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Natural and Human Resource status in divided Bihar – An Agro-economic perspective

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ABSTRACT

There are three agro-climatic zones comprising North-West (Zone-I), North-East (Zone-II) and South-Bihar (Zone-III) alluvial plains. After the division of Bihar, the states have endowed with adequate ground water resources, which is unevenly distributed and it has not been exploited to the maximum advantage. Utilization of water flowing through the various rivers has also not been satisfactory. Canal irrigated area has been declining due to the poor maintenance of this system, while tube-well irrigation system has emerged as main source of irrigation over the years. The climate is sub-tropical with extremes of summer and winter. The temperature ranges between 4°C to 43°C. Relative humidity varies between 55 to 85 percent, which is suitable for cultivation of wide varieties of crops and trees, but land available for cultivation accounted a continuous decline due to land put to non-agricultural use. The level of male and female literacy is 60.3 and 33.6 percent respectively i.e. very low in comparison to other states; 43% of its population is below poverty line. There is excessive pressure of population on agriculture (86%) and here is low availability of non-farm employment opportunities. Intensive cultivation & creation and proper-maintenance of infrastructural facilities have been suggested for agricultural development.

Keywords: *Climate, Temperature, Irrigated area, Demographic features, Net sown area.*

INTRODUCTION

Resources are generally defined as all those things available in man's physical environment on which he depends for the satisfaction of some want or the other. In the broad sense, resources would include the surface of land, which man uses not only for habitation but also for farming and many other economic activities. In the process of man's learning when his interaction with nature increased, he discovered the importance of these resources for fulfillment of his continuously increasing wants. This was in fact, a turning point in the history of man. Both surface and underground water are also included in natural resources, as they are indispensable to human, animal and plant life. Man had known the use of water for consumption purposes ever since the life came on earth, but other uses he discovered in the process of his interaction with nature.

India has the one of the fastest growing population in the world today, which compels the country to take frequent stock and appraise its natural resources like land, water etc; Since land is a vital and natural gift, it needs to be passed on to the succeeding generations without improvising it. Here, the investigation is confined only to the new Bihar, because Bihar after division on Nov. 14-15,2000 has emerged as the most potential frontline agricultural state, but with least or marginal production spectrum in major food crops in the map of India. Hence, rational management of natural resources plays a vital role in developing the economy of the state.

This paper attempts to analyze the status of natural and human resources in Bihar; however, the major emphasis is laid on land, water and forest resources which influence the economic life in the state. For the purpose, the district-wise data (secondary) compiled from the various publications of Directorate of Statistics and evaluation (Govt. of Bihar) and these information were analyzed in zonal basis.

PHYSICAL FEATURES OF BIHAR

Bihar lies between 24° 15' to 27° 31' N latitudes and 83° 20' to 88° 19' E longitudes with an average length of 483 (E-W) and width of 385 km (N-S). The state has subtropical sub humid monsoonal climate with moderate cold winter followed by hot dry and humid summer. It is bounded by Nepal from North, Jharkhand from South, Uttar Pradesh from West and West Bengal and Bangladesh from East. At present there are 38 districts in new Bihar with three distinct agro-climatic zones which are known as NARP zones. Important features of different Agro-climatic zones are given in **Table-1** & also sown in **Fig-1**.

The topography of Zone-I is plain with a slope towards south-east. Altitude of the area varies from 31 to 61 m from sea level. There are four major river basins in this zone namely Ghagra (Saryu). Burhi-Gandak. Bagmati and Kamla-Balan. Their beds have risen due to recurrence of floods and deposition of sand silts. Zone-II comprises the alluvial plains of Koshi, Mahananda and Ganga rivers is undulating to rolling landscape with a slope towards south-east. There are a large number of braided streams and dead channels of Koshi and its tributaries. Zone-III is the alluvial plains of the river Ganga on its southern side and the sediments are received from the river Ganga and those flowing from south having their origins in Chotangpur plateau. The zone has been divided into three distinct physiographic divisions namely: (a) Diara land (active flood plains) (b) Tal land (Passive flood plains) (c) Old alluvial plains. Diara land is located along the bank of river Ganga and remains often flooded in a kharif season. Tal land is saucer shaped land situated in the south of the river Ganga, particularly from Barh to Lakhisarai. It is one km to more than 15 km in width. It remains flooded for a period of 3-4 months in rainy season. Alluvial plains are situated between Ganga and plateau region.

Table 1: **Important features of different agro-climatic zones of Bihar.**

Name of the Zone	Geographical area (in 000 ha)	Percentage area of the state	Districts
Zone-I North-West Alluvial plains	3449.09	36.85	E/W Champaran, Saran,Siwan, Gopalganj, Siwhar,Muzaffarpur, Vaishali,Darbhanga, Samastipur,Begusarai, Madhubani,Sitamarahi.
Zone-II North-East Alluvial plains	1798.11	19.25	Purnea, Katihar, Khagaria,Saharsa, Supaul, Araria,Madhepura, Kishanganj.
Zone-III South Bihar Alluvial plains	4112.35	43.90	Munger, Shekhpura, Jumui,Banka, Lakhisarai, Bhagalpur,Patna,Gaya, Jehanabad,Nawada, nalanda, Rohtas,Bhojpur, Aurangabad, Buxar, Bhabhua, Arwal.
Bihar	9359.56	100.00	-

Source : NARP report, R.A.U., Bihar

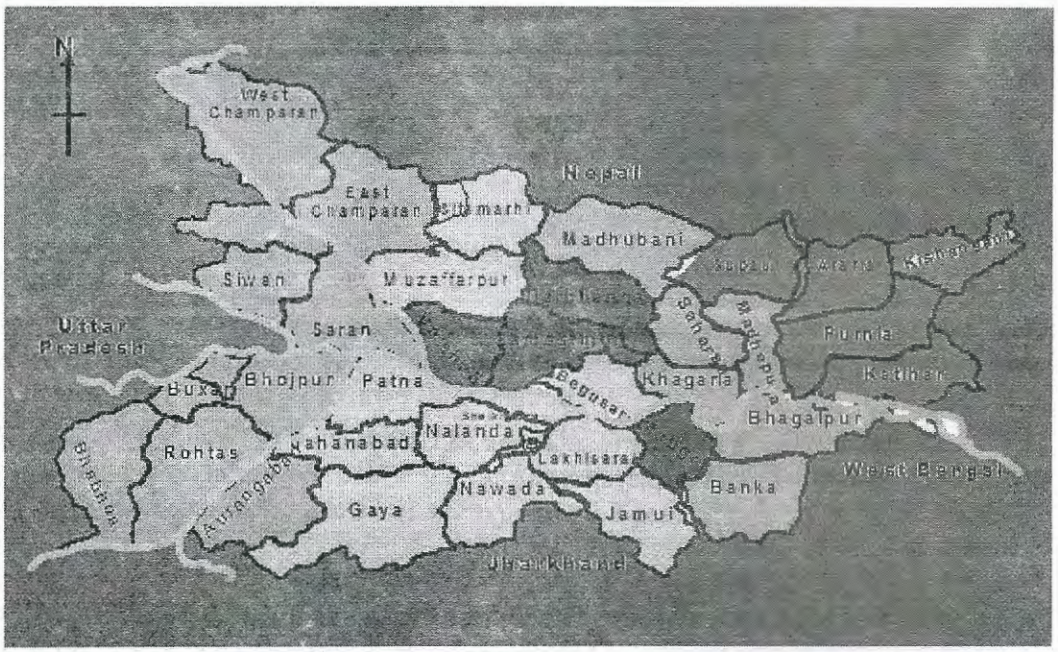


Fig. 1: **Map of Bihar**

Climate: The generous nature of state's climatic condition favours cultivation of various types of crops and trees in the state. The climate is characterized by having tropical humid to sub-humid type with average annual rainfall of about 1235 mm in the state, out of which 75 percent rainfall occurs during the monsoon period, but its distribution is not periodically and regionally uniform **(Table-2).** The state enjoys four distinct seasons in a year, which are (i) Summer (March to May) (ii) Monsoon (June to Sep.) (iii) Post monsoon (Oct. to Nov.) (iv) Winter (Dec. to Feb.).

The North-east alluvial plains (Zone-II) receives maximum annual precipitation (1385 mm) followed by Zone-I (1206 mm) and Zone-III (1105 mm). More than 80 percent of rainfall is received during kharif season. About 6 to 8 percent of annual rainfall is received during Rabi season. These rains are received due to extension of Westerly disturbance in Bihar. Occasional showers are experienced during summer in different zones of Bihar and account for 6 to 11 percent of annual precipitation. These are mostly convectional or cyclonic in nature. Monsoon enters in Bihar through Zone-II in between 5th to 10th June. In Zone-I and III, monsoon arrives in between 10th to 15th June.

Table 2: **Annual rainfall and its distribution by crop seasons (Average of five year ending 2004-2005)**

Zone	Annual rainfall	Kharif rainfall	Rabi rainfall	Summer rainfall
Zone-I	1206	1026	84	96
	(100.00)	(84.93)	(7.12)	(7.95)
Zone-II	1385	1155	82	148
	(100.00)	(83.28)	(5.91)	(10.81)
Zone-III	1105	955	87	63
	(100.00)	(86.39)	(7.89)	(5.72)

Figures in parentheses show percentage of annual rainfall in respective zones.
Source: Directorate of Statistics & Evaluation, Govt. of Bihar.

However, erratic behaviour of monsoon and dependence of farming on rain water are the major drawbacks that affect farming to a large extent. Recurrent drought or floods at different stages of crop production are some of the important constraints often faced by the farmers.

Temperature and Relative humidity: The highest values of maximum temperature are recorded in meteorological weeks of 14th to 24th which is corresponding to the period of mid March to mid-June. During this period maximum temperature ranges between 34° to

37°C in Zone-I, 34° to 38°C in Zone-III and 32° to 34°C in Zone-II. The lowest minimum temperature occurs between 49th to 6th meteorological week which fluctuates generally between 7° to 10°C in Zone-I and Zone-III and from 4° to 9 °C in Zone-II. In the remaining part of the year, minimum temperature ranges between 10° to 26°C.

The mean relative humidity of all three zones is more than 75 percent during Kharif season. Zone-II is comparatively humid in comparison to other two zones of the state. During Rabi season, mean relative humidity of Zone-I, II and III are 67, 74 and 70 percent, respectively. The lowest mean relative humidity recorded during summer season which varied from 58 to 62 percent.

Abnormal weather phenomena: Low temperature accompanied with cold wave is commonly experienced from 48th to 5th meteorological weeks (Dec-Jan.). During this period foggy whether continues for several days resulting in poor growth of Rabi crops due to reduced availability of solar radiation. Westerly dry wind with high velocity usually starts blowing after 15th of March which causes forced maturity of late sown Rabi crops in general and wheat crop in particular. Un-seasonal and prolonged rains during March-April damage to mature crops standing in the field and also to harvested produce kept at the thrashing floor.

Soils: The soils of Bihar have a varying degree of fertility level and nutrient availability with different physical, chemical, physico-chemical and biological properties. Both the plains of north and south Bihar are formed by the alluvial deposits and come under alluvial plains of Bihar. The sediments received by the alluvial plains of north and south Bihar comes directly from the rivers originating from Himalayas. There are 15 broad soil association groups, identified and recognized in Bihar. The soil of zone-I is moderately rich to poor in nitrogen and has wide variation in its available phosphorus from very low to moderate. However, the soil is medium in potassium status. Soil of Zone-II is low to medium in nitrogen and available phosphorus and rich in available potassium. The soil of Zone-III is invariably poor in nitrogen status but it is rich in available phosphorus and available potassium. Zinc deficiency which is most widely spread among micro-nutrients is found invariably in all soil groups but the magnitude of expression of deficiency symptom is more pronounced in calcareous and salt affected calcareous soil. Copper deficiency is reported in the soil of north-east portion of Zone-II. Boron deficiency is also reported in the soil of zone-I and II with varying intensities in isolated patches. However, in Zone-III, the deficiency problem of micro-nutrients except zinc is not so alarming (Mishra et al. 2001).

Sheet and rill erosions are common problems in Bihar due to high intensity of rainfall. A considerable loss of top soil occurs in areas having slopes in between 3 to 8 percent which affects fertility of soils adversely. Gullies are commonly found in sloppy lands of Kaimur

plateau of Kaimur district and hilly tracts of Gaya, Nalanda, Nawada and Munger districts in Zone-III. Wind erosion is not a major problem in the area, but it occurs in light soils of Zone-I and II when the top soil is dry during summer season. Other forms of degraded lands are salt affected (10.4 mha) and marshy land (0.2 m.ha). Apart from degraded land, there are some areas of special problem such as Diara (1.1 mha), Tal (0.1 mha) and Chaur land (0.8 mha).

Major River systems: In Bihar, there are seven river systems (excluding the Gangas) which serve as principal drainage outlets. Except Burhi Gandak, all river system of Zone-I and II originate from the Himalayas and serve as drainage outlet for vast areas in Nepal, UP and Bihar. The river systems of Zone-III originate from the plateau of Jharkhand. Sone is the only perennial river of this zone. All the rivers of Bihar terminate into Ganga at different places. However, Mahananda terminates into Ganga in Bangladesh. The Ganga serves as the main drainage outlets for the entire state of Bihar.

Irrigated area: In Bihar gross irrigated area increased from 3403 thousand hectares in 1980-81 to 4497.57 thousand hectares in 2004-05, recorded an increase of 32 percent during last 20 years **(Table-3).**

Table 3: **Source wise irrigated area in different agro-climatic zones of Bihar**

(In 000 ha)

Source of irrigation	1980-81				2004-05			
	Zone-I	Zone-II	Zone-III	Bihar	Zone-I	Zone-II	Zone-III	Bihar
Canal	306	154	866	1325	275.00	159	834	1267.41
	(35.83)	(39.03)	(40.15)	(38.94)	(20.49)	(17.17)	(37.35)	(28.18)
Electric tube-well	100	8	205	313	56.04	15.20	307.46	378.70
	(11.71)	(2.04)	(9.50)	(9.20)	(4.18)	(1.65)	(13.77)	(8.42)
Diesel tube-well	360	101	304	765	795.07	682.03	556.70	2033.80
	(42.15)	(25.77)	(14.09)	(22.48)	(59.28)	(73.90)	(24.94)	(45.22)
Well	9	2	75	86	7.25	1.41	15.63	24.29
	(1.06)	(0.51)	(3.48)	(2.53)	(0.54)	(0.15)	(0.70)	(0.54)
Other sources	79	128	707	914	208.68	65.80	518.89	793.37
	(9.25)	(32.65)	(32.78)	(26.85)	(15.55)	(7.13)	(23.24)	(17.64)
All sources	854	392	2157	3403	1342.04	922.93	2232.60	4497.97
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Figure in parenthesis indicate the percentage to gross irrigated area.
Source: Directorate of statistics and evaluation, Govt. of Bihar.

The table further revealed that percentage of canal irrigated area has been declining continuously. In 1980-81, canal irrigation constituted 38.9 percent of gross irrigated area which declined to 28.2 percent in 2004-05. Poor maintenance of the existing canal system may be responsible for this situation. Zone-wise analysis showed almost similar trend. Diesel tube well emerged as major source of irrigation in Bihar. Diesel tube well irrigated area showed an increasing trend during the last 20 years. The area irrigated by diesel tube well increased from 765 thousand hectares in 1980-81 to 2033.80 thousand hectares in 2004-05 thereby registering an increase of 165.9% during the period. In terms of proportion of total irrigated area, the diesel irrigated area was 22.5 percent in 1980-81 which increased to 45.2 percent in 2004-05. Among all the zones of the state, larger increase was noticed in Zone-II (575.3 percent) followed by Zone-I (120.9%) and Zone-III (83.2%).

Declining area for cultivation of crops and trees: In Bihar, net sown area constituted 63.6% of the total geographical area in the year 1974-75 which declined to 59.6% in 2004-2005, the decreasing trend was mainly due to increase in area under non-agricultural uses i.e. creation of rural roads, railways, migration of people towards the cities as well as various highway projects through the village during these periods **(Table-4).** Area under barren and uncultivable land showed continuous decline from 9.0% of geographical area in 1974-75 to 4.7 percent in 2004-2005. The decline was more evident in Zone-I where barren and uncultivable land declined from 9.0% of respective geographical area in 1974-75 to 2.9% in 2004-2005.

It was mainly due to profitable agriculture during early green revolution period and development of agricultural infrastructure which made possible conversion of barren land to cultivable land in Zone-I. Additional land available for cultivation was 12.0% of total geographical area in 1974-75 which declined to 9.2% in 2004-2005. Almost similar situation prevailed in Zone-I and III. However, Zone-II experienced continuous declining trend over the decades for additional land for cultivation. Thus, it may be said that if the agricultural production of Bihar is to be increased, it can be achieved only by increasing the productivity of different crops grown in the state and this includes provisions of more and more irrigation facilities and application of whole range of improved technology because cultivable land is likely to be reduced further due to increase in non-agricultural use of cultivable land.

Demographic Feature: According to Census-2001, the population of Bihar is 82.88 million, which constitutes about 8.1 percent of population of India. The geographical area of Bihar is 93595 sq. km. which is about 2.5 percent of India's geographical area. Bihar is second most densely populated state (880 persons per sq.km.) after West Bengal (904 pesons/ sqkm). Among different zones, population density was higher in zone-I (1082/km2) followed by Zone-II (766/km2) and Zone-III (756 km2) **(Diagramme-1).**

Table 4: **To changes in area under forest, barren land and net sown area in different zones of Bihar.**

Zone	Year	Geographical area	Forest	Barren and uncultivable land	Cultivable Waste Land	Net sown area
Zone-I	1974-75	3449.09	85.00	310.00	284.60	2452.29
		(100.00)	(2.46)	(8.98)	(8.23)	(71.90)
	2004-2005	3449.09	91.87	101.38	188.76	2255.78
		(100.00)	(2.66)	(2.93)	(5.47)	(65.90)
Zone-II	1974-75	1798.11	1.60	147.00	315.60	1146.91
		(100.00)	(0.09)	(8.17)	(17.55)	(63.78)
	2004-2005	1798.11	3.07	100.13	171.50	1125.21
		(100.00)	(0.17)	(5.56)	(9.54)	(62.57)
Zone-III	1974-75	4112.35	480.40	373.40	521.20	2353.95
		(100.00)	(11.68)	(9.08)	(12.67)	(57.24)
	2004-2005	4112.35	522.13	234.96	497.47	2201.57
		(100.00)	(12.70)	(5.71)	(12.10)	(53.54)
Bihar	1974-75	9359.56	567.00	830.40	1120.40	5953.15
		(100.00)	(6.06)	(8.87)	(11.97)	(63.66)
	2004-2005	9359.56	617.07	436.47	857.74	5582.56
		(100.00)	(6.59)	(4.66)	(9.16)	(59.64)

Figures in parentheses indicate the percentage of respective geographical area.
Source: Directorate of Statistics and Evaluation, Govt. of Bihar.

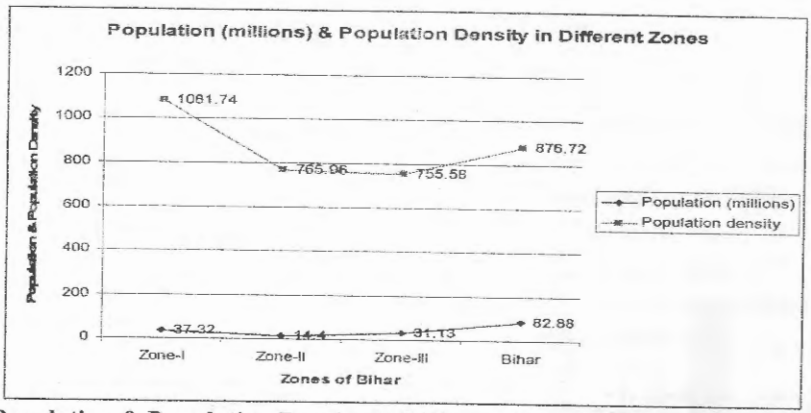
Education is considered as one of the most important indicators of development. Bihar lagged much behind so far as general spread of education is concerned. In 2001, the literacy in Bihar was lower (47.5 percent) as compared to national literacy (54.2 percent). Literacy rate was higher in Zone-III (55.1 percent) followed by zone-I (45.5 percent) and Zone-II (36.2 percent). Gender analysis suggested that there exists a wide gap between male and female with respect to literacy rate. Male literacy being much higher (60.3 percent) than female literacy (33.6 percent). Zone-wise literacy also exhibited similar trend in case of both male and female literacy **(Table-5 & sown in Fig-2).** So far poverty of the people is concerned; about half of the populations have to manage their livelihood with income below poverty line. No marked differences were observed between zones with respect to proportion of population below poverty line.

Rural population: Bihar is primarily a rural based economy. About 89.5 per cent of its population lives in rural areas of Bihar against 72.2 percent in the country. Among the three zones of Bihar, the proportion of rural population is comparatively high in Zone-I (93.5 percent) followed by Zone-II (92.8 percent) and Zone-III (84.3 percent) **(Table-5 & Sown in Fig-2).** Proportion of workers who get gainful employment in rural areas of Bihar is lower (34.9 percent) in comparison to national level (39.2 percent). However, the proportion is comparatively low in Zone-I (31.9 percent) in comparison to Zone-III (36.9 percent) and Zone-II (39.8 percent).

Table 5: **Demographic Features of Bihar (2001)**

Sl.No.	Particulars	Zone-I	Zone-II	Zone-III	Bihar
1.	Population (millions)	37.32	14.40	31.13	82.88
2.	Population density (Persons/sq.km)	1081.74	765.96	755.58	876.72
3.	Rural Population (%)	93.46	92.77	84.32	89.56
4.	Literacy (%)	45.46	36.24	55.10	47.53
5.	Female literacy (%)	31.60	23.15	40.90	33.57
6.	Male literacy (%)	58.35	48.07	67.87	60.32

Source: Bihar through Figures (2001), Deptt. of Statistics & Evaluation, Govt. of Bihar



Dig. 1: **Population & Population Density in Different Zones of Bihar**

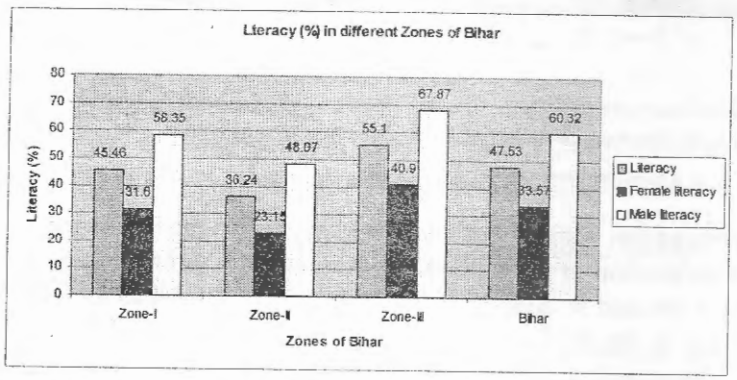


Fig. 2: **Literacy in different Agro-climatic Zones of Bihar**

Table 6: **Rural population, total workers, agril. workers and labourers in different zones of Bihar (2001)**

Sl. No.	Particulars	Zone-I	Zone-II	Zone-	Bihar
1.	Rural population	34.88	13.36	26.25	4.20
2.	a) Total workers	11.13	5.32	9.50	5.86
	b) percentage to rural population	31.91	39.82	36.19	4.85
3.	Agricultural workers	8.93	4.76	7.62	21.31
		(80.23)	(89.47)	(80.21)	(82.41)
	a) Cultivators	3.24	1.53	3.29	8.06
		(29.11)	(28.76)	(34.63)	(31.17)
	b) Agricultural labourers	5.69	3.23	4.33	13.25
		(51.12)	(60.71)	(45.58)	(51.24)
4.	Non-farm workers	2.20	0.56	1.88	4.55
		(19.77)	(10.53)	(19.79)	(17.59)

Figures in parentheses indicate percentage to local workers
Source : Directorate of Statistics and Evaluation, Govt. of Bihar

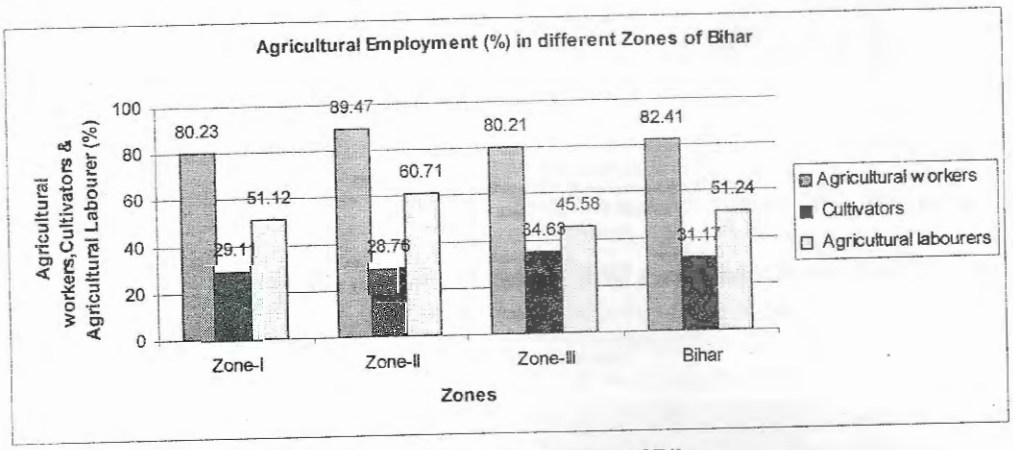


Fig 3: **Agricultural Workers in different Agro-climatic zones of Bihar**

Employment Scenario: Majority of rural workers are engaged in agriculture and allied activities. The proportion of agricultural workers to total workers is 82.4 percent which varied from 80.2 percent in zone-III to 80.2 percent in Zone-I to 89.5 percent in Zone-II **(Table-6 & Sown in Fig-3).** Cultivators constituted 31.2 percent of the total workers. The proportion of cultivators to total workers worked out to be higher in case of Zone-III (34.6 percent) followed by Zone-I (29.1 percent) and Zone-II (28.76 percent). Agricultural labourers

are workers who earn their livelihood mainly by working on others farms and majority of them are landless. There are 13.25 million agricultural labourers in Bihar accounting for 51.2 percent of the total workers in the State. Among the three zones, comparatively high proportion of agricultural labourers to total workers is found in zone-II (60.7 percent) followed by Zone-I (51.1 percent) and Zone-III (45.6 percent).

The population of Non-farm workers is 4.55 millions in Bihar which constitutes 17.6 percent of total workers. It indicates towards less availability on non-farm employment opportunities to the people in the state. The opportunity for employment in non-farm sector is much lower in the case of Zone-II (10.5 percent). However, the situation is marginally better in Zone-I (19.8 percent) and Zone-III (19.8 percent) which is sowed in **Fig-10**.

Emerging issues and policy approach: It emerges from the above discussion that further tendency for extensive cultivation though land shifts from outside the agricultural sector need now to be fully checked and a concerted effort is required to bring all the irrigated areas under intensive cultivation and all the fallow land under cultivation of region-specific remunerative possibilities.

Lack of irrigation, soil problems, water stagnation, problem of accessibility (i.e. lack of link roads) menace of wild animals, legal disputes and financial problems as the major reasons for leaving the land fallow in all the zones of the state. Many of these reasons can be effectively resolved within the framework of the existing policies and programmes. For instance, the policies of price support and input subsidies can effectively ensure remunerativeness of crop production even under dry land conditions.

Some states have already declared a premium over centrally announced support prices, which can be extended to cover unremunerative crops in a particular region. Similarly, the existing farm development programmes can cater to the problems of water logging, link roads, treatment of problem soils and protection from wild life.

Forest cover in the state is meager which is for below the norms set under the **"National forest policy (1952)"** envisaging about one third of the geographical area under forests, hence the forest area has to be increased considerably for maintaining ecological balance.

Due to higher rainfall and a typical land situation of Bihar, paddy will remain a main crop in Kharif season.

Special efforts are needed to develop agriculture in typical areas like Tal land, Diara land and Chaurs.

Poor maintenance of canal irrigation system is the cause of existence of large acreage under fallow land, hence existing canals have to be maintained properly.

Farmers should be provided easy access to Govt. procurement centres for selling their agricultural produce at remunerative prices.

The area-specifie characteristics and the determinants of under-utilized lands need to be identified for developing strategies for their full utilization, one general policy approach flows quite obviously in this context. It relates to revisiting tenancy reforms. If tenancy is duly recognized and legalized, it will instill a sense of security of land ownership and promote full utilization of agricultural lands.

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