pool and nearly 95 per cent of interstate movement of foodgrain is from the stock procured at the state. Punjab leads the other States in terms of contribution of wheat and rice to Central Pool. It contributed 51.8 percent of wheat and 48.8 percent of rice to Central Pool in 2002-03. The total contribution of wheat and rice to the Central Pool has increased from 115.6 lakh tonnes in 1990-91 to 178.0 lakh tonnes during 2002-03 consisting of 98.6 lakh tonnes of wheat and 79.4 lakh tonnes of rice. Therefore the Punjab glory is basically a glory of agriculture.

- How does Punjab climbed such a glorious peak in a short period of history is a question worth emulating. A related question arises that why the Punjab model does not replicate in other states.

- An in-depth understanding of the agricultural development in Punjab requires a thorough both historical and contemporary account of the design and the process of growth and development.

- Agriculture is the most important sector and is the backbone of the State economy, which contributed 24.4 percent of Gross State Domestic product at constant prices (1993-94) during 2002-2003 and around 39.4 percent of the working population of the State is employed in this sector.

- The resource base of the state is almost fully utilized as 97.6 percent of cultivable land in the State is under plough. Thus, there is a little scope to bring more area under cultivation. The agriculture production can only be increased through enhanced cropping intensity, change in cropping pattern, improvement in seeds of high yielding varieties, cultivation practices and with the availability of better post harvest technology etc. State Govt. is trying to re-orient agriculture in this direction through various policy measures.

A historical perspective of agricultural scenario

- The developmental regime in Punjab agriculture can be divided into three distinct stages viz., a period of relatively dismal performance at the dawn of independence, post independent era of preparedness for structural change in agriculture, green revolution and quantum jump.

- Punjab was among the other states, and little known in the country at the dawn of Independence. It suffered due to the scar of a food grain deficit area. In 1951, total production of food-grains production was about 1.99 million tonne only, which was dominated by wheat at 1.10 million tonne and rice 0.11 million tonne. About 54 per cent of Gross Domestic Product of the state of Rs. 655 crores only (1970-71 prices) was originated from the agriculture sector. Although at that time, foodgrain crops occupied a major share in the cropping pattern at 68 percent of the cropped area, yet 32 percent of the area was cropped with pulses and coarse grains, mainly on un-irrigated lands. With net area of 3544 thousands hectare and gross cropped area of 4170 thousand hectare, intensity of cropping was 118 per cent only. Fertilizers and pesticides were rarely used, tubewells and tractors were unknown to the farmers in the state. Only 52 per cent of the area was irrigated and land holdings were quite fragmented.

- The state responded to this dismal performance and made adequate preparation for ushering a change. It resorted to policy implementation of mandatory consolidation of land holdings, which was considered a prerequisite for effective use of canal irrigation water that became available through the Bhakra Nangal Canal System. The availability of hydel power encouraged the installation of tubewells on consolidated holdings that provided assured irrigation supplementing the canal water supply. Although, the share of agricultural GDP remained at 54 per cent even in 1960-61, production of foodgrain improved to 3.16 million tonnes of which wheat was 1.74 million tonnes and rice 0.25 million tonnes. Irrigated area increased to 54 per cent of the net sown area and cropping intensity improved to 121 per cent.

- Yield of wheat in 1960-61 was still 1.24 tonne per ha. and of rice was 1.0 tonne. Similarly productivity of other crops; American cotton was 0.27 tonne and sugarcane 36.54 tonne only. Productivity of crops started improving but only marginally. Therefore, agricultural situation witnessed a marginal improvement up to the mid-60s.

The factor of change and Green Revolution

- The vigorous multi-pronged policy implementations during the late 1960s and 1970s provided adequate impetus for a changed the agricultural situation dramatically consequential upon the consolidation of holdings, availability of canal water, tubewell irrigation and establishment of Punjab Agricultural University with strong research and extension education components that developed close interactive relationship with the various stakeholder in the state in 1962. Introduction of dwarf wheat germplasm and cultivators from CIMMYT Mexico in 1964-65 and required assured irrigation, revolutionized agriculture in Punjab and set the stage for wheat-based green revolution in the state.

- With the indulgence of the state in creating conducive production environment, assured remunerative prices provided by the government through price support and procurement system as well as spread of rural and approach roads network, production and productivity as well as agricultural income induced the positive change quite fast. Tractors and tubewells started dotting the landscape everywhere, uses of fertilisers and pesticides expanded and irrigated area as well as intensity of cropping started increasing. Even net sown area also increased.

- Cropping pattern started witnessing significant change. The foundations of the green revolution were thus laid and enabling infrastructural, technological and economic environment was rendered conducive for the interaction of elements of growth and productivity in the state.

- Dwarf varieties for paddy crop were introduced and production increased manifold. New dwarf varieties of rice from IRRI were introduced and the area under rice production started expanding.

- Net sown area increased from 3.76 million hectare in 1960 - 61 to 4.05 million hectares in 1970 - 71. Gross sown area increased from 4.73 to 5.68 million hectare and cropping intensity improved from 121 to 140% over the same period. Share of area under wheat increased from 29% to 40% of the total cropped area.

- Production of food grains in 1970-71 more than doubled to 7.3 MT from 3.16 MT in 1960-66, with wheat production increasing to 5.15 MT. Wheat and rice played a major role in pushing up agricultural production. During the year 2002-03, 100 percent area of rice and wheat was under high yielding varieties. The production of rice of 65.06 lakh tonnes in 1990-91, increased to 88.80 lakh tonnes in 2002-2003 showing an increase of 36 percent. Similarly, the production of wheat, which was 121.59 lakh tonnes in 1990-91 rose to 141.75 lakh tonnes during 2002-2003 registering an increase of 17 percent.

- Input use revolution and green revolution matured in 1970s:

- It is a notable that within a decade, the state achieved marvelous success in agriculture. With the introduction of dwarf varieties for wheat and paddy, production increased manifold. By 1970-71 GDP of the state at constant prices increased to Rs1509crore, having the agricultural share of Rs 866 crore, which jumped about 86 per cent in one decade. Net sown area increased from 3.76 million hectare in 1960-61 to 4.05 million hectares in 1970-71. Gross sown area increased from 4.73 to 5.68 million hectare and intensity cropping improved from 121 to 140 per cent over the same period.

- Production of food grains in 1970-71, more than doubled to 7.3 million tonnes from 3.16 million tonnes in 1960-6, with wheat production increasing to 5.15 million tonnes. Rice did not as yet caught the imagination of the farmers although area under this crop and production had started increasing and the future looked bright.

Quantum jump

- From here on agricultural sector growth made a quantum jump. The growth in agriculture initiated by green revolution in wheat crop production in late sixties and further fuelled by rice revolution in mid-70s, continued un-abated under conducive commercial environment. By 1993-94, the GDP of the state had increased to Rs. 4565 crore at 1970-71 prices. Agriculture Sector GDP touched an all time high of Rs 2135 crore, whose share declining to 47 per cent from 54 per cent in 1970-71. Net sown area increased almost to its limit of over 4.2 million hectares. With cropping intensity of 181 per cent, the gross cropped area increased to over 62 million hectare. In the cropping pattern, wheat occupied 44 per cent of the gross cropped area and rice at 29 per cent, the foodgrain crops accounted for 76.9 per cent of the gross cropped area.

- During this period productivity improved dramatically with wheat yield increasing from 2.24 tonne to 4.01 tonnes per hectare and rice from 1.77 (2.68 tonnes in rough rice) to 3.51 tonne (5.32 tonnes rough rice) per hectare. Productivity of other crops also improved but not that significantly. The conducive policy impetus propelled the expansion of tubewell irrigation, tractor cultivation and intensive use of fertilizers. Fertilizer use increased from 54 kg per hectare of net area sown in 1970-71 to 266 kg per hectare in 1993-94. Pesticides use increased manifolds. The number of tractors increased from 10 to 80.3 per thousand hectare of net sown area and tubewells number increased from 192 thousand to 850 thousands in the state. Area irrigated increased from 71 to 93 per cent of the net sown area. This demonstrated a revolution in input use in the state. As a result, the cropping intensity increased to 181 per cent. Production of foodgrain increased to 21.58 million tonne, with wheat production at 13.34 million tonne and rice 7.65 million tonne.

Present Scenario

- At present over 84 per cent of the total geographical area of the state stands cultivated. Only about 28 thousand hectares land is classified as cultivable waste. This, however, limits the scope for expansion of crop cultivation horizontally. Moving ahead vertically, the cropping intensity has already touched over 186 per cent in the 2003-04. Moreover, with the restrictive policy followed on the present set of main economic crops grown in the state, Punjab seems to poise for another revolutionary change in the structure of agriculture. While trying to break the dominance of "prize-winning" rice-wheat system, state has already diverted about 1.75 lakh acres of area under crop diversification in 2003-04 up from 12234 acres in rabi 2002. It is proposed to cover an area of 22 lakh acres under the crop diversification based contract farming in the next 4-5 years. Newer crops such as Hyola, Barley, winter Maize, Guara, Moong, Castor etc. are put into cropping system. Corporate houses such as Rallis India, Mahindra Shubhlabh, Escort, DCM Hariyali and United Brewaries have participated in the innovative crop diversification programme. Can it pave the path for another success story?

- The last few years show a changing the scenario, which needs careful attention in the context of overall sustainability of food security of the country. Total food grain production has decreased from 249 lakh tonnes in 2001-02 to 235 lakh tonnes in 2002-03 showing a decline of 5.66 percent. The gross area under food grains has also decreased from 6155 thousand hectares in 2001-02 to 6132 thousand hectares in 2002-03 showing a decrease of 0.37 percent. Though, rice production shows a marginal increase of 0.63 percent, the wheat production has recorded a negative growth rate of 8.60 percent in 2002-03 over the previous year.

Source : www.punjabgov.nic.in, 2004