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## Geophysical view of landuse patten in India

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### Abstract

Land is an important natural resource that embraces the elements like the overlying temperature, moisture, topography, soil matrix and physical structure. It is certainly a manifestation of the past and present human activities. But land has the characteristics of its fixity in supply and scarcity. Therefore, land use pattern is directly concerned with the problem arising in the process of deciding upon and carrying out into action the optimum use. In a dynamic world, certain modification can occur in the existing pattern of land utilization.

Conventional Land-use pattern has frequently failed to produce a statistical improvement in land management and also to satisfy the priority objectives of the Land users. The trend in Net-irrigated area sown is also declining in many states, due to scarcity of irrigation facilities and also, poor irrigation management. The increase in Land prices due to enhanced income of some sections lead to investment on Land is a way to invest the black money in the economy. It affects the cost of cultivation and cost of land among the farmers to a greater extent. The farmers are seeking returns from other than agricultural uses in order to earn more. This trend in the state affects the Land use pattern to a greater extent.

**Keywords:** Patches, Khandi, Strip, Energy-intensive, Fit & spruce, Nursery stock.

### Introduction

#### Methods

Mapping and identifying land cover/land use and its change is the most important, as well as the most widely researched, topic in remote sensing. Land cover/land use has been used extensively to derive a number of biophysical variables, such as vegetation index, biomass, and carbon content. More importantly, land cover/land use pattern and its change reflect the underlying natural and/or social processes, thus providing essential information for modeling and understanding many different phenomena on the Earth. Knowledge of land cover/land use and its change is also critical to effective planning and management of natural resources. This paper presents a Land Transformation Model of urban land-use change based on an artificial neural network and a geographical information system. For developing this approach, future development of Plains of north Bihar based on past development trend and infill development pattern is modeled.

#### The Land & Agriculture

Indian agriculture is a land-based activity and as such water and land have been the basic elements of life support system and an important resource for the economic life of a majority of people in the country. The way people handle and use land resource is decisive for their social and economic well-being as well as for the sustained quality of resources. Indian agriculture is now poised for technical transformation for ensuring food security, export earnings and decentralized development to reduce rural poverty owing to the severe population pressure on the natural resources base of land, water, bio-diversity and other resources to meet its growing food and development demands.

#### Determinants of Land use Pattern

The physical, economic and institutional framework taken together determines the pattern of land use of a country at any particular time. In other words, the land use pattern in different regions in India has been evolved as the result of the action and interaction of various factors taken together, such as physical characteristics of land, the structure of resources like capital and labour. Finally, land use is important not only for producing foodstuffs, cereals, fruits

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and vegetables for consumption but also for generating surpluses to meet the increasing demands created by rising population and developing industrial sector.

### Over View of India

Land use Pattern in India has undergone tremendous transformation due to the impact of urbanization and

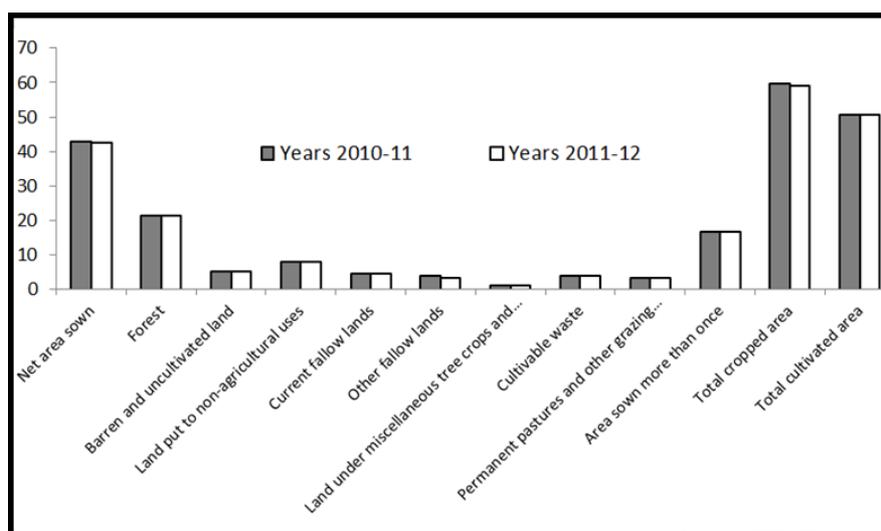
industrialization. Changes in the land use pattern are associated with ecological changes. Therefore, at the outset, it is important to give an overview of land use pattern.

In India, out of the total geographical area of 329 million hectares, only 305 million hectares is the reporting area in 2007-08 (the rest unadministered for various reasons).

**Table 1:** Changes in Land Use Pattern in India (2010-11 to 2011-12) (Area in `000 Hectares)

Sl no.	Land use Classification	Years	
		2010-11	2011-12
1	Net area sown	42.88	42.57
2	Forest	21.30	21.30
3	Barren and uncultivated land	5.24	5.26
4	Land put to non-agricultural uses	8.00	8.05
5	Current fallow lands	4.42	4.65
6	Other fallow lands	3.84	3.35
7	Land under miscellaneous tree crops and groves not included in the net area sown	0.96	0.96
8	Cultivable waste	3.84	3.83
9	Permanent pastures and other grazing lands	3.14	3.12
10	Area sown more than once	16.63	16.57
11	Total cropped area	59.51	59.14
12	Total cultivated area	50.54	50.56
	Total geographical area	328726 328726	328726 328726

**Source:** Directorate of Economics & Statistics, Ministry of Agriculture, New Delhi. (Share in the percentage)



**Fig 1:** Changes in Land Use Pattern in India (2010-11 TO 2011-12)

Table -1 brings out the changes in the land use pattern from 2006-07 to 2007-08 for 12 categories. Total cropped area emerges as the dominant category with an increase in its share from about 50.54 per cent in 2010-11 to 50.56 per cent in 2011-12. The next major land use category for India is net area sown which accounted for 42.88 per cent in 2011-12 and was 0.31 per cent higher as compared to 2010-11. The other categories to register an increase in their percentage share includes net area sown, land put to non-agricultural uses, area sown more than once, total cropped area and total cultivated area although the increase is quite modest from 42.57 per cent to 42.88 per cent, 8.05 per cent to 8.00 per cent, 16.57 per cent to 16.63 per cent, 59.14 per cent to 59.51 per cent and 50.56 per cent to 50.54 per cent respectively. In addition, forest, barren and uncultivated land, current fallows, other fallow lands, land under miscellaneous tree crops and groves not included in the net area sown, cultivable waste and permanent pastures and

other grazing land have recorded a decline in percentage terms over the time period 2010-11 to 2011-12.

### Factors Influencing on Agricultural Land Use in India

In India, there is interaction of various demands on agricultural land mainly for the production of food, fiber, fodder, oil seeds, fruits, vegetables and other crops. This provides significant support to farmers to develop or increase their economic growth and social transformation of the country. But in recent years uses of agricultural land or area of agricultural productivity is getting declined, because of the action and interaction of various factors such as population pressure, socioeconomic forces, livestock pressure and various types of institutional development that regulate the land use formally and informally. But the main cause of decline in the agricultural land is rapid growth of population. Land use for modified based on the needs of the population. According to census of population shows that

India accounts from only 2.4 percent of the world surface area and yet it sustains 16.9 percent of the world population (Government of India, 2011)<sup>[10]</sup>. The impact of population pressure on land is such that, the fragmented into small pieces of land. Not only population pressure causes on the decline of agricultural land, there are some other factors that affect the agricultural land use pattern such as industrialization, energy production, urban development or urbanization, mining, residential and commercial as well as supporting infrastructure which force are forcing to conversion of agricultural land to various non-agricultural purpose. Therefore an expanding population, and urbanization and other development programme continue to exert increasing pressure on agricultural land uses in India. Recent trends on Land use pattern in India In general, the land use pattern indicates the way in which the land area are used under various circumstances. The pattern of land use of a country at any particular time is determined by the combination of economic and institutional framework. Hence, the land use pattern and the trends during years will help to suggest the scope for planned shift in the pattern. The analysis regarding the trend of land use in India during the period 1990-91 to 2010-11 are as follows. Out of the total geographical area of 328.73 million hectares, the land use statistics were available for roughly 304.86 million hectares in 1990-91; however, in 2010-11 the reporting area is around 305.90 million hectares. Land under net area sown in 2010-11, decreased to 141.57 million hectares from 143 million hectares in 1990-91. In percentage terms, it decreased from 46.90 percent of the reporting area in 1990-91 to 46.27 percent in 2010-11 (Government of India, 2012)<sup>[10]</sup>. The decline in the net area sown was mainly attributed to increasing conversion of agricultural land into non-agricultural purpose. Area under horticulture crops has increased from 9.01 million hectares in 1990-91 to 21.8 million hectares in 2010-11 (Government of India, 2012)<sup>[10]</sup>. The increase in area of horticulture has proved to be the best diversification of agricultural land use, because of assured and the remunerable increasing returns to farmers. This is the reason which has stimulated farmers to grow more horticultural crops.

**Land Use Change** Our analysis of land use for the last 40 years in the four states suggests that Punjab and Haryana have reached the absolute limit of expansion of area under cultivation with almost 84 per cent of the area being cultivated. 6 per cent to 8 per cent of the area in these states is under urban uses. Another 5 per cent are under forests (mainly strip forests), and the remaining 2-3 per cent is roads, canals, and other infrastructural and industrial uses. Cultivable waste as a category has virtually disappeared in these two states. Such intensive land use for agriculture is sustainable only with increasing and continued high doses of balanced nutrients and other inputs such as chemical fertilizers and insecticides. The proportion of area available for cultivation in Himachal Pradesh and Jammu & Kashmir because of topography and physiographic factor is rather small and cannot be expanded without major private and public investments that in return will result in major ecological problems and should be avoided.

### **The Cropping Pattern**

The cropping pattern in the region has undergone a substantial change, with wheat and rice emerging as a major crop rotation in Punjab and half of Haryana. Its expansion in

Himachal Pradesh and Jammu & Kashmir has been moderate. Crops that have been replaced by wheat and rice, are gram, bajra, barley, millets and pulses. Area under cotton has grown in Haryana. In absence of expansion of the sugar industry, the area under sugarcane has remained static. The cropping pattern of the region has unnecessarily become energy-intensive and is affecting the static balance of the underground water resources in the plains of Punjab and Haryana. The growth of infrastructure, irrigation, and other technological factors are responsible for a major shift in cropping pattern in favour of wheat and rice in the states of Punjab and Haryana. A number of policy steps must be taken to encourage farmers to switch from rice, which is a water and fertilizer-intensive crop in the region, to crops that demand less water. This can be achieved through price policy, research and development efforts, and establishment of agro processing industries so as to make sustainable alternatives more attractive to the individual farmers. Without supplementary organic manure, intensive agriculture leads to depletion of soil fertility. Ludhiana district in the green revolution State of Punjab, which records the highest yields of many crops, now also records the highest deficiencies of plant micronutrients. Extensive use of organic manure is the only way to overcome the deficiency. In Punjab, above 5 million tons of rice straw is being burnt every year during October to December. If crop residues were ploughed back into the soil, the rate of micronutrient depletion would be substantially reduced (CSE, 1982)<sup>[13]</sup>. Since 1965, when water from the Bhakra canal was brought to the farm, the rise of the water table has also been a serious phenomenon. Since 1985, the rate of rise in the water table has been above 1 m annually. Patches of salinity have started appearing at the farm level. The situation is worse in higher rainfall areas where water logging follows shortly after the rains. Apart from affecting agricultural crops, a high water table causes floods even during slight rains because of the reduced moisture storage capacity of the soil. In Hissar, the bearing strength of the soil has declined to less than 50 per cent in 50 years.

### **Diversification of Agriculture**

A diversification of agriculture to increase the area under oilseeds and pulses should be encouraged. Sunflower is becoming a prominent crop among the oilseeds. Its water requirement is quite high. Although the sugarcane area has been substantially increased, it has not reduced pressure on ground water. The ground water position has been distributed by a tremendous increase in food production, especially wheat and rice (119.2 lakh tons in 1980-81 to 192.14 lakh tons in 1992-93). The ravenous and undulating areas of Khandi tract can also be developed for horticulture, which will reduce spending on reclamation. The development of land first for agriculture and then its conversion for horticulture is not the appropriate method. Horticulture requires less water than an intensive cropping system. More area is brought under cotton because its returns per hectare can compete with those from paddy. Crop rotation, which is a fertilizing process, should be promoted in a holistic manner. About 7 to 8 per cent area should be cultivated for fruit trees and provision of marketing facilities.

### **Potential for Diversification of Agriculture**

The economics of Jammu & Kashmir and Himachal Pradesh have large forestry and horticulture sub-sectors. Forest area

and forestry development area in both these states are substantial. The growth of different types of forests during the last two decades has been uneven; the area under forests in Punjab and Haryana is less than 5 per cent but is slowly growing. There is not much scope for growth of block forests in these states. Most of the growth has been in strip forests on the banks of canals. Despite major data problems for a temporal analysis of forest cover in the study area, we found that as per official records, 33 percent geographical area of Himachal Pradesh, 9.9 percent of Jammu & Kashmir, 5.6 percent of Punjab, and 3.8 percent of Haryana were under forest cover in 1986-87. On per capita basis the lowest forest cover is in Haryana and the highest in Himachal Pradesh. In absolute terms total tree cover is 20,880 sq. km in J & K, 12882 sq. km in Himachal Pradesh, 776 sq. km in Punjab, and 644 sq. km in Haryana. The regeneration of forest in Himachal Pradesh and Jammu & Kashmir has been observed and needs to be monitored more carefully. A study of various forest types in combination with horticultural, pastoral, and other systems suggests that there is a wide variation in expected returns per year per hectare, which seem to be more attractive than those from crop husbandry provided marketing is taken care of. Establishment of agro forest processing is required on a regional basis rather than on a state basis. The problem of marketing forest products, particularly wood in the absence of such industries within the region discourages individual producers from undertaking this activity.

#### **Integration of Horticulture with Agriculture**

Area under horticulture in all the four states has been growing rapidly since 1970-71 with fastest growth in Himachal Pradesh. The economics of Himachal Pradesh and Jammu & Kashmir have a significant horticulture sub-sector that is growing and emerging as a major component of the agricultural and agro processing facilities are some of the important problems of this sector. Himachal Pradesh and Jammu & Kashmir are considered the fruit baskets of the region because of favourable climate and topography. In Punjab and Haryana, area under horticulture is small (less than 1 per cent) but increasing. Some illustrative measures of rates of returns from horticulture suggest returns from ranging from 30 to 40 percent. However, the experience of marketing, particularly of apple, suggests that the expanding wood demand for packing of fruits is creating serious stress on the forests, especially silver fir and spruce. This has already been noted by the Government of Himachal Pradesh and Jammu & Kashmir. Subsidized cardboard boxes are being experimented with. In view of the climate and the rugged terrain, fruit production is the only highly profitable enterprise where crop growing is not of much utility. Moreover, horticulture enhances the cohesiveness of the soil, preventing soil erosion. With increase in demand for fruits, the National Commission on Agriculture has indicated that production must increase. Farmers ought, therefore, to be induced to grow more fruit trees. Induction of farmers is possible, once a complete understanding of soil economics is arrived at. The following possibilities are favorable to horticultural activities in the zone:

a) Agro-climatic and topographic conditions favour horticulture as an excellent source of income per unit of land area.

- b) Horticulture helps in using the land more efficiently than crops and conserving the soil, which is highly susceptible to erosion in case of cultivation.
- c) Horticulture permits the maximum use of natural resources by adopting the negative propagation.

The actual impact of horticulture on environment is increased by the need for packing cases. The use of wood for packing fruits has greatly increased the burden on the forest wealth, leading to extensive deforestation. The standard boxes for packing apple can contain 9 to 18 kg. However, 1t of the fruit is supposed to be contained in 55 standard boxes. Apart from the wood required to manufacture the boxes, 25 percent is further wasted on manufacture of logs and billets, 10 percent on sawdust and 15 per cent on cut off rejection. Thus, one-third of the standing volume is wasted. About 65 packing cases of standard size are obtained from 1 cu.m. of the silver fir and spruce forest. The trend indicates that annually 10.8 km<sup>2</sup> of forest is lost while 6 km<sup>2</sup> is planted, i.e., about 3000 trees are lost. While the nursery stock takes about 5 years to be raised, a tree must grow about 100 to 120 years before it can be exploited. The result is deforestation. Deforestation in turn leads to land degradation and soil erosion. To curb the problem of packing cases, use other materials for packing, and use wood in other forms. The Himalaya is now under tremendous transformation that is accelerated with enormous speed. Most of the original lush green natural vegetation is presently replaced by shrubs, savannas grass accompanied by gullies, ravines, and eroded and scraped landscape. The major use of forests presently is to meet the demand for industrial wood, which is needed in a great quantity, a large part of which is used for packing horticultural products. Native plant cover normally provides good erosion control; hence sustenance of natural resource is basic for economic growth and development compatible with environment. Problems arise, though, when an area is deforested and converted into cropland, increasing soil erosion. The resulting soil loss reduces soil productivity and modifies the environment.

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