Changing Acres
Sustainable Agriculture Country Profiles

India
Dr. Alexander Daniel

Asia and the Pacific
Sustainable Agriculture

The Indian Scenario

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June 1996
Changing Acres is the publication series of PAN AP's regional study on sustainable agriculture. The study launched in February 1994, is intended for policy and strategy building to strengthen sustainable agriculture development in the region. The initial exercise, including country profiles, a benchmark survey and selected farm case studies, covered seven countries: India, Indonesia, Malaysia, Nepal, Pakistan, Philippines and Sri Lanka.

A subsequent joint project undertaken in 1996, between PAN AP and IFOAM-Asia extended country profile coverage to another seven countries: Bangladesh, Cambodia, China (People's Republic), Korea (South), Laos, Thailand and Vanuatu.

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Acknowledgment
PAN AP would like to thank the following for their work and contribution to this initial set of country profiles and case studies:

the respective authors, writers and researchers,

PAN AP staff, particularly Ong Kung Wai, for project coordination,

Vicky Lopez, Shen Maglinte, Gloria Benjamin, Teng dela Cruz and Jobe Benosa of SIBAT Philippines, for editing and layout, and

DANIDA, for financial support of the initial set of country profiles and case studies.

Pesticide Action Network Asia Pacific (PAN AP)
December 1997
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Country Profile

Summary

Decline of sustainable agriculture, in India, can be traced to colonialism and the lopsided manipulation of India's economy in the interests of the foreign rulers.

Pre colonial Era

Indian culture is expressed in its agriculture which is traditionally self-reliant, self-sufficient and exist in harmony with nature. Before colonial intervention, India was ruled by hundreds of benevolent monarchs, who patronised agricultural activities. Promotion of agricultural activity in the princely states include construction of tanks, earthen/stone dams, canal systems, markets, roads and resting places for itinerant agricultural traders. Self sufficiency was the core principle around which village economies evolved, and local administrations (panchayats and similar bodies) took keen interest in environmental enrichment, such as harvesting rainwater, growing of trees for green manuring and maintenance of friendly and healthy relationship with the cattle population.
A survey conducted on agricultural productivity during the pre-British period, on the basis of ancient palm leaf records in 800 villages in South India, indicated an average productivity of 3600 kg per hectare in very prosperous areas. Paddy yields touched as high as 8200 kg per hectare. Indian agriculture productivity was definitely much higher than the western world, at the time, and were based on caring for the soil, recycling of organic matter, multiculture, crop rotation and prudent water management. The practices arise out of the eco-friendly policy of thousands of panchayats and princely governments.

Colonisation

Colonisation severed the roots of sustainability of Indian agriculture, by destroying the self-sufficient and self-reliant nature of village economies. Decline of sustainable agricultural practices in India can be traced to the decline of Indian handicrafts with the opening up of the Indian economy for large scale machine made goods from Britain. Hordes of unemployed skilled labour turned to agriculture as a means of subsistence. In the middle of the 19th century about 35 percent of the population depended on agriculture, in 1901 it was 68 percent, in 1931 it increased to 72 percent.

The early phase of British rule was characterised by the lack of a state policy for agriculture. The main thrust of British India agriculture was molded through representations from planters associations, i.e. representative bodies of British tea, coffee, cardamom and rubber. Introduction of land tenure systems, opening up of road and rail communications favoured the promotion of export trade, in tea, coffee and spices.

Frequent famines subsequently led the British to establish a separate department of Agriculture in 1871. After the Great Famine of 1876-78, the Famine Commission was appointed in 1880. The Royal Commission on Agriculture (RCA) appointed in 1926 was the first effort by the colonial rulers to develop a comprehensive policy towards agriculture in India. The RCA made detail suggestions and recommendations, resulting in the establishment of the Imperial Council of Agricultural Research. Activities to encourage co-operative credit, irrigation, seed production and improved implements followed.

The new policies however, could not make much headway. World War-II generated steep demand for commercial crops like jute, cotton and ground nut, leading to a steady decline in the area under food grains. In 1943, the eastern region of India was subject to unprecedented famine and loss of life. This made the government take wider responsibilities. It then issued a statement on Agriculture and Food policy in India.

According to the Statement, “The all-India policy is to promote the welfare of the people and to secure a progressive improvement of their standard of living. This includes the respon-
sibility of providing enough food for all, sufficient in quantity and of requisite quality. For the achievement of this objective, high priority will be given to measures for increasing the food resources of the country to the fullest extent, and in particular to measures designed to increase the output per acre and to diminish dependence on the vagaries of nature. Their aim will be not only to remove the threat of famine but also to increase the prosperity of the cultivator, raise levels of consumption and create a healthy and vigorous population."

The ten objectives of the policy include increase in production of food grains and protective foods; improvement in methods of agricultural production and marketing; stimulating production of raw materials for industry and exports; securing remunerative prices for the producer and fair wages to the agricultural labour; ensuring fair distribution of the food produced; and promoting nutritional research and education.

Post independence and present day

In the early fifties, India faced the serious crisis of low production, low productivity, heavy farm debts and exploitative land tenure systems. From this state of hopelessness and hurdles, the agricultural sector was lifted into a sector which now produces enough for the population and generates creditable export surplus. As we review Indian Agriculture (as on May 1995), we can look back with great satisfaction. Nature provided an excellent support with seven successive favourable monsoons. The country achieved a record food grains output of 191.1 million tonnes in 1994-95, around 3.7 percent more than the previous year. It then dropped marginally to 185 million tonnes in 1995-96 due to some unseasonal rains.

While the story of success is laudable, the effort to reach higher levels of production, through Green Revolution technologies, have left many side effects which continuously impair the sustainability of Indian agriculture. (Green Revolution is the aggressive propagation package of agricultural practices involving hybrid seeds, chemical fertilizers, pesticides, irrigation, monoculture patterns, mechanization, along with easily available credit schemes)

It is high time for Indian agriculture to make another turn and adopt a renewal of holistic traditional practises through organic agriculture. Whilst it is true that the Indian agricultural economy has lost much of its inherent strength in the race to enhance production, we can never underestimate the strong nationalistic effort of Indian planners. Their contribution made India independent of food deficits and the humiliating food aid from other nations, especially the United States under PL-480.

Alex Daniel
I. **Biophysical Characteristics**

**Location**

India consists geographically of the entire Indian Peninsula and portions of the Asian mainland. It is bounded on the north by Afghanistan, China, Nepal and Bhutan; on the east, by Bangladesh, Burma (Myanmar) and the Bay of Bengal; on the south, by Palk Straits and the Gulf of Mannar (separating it from Sri Lanka) and the Indian Ocean; and on the west, by the Arabian Sea and Pakistan. The capital is New Delhi. The country’s largest city is Bombay.

**Land**

India covers more than two-thirds of the entire area of the Indian subcontinent. With Jammu and Kashmir (the definitive status of which has not been determined), India has an area of 3,287,263 sq km (1,269,219 sq miles). India may be divided into four main regions: the Himalaya, the northern river-plains region, the Deccan, and the Eastern and Western Ghats.

The Himalaya is a mountain system, about 160 to 320 km (about 100 to 200 mi) wide, which extends about 2,415 km (about 1500 mi) along the northern and eastern margins of India. The Himalaya is the highest mountain system in the world.

South and parallel to the Himalaya lies the northern river-plains region, a belt of flat, alluvial lowlands about 280 to 400 km (about 175 to 250 miles) in width. The region comprises the major part of the vast plains area watered by the Indus, Ganges, and Brahmaputra rivers. The plains extend from the border with Pakistan to the border with Bangladesh and continues east into Assam. The Ganges River and its tributaries traverse the central and western portions of the Indian plains region. The Brahmaputra River and its affluents supply water to the Assam region. The Indus River rises in Tibet, flows west through Jammu and Kashmir, and crosses into Pakistan. The Northern plains region, with its abundant water and rich alluvial soil, is said to be the most fertile and the most densely populated area of the republic. The plains are also said to be the cradle of Indian civilization.

Occupying most of peninsular India is the Deccan in the South. The Deccan, a vast, triangular tableland is a generally rocky and uneven plateau which is divided into natural regions by low mountain ranges and deep valleys. Elevations range from about 305 to 915 m (about 1000 to 3000 ft), although outcroppings as high as about 1220 m (about 4000 ft) occur. The Deccan Plateau is bordered on the east and west by the mountain systems of the Eastern Ghats and the Western Ghats.
The Eastern and Western Ghats have a general elevation of 460 m and 915 m respectively. The Western Ghats overlooks the Arabian Sea. The fertile Malabar Coast is between the Western Ghats and the Arabian Sea. Between the Eastern Ghats and the Bay of Bengal is the Coromandel Coast, a narrow coastal plain.

**Land Use**

The area under farming is 45 percent of the total geographical area. This is one of the highest in the world.

The area under cultivation (net sown area) increased from 41.8% in 1950-51 to 46.3 percent in 1970-71 and stagnated since. Forest cover is estimated at 67.76 million ha. Only 40 percent has a crowned density of 40 percent or more, which is approximately 11.7 percent of India’s total area.

Irrigated area is only 59.64 million ha as against the gross cropped area of 181.14 million ha. The rest is rain-fed.

### Table 1: All-India land use classification

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<tr>
<td>Total geographical area: 328.73 Million hectares</td>
<td>(P): projections</td>
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<tr>
<td>1. Forests</td>
<td>40.48</td>
<td>54.05</td>
<td>63.91</td>
<td>67.47</td>
<td>67.76</td>
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<td>(14.2)</td>
<td>(18.1)</td>
<td>(21.0)</td>
<td>(22.2)</td>
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<td>(3.3)</td>
<td>(5.0)</td>
<td>(5.4)</td>
<td>(6.4)</td>
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<td>(13.4)</td>
<td>(12.0)</td>
<td>(9.3)</td>
<td>(6.6)</td>
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<td>(2.3)</td>
<td>(4.7)</td>
<td>(4.4)</td>
<td>(3.9)</td>
<td>(3.8)</td>
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<td>5. Land under misc. tree crops and groves</td>
<td>19.83</td>
<td>4.46</td>
<td>4.30</td>
<td>3.60</td>
<td>3.57</td>
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<td>(7.0)</td>
<td>(1.5)</td>
<td>(1.4)</td>
<td>(1.2)</td>
<td>(1.2)</td>
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<td>6. Cultivable waste</td>
<td>22.94</td>
<td>19.21</td>
<td>17.50</td>
<td>16.74</td>
<td>15.04</td>
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<tr>
<td>(8.1)</td>
<td>(6.4)</td>
<td>(5.8)</td>
<td>(5.5)</td>
<td>(4.9)</td>
<td></td>
</tr>
<tr>
<td>7. Old fallow</td>
<td>17.44</td>
<td>11.18</td>
<td>8.76</td>
<td>9.92</td>
<td>10.62</td>
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<tr>
<td>(6.1)</td>
<td>(3.8)</td>
<td>(2.9)</td>
<td>(3.3)</td>
<td>(3.5)</td>
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<td>8. Current fallow</td>
<td>10.68</td>
<td>11.64</td>
<td>11.12</td>
<td>14.83</td>
<td>15.72</td>
</tr>
<tr>
<td>(3.8)</td>
<td>(3.9)</td>
<td>(3.5)</td>
<td>(4.9)</td>
<td>(5.1)</td>
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<tr>
<td>9. Net sown area</td>
<td>118.75</td>
<td>133.20</td>
<td>140.27</td>
<td>140.00</td>
<td>139.52</td>
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<td>(41.8)</td>
<td>(44.6)</td>
<td>(46.3)</td>
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<td>10. Area sown more than once</td>
<td>13.14</td>
<td>19.57</td>
<td>25.52</td>
<td>32.63</td>
<td>41.62</td>
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<td>11. Cropping intensity (Gross cropped area x 100/net sown area)</td>
<td>111.1</td>
<td>114.7</td>
<td>118.2</td>
<td>123.3</td>
<td>129.8</td>
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<td>12. Gross irrigated area (Source: The Hindu Survey of Indian Agriculture 1994)</td>
<td>22.56</td>
<td>27.98</td>
<td>38.19</td>
<td>49.78</td>
<td>59.64</td>
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Soil

Alluvial soil is the largest and most important soil group of India. Alluviums derived largely from the Indus, Ganges and Brahmaputra systems of the Himalayas, make for fertile river banks. Others include black, red, desert and lateritic soil.

Climate

The climate of India is generally known as the tropical monsoon type. Because of its peninsularity, unusual topography and geographical position, climatic conditions are widely diverse, on both seasonal and regional basis. The diversity ranges from tropical to temperate zonal extremes, with temperature extremes confined largely to the slopes of the Himalaya.

Except in the elevated regions, most of India has a uniform tropical climate. Seasonal variations, from the southwestern and northeastern monsoons, significantly influence temperature, humidity, and precipitation throughout the subcontinent. For general purposes, the seasons of India may be classified as rainy and dry.

India's agriculture depend on a successful southwest monsoon which is the source of about three fourth of India's annual rainfall. The rainy season of the southwestern monsoon, a moisture-laden wind blowing off the Indian Ocean and the Arabian Sea, extends from June to November. Beginning early in June on the western coast of the peninsula, the monsoon gradually affects almost the entire country. Occasionally the winds fail to deposit sufficient rain causing severe droughts and famines.

The cool season of the northeastern monsoon, extending from early December through February, is usually accompanied by extremely dry weather. Severe storms, attended by slight precipitation on the northern plains and heavy snowfalls in the Himalaya, sometimes cross the country. The hot season, which starts in the middle of March and extends until the onset of the southwesterly monsoon, reaches its most oppressive stage in May, with temperatures as high as 47°C (116.6°F) commonly recorded in central India. Few areas in central India have recorded temperatures above 50°C. Annual mean temperatures around Calcutta is about 26.1°C (about 79°F); about 27.8°C (about 82°F) in the west central coastal region; and about 28.9°C (about 84°F) in the vicinity of Madras.

Droughts and floods are usual in India. Whilst one part of India experiences severe drought, the other part could be reeling under the effects of flooding. When the annual rainfall is less than 75 percent of the normal, drought is said to occur. On the other hand, if rainfall exceeds 400-500 mm within 24 hours, there would be flooding. Droughts leading to famine occurs in Bihar, West Bengal, Orissa, Rajasthan, Maharashtra, Tamil Nadu, Karnataka and Andhra Pradesh. Flooding occurs mostly in Tamil Nadu, Assam, Bihar, West Bengal, in the foothills of Himalayas and in southern Andhra Pradesh.
Plants and Animals

India has a rich biodiversity, with 75,000 species of fauna and 45,000 species of flora. Many of which are considered endangered: 79 species of mammals, 45 species of birds, 16 reptiles, 3 amphibians and 1,500 plant species.

In the arid areas adjoining Pakistan, the flora of India is sparse and largely herbaceous. Various thorny species, including representatives of the genera Capparis (caper) and Zizyphus (jujube) are common. Vegetation, mangrove and sal flourish in the southeastern part of the plains region. Many varieties of arctic flora are found on the higher slopes of the Himalaya. There are numerous families of subtropical plant life, particularly the orchidaceae. Conifers such as cedar and pine, tower in the northwestern portion of the Himalaya region while tropical and subtropical types of vegetation abound in the eastern portion. The Malabar Coast in southwestern Indian peninsula and the slopes of the Western Ghats, (areas of much rainfall), are thickly wooded with valuable timber (like teak), evergreens and bamboo. There are extensive tracts of impenetrable jungle in the swampy lowlands and along the lower elevations of the Western Ghats. The Deccan plateau has less abundant vegetation, but imbued with thickets of bamboo, palm and deciduous trees.

The forests, plains, hills, and mountains of India are inhabited by a wide variety of animal life which includes in some sections: tigers, snow leopards, jungle cats and clouded leopard, cheetah, elephant, rhinoceros, guar, black bear, wolf, jackal, dhole, wild buffalo, wild hog, Venomous reptiles (including the cobra, the daboia, and saltwater snakes) and pythons which consume destructive rodents. The reptilian fauna also includes the crocodile. Among noteworthy examples of the tropical bird life of India are the parrots, peacock, kingfisher and heron. The rivers and coastal waters of India teem with marine life.
II. Socio-Economic Background of Indian Agricultural Sector

The Indian Economy

The Government of India today, supports a mixed economy, most of which is in the control of private enterprise. Earlier, under a 1956 policy, the government undertook a plan to nationalize entire segments of the economy, leaving other sectors subject to varying degrees of governmental planning and control. Government control, is being rolled back at a gradual rate.

Successive five-year plans since 1951, have achieved a steady rate of economic growth, except for periods of severe drought, as in 1979 and 1987. In 1992 India's gross domestic product was estimated at US$ 269.7 billion. The economy grew at an annual average of 3.6 percent from 1965 to 1980 and 5.2 percent from 1980 to 1988. The estimated annual budget during 1995-96 included revenues of about Rs. 231,018 crore and expenditure of Rs. 339,485 crore (1 crore = 10 million and US$1 in Mar. 96 = Rs. 33.45).

The weaving of cotton fabrics, mostly used domestically, is the leading manufacturing industry in India. The annual output of cotton cloth was about 17,252 million sq. m in 1995-96. The manufacture of jute products (1.4 million metric tonnes) ranks next in importance to cotton weaving. The iron-and-steel industry was greatly expanded in the 1950s, and by the late 1980s finished steel production climbed to about 10.4 million metric tonnes annually.

Other important industries are carpet weaving, tea processing, rice processing, cotton ginning, flour milling, printing, petroleum refining, sugar refining, and the manufacture of lumber, wool and silk goods, leather, electrical and electronic equipment, motor vehicles, chemicals, tile and bricks, linseed and other vegetable oils, paper, iron, aluminum, brass, tobacco products, and railroad equipment. Renowned high-quality handmade products include wood carvings, pottery, and brass, copper and silver objects.

India's major exports include clothing, gems and jewelry, sugar, tea, jute manufactures, textile yarns and fabrics, chemicals, leather goods, iron and steel, jewelry, and metal ores. Whilst export of indigenous products are considerable, India is largely dependent on foreign purchases for various commodities, including manufactured goods, raw materials, and foodstuffs. Among the principal products imported into the country are petroleum, precious and semi-precious stones, chemicals, metals, and machinery. India's import trade is extensive and an unfavorable annual balance of trade is a traditional feature of the Indian economy. During 1995-96, the country's annual import cost some US$ 38.3 billion, and its yearly export earned about US$ 33.2 billion.
Countries maintaining large-scale commercial relations with India include the United States, Germany, Japan, Great Britain, Saudi Arabia, Belgium, the Commonwealth of Independent States, and the United Arab Emirates.

Agriculture’s Contribution to GDP

Agriculture is the primary occupation of more than 60 percent of India’s people, which generates about one-third of the country’s annual domestic product. Most farms are very small. Food crops, cash or commercial crops, plantation and horticulture crops are cultivated. Rice is the most important crop grown in the five agro-climatic zones. Next to rice is wheat.

India is amongst the world’s leading producers of sugarcane, tea, cotton and jute. During 1994-95, annual production of sugarcane was 275.5 million tonnes; rice 81.8 million tonnes; wheat 59.8 million tonnes; tea 800,000 tonnes; cotton lint 2 million tonnes; and jute 1.4 million tonnes. Other crops cultivated include cereals, fruits, vegetables, coffee, linseed, peanuts, various spices and rubber.

Livestock raising, particularly of cattle, buffalo, horses and mules, is a central feature of Indian agriculture. However, as a consequence of inadequate pasture and water supply, India’s cattle breeds are generally inferior. The animals are mostly utilized as beasts of burden (draught animals and for transport). Sheep and goats are mainly raised for wool. The buffalo (72 million) are largely used in the deltaic regions. In the dry regions of Punjab and Rajasthan, camels (1.4 million) are the principal beasts of burden.

Forestlands cover about 23 percent of total land area. By-products such as charcoal, fruits and nuts, fibers, oils, gums and resins are among India’s valuable commodities. The annual timber harvest was 264.4 million cubic metres in the late 1980s.

Fishing, although largely undeveloped on a national scale, remains vital in certain regions, such as in the Ganges delta in Bengal and along the southwestern coast. In recent years the government has been encouraging deep-sea fishing by constructing processing plants and underwriting oceangoing fleets and vessels. During 1994-95, the country’s annual catch totaled 4.7 million metric tonnes, about 57 percent included marine species.

People

India ranks second to China with a population (1995 estimate) of 915.9 million. This represents an increase of about 232 million, or 34 percent, over the 1981 census. The overall population density in 1995 is estimated to be about 288 persons per sq km. More than 70 percent of India’s population live in rural areas. The diverse racial and cultural origins of the people of India are bound intricately with the other peoples of the Indian subcontinent including Pakistan, Bangladesh, Nepal, Bhutan, and Sri Lanka.
III. Agricultural Production

India suffered serious food shortages at the eve of independence in 1947. Since then, Indian planners have made efforts to revitalize the agricultural economy and achieved not only self-sufficiency in food and other agricultural products, but also enhanced India’s position as an exporter of agricultural commodities.

Notwithstanding adverse side effects to the sustainability of Indian agriculture, the substantial increase and higher levels of agricultural production have been achieved through:

1) use of chemical inputs:
2) aggressive propagation of hybrid seed varieties;
3) uncontrolled mining of underground water sources; and
4) tuning the agricultural sector to market economics in India and abroad.

Table 2: Production of principal crops (Million Tonnes)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>74.7</td>
<td>72.9</td>
<td>80.3</td>
<td>81.1</td>
<td>79.6</td>
</tr>
<tr>
<td>Wheat</td>
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<td>57.2</td>
<td>59.8</td>
<td>65.5</td>
<td>62.6</td>
</tr>
<tr>
<td>Coarse Cereals</td>
<td>26.0</td>
<td>36.6</td>
<td>30.8</td>
<td>29.9</td>
<td>29.7</td>
</tr>
<tr>
<td>Pulses</td>
<td>12.0</td>
<td>12.8</td>
<td>13.3</td>
<td>14.1</td>
<td>13.2</td>
</tr>
<tr>
<td>Total</td>
<td>168.4</td>
<td>179.5</td>
<td>184.3</td>
<td>191.6</td>
<td>185.1</td>
</tr>
<tr>
<td>Kharif</td>
<td>91.6</td>
<td>101.5</td>
<td>100.4</td>
<td>101.1</td>
<td>98.2</td>
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<tr>
<td>Rabi</td>
<td>76.8</td>
<td>78.0</td>
<td>83.9</td>
<td>90.4</td>
<td>86.9</td>
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<tr>
<td>Oilseeds</td>
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<td>20.1</td>
<td>21.5</td>
<td>21.3</td>
<td>22.4</td>
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<tr>
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<td>228.0</td>
<td>229.7</td>
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<tr>
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<td>9.7</td>
<td>11.4</td>
<td>10.7</td>
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<td>13.1</td>
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<tr>
<td>Jute &amp; Mesta**</td>
<td>10.3</td>
<td>8.6</td>
<td>8.14</td>
<td>9.1</td>
<td>8.9</td>
</tr>
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</table>

(Percentage variation in production over the previous year)

<table>
<thead>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
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<tr>
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<td>-2.4</td>
<td>10.2</td>
<td>1.86</td>
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<tr>
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<td>2.7</td>
<td>4.5</td>
<td>1.0</td>
<td>-4.8</td>
</tr>
<tr>
<td>Coarse Cereals</td>
<td>-20.5</td>
<td>40.8</td>
<td>-15.8</td>
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<td>-0.6</td>
</tr>
<tr>
<td>Pulses</td>
<td>-16.1</td>
<td>6.7</td>
<td>3.9</td>
<td>6.0</td>
<td>-6.4</td>
</tr>
<tr>
<td>Total</td>
<td>-4.5</td>
<td>6.6</td>
<td>2.7</td>
<td>3.9</td>
<td>-3.4</td>
</tr>
<tr>
<td>Kharif</td>
<td>-7.8</td>
<td>10.8</td>
<td>-1.1</td>
<td>0.7</td>
<td>-2.9</td>
</tr>
<tr>
<td>Rabi</td>
<td>-0.3</td>
<td>1.6</td>
<td>7.5</td>
<td>7.7</td>
<td>-3.9</td>
</tr>
<tr>
<td>Oilseeds</td>
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<td>8.1</td>
<td>7.0</td>
<td>-0.9</td>
<td>5.16</td>
</tr>
<tr>
<td>Sugarcane</td>
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<td>-10.2</td>
<td>0.7</td>
<td>19.9</td>
<td>2.7</td>
</tr>
<tr>
<td>Cotton</td>
<td>-1.0</td>
<td>17.5</td>
<td>-6.1</td>
<td>11.2</td>
<td>10.6</td>
</tr>
<tr>
<td>Jute &amp; Mesta**</td>
<td>12.0</td>
<td>-16.5</td>
<td>-2.3</td>
<td>8.3</td>
<td>-2.2</td>
</tr>
</tbody>
</table>

*Million bales of 170 kg each, ** Million bales of 180 kg each

Crop Production

**FOOD GRAINS**

Good rainfall conditions and the government's production oriented policies, have led the country to achieve food grains output of 191.5 million tonnes in 1994-95, around 7 million tonnes more than the previous year. The annual growth of food production is around 6.2 percent, which is more than the population growth.

**Rice (Oryza sativa var indica)**

Rice is the main cereal of the country. There are two main seasons for growing rice in India, the Kharif and Rabi seasons. The principal rice cultivation systems followed in India are 'dry', 'semi-dry' and the 'wet'. The dry and semi-dry systems of cultivation are mainly confined to tracts which depend on rain and do not have supplementary irrigation facilities. The wet system is practiced in areas with assured and adequate supply of water, either by rainfall or by irrigation.

Rice growing areas in India can be grouped into five main zones on the basis of agro-climatic conditions.

1. The North Eastern zone, including the States of Assam, West Bengal, Orissa and southern districts of Bihar, i.e. the basins of Brahmaputra, Ganga and Mahanadi rivers.

2. The Southern zone, including the deltaic regions of Godawari, Krishna, Kaveri and Tarnarbarani rivers and also some non deltaic rainfed areas of Andhra Pradesh, Tamil Nadu and parts of Karnataka.

3. The West coast zone, including Kerala state, the coastal districts of Karnataka, Maharashtra and Gujarat.

4. The Central zone, including whole of Madhya Pradesh, Telangana region of Andhra Pradesh and eastern parts of Karnataka and Maharashtra.

5. The Northern region, including North Bihar, Uttar Pradesh, Punjab, Himachal Pradesh and Jammu and Kashmir.

1994-95 was a good year for rice production. Rice production reached 81.8 million tonnes, exceeding the target of 80 million tonnes. During 1995-96, the total rice production may drop to 79.6 million tonnes due to unseasonal rains.

**Wheat**

Wheat contributes about 25 percent of the total food grain production of the world. In India wheat is consumed in the form of unleavened pan-baked bread called 'chapati'. India is fourth among the wheat growing countries of the world which includes Russia, the Peoples Republic of China and the USA.
Wheat growing areas in India can be grouped into five main zones on the basis of agro-climatic conditions.

1. The North Western plains zone, consisting of the plains of Punjab, Haryana, Jammu, Rajasthan and western Uttar Pradesh.
2. The North Eastern plains zone consisting of eastern Uttar Pradesh, Bihar, West Bengal, Assam, Orissa, Manipur, Tripura, Nagaland, Meghalaya, Mizoram, Arunachal Pradesh and Sikkim.
3. The Central zone consisting of Madhya Pradesh, Gujarat, South-eastern Rajasthan and the Bundelkhand area of Uttar Pradesh.
4. The Peninsular zone, consisting of Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.
5. The Northern hill zone, consisting of the hilly areas of Kashmir, Himachal Pradesh, Uttar Pradesh, West Bengal, Assam and Sikkim.

Wheat production during 1994-95 was 65.8 million tonnes and is expected to reduce marginally for 1995-96. For maximum yield, farmers prefer disease-resistant, fertilizer-responsive, lodging and shattering-resistant varieties for cultivation under irrigated conditions.

Coarse Cereals

Bajra, jawar, maize, ragi, barley and small millets constitute the coarse cereals cultivated in India. A considerable increase in the production of major food crops like rice and wheat and other commercial crops corresponds to the drastic reduction of areas planted to coarse cereals. Farmers even hesitated to cultivate coarse grains on less productive lands, suited for coarse grains, due to poor government price support. The area, for example, under Jawar, which was 18.586 million hectares, in 1969-70, was reduced to 11.5 million hectares, in 1994-95. Maize area increased by only 0.1 per cent. Quite recently though, there are plans from the food ministry to include coarse cereals in the public distribution system.

Barley is an important rabi cereal, ranking next to wheat both in acreage and grain production. Barley is consumed either in the form of Chapati or as ready-to-eat paste called ‘Sattu’. It is also used to prepare malt for manufacturing beer and whisky. It is grown mainly in the states of Uttar Pradesh, Rajasthan, Bihar and to some extent in northern Madhya Pradesh, Haryana, Punjab, West Bengal, Himachal Pradesh and Jammu and Kashmir. It thrives well on well drained and moderately rich loams, in medium black soil and on coastal saline soil.

Maize: In terms of area and production, maize ranks next to rice and wheat. The states of Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan and Punjab account for over 75 percent of production in the country. It is consumed directly as food in various forms, as Chapaties (the commonest preparation), roasted ears, popcorn and porridge. Maize is also used for animal and poultry feed. The germ of maize and bajra contains a high percentage of oil which can be used in soap manu-
facture and refined edible oil. Maize requires fertile, deep and well drained soils. It can however, be grown on any soil ranging from deep heavy clays to light sandy ones.

Millet account for about 40 percent of the Kharif crops. Millets are predominantly rainfed. Under higher rainfall, after harvesting rice, the next best lands are put under maize. Once a choice has been made for maize, the next best is put under bajra while the least productive lands are put under ragi or small millets. Ragi and small millets have two significant characteristics (1) its high degree of resistance to soil drought, and (2) its capability to thrive on poor and shallow soils.

Millets are used for human and animal consumption. Millets are also used in starch manufacturing and brewing.

Pulses

Pulses and forage legumes such as black gram, Bengal gram, horse gram, chickpea, cowpea, lentil, pea and pigeon pea are used in maintaining soil fertility. The various pulses and where they are grown are as follows:

- **Black gram** - Madhya Pradesh, Uttar Pradesh, Punjab, Maharashtra, Andhra Pradesh, West Bengal and Karnataka.
- **Bengal gram** - Madhya Pradesh, Maharashtra, Uttar Pradesh, Punjab, Andhra Pradesh, Rajasthan and Karnataka.
- **Horse gram** - Andhra Pradesh, Karnataka, Tamil Nadu, and to a small extent in Maharashtra and Madhya Pradesh.
- **Chickpea** - West Bengal, Bihar, Madhya Pradesh, Gujarat and eastern Uttar Pradesh.
- **Cow pea** - Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.
- **Lentil** - Madhya Pradesh, Maharashtra and Kashmir.
- **Pea** - Uttar Pradesh.
- **Pigeon pea** - Uttar Pradesh, Punjab and Maharashtra.

The production of pulses fluctuated between 10-15 million tonnes for the past three decades. Production was 14.1 million tonnes in 1994-95 but reduced to 13.2 million tonnes for 1995-96.

Oil seeds

Oil seeds grown include ground nut, rapeseed and mustard, sesame, linseed, castor, safflower, sunflower and niger. Oil seed production during 1994-95 was 21.3 million tonnes. The places of production are as follows:
Groundnut: Gujarat, Andhra Pradesh, Tamil Nadu, and Karnataka.

Rapeseed: Uttar Pradesh, Rajasthan, Madhya Pradesh, and Andhra Pradesh.

& Mustard: Maharashtra, Gujarat, Tamil Nadu, and Orissa.

Sesame: Uttarak Pradesh, Rajasthan, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Gujarat and Orissa.

Linseed: Madhya Pradesh, Uttar Pradesh, Maharashtra, Bihar, Rajasthan, Karnataka, and West Bengal.

Castor: Andhra Pradesh, Gujarat, Karnataka, and Orissa.

Safflower: Maharashtra, Karnataka, and Andhra Pradesh.

Sunflower: Maharashtra, Andhra Pradesh, and Karnataka, also in Haryana, Punjab, Uttar Pradesh, and Rajasthan.

Niger: Madhya Pradesh, Bihar, Maharashtra, Orissa and Tamil Nadu.

OTHER CROPS

Sugar cane

Sugar cane is produced in Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Tamil Nadu, and Uttar Pradesh. Production of sugarcane during 1991-92 registered 254 million tonnes. The following year it decreased to 228 million tonnes, due to the fall in production areas in Andhra Pradesh, Gujarat, Haryana, Madhya Pradesh, Maharashtra, and Tamil Nadu. However, during 1994-95 it increased to 275.5 million tonnes and is expected to increase further to 282.9 million tonnes in 1995-96.

Cotton

The states which registered a high production of cotton are Gujarat, Maharashtra, and Andhra Pradesh. During 1994-95, 11.9 million bales (of 170 kg each) were produced. The production of cotton may reach 13.1 million bales in 1995-96.

Jute and Mesta

Jute is grown in West Bengal, Assam, Northern Bihar, south east Orissa, Tripura, and eastern Uttar Pradesh. Mesta is produced in west Bengal, Bihar, Assam, Tripura, Andhra Pradesh, Orissa, eastern Madhya Pradesh, Maharashtra, Karnataka, and Uttar Pradesh.

The production of Jute and Mesta touched a peak of 10.3 million bales (of 180 kg each) during 1991-92 but showed a marked decline the following years. The target fixed for 1995-96 is only 9.3 million bales (of 180 kg each). Decreased production is due to the increased cost of cultivation of these crops and their stagnant prices.
PLANTATIONS AND HORTICULTURE CROPS

Coffee

Coffee is mainly produced in Karnataka, Kerala and Tamil Nadu. The rest of India produces only a negligible quantity. Both Arabica and Robusta varieties are grown. Nearly two thirds of the production is exported. According to the Coffee Act 1942, coffee production is handed over to the Coffee Board for auction/sale. The Coffee Board manages the pooling and sales of coffee besides, being responsible for the development of the coffee sector.

During the eighties, growers, not able to cash in on the price opportunities of the export market, began to agitate for a free market. The Government has liberated the internal market. Growers are now demanding more deregulation for the international market. Coffee production which was 18,893 tonnes in 1950-51 has increased to 223,000 tonnes during 1995-96. Opportunities in Coffee could be better exploited if the quality produced is improved and producers are allowed to export directly.

Rubber

India ranks fourth in global rubber production. Of all agricultural crops produced, rubber tops both in area expansion and rise in production. Kerala leads among the rubber producing states.

<table>
<thead>
<tr>
<th>Year</th>
<th>Area ('000 ha)</th>
<th>Production (tonnes)</th>
<th>Average yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-51</td>
<td>75</td>
<td>15,830</td>
<td>284</td>
</tr>
<tr>
<td>1960-61</td>
<td>144</td>
<td>25,697</td>
<td>365</td>
</tr>
<tr>
<td>1970-71</td>
<td>217</td>
<td>92,171</td>
<td>653</td>
</tr>
<tr>
<td>1980-81</td>
<td>284</td>
<td>153,100</td>
<td>788</td>
</tr>
<tr>
<td>1990-91</td>
<td>475</td>
<td>329,615</td>
<td>1,076</td>
</tr>
<tr>
<td>1994-95</td>
<td>516</td>
<td>472,000</td>
<td>1,362</td>
</tr>
<tr>
<td>1995-96</td>
<td>522</td>
<td>507,000</td>
<td>1,422</td>
</tr>
</tbody>
</table>

Rubber plantations are dominated by small landholders with an average holding of 0.5 hectare. Eighteen percent comes under the corporate sector which is mainly responsible for propagating chemical agricultural practices. Remunerative and attractive incentives offered by the Rubber Board has resulted primarily in the monocropping of rubber. Of recent, the United Planters Association of Southern India (UPASI) has come forward with a project to implement organic farming practices. The project replaces the monocropping and use of chemical fertilizers with intercropping, mixed cropping and other sustainable agricultural practices. Rubber cultivation is now being expanded to non traditional areas like Tripura, Maghalaya, Mizoram, Manipur, Assam and Nagaland.
Tea

The tea industry in India plays a very important role in the Indian economy. India is the leading producer of tea and is responsible for 30 percent of the global produce. Tea production has increased continuously from a level of 283 million kg in 1950-52 to 762.35 million kg in 1995-96. By the year 2000, tea production is expected to reach 1000 million kg. Substantial increase in domestic consumption has resulted in the export of tea being constant at 200 million kg.

Coconuts

India produces 17 percent of the world’s total coconut products. Coconut production in 1993-94 was 12,355 million nuts. The eighth plan target (1992-97) for annual output of coconut is 15,000 million nuts. The principal states producing coconuts are Kerala, Tamil Nadu, Karnataka, and Andhra Pradesh.

Fruits

India produced about 39.5 million tonnes of fruits in 1993-94. The major fruits grown are as follows:

Banana: Important producing states are Tamil Nadu, West Bengal, Kerala, Maharashtra, Gujarat, Karnataka, Assam, Andhra Pradesh and Bihar.

Mango: From Assam to the Southern limits and from the sea level up to about an altitude of 1,5000 mt.

Orange: Grown in Coorg, Wynad tract, Palani hills and Nilgiris in South India at an elevation of 600 and 1500 m. In Assam, it is produced in the Khasi, Jaintia and Lushai hills. In Nagpur, they are grown under irrigation at an elevation of 370 m. In Punjab, it is cultivated at an elevation of 600 m. Varieties grown are nagpur orange, khasi orange, coorg orange, desi emperor and sikkim orange.

Sweet Orange: Varieties grown are Blood Red, Pineapple Mamlin, Jaffar and Valencia Late in North India, Mosambi in west India and Sathugudi and Batarian orange in south India.

Grape: Punjab, Uttar Pradesh, Himachal Pradesh, Maharashtra, Hyderabad, Deccan, parts of Karnataka and Tamil Nadu.

Guava: Cultivated in Uttar Pradesh and Bihar.

Papaya: Everywhere except at altitudes higher than 1500 m.

Pineapple: Assam, West Bengal, Tripura, Uttar Pradesh, Andhra Pradesh, Kerala and Karnataka.

Sapota: Grows well in heavy rainfall areas of western and southern India.

Pomegranate: Grows best in Maharashtra.

Cashew: Grown in coastal India.
Jackfruit: Grown as stray trees in home gardens.
Loguat: Grown in Punjab, Uttar Pradesh, Delhi, Assam and Maharashtra.
Mangosteen: Cultivated in Nilgiris, Malabar and Tirunelveli district in Tamil Nadu.
Litchi: Northern Bihar, western Uttar Pradesh and Punjab.
Date Palm: Punjab, Rajasthan and Kutch.

Other fruits cultivated are phalsa, custard apple, gooseberry, fig, jujube, apple, apricot, peach, pear, persimmon, plum and strawberry.

Nuts
Cashew is considered as a crop for waste land development and is grown in marginal lands of poor fertility. India is the largest producer of processed cashew nut. Production in 1993-94 reached 350,000 tonnes.

Spices
The important spices and condiments grown in India include: chilly (Capsicum annuum), coriander (Coriandrum sativum), turmeric (Curcuma longa), ginger (Zingiber officinal), onion (Allium cepa), garlic (Allium sativum), black pepper (Piper nigrum) and cardamon (Elettaria cardamomum).

Production of spices during 1994-95 was 2.2 million tonnes. The eighth plan target for major spices is 3.2 million tonnes and an investment of Rs. 150 crore is allotted aiming at a growth rate of ten percent in production.

Animal Husbandry
It is estimated that India has 200 million cattle, 75 million buffalo, 110 million goats, 56 million sheep and 18 million chicken. India supports 15 percent of cattle and 20 percent of goats and sheep of the world, with 2.5 percent of the land mass. The gross output value from the animal husbandry sector was around Rs. 58,800 crore in 1993-94, which is over 25 percent of the gross value of agricultural output. The dairy sector contributes about Rs. 30,000 crore excluding the contribution of draught output.

Dairy production
Although India has the largest number of livestock in the world, it is second in milk production. Indian livestock has very low milk productivity as compared to many developed countries, due to poor nourishment and many other factors. Farmers with small and marginal holdings, constituting 30 percent of the land, have 80 percent of the total livestock in the country. The poor farmers can only give...
insufficient feed and fodder which are poor in quality. Low milk productivity has forced farmers to increase their livestock, further increasing the burden on scarce grazing land.

Sheep and Goat

India has over one fifth the number of goats and sheep in the world. It ranks first in goat population and sixth in sheep population. Sheep and goat husbandry is a main source of income for low-income families who do not have enough money to invest on high yielding cows nor have land for cows to graze or raise the fodder.

The goat population notched the highest livestock growth rate in the country, increasing from 95 million in 1982 to 112 million in 1991. In a country like India, where a considerable population do not eat pork and another section do not eat beef, mutton can cater to both sections.

Sheep did not show any significant growth, increasing from 49 million in 1982 to 56 million in 1991. Sheep raising is mainly done by people belonging to weaker sections of the community, i.e. those without land or their land holdings are so small, that crop cultivation does not provide remunerative employment all the year round. In many places, shepherds lead a nomadic life. In the north western districts of Rajasthan, grazing and stock watering resources are available only for a few months in a year, compelling shepherds to move. Sheep breeders from the districts of Jaisalmer, Barmer and Bikaner and parts of Jodhpur practice temporary migration lasting from six to nine months. They migrate towards the south to Nagda in Madhya Pradesh which is a central place for the sale of wool.

Low production of mutton and wool from indigenous sheep is mainly due to the economic backwardness of shepherds, also non-adoption of scientific methods of breeding, feeding and management. With the constant movement of sheep over long distances and uncertain grazing and stock watering facilities, sheep owners are unable to adopt scientific methods of sheep management. Shearing of sheep in distant places and sale of wool at far away markets do not give opportunities for organised collection, processing and marketing of wool. Sheep breeders are therefore unable to bargain for a remunerative price. These difficulties could be alleviated if service centres are set up on migration routes.

The constant migration is one of the main reasons for a high percentage of illiteracy among these people. The children also have no chance of education because they are on the move, employed by their family for grazing the flocks. Due to lack of education, these sheep owners are not able to appreciate and adopt improved sheep husbandry practices brought to them by extension workers...
Rainfall in most parts of India is confined to the four rainy months of June to September. Total annual precipitation is about 400 Million hectare meter (MHm). Of this 180 MHm flows as run off and about 70-75 MHm is usable if adequate storage is provided.

It takes an average of 0.65 hectare meter of groundwater to irrigate a cropped hectare, and 0.90 hectare meter from surface water sources, as conveyance losses are higher. On the basis of an average of 0.8 hectare meter per cropped hectare, available water resources in India would suffice for irrigating about 96 million hectares. India is a rich nation in terms of water resources. The annual average precipitation in India is double that of the average precipitation for the whole of Asia and ranks next only to South America.

Tank irrigation, long used even before the British rule, declined to about 7 percent in 1989-90. Modern irrigation schemes include irrigation by major, medium and minor works. Minor irrigation schemes are irrigation by open and tube wells, tank irrigation, lift irrigation from rivers, drip irrigation and sprinklers. Major irrigation is by multipurpose huge dams and canals. India's irrigation potential increased from 22.6 million hectares in 1950-51 to 85 million hectares in 1993-94. The irrigated potential to be created by the end of 1994-95 is 87.8 million hectares. The irrigation sector is given considerable importance in the eighth five year plan where a total outlay of Rs. 32,525 crore is devoted to irrigation.

About 90 to 95 percent of the potential for ground water irrigation may be reached by the year 2000. Full exploitation of irrigation from surface-water sources may be reached by the year 2025. The percentage of utilization of water resources for purposes other than irrigation is low at present. It is however, expected to rise appreciably in the future with increasing population and industrialisation. There is need for laying maximum emphasis on conservation and efficient utilisation of available water resources.

Table 4: Annual precipitation (mm)

<table>
<thead>
<tr>
<th>Region</th>
<th>Precipitation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>South America</td>
<td>1596</td>
</tr>
<tr>
<td>India</td>
<td>1150</td>
</tr>
<tr>
<td>North America</td>
<td>908</td>
</tr>
<tr>
<td>Europe</td>
<td>769</td>
</tr>
<tr>
<td>Africa</td>
<td>725</td>
</tr>
<tr>
<td>Asia</td>
<td>830</td>
</tr>
<tr>
<td>Australia</td>
<td>456</td>
</tr>
</tbody>
</table>

(Source: The Wrath of Nature—CSE)
IV. IMPACT

The Indian economy was based on sustainable agricultural practices during the pre-colonial era. Cultivation had direct co-relationship with rainfall patterns, soil types, and local demand, in ancient India. Several hundred years of foreign rule disoriented the self-reliant economic system into a dependent and deteriorating economy by the time of independence.

As the Indian economy shifted and orientated towards markets outside the country, the chemical input, hybrid variety, irrigation based colonial production system, established itself as the mainstream culture along with:

- monocultures for commercial plantations as well as food crops;
- intensive cropping without crop rotations;
- greater emphasis on annual crops in attempts to get quick returns to the neglect of growing of trees (once an integral part of Indian agriculture);
- excessive orientation to commercial crops, neglecting the cultivation of coarse cereals, the staple food of poor farmers;
- unabated mining of underground water resources, over-use of commercial energy and misdirected public resources in terms of research and extension catering to market situations; and
- injustice to women, through reduced available nutrition for rural households and access to fuelwood and shelter resources.

Considering India’s population growth rate along with the need for human settlement and industrial purposes, there is little scope of increasing the land area for cultivation. There is danger of more intensive cultivation through irrigation, chemical inputs and more of the above, whilst ignoring their impact on long term sustainability.

Soil Degradation

The fertile soils in India have been subjected to serious degradation due to lack of soil conservation measures, mismanagement of irrigation water and aggressive cultivation practices involving chemical inputs, monoculture and commercial cropping. It is estimated that nearly 175 million hectares of farm land in India is affected by soil degradation through water and wind erosion, salinity, water logging and loss of soil nutrients. Salinity and water logging are water-related man-made problems, the main culprit being mismanaged canal irrigation.
Depletion of Soil Fertility

Depletion of soil nutrients is becoming increasingly evident in Indian soils. The average loss of nutrients due to soil degradation is estimated at 5.4 to 8.4 million tonnes every year. Average annual depletion of NPK by the major crop, cereals, is about 7.5 million tonnes while actual addition of nutrients through fertilizers is an alarming low of 3 million tonnes. Intensive monocrop cultivation has resulted in serious depletion of nitrogen (N) and phosphorus (P) in central and south India. Nearly 67 percent of soil samples taken during the National Soil Sample Survey indicated zinc deficiency. Copper deficiency is serious in Uttar Pradesh and severe boron deficiency is noted in Bihar, whilst Iron and Manganese deficiency is a common feature in Uttar Pradesh.

Long Term Sustainability

To assess long-term sustainability of modern farming, the Indian Council of Agricultural Research sponsored the All India Coordinated Research Project on Long Term Fertilizer Experiments during the IV Plan period at 11 selected centres, representing the major soil climate regimes of India. Effects of plant nutrients on long term sustainability of four major cropping systems, alluvial soil (Ludhiana, Punjab), medium black soil (Jabalpur, Madhya Pradesh), Laterite soil (Bhubaneswar, Orissa) and foothill soil (Pantnagar, Uttar Pradesh) was assessed with the following conclusions:

1. The biological sustainability of maize in maize-wheat-cowpea fodder rotation on alluvial sandy soil at Ludhiana (Punjab) was significantly affected by the deficiency of Zinc (Zn) after 10 annual rotations when the available soil Zn decreased from 1.1 to around 0.68 mg/kg.

2. The sustainability of soyabean, wheat and fodder maize was found to be affected on medium black soil at Jabalpur (Madhya Pradesh) after 11-12 annual rotations by the depletion of available Sulphur (Morgan’s-extractable S) below the critical level (5-7 mg/kg).

3. The sustainable productivity of monsoon and winter rice was affected by the deficiency of S on laterite soil at Bhubaneswar (Orissa) after 12 and 17 annual rotations, respectively. The biological sustainability of the rice-rice cropping system was also affected by accumulation of Iron (Fe) and Aluminum (Al) to toxic levels interfering with the uptake of P and micro-nutrients.
4. The biological sustainability of rice in the rice wheat-cowpea fodder system was severely affected on tarai (foothill) soil at Pannagar (Uttar Pradesh) after 15 annual rotations. The overall decline in rice productivity was found to be associated with the reduction in inherent soil fertility as a consequence of intensive cropping and inadequate application of plant nutrients especially NPK. The decline in rice productivity was further accentuated by the deficiencies arising from S and Zn. Loss of native soil fertility was also exhibited through sharp reduction in soil organic matter, cation exchange capacity and available soil N and Potassium (K). The diminishing trend in rice productivity could be ascribed to the compounded effects of various fertility parameters involved in the decline of soil quality.

5. Nonetheless, the initial productivity of wheat was maintained with the recommended doses of S-containing NPK fertilizers. Reduction in productivity of wheat with higher NPKS (150 percent NPKS) doses was found to be affected by acute Zn deficiency. Thus, the fertile soils in India, are subject to serious degradation due to lack of soil conservation measures, mismanagement of irrigation water and aggressive cultivation practices involving chemical inputs monoculture and commercial cropping.

| Table 5: Problems of soil erosion and land degradation in India. (Area in m. ha) |
|---------------------------------|------------------|
| Total geographical area         | 329              |
| Total problem area              | 175              |
| Area subject to water & wind erosion | 150            |
| Area degraded through special problems | 25              |
| a. Water logged                | 6.0              |
| b. Alkaline soil               | 2.5              |
| c. Saline soil including coastal sandy areas | 5.5           |
| d. Ravines and gullies         | 3.9              |
| e. Area subject to shifting cultivation | 4.4           |
| f. Ravine and torrents          | 2.7              |
| Annual average                  |                  |
| Loss of nutrients from total problem area | 5.4 to 8.4 mt |
| Loss of production from net developing ravines (d) | 3 mt |
| Rate of encroachment to arable land by ravines | 8 m ha |
| Total flood prone area          | 40 m ha          |
| Average area affected by floods | 9 m ha           |
| Average cropped area affected by floods | 9 m ha         |
| Total drought prone area        | 260 m ha         |

(Source: Sustainable Agriculture Issues, Perspectives and Prospects in Semi and Tropics - Indian Society of Agronomy)
**Pesticide Hazards**

Correspondingly, the findings of a special committee appointed by the Indian Council Agricultural Research (ICAR) on the use of pesticides, also concluded that there are serious hazards (to consumers, domestic animals, fish and wild life) due to manufacture and formulations of pesticides; transport, distribution and storage of these chemicals; during application as well as post-application of the chemicals.

The committee produced conclusive evidence of harmful effects of pesticides on all the above areas. While not going into the details, below are some indication of the important findings:

1. The DDT and BHC content in human fat in India show that exposure due to these chemicals is higher than other countries.
2. There is evidence of growing number of people dying while spraying.
3. There are increasingly more cases of food poisoning as a result of eating food grains which are reported to have been treated with BHC.
4. There are several incidences of cattle dying out of excessive use of pesticides in the farms. Besides, cattle fed with straw contaminated with pesticides led to convulsions and food poisoning.
5. There was massive destruction of fishes in Jamuna river and other rivers due to insecticide use.
6. There are many incidences of death among deer and wild elephants due to the use of weedicides in the tea estates. Similarly several elephants have died after eating bananas sprayed with parathion emulsion.
7. Considerable mortality to bees and silk worms have also taken place due to the use of pesticides.

**Inappropriate Lifestock Breeds**

The dairy revolution in the country, beginning from the sixties brought about a considerable increase in livestock population and output through popularizing cross breeds, artificial insemination and embryo transfer.

Import breeds are not always better than the country animals. The pure breed dairy cows from temperate zones usually degenerate when used in tropical areas and are more susceptible to diseases. The bulls are not very useful for ploughing as they lack the brawn, neither can they be sold as beef due to the religious beliefs of the Hindu people. Native breeds like “Tharparkar”, “Sahiwal” and “Red Sindhi” produce as much as 4600, 4400 and 5440 litres of milk in a single lactation if they are well looked after. The cross breed cows are no match with their average output at 2500 to 3000 litres.
Overstocking

Most of the livestock is owned by farmers with small and marginal holdings. Those with enough land grow livestock feed in their own farms. Others tend to overgraze nearby pastures or move their livestock to complementary environments (nomadism). City dwellers force their animals to adapt to all available, non conventional feed and garbage in the surrounding urban environment.

Fodder resources in India is just enough for 60 percent of the livestock. There is therefore, considerable malnutrition and reduction in productivity. About 100 million animals are said to be surplus and the country loses Rs. 7000 crore a year in maintaining them. If the meat, hides and horns of the animals could be used, it would earn at least Rs.1000 crore for the country in foreign exchange.

Religion and superstition against cattle slaughtering and declining death rate, due to better veterinary aid, contribute to the surplus livestock. The problem is also due to the poor extension service, education of farmers, institutional and policy support.

Traditional systems use low cost agricultural byproducts as fodder for the animals. The most abundant crop residues come from the cereals, of which rice and wheat straws form the bulk. Sugarcane leaves are also used in some parts of the country. The current fodder production is estimated at around 3 tonnes per hectare during the rainy season. It has to increase to 8 tonnes per hectare. This could be done through intercropping, timely harvesting and conservation, development of waste land for fodder and fodder seed multiplication. Effective utilization of crop residue, agro-industrial byproducts and non conventional feed resources could add to the nutritional resources for livestock. This will also depend on policy decisions on deoiled cake and marketing of cereal residues.

Traditional Husbandry

With the western oriented promotion of animal husbandry programmes, traditional knowledge and practices concerning animal husbandry is being lost.

Land use and Forest Encroachment

Increase in the density of population of both human beings and animals, has led to over exploitation of forests and grass lands. Forest resources are threatened from over grazing, fuel wood removal and other exploitative practices. It is estimated that total fuel wood removal from forest exceeds 235 million cubic tonnes as against a sustainable level of 48 million cubic tonnes.

The gap between the demand and supply will widen if effective steps are not taken for increasing the availability of human food, animal feed and fuel wood resources.
V. SUSTAINABLE AGRICULTURE IN INDIA

Traditional Indian Agriculture and Sustainability

Agriculture is the prime occupation and an integral part of life for a majority of Indians, living in hundreds of villages. Some of the key attributes of India’s traditional agriculture requires recapitulation before we address ourselves to the present status of the agricultural situation in India. While variations could be found as per different agro-climatic conditions and cultural hues, the following are the main attributes of India’s traditional agriculture.

SELF-RELIANCE AND SELF-SUFFICIENCY

Traditionally, agricultural production was not for profits but to meet the needs of the families living in the villages. Excess produce was exchanged for goods and services produced by other members of the village community. Such a system of self-reliance and self-sufficiency functioned on the basis of many norms and cultural values. As the norm dictates, the products of an agricultural family were also to be shared with other villagers involved in other occupations such as artisans of various categories, temple priests, artists etc. Hence, agriculturists were considered the linchpin of the world. As the ancient Tamil scholar Thiruvalluvar of the 3rd century BC puts it, “Uzhuthundu vazhvare vazhvar : Mattallam thezhuthundu pinchelbavar”. (They who live by agriculture, live with self-respect, all others lead a cringing, dependent life).

WORKING WITH NATURE

Traditional agricultural practices in India worked in harmony with nature. This is evident when we explore details of land use, cropping patterns, calendar of farm operations, festivals related to farming and such.

Land classification and cropping patterns were decided on the basis of the natural attributes of the land. For example, in the traditional cultures of South India, land was classified as “Nanchai” and “Punchai”. ‘Nanchai’ land were lands with water availability near rivers, streams or wells. Crops such as paddy and sugarcane were cultivated on such lands. Cereal crops such as sorghum, corn and pulses were cultivated on ‘Punchai’ lands, where irrigation is not available. Traditional land classification and cropping systems resulted in a high degree of biodiversity and availability of plants not only for food but also for fuel, housing and medicine.

Preparation of seed bed, sowing and other agricultural operations were linked to the appearance of stars and lunar cycles. Extreme care was taken for preserving the quality of land. After ploughing the land with wooden equipment, which are not destruct-
tive, the land is left to dry in the sun. The solarisation process is one of many ancient agricultural methods in which solar energy was used to improve the quality of land.

The agricultural system was supported by indigenous water harvesting practices, including the construction of tanks. Earthen dams were also constructed by ancient kings who ruled different parts of India. The water management systems in traditional Indian agriculture show evidence of understanding natural water cycles and of conscious efforts to preserve and use water.

Cattle were considered as companions. The draught cattle was taken care with a great sense of friendship. They also facilitated rural transport through bullock-carts and participated in the festivities of village life. The cow was a precious member of the family. Religious traditions led to the worship of cows. Cow dung and urine were used as manure. There was harmony between the human and livestock population which depended on the land.

There is also ample evidence to prove there was an ancient system of plant protection through the use of herbal extracts and other natural remedies known as 'Vriksha Ayurveda'. This ancient science of treating plants through natural processes, is recorded in palm leaf writings preserved through centuries. Traditional Indian agriculture was thus ecologically, economically and socially sustainable.

Colonial Impact

In the Indian context, the decline of sustainable agriculture could be traced to the roots of colonialism and lopsided manipulation of India's economy in the interests of the foreign rulers.

The land system introduced by the British in 1793 to increase land revenue added to the misery of poor farmers, forcing them to sell their lands to landlords or moneylenders and become bonded-laborers in the process. Under the Zamindari system, landlords squeezed the poor farmers for ever higher and exorbitant rents.

Another impact of British rule was the commercialization of agriculture. The British Government in order to export more and more raw materials from India for their thriving industries in Britain, raised the prices of cotton, jute, sugarcane and etc. The poor farmers were induced to cultivate commercial crops rather than food crops. Food production plummeted and prices of food grains soared. On the other hand, rural labor pressed into dependency on agriculture due to the absence of alternative employment, received low wages. It resulted in famines. During the British rule in India more than 30 famines were recorded.

The system of land tenancy progressively led to the emergence of absentee landlords and a lack of attention and care for the land, water harvesting and other sustainable farming practices.
Post Independence

The First Five Year Plan (1950-55) focused on the food problem. Its main objective was to reduce food shortages and to become self-sufficient. An amount of Rs. 600 crore (31 percent of the total outlay) in the First Five year plan was earmarked for the development of agriculture and allied activities. Various agro-based industries and handicrafts were set up in rural areas to encourage people to shift from agriculture to the industrial sector to reduce the pressure on lands.

Numerous land reforms were introduced to protect the tenant, to abolish the Zamindari system and to distribute surplus land to the landless farmers. More land were brought under cultivation and irrigation facilities were extended to barren lands. An amount of Rs. 450 crore was devoted solely to irrigation. Seeds, fertilizers and pesticides were supplied to the farmers to increase production. Regulated markets were set up to discourage unhealthy market practices and assure fair prices. Due to the effective planning and favorable weather conditions the actual production for the First Five Year Plan exceeded the target. 66 million tonnes of food grains were produced as against the target of 62 million tonnes. The contribution of the agricultural sector to the national economy at the time was 57 percent.

Stabilization of the food situation lead to complacency in the Government towards agriculture. The Second Five Year Plan was devoted to the development of the Industrial Sector. During the Third Five Year Plan (1961-66) the production of food grains fell to a low 72 million tonnes as against a target of 100 million tonnes. Food prices rose by 50 percent and the country came under another tragic famine. The importance of agriculture to the Indian national economy was made plain. The food problem was looked into afresh and priority was once more given to agriculture.

Green Revolution

In 1960-61 the Intensive Area Development Programme (IADP) was introduced, followed by the High Yielding Varieties Programme (HYVP). A total of Rs. 1750 crore was earmarked for agriculture i.e. 21 percent of the total plan outlay. As a result of the renewed attention and priority given to agriculture, there was consistent improvement in Indian agricultural production. The IADP programme which involved massive inputs of chemical fertilizers and intensive production techniques in the irrigated areas of the country, underscored the so called ‘Green Revolution’.

During the last 25 years of implementing the green revolution, the country achieved remarkable increases in agricultural output. In 1968, Indian farmers harvested 17 million metric tonnes of wheat. In 1994-95, they harvested 65.8 million metric tonnes of wheat. Similarly, rice production reached 81.8 million metric tonnes as against 59 million metric tonnes in 1970. Likewise remarkable performance has been achieved in plantation crops and other com-
merical crops. Looking purely from the production angle, the agricultural economy has made an impressive 'turn around'. A country which had to depend on food grain supplies from the United States of America for two decades, has emerged as an exporter of agricultural products including food grains. Annual exports from the agricultural sector touched Rs. 21,138 crore (1 crore = 10 million) in 1995-96, equivalent to US$ 6,320 million.

**Current Status**

This so called success of Indian agriculture has brought improvement to the Indian economy, but has resulted in serious scars on the environmental face of the country, causing heavy damages to the economic, social, and cultural fabric of the nation. Massive dosages of fertilizers were a basic feature of the agricultural growth. Consumption of chemical fertilizers increased from 0.9 kg/ha in 1955-56 to 75.4 kg/ha in 1991-92. The country imported 4.008 million tonnes of NPK in 1995-96 and provided a subsidy of over Rs. 62,350 million for fertilizers. Similarly, the consumption of pesticides increased from 130,000 tonnes in 1955-56 to 1,410,000 tonnes in 1994-95. Power consumption in agriculture increased from 1.5 kwh/1000 ha in 1951 to 239 kwh/1000 ha in 1990. Institutional credit increased from Rs. 240 million in 1951 to Rs. 13,000 million in 1992-93. The irrigation potential increased from 22.6 million hectares in 1950 to 85 million hectares in 1994.

**AT the Crossroads**

Indian agriculture today is at the crossroads. The steady increases in output have been complemented by the heavy cost and risk of destroying the roots of sustainability with continuing depletion of soil and water resources. With 940 million people to feed, Indian agriculture has to play a dynamic role in continuously improving production levels and simultaneously preserving the environment. In this context, bio mass generation in the rainfed area assumes great significance in any policy towards sustainable development of agriculture.

The features of traditional agriculture, i.e. self-reliance and working with nature, have the characteristics of sustainable agriculture. The traditional systems of agriculture retained and improved the productive qualities of land through natural methods of production. Its practices did not lead to the depletion of non-renewable resources. It is high time for Indian agriculture to make another 'turn around' and adopt a renewal of the holistic traditional practices through organic agriculture.

**Movement Towards Sustainable Agriculture**

Organic or Sustainable Agriculture in the modern sense of the word is still in the infant stage in India. It was Mahatma Gandhi the father of India, who pioneered organic agriculture through his constructive programmes at Sabarmati, Wardha, Champaran and Madurai in India. A protagonist of self reliance, he urged every
village to plough back resources within the village. He taught all the fellow workers in his Ashram’s Centre of Gandhian Constructive Action about composting and farming based upon local inputs.

The Gandhian concept of organic agricultural practices continues in all Sarvodaya (movement) projects, spread over different parts of the country. The spread of organic farming throughout the country by the Gandhian movement however, was set back by the aggressive promotion of Green Revolution.

Currently, the organic agriculture movement is spearheaded by the members and associates of the International Federation of Organic Agricultural Movements (IFOAM) in India. IFOAM membership in India includes a spectrum of corporate concerns, non-government organisations and professionals. Apart from IFOAM members, other institutions and movement are also similarly involved in the task of promoting sustainable agriculture in the country.

In January 1994, farmers and institutions committed to organic agriculture came together through the efforts of PRAKRUTI (IFOAM member organization) at Mahatma Gandhi’s Ashram in Savagram. They drafted the Sevagram declaration which contained several recommendations for promoting sustainable agriculture in the country. In April 1994, a national conference on sustainable farming and environment was organized at Cochin where over 400 participants defined their vision on sustainable agriculture. Subsequently, in April 1995, Indian members of IFOAM came together for the first time for a networking-workshop organized by the Institute for Integrated Rural Development (IIRD) at Aurangabad. The important recommendations of this workshop included publication of newsletters, promotion of training and education, market development, lobbying and image building for organic agriculture. Consequently the IFOAM members in India constituted a national level standards committee that developed "Concepts, Principles and Basic Standards of Organic Agriculture". The Standards developed by the committee is under process for recognition by the Government and other development bodies in the country.

Similarly an All India Organic Farmers Conference was held at Auroville, Pondicherry where various themes on sustainable agriculture were discussed.

Alongside the efforts of NGOs and private bodies, the government has recently evolved some incentive programmes to encourage sustainable agriculture. These include institution of prizes for individual farmers practicing sustainable farming and efforts by the Agricultural and Processed Food Export Development Authority (APEDA) to promote export of organic agriculture products.
Constraints and Challenges

Notwithstanding the current encouraging scenario for sustainable agriculture, India has a long way to go in developing a policy framework for sustainable agriculture and implementing it. The country’s involvement in the sustainable agriculture movement is fundamental for revitalizing environmental conditions and food security to Asia.

Of the many factors which hinder the progress of sustainable agriculture movement, the following are critical:

a) lack of organized markets for organic products within the country;

b) lack of standards and certification institutions to enable export of organic products;

c) very high publicity and propaganda for pesticides, fertilizers and other agro-chemicals which erode the confidence of the common man in sustainable agriculture;

d) lack of recognized training institutions to impart training in sustainable agriculture;

e) weak political will on the part of the local and national government to evolve and promote sustainable agriculture on the basis of a long term policy;

f) rapidly increasing population of the country and marginalization of small farmers; and,

- End -

Dr. Alexander Daniel, ENCON, 1996
ANNEX I

NGOs and People’s Organizations Advocating Sustainable Agriculture in India.

It is not possible to include all organizations, the following are a few path breaking efforts known to the author.

The Society for Equitable Voluntary Actions (SEVA) in Eastern India with its thrust area in 24 Parganas in West Bengal, is promoting sustainable agriculture through training programmes for farmers and field action programmes.

PRAKRUTI is playing a dynamic role in mobilizing public opinion for sustainable agriculture, by promoting domestic marketing of organic agricultural products and organizing organic cotton growers in Western India.

IIRD in Aurangabad in central part of India, is involved in training women’s groups in organic agriculture and networks NGOs and other groups involved in organic agriculture. The organization has also set up a school for organic agriculture.

The ILEIA network (Low External Input for Agriculture) is also making headway in different parts of the country by strengthening its network through Agriculture Man Ecology (AME), Bangalore.

The Gloria farm as well as the Auroville in Pondicherry are also contributing an effective role in strengthening sustainable agriculture movement in the country.

The Society for Organic Agriculture (SOA) of Secunderabad, Andhra Pradesh is involved in developing marketing strategies for organic products.

The Society for Employment Welfare and Agricultural Knowledge (SEWAK) with the leadership of Dr. Tiwari is involved in training programmes and documentation of indigenous agricultural practices in Uttar Pradesh.

The Bombay Burmah Trading Corporation Limited (BBTC) as a corporate leader has demonstrated the feasibility of organic tea production and marketing from Southern India.

Sanghvi farm and Mr. Save’s farm (individual farms) are promoting natural farming techniques in Western India.

Dr. Vandana Shiva, Research Foundation for Science Technology & Natural Resource Policy (STNRP), New Delhi, has initiated the Navdanya agricultural biodiversity conservation programme.

Earthworm Research Institute, Pune has done exploratory work in developing vermiculture technology. Use of earthworm for improving fertility of soil is a time old practice in India. Research about Vermiculture is also being undertaken by a number of other institute in various parts of the country.

Prof. Anil Gupta of the Indian Institute of Management, Ahmedabad, is collecting a wide variety of data on indigenous agricultural practices, and offer continuous exchange of information concerning indigenous knowledge through the Honey Bee Network and publication. He has also set up SRISTI to promote innovation and adaptation of indigenous knowledge.

Institutes for Studies and Transformation, Ahmedabad has also initiated a number of research and field investigation programmes, concerning sustainable agriculture. These include production of low cost bio-fertilizers, Micro nutrient fortified compost, developing infrastructure for composting and Bio fertilizers, drip irrigation systems and the like.

Centre for science for villages, Wardha, has continuous programmes for research and extension related to sustainable agriculture issues. Preparation of a compendium of technologies, useful particularly for women engaged in agriculture, is an important contribution of the institution.

Sri AMM Murugappa Chettars Research centre, Madras is also engaged in continuous research in the fields of Vermi culture, composting algae, bio-intensive gardening and other technologies relevant for promoting ecologically sustainable villages and watershed development programmes.
ANNEX II

SOME VIEWS ON SUSTAINABLE AGRICULTURE

q Awareness programmes about organic agriculture should be promoted. Producer and consumer forums to be made. Training as well as education programmes will create employment.

Arvind Mishra
MITRANKETAN, Kerala.

q Sustainable Agriculture will become the only alternative viable as costs of inputs increase.

Ramanna, Managing Trustee
BIORAMA TRUST, Ganapathi Palayam Post, Udamalpet Taluka, Tamil Nadu.

q Need to be discussed at high level in propagating Sustainable Agriculture and to stop the use of chemical fertilizers. More demonstrations and practical trainings are needed at grass root level. As chemical fertilizers are propagated, Sustainable Agriculture methods also should be propagated through TV and Radio. Village level training or block level training with experiments are needed.

Mr. Paul Raja Rao, Executive Director, Bharati Integrated Rural Development, BIRDS, Nandyal.

q The scope is vast as small and marginal farmers mainly have not still completed the transition from traditional to conventional way of farming. Government policies regarding Sustainable Agriculture should be given more strength and conventional mode of agriculture which advocates use of chemicals should be de-emphasized or discouraged. The price of organically produced crops should be given a boost to encourage farmers to grow farm without chemicals. Media should propagate Sustainable Agriculture practices and also ill effects of chemicals should be highlighted.

Dr. Shiraz A. Wajih, Secretary, Gorakhpur Environmental Action Group, Gorakhpur (U.P.)

q Policy level changes relating to inputs and credits is a must. A holistic approach to environment and agriculture must be promoted at all levels.

Ms. Geetha Rani, gene Bank Manager, M.S. Swaminathan Research Foundation, Madras

q Modern agriculture is not going to help the marginal farmers in the country who are about 70 percent of the total farming community. They are now being marginalized as inputs of modern agriculture are out of their reach and as the total productivity system is totally market dependent. They are bound to lose their land as farming is not turning to be a profitable venture and they would only add to the landless agriculture labourers or urban labour residing in slums. Through Sustainable Agriculture their profits can increase and it can provide them self sustenance as production cost would be low. Stress should be on providing them basic irrigation and strategy for farm development to make them self sufficient.

Dr. Tarak Kato, Secretary, DHRAMITRA, Wardha.

q Good scope
We were co-organizers of sustainable agriculture workshops at Auroville, Pondicherry.

Shirin and Deepak Gadalia, Promoters and Co-ordinators, Eco-Centre ICNEER, Valsad.

q Great scope because though modern agriculture practices were introduced in the '50 and '60s, our farmers particularly the small and marginal farmers still follow traditional farming practices developed over centuries. Government and big business is trying to break this reliance on traditional practices. Voluntary organizations should review confidence amongst small farmers in traditional practices. They should be shown through demonstration and model farms as to how Sustainable Agriculture can be used for optimum results.

Mr. Kisan Mehta, President, PRAKRUTI, Bombay.

q By its own merit Sustainable Agriculture will spread. 20 years ago agi-scientist used to call me crazy, today they respect me.

It is a fact that so called scientific chemical farming - is struggling to survive - by coining new words and terminologies - so that it sounds scientific - (as they term). Conventional agriculture is rolling with half deflated wheels.

Mahindra Pal, Manager (Founder), SRI AUROBINDO ASHRAM, Pondicherry.
**Annex III**

### Problem Areas/Issues and Possible Solutions

Identified during a national meeting of Women Scientists in the country in 1993

<table>
<thead>
<tr>
<th>Problem Areas/Issues</th>
<th>Possible Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology/Women-Related Issues</strong></td>
<td><strong>Intensive and extensive study of indigenous method of cultivation, preservation and propagation of indigenous farm technology. Documentation and disseminations of the traditional know how should be done.</strong></td>
</tr>
<tr>
<td>Tools and know how are designed and tested only at the laboratory level with no interaction with the women users. Therefore these devices are too costly, difficult to operate and maintain at the local level.</td>
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<tr>
<td>When a new agricultural technology is introduced men are generally trained when in reality much farmwork is done by women.</td>
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<tr>
<td>Hazardous farm practices including carrying excessive loads in shoulder and back. Defective tools, wrong postures and other drudgery prone practices are detrimental to the physical and mental health of women.</td>
<td><strong>S &amp; T inputs should be made to develop local species (region specific) which are sturdy and pest free. Quality seed bank should be established within the villages. Women should be trained to develop, manage and propagate quality traditional seeds.</strong></td>
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<tr>
<td>The excessive use of chemicals, pesticides and fertilizers have a hazardous impact. Women who handle these activities have very little knowledge of the dangerous chemicals.</td>
<td><strong>Safety devices to deal with the hazards in the farm and the field level should be introduced e.g. safer threshers, cutters, better sickles etc. Protection devices while processing of farm produce (like dehusking, removing cotton, pod grinding or straining).</strong></td>
</tr>
<tr>
<td>Ownership of the land belongs to men with very little resources in the hands of women to invest in.</td>
<td><strong>Natural and toxic free alternatives to chemical pesticides and fertilizers should be developed. These products could be manufactured by local women. Local resources could be used for starting such units.</strong></td>
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<tr>
<td>Several agro-processing are done outside the village depriving women of their traditional occupations.</td>
<td><strong>Effective methods for using wastelands and unused water bodies, unused space around the house and the roof and farm boundaries. Woman to be supported in claiming ownership of these resources.</strong></td>
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<td></td>
<td><strong>Appropriate agro processing methods and devices should be developed. Simple and efficient tools at low cost involving women farm workers should be developed. Their availability and maintenance at the local level should be made possible.</strong></td>
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<td></td>
<td><strong>Technologies to reduce drudgery at the farm and field level need to be developed, e.g. small water lifting and load carrying devices, which can be owned individually or collectively.</strong></td>
</tr>
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<td></td>
<td><strong>To alleviate women’s drudgery in collecting fuel, alternative fuels, such as briquettes from agro wastes, coal from fuel waste, coal from crop residues and peosopes jaulifloea (babool) should be developed and manufactured at the local level by women. The propagation and popularization of renewable plants like ‘Rathan Jothi’ should be made.</strong></td>
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*Dr. Alexander Daniel, ENCON, 1996*
INDIA: SA Country Profile

Problem Areas/Issues

Post Harvest Processing & Employment
There is little work done on local species processing, marketing and preservation of seasonal products which are produced in excess.

Agro by-products (used as animal feed, fertilizer, pesticide, etc) which used to be available to the rural people for their use, are no longer available due to industrial processing.

Employment in agriculture entails only 180 days in a year, even less in some areas. There are no alternative employment opportunities in the villages.

Of late there is a major shift in occupational preference by the rural people from agriculture to industry or urban jobs.

Possible Solutions

Agro-based industries like agro-processing, compost making, natural pesticides, tools manufacture, preservation, vermi-culture, bee-keeping, sericulture, tissue culture, algae cultivation, new food products for consumption, fibre ropes and many such employment generating technologies have to be identified and propagated with a view to provide employment opportunities for women.

Improved solar devices should be introduced for food processing.

Water

Commercial farms and the new industries use water excessively. This siphons away available drinking and underground water.

Agriculture methods which use minimum water (bio-dynamic gardening, pitcher method, clay emitters, drip irrigation, Dobhokar method, Natural farming etc) should be field tested and propagated to suit regional conditions.

Rain water harvesting, percolation tanks, widening and deepening of wells, de-silting of existing water bodies and contour bunding are some of the proven technologies and should be disseminated all over India.

Pollution

Environmental (soil and air) pollution by industries near the farms.

Deforestation

Problems regarding monkeys, birds and wild animals due to deforestation.

Policy Changes called for

Joint ownership of land.
Fair prices for agriculture products.
Equal wages for women and man.
Crop pattern to be based on factors like soil, climate, availability of resources and physical input - women in cold hilly regions can grow horticulture plants and herbs, instead of the hazardous task of growing rice, for exchange with rice from other regions.

Policy should stress on multiple cropping instead of mono cropping, and perennial crops instead of annual crops. This will enrich the soil and minimize pest damage.

Policies and programmes to promote dry farming and work on local species should receive top priority.

Subsidy on chemical fertilizers and pesticides should be removed.

Dr. Alexander Daniel, ENCON, 1996
ANNEX IV

KEY RECOMMENDATIONS
National workshop for sustainable agriculture, Hyderabad, January 1996

Nearly two hundred representatives from NGOs and scientists involved in organic agriculture met at the national workshop for sustainable agriculture in Hyderabad and made elaborate recommendations for promoting sustainable agriculture in the country. Some of the key recommendations are listed below:

1. A central institute for sustainable agriculture to be established by the Indian Council of Agricultural Research (ICAR).

2. Participation of NGOs and voluntary organisations will help in identifying the needs, problems and expectations of farmers and suitably modify research programmes.

3. Ecology, environment, pollution and sustainability should form part of the curriculum in school, junior college, graduate and post-graduate curricula of various courses.

4. Government, NGOs, voluntary organisations and R&D institutions to publish and popularise agricultural diaries, pamphlets, brochures, (incorporating organic practices) in local languages for farmers' use.

5. Field extension personnel of agriculture, horticulture, forestry, fisheries and other departments should be trained to appreciate sustainable agriculture, to act as effective mediators in transferring eco-friendly technologies.

6. An information network needs to be established at National & State levels on sustainable agriculture involving state agricultural universities, ICAR institutions and NGOs.

7. The print and electronic media should play a prominent role in spreading the message of ecology, environment and sustainable agriculture. Video presentations in local languages should be prepared for farmers in the country. Modules should take into consideration the farmers' needs, farming practices and the local agro ecological situations.

8. The concept of sustainable agriculture/organic farming should be promoted through existing channels of communications like radio, TV and the Krishi Vigyan Kendras, Agriculture information and communication centers. Farmer's training centers should also promote the adoption of eco-friendly technologies in agriculture.

9. Continuous and improper use of harmful pesticides and other chemicals have caused a lot of damage to the eco-system. The promotion of non-pesticides based approach to pest control and plant disease is very relevant and ecologically prudent.

10. The government should ban export of neem oil, extractives and other raw materials and allow export of value added products such as azadarachtin.

11. Use of highly toxic, recalcitrant pesticides, fungicides and weedicides should be banned. Products, banned in developed countries should be prevented from being 'dumped' in developing countries.

12. Scientific validation is to be given to traditional plant products with pesticidal properties and to review traditional methods of pest control and also popularising them if they are effective and viable.

13. Standards for organic inputs: An apex organisation should be established to monitor the standards of commercial products which are offered in the markets specifically to promote organic agriculture/sustainable farming practices.

14. Certification bodies to be developed at local, state and national level. Such organisations should be recognised and encouraged by the government.

15. Production standards have to be developed for both domestic and export markets and these standards should be comparable to International standards. This will ensure competitiveness of the products both in domestic and International markets.

16. Aspects of bio-resource inventory (bio-mapping) and micro-biological properties of soils are often ignored in soil surveys. It is essential that in any effort to categories soils. the aspect of bio-mapping with specific reference to the capability of soils to support different flora for generation of organic matter should be included.

17. A lot of traditional knowledge is available which is of great relevance to promote organic farming/sustainable agriculture. The vast store house of information available with the farmers, scriptures and publications should be cataloged, classified and published for the benefit of the farmers.


Dr. Alexander Daniel, ENCON, 1996
ANNEX V

TRADITIONAL ANIMAL HUSBANDRY PRACTICES

tested by Society for Employment Welfare & Agricultural Knowledge (SEWAK) and presented by Dr. H.C. Tiwari at a networking workshop on organic agriculture held between 10-12th April 1995,

1. “Sisaun” or “Bichhu” ghas causes irritation on skin when comes in contact, therefore, called Bichhu ghas or scorpion grass. It’s botanical name is Urtica dioecia. This is a wild grass available in plenty, in the lower Himalayan region of Uter Pradesh. Farmers of Kumoun hills feed this grass to lactating cattle and is believed by all, to be very effective in enhancing milk in buffaloes. Besides, it is consumed by human beings too, as a green leafy vegetable particularly during winter owing to its medicinal value in treating cough and cold related ailments and licechorrea of women.

2. Fermented wheat flour or fermented banana is fed to the weak and anemic animals.

3. Mixture of rice, urad dal and Fenugreek seeds is cooked (Chichadi) and given to the cattle at the time of calving for quicker recovery and improved production.

4. Human urine is given as drink to draught animals like oxen and horses to improved their vigour and efficiency.

5. Mixture of salt and water is applied on the body of animals infested with ticks. Smoke tar is also applied. Both practices are commonly and effectively used in the rural area of Kumoun hills.

6. Rice husk or paddy is fed to the cattle to speed up the dropping of retained placenta after calving.

7. Pigeon droppings are fed to cows and buffaloes to bring them to heat. The droppings are said to contain estrogen. Fried salt with cucumber leaves is also fed to the animal to bring them to heat.

8. Farmers apply tobacco tar or common salt inside the nostrils of animals to kill leeches, in the hill areas. Tobacco tar is proved to be very effective to control leech infestation.

9. To control diarrhea in animals, farmers feed them ‘Bhut’ (black soyabeen). Black soyabeen grounded and mixed with water, is given to the animals suffering from diarrhea for 2-3 days. This has nutritional value too. A mixture of black soyabeen flour and ‘ragi’ flour in water is also fed to animals with diarrhea and is very effective.

10. To control hematuria in animals, farmers feed the mixture of limewater and grounded black soyabeen for 2-3 days.

11. To control contagious ecthyma; a mixture of fuelwood coal and ash which is generally used for washing the utensils in rural areas of Kumoun hills, is applied on the affected parts. It is said to be very effective in controlling the contagious ecthyma of animals.

12. To control colic in horses; tobacco smoke is given by closing one nostril so that the horse can inhale maximum smoke quickly.

13. To check the growth of papallae in cattle, lime (citrus) and salt is nbbed on the papallae in the mouth of animals. Red hot rod is also touched on the papallae but it is very painful, thus generally avoided.

14. To treat bone fracture, a lotion prepared from ‘harjozan’ and ‘sakar’ mud (clay) is applied on the fractured bones and it is tied/plastered to make the affected part immovable. Harjozen is a type of herb found in the Kumoun forest and sakar is a type of mud. This method is very popular and is amazingly efficient in treating the fractured bones of animals. Farmers do not see any veterinary alternative for this practice.

16. In case of indigestion or tympani, grounded coriander seeds mixed with water is fed to animals.

17. To prevent the spread of Foot and Mouth disease, farmers isolate the diseased animals and apply ‘Guru’ on the horns of all the animals. For treatment, hoof scrapings of horses are burnt to smoke the nostrils of the animal. As a preventive measure, farmers feed spider eggs with the flour of ‘ragi’ too.

18. In fever/loosened teeth and pneumonia, smoke of rice husk, cotton sack, black ‘t’il’ or barley is given for treatment.

19. Ash of ‘Bhang’ (Canabis sativus) is applied on haematoma animals.

Dr. Alexander Daniel, ENCON, 1996
ANNEX VI

WATER MANAGEMENT

The vedas and epics refer to the presence of wells, canals, tanks and dams. Ancient kings, e.g. the Mauryans, Cholas and Pallavas built huge tanks to facilitate irrigation. History recorded that Karikala chola, the greatest chola of the sangam age constructed a dam of stones across the river kaveri, near Trichy in Tamil Nadu. During the British rule, tank irrigation works were abandoned as they did not contribute to increased revenue. Tank irrigation started declining. During 1950-51 only about 17.2 percent of land was irrigated by tanks. It has further declined to about 7 percent in 1989-90.

Open Wells have been in use in India from time immemorial. About 35 percent of irrigated area is well irrigated. In recent years, a number of factors gave rise to open well construction. The introduction of high yielding varieties, encouragement of multiple cropping and price policy incentives encouraged the farmer to have an irrigation system. Easy credit helped a great deal in the matter. Rural electrification enabling the farmer to replace the man or animal operated water lifting devices with a water pump, also gave the desired push. Land above one hectare was irrigated with a pump and the bullock released for other purposes. Open wells however, tend to go out of use when canal irrigation is introduced, or when the ground water table drop. Well sides also collapse when no proper maintenance is done.

Tube wells: 28 percent of the total irrigated area is irrigated by tube wells. A large number are privately owned. They are mostly shallow with a discharge of about 30,000 litres per hour. They generally run for 500 to 1000 hrs. per annum and irrigate 4 to 8 hectares. On the other hand, State tubewells tap deep aquifers and give an average discharge of about 135,000 litres per hour and run 2000 to 3000 hrs. per annum. They irrigate a gross area of 80 to 100 hectares. A recent innovation in Bihar, is the low cost Bamboo tubewell which irrigates 2-4 hectares. They are operated with mobile diesel pumps and exploit shallow aquifers. Tubewells operated by electric pumps are cheaper in capital and operating cost. But in regions of inadequate supply of power, farmers turn to diesel pumps. In a scramble for water, people go for large and deeper wells. They bore or space the tube and open wells closer than they should, leading to over pumping and permanent lowering of the ground water table. Tube well irrigated area increased from 0.2 million hectares in 1960-61 to about 13.2 million hectares recently.

Canal Irrigation: In most parts of India, water resources are insufficient for irrigation requirements. Dependable irrigation is only possible with water brought in from other places. When surface water brought through canals become erratic, ground water is fed into the canals to augment their supply. In unlined canals, only about two fifths of water released at the canal head, is utilised by crops, the rest is lost in transit. Canals are now increasingly lined with concrete, stone masonry and brick masonry. Underground pipelines are also adopted by farmers. Canal irrigated area increased from 8.3 million hectares in 1950-51 to 16.3 million hectares in 1989-90.

Major Irrigation schemes: Huge dams were built soon after independence. During the seventh plan Rs. 11,560 crore was allocated for major irrigation schemes. Irrigation potential created by dams and canals increased from 10 million hectares in 1950-51 to 32.27 million hectare is 1994-95. The eighth plan proposes an outlay of Rs. 22,840 crore on major and medium works. Dams do not give sufficient returns. A delay of about two decades in completion of major works lead to huge cost escalations, the states are unable to recover. Often fertile agricultural and forest lands are taken for construction, resulting in displacement of thousands of rural poor and the destruction of rare flora and fauna. Heavy losses happen whilst distributed through unlined distributaries. Heavy sitation result in dams unable to check floods. In addition, panic discharges from such dams cause flash floods. Moreover water logging and soil salinity is a major complaint of areas irrigated by such schemes.

Not withstanding agitation against projects like ‘Tehri’ and the Narmada river, the government continues to implement such projects. Huge dams with canal irrigation systems should be replaced by micro watershed development programmes aimed at increasing the ground water level, checking soil erosion, afforestation and local eco system development. Political will and peoples initiatives are now gaining ground for implementing micro-watershed programmes in a significant manner in various districts of India. Since 1985, the Maharashtra State spearheaded micro-watershed programmes. Successful watershed projects such as Adgson, Baliraja dam and Pani Panchayat have set the trend. Recently the World Bank and the State Government have joined the land wagon of promoting micro-watershed projects in the country.

Where the water goes? Water is concentrated in areas of the dominant crop. In Punjab, Haryana, and Uttar Pradesh, more than 40 percent of the irrigated area is under wheat. In Bihar, Tamil Nadu, Andhra Pradesh and West Bengal, more than 70 percent is under rice. In Maharashtra and Uttar Pradesh, it is sugarcane.
ANNEX VII

RESEARCH AND EXTENSION

Prior to Independence, the British concentrated research to improve the export of wheat, jute, tea and other raw materials. Famines and the devastation that followed, later focussed attention on measures to prevent or mitigate them. The famine enquiry reports were eye openers. They recommended conscious efforts to introduce scientific agriculture. Establishment of the Department of agriculture at the centre was a beginning of a series of steps taken. Soon after, organising of agricultural research started in the provinces. In order to analyze its agricultural situation the Government constituted the Royal Commission on Agriculture (RCA). The RCA recommended, a new organization called the Imperial (now Indian) Council of Agricultural Research (ICAR), to be established for a comprehensive study of agricultural and veterinary problems through the institution of fellowships, scholarships, and financial assistance to universities and other research organizations.

The great depression of the thirties, world war II and the Bengal famine brought home the truth that production must be increased. There was considerable spurt in research and developmental activities throughout the country. The forties was spent in consolidation of achievements made and in surveying the situation for future strategies and planning. A number of crop committees (coconut, sugarcane, tobacco, coconut, oilseeds) sprung up during this period. In animal husbandry the main thrust was on improvement of draught and mulch cattle through breeding, feeding, health cover and strengthening the Indian Veterinary Research Institute with establishing an animal genetics division.

The Department of Agricultural Research and Education, established in 1973, in the Ministry of Agriculture, is responsible for coordinating research and educational activities in the fields of agriculture, animal husbandry and fisheries. It also helps to bring about inter-departmental and inter-institutional collaboration with national and international agencies engaged in the same and allied fields. The Department provides Government support, service and linkage to the Indian Council of Agricultural Research (ICAR).

Indian Council of Agricultural Research (ICAR)

The Imperial Council of Agricultural Research set up in 1929 was renamed the Indian Council of Agricultural Research in 1947. Its objectives are:

i) To undertake, aid, promote, and co-ordinate agricultural and animal husbandry education, research and it’s application, development and marketing, to increase scientific knowledge of the subjects and to secure its adoption in everyday practices;

ii) To act as a clearing house of information not only in regard to research but also in regard to agricultural and veterinary matters generally;

iii) To establish a research and reference library with reading and writing rooms and to furnish the same with books, reviews, magazines, newspapers and other publications;

iv) To do all other things as the Society may consider necessary, incidental or conducive to the attainment of the above objectives.

In recent times, with increasing awareness about sustainable agriculture, ICAR institutions as well as universities are beginning to reorient their research and extension programmes. At this stage, two important factors hamper their transformation.

First, the definition of sustainable agriculture. For many professional scientists and researchers, sustainable include any factor used for sustaining agricultural production. This could mean use of chemicals or mix of chemicals with organic inputs. However, sustainable agricultural viewed from the perspective of ecological and social sustainability excludes the use of chemicals in farm production.

Secondly, attempts are handicapped by the conventional scientific orientation of researchers and extension specialists. There is a strong prevailing conviction on the need for chemicals to increase levels of production, to meet demand arising out of population growth and economic development.

As such, research and extension for sustainable agriculture through ICAR and universities cannot gain momentum. They are also implemented without reference to the needs of women.
ANNEX VIII

THE FIVE YEAR PLANS

Emphasis on the agricultural sector varied, receiving between 22 to 31 percent of the total plan outlays. The pattern of the outlay for agriculture and irrigation can be seen from table below:

Pattern of Government Outlay on Agriculture in the Five Year Plans

<table>
<thead>
<tr>
<th>Total plan outlay (Rs. crore)</th>
<th>Outlay on agric. and Irrigation</th>
<th>Percent of total outlay</th>
</tr>
</thead>
<tbody>
<tr>
<td>First plan</td>
<td>1,960</td>
<td>600</td>
</tr>
<tr>
<td>Second plan</td>
<td>4,600</td>
<td>950</td>
</tr>
<tr>
<td>Third plan</td>
<td>8,600</td>
<td>1,750</td>
</tr>
<tr>
<td>Fourth plan</td>
<td>15,780</td>
<td>3,670</td>
</tr>
<tr>
<td>Fifth plan</td>
<td>39,430</td>
<td>8,740</td>
</tr>
<tr>
<td>Sixth plan</td>
<td>1,09,290</td>
<td>26,130</td>
</tr>
<tr>
<td>Seventh plan</td>
<td>2,18,730</td>
<td>48,100</td>
</tr>
<tr>
<td>Eighth plan (1993-97)</td>
<td>4,34,100</td>
<td>93,680</td>
</tr>
</tbody>
</table>

Note:  
- a) Figures for all except the Eighth are actual: Eighth plan figures are projected outlay figures.  
- b) 1 crore - 10 million

Overall objectives and strategy of the Plans:

Each Five Year Plan evolved on the basis of the economic situation prevalent at the outset of the plan, the investment pattern and programmes relating to agriculture therefore varied. However, as one analyses the plan documents, the following overall objectives are evident:

1) Increase agricultural production - through intensive use of irrigation, improved/hybrid seeds, fertilizers, pesticides, energy, mechanisation and extension of cultivation area.
2) Employment generation - through programmes aim at generating additional employment opportunities to meet the requirements of poor sections of the community.
3) Reduce income inequalities in the rural sector - bring social justice through tenancy legislation, minimum wage regulation and distribution of surplus land over ceilings to the landless.
4) Reduce population pressure on land - through programmes designed to develop subsidiary enterprises in rural areas, i.e. revival of handicrafts and development of agricultural processing and other ancillary activities.

Of the many objectives, increase in agricultural production was central. It was an ‘all or nothing’ drive to achieve high agricultural output. Major achievements in relation to targets are listed below:

Achievements in the Agricultural sector in the Various Plans (T- Target, A- Achievement)

<table>
<thead>
<tr>
<th>Food Grain</th>
<th>Oil seeds</th>
<th>Sugar cane</th>
<th>Cotton</th>
<th>Jute&amp;Mesta</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>A</td>
<td>T</td>
<td>A</td>
<td>T</td>
</tr>
<tr>
<td>First plan</td>
<td>62</td>
<td>67</td>
<td>5.5</td>
<td>5.6</td>
</tr>
<tr>
<td>Second Plan</td>
<td>81</td>
<td>80</td>
<td>7.6</td>
<td>6.5</td>
</tr>
<tr>
<td>Third plan</td>
<td>100</td>
<td>72</td>
<td>9.8</td>
<td>6.4</td>
</tr>
<tr>
<td>Fourth plan</td>
<td>120</td>
<td>104</td>
<td>10.5</td>
<td>8.7</td>
</tr>
<tr>
<td>Fifth plan</td>
<td>125</td>
<td>126</td>
<td>12.0</td>
<td>8.9</td>
</tr>
<tr>
<td>Sixth plan</td>
<td>154</td>
<td>146</td>
<td>11.1</td>
<td>13.0</td>
</tr>
<tr>
<td>Seventh plan</td>
<td>180</td>
<td>172</td>
<td>18.0</td>
<td>17.0</td>
</tr>
</tbody>
</table>

Sources: Plan documents
Note:  
1. Production of food grains, oilseeds and sugarcane are in million tonnes.
2. Production of Cotton are in millions of bales of 180 kg each.
3. Production of Jute are in millions of bales of 170 kg each.
Pesticide Action Network Asia and the Pacific (PAN AP) is one of five regional centres of PAN International - a global coalition of citizen's groups and individuals who work to promote sustainable agriculture and oppose the use of pesticides. PAN AP is dedicated to ensuring the empowerment of people, especially women, agricultural workers, peasant and indigenous farmers. PAN AP is specially committed to protect the safety and health of people and the environment from pesticide use.

Changing Acres is the publication series of PAN AP's regional study on sustainable agriculture. The study launched in February 1994, is intended for policy and strategy building to strengthen sustainable agriculture development in the region. The study will also guide PAN AP's sustainable agriculture programme activities. The initial exercise, including country profiles, a benchmark survey and selected farm case studies, covered seven countries: India, Indonesia, Malaysia, Nepal, Pakistan, Philippines and Sri Lanka.

A subsequent joint project undertaken in 1996, between PAN AP and IFOAM-Asia extended country profile coverage to another seven countries: Bangladesh, Cambodia, China (People's Republic), Korea (South), Laos, Thailand and Vanuatu.

published by
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