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AGRICULTURAL DEVELOPMENT IN THE STATE OF PUNJAB DURING THE LAST TWO DECADES

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ABSTRACT : The paper reviews the recent development of agriculture in Punjab. Attention is drown to the adverse impact of over irrigation faulty agricultural practices and indiscriminate use of chemical fertilizers.

The State of Punjab, situated in the north-west India, is one of intensively cultivated and irrigated areas of the world. Here nearly 84 per cent of the total geographical area of 5.036 million hectares is under agricultural use and contributes 65 per cent of food grains towards the central pool. The success of agriculture sector in Punjab has very few parallels in the world. Starting with a food grain production of 1.4 and 2.0 million tonnes in 1947 and 1950, respectively, it achieved a new peak of 20 million tonnes in 1992-93. Its share in the country's production of cotton (around 20%) and milk (around 10%) is equally praiseworthy.

Our ability to sustain the pace of national development critically depends on the resources of soil, water, vegetation, livestock and genetic diversity. Unfortunately, our development efforts have stressed the intensive resource use without due regard for long term sustainability. The consequences have been disastrous, viz., large scale soil erosion, siltation, floods and droughts, waterlogging and salinization, lowering of ground water table, gradual depletion of soil fertility, extensive deforestation and overgrazing by ever increasing population of cattle. In order to check soil degradation, it is essential that an appropriate long term planning is done for the rational use of natural resources of the state.

Natural resources (land, water, forests) are a key input in national productivity and in all planning activities. Efficient management of land and water resources calls for an integrated approach. Integrated area development needs integrated study of :

- Resource potential
- Resource limitations
- Physical set up
- Socio-economic services and conditions
- Technical know how appropriate to the area

Green revolution has rendered us self-sufficient in food and enabled us to pursue modernization with a measure of confidence. We are now beginning to be aware of the limitations of the single minded approach towards intense resource use without adequate consideration for its wider environmental repercussions. The continued progress will depend on a more holistic approach that would have its focus on

the health of the resource base.

Further the information about land and water resources of an area is an essential prerequisite for effective agricultural planning and monitoring of the agricultural development. However, reliable and uptodate information on the quality and quantity of these resources is not available. Even where detailed information does exist, its dissemination has been poor or the information is of limited utility to other agencies.

The advent of satellite remote sensing technology with the launch of first earth resource satellite by U.S.A. in 1972,-ushered a new era in the mapping and monitoring of natural resources. Remote sensing technology helps in making :

— Accurate, timely/quick and cost effective assessment of natural resources
— Spatial distribution of the resources
— Regular/periodic monitoring of the resources

The periodic monitoring of resources facilities better understanding of :

— Inter - relationships and linkages of resources
— Environmental impact

The remote sensing technology is being increasingly utilized in natural resource service by various organisations in the country as well as in the state of Punjab.

LAND USE PATTERN IN PUNJAB

About 83% of the State's geographical area (5.036 m ha) is cultivated, which is a record in the country. Similarly, cropping intensity has touched the peak i.e. 183% Since maximum possible area of the State is already under cultivation, very little scope is left for increasing agricultural production through horizontal increase in the area. Thus, we would have to continue our existing strategy of intensive cultivation of land i.e. multiple cropping for affecting increase in the agricultural production. There is some scope for increasing agricultural area by brining degraded and waste lands under the plough through their reclamation, development and management. The following table gives the land utilization in Punjab during the last few years :-

The state has negligible area under permanent pastures or grazing land. About 9 per cent of the total area of the state was either barren and unculturable or under non-agricultural use.

Table 1

Land Utilization in Punjab

(000 hectares)

Item	1979-80	1984-85	1989-90	1992-93
(a) Geographical area	5036	5036	5036	5036
(b) Reported Area	5033	5033	5033	5033
(c) Forest Area	217	221	230	284
(d) Land not available for cultivation	531	519	508	504
(e) Other uncultivated land excluding fallow lands	52	49	49	37
(f) Current fallow land	51	55	57	74
(g) Net cultivated area	4182	4189	4191	4134
(h) Percentage of reported area	83	83	83	83
(i) Gross cropped Area	6535	7013	7391	7550
(j) Cropping intensity	156.3	167.4	176,4	183.0

Table 2

Area (000'ha) and production (000'mt) of Principal crops in Punjab

Crop	1960-61	1970-71	1980-81	1992-93
Rice	2.27	390	1183	2073
	(229)	(668)	(3233)	(7031)
Maize	327	555	304	189
	(371)	(861)	(612)	(434)
Bajra	123	207	69	7
	(58)	(243)	(86)	(7)
Whete	1400	2299	2812	3283
	(1742)	(5145)	(7677)	(12399)
Pulses	903	414	341	99
	(709)	(308)	(204)	(75)
Groundnut	67	174	83	12
	(62)	(169)	(104)	(11)
Oilseeds	185	295	238	109
	(121)	(233)	(187)	(89)
Cotton	447	397	649	701
	(709)	(818)	(1178)	(2348)
Sugarcane	133	128	71	113
	(486)	(527)	(392)	(689)
Total food-grains	**3063 (3162)**	**3928 (7305)**	**4854 (11921)**	**5693 (20055)**

Figures in parentheses indicate the production of various crops in thousand metric tonnes in cotton-thousand bales

There is a lot of confusion about the area under Forests. According to land use statistics, the total area under forests was 2.23 lakh hectares and according to Department of Forest the area was 2.85 lakh hectares in 1991-92. Even the land use statistics may be misleading. Accordingly area of forest increased from 1.2 lakh hectares in 1970-71 to 2.2 lakh hectares by 1980-81 because the area that was earlier classified as hilly (mostly privately owned) was reclassified as forest. Most of the area classified as forest in Hoshiarpur and Ropar districts where they form 45 and 17 per cent. Major part of the hilly area is not suitable for production of trees because of the soil conditions. They are suitable only for shrubs bushes and grasses. This was probably the reason that these hilly areas were not acquired by the British and were left to be managed privately. Even the plantation in the hilly area during the British time was confined to bushes, shrubs or slow growing industrial tree –Acacia catechu.

According to the present definition of forests all area to which any of the forest act is applicable is classified as forest irrespective of the fact whether it is under forest or cultivated. Thus the lands that had been under cultivation for many hundred years are classified as forest. Most of the difference in the forest area reported in land use statistics and Forest Department is in Hoshiarpur and Ropar Districts.

Table 3A

Net Irrigated Area (000ha) in Punjab

Soure	1960–61	1970–71	1980–81	1992–93
Governament & Private canals	1180	1292	1430	1453
Tubewells & wells	829	1591	1939	2386
Other sources	11	5	13	3
Total	**2020**	**2888**	**3382**	**3842**
% age of net area irrigated to net area sown	54	71	81	93

Table 3B.

Tubewells (in lakhs) in Punjab

Type	1960–61	1970–71	1980–81	1992–93
Diesel operated	N.A.	1.01	3.20	1.82
Electric operated	N.A.	0.91	2.80	6.39
Total	**N.A.**	**1.92**	**6.00**	**8.21**

Table 4.

Consumption (000'Nutrients tonnes) of chemical fertilizers in Punjab

Fertilizer	1960–61	1979–71	1980–81	1992–93
Nitrogenous	5	175	526	934
Phosphatic	–	31	207	254
Potassic	–	7	29	11
Total (NPK)	**5**	**213**	**762**	**1199**

CROP PRODUCTION IN PUNJAB

Because of the availability of irrigation water in the Punjab the total cropped area increased from 57 lakh hectares in 1970-71 to 75.5 lakh hectares in 1992-93 giving a cropping intensity of 183 per cent. Wheat, rice and cotton are the major crops of Punjab. The area of these crops in 1992-93 was 3.28, 2.07 and 0.68 million hectares respectively, which formed 13.4, 5.0 and 9.1 per cent of the total area under these crops in India. The average yield of rice–wheat rotation during the period 1986-89 ranged from 13.5–14.5 tonnes/ha, under scientific management and optimal supplies of nutrients at Punjab Agricultural University, Ludhiana. The contribution of Punjab to the production of the above crops in India was 21.8, 9.6 and 19.9 per cent respectively. About 40 per cent procurement of rice and 70 per cent procurement of wheat is from Punjab. Punjab is fortunate to have irrigation facilities. Since 1970–71 the area of maize decreased from 3.09 lakh hectare to 1.90 lakh hectares. The decrease was primarily in the irrigated area and production of maize in 1992–93 was 3.8 lakh tonnes compared to 8.6 lakh tonnes in 1970–71. Most of the area of this crop is in Kandi belt. Area

under pulses in the Punjab in 1992–93 was 99,000 hectares compared to 4.14 lakh hectares in 1970-71. The area of oilseed crops decreased from 3.97 lakh hectares in 1970–71 to 1.09 lakh hectares in 1992–93. The area and production of principal crops in Punjab is given in Table 2.

A reference to Table 2 & 3A 3B indicates that above achievements came from the adoption of increasing intensive irrigated agriculture which is heavily dependent on off-farm commercial inputs of energy (Table 4). The irrigated area in Punjab increased from 54 per cent of cultivated area in 1960–61 to 93 per cent 1992–93. This is primarily due to the installation of diesel/electric operated shallow tubewells by the farming community. There has been a phenomenal increase in the number of tubewells in the State i.e. from negligible number in 1960–61 to 8.21 lakhs in 1992–93. Similarly the consumption of fertilizers also increased considerably during the last 30 years (Table 4). The development of high-yielding varieties of grains, improved technology, and farm machinery etc. have also contributed significantly in increasing agricultural production in the State. The Punjab Agricultural University and the State development departments related to agriculture deserve appreciation for an exemplay support in sustaining and improving upon the gains in agricultural production. But it is more of a tribute to the management skills of our robust and enterprising farming community.

While Punjab can take considerable pride in its past achievements in the agriculture sector, doubts are being expressed that unless we immediately reorient our agriculture to meet the requirements of a sustainable agriculture, it can be irreparably damaged.

Without any regard to sustainability, for quite sometime, targets for food grains production and other agricultural commodities were proposed and implemented in Punjab which were not consistant with the natural resource base of the state. Soil and water are the most important natural resources on which agricultural production depends. In the recent years, concern has been expressed whether the growth in agricultural production in the Punjab could be sustained. The declining water–table in the tubewell irrigated areas, lower response per unit of fertilizer, poor soil physical conditions, increasing incidence of flash floods in the rainy season are a cause for worry. If the present trend in the decline of ground water table continues for the next 15–20 years, even at current prices 1500 crores rupees will be required to replace the traditional shallow water lifting pumps by submersible pumps.

WATER RESOURCES OF PUNJAB

A team of scientists of the Punjab Agricultural Univeristy consisting of Dr. S.S. Prihar, Dr. S.D. Khepar, Dr. Raghbir Singh, Dr. S.S. Grewal and Dr. S.K. Sondhi brought out an excellent report on water resources of Punjab They concluded that whereas the requirement of water in the Punjab at present was 4.9 million ham, the supply was only 3.12 million ham, thus showing a huge deficit. Though one may not entirely agree with the absolute figures given by them but there is absolutely no doubt that Punjab does not have enough water to meet its needs. This should certainly be a matter of concern not only for the future of agriculture in Punjab but future of Punjab itself. In the tubewell irrigated areas having good quality water, the water table is falling at the rate of 20–30 cm/year but in the south–western districts of Punjab having saline underground water, the water table is rising at the rate of 30–40 cm/ year. These are average figures for the period 1983-1990 recorded in the observation wells from 1983 to 1990. Both these situations call for concerted efforts.

Ground water is the life line of the Punjab. It accounts for more than 90 per cent of the net irrigated area in Ludhiana, Jalandhar, Kapurthala, Patiala, Hoshiarpur and Ropar districts and about two thrids of the irrigated area in Sangrur district. Most of the increase in food grain production has come from these areas. Increasing the recharge to ground water and its efficient use should have the highest priority.

Nearly the entire cotton area in the arid zone (S–W Punjab) is irrigated by canals. Cotton is the main cash crop of the state contributing significantly to the economy of state. Unless adequate steps to control the rise of water–table by providing drinage and reducing the seepage losses, the cotton production may be affected adversely.

It is evident from above that for sustaining agricultural production at the current levels in the central districts of Punjab, we have to improve the recharge capacity of groundwater by well over 3 MAF rather than withdrawing the same from the region.

SOIL RESOURCES OF PUNJAB

The soil is a crucial life supporting natural resource since it produces food that is basic to man's existence. Under a given climate the growth and yield of a crop/variety is determined by available nutrients and water supplies. Both nutrients and water are taken up from the soil and have to be carefully managed. Good culturable soils are not only limited but also unevenly distributed. Often the improper land use is causing various forms of degradations, thereby reducing its support capacity, sometimes, irreversibly as in the case of excessive soil erosion. The quality of soil, however, varies widely. For sustained utilization of the land ecosystem, it is essential to know the nature, characteristics, extent and location of the soil resources, and its quality, production capacity, suitability and limitations for various land uses. comprehensive information about soil and site characteritics can form the basis for suggesting systems of management for sustaining high productivity of each specific type of soil.

The quality of soil governs the productivity of the soil. The important factors determining the quality of soil are its depth, texture, structuree, pH or acidity and alkalinity, salts and organic matter. These properties are important for efficient management of water and nutrients. Soil physical conditions are even more important than their chemical constituents. The topographic conditions and land treatment determine the rate of erosion by water.

It is indeed satisfying that soil resource map of Punjab has been finalised. The State has been divided into 4 agroecological regions, 5 sub–regions and 124 soil resource units. It will be desirable to catalogue all available natural resources information in respect of each of these 124 classification units, generate additional information for missing gaps in our knowledge and gradually build up a scientifically sound Geographic Information System (GIS). This will permit us to monitor precisely the health of our natural resources.

Most of the soils of the Punjab which is a part of indus plains are derived from alluvium and are deep. The soil texture varies from sand to silty clay. Nearly all soils are low in organic matter, the soils of medium rainfall areas (submo ntainous kandi belut) are free from salinity and sodicity but because of topographical conditions, are highly susceptible to erosion by water. In the foot hills soils are coarse textured. The choes or seasonal streams are a serious menace in the kandi area.

The soils of low rainfall areas comprising Upper Bari Doab plain, Bist Doab plain and major part of Malwa plain are though generally

free of salts but large areas have sodic soils. Making use of the technology developed by the scientists of Punjab Agricultural University, the help provided by the state Government in form of subsidy on gypsum, large area of land have been reclaimed by the farmers of the state. It is estimated that since late seventies an area of more than 2 lakh hectares have been reclaimed in the Punjab.

The soils of very low rainfall (arid) areas i.e. south–western districts bordering Rajasthan are generally of coarse to medium textured with wind blown material at the surface. Calcium carbonate is usually present in the profile often restricing root growth. The high water table, soil salinity, brackish underground water, thick sand covers are the major problems of this region.

LAND DEGRADATION IN PUNJAB

In India, out of a total area of 320 million ha., over 150 million ha. have been reported to be suffering from different kinds of degradation such as erosion, salinity and /or alkalinity (7 million ha.) and waterlogging (6 million ha.) (National Commission on Agriculture, 1976).

Even though Punjab has made great strides in the field of agriculture, still sizeable area is suffering from different kinds of soil problems, such as salinity, waterlogging, water and wind erosion, thick sand cover etc. Soil degradation due to water and wind erosion and soil salinity and sodicity have affected about 1.94 million ha (38.7% of the area). The area affected by each form of degradation as reported by Sehgal et al. (1992) is given below :

1.	Wind erosi	0.58 million ha
2.	Water eros	0.54 million ha
3.	waterlogged	0.45 million ha
4.	Salt affected	0.33 million ha

The Kandi area, comprising of Siwalik hills and piedmont plain in NE Punjab has undulating topography, steep slopes and suffers from the problem of excessive soil erosion due to deforestation and overgrazing. For the preparation of integrated watershed development plans, knowledge of soils, land use, erosion status, topography, drainage pattern etc. is essential. The problem of soil salinity and /or alkalinity is wide spread in the localized low lying areas within the alluvial plain. Remote sensing technology is being utilized for mapping and monitoring of degraded lands. The technique promises to accomplish the task of mapping degraded lands in an efficient and cost effective manner.

The map showing the salt-affected soils for the year 1973 was prepared using satellite imagery, aerial photographs, existing soil maps and collateral data. This map was up–dated during the year 1984 based on delineation of various categories of salt-affected soils using satellite data for the year 1983 and 1984. During this period, the Government of Punjab started various schemes for the reclamation of salt–affected soils of Punjab having high ESP (generally 50). Large areas in central and north western parts of the state affected by the problem of salinity and/or sodicity were reclaimed during the last decade. However, in the south western districts of the state this has come up in the recent years (after 1981) due to rise of water table since 1980–81. In order to monitor the extent of salt-affected soils in the state of Punjab, the Satellite data for the year 1988 was interpreted visually. The extent of salt-affected soils during the year 1973 and 1987 (Sidhu et al., 1991) is given in Table 5.

The results in Table 5 suggests that in Punjab during the year 1988, 60, 535 hectares of land (barren patches) was affected by salinity and sodicity problem. It was also estimated that

Table 5.

Districtwise area (in ha.) of Salt-affected soils in Punjab

District	1973*	1984*	1988**
Firozpur	71,650	1,03,214	12,652
Faridkot	7,030	74,630	8,816
Bathinda	22,687	22,855	3,453
Sangrur	51,125	27,110	12,579
Patiala	19,346	11,923	4,322
Rupnagar	1,724	1,542	1,259
Ludhiana	31,808	6,667	157
Kapurthala	31,808	25,252	6,995
Amritsar	1,30,649	66,330	6,065
Gurdaspur	31,185	19,560	3,663
Hoshiarpur	963	702	431
Jalandhar	16,549	12,578	143
Total :	**3,91010**	**3,72,363**	**60,535**

* *In case of slightly salt-affected cultivated soils, only 30 per cent area of mapping units is included*

** *Area of only barren, severely salt-affected patches*

additional 60,000 ha. area may be existing in unmappable barren patches and scattered saline pots in cultivated area. The extent of salt-affected soils in the year 1973 and 1984 was 3,91,010 ha. and 3,72,363 ha. respectively which has come down to 1,20,535 (60,535+60,000) ha. in 1988 as a consequence of reclamation.

The perusal of results in Table 5 suggests that the area of salt-affected soils decreased in some of the districts of Punjab, but due to waterlogging and flooding the problem of salinity and waterlogging has come up in south western parts of the state between the period 1981–88. In view of the changing scenario, it is imperative to continuously monitor the extent of degraded lands for planning reclamation measures for the amelioration, as such salinity for various districts of Punjab is being monitored using satellite data maps prepared on 1:50,000 scale.

During the year 1973, Kapurthala and Sangrur districts were the worst affected with the problem of soil salinity and alkalinity (Sehgal et al., 1973 and Sharma et al., 1982). In addition large areas in these districts had thick sand covers. Keeping in view the severity of problem, the soil salinity in these districts was monitored using remote sensing technology.

In order to study land transformations in Kapurthala district, Landsat TM data in the form of false colour composite (generated from bands 2,3 and 4) on 1:50,000 scale for March 1987, covering Kapurthala district was interpreted visually to delineate the extent of salt–affected and sand dune soils map of Kapurthala district based on 1965 aerial photographs and semi–detailed survey of the district undertaken jointly by Department of Soils, PAU and Department of Soil Conservation and Engineering, Punjab during 1975–76. The study revealed that in a span of 22 years (1965 to 1987) the area of salt-affected soils decreased from 20.95 per cent to 2.3 per cent and that of sand dunes decreased from 22.7 per cent to 2.3 per cent as a consequence of reclamation of salt-affected soils and clearing and/or levelling of sand dunes.

Similarly, the Landsat TM and IRS–1A data in the form of false colour composites (prints and film diapositives) for seasons March 1987 to October 1988 have been interpreted visually in conjunction with collateral data and limited field check for delineating the extent of salt-affected soils in Sangrur district of Punjab. the map showing the extent of salt–affected soils was prepared on 1:50,000 scale. The final map was compared with the soil map of salt-affected areas of Sangrur district based on 1965 aerial

Table 6.

Area and image characteristics of different categories of salt-affected soils in Sangrur district

Category	Image Characteristics		Area (ha)	
	1965 aerial photographs	1988 Landsat TM Imagery (FCC)	1965*	1988**
Severely saline-sodic, barren, morethan 80% area salt affected	White to whitish grey tone	Bright white tone	21,224	9,146
Moderately to severely saline-sodic 50-80% area salt-affected, cultivated in pockets	Whitish grey	Yellowish white tone with bluish tinge	21,023	3,317
Slightly to moderately saline-sodic inpatches, 20-50% area salt-affected, cultivated	Mottled white and dark tone	Mottled red an white tone	24,511	348
Total			**66,758 *** (13.1%)**	**12,811 (2.5%)**

* *Based on 1965 aerial photographs and soil survey in 1973*

** *Based on Landsat TM data of 1987 and 1988*

****Figures in parentheses indicate the overall percentage of the total area.*

photographs and semi-detailed survey of the district 1973. The study revealed that in a span of 23 years (1965 to 1988), the area of salt-affected soils decreased considerably from 13 per cent to 2.5 per cent (Table 6) as a consequence of reclamation of salt-affected soils. Salt–affected soils after reclamation in both the districts (Kapurthala and Sangrur) have been brought under paddy–wheat rotation.

USE OF REMOTE SENSING TECHNOLOGY IN PUNJAB

Recognizing the need and importance of natural resource management, the Planning Commission, Govt. of India set up National Natural Resources Management System (NNRMS) in 1988 under Indian Space Research Organization with its Headquarter at Bangalore. The Punjab Remote Sensing Centre located at the Punjab Agricultural University Campus, Ludhiana was esablished in July 1987 under the over all concept of NNRMS.

Keeping in view the priorities and needs of various user Departments in the State, application projects have been undertaken by the Centre since its establishment in 1987. The salient findings of various projects are as under:

LAND TRANSFORMATIONS IN PUNJAB

A case study of Kapurthala district was undertaken using aerial photographs of 1965 on 1:25,000 scale and Landsat TM data in the form of false colour composite on 1:250,000 for march 1987. The study revealed that in a span of 22 years the sand dune area decreased from 22.7 per cent to 2.3 per cent and that of salt affected soils from 20.95 per cent to 2.3 per cent.

MONITORING OF PONDED AREA OF LAKES

A case study of Sukhna lake in Chandigarh was taken up using Landsat TM data for March 1987 and topographical maps based on 1987 survey. It was estimated that the ponded area of Sukhna lake decreased by about 30 hectares in a span of 20 years (1967–1987) and courses of Sukhna Nadi and Kansal Nadi have also changed considerably during this period.

INTEGRATED SURVEY OF WATER-SHEDS UNDER IWDP (HILLS)

This Project is funded by the World Bank. It is being undertaken for Integrated Watershed Development Project Directorate, Punjab. Soil, land use and hydrological surveys provide information needed for scientific watershed management and further enables us to evaluate various watershed characteristics for optimum afforestation, soil conservation and landuse planning.

Under this project thematic maps (soil, landuse–cum–drainage and land capability have been prepared (both village wise and combined) for Jainti Devi Ki Rao, Arniala, Nara–Dada–Manjhi, Dasuya Langarpur, Sughrao, Balachaur, Mohan Majra Nighi and Suan Khad watersheds in Hoshiarpur and Ropar districts of Punjab. The maps were prepared on 1:5,000 and 1:10,000 scale and supplied to the Project Director IWDP (Hills), Punjab.

MAPPING AND MONITORING OF WETLAND AND SURFACE WATER BODIES IN PUNJAB

Mapping and monitoring of wetlands in Punjab was undertaken in collaboration with Space Applications Centre (ISRO), Ahmedabad through the funding of Ministry of Environment and Forests, Government of India. Under this project wetland mapping of entire state including four notified wetlands viz., Sukhna, Harike, Ropar and Kanjli is to be accomplished on 1:50,000 scale using multidate IRS LISS-II data. Comprehensive reports with various thematic maps of four notified wetlands have been prepared. The mapping of surface water bodies in Punjab is in progress.

WASTELAND MAPPING IN PUNJAB

This investigation has been carried out under the National Wasteland Mapping Project, financed by Govt. of India through National Remote Sensing Agency (Nodal Agency) Hyderabad. Under this project, wasteland mapping on 1:50,000 scale in three districts of Punjab viz., Patiala, Jalandhar and Gurdaspur has been completed and comprehensive reports have been prepared. The information generated under this project will provide a strong base for various national and state level agencies for executing reclamation measures for the development and management of different categories of wastelands.

MAPPING AND MONITORING OF SOIL SALINITY ASSOCIATED WITH WATER LOGGING IN PUNJAB

This project, funded by Punjab state Council for Science and Technology, was undertaken by the Centre in collaboration with Deptt. of Soils, P.A.U. Ludhiana. Till recently, the problem of soil salinity and / or alkalinity was quite serious in the districts of Kapurthala, sangrur, Amritsar, Gurdaspur, Firozpur and Patiala. In Faridkot, Bathinda and South western parts of Sangrur district, this problem has come up in recent years due to rise in water table since 1980-1981. However, large areas in other districts have been relaimed during the last decade. During the past five years 1989-1994, the mapping and monitoring of salt affected and / or water logged soils in Sangrur,

Kapurthala, Faridkot, Gurdaspur, Bathinda, Jalandhar, Firozpur, erstwhile Patiala, Mansa and Amritsar have been completed.

INTEGRATED MISSION FOR SUSTAINABLE DEVELOPMENT

This project partially funded by Deptt. of Space, Govt. of India and partially by own resources is being undertaken in collaboration with RRSSC, Dehradun, Deptt. of Soils, PAU, Deptt. of Soil Conservation, Punjab and other state organisations. Under this project multi disciplinary studies are to be carried out in three districts of Punjab viz., Bathinda, Hoshiarpur and Sangrur. A detailed report for integrated development of Talwandi Sabo block, Bathinda district has been prepared and action plan has been finalized and work in other blocks is in progress.

SITE SELECTION OF SEWERAGE TREATMENT PLANT (STP)

Realizing the importance of remote sensing in conjunction with GIS, the Ministry of Environment and Forests entrusted Space Applications Centre, Ahmedabad to provide remote sensing inputs in the river action plan for policy planning and implementation of National River Action plan. Under this project, in the state of Punjab four cities namely Jalandhar, Ludhiana, Phillaur and Phagwara located near Sutlej river wherein all the domestic and industrial sewerage is being discharged were identified and the job assigned to Punjab Remote Sensing Centre Ludhiana. Under this project, land use/land cover mapping for site selection of STP in Jalandhar and Ludhiana cities have been completed by PRSC where as work in remaining two cities is in progress.

ATLAS FOR SITING POLLUTING INDUSTRIES :

The project is being undertaken in collaboration with Punjab Pollution Control Board, Patiala. The project relates to demarcating suitable sites for locating air polluting, water polluting and hazardous industries in the state of Punjab. All the 14 districts of the state are to be covered. The work in Ludhiana district has already been completed. In this study 22 attributes have been recognized. Some of the attributes selected are - soil, geomorphology, hydrological conditions, land use, susceptibility to flooding, water quality and availability, transport and other infrastructure facilities, pollution level etc. These attributes are given weightage according to their importance and an overlay is generated, which in turn helps to demarcate four categories of land viz. less sensitive area, medium sensitive area, most sensitive area and no industry area for locating various types of polluting industries as stated above.

WHEAT ACREAGE AND PRODUCTION ESTIMATION IN PUNJAB

This project is being undertaken in collaboration with Department of Agronomy, Punjab Agricultural University, Ludhiana and Space Applications Centre, Ahmedabad from the cropping season of 1989–90 on continuing basis using Remote Sensing Technology. This project is partially funded by Deptt. of Space, Govt. of India. The accuracy level of 95% at state level and 90% at district level acreage and production estimation has been achieved. The district wise estimates are being provided to the Govt. of India, State Govt. and Directorate of Agriculture, Punjab during the first fortnight of March every year.

COTTON ACREAGE AND CONDITION ASSESSMENT

This Project is being taken up by the Centre in collaboration with the Department of Agronomy, Punjab Agricultural University,

Ludhiana and Space Applications Centre, Ahmedabad from the cropping season of the year 1990 on continuing basis in four major cotton growing districts of the state namely Ferozpur, Faridkot, Bathinda and Mansa. This project is partially funded by Department of Space, Govt. of India. The accuracy level of 90% in acreage estimation has been achieved. The estimates are being provided to the Ministry of Textiles, Govt. of India. State Govt. and Directorate of agriculture, Punjab during the month of September/October every year.

LAND USE MAPPING

Land use maps for all the districts in Punjab on 1:250,000 have been prepared using satellite data (digital) and following nine fold classification system developed by NRSA, Hyderabad.

MAP OF PUNJAB - A VIEW FROM SPACE

The digital mosaic of Punjab was prepared using IRS 1A satellite data through digital image processing techniques. The map was published on 1:50,000 scale with the permission of Surveyor General of India at NRSA, Hyderabad. The map has been distributed to all the senior level officers in the State. The map gives the overview of the physical and topographical features in the State.

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