CHAPTER – I

AGRICULTURAL DEVELOPMENT AND ENVIRONMENTAL ISSUES

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CHAPTER - I

AGRICULTURAL DEVELOPMENT AND ENVIROMENTAL ISSUES

1.1 INTRODUCTION:

Agriculture is the largest and most important sector of Indian economy. It accounts for nearly 33 percent of Indian national income. About 67 per cent of the people depend upon agriculture and more than 75 per cent of the rural population lives on it. Those who live outside villages belong to agriculture in more than one way, through trade in agricultural products, through work in agro-based industries, etc. (1)

In India, the scope of bringing further areas under cultivation is limited by nature; half of the land in India is already occupied by agriculture. This is higher proportion than in Europe, U.S.A. and Canada. Hence, the possibilities in agriculture development rest on intensive use of inputs on land. Since last 40 years Indian agricultural production has moved upward. India now produces 170 million tonnes of food grain annually, a far higher production that what she produced in (51million tonnes) 1950-51. Over the years, India has developed a strong input supply infrastructure and because of this, their use has been increasing at a very fast rate. The institutional agricultural credit, which stood at Rs. 3,389 crores in 1980-81, has stood Rs.66,771 crores in 2001-2002. Fertilizer application has gone up from 69 lakh tonnes in 1950-51 to 173.60 lakh tonnes in 2001-2002, and the irrigated area has nearly doubled. In 1970-71,31.1 million hectares area was irrigated which increased 54.6 million hectares in 1997-98.

Over the years, indiscriminate use of fertilizers, pesticides and irrigation water has produced a vast array of waste, which has jeopardized the existing ecosystem and has created also innumerable problems.

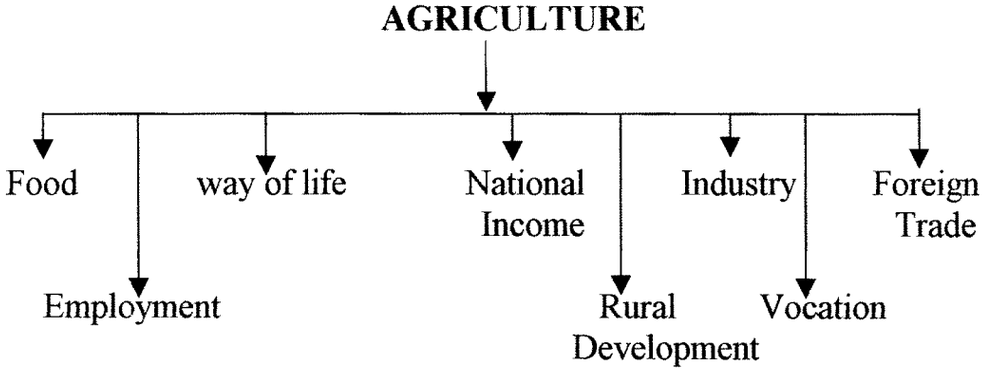
The excessive use of pesticides reduces the quality of food and water and it brings salinity in the soil. But the price of such agriculture pollution will have to be paid one or the other day. If not immediately then later, therefore the key to the success of agricultural development is an environmentally safe agricultural development. There is still time to adopt ecological appropriate strategies for agricultural development. (2) In the new millennium, the challenges in Indian agricultural sector are quite different from those meets in the previous decades. The enormous pressure to produce more food from less land with shrinking natural resources is a tough task for the farmers. To keep up the momentum of growth a careful economic evaluation of inputs like seeds, fertilizers, irrigation sources etc are of considerable importance. Considering the irrigation needs in Indian agriculture, emphasis be given to promote the proven cost-reducing micro irrigation technology of drips irrigation which helps conserve water, fertilizer inputs and ensures higher productivity. Farmers awareness programs coupled with subsidy incentive may prove helpful strategies. The sustainable method of irrigation needs to be popularized. Salinity and water logging problems in the commands of major irrigation systems need to be minimized by recognizing and incorporating corrective measures. Further, proper drainage facilities involving farmer's groups need to be created. Watershed approach to management of water in rain fed areas should continue to get the due thrust.

Diffusion of fertilizer consumption in Indian agriculture has been quite widespread. The imbalances in the use of N, P, and K have become highly conspicuous. The intensity of fertilizer use has gradually gone up

from about 3 kg/ ha, in early sixties to about 88 kg/ha in 1997-98. Therefore, wider distribution of fertilizer needs to be promoted by covering regions of Uttar Pradesh (in the case of wheat and rice) through creation of an extensive network of rural infrastructure (including roads and credit) for establishing an appropriate interface of input markets and output markets in these regions. (3)

1.2 ROLE OF AGRICULTURE IN ECONOMIC DEVELOPMENT:

The role of agriculture can be summarized as follows;



It is evident from the above chart that agriculture is the backbone of the Indian economy (4) however; following main points can be highlighted.

A) The share of employment Indian agriculture in total is high because agriculture dominates the economy to such an extent that 67% of the population is engaged in agriculture.

B) Nearly 75% of the rural population earns its livelihood from agriculture and other occupations allied to agriculture.

C) In cities a considerable part of labour force is engaged in jobs depending on processing and marketing of agriculture produce.

1.3 MELLORS THEORY OF AGRICULTURE DEVELOPMENT:

Mellors theory of agricultural development has been seen in every country. Our country has reached at the third stage of development i.e. high capital-intensive technology.

Mellor divides agriculture in the following three phases.

Phase I: Traditional Agriculture

"It is a technologically stagnant phase in which production is increased largely through slowly increased application of traditional forms of land, labour and capital." The increase in output takes place through an essentially symmetrical expansion of all inputs or through increased input of the already abundant low productivity resources. Declining income and productivity per unit of an input is a common feature of this phase.

Phase II: Technologically Dynamic Agriculture-Low Capital Technology

In phase II, " a complex of technology changes substantially increases the efficiency of agricultural processes and raises the rate of increase of agricultural production. The critical characteristics of phase II, as compared with phase I is the constant generation and application of technology which is facilitated by a complex institutional frame work..." In this phase, "(a) agriculture still represents a large proportion of the total economy (b) demand for agricultural products is rising rapidly due to both demographic and income effects, (c) capital for industrial development is particularly scarce and returns are rising (d) limitations to the pace of economic transformation and pressure of population growth preclude enlargement of the average acreage per farm and (e) use of labour saving agricultural machinery is largely precluded by unfavorable labour- capital

cost relationships. These conditions call for a type of agricultural development which at one time was not possible, but which is now facilitated by modern science."

Phase III: Technologically Dynamic Agriculture – High Capital Technology

This is the stage when agriculture has lost much of its relative importance in the generation of the National Income. Agriculture of various developed countries is included in this phase.

Government's role in different phases is quite important. We would like to highlight the objectives and important policy measures relevant for each phase in the paragraphs that follow. It may be noted that as the phase of agricultural development cannot be very finely demarcated, the objectives of agricultural policy at a particular time, too cannot be defined rigidly. What we find at a particular point of time is a set of objective, their order of priority of course, changing as the time changes. We can give below the relatively more important policy objectives vise-a visa agriculture in different stages of development (5)

1.4 INPUTS FOR AGRICULTURE DEVELOPMENT:

We know that in any sector, maximum utilization of inputs brings maximum production. In the agricultural sector land is the most important factor of production. But in our country agricultural land is not utilized at a maximum level. For maximum utilization of land needs irrigation facilities. On account of limited irrigation facilities, agricultural land is not utilized at a maximum level. Moreover, there are some other factors, which influence agricultural production (4)

These are called inputs factors such as Seeds, Fertilizers, Irrigations, Credit and Machinery etc.

1.4.1 Role Of Land In Agriculture:

Land is the first thing that comes to mind when one talks of agriculture. In fact, it is not possible to think of agriculture without the use of land. Land has been man's most significant input but it is natural factor of production and it continues to be so, more important in the less developed countries of the world.

Pastures and Grazing Lands:

Land is again a key resource for pastures and grazing lands which feed a growing livestock and help to improve the supply of food to man. Since grazing lands do not fall under private ownership, the productivity of such lands is low. Nevertheless these lands play a significant role in feeding millions of cattle on the earth's planet. Most of these pastures and grazing lands are found in mountains and in rugged topography.

Forests:

Land under forests serves man in several waysed, in general, and agricultured, in particular. Forest wealth plays a pivotal role in the development of a region and agriculture enterprises. *Any country should possess 33 % of its geographical area under forest. But it is not available in India. India is having only 21 % of forest area.*

1.4.2 Irrigation:

The provision for irrigation in the agricultural field is most important from the point of view of crop production, crop safety, cropping pattern and lastly fuller and greater utilization of human, animal and other resources, but excessive irrigation and inadequate irrigation are both detrimental to crop production. Too little irrigation will result in the withering of the plant, too much will cause water logging and disease or death of the plant. Excess irrigation leads to depletion of soil fertility as well as total destruction of the crop. To get rid of this problem, the construction of field channel for

drawing out the excess water is essential. Similarly in areas, where water supply is inadequate knowledge of scientific use of water to the farmers is most urgent (6)

Table No. 1.1

AREA IRRIGATED BY SOURCE

(Million.Hactare.)

Source	1970-71	1980-81	1990-91	1996-97	1997-98
Government canals	12.0 (38.6)	14.5 (37.5)	17.0 (35.4)	16.9 (30.7)	16.6 (30.4)
Private canals	0.9 (2.9)	0.8 (2.1)	0.5 (1.0)	0.5 (0.9)	0.5 (0.9)
Tanks	4.1 (13.2)	3.2 (8.3)	2.9 (6.0)	3.3 (5.9)	3.1 (5.7)
Wells and tube well	11.9 (38.3)	17.7 (54.7)	24.7 (51.5)	30.8 (55.9)	30.9 (56.6)
Others	2.3 (7.4)	2.6 (6.7)	2.9 (6.0)	3.6 (6.5)	3.5 (6.4)
Total net irrigated area	31.1 (100.0)	38.7 (100.0)	48.0 (100.0)	55.1 (100.0)	54.6 (100.0)

Source: Statistical Outline Of India.2002-2003, Tata Service Ltd.,Mumbai.

The above table shows that, net total area under irrigation has increased from 31.1 percent to 54.6 percent from year 1970-71 to 1997-98 respectively. The area under government canal irrigation has decreased considerably from 38.6 to 30.4 percent. Percentage of irrigation through private canals has decreased marginally from 2.9 to 0.9 percent. Hence we can conclude that use of private canals for irrigation has almost stopped; whereas irrigation through tanks have sharply decreased from 13.2 to 5.7 percent, which is serious for agricultural development.

Area under irrigation through wells and tube wells shows considerable amount of growth i.e. from 38.3 to 56.6 percent. This is due to propagation of various government policies and easy availability of loans from banks to the farmers for this project. In the year 1970-71 tube wells were not main source of irrigation but in the year 1997-98 it has emerged as main source of irrigation (7)

Irrigational environment means the environment of any area, which is artificially created through introduction of irrigation. The influence of irrigation in promoting the spatial changes in land use, cropping pattern, agricultural inputs and also crop yield come in the purview of irrigational environment. It also includes the negative aspects like environmental degradation, particularly related to irrigation such as emergence of saline and alkaline soils, water logging lands etc. It is a proven fact that irrigation is a vital infrastructure for agricultural development. Introduction of irrigation in any area increases agricultural production 5 to 10 times but it is not always true that irrigation under all conditions reaps a golden harvest. It has its own repercussions too if proper management of soil, water and drainage are not visualized.

Thus, the above analysis has proved by R.K. Gurjar in his book "Irrigational Environment" in the following points.

1) The constantly increasing demand for water and its decreasing availability has made water problem the most important problem next only to the threat of a world war or a nuclear holocaust.(Sundar Lal Bahuguna)

2) The exploitation of the groundwater has been so excessive, thoughtless and indiscriminate that the water table has gown down almost everywhere. In the sugarcane growing areas of Maharashtra the level of the groundwater is going down by one or two meters every year. We are drawing out more water from the underground than the water, which seeps

and percolates into the ground. It is like a kind of mining water from the earth.

3) In 1986, the then Prime Minister, Shri Rajiv Gandhi, while addressing a meeting of the irrigation ministers of the states said that out of the 246 large irrigation projects begun in 1951 only 65 had been completed and the projects which had begun after 1970 had not done much good. He added, "For sixteen years we have been pouring money on these projects. What have the people got in exchange? Nothing- no irrigation, no water, no increase in agricultural production or no facilities in day-to-day living to make life better".

Negative Effects of Irrigation:

1) The Problem of Water logging:

This problem of water logging is more acute in the areas where intensive irrigation is carried on. The problem of water logging does not occur in the areas where intensity of irrigation is low or where no irrigation is possible.

2) The Problem of Alkalinity and Salinity of Soil:

This problem is more common in the areas, which have high density of irrigation because the problems of water logging and high alkalinity and salinity in the soil are inter-related. This problem is not found in areas with low density of irrigation.

3) Various Crop Diseases:

In the high density irrigated areas the percentage of crop diseases is higher as shown in wheat, bajra, guar, mustard etc and in the low density irrigated areas it is lower in bajra, cotton, wheat, gram and in the non irrigated areas.

4) Weeds:

Irrigation and growing of weeds are closely related. It is natural that more weeds will grow in the areas brought under irrigation because of availability of more water. The number and amount of weeds has increased, more in the high density irrigated areas than in the areas with low density irrigation or with no irrigation. (8)

1.4.3 Fertilizer:

Chemical fertilizer is the most important ingredient for augmenting crop production with the introduction of the HYV seeds; the need for fertilizers has been growing a pace. Till now cow dung forms bulk of manures, which is usually obtained from the domestic sources. In western countries, soil fertility is maintained by using straw and the residue of crops as manure in addition to chemical fertilizer, in India straw is used as fodder and a small quantity of cow dung is used as manure, leaving greater quantity to be wasted as fuel.

In India per hectare consumption of chemical fertilizer is around 50 kilograms and its use is increasing at a very fast rate (6 lakh tones per annum) causing concern to the existing eco-system. In view of this the role of chemical fertilizers has to be lessened by phases. A balanced use of NPK (Nitrogen, Phosphate and Potash) Farm Yard Manure (FYM) and green manure based on soil tests can reduce costs and ecological damages at the same time and achieve greater efficiency both in short and in long term. Intercropping sequence of cereals and legumes (which fix nitrogen in soil) reduces the need of nitrogenous fertilizers. In several areas this method have acquired much success. In recent years, bio fertilizer such as biogas slurry has come into use as most effective and efficient manure. This fertilizer contains 2 percent nitrogen as against 0.5 percent in FYM. Thus the use of

bio fertilizer and organic manure which farmers ignores has to be given top priority over chemical fertilizer. *(9)*

Table No. 1.2

FERTILIZER CONSUMPTION

Year	Nitrogenous	Phosphate	Potassic	Consumption Ratio		
000 tones 1 nutrients				N	P	K
80-81	3,678	1,214	624	5.9	1.9	1
90-91	7,997	3,221	1,328	6.0	2.4	1
91-92	8,046	3,321	1,361	5.9	2.4	1
92-93	8,437	2,844	884	9.5	3.2	1
93-94	8,789	2,669	908	9.7	2.9	1
94-95	9,507	2,932	1,125	8.5	2.6	1
95-96	9,823	2,898	1,156	8.5	2.5	1
96-97	10,302	2,977	1,029	10.0	2.9	1
97-98	10,901	3,914	1,373	7.9	2.9	1
98-99	11,354	4,112	1,332	8.5	3.1	1
99-00	11,592	4,799	1,678	6.9	2.9	1
00-01	10,920	4,215	1,567	7.0	2.7	1
01-02	12,197	5,198	1,911	N.a	N.a	N.a

Source:http://agricoop.nic.in

Fertilizer Consumption:

The consumption of chemical fertilizers in India during 2001-02 was 173.60 lakhs tonnes of nutrients as against 167.02 lakh tonnes of nutrients during 2000-01 and 180.69 lakh tones of nutrients consumed during 1999-2000,an increase of 3.94% over 2000-01 but still lowered by 3.92% over 1999-2000. This was due to drought condition prevailing in many parts of the country. All chemical fertilizers except urea continue to be decontrolled. The Government continues to provide subsidy to the manufacturers of urea to enable its availability to farmers at reasonable prices. Also for enabling sale of decontrolled Phosphates (P) and Potassium (K) fertilizers at reasonable prices, the Government has been implementing a scheme of concession on sale of P and K fertilizers. The consumption of major fertilizers during the last five years is shown below.

Table No.1.3

CONSUMPTION OF FERTILIZERS: (in lakh tonnes)

Year	Urea	D A P	MO P	N	P	K	Total
97-98	196.19	53.72	17.29	109.01	39.14	13.73	161.88
98-99	203.96	58.28	16.21	113.54	41.12	13.32	167.98
99-00	202.78	69.37	20.49	115.93	47.99	16.78	180.69
00-01	199.86	58.84	18.29	109.20	42.15	15.67	167.02
01-02	199.17	61.81	19.93	113.10	43.82	16.67	173.60

The per hectare Fertilizer consumption of NPK has increased from 86.71 kg/ha, during 2000-01 to 90.12 kg/ha during 01-02. However, it is

still lower than 93.81 kg/ha of 99-2000. It varied from 173.38 kg/ha in Punjab, 143.46 kg/ha in Andhra Pradesh to only 17 kg/ha in Meghalaya(9) But there is slight rise in use of NPK year after year.

1.4.4 SEEDS:

Seeds are a critical and basic input for attaining sustained growth in agricultural production; seeds are the carrier of new technology for crop production. Distribution of assured quality seeds are necessary for attaining higher crop yields. Policy initiatives taken by government of India during 1960s and 1970s for quality seed production and distribution of improved plant varieties developed by the scientists is one of the reasons for the country's self sufficiency in food grains.

An Indian seed programme largely adheres to the limited generation system for seed multiplication. The systems recognize three generations, namely, breeder, foundation and certified seed. Details of production of breeder and foundation seeds as well as certified seed distribution for 1998-99 to 2001-02 and for 2002-03 are as under (10)

Table No.1.4

PRODUCTION OF BREEDER, FOUNDATION AND CERTIFIED SEED.

Types of Seeds	Unit	1998-99	1999-2000	2000-01	2001-02	2002-03(A)
Breeder Seeds	MT	3899	5064	4269	4702	6292
			Production			
			Foundation			
Seeds Production	MT	67500	46600	59100	54400	56800
Certified /Quality		849700	87.98	862700	910000	950000
Seeds Distributed	MT		(678900)	(72.96)	(709200)	

1.4.5 Pesticide: -

While fertilizers and irrigation water have been applied in appropriate combinations to get higher yields, the control of diseases and pests is equally important. This is more so when seeds are of high yielding varieties, HYV seeds are more susceptible to pests and insects, which mean higher input, cost for the farmer in terms of chemical pesticides and insecticides. In India, pests annually destroy about 20 percent of the standing crops a loss of money not less than rupees 1,500 crores. Some crops like Pulses, Oilseeds, and HYV rice are more susceptible to pests and hence cultivators avoid cultivating them, despite high returns for combating the problems of insects and pests.

Agronomical (pulling off pest effected part of the crops, use of Neem, Mahua dust in the soil, crop sanitation) and cultural control such as light trap erection of post (Pinjarapol) for insect eating bird in the field. Crop sanitation etc. has to be given to priority over the use of chemical pesticides, The use of pest resistant varieties and chemically treated seeds can minimize the chances of pests attack and cut down the cost of pesticides.

During the last 40 years, India has achieved reasonable self-reliance in food grain production, It has now come when the possible alternatives in the practices of agriculture should be given due consideration. The consideration should no longer be the high output of food grains per hectare but due safeguards from the ecological standpoints. This is utmost important for saving the soul of out future generations.

Faulty irrigation practices and use of pesticides have led to waterlogging, salinization, and soil erosion of vast tracts of our fertile land. This has been proved by Prof.S.G.Misra in his book, Agricultural Pollution.

Pesticides are substances used to kill or control undesirable organisms. They were introduced in India some 40 years back. Pesticides

are used against pests but the non target species also get harmed. The situation becomes serious when the pesticides-residues get build-up in food chain and ultimately reach man. Soil harbours many beneficial organisms like nitrogen fixing bacteria, algae and earthworms, which play important role in maintaining soil fertility and soil quality.

Problems arising from pesticides use:

Three major problems threaten to limit the continued usefulness of pesticides:

i) **Resistances:** Some pest organisms (particularly the insects) have developed resistance for the chemicals. This necessitates higher dosage of the development of new chemicals to replace those to which the pests are resistant.

ii) **Persistence:** Some pesticides are not readily biodegradable and tend to persist for years in the environment. Although this characteristic may be advantageous in controlling some pests, it is a disadvantage as the chemical moves to other parts of the environment.

iii) Harm to non-targets: As little as 1 per cent of the pesticides applied may contact the target organism, much of the remainder moving into the soil. Soil flora and fauna may be adversely affected, as may be fish and other wildlife. This problem is compounded by the tendency of the chemicals to build up in organism as movement up the food chain occurs.

Fate or Behavior of Pesticides in Soil:

We all know that pesticides are commonly applied to plant foliage or on the soil surface or incorporated into the soil. In any case, a high proportion of the chemicals (up to 99%) eventually move into the soil.

Pesticidal Residue in Soil Organisms:

Edward (1973) gave following four effects of pesticides on living organisms (soil microorganisms, soil invertebrates and plants) in soil-

a) They may be directly toxic to animal in soil.

b) They may affect the soil organisms genetically to produce population resistant to the pesticides.

c) They may be taken into bodies of soil flora or fauna and passed onto the other organisms.

Ash and Lee (1980) showed that lead, cadmium and copper accumulated in 3 species of earthworms i.e. lumbricus terrestris, L. rwbellus and Allo Lobophora chlorotica. Earthworms are the important members of soil fauna, aiding the maintenance of aeration, water permeability. Van hook (1974) has shown that earthworms from soil contaminated by heavy metals accumulated lead and cadmium and can survive in conditions of considerable metal pollution. (11)

1.4.6 Improved Tools And Implements:

A) Previously agricultural activities were done with the aid of old machine and tools due to which productivity was low.

B) In order to increase agricultural productivity better tools and machine are used.

C) Extensive use of farm machinery definitely leads to increase in agricultural production and also reduces cost.

D) Now ploughing is done with a tractor, sowing, and sprawling fertilizer with a drill, reaping and threshing with a thresher.

E) Mechanization leads to saving of time and costs, leads to increase in productivity.

Thus tools and implements are a most for the development of agriculture.

1.5 IMPORTANCE OF MODERN TECHNOLOGY IN AGRICULTURE DEVELOPMENT:

A) The replacement of traditional agricultural practices by modern technology and farm practices is essential for agricultural development.

B) The Green Revolution of 1960's demonstrated that India could achieve self-sufficiency in the production of food grains by adoption of modern technology on extensive scale.

C) The modern technology has given a boost to production of major cereals.

D) The production of food grains has more than doubled by the adoption of modern technology which alone is capable of meeting food requirement of India's rapidly increasing population.

E) Application of modern technology has made the Indian farmers market oriented and develops a commercial outlook.

F) The progressive farmers have become cost conscious and adoption of management practices in various operations have led to better productivity to farmers.

Table No.1.5

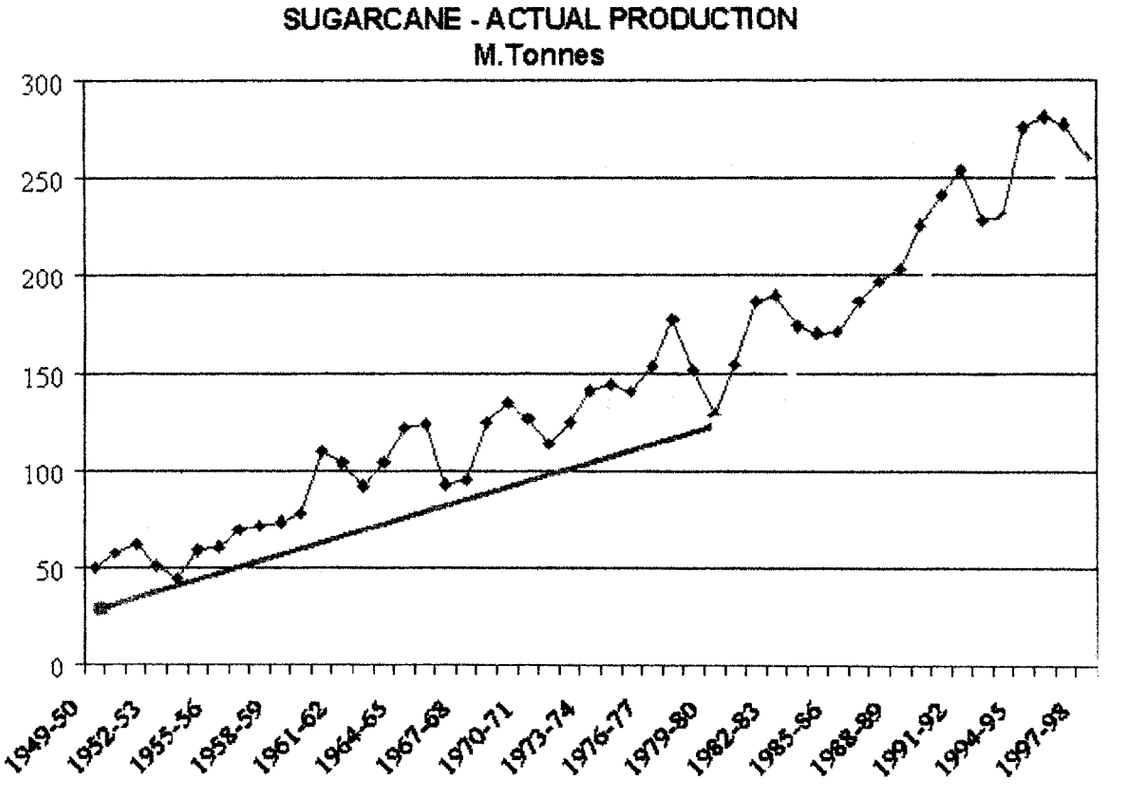
AREA UNDER DIFFERENT CROPS

Crops	2000-01	1999-00	1998-99	1990-91	1980-81
			Mn. Hectares		
Food grains	119.8	123.1	125.2	127.8	126.7
Cereals	99.8	102.0	101.7	103.2	104.2
Rice	44.3	45.2	44.8	42.7	40.1
Wheat	25.1	27.5	27.5	24.2	22.3
Jowar	10.0	10.2	9.8	14.4	15.8
Bajra	9.8	8.9	9.3	10.5	11.7
Maize	6.6	6.4	6.2	5.9	6.0
Others	4.0	3.8	4.1	5.5	8.3
Pulses	20.0	21.1	23.5	24.7	22.5
Gram	4.9	6.2	8.5	7.5	6.6
Tur	3.7	3.4	3.4	3.6	2.8
Others	11.4	11.5	11.6	13.6	13.1
Oilseeds	22.3	23.2	26.2	24.1	17.6
Groundnut	6.7	6.9	7.4	8.3	6.8
Rapeseed and mustard	4.5	6.0	6.5	5.8	4.1
Others	11.1	10.3	12.3	10.0	6.7
Cotton	8.6	8.7	9.3	7.4	7.8
Jute	0.8	0.8	0.8	0.8	0.9
Sugarcane	4.3	4.2	4.1	3.7	2.7
Tea	N.a	0.4	0.4	0.4	0.4
Coffee	0.3	0.3	0.3	0.2	0.2

Source: http://agricoop.nic in

Explanation of the above table tells that area under food grains has decreased from 126.7 to 119.8 Mn. Hectares from 1980-81 to 2000-01. Area under cereals shows minimum decrease i.e. from 104.2 to 99.8 Mn. hectares

The following chart shows the actual production of sugarcane have drastically increased from 50 million tones to 275 million tones (1949-50-1997-98). (12)



1.6 RELATION BETWEEN AGRICULTURE AND ENVIRONMENT ISSUES:

In this chapter we have studied that, our farmers had gone through many phases of agriculture development. In the last fifty-years of agriculture development farmers has used considerable amount of technology but it is found that these methods are not fully environmental friendly.

Today farmers in India are found to be in a depressed and angry mood. The depression is said to have resulted partly from growing rural-urban disparities and partly from declining trends in profitability of agriculture in almost all the states. The rates of decline being higher in the more developed states. The farmers are also angry under the impression that the government under the direction of World Trade Organization (WTO) may withdraw various forms of farm protection, which may affect their future prospects adversely. While the reasons for relatively greater decline in agricultural profitability is in developed states which are the main beneficiaries of green revolution. Due to the blind adaptation of new technology, the yields and income levels of farmers are low. The problem of low productivity has become a serious problem to small and marginal farm holders. (13)

Environment can be defined as the totality of man's surrounding. It may be referred as " *the sum of all social, biological and physical or chemical factors which constitute the surroundings of man".* Each element of these surroundings constitutes a resource which man utilizes in different ways to develop and lead a better life. In the beginning, the environment, which controlled and shaped its evolution, shaped man and man remained in equilibrium with the environment. But in the quest of its development, man broke this equilibrium and since then he is exerting an ever-increasing influence on his environment. Due to growing urbanization and

industrialization, man has distorted the environment. The distortion seems only when it exceeded the limits beyond which it became irreparable

Development Versus Environment Degradation

All developmental activities, irrespective of their scale, nature and magnitude affect the environment. The impacts of these developmental activities may have short-term as well as long-term implications. The short-term implications may be negligible as compared to the benefits of the developmental programs, but the long-term implications may further create new ecological and environment problems, the solutions for which may not be easy to find. Some of these implications may be summarized as follows.

1) Deforested lands

2)Denudation of slopes

3)Soil erosion and silting of rivers

4)Land degradation

5)Regular occurrence of floods and droughts

6)Impoverishment of important fauna and flora

7)Changed climate

8)Polluted water to drink and contaminated air unfit to breathe.

1.7 IMPACT OF DEVELOPMENT ACTIVITIES ON ENVIRONMEN

Development activities	Major impacts on environment
Forest clearing and land settlements	Extinction of rare species of flora and fauna, creation of conditions for mosquito breeding leading to infectious diseases.
Shifting cultivation in upland agriculture.	Soil erosion in upland areas, soil fertility declines due to shorter cultivation cycle, flooding of low land areas.
Agro industries	Air pollution due to burning of bagasse as fuel in sugar mills, large amount of highly polluting organic wastes, surface water pollution.
Introduction of new varieties of cereals.	Reduction of genetic diversity of traditional monoculture resulting in instability, danger of local strains of fungus, bacteria or virus on new variety.
Use of pesticides	Organisms develop resistance and control methods are needed (e.g. in malaria widespread use of dieldrin as a prophylactic agent against pests of oil palms made the problem worse), creation off complex and widespread environmental problems.
Timber extraction	Degrades land, destroy surface soil, reduces production potential of future forests.

Land Degradation

Land degradation may be defined as the loss of utility or potential utility of land or the reduction, loss or change of features or organisms, which cannot be replaced.

Land is degraded when it suffers a loss of intrinsic qualities or a decline in its capabilities. Land degradation may be due to combination of both.

Soil Erosion:

Soil is the non-renewable natural resource, which supports life on earth. About 130 million-hectare of land (45 % of total geographical area) is affected by serious soil erosion through ravine and gully, shifting cultivation, cultivated wastelands, sandy areas, deserts and water logging (Government of India, 1989).

Soil erosion by rain and river that takes place in hilly areas causes landslides and floods, while cutting trees for firewood, agricultural implements and timber, grazing, by a large number of livestock over and above the carrying capacity of grasslands, traditional agricultural practices, construction of roads, indiscriminate (limestone), quarrying and other activities, have all led to the opening of hill-faces to heavy soil-erosion. Wind erosion causes expansion of deserts, dust storms, whirlwinds and destruction of crops, while moving sand covers the land and makes it sterile (14)

1.8 THE RELATION BETWEEN ENVIRONMENT AND AGRICULTURE DEVELOPMENT

Agriculture and environment have an age old and permanent relationship with each other. Perhaps no other human effort has interacted with environment as early as agriculture did.

Ever since man started realizing the existence of his entrepreneurial qualities and the urges of going his own way, the exploitation of nature began. When man no longer wanted to gather food that nature produced for him, he started working against it by clearing patches of land and growing

the food he wanted. Nature has learned only to give and not to refuse and the aggressive man never relented in his efforts to exploit the natural resources. Modern agriculture had lead in bringing about the natural disorders as its ever-increasing greed for land.

This unending exploitation of nature started causing disequilibria in the environment on a large scale. The technology developed over time did not help much. While it enabled the deepening of the resource-use at its present level, it certainly did not prevent further exploitation of whatever was left. Much less effort was made to replenish the resources. Nature, therefore, retaliated by creating agricultural instability in the following manner:

(i) Reduced water supply.

(ii) Increased floods.

(iii) Spreading crop diseases.

(iv) Resulting higher cost of production.

The impact of agricultural development on the environmental situation in now more complex and manifold. Agriculture is heavily dependent upon industry and many a product produced by the industry and causing harm to environment is meant for agricultural development only. Thus industry and agriculture, together, are harming the environment in a greater measure than at any time in the past. New agricultural technology having many inorganic components has produced highly harmful effects on nature. It is reported to have affected the earth's crust and the useful bacteria, besides upsetting the ecological balance in its own way

An increased use of chemical fertilizers has been hardening the upper layers of the soil and with each successive crop season, the tractors have to be so designed as would dig deeper and deeper. With each such exercise, the depth of the hard layer goes on increasing and this makes the soil barren and future cultivation. For how long shall tractors be used to dig deeper should

not be hard to understand and unless the process is immediately reversed through some alternative technology, it might threaten the whole process of agriculture is not a too distant future.

Hardening the upper layers of the soil destroys the moisture retention quality of the soil which not only reduces its potential for growth of vegetation, it also deprives it of its capacity of holding rain water and preventing low lying areas from getting inundated. Many a time, it has come to notice that during the rainy season, the appreciable measure. The whole of the rainwater flows down. It acts as a double-edged weapon. The high lands do not retain moisture which is essential for living organisms such as earthworms and other useful bacteria which in turn are highly conducive to the growth of agricultural crops and on other hand, the low-lying areas get inundated, threatening the standing crops and also bringing large-scale destruction to these areas.

One of the important elements of the new farm technology is assured irrigation. In areas where irrigation was assured, it worked wonders including exploitation of avenues of irrigation in other areas. This resulted in digging of wells on a large scale. In the process, instead of optimal use of water, excessive use was made. This affected in two ways. On the one hand, the problem of salinity arose and on the other, the water table started going deep down to an alarming proportion. This over-excitement of adopting the new techniques makes us indifferent towards the future consequences and hence excessive use of the revolutionary technology. In some places, even water logging is reported to be causing concern. In a country of acute scarcity of land, wasting some areas owing to water logging can be ill afforded. Similar problems arise with respect to those activities where forest resources are used. Excessive use of already depleting forest resources without giving sufficient attention to its regeneration is causing concern.

In studies conducted all over the world, it has been seen that organic farming can still be adopted without affecting the quantum of production. *A study from Karnataka Western Ghats has shown that unscientific over-exploitation of forests has fully silted up three of the five perennial irrigation ponds and reduced the area irrigated from 17 to 9 hectares.* A study in Andhra Pradesh showed that continuous mono-cropping of new seeds of cotton with the indiscriminate use of chemical fertilizers resulted in ecological disorders and falling yields. This clearly showed that inorganic farming results in a change in the ecosystem. Constant disorders in agro-ecological conditions had certainly threaten long-run perspectives of agricultural growth.(15) At the dawn of the new millennium, the evidence is overwhelming that an agriculture transformation is essential to meet the global challenges of feeding the world's growing population, conserving the environment, and reducing the poverty. Such a transformation is urgently needed in large agrarian economies such as India where it will have to occur at the level of small farmers so that their complex farming systems can be made more productive and more efficient in the use of resources.

1.9 NEED FOR RATIONAL POLICY:

The challenge to world agriculture, inherent in these projections is immense. The challenge is both technological (requiring the development of new, high-productivity, environmentally sustainable production system) and political (requiring policies that do not discriminate against rural areas in general and agriculture in particular) and will have to confronted at a time when attain to agricultural development and rural well being is diminishing.

The Nobel laureate, Dr. Norman Borlaug calculates that " to meet projected food demands, by 2025 the average yield of all cereals must be 80 per cent higher than the average yield in 1990. this increase will have to be achieved in increasingly complex circumstances. "

Future increases in food supplies must come primarily from increasing biological yields rather than from area expansion and more irrigation, because land and water are becoming increasingly scarce. Most new lands brought under cultivation are marginal and ecological fragile, and cannot make up for the land being removed from cultivation each year because of urbanization and land degradation. The sources of water that can be developed cost–effectively for irrigation are nearly exhausted, and irrigation water will increasingly need to be shared with municipal and industrial users. For these reasons sustainable agricultural growth is an essential element of economic growth in most developing countries.

1.10 MEETING THE CHALLENGES:

Despite the daunting nature of India's fight against poverty. the country has made substantial strides in prompting agricultural development and reducing poverty.

The most outstanding and significant of these has been the revolution in agricultural production that transformed India which could not feed its450 million inhabitants that now produces enough grain for the caloric coverage of 102 million persons and has recorded a surplus of 33 million tonnes of grain. This agricultural transformation prevented the famines predicted by the doomsayers of the 1960s,without question, one of the great human achievements of this century.

The remarkable facts can be summarized as;

- Cereals output in India has risen from 80 million tonnes (1966) to 221 million tonnes (2000)- an increase of 176 per cent over 30 years.
- Cereal yields increased by 156 per cent over the same period,
- India is the world's second largest producer of rice after China.
- Rice yields increased by 170per cent,
- India is now the world's second largest wheat producer, behind China but ahead of the U.S.
- Wheat yields increased by 167 per cent.

This remarkable transformation was made possible by political will, visionary policies, sound decision-making, effective policy implementation, the engagement of both the public and the private sector in a powerful national enterprise, and the crucial partnership between farmers and scientists.

Along with remarkable achievements, India continues to face formidable problems, as following summary shows:

- Every minute 48 children are born in India; every minute the population increases by 42 people.
- Over 140 million hectares are affected by water and wind erosion.
- Over a million hectares are damaged each year as a result of shifting cultivation.
- Environmental issues are mounting –falling ground water tables, salinitation water pollution, etc. Most forests are degraded and agricultural productivity is low. About one third of all forests have a crown density of less than 40 per cent

1.11 TOOLS FOR SUSTAINABLE AGRICULTURE DEVELOPMENT:

For the above mentioned environment problems farmers should undertake the following methods for sustainable agriculture development.

Future course of agricultural development, therefore, shall have to be chalked out carefully if it is to be ensured that no more degradation of our environment takes place. Some of the important points to be kept in mind may be listed as under :

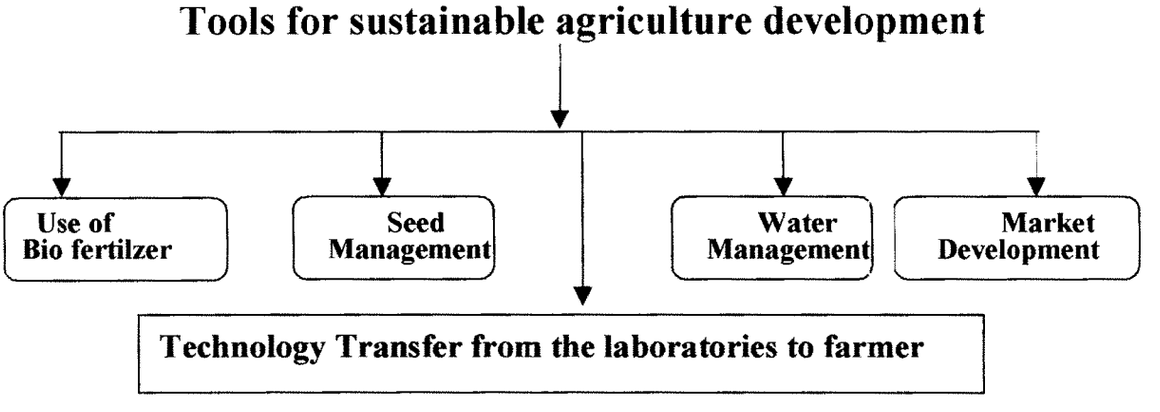
1) The development support should begin from,

i) Seed management and supply of quality seeds of improved verities.

ii) Technology transfer from the laboratories to farmers.

iii) Water management

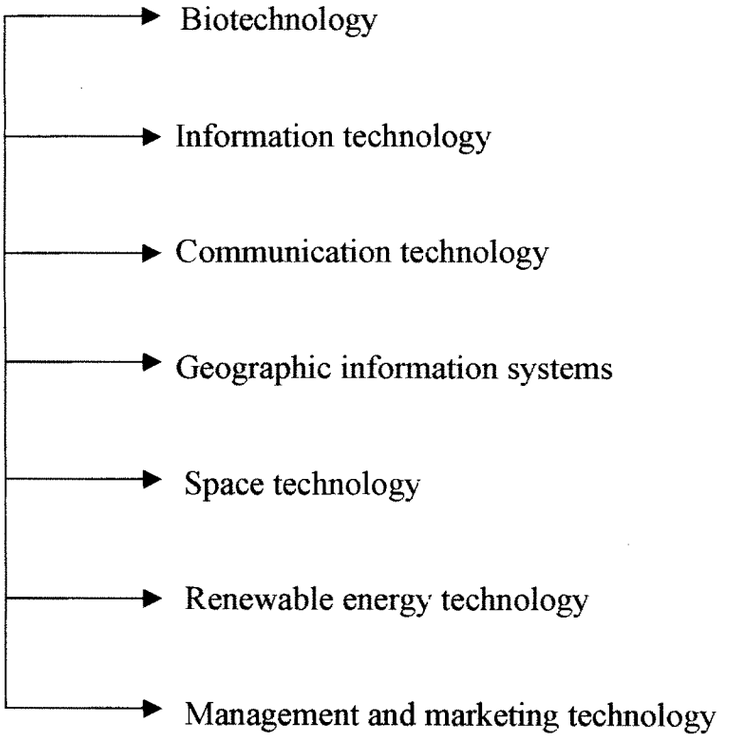
iv) Market development



2) We are now in a position to launch the second green revolution that can help to increase yield, income and livelihoods per units of land and water, if we bring about a paradigm shift in our agriculture research and development strategies. The ever green revolution will be triggered by farming systems that can help produce more from the available land, water and labour resources without either ecological or social harm.

3) We should shift our mindset from a commodity-centered approach to an entire cropping or farming system based on an integrated natural resources management strategy and caring for cattle wealth.

4) Scientists now have unique opportunities for designing farming systems to achieve the triple goals of more food, more income and more livelihoods per hectare of land, provided we harness the tools of eco-technologies, resulting from a blend of traditional knowledge with frontier technologies. Such tools include 1) biotechnology, 2) information and communication technology, 3) Geographic Information Systems (GIS) mapping, 4) space technology, 5) renewable energy technology (solar, wind, biomass and biogas), and 6) management and marketing technologies.

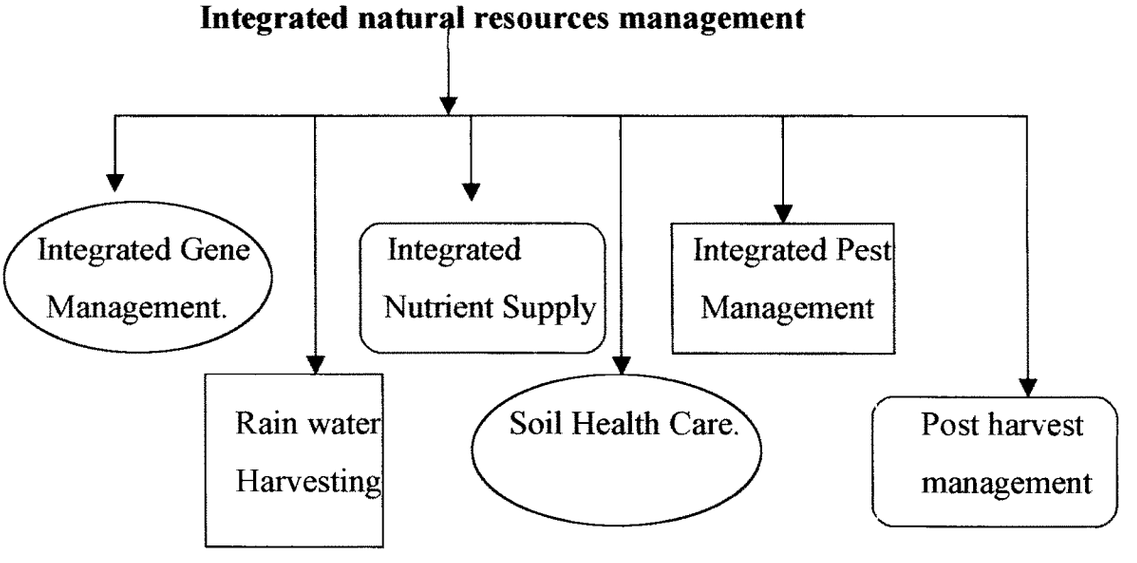


5) **Integrated natural resources management:** The future belongs to small farm families taking to precision farming, involving the use of the right inputs at the right time and in the right way. Biotechnology will play

an impotent role in all the following six major components of integrated natural resources management and precision farming.

- Integrated Gene Management.
- Efficient Water Management/Rain water harvesting.
- Integrated Nutrient Supply.
- Soil Health Care.
- Integrated Pest Management.
- Efficient Post-harvest Management.

Ecotechnology based precision farming can help to cut costs, enhance marketable surplus and eliminate ecological risks. This is pathway to an evergreen revolution in small farm agriculture.



6) The biological methods of pest management augurs well for the future of sustainable agriculture.

7) The use of biological fertilizers would reduce the cost of chemical fertilizers involved in crop production. The effective utilization of these biological fertilizers for different cropping systems will not only provides

economic benefits to rice farmers, but also improve and maintain the soil fertility and sustainability of the soil ecosystem.

8)The biological nitrogen fixation (BNF) systems would provide 15-20 lakh tonnes of nitrogen for crop production in India, while the equivalent urea fertilizer needed is around 33-44 lakh tones. Moreover, they also help to maintain the long term soil fertility and ecological sustainability required for increasing crop productivity. The use of biofertilizer also enriches the soil organic matter, soil enzymes and soil microbial population. The long-term soil fertility largely depends on the above parameters, which is essential for achieving higher productivity of crops and sustainability of yields. So the Indian farmers like China should use the organic farming including the Azolla biofertilizer technology (15)

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