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Dalit Population in India : A Case of Punjab

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The paper examines the demographic characteristics, such as size, growth and spatial distribution of Dalit population in Punjab with a focus on inter-caste differences within the Dalit communities. Punjab, the state having the highest share of the Dalit population in India, has the massive size (8.86 million persons in 2011), higher than the total population of Israel. There are 39 castes of the Dalits in the state, but four of these, in combine, subsume nearly three-fourths of total Dalit population. The *Mazhabi,* the largest Dalit caste with about 30.0 per cent in total Dalit population, was so widely distributed that it made the first ranking caste in the seven of the twenty districts in the state. The same was true of the *Chamar,* the second largest SC caste. However, the *Mahatam,* Rai Sikh, notified in 2007, enumerated for the first time in 2011 Census, and ranking at the fifth place among the largest Dalit caste in the state, was highly concentrated in Firozpur district, where it made the first ranking Dalit caste. The Dalits in Punjab were though predominantly rural by residence but quite literate, aware, awakened and dominantly engaged in non-farm economic activities. During 1971-2011, the Dalit population in the state grew at much faster rate than the entire state population. The high growth rate of the *Mazhabi* and the *Bazigar,* the two large sized Dalit castes in the state, was a cause of concern, needing priority attention of the policy planners in the state. The *Mazhabis*, in particular, are predominantly rural by residence, agricultural by occupation and poorly literate, restricting awareness and knowledge.

Introduction

India is the home to more than two hundred million persons, who are officially termed as 'Scheduled Castes", but now identify themselves as the 'Dalits' (oppressed). According to 2011 Census, their total of 201.4 million persons is larger than the total population of Brazil (199 million in 2012), the fifth largest populated country in the world. Every sixth person in India belongs to this or that community of the scheduled castes. The size of their population is not only quite large but also growing fast over the period. Their total population, which was 51.3 million persons at 1951 Census, increased to 201.4 million persons by 2011, registering an annual compound growth of 2.3 per cent. Against this, total population of India grew at2.0 per cent per annum during the same period.

Historically, this segment of population suffered huge socio-economic deprivation at the hands of the upper castes in Indian society. They were asked to perform menial jobs, such as scavenging, skinning of hides of dead animals, leather tanning, agricultural labour and so on for the upper castes under a contractual system, the *'zajmani'* system, which had the social sanction. They were kept out of the

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caste-system and denied the right to resources (e.g. land, water and village commons) and knowledge (e.g. education). Being untouchable, they were forced to live at a distance from the residential areas of the upper castes within the same settlements,and that too in deplorable living conditions. After the Independence in 1947, the government of India took several special welfare measures for their socio-economic upliftment. Some of the important measures included the complete ban on untouchability by making it a punishable act under the Constitution, strict ban on caste based atrocities, right to own and cultivate land, reservation of seats in educational institutions and public sector jobs, and the reservation in the democratic institutions, such as the parliament, the state assemblies, the urban local bodies and the *panchayati raj* institutions, in accordance to their share in total population of India.The reservations were initially made for a period of ten years but have been extended continuously since then.

The above stated constitutional and administrative measures initiated by the union and state governments in India brought in perceptible transformation in their socio-economic wellbeing and political mobilization. Earlier to this, the economic and administrative changes taking place in the late nineteenth century during the British rule, especially the commercialization of agricultural production and agrarian relations, emergence of employment opportunities in factories, government services, and the army, social reform movements questioning the caste system and caste based inequality, Mahatama Gandhi's efforts to create a movement against untouchability in 1930s, weakening of master-servant relationship in the village social system, political mobilization and creation of Dalit identity by the Dalit leadership, such as B.R.Ambedkar, Jagjivan Ram and JyotibaPhule, also helped this process.

Nevertheless, this has also exposed their internal differentials emanating from the caste, sub-caste, clan and class identities. For example, the relatively well-off and politically articulate scheduled castes (henceforth SCs) have cornered the major share of government largesse. This eventually consolidated the position of the elite groups or individuals within the Dalit castes. For instance, the Mahars in Maharashtra, the Malas in Andhra Pradesh, the Pariahs in Tamil Nadu and the Chamars in Uttar Pradesh are relatively better off than other competing communities within the SCs (Rao, 2009:9). Moreover, rivalries among the lower castes such as Mahars and Mangs in Maharashtra, Malas and Madigas in Andhra Pradesh, Chamars and Chuhras in the north Indian states have emerged as the impediments to political mobilization, further reinforcing cleavages (Chandra *et. al*., 2008:637).

In addition, given the wide differences in historical background across regions and sub-regions of India, some states have done better than others to improve their socio-economic conditions. For instance, the union territories have generally done better than the states in this context. It is generally stated that not only a creamy layer has emerged within the 'scheduled' population but also inter-regional and sub-regional differentials in their socio-economic development have widened further.

Notwithstanding the wide socio-economic, cultural, regional and sub-regional divide within the dalit castes in India, they are considered as one homogeneous category not only by the general masses but also by the government and even by the academicians. It

may not be very difficult to understand the government in India treating these castes as one monolithic block. For the government, it is functionally convenient and politically correct in distribution of welfare benefits to them.However, it is difficult to understand why most of the academicians especially the geographers have treated SC castes as one homogeneous category in their researches.

The number of castes/communities among Dalits is quite large in India. At the time of 2011 Census, there were 1208 castes/ communities of Dalits in India, the number ranging from a maximum of 101 in Karnataka to a minimum of only four in Sikkim. Even after ignoring the multiple counting of castes listed in several states, the number of Dalit castes is still as high as 540; contradicting the general impression of the Dalits, making a homogeneous group of people. There is awide regional diversity in their geographical distribution, social-economic status, political mobilization and transformation process. Under the democratic system of governance based on equal voting rights for all in the Indian parliament and the state assemblies reserved for the SC in proportion to their population size, the castes with higher numerical strength and geographical concentration could reap disproportionately large benefits not only in political but also in economic and social spheres. Castes with higher educational levels cornered not only the larger number of government jobs but also higher positions in administration; increasing their decision-making power in administration along with residential and occupational mobility. Consequently, a growing body of urban based middle class or new middle class or white-collar workers' (occupational) group, sometime termed the elites (Sachchidanand, 1977) or neo-Brahmins of the dalit castes (Parvathamma 1989:128-144), has emerged within them.

Taking a cue from the above statements, the present paper attempts to examine inter-district and inter-caste differentials in size, growth and spatial distribution of Dalit population in Punjab. Punjab has the highest proportion of Dalit population among all the states and union territories in India. The proportional share of Dalit population in Punjab's total population, about 32.0 per cent in 2011, is not only the highest among all the states and union territories in India but also nearly double of the national average of 16.6 per cent. Within Punjab, their share in total population ranged from a maximum of 42.5 per cent in Shahid Bhagat Singh Nagar (Nawanshehr) to a minimum of 21.7 per cent in Sahibzada Ajit Singh Nagar (Mohali), indicating all the districts in the state have the proportional share of Dalit population higher than the national average. There are 39 castes of Dalits in the state. Two of them, Mahatam Rai Sikh and Mochi, notified in 2007 after the conduct of 2001 Census, were enumerated for the first time in 2011 Census. However, 13 important SC castes subsume more than 92.0 per cent of total SC population in the state. The Mazhabis and the Chamars, in combine, make more than a half of the total Dalit population.

The Dalit situation in Punjab differs in several ways from other parts of India. At the beginning of the 20th Century, untouchables in a large got converted to Sikhism. The Sikhism, as a religion, is more egalitarian than the Hinduism. Discrimination on the basis of caste is little and limited in Sikhism, but it never mean that there is no caste system and caste based discrimination within the Sikhs. Secondly, the

Brahminical culture and Brahmins are accorded such a high social status as in other parts of India especially in U.P., Bihar, Orissa, West Bengal, Madhya Pradesh, Tamil Nadu, Kerala and so on. Thirdly, social movements such as the *Bhakti*, the *Arya Samaj*, the *Ad Dharm*, and the *Ravidasia* played an important role in Dalit emancipation and minimization of caste based discrimination. Fourthly, the Dalits in Punjab are relatively mobile. Several households from the Jalandhar *doab* (including Jalandhar, Nawanshahr, Kapurthala and Hoshiarpur districts) have emigrated to different countries including United Kingdom, U.S.A., Canada, Australia and Middle East Countries and are remitting the foreign money to their family members and relatives in Punjab. All this makes the study of Dalit population in Punjab quite interesting and academically rewarding.

The paper will make an attempt to answer the following research questions with help of data analysis.

1. What is total size and growth of Dalit population in Punjab vis-à-vis other states of northwest India?

2. What is the spatial pattern of growth and distribution of Dalit population at the district level in Punjab and how has it changed during 1971-2011?

3. Which of the Dalit castes form the dominant or first ranking caste at the district level and what is the significance attached to such a spatial distribution?

4. How the growth rates of Dalit population in Punjab vary across castes/ communities?

For the purpose of the study, data have been picked up from the Census of India, *Special Tables for Scheduled Castes*, published by the Registrar General and Census Commissioner of India, New Delhi. The district has been selected as the unit of study. In 2011, there were 20 districts in Punjab. For studying growth of Dalit castes/communities in Punjab a period of four Census decades between 1971 and 2011 has been selected. The 1971 Census was the first to be conducted in Punjab after it was linguistically reorganized in 1966 between Haryana and Punjab and northern Hindi speaking areas were merged with Himachal Pradesh. There were twelve districts in Punjab at the time of 1971 Census. This number has gone to twenty districts by 2011 Census, making the comparative analysis of district level changes in growth and distribution of Dalit population almost impossible task. The territorial changes made during the reorganization of districts bifurcated several subdivisions/tehsils to merge into newly created in such a manner that it has become almost impossible to readjust the population of old administrative units to fit according to newly created administrative units.

The paper is divided into the three sections. The first section briefly examines the historical context of the change in nomenclature of these castes from the 'depressed classes' to the 'Dalits'. The second section is devoted to growth rates of different Dalit castes/ communities in Punjab during 1971-2011. The third section examines inter-district and inter-caste differentials in spatial distribution of such castes in the state.

(I). A Journey From 'Depressed Classes' to 'Dalits'

It would not be out of the place to briefly recapitulate the historical context of the different nomenclatures by which these untouchable castes of traditional Hindu society

were called before they themselves started identifying them as 'Dalits'.

Untouchability, rooted in the religious and cultural notion of purity and pollution, is believed to have developed in the later *Vedic* period. It coincides with the emergence of the Brahmanic literature such as the *Smrits*, the *Samhitas* and the *Upanishads*. The British rulers in India, who remained almost neutral in social matters in the beginning, made a deliberate attempt to ascertain the population of untouchables in India at the time of 1911 Census. The provincial Census Superintendents were instructed by the Census Commissioner of British India to draw separate enumerations of castes and tribes,classed as Hindus but who did not conform to certain standards and were subject to certain disabilities. A ten-fold criterion was adopted for their identification by the census enumerators. These castes were given a common nomenclature of 'depressed classes', not acceptable to B.R. Ambedkar and other leaders of these castes.Ambedkar argued that 'it has degrading and contemptuous' connotation and suggested that 'they should be called 'non-caste Hindus', 'protestant Hindus' or 'non-conformist Hindus' or some such designation' (cited in Rao,2009:4).

In view of the opposition from the members of the 'depressed classes', a new term, 'exterior castes', was adopted at the time of 1931 Census. The term, originally suggested by C.S.Mullan, the then Census Superintendent for Assam, was considered as the most satisfactory alternative to the earlier term,'depressed classes'. It was decided that each province should prepare a list of castes, who suffered disability on account of their low social status and of being debarred from temples, schools or wells. Keeping in view the sharp regional and sub-regional variations in prevailing conditions and practices, Superintendents of Census Operations were not issued precise instructions to frame the list and then to enumerate such castes. Notably, the population figure of such castes and communities arrived at by the 1931 Census was much more comprehensive and precise than the previous Censuses. However, like the term 'depressed classes', used in 1911 Census, and 'exterior castes', used in the 1931 Census for such castes, also did not find favour with their leadership. Hence, a value neutral term, scheduled castes, standing for the castes and communities listed for purpose of scheduling castes and communities to provide certain special benefits, was agreed upon between the British officials and the leaders of these castes. The term 'scheduled castes', in fact, received the official recognition for the first time in Government of India Act, 1935; and in April 1936, the British Government issued the Government of India (Scheduled Castes) Order, specifying certain castes, races and tribes as schedule castes (SCs) in the then provinces of Assam, Bengal, Bihar, Bombay, Central Provinces & Berar, Madras, Orissa, Punjab, and United Provinces.

The 1931 Census adopted the nine-fold criteria in place of ten-fold criteria,used earlier in the 1911 Census to identify the population of these castes and communities. The basic criteria, in fact, was the social, economic and educational backwardness caused due to the traditional practice of untouchability.[1]Obviously, the untouchability was the sole criteria for inclusion of these communities in the scheduled list of castes and communities. Later on the Indian Constitution also, legally and officially, adopted the term scheduled castes to design

such groups of communities. The Article 341, governing the listing of castes in the scheduled of the Constitution, reads the following:

1. The President may with respect to any State or Union Territory and where it is a state after consultation with the governor thereof, by public notification, specify the castes, races or tribes or parts of or groups within castes, races or tribes which shall for the purposes of this Constitution be deemed to be Scheduled Castes in relation to that state or union territory, as the case may be.

2. Parliament may by law include in or exclude from the list of Scheduled Castes specified in a notification issued under clause (1) any caste, race or tribe or part of or group within any caste, race or tribe, but save as aforesaid a notification issued under the said clause shall not be varied by any subsequent notification.

The term Scheduled Castes is defined in The Article 366 of the Indian Constitution in the following words:

'Scheduled Castes' means such castes, races or tribes or parts of or groups within such castes, races or tribes as are deemed under article 341 to be Scheduled Castes for the purpose of the Constitution.

Being out of the caste system, based on the concept of purity and impurity of their occupations and eating habits, these castes and communities are also called as 'untouchables'. They are not allowed to touch the upper castes and their presence was considered inconvenient and embarrassing, when not needed to perform the specific tasks.

M.K. Gandhi, who stated a reformist movement for inclusion of untouchables in the main stream of Indian society and for that he started a major national campaign, known as a '*Harijan* Movement', between 1932 and 1936, called the untouchables by a new name, as Harijans, which literally mean the Sons of the God. He considered untouchability as a social stigma of Hindu social system, which he wanted to remove through a social movement against untouchability. Here, M.K.Gandhi and B.R.Ambedkar differed in their approach on the problems of untouchables. The latter was for the eradication of caste system rather than simply working for and the removal of untouchability. Secondly, Ambedkar also wanted the leadership in the hands of untouchables. The British rulers in India agreeing with Ambedkar recommended separate electorates to select leaders for untouchables, on the pattern of Muslims and Sikhs, in the Communal Award in 1932. Gandhi opposed it and went on hunger strike against the Award. Finally, an agreement signed between Gandhi and Ambedkar in September 1932, popularly known as the Poona Pact,accorded reservation of seats in educational institutions, government jobs and the democraticinstitutions, such as Lok Sabha and State Assemblies to the SCs in proportion to their share in total population of India.

After years of Independence, the followers of Ambedkar started objecting to the use of term the *'Harijan'* to address the untouchables, stating that all the human beings are the sons of the God, then why we should be single out? Another argument was that when the *Hari* (God) has failed to do anything tangible for the benefit of his *'janas'* (people or sons), then why we should feel happy in calling ourselves 'Harijans'. Gradually, Ambedkar also got frustrated with the policies of the Indian National Congress with regard to upliftment of the untouchables. He resigned as the Law

Minister from the Union Cabinet, formed his own political party, Republican Party of India, and got converted to the Buddhism along with his followers.

In the preceding paragraphs, we have been talking about their nomenclature-semanating out of their caste (*jati*) identities, such as Chamar, Mala, Mang, Mahar and so on or structural exclusion and inferior status, such as *Asuras, Harijans, Chandala* etc. or resulting from administrative and political policies of colonial and post-colonial states, such as Depressed Classes, Exterior Castes, and Scheduled Castes. Now, we move to the fourth and final type of identities of the untouchables, the generic identities, adopted by the untouchables themselves.The first self-reclaimed identities, emerging in the decade of 1920s, were centred on the ideology of 'Adi'. 'Adi', which stands of early or original, claimed that they were the original inhabitants of this land, and the rest outsiders or the immigrants. Consequently, they started called themselves such as Adi-Andhra, Adi-Dradiva, and Adi-Karnataka in south Indian states, Adi-Hindu in Uttar Pradesh and Ad-Dharmi in Punjab. Of late, they prefer to call themselvesas 'Dalits' (oppressed), in preference to the official identity of 'Scheduled Castes'. The term 'Dalit', derived from Sanskrit language and literally means 'crushed', or 'broken to pieces', was perhaps first used by Jyotirao Phule, a Dalit leader and a writer, in the nineteenth century. Recently, it came in vogue with the formation of Dalit Panther Movement in Maharashtra in 1972. It is that the inspirations for this term came from 'Black Panthers'Movement of Black Americans in the U.S.A.

Some scholars view it in political terms. According to Sharma (1995) 'the process of the emergence of the word Dalit is a part of journey which starts from *harijan* to `scheduled castes' and from scheduled castes to Dalit.Definitely, the former untouchables are now more assertive, aggressive, mobilized and conscious of their electoral importance in the current scenario of vote-bank politics.

(II). Dalit Population in Punjab: Size and Growth

Among all the states, Punjab has the highest proportion of Dalit population in its total population. According to 2011 Census, Dalit population of 8.86 million persons in Punjab, making about 32.0 per cent in the total population of the state,is roughly double of the national average (16.6 percent).

It is definitely a massive in size. It was more than the total combined population of Himachal Pradesh and Union Territory of Chandigarh (7.92 million in 2011), more than the total combined SC population of Haryana, Himachal, Jammu & Kashmir and Chandigarh (UT) in 2011, and even higher than total population of Israel or Austria (8.0 million each in 2012). In fact, more than a half or 52.7 per cent of the total 16.83 million SCs in the Northwest region resides in Punjab.

Within the state, the share of Dalit population in all the twenty districts of the state in 2011 was higher than the national average of 16.6 per cent. It ranged from a high of 42.5 per cent in ShahidBhagat Singh Nagar (Nawanshehr district) to a low of 21.7 per cent in Sahibzada Ajit Singh Nagar (Mohali). In one-half of the districts, Dalit population made one-third or more in total population.

The size of Dalit population differed widely across the sub-regions and districts in the state. Among the three cultural regions of the state, namely *Majha, Doaba* and *Malwa*,

Doaba region has the highest concentration of Dalit population. Traditional Jalandhar Doab,falling in between the Beas and the Sutlej rivers,is agriculturally prosperous for its fertile and irrigated land. Among the districts, the size of Dalit population ranged from a high of 9.2 lakh persons in Ludhiana to only 1.8 lakh persons in Rupnagar district. The six topmost districts, namely Ludhiana, Firozpur, Jalandhar, Amritsar, Gurdaspur and Hoshiarpur have, in combine, 51.3 per cent of total Dalit population in the state. Against this, their combined population made only 50.8 per cent in state's total population.Ludhiana, Jalandhar and Amritsar districts, where are located the three largest million cities of Ludhiana, Jalandhar and Amritsar, have, in combine, 28.7 per cent of the total Dalit population against 29.5 per cent share in total population of the state. These facts and figures reveal that, at least in the case of Punjab, there is hardly any association between the high degree of urbanization and the high concentration of Dalit population. In the *Doaba* region of the state, the Dalit population is highly concentrated even in the villages. The youth from the Dalits households of this region have emigrated to work and are remitting back the remittance to their family members and relatives, who stay back in the villages. Secondly, Ad-Dharmis, originally the Chamars, are enjoying good economic status for their foothold in the local leather and sports goods industry.

In Punjab, there are 39 castes or communities of the Dalits, including the two (Mahatam, Rai Sikh and Mochi), enlisted in the scheduled list of castes for the first time in 2007 after the conduct of 2001 Census; hence were enumerated for the first time during the 2011 Census.

Against this, there are the thirteen SC Castes, identified as the "Depressed Scheduled Castes" by the Punjab Government for Development purpose, included-

1. Bangalis	2.Burar/Berar
3. Baurias	4. Bazigars
5. Bhanjras	6. Dumna/Dooms
7. Gandhilas	8. Khatiks
9. Kori/Koli	10.Meghs
11. Ods	12.Nats
13. Sansis	

Also, there are seven "De-notified tribes" or "Vimukat Jatis", declared first as the "Ex-criminal tribes' and then notified as Scheduled Castes, included-

1. Bangalis	2. Burar/Berar
3. Bauria	4. Gandhilas
5. Maujas/Marecha	6. Nats
7. Sansis	

These communities differ widely in their population sizes. In 2011, the Mazhabi with 2.6 million persons was the largest SC caste and the Perna, with only 68 persons, the smallest of the all. It is to be noted here that apart from these 39 Dalit castes enumerated in Punjab by the 2011 Census, there were 471,871 persons, making 5.3 per cent of total Dalit population in the state and belonging this or that caste or community of Dalit population, have been put under the category of 'unspecified castes' because they either refused to report to the Census enumerator their castes and simply reported as 'Harijan' or 'scheduled caste' or the enumerator found it difficult to put the enumerated person under this or that of the 39 Dalit castes notified by the Punjab Government.

Mazhabi or Mazhabi Sikh is the most dominant Dalit caste in Punjab. In 2011, they made 29.7 per cent in total Dalit population of the state. In other words, roughly three of each

ten Dalits in Punjab is a Mazhabi. They originally belonged to Chuhra or Bhangi caste but got converted to Sikhism; left their traditional occupation of scavenging and sweeping to work as agricultural labourers. The Chuhra or Bhangi, the fourth ranking SC caste in the state, made another 9.8 per cent in total Dalit population. The combined population of these two castes made39.5 per cent or roughly two-fifths in total SC population of the state. The Chamar etc., a second ranking SC caste, made another 23.5 per cent in total Dalit population of the state. The combined population of the Mazhabis and the Chamars made 53.2 per cent or majority ofthe Dalits in the state. So far as distribution of welfare benefits or electoral politics is concerned, such kind of caste arithmetic is full of implications. The third largest SC caste, Ad-Dharmi, made another 11.5 per cent in total SC populatione. The Ad-Dharmi caste or sect is an outcome of the Ad-Dharm movement, initiated by Mangoo Ram during the 1920s in the state. The dominant majority of the followers of this movement were the Chamars from the Doaba region. In a way, the Ad-Dharmis are the off-shoot of the Chamars and the Mazhabis are of the Chuhra or Bhangi in the state. These four castes, in combine, made roughly three-fourths or 74.5 per cent of the total Dalits in Punjab; and the eleven top ranking castes, each having one per cent or more in total Dalit population in the state, in combine, made more than nine-tenths or 90.7 per cent of the total Dalit population in the state (Table 1). Evidently, notwithstanding the fact that there are as many as 39 Dalit communities in Punjab, only a few among these predominates the Dalit population of the state; and four of them makes nearly three-fourths of total Dalits in Punjab.

Dalit population in Punjab has registered an annual growth rate 2.46 per cent during 1971-2011, against the state recording an annual growth rate of only 1.81 per cent during the same period. During this period, the Dalit population of 3.34 million in 1971 increased to 8.86 million in 2011, registering an absolute increase of 5.52 million persons. This entire increase has not occurred due to natural increase and/or migration; increase in number of notified list of SC castes has also contributed to this. For example, the two new castes, Mahatam, Rai Sikh and Mochi, added to the list of notified SC castes in 2007, were enumerated for the first time in 2011 Census. It means, 5.3 lakh persons were added in the Dalit population of the state for the first time in 2011. If we calculate annual compound growth of SC population after the subtraction of 5.3 lakh persons (the combined population of Mahatam, Rai Sikh and Mochi castes in 2011), it comes down to 2.31 per cent from 2.46 per cent. Obviously, there is always a need to be careful, while calculating the growth rate of SC population. Addition/deletion and some other factors contribute to non-comparability of SC population figures reported in two different Census decades.

Different Dalit communities recorded differential growth rates during 1971-2011. Annual compound growth rate varied from a high of 11.9 per cent in the case of the Nats to a negative growth of -0.7 per cent for the Sansois. While, the former are professional dancers, singers and acrobats, the latter traditional specializes in extracting gold particles from the river sand. The numerical strength of both the castes is quite low in the state. Among the 39 SC castes in the state at the time 2011 Census, the former ranks at 26th and the latter

Table 1: Eleven Top-Ranking Dalit or SC Castes in Punjab, 2011

Rank in 2011	Name of SC Caste	Percent to total SC population	Cumulative %
1	Mazhabi, Mazhabi Sikh	29.73	29.73
2	Chamar, JatiaChamar, Rehgar, Raigar, Ramdasi, Ravidasi, Ramdasia, Ramdasia Sikh, Ravidasia, Ravidasia Sikh	23.45	53.18
3	Ad Dharmi	11.48	64.66
4	Balmiki, Chuhra, Bhangi	9.78	74.45
5	Mahatam, Rai Sikh	5.83	80.28
6	Bazigar	2.72	83.00
7	Dumna, Mahasha, Doom	2.29	85.29
8	Megh	1.59	86.88
9	Bauria, Bawaria	1.41	88.29
10	Sansi, Bhedkut, Manesh	1.38	89.67
11	Dhanak	1.01	90.68

Source: Source: Calculated from Census of India, *Special Tables for Scheduled Castes*, for 2011, Registrar General and Census Commissioner of India, New Delhi.

on 32nd position. Both the castes are quite mobile, especially the Nats. More than a half of 3902 Nats in the state were, however, residing in Ludhiana district.

On the whole, 25 of 39 SC castes in the state had higher annual growth rate than the state average (2.46 per cent) for all such castes (Table 2). However, more than a half of these castes are small in population size, less than ten thousands in each case. Among the major castes, it is only Mazhabis, Bazigars, Meghs, Bawarias, and Sansis, who recorded the annual compound growth rate higher than the state average for such castes. Annual growth rates of the Mazhabis and the Bazigars, making the first and the sixth ranking castes in the state, need the special attention of the state government to spread family welfare program among these two castes for uplifting their social wellbeing. The Mazhabis[2] and the Bazigars are predominantly rural by residence, agricultural and casual labourers by occupation and have low level of literacy. For example, more than four-fifths or 81.7 per cent of Mazhabis were residing in rural areas, about 49.0 per cent of their main workers were engaged as agricultural labourers and only 54.5 per cent were literate in 2011. Against the high population growth rate among the Mazhabis and the Bazigars, the Chamars etc., and the Chuhras/Bhangis are growing at a rate, which is quite close to average growth (1.81 per cent) of the entire population of the state. Both these castes have much higher level of literacy and pre-dominantly non-farm employmet. Literacy rate among the Chamars was 72.8 per cent and 73.4 per cent of their workers were engaged in non-farm activities. The two castes, Mahatam, Rai Sikh and Mochi, enumerated for the first time in 2011

Table 2: Growth Rate of Different SC Castes in Punjab during 1971-2011

Rank in 2011	SC Caste Name	Total Population in 2011	1971	Rank in 1971	CAGR in %
	All Schedule Castes	8,860,179	3,348,217		2.46
1	Mazhabi, Mazhabi Sikh	2,633,921	962,546	2	2.55
2	Chamar, JatiaChamar, Rehgar, Raigar, Ramdasi, Ravidasi, Ramdasia, Ramdasia Sikh, Ravidasia, Ravidasia Sikh	2,078,132	981,471	1	1.89
3	Ad Dharmi	1,017,192	439,632	3	2.12
4	Balmiki, Chuhra, Bhangi	866,953	401,960	4	1.94
5	Mahatam, Rai Sikh	516,695	*	*	*
6	Bazigar	241,125	75,092	6	2.96
7	Dumna, Mahasha, Doom	202,710	91,685	5	2.00
8	Megh	141,023	52,608	7	2.50
9	Bauria, Bawaria	125,259	42,713	8	2.73
10	Sansi, Bhedkut, Manesh	122,201	39,084	9	2.89
11	Dhanak	89,406	27,910	12	2.95
12	Kabirpanthi, Julaha	84,711	37,625	10	2.05
13	Sirkiband	57,555	1,948	17	8.83
14	Pasi	39,111	1,713	20	8.13
15	Od	32,061	1,251	11	8.45
16	Kori, Koli	24,921	2,057	16	6.43
17	Batwal, Barwala	19,979	6,210	13	2.96
18	Khatik	14,482	5,943	15	2.25
19	Sarera	14,419	5,969	14	2.23
20	Sikligar	11,807	1,514	22	5.27
21	Deha, Dhaya, Dhea	10,560	1,524	21	4.96
22	Mochi	8,763	*	*	*
23	Barar, Burar, Berar	8,451	1,911	18	3.79
24	Sapela	5,872	823	24	5.04
25	Bangali	4,690	498	26	5.77
26	Nat	3,902	43	34	11.93
27	Bhanjra	3,659	1,907	19	1.64
28	Gandhila, Gandil Gondola	3,513	883	23	3.51
29	Sanhal	1,538	163	29	5.77
30	Darain	865	162	30	4.28
31	Gagra	799	55	32	6.92
32	Sansoi	456	601	25	-0.69
33	Dhogri, Dhangri, Siggi	391	46	33	5.50
34	Sanhai	359	180	28	1.74
35	Dagi	322	29	36	6.20
36	Marija, Marecha	260	218	27	0.44
37	Chanal	97	37	35	2.44
38	Pherera	80	72	31	0.26
39	Perna	68	4	37	7.34
	Unspecified Castes	471,871	160,130		2.74

Source: Calculated from Census of India, *Special Tables for Scheduled Castes*, for the decades 1971 and 2011, Registrar General and Census Commissioner of India, New Delhi

1. CAGR stands for compound annual growth rate

Census, will require more time before we know their growth rates.

(III). Dalit Population in Punjab: Spatial Distribution and Concentration

The geographical distribution of Dalit population in the state reveals that there are areas of concentration and dispersal too. Of the twenty districts in the state at the time of 2011 Census, six top ranking districts in numerical strength of SC population, in combine, stole more than a half (50.8 per cent) of their population in the state. This category included Ludhiana, Firozpur, Jalandhar, Amritsar, Gurdaspur, and Hoshiarpur districts. Ludhiana district alone shared more than one-tenth or 10.4 per cent of total Dalit population, and this district along with Firozpur and Jalandhar had more than one-fourth or 27.8 per cent of total such population in the state. On the other side of the scale, six lowest ranking districts had only about one-seventh or 15.4 per cent of the total Dalit population in the state. This category included Mansa, Faridkot, S.A.S. Nagar (Mohali), Fatehgarh Sahib, Barnala and Rupnagar.Among these districts, Rupnagar, which falls in close proximity to Chandigarh City, had the smallest population size of only 1.8 persons or 2.0 per cent, which comes to less than one-fifth of Ludhiana district (9.2 lakh persons). The size of Dalit population in Ludhiana district is, in fact, so large that it is much higher than the combined such population of four lowest ranking districts, namely S.A.S. Nagar (Mohali), Fatehgarh Sahib, Barnala and Rupnagar (7.8 lakh persons).

However, the picture differs when examined in term of the share of such population in the total population of individual districts.ShahidBhagat Singh Nagar (Nawanshehr) has the highest proportion (42.5 per cent) of Dalits in its total population. This is the second highest share after Koch Bihar district (West Bengal). Koch Bihar is the only district in India, where the Dalits make the majority population. In the three districts of Punjab, namely Nawanshehr, Muktsar and Firozpur, Dalit population makes more than 40.0 per cent in total population of respective districts. In other words, in these three districts at least two of each five persons belong to Dalit community. On the whole, one-half of the districts in the state have more than one-third share of Dalits in their total population. On the other side of the scale, the two districts of Patiala and S.A.S. Nagar have this share of less than 25.0 per cent or one-fourth. However, all the districts in the state have this share higher than the national average of16.6 per cent.

At least, there are seven districts in the state where is the high concentration of Dalit population. This category included Jalandhar, Hoshiarpur, and Nawanshehr from BIST Doab, Firozpur, Muktsar and Faridkot from the Malwa and Tarn Taran from Majha region. Against this, low concentration districts included six districts of S.A.S.Nagar (Mohali), Gurdaspur, Ludhiana, Patiala, Sangrur and Rupnagar (Table 3). Notably, the dominant majority of districts in this category belong to the Malwa region.

Now, we move to examine Dalit castes ranking by districts. The proportional share of the top or first ranking caste in total Dalit population for individual districts has been calculated and mapped for 1971, 1981, 1991, 2001 and 2011 Censuses. The main objective behind such an exercise is to understand the internal composition of different Dalit castes/ communities in an individual district and a group of districts from sub-regional perspective. The concentration of a particular caste in a district or a group of districts carries a great

Table 3: District-wise shares in total population and SC population in Punjab, 2011

District Name	Share in total population (%)	Share in total SC population (%)	Index of concentration
Ludhiana	12.61	10.42	0.83
Firozpur	7.31	9.66	1.32
Jalandhar	7.91	9.64	1.22
Amritsar	8.98	8.70	0.97
Gurdaspur	8.28	6.55	0.79
Hoshiarpur	5.72	6.29	1.10
Patiala	6.83	5.25	0.77
Sangrur	5.97	5.21	0.87
Bathinda	5.00	5.08	1.02
Muktsar	3.25	4.31	1.33
Tarn Taran	4.04	4.26	1.05
Moga	3.59	4.10	1.14
Kapurthala	2.94	3.12	1.06
S.B.S. Nagar	2.21	2.94	1.33
Mansa	2.77	2.92	1.05
Faridkot	2.23	2.71	1.22
SahibzadaAjit Singh Nagar	3.59	2.44	0.68
Fatehgarh Sahib	2.16	2.17	1.00
Barnala	2.15	2.17	1.01
Rupnagar	2.47	2.04	0.83

*****Districts having higher share of Dalit population than their share in total population of the state

Notes:

1. Invariably all the districts falling in BIST Doab have high concentration of SC population.

2. Index of concentration has been calculated by taking ratio between the percentage share of a district in total SC population of state and its share in total population of the state. Index value than of higher than 1 for a district indicates to relatively higher concentration of SC population and vice versa

significance in distribution of welfare benefits, political mobilization and riding the ladders of political power. As already, this has been stated that the Mazhabis/Mazhabi Sikhs made the largest community among the Dalits in the state. In 2011, they made first ranking Dalit caste in seven districts, including Amritsar and Tarn Taran (Majha region) and Moga, Bathinda, Faridkot, Muktsar and Mansa districts (Malwa region). Interestingly, they form majority in total Dalit population of all but Mansa district of this category (Fig.1). The Chamars etc., making the second largest Dalit caste in the state, was the first ranking caste in another seven districts, including Rupnagar, S.A.S. Nagar (Mohali), Patiala, Sangrur,

Ludhiana, Fatehgarh Sahib, and Barnala, all falling in the Malwa region of the state. Except Barnala and Patiala districts, the Chamars made the majority SC caste in total Dalit population of the respective districts. Ad Dharmis, the third largest Dalit community in the state, made the first ranking caste in another three districts of Jalandhar, Hoshiarpur, and Shahid Bhagat Singh Nagar (Nawanshehr), all in the BIST doab. They made the majority dalit community also in Hoshiarpur and Nawanshehr districts. The Dumnas made the first ranking caste in Gurdaspur, the Balmikis/Chuhras in Kapurthala, and Mahatam, Rai Sikhs in Firozpur districts. However, none of these castes made the major among the Dalit castes of the respective districts. It is, however, to be noted that the Balmikis/Chuhras made the third, the Mahatam, Rai Sikh, the fifth and the Dumnas, the seventh largest Dalit castes in the state at the time of 2011 Census. This indicates to the dispersed nature of their spatial distribution in the state. The same applies to the Bazigars, the sixth largest Dalit caste in the state. The Meghs, the Baurias, the Sansis, the Dhanaks,

Table 4 A: First Ranking SC Caste by Districts in Punjab, 2011

Name of the District	Name and share of First Ranking SC Caste (%)	Name of the District	Name of First Ranking SC Caste
Amritsar	Mazhabi, 68.3	LUDHIANA	Chamar,55.2
Tarn Taran	Mazhabi, 83.0	Patiala	Chamar, 41.0
Gurdaspur	Dumna/Mahasha, 27.2	SANGRUR	Chamar, 56.5
Kapurthala	Balmiki, 32.7	Barnala	Chamar,46.9
Jalandhar	Ad Dharmi, 42.1	FARIDKOT	Mazhabi, 65.9
Hoshiarpur	Ad Dharmi,66.6	MOGA	Mazhabi, 67.8
SBS Nagar	Ad Dharmi, 77.7	Mansa	Mazhabi,46.1
Rupnagar	Chamar, 63.0	BATHINDA	Mazhabi,50.7
Fatechgarh Sahib	Chamar, 59.8	MUKTSAR	Mazhabi,59.0
SAS Nagar (Mohali)	Chamar,52.4	Firozpur	Mahatam,Rai Sikh,43.7

Amritsar: Districts, where first ranking SC caste is also a dominant caste

Table 4B: Two SC Caste Majority Districts in Punjab, 2011

Name of the District	Name and share of SC Caste (%)	
Gurdaspur	Dumna/Mahasha (27.2)+ Mazhabi (24.1)	= 51.3
Kapurthala	Balmiki (32.7) +Ad Dharmi (25.3)	= 58.0
Jalandhar	Ad Dharmi (42.1) + Balmiki (25.1)	= 67.2
Patiala	Chamar (41.0) + Balmiki (19.6)	= 60.6
Barnala	Chamar,46.9+Mazhabi (38.8)	= 85.8
Mansa	Mazhabi,46.1+Chamar (33.6)	= 79.7
Firozpur	Mahatam,Rai Sikh (43.7)+ Mazhabi(23.2)	= 66.9
		Total = 07

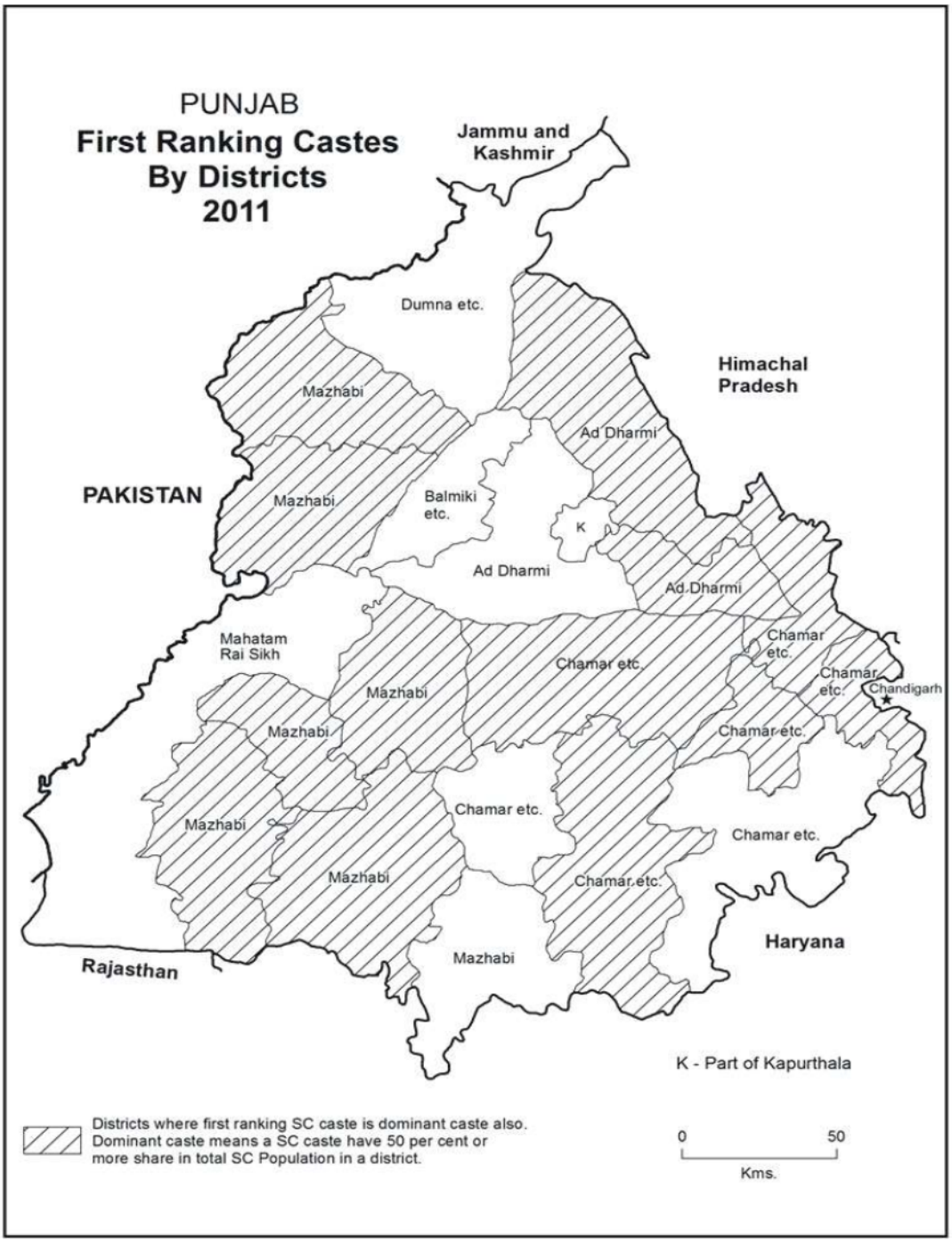
PUNJAB
First Ranking Castes
By Districts
2011
Jammu and Kashmir
Himachal Pradesh
PAKISTAN
Rajasthan
Haryana
Chandigarh
Dumna etc.
Mazhabi
Ad Dharmi
Balmiki etc.
K
Ad Dharmi
Ad.Dharmi
Mahatam Rai Sikh
Mazhabi
Mazhabi
Chamar etc.
Chamar etc.
Chamar etc.
Chamar etc.
Mazhabi
Chamar etc.
Chamar etc.
Mazhabi
Chamar.etc.
Mazhabi
K - Part of Kapurthala
Districts where first ranking SC caste is dominant caste also.
Dominant caste means a SC caste have 50 per cent or
more share in total SC Population in a district.
0
50
Kms.

Fig. 1

PUNJAB: **First Ranking Scheduled Caste by Districts**

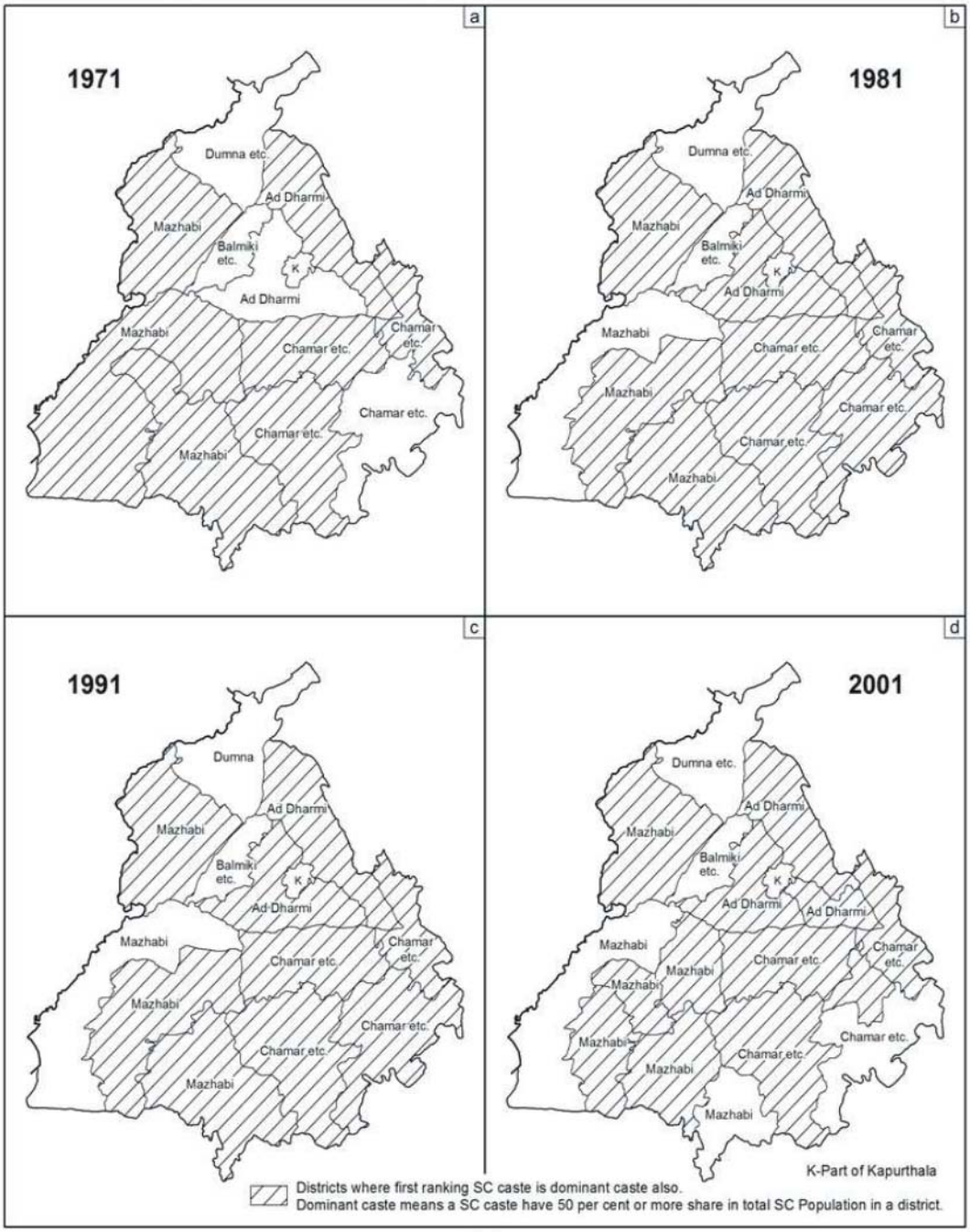

Fig.2

the Kabirpanthis/Julahas, and Sirkibands castes also display the similar pattern, in spite of being counted among the large Dalit castes in the state. Each one of these caste have more than 50 thousand persons, in each case.

Such a distribution of Dalit castes in the state, at least of first ranking castes in districts, has remained continued since the 1971 Census. The only change in the patterning of first ranking castes has come in Firozpur district, where the Mazhabis remained the first Dalit ranking caste from 1971 to 2001, before the Mahatam, Rai Sikhs emerged as the top ranking caste there in 2011 (See Fig. 2 and Table 4). The Mahatam, Rai Sikh, notified in the Scheduled list of Castes by the Punjab Government in 2007, was enumerated for the first time in the 2011 Census. Obviously, it is the notification of a new caste in the SC list that has been responsible for such kind of change in geographical distribution of first ranking SC castes at the district level in the state.

Yet, another way of looking at the geographical distribution of Dalit population is to examine it in terms of urban-rural distribution. Urban mobility transforms not only their occupational structure but also enhances awakening against the caste based discriminations and prejudices, helps in political mobilization and upward movement of socio-economic conditions. In general, Dalit castes are predominantly rural by residence. In Punjab, only 26.7 per cent of them were residing in urban areas against the state average of 37.5 per cent in 2011, indicating to a sharp difference of about 11.0 per cent points. Within the Dalit castes, there were sharp inter-caste differentials in degree of urbanization. While, the Ad Dharmis, the Bazigars, the Gagras, the Ods, the Mazhabis, the Sareras, the Baurias, the Sanhals, and Mahatam, Rai Sikks were among the least urbanized SC castes in the state, the Dehas, the

Mochis, the Khatiks, the Bangalis, the Nats, the Sapelas, the Sikligars, the Koris, the Dhongris, the Dhanaks, the Sansois and Chanals were highly urbanized castes (Table 5).

It is interesting to note that the majority of the Dalit castes having large population size in Punjab are predominantly rural by residence. At evident from Table 5, the Mazhabi, the Ad Dharmi, the Mahatam, Rai Sikhs and the Bazigar are among the least urbanized castes in the state, whereas the Chamars, the Balmiki/ Chuhra and the Dumna are also among the low urbanized SC castes in the state. It is only the Dhanaks (71.3 per cent) and the Kabirpanthis (68.5 per cent) in the group of the large population sized castes, which have relative high degree of urbanization.

It is generally accepted that there is a high

Table 5: List of the least and the high urbanized Dalit Castes/Communities in Punjab, 2011

Urbanization Level	Name of Caste with degree of urbanization (in %)
Least Urbanized	Ad Dharmi (21.4), Bazigar (21.1), Gagra (18.5), Od (18.5), Mazhabi (18.3), Sarera (14.1), Bauria (10.8), Sanhal (8.0), Mahatam, Rai Sikh (3.5) Total=09
Highly Urbanized	Deha (93.7), Mochi (93.4), Khatik (87.7), Bangali (80.1), Nat (79.0), Sapela (77.6), Sikligar (75.8), Kori (72.7), Dhongri (71.4), Dhanak (71.3), Sansoi (70.6), Chanal (69.1) Total= 12

State Average: 37.5 % Dalit Castes Average = 26.7 %

positive association between urban living, on one hand, and high literacy level and occupational diversity, on the other. This has been, however, found true only marginally in the case of Dalit castes in Punjab. Rather, there are glaring exceptions to this. For example, there is a high level of literacy and occupational diversification notwithstanding the moderate to low level urbanization among the Ad Dharmis, the Dumnas, the Megh, the Chamars, and the Batwals in Punjab. In contrast, the level of literacy is quite low among the Bangalis, the Nats, the Dhogris, the Dehas, the Sanhais, the Sikligars, the Mochis, and the Sapelas in spite of high degree of urbanization. This indicates that it is their arts and crafts, which compel them to move to urban areas, otherwise urban living hardly makes any significant dent on their living standards and social awakening. Nevertheless, the fast emerging scenario in Punjab is that even those Dalit castes residing and working in rural areas have only a limited or little interaction with and dependency on the traditional land owning farm communities in the village. As evident from the industrial classification of Dalit (main) workers in 2011 Census, the dominant majority (63.1 per cent) of them were engaged in non-farm economic activities. In fact, in the case 25 of the total 39 Dalit castes in Punjab this share was higher than four-fifths; and in the case 13 castes/ communities, namely the Deha, the Mochi, the Sikligar, the Bangali, the Barar, the Dhongri, the Bhanjra, the Nat, the Sapela, the Marija, the Darain, the Sansoi, and the Khatik, the proportion of workers engaged in non-farm economic activities was as high as more than 90.0 per cent, in each case. It is only the four castes, namely the Mazhabi, the Sanhal, the Mahatam, Rai Sikh and the Bauria/Bawaria, whose dependence on farm employment is still quite high. However, in the case of the Mahatam, Rai Sikh community 26.3 per cent of total (main) workers were the cultivators, the highest for any Dalit caste in the state.

The educated youth among the Sikh Dalits are highly radicalized now. They are not ready to accept the hegemony of land owning Jat Sikh community in the villages; and fight tooth and nail against the upper castes in the case of caste based discriminations. They reply the Jat Sikh youths in their language (see Judge, 2004:100-131; Vairagi, 2003:5); and the Ad Dharmis/Chamars are now turning to *Ravidasideras*, such as the Sachkhand at the village Ballan near Jalandhar City (Ronki Ram,2004:132-189). In Punjab, the Dalits have their own Gurdwaras, to save them from any kind of insult and humiliation. Of the nearly 13 thousand villages in Punjab, about 10 thousand villages have separate Dalit Gurdwaras (Chachrari, 2003:33). In opinion of Jodhka (2004:62-99) 'dissociation, distancing and autonomy' have been three main component of the Dalit strategy in Punjab to liberate them from the social, economic and religious hegemony of the upper castes.

Summary and the Conclusion

India has massive size of the Dalit population. Account for 201 million persons as per the 2011 Census, their population was higher than the total population of Brazil- the fifth largest country in the world. These castes, however, widely differ across states and districts in their demographic and socio-economic characteristics as well as in the number castes. Officially known as the Scheduled Castes but they prefer 'Dalit' as the self-proclaimed identity.

Punjab, located in the northwest India, has the highest proportional share (32.0 per cent) of the Dalit population among all the states and union territories in India. Its Dalit population of

8.80 lakh persons in 2011 was more than the entire population of Israel. Having several characteristics, which differentiate the Dalit population in Punjab from many other states of India, differ widely in size, growth, and spatial distribution within the state. The six topmost districts, in numerical strength, subsumed more than a half or 51.2 per cent of the total Dalit population in the state, against this the six lowest ranking districts had, in combine, only about one-seventh or 14.5 per cent of the total such population. At the level of individual districts, while Ludhiana was at the top with 9.2 lakh persons or more than 10.0 per cent of the total Dalit population, Shahid Bhagat Singh Nagar (Nawanshahr) had the highest proportional share (42.5 per cent) of SC population in its total population, placing it next only to Koch Bihar district (West Bengal) in all-India context. While, all the districts in the state had this share much higher than the national average of 16.6 per cent, one-half of the districts in the state registered this share more than one-third.

There were 39 Dalit castes in the state. Thirteen are identified as highly backward in terms of socio-economic development and seven of them are ex-criminal tribes, notified as Scheduled Castes. Four of the 39 Dalit castes in the state were so large in their numerical strength and geographical spread that these, in combine, had about three-fourths or 74.5 per cent of total Dalit population in the state. Mazhabi, the largest Dalit caste and the Sikh version of Hindu Balmiki/Chuhra caste, alone had about 30.0 per cent of total such population and along with the Chamars subsumed more than a half or 53.2 per cent in total such population of the state. Ad Dharmis, followers of Ad Dharm movement and previously belonging to the Chamar caste, made another more than one-tenth or 11.6 per cent, and the Balmikis/Chuhras yet another 9.8 per cent. The Mazhabis made the first ranking/ dominant SC caste in seven of the twenty districts in the state. The same was true of the Chamars, while such a position was acquired by the Ad Dharmi caste in three districts and by the Balmikis in one district. In remaining two districts, the Dumnas made the first ranking caste in Gurdaspur and the Mahatam, Rai Sikhs in Firozpur district. In 13 of the 20 districts in the state, the first ranking caste was also the dominant SC caste. At the sub-regional level, Ad Dharmis dominated the BIST doab, the Mazhabis and the Chamars jointly the Malwa region and the Mazhabis the Majha region.

During 1971-2001, Dalit population in the state was growing at a much faster rate (2.5 per cent per annum) than the total population (1.81 per cent). The majority of small population size Dalit castes were growing at a very fast rate; for example the Nats grew by 11.9 per cent during this period. The fast growth of the two large sized castes, Mazhabis and the Bazigars, is really a cause of concern, needing attention of the policy planners in the state. The Mazhabis are predominantly rural by residence, have low literacy level, and are mostly engaged in farm operations as agricultural labourers.

Like other parts of India, the Dalit castes in Punjab are predominantly rural by resident. The degree of urbanization among SC castes was about 11.0 per cent point lower than the state average. Nevertheless, some of the Dalit castes are highly urbanized and have a high degree of occupational diversification. Interestingly, several Dalit castes are though predominantly rural by residence but have high level of literacy and occupational diversification. The Ad Dharmi, the Megh, the Dumna, the Chamar, the Balmiki/Chuhra and the Batwal castes fall in this category. In fact, the dominant majority of rural workers from the dalit castes

in Punjab do not work on agricultural farms as agricultural labourers, educated youths are radicalized and assertive and the Dalit Sikhs have separate Dalit Gurdwaras.

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Notes :

1. Initially, Untouchability was the main criterion but now there are castes and communities in the scheduled list of castes and communities which never experienced untouchability. Ex-criminal tribes, such as Bangalis, Baurias and Sansis in Punjab list and several OBC castes such as Lohar, Jogi and Dhobi in Himachal Pradesh list come in this category.
2. Keeping in view the relative backwardness of Mazhabi Sikhs community along with that of the Balmikis within Dalits in the state, the Government of Punjab issued a notification on May 5, 1975 stating that henceforth 50 per cent vacancies of the quote reserved for Scheduled Castes should be offered to Balmikis and Mazhabi Sikhs, if available, as a first preference from among the Scheduled Castes candidates (see Letter No.1818-SWI-75/ 10451, dated 5th May, 1975 issued from the Office of the Secretary to Government of Punjab, Welfare of Scheduled Castes and Backward Classes).

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Sericulture as an Employment Generating Household Industry- A Case Study of Gayesbari Village of Kaliachak-I Block in Malda District, West Bengal

NasimAktar, Chand Sultana and Shamsul Haque Siddiqui

Employment generation is one of the major potentials of Sericulture and Silk Industry in Malda district. Sericulture with its high employment potentiality and more income generation in the households itself has been identified as one of the major sources of rural development by empowering women through the financial self-dependent. Men and women have been contributing in all the stages starting from on-farm activities such as Mulberry plantation, indoor rearing of silk worm, feeding the silk worm, processing the cocoons etc. to off-farm activities. Present study has investigated the earning from sericulture as a livelihood in the Gayesbari village of Kaliachak-I Block of Malda District. A structured schedule was designed based on existing literature and used as an instrument for data collection. Collected data had been analyzed using standard statistical methods and final conclusion was drawn based on it. The study finds that sericulture is one of the most important sources of income, so most of the villagers are engaged in sericulture. I have selected the area due to the fact that Kaliachak-I block – the most intensive sericulture block in the district of Malda as well as in the state of West Bengal and as such it is the only block in the state where 04 (Four) Nos. of Technical Service Centre (TSC) of Sericulture are there with the support of biggest Cocoon Market of the state. Almost 70% of the district Sericulture has been confined in this block.

Key words : Employment, Sericulture, Silk-worm, Mulberry, Coccon.

Introduction

Sericulture has originated from two French words, 'Seri' meaning silk and 'Culture' means rearing. Sericulture is a science which deals with various aspects of silkworms. It is an agro-based cottage industry, in which the end product is silk. Mulberry silk is also called Mori silk and non mulberry silk is called Vanya silk. It has become the most important cottage industry in a number of countries like China, Japan, Korea, Brazil, Russia, Italy, France and India. Today, China and India are the two main producers, together manufacturing more than sixty per cent of the world's production. Silk, the typical natural fibre, is mostly a producer

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of insects that belong to the order *Lepidoptera*. Silk fibre is produced at the end of the larval life of these insects and is woven in the form of cocoon in which the larva is metamorphosed into pupal form. Silk cocoon is woven by the insect larva to safeguard the sedentary, non-feeding phase of insect's life cycle and the practice of raising silkworm is known as sericulture. The discovery of silk production dates to about 2700 B.C. Silk fibre has been a precious trade commodity for more than 4000 years now. The route for transporting silk consignments from China to Mediterranean countries came to be known as the "Silk Road" or "The Silk Route. Finished products of silk (fibre, fabrics and garments) became possessions of the affluent and found patronage under various kingdoms. Even today, silk reigns supreme as an object of desire and fabric of high fashion. Ironically, and as is the case with many objects *desir*, production and weaving of silk are largely carried out by relatively poorer sections of the society.

Employment generation is one of the major potential of the sericulture and silk industry all over the world. The farm and non-farm activity of this sector creates sixty lakh employments every year mostly in rural India. The significant part of this employment generation includes its capability of transferring wealth from high and urban customer to poor artisan classes. Rural employment generation which has become the major focus of the inclusive development in all the developing economies in the era of post-globalization has received enormous scope of expansion under the sericulture industry in West Bengal as well as in few other states in India. Sericulture development provides opportunities to improve the living standards of people in the rural area.

Sirajudeen (2011) in the study "Sericulture industry: An overview" revealed that sericulture is essentially a village based industry providing employment to a sizeable section of the population. Although sericulture is considered as a subsidiary occupation, technological innovation has made it possible to take it up on an intensive scale capable of generating adequate income. Anitha (2011) in the study "Status of Silk Industry in India" revealed that sericulture is ideally suited for improving the rural economy of the country, this sector has been identified as a sector of the Indian economy with strong potential to create jobs and contribution to foreign trade with Japanese technology and cooperation, the central silk Board has recently been able to evolve and popularize bi-voltine silkworm races which can yield raw silk of international standards. With these races, provided there are simultaneous reforms in the marketing and processing of cocoons, India can hope to develop its sale of domestic raw silk beyond its own borders.

Sericulture in India

Silk is a way of life in India. Over thousands of years, it has become an inseparable part of Indian culture and tradition. No ritual is complete without silk being used as a wear in some form or the other. Silk is the undisputed queen of textiles over the centuries. Silk provides much needed work in several developing and labour rich countries. Sericulture is a cottage industry par-excellence. It is one of the most labour intensive sectors of the Indian economy combining both agriculture

and industry, which provides for means of livelihood to a large section of the population *i.e*. mulberry cultivator, co-operative rearer, silkworm seed producer, farmer-cum-rearer, reeler, twister, weaver, hand spinners of silk waste, traders etc. It is the only one cash crop in agriculture sector that gives returns within 30 days. This industry provides employment nearly to three five million people in our country. Sericulture is cultivated in Karnataka, Bengal, Tamil Nadu, Andhra Pradesh, Jammu & Kashmir, Gujarat, Kerala, Maharashtra, Uttar Pradesh, Rajasthan,Bihar, Orissa etc.Though India is the second largest silk producer in the World after China, it accounts for just 5% of the global silk market, since the bulk of Indian silk thread and silk cloth are consumed domestically. Germany is the largest consumer of Indian silk. The sericulture industry is land based as silk worm rearing involves over 700,000 farm families and is concentrated in the three Southern states of Karnataka, Tamilnadu and Andhra Pradesh. (The states of Assam and West Bengal are also involved in the industry to a certain extent).Silk, the queen of the fabrics still commands passion of consumer right from 2200 BC to till today, nationally and internationally. The export potential of Indian Sericulture Industry is evident from the fact that the annual export is Rs.2879.56 crores during the year 2004-05.The Central Silk Board, Ministry of Textiles, Govt. of India has been acting as a facilitator for planning, development and monitoring of sericulture industry between the States and Central Govt. The subject of Research is the exclusivity of the Central Silk Board and its sub-ordinate Research and Training Institutes.

Sericulture in West Bengal and Malda

Sericulture is ideally suited for land and labour abundant economy like India as well as in West Bengal, not only because it is low capital intensive but also because it is women labour intensive. Traditionally, Malda, Murshidabad and Nadia districts are famous for production of high quality silk. The extent of adoption of upgraded technology by silk growers in these districts is quite encouraging. Sericulture had been a traditional livelihood activity for rural families of Malda District in West Bengal also. This district shares 75% of total silk production of the state and 6% of country's total. The district has produced 13,086.87 MT cocoon and 1,472.2 MT of raw silk during the last financial (2013-14) year. There are 60,318 farmers engaged in sericulture using 20,789.28 acres of private land in this district. Sericulture flourished well in the Kaliachak-I, II and III Block of Diara region in Malda District of West Bengal which encourages investigating one of the villages located herein.

Objectives:

1. To identify the participation workers in Sericulture
2. To identify the reasons and factors influenced, particularly women workers to venture into sericulture
3. To understand the problems faced by workers
4. To offer suggestions based on research findings

Research Methodology

Type of the Study: Descriptive study is undertaken to understand the participation of

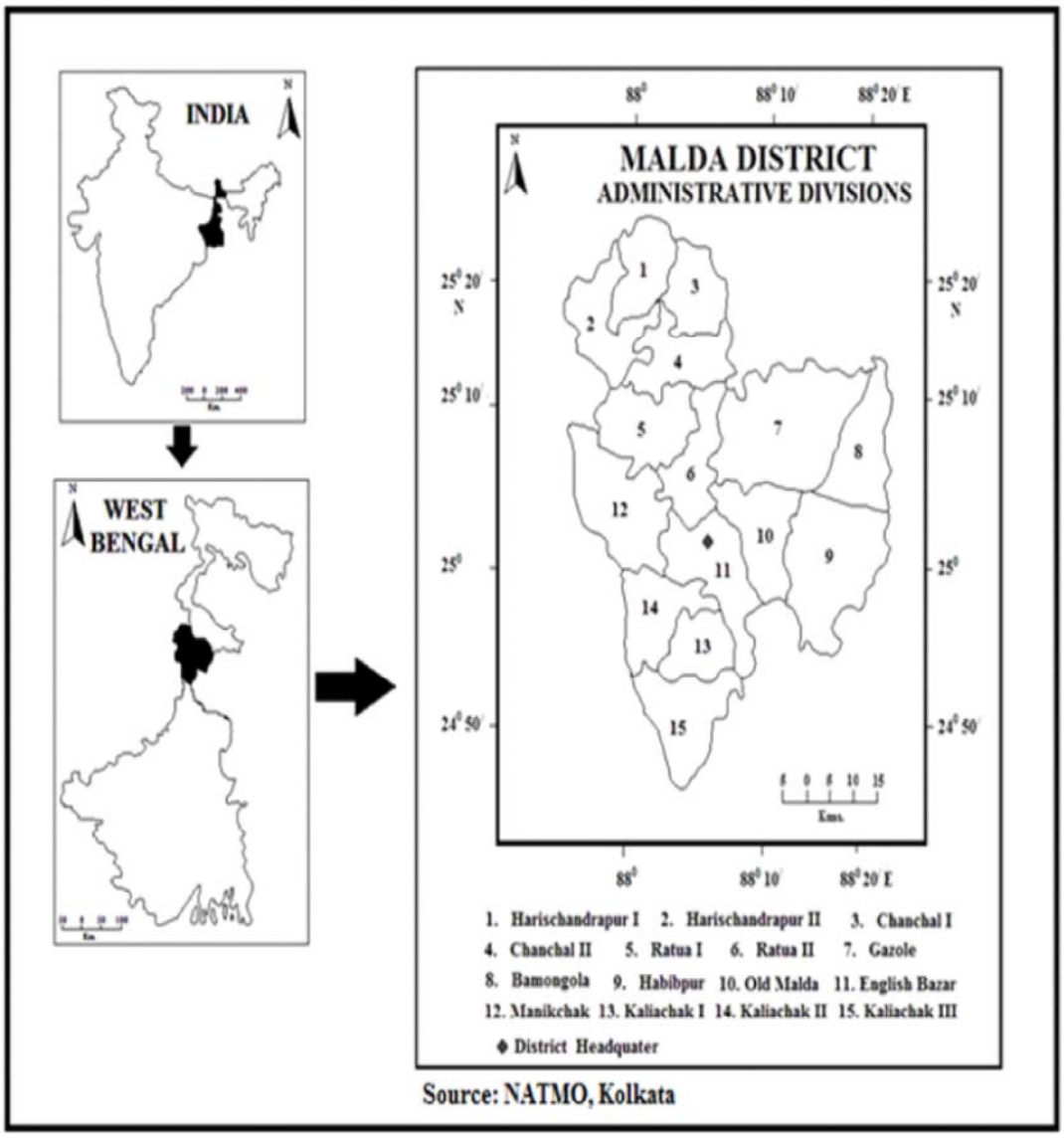

Fig. 1: Locational Map of the Study Area

farmers in sericulture, factors which influenced them to venture into sericulture and the problems faced by them while starting and promoting the business.

Sampling Design: A total of 120 Sericulture entrepreneurial farmers in Gayesbari village of Kaliachak-I block were taken as the samples for the study using random sampling method.

Table 1: Demographic Profile of the Respondents

S. No	Demographic Profile		Percentage
1	Marital Status	Married	76
		Unmarried	24
2	Age Group	< 20	18
		20-25	22
		25-30	35
		> 30	25
3	Educational Qualification	Primary	30
		Madhyamik	45
		H.S.	21
		Graduation	04
4	Occupational Status	Farmer	62
		Private Employees	06
		Govt. Employees	11
		Business	21

Data Collection: Primary data were collected from respondents using questionnaire and interview schedule methods. Secondary data were collected from various books, journals, magazines, newspapers and internet sources.

The Study Area

Kaliachak-I block (Figure 1) is one of the main centre of business and commerce of Malda District in Diara region of West Bengal. The total geographical area of the block is 106.60 square kilometres. It is surrounded by Kaliachak II to the north, Kaliachak III to the south, English Bazar to the east and Kaliachak III and Kaliachak II to the west.It is a main centre of silk production.The block is located between 24°48'N latitude to 24°56' N latitude and 87°57' E longitude to 88°8' E longitude. Total population of the block is 3, 92,439 out of which 200643 male and 191795 female population. Out of total population 98.17% lives in rural areas and only 1.83% lives in urban areas which clearly indicate that the block is rural in character. There are 66 *mouzas*, 14 *Gram Panchayats* and 183 villages in the block. There is only one cocoon market in Kaliachak where the villagers sale their product.Gayesbari is one of the most important centre of sericulture production in this block. Most of the people of this village are engaged in Sericulture.

Table 2: Respondents Monthly Income from Sericulture

S. No.	Monthly Income (Rs.)	Percentage
1	Below 5000	12
2	5001 to 10000	18
3	10001 to 15000	23
4	15001 to 20000	27
5	20001-25000	20
	Total	100

Source: Based on Primary survey, Jan-Feb, 2015

Result and Discussion:

Kaliachak-I block – the most intensive sericulture block in the district of Malda as well as in the state of West Bengal and as such it is the only block in the state where 04 (Four) Nos. of Technical Service Centre(TSC) of Sericulture are there with the support of biggest Cocoon Market of the state. Almost 70% of the district Sericulture has been confined in this

Table 3 : Motivational Factors to start Sericulture

S. No.	Factors	Percentage
1	Hereditary	08
2	Relatives	28
3	Awareness Programme	23
4	Field Officer	30
5	Others	11
	Total	100

Source: Based on Primary survey, Jan-Feb, 2015

Table 4: Reasons for Starting Sericulture Business

S. No.	Reasons for Starting Sericulture Business	Percentage
1	High net income	16
2	To do independent business	19
3	Economic Status will be increased	12
4	Full employment for family members	22
5	Low investment	13
6	Suitable occupation for small farmers	14
7	Other Reasons	04
	Total	100

Source: Based on Primary survey, Jan-Feb, 2015

block. Though the Mango and Litchi are good cash crops in this area yet, almost 80% of the population has been involved directly or indirectly with Sericulture activity. Being a traditional area of sericulture this block plays a vital role in the State economy on Sericulture. All the three sector of Sericulture *i.e.* Mulberry cultivation and silkworm rearing, Preparation of Disease free Laying (Eggs) and Preparation of Mulberry Silk Yarn (Silk thread) are in a compact shape in this block.

Table 5: Problems faced at the Time of Promoting Sericulture Business

S. No.	Problems	Percentage
1	Financial problems	26
2	Labour problems	18
3	Natural Problems	16
4	Technical problems	18
5	Administrative problems	14
6	Political problems	10
7	Other problems	08
	Total	100

Source: Based on Primary survey, Jan-Feb, 2015

Table 1 indicates that 74% of the respondents are married. The 35% and 25% of the respondents are in the age groups of 25-30 and above 30, respectively. Nearly 45% of the respondents are having educational qualification of *madhyamik* level, 30% primary level, 21% higher secondary level and remaining 4% graduate. Most of the respondents are farmers.

Table 2 indicates that 20% of the respondents are earning between Rs.20,001 and Rs.25,000 per month followed by 27% of the respondents earning between Rs.15,001 and Rs.20,000, 23% earning between Rs.10,001 and Rs.15,000, 18% earning between Rs.5,001 and Rs.10,000 and 12% earning below Rs.5,000 per month from sericulture.

Table 3 indicates that most (30%) of the respondents were motivated by field officers to start sericulture, followed by 28% of the respondents being motivated by their relatives and 23% were motivated through awareness programs.

Table 6: Opinion regarding Growth in Sericulture Business

S. No.	Reasons for Starting Sericulture Business	Percentage
1	Highly Satisfied	42
2	Satisfied	31
3	Unsatisfied	27
	Total	100

Source: Based on Primary survey, Jan-Feb, 2015

Table 7: Time spend by the workers in Sericulture activity

S. No.	Time spend per day	Percentage
1	Three Hours	25
2	Six Hours	45
3	Above Six Hours	30
	Total	100

Source: Based on Primary survey, Jan-Feb, 2015

Table 8. Respondents priority for opting Government Subsidies

S. No.	Govt. Subsidies	Total Score	Rank
1	Silkworm Rearing Shed	562	I
2	Const. of Cocoon Preservation Room	554	II
3	S.T.W and Pumpset	528	IV
4	Health Scheme	540	III
5	Disease control measures	475	VII
6	Rearing Appliances	480	VI
7	Mulberry cultivation	490	V

Source: Based on Primary survey, Jan-Feb, 2015

Table 4 indicates that 22% of the respondents have started sericulture in order to have full employment for the family members, followed by 19% of the respondents to do independent business, 16% of the respondents for earning high net income and 14% have felt that it is suitable for small farmers. And 4% of the respondents stated other reasons like availing subsidies, readily available technical guidance, easy to understand and adopt sericulture technology.

Table 9: Respondents Satisfaction level towards Government Subsidies

S. No.	Reasons for Starting Sericulture Business	Percentage
1	Satisfied	78
2	Unsatisfied	22
	Total	100

Source: Based on Primary survey, Jan-Feb, 2015

Table 5 indicates that 26% of the respondents face financial problems at the time of promoting Sericulture, followed by 18% of the respondents facing labour and technical problems, 16% natural problems, 14% administrative problems, 10% political problems and 8% of the respondents face other problems like lack of research and innovation, subsidiary activities, and lack of quality production.

Table 6 indicates that 42% of the respondents are highly satisfied followed by 31% of the respondents satisfied with their growth in sericulture business. 27% of the respondents are dissatisfied regarding their growth in Sericulture business.

Table 7 indicates that most (45%) of the respondents spend six hours per day in sericulture followed by 30% of the respondents spending above 6 hours per day and 25% three hours per day.

Table 8 shows ranking of respondents' priority for opting government subsidies. Silkworm rearing sheds has been ranked 1 followed by construction of cocoon preservation room, health schemes, water facilities, mulberry cultivation etc.

Table 9 indicates that majority (78%) of the respondents are satisfied with the subsidies provided by the government.

Conclusion

Even though the participation in Sericulture Industry is high and majority of the sericulture entrepreneurs are satisfied with subsidies provided by the government, still they are facing various problems while starting and promoting sericulture business. Most of the respondents have the minimum educational qualification, so government and sericulture department can organize various developmental programmes and training for them. These various programmes will help them to overcome the obstacles. Sericulture is one among the high income generating industry. Silk production is a significant factor which positivelyinfluences the level of employment. Higher level of production always expands the scope of employment generation in this low-skilled over populated rural economy. The study reveals that unitary household structures have greater positive contribution in creating employment compared to joint household structures, while income, school education, and number of females in household also help to increase the level of employment in sericulture. To combat with the present situation, some developmental scheme has been taken to strengthen the financial backbone of Sericulture during 2013-2014.The trial of this scheme has shown a good profitability and it is expected that during coming year the same schemes will be popularized among the Seri culturist. These schemes are introduction of Bi-voltine Rearing during Favourable Season, Mass Disinfection Programme, Re-plantation with High Yielding Variety and Wider Spacing, Construction of Reeling Shade etc.

Suggestions

Under the Directorate of Sericulture every year certain targets have been adopted by the planners. However, difficulties lie in implementation of the stages. Increase in are of mulberry cultivation is shrinking in the study region, which can be reasoned out as one of the major factors for slow growth of sericulture in Kaliachak I block. Improved mulberry variety is to be planted with greater care for manures and fertilizers. Innovations and technologies need to be directed so that more output can be produced in cost effective ways. Quality yarn needs to be produced by the domestic farms so that Chinese aggression can be tackled. Irrigated lands have higher productive and therefore greater stress should be given on expansion of the irrigation network. Cocoon markets are usually public market, though private cocoon-markets also exist at wider scale. Enhancement in number of cocoon markets and power-looms can be done with a little effort from the government. Credit facilities to sericulture artisans need to be made at discounted rate so that poor farmers can easily adapt themselves with the rise in costs arising out of inflation trends. Education have also been found to be an important factor in

raising the level of employment and that would also deepen the rate of technology diffusion in sericulture in coming days. With all these bright hopes we can expect that a step towards inclusive development is possible with development of sericulture in rural areas of the district.

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Reproductive and Child Health status in EAG States, India (A District Level Analysis)

Kalyan Sundar Som and R. P. Mishra

Reproductive and child health status (RCH) has been analysed both at state level and district level in eight Empowered Action Group of States (EAG states) of India in this study. The RCH value calculated in these EAG states is by using composite z-score method. Among these EAG states Uttar Pradesh and Bihar, the most populous states of the country, are in very poor condition, while Uttarakhand and Chhattisgarh, the new and small states, are in better condition in terms of RCH status.

At district level Baharaich and Balrampur districts of Uttar Pradesh are in the worst condition, while Dehradun of Uttarakhand is in the good condition in terms of RCH status. Several determinants have an impact on the RCH status in different states of our country. To find out the relative significance of these determinants, the multiple regression analysis has been made in this study. The most significant determinants are literacy and education, family size, accessibility, safe delivery and quality care.

Key words: RCH, EAG states, *composite z-score method, multiple regression analysis, Factor analysis*

Introduction

The decline in maternal and infant deaths in developing countries, particularly in India during the last few decades is a significant sign that increases global attention towards mother health and child care services in these regions (Singh *et al*, 2014). Earlier, the status of reproductive and child health in BIMARU states was in a critical stage, and now the situation has improved in these Empowered Action Group of States (EAG states) of the country. This situation has changed because of several schemes and special projects implemented by the Central Government and concerning state governments to uplift their position on demographic transition during last five decades (Som and Mishra, 2014).

Generally, fertility and mortality are related to each other, earlier the high birth rate was the consequence of high infant mortality in most of these states. The insecurity among the parents has given the concept to produce more children to secure some of the children to help in old age of the parents. Now, the situation has changed because of the socio-economic development in our country and the birth of a child is associated with the level of living standard, education level and economic

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resources of a family.

The reproductive and child health (RCH) programme is an integrated programme for the two vulnerable sections of the society i.e. mother and child. Reproductive and child health is the most vulnerable and deprived section among all the sector of public health in our society (Akhtar and Izhar, 2010; Boopathy and other, 2014; Lule, and others, 2005; Mondal, 2003; and Taneja, 2015). Reduction in the infant mortality is one of the major objectives of this programme, and it has recorded a remarkable success in the last few decades (Bhumik 2013 and Ram et al., 2009). The reproduction starts after the marriage due to the cultural custom and trait, therefore the age at marriage is one of most significant determinants of fertility in our country (Gulati and Patnaik, 1996).

Maximum percentage of Maternal Near Miss Case (Jabir and others, 2013) is induced by the less receive pre-natal care (PNC) and Ante-natal care (ANC) services (Mondal 2003; Satia and others 2014). Some studies indicate that lower PNC and ANC is the result of poor economic condition of families and they are unable to pay for these services. However, these services are provided by the government, so inability to pay (Gage and Calixte, 2006) is not a reason in case of India for less receives PNC and ANC but because of awareness, traditional believes, rigidity and misconception (Nagahawatte and Goldenberg, 2008).

There is a variation in the age at marriage in our country at state level, mostly EAG states have recorded low mean age at marriage when comparison made with the country's average and especially with the some of the southern states. Lower age at marriage generally tends to lower age at first birth which gives the result of high pregnancy complication and high maternal mortality and high infant mortality rate (Gulati and Sharma, 2001).

Objectives of this study

The main objectives of this study are:

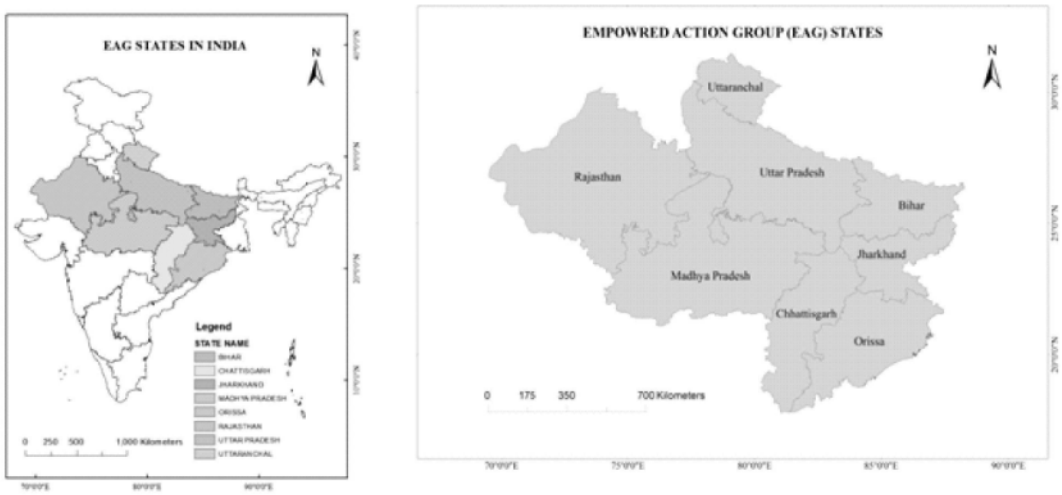
(i) To analyze the spatial pattern of reproductive and child health status in EAG states of India at district level.

(ii) To find out the scaling and the factor weight of variables, which have most influenced the RCH status in these states and districts.

The Study Region

There are eight EAG states in the country (Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh and Uttarakhand), these states have 277 districts. These districts have 617 million population (51% of country), which is equivalent to the combined population of Latin America and the Caribbean (618 million) (*PRB, 2014*). Uttar Pradesh has recorded the highest infant mortality rate and highest fertility rate, while Madhya Pradesh has recorded acute child malnourishment and higher maternal mortality rate (*CAB Report 2014*). Rajasthan has lowest female literacy rate in the country. Bihar has recorded second highest population growth rate in the country. Jharkhand and Chhattisgarh are the states which have higher proportion of tribal population, where women education, health condition are lower than other Indian states.

Literacy rate of EAG states vary from 62.34 percent in Rajasthan to 77.11 percent in Uttarakhand. Very high rural-urban differential and gender disparity prevail in literacy rate in EAG states. Among EAG states, very low urbanization is one of the characteristics where Bihar (11.30 percent) recorded lowest and hilly state Uttarakhand has highest (30.55 percent) urban population. Out of eight states, six have



Map 1: Location Map of EAG States

less than one quarter urban population which is very low in comparison to that of the country average.

Material and Methods

This study is primarily based on secondary sources of data, obtained from Annual Health Survey (2012-13), Census of India (2011), and District level Health Survey (DLHS-3) for 277 districts of eight EAG states of India. These data processed by the use of R i.e. statistical analysis programme.

The reproductive and child health index computed in this study, which gives an insight into the RCH status in the EAG states. The index is based on seven parsimony variables i.e. (i) Above third order birth, (ii) Percent of girls marrying before 18 years, (iii) Modern contraceptive prevalence rate, (iv) Percent of safe deliveries, (v) Percent of child having full immunization, (vi) Mother received above three antenatal care, and (vii) Infant mortality rate.

RCH status is computed by the composite Z-score method. The RCH index has been computed by giving equal weights to each of the seven indicators. After that district are classified into six groups on the basic of standard deviation technique. For better visualization of the spatial pattern of RCH status it is shown by the thematic map using GIS software.

Factor analysis has established the association between fertility, marriage age pattern, contraception usage, reproductive health and child health care utilization, socio-economic profiles. Quantitative insight into the association and assist in selection of the germane variables for electing the district wise composite indices is made by the factorial analysis. The indicators which have determined the RCH status have been worked out at district level by using the principal component analysis. These indices are helpful in identification of demographically sensitive districts that needs to be prime attention upon to convey about optimal results towards population stabilization which is the main aim of Indian population policy. They will be helpful in the process of bringing down of the rapid population growth

in the demographically backward districts of EAG states.

Result and Analysis:

District level Analysis

EAG states include eight states of India namely Uttar Pradesh, Uttarakhand, Rajasthan, Madhya Pradesh, Chhattisgarh, Bihar, Jharkhand and Odisha and they together have 277 districts. A district level analysis of EAG states reveals that out of these 277 districts, 19 districts (6.86%) are in the category of problematic RCH status and 109 districts (61.01%) belong to the category of progressive RCH status, while, remaining 89 districts (32.13 %) belong to the category of dynamic RCH staus (Map 2). Moreover, among the districts of EAG states, districts of Uttar Pradesh have recorded very poor condition compared to that of other EAG states and two districts of Uttar Pradesh recorded very poor RCH status, these two districts are Bahraich and Balrampur. All these districts can be classified into three categories on the basis of their RCH status:

(a) Problematic districts: Out of the 19 problematic districts, 10 districts (13.99 %) are from Uttar Pradesh , 6 districts (15.79 %) are from Bihar and 3 districts (12.50 %) are from Jharkhand.

(b) Progressive districts: Out of the 109 progressive districts, 60 districts (13.99 %) are from Uttar Pradesh and 32 districts (13.99 %) are from Bihar, 19 districts (13.99 %) are from Jharkhand, 20 districts (13.99 %) are from Madhya Pradesh, 9 districts (13.99 %) are from Chhattisgarh, 3 districts (13.99 %) are from Uttarakhand, 6 districts (13.99 %) are from Odisha and 20 districts (13.99 %) are from Rajasthan.

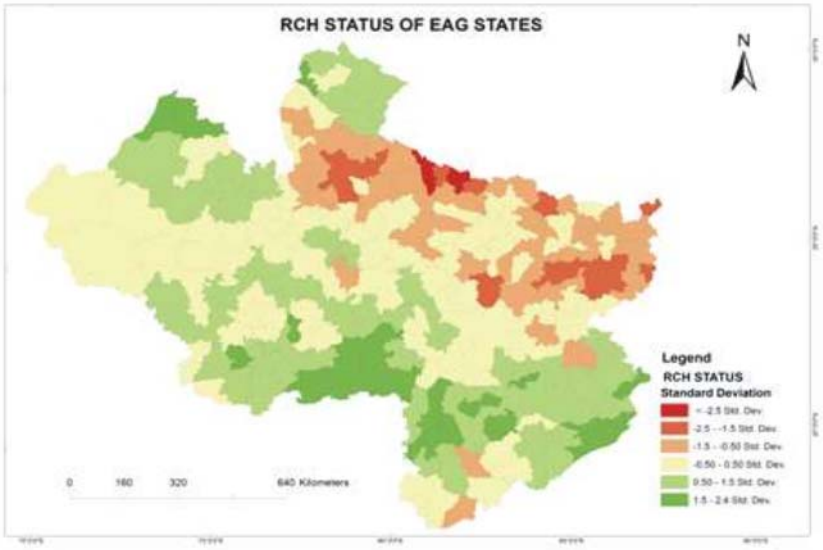
(c)Dynamic districts: Out of the 89 dynamic (prospective) districts, 1 district (13.99 %) is from Uttar Pradesh, 2 districts (13.99 %) are from Jharkhand, 30 districts (13.99 %) are from Madhya Pradesh, 9 districts (13.99 %) are from Chhattisgarh, 10 districts (13.99 %) are from Uttarakhand, 24 districts (13.99 %) are from Odisha and 13 districts (13.99 %) are from Rajasthan.

Out of 71 districts of Uttar Pradesh, 60 districts (84.51 percent) are in the category of progressive RCH status, 10 districts (13.99%) are in the category of problematic RCH status, and on the other hand one district has recorded good status. It is to mention here that not a single district comes in the category of better RCH status.

District level analysis reveals that most of the districts of Bihar fall in the poor categories such as poor, lower medium and higher medium out of six categories (Map - 2) and no one district is under the category of dynamic RCH status, this condition is serious and needs urgent attention. Six districts (15.79 percent) have recorded problematic (poor) RCH status, and 32 districts (84.21 percent) have recorded progressive RCH status among the districts of EAG states.

In Jharkhand only three (12.5 percent) districts out of 24 districts have recorded problematic RCH status, 19 (79.17 percent) districts have recorded progressive RCH status while only two districts (8.33 percent) recorded in the group of good RCH status.

In Madhya Pradesh no district is recorded problematic RCH status, 20 districts (40 percent) have recorded progressive RCH status, while 30 districts (60 percent) stand in the categories of dynamic RCH status. On the other hand, among these thirty districts, 22 have good RCH status while only 8 districts are in



Map 2: District wise RCH Status in EAG States

Table 1: RCH Status of Empowered Action Group States of India, 2012

S. No.	RCH Value (Composite Z Score)	Category	Districts
1	Above -9.4	Very Poor	Bahraich (Uttar Pradesh) and Balrampur (Uttar Pradesh).
2	-9.4 to -5.64	Poor	Uttar Pradesh (8 Districts) Bihar (6 Districts) Jharkhand (3 Districts).
3	-5.64 to -1.88	Low Medium	Uttar Pradesh (29 Districts) Bihar (25 Districts) Jharkhand (10 Districts) Odisha (2 Districts) Madhya Pradesh (1 District).
4	-1.88 to 1.88	High Medium	Uttar Pradesh (31 Districts) Bihar (7 Districts) Jharkhand (9 Districts) Odisha (4 Districts) Madhya Pradesh (19 Districts) Rajasthan (20 Districts) Chhattisgarh (9 Districts) Uttara Khand (3 Districts).
5	1.88 to 5.64	Good	Uttar Pradesh (1 District) Jharkhand (2 Districts) Odisha (16 Districts) Madhya Pradesh (22 Districts) Rajasthan (11 Districts) Chhattisgarh (5 Districts) Uttara Khand (9 Districts).
6	5.64 to 9.03	Better	Odisha (8 Districts) Madhya Pradesh (8 Districts) Rajasthan (2 Districts) Chhattisgarh (4 Districts) Uttara Khand (1 District).

Source: Data obtained from (i) AHS, (ii) Census of India, (iii) DLHS and calculated by authors

Table 2: District wise RCH Status, EAG States of India, 2012

State	Problematic		Progressive		Dynamic		Total
	Very Poor	Poor	Low Medium	High Medium	Good	Better	
Uttar Pradesh	2 Districts (2.82%)	8 Districts (11.27%)	29 Districts (40.85%)	31 Districts (43.66%)	1 Districts (1.41%)	-	71 Districts (100%)
Bihar	-	6 Districts (15.79%)	25 Districts (65.79%)	7 Districts (18.42%)	-	-	38 Districts (100%)
Jharkhand	-	3 Districts (12.5%)	10 Districts (41.67%)	9 Districts (37.5%)	2 Districts (8.33%)	-	24 Districts (100%)
Madhya Pradesh	-	-	1 Districts (2%)	19 Districts (38%)	22 Districts (44%)	8 Districts (16%)	50 Districts (100%)
Odisha	-	-	2 Districts (6.67%)	4 Districts (13.33%)	16 Districts (53.33%)	8 Districts (26.67%)	30 Districts (100%)
Chhattisgarh	-	-	-	9 Districts (50%)	5 Districts (11%)	4 Districts (27.78%)	18 Districts (22.22%)
Uttarakhand	-	-	-	3 Districts (23.08%)	9 Districts (69.23%)	1 Districts (7.69%)	13 Districts (100%)
Rajasthan	-	-	-	20 Districts (60.61%)	11 Districts (33.33%)	2 Districts (6.06%)	33 Districts (100%)
Total	2 Districts (0.72%)	17 Districts (6.14%)	67 Districts (24.19%)	102 Districts (36.82%)	66 Districts (23.83%)	23 Districts (8.30%)	277 Districts (100%)

Source: Data obtained from (i) AHS, (ii) Census of India, (iii) DLHS and calculated by authors

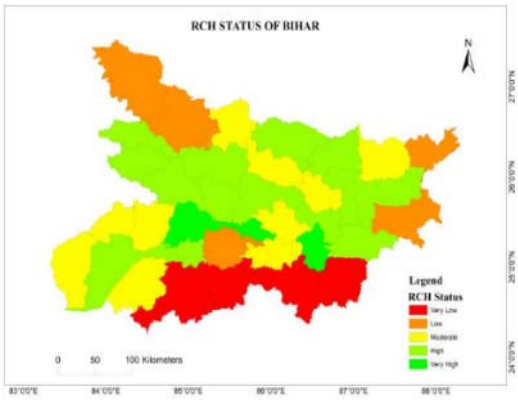
better RCH status category.

Chhattisgarh and Uttarakhand are two small states under the EAG states; they have total 31 districts (Chhattisgarh -18 & Uttarakhand-13 districts) and both the states have better condition in RCH status when comparison made with the other EAG states. Nine districts of Chhattisgarh are in the category of progressive RCH status and 9 districts are in dynamic category of RCH status. In Uttarakhand, 3 districts have recorded progressive RCH status, while 10 districts have in category of dynamic RCH status. It is interesting to note here that no one district in both the states is in the category of the problematic RCH status.

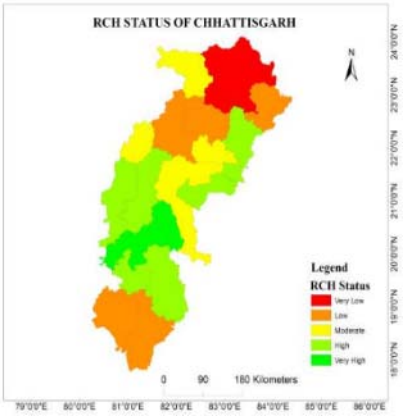
In Odisha state six districts (20 percent) have reccorded progressive RCH status, where 2 districts have lower medium and 4 districts have higher medium RCH status. On the other hand, 24 districts (80 percent) have recorded dynamic RCH status where 16 districts (53.33 percent) are in good status and 8 districts (26.67 percent) are in better RCH status.

Rajasthan have 33 districts where no one district has recorded problematic RCH status, 20 districts (60.61 percent) have recorded progressive RCH status while 13 districts (39.39 percent) recorded in the category of dynamic RCH status. Among these districts, 11 districts (33.33 percent) have good status and 2 districts (6.06 percent) have better status among the districts of EAG states.

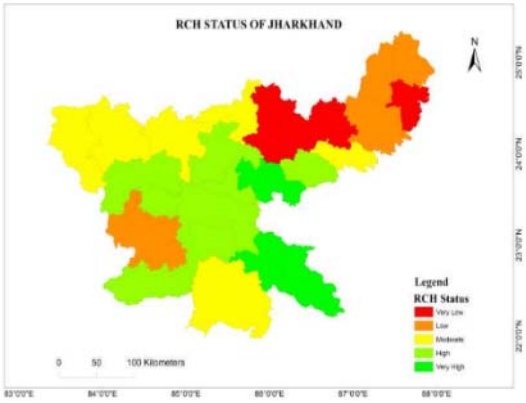
Map 3a: RCH status of Bihar



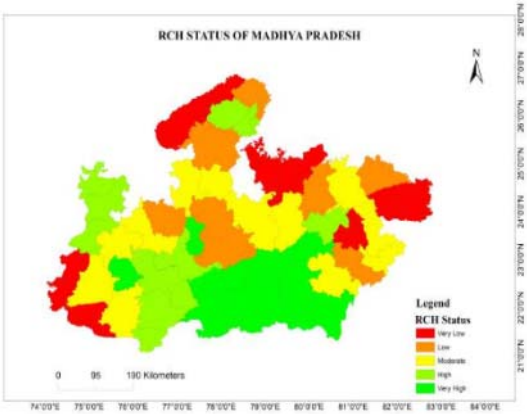
Map 3b: RCH status of Chhattisgarh



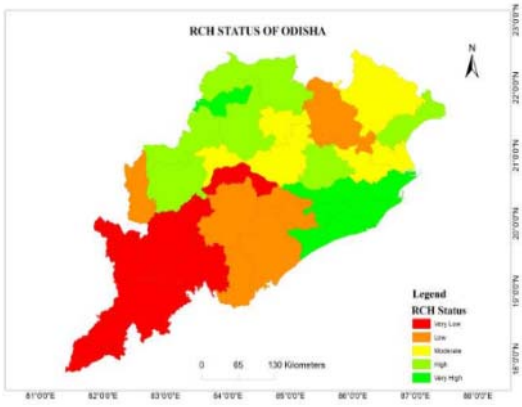
Map 3c: RCH status of Jharkhand



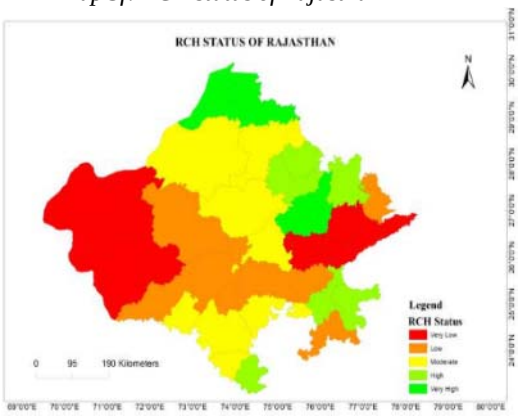
Map 3d: RCH status of Madhya Pradesh



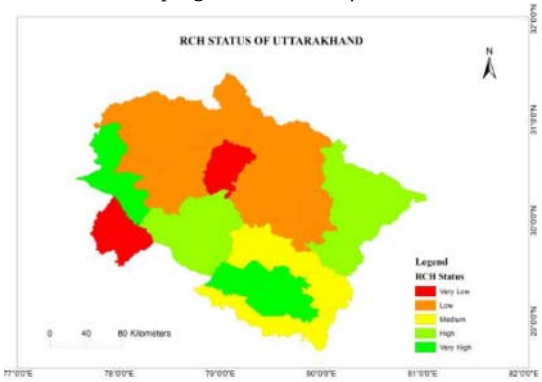
Map 3e: RCH status of Odisha



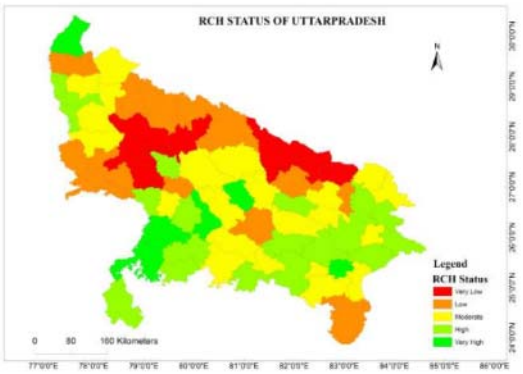
Map 3f: RCH status of Rajasthan



Map 3g: RCH status of Uttarakhand



Map 3h: RCH status of UttarPradesh



Regional variations within the EAG states

***Bihar*:** Southern districts are poor in RCH status and the central part of Bihar has good RCH status, while other districts belong to moderate RCH status category (Map3a).

***Chhattisgarh*:** In this state, the districts of Mahanadi plain have better RCH status than northern pat region and southern hilly region which have recorded low RCH status (Map3b).

***Jharkhand*:** North-eastern region of the state have lower RCH status while north-western have moderate RCH status region. On the other hand, central most part of the state has better RCH status (Map 3c).

***Madhya Pradesh*:** Northern parts of Chambal region, western part of tribal region and northern part of Bundelkhand region have lower RCH status in the state. On the other hand, south-eastern region of the state has highest RCH status, while other parts of the state have moderate RCH status (Map3d).

***Odisha*:** Among the districts of Odisha, it is a clear north south divide line, where northern part is in better RCH status and southern part is in poor RCH status (Map3e).

***Rajasthan*:** Northern and southern parts of this state have better RCH status when comparison made with the western and eastern counterpart. On the other hand, the northern districts are in the better condition and western most districts have poor RCH status (Map3f).

***Uttrakhand*:** In Uttarakhand, north-western districts have low RCH status while southern and eastern districts have good RCH status. On the other hand, south-eastern district have moderate RCH status among the district of Uttarakhand (Map 3g).

***Uttar Pradesh*:** Uttar Pradesh has four macro physiographic regions, they are western Uttar Pradesh, Avadh region, Bundelkhand, and Purvanchal. Poor RCH status has recorded in the eastern part of western Uttar Pradesh and northern part of Avadh, while Bundelkhand and Purvanchal have better RCH than other parts (Map 3h).

Discussion

A. Demographic Indicators: The demographic indicators are divided into two categories on the basis of their nature where first group provide good RCH status and second one give inverse impact. First group includes-female literacy rate (FLR), current married literacy rate (CMLR), children attending the

school (school age), work participant rate (WPR), percent of urban population (PUP), television, telephone, mobile and household having sanitation facility. On the other hand, second group includes- higher household size (HH size), percent of child engage in work (ChEW), percent of schedule cast (SC), percent of schedule tribe (ST), and percent of below poverty line (BPL).

B. Health Indicators: Health Indicators include institutional delivery (Ins. Deli), percent of safe delivery (PSD), percent of village having sub-centre (PVWSbC), percent of village having doctor (PVWD), adequately equipped Sub Center (at least 60%) (AESbC) and essential medicines and drugs (at least 60%) (Essen Drug). Institutional delivery increases the chance of safe delivery that stimulates the RCH status.

C. Proximate Indicators:

I. Marriage and Fertility: Marriage and fertility is one of the most important indicator of reproductive and child health (RCH) in EAG states. This give an impact of RCH status on the two ways one is positive and another is negative ways.

Negative indicators of Marriage and Fertility: These variables have been affected by some demographic and some health facility indicators. This section includes those variables of the marriage and fertility which gives negative impact on RCH status they are high TFR, percent of birth above 3rd order and percent of girls marring before 18 years of age.

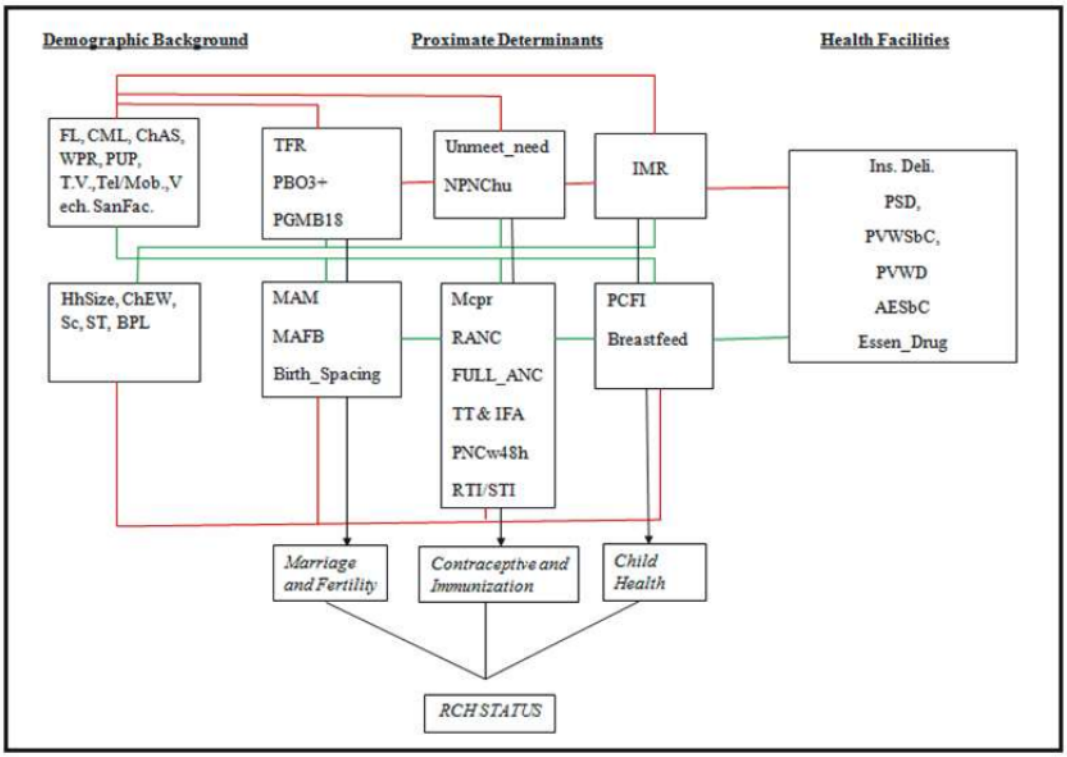
Positive indicators of Marriage and Fertility: This section includes those variables of the marriage and fertility which give positive impact on RCH status which are mean age at marriage, median age at first birth, and birth spacing between two successive births.

Good demographical variables have determined 55.47 percent variability of negative marriage and fertility status in EAG states with 0.001level. Among these variables CMLR, WPR, PUP has individually giving an impact with a significance level. Three variables - CMLR, WPR, PUP can determine 54.09 percent variability of negative marriage and fertility status in EAG states with 0.001level. This indicates that literacy is one of the best determinants which influence the work participant rate and also urbanization. It gives a result to policy maker to improve RCH status among EAG states by improving current married literacy rate.

Negative demographical variables have determined 30.08 percent variability of negative marriage and fertility status in EAG states with 0.001level. Among these variables HH size individually determined 25 percent variability of negative marriage and fertility status in EAG states with 0.001level. Because joint family system has lower age at marriage and they have so many persons to care the new born child that ultimately tends to produce more number of children by a women.

Model showing the RCH status in EAG states

Good demographic variables have determined 31.75 percent variability of positive marriage and fertility status in EAG states with 0.001level. Among those variables CMLR, ChAS and WPR are individually giving an impact with a 0.001significance level. On the other hand, FL and T.V has also give a significant impact with 0.5 and 0.1 level respectively. FL, CMLR, ChAS, WPR, and T.V have determined 31.69 percent variability of negative marriage and fertility status in EAG states with 0.001level. This indicates that



Note: This model has formulated by authors on the bases of demographic variables, health facilities and proximate determinants to prove the RCH status in EAG states of India.

increase in literacy and education (Schooling Age) directly hike the age at marriage and first birth and also this knowledge and awareness increases birth space between the successive birth which gives a positive impact to improve good RCH status. Similarly, television factor gives positive impact on RCH status in EAG states by creating awareness towards RCH and other health programmes.

Negative demographical variables have determined only 5.26 percent variability of positive marriage and fertility status in EAG states with 0.001level. Among these variables BPL was individually determined very low variability (2 percent) but with high significance level.

Health indicators have determined 24.48 percent variability of the negative marriage and fertility status in EAG states with 0.001level. Among these variables Ins. Deli and PSD jointly determined 14.56 percent variability of the negative impact on marriage and fertility status in EAG states with 0.001level.

Health indicators have determined 15.59 percent variability of the positive marriage and fertility status in EAG states with 0.001level. Among these variables PSD, PVWSbC and AESbC jointly determined 12.70 percent variability of the positive marriage and fertility status in EAG states with 0.001level.

II. Contraceptive and Immunization : *Negative indicators of contraceptive and Immunization:* This section includes those variables of the contraceptive and immunization which gives negative impact on RCH status which are unmeet need and percent of child not received post natal care. These variables are affected by some demographic and some health facility indicators.

Positive indicator of contraceptive and Immunization: This section include these variables of the contraceptive and immunization which gives positive impact on RCH status which are modern contraceptive prevalence rate (Mcpr), received antenatal care (RANC and Full-ANC) percent of women received tetanus and iron folic tablet (TT&IFA), percent of women who received post natal care within 48 hours (PNCw48h) and percent of RTI and STI affected women (RTI/STI). These variables are affected by some demographic and some health facility indicators.

Good demographical variables have determined 10.95 percent variability of negative contraceptive and immunization status in EAG states with 0.001level. Among these variables CMLR and vehicles individually give an impact with a significance level. CMLR and vehicles have determined 9.87 percent variability of negative contraceptive and immunization status in EAG states with 0.001level. This indicates that accessibility and transport is one of the best determinants which influence the reach in the nearest health centre. It gives a result to policy maker to improve RCH staus among EAG states by improving accessibility of health centre.

Negative demographical variables have determined very low (below 1) percent variability of negative contraceptive and immunization status in EAG states with 0.05 level.

Good demographical variables have determined 63.33 percent variability of positive contraceptive and immunization status in EAG states with 0.001level. Among these variables four variables CMLR, ChAS WPR and vehicles individually giving an impact with a 0.001significance level. CMLR, ChAS, WPR, and vehicles have determined 63.11 percent variability of negative contraceptive and immunization in EAG states with 0.001level. This indicates that increase in literacy and education (Schooling Age) directly hike the age at marriage and first birth and also this knowledge and awareness increases birth space between the successive birth those give a positive impact to improve good RCH status in EAG states.

Negative demographical variables have determined only 23.79 percent variability of positive contraceptive and immunization status in EAG states with 0.001level. Among these variables HH size and ChAS was individually determined 23.71 percent with high significance level.

Health indicators have determined 11.06 percent variability of the negative contraceptive and immunization status in EAG states with 0.001level. Among these variables no one has individually statistically significant impact on variability of the negative contraceptive and immunization status in EAG states.

Health indicators have determined 49.31 percent variability of the positive contraceptive and immunization status in EAG states with 0.001level. Among these variables AESbC and Essen_Drug have jointly determined 26.39 percent variability in terms of positive contraceptive and immunization status in EAG

states with 0.001level. This indicates that the availability and quality care can help to increase the success of Contraceptive and Immunization adaptability.

III. Child Health

Negative indicator of Child Health: This section includes the variables of the Child Health which give negative impact on RCH status i.e IMR.

Positive indicators of Child Health: This section includes the variables of the marriage and fertility which give positive impact on RCH status which are PCFCI and breastfeed. These variables are affected by some demographic and some health facility indicators.

Good demographic variables have determined 34.85 percent variability of negative child health status in EAG states with 0.001level. Among these variables CMLR, ChAS, PUP and vehicles individually give an impact with a significance level. CMLR, ChAS, PUP and vehicles have determined 21.38 percent variability of negative child health status in EAG states with 0.001level. This indicates that accessibility and transport is one of the best determinants which influence the reach in the nearest health centre.

Negative demographic variables have determined very low (below 1) percent variability of negative child health status in EAG states with 0.05level.

Good demographic variables have determined 50.60 percent variability of positive child health status in EAG states with 0.001level. Among these variables CMLR, ChAS WPR and PUP individually give an impact with a 0.001significance level. CMLR, ChAS, WPR, and PUP have determined 50.96 percent variability of negative child health status in EAG states with 0.001level.

Negative demographic variables have determined only 42.95 percent variability of positive child health status in EAG states with 0.001level. Among these variables HH size and ChAS individually determined 39.78 percent with high significance level.

Health indicators have determined 3.33 percent variability of the negative child health status in EAG states with 0.001level. Among these variables Ins. Deli and PSD jointly determined a very low variability with a statistical significant impact on of negative child health status in EAG states.

Health indicators have determined 25.04 percent variability of the positive child health status in EAG states with 0.001level. Among these variables PVWD and Essen_Drug jointly determine 14.44 percent variability with a statistical significant impact on of the positive child health status in EAG states.

Conclusions

1. This study is primarily based on secondary sources of data, obtained from Annual Health survey (2012-13), Census of India (2011), and District level Health Survey (DLHS-3) for 277 districts of eight EAG states of India. The data processed by the use of R i.e. statistical analysis programme.

2. EAG states include eight states of India, namely Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttarakhand and Uttar Pradesh, they together have total 277 districts.

3. The reproductive and child health index has been computed in this study, which gives an insight into the RCH status in these states. The index is based on seven parsimony variables i.e. (i) Above third order birth, (ii)

Percent of girls marrying before 18 years, (iii) Modern contraceptive prevalence rate, (iv) Percent of safe deliveries, (v) Percent of child having full immunization, (vi) Mother received above three antenatal care, and (vii) Infant Mortality rate.

4. Factor analysis has established the association between fertility, marriage age pattern, contraception use, reproductive health and child health care utilization, socio-economic profiles.

5. A district level analysis of EAG states reveals that out of these 277 districts, 19 districts (6.86%) are in the category of problematic RCH status and 109 districts (61.01%) belong to the category of progressive RCH status, while, remaining 89 districts (32.13 %) belongs to the category of dynamic RCH staus.

6. Moreover, among the districts of EAG states, districts of Uttar Pradesh have recorded very poor condition compare to that of other EAG states and two districts of Uttar Pradesh recorded very poor RCH status, these two districts are Bahraich and Balrampur.

7. There are several indicators which affect the RCH status in our country; the most important are literacy and schooling age, accessibility of health facility, quality health care, and media exposure in the society.

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Estimation of Irrigation Water Requirement for Paddy Cultivation in Parts of Hirakud Command Area, Orissa, Using RS & GIS Techniques

Narayan Chopra

In this study an attempt has been made to extract information on water demand for paddy at the distributary level. An estimation of Irrigation water requirement for paddy cultivation in the central part of the Hirakund Command Area towed by distributaries Babebira and Bugbuga with command area of 1662 ha and 1211 ha respectively was carried out using remote sensing & meteorological data in a GIS environment. The overall irrigation water requirement when considering an average irrigation application efficiency of 85% were estimated for Baberia Distributory & Bugbuga Distributory for the month of January, Feburary & March. Irrigation water requirement highly correlated with crop water requirement due to absence of monsoon during rabi season in the study area. The present study establishes the importance of Geospatial Technology in estimation of crop water requirement and irrigation water requirement.

Key Words: Reference evapotranspiration, Vegetation index, Crop Water Requirement, Irrigation Water Requirement, Crop coefficient

Introduction

With ever increasing population, limited land and water resources the demand for food crops is increasing with each passing year. For agricultural output to keep pace with the food demand, irrigation systems are quintessential to enhance crop productivity in order to meet future food needs and ensure food security. Developments in irrigation are often instrumental in achieving high rates of agricultural goals but proper water management must be given due weightage in order to effectively manage water resources (Pakhale et al., 2010). Better management of existing irrigated areas is required for growing the extra food to fulfill the demand of increasing population (Prasad et al., 1996).

Irrigation system water allocations are, most often, based on assumptions about the irrigated area, crop types, and the near-surface meteorological conditions that determine crop water requirements. Remote sensing is promising in monitoring agricultural and water management activities as both the spatial and

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temporal characteristics of a region can be easily accounted for by satellite imageries. Remote sensing, with varying degrees of accuracy, has been able to provide information on irrigated area, crop water requirements, etc. (Bastiaanssen et al. 2000). Remote sensing determinants like actual evapotranspiration (Reginato, R. et. al., 1985), soil water content (Huete, 1988; Qi et al., 1994; Gontia and Tiwari, 2004) , crop growth & vegetation indices (Ray and Dadhwal 2000; Gontia and Tiwari 2004; Mishra et al., 2005,) are in use to compute overall water utilization at a range of scale upon field level (Bastiaanssen and Bos, 1999).

Water demand for paddy rice depends upon growth stages, the so -called phenological stages. It is possible to extract crop phenological stages from satellite image (Ray and Dadhwal, 2001; Ray et al., 2002). Crop transpiration rate is low at early stages of growth and increases almost linearly (Tomar and O'Toole, 1980). Four phenological stages of crops can be distinguished: initial, crop development, mid season, late season (farmwest.com, 2004). In the present study, it is proposed to develop a model to estimate field level water demand from satellite images and meteorological data.

In order to be able to carry out this study, several assumptions had been made from the beginning. The main assumptions were 'crops in the field at the time of study are free from stress and disease', and 'the crop coefficients obtained from literature can be used effectively without much error'.

Study area

The study area comprises parts of Hirakud command, Orissa, India extending from 21 18' 27" N to 21 22' 27" N latitude and from 83 45' 05" E to 83 50' 02' E longitude (Fig.1). It comes under agro climatic zone no. 12 i.e. eastern plateau (Chhotanagpur) and Eastern Ghats, hot sub humid eco-region with red and laterite soils and Length of Growing Period 150-180 days (Mandal et al., 1999). In the entire Hirakud command area paddy is the predominant crop covering 95% of the total crop area (NRSA, 2004). Hirakud command

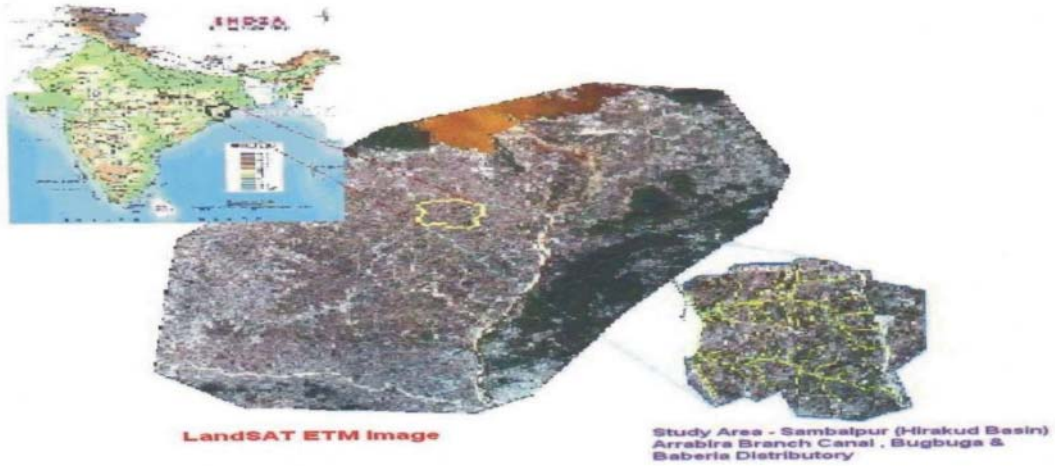

Fig. 1 : Location of study area

area has a culturable command area of 159106 ha. Source of irrigation of the command is Hirakud reservoir. A dam over Mahanadi river in Orissa was built up in 1957 having live storage capacity of 4823x 10 m and it provides irrigation potential of 159106 ha during kharif and 108385 ha during rabi season. In the central part of the command tow distributaries namely Babebira and Bugbuga distributary with command area of 1662 ha and 1211 ha respectively have been taken up for this study. In this study area, rice is the dominant crop covering 81 % of the total crop area.

Agriculture

There are two cropping season namely kharif from June to December and Rabi from Dec -Jan to May in practice. Culturable Command Area of Hirakud command area during Kharif is 159106 ha and during Rabi is 108385 ha. The major crops are paddy, Wheat, Pulses like Arhar, Mung and Biri, Oil-seeds like Groundnuts, Til and Mustard, and Sugarcane. Paddy is the most dominant crop. There are three varieties of rice namely early, normal and late. The crop period of rice varies according to varieties. It is 75 days for early rice paddy and 150 days for late rice paddy. The transplantation days are also spread over a month. For Rabi-paddy, it spreads from January 10 to February 10, January 20 being the peak period of transplanting.

Agricultural practices: paddy is the dominant crop in both Rabi and kharif season. Nearly 95% of the CCA is under paddy cultivation (NRSA. 2004).

Crop calendar: The agriculture year of the command begins from July and ends in next June. The crop calendar provides information about cultivation of various crops in a year, two principal cropping seasons Rabi and kharif

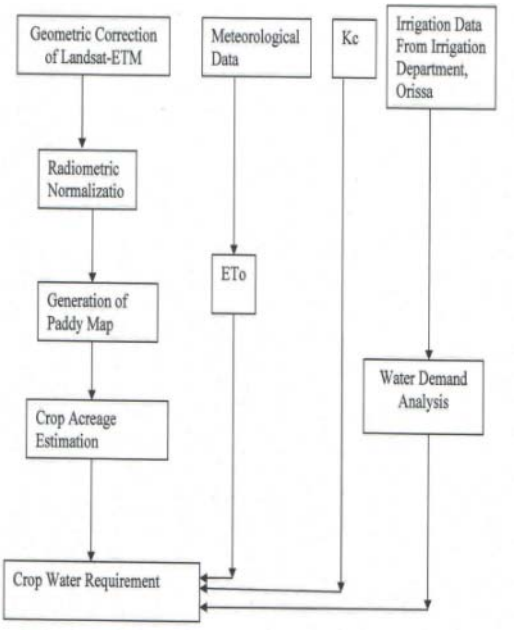

Fig.2 : Flow Chart Showing Methodological Steps Follwed

prevailed in most of the command. Rabi crops also known as winter crops are grown from December to May. Kharif crop also known as summer crops are grown from July to December.

Crop period: The period from the instant of sowing to the instant of its harvesting is called crop period. Crop period of Rabi paddy varies from 110 days to 130 days in Hirakud command.

Cropping pattern: The cropping pattern practised in the study area is Rice - Rice -Rice during Kharif, Rice - Mung - Rice during winter. Other crops grows in the command area are pulses, vegetables, oilseeds and sugarcane,

Data Sets & Methodology

Multi-temporal Landsat ETM satellite images available for the rabi crop period 2001

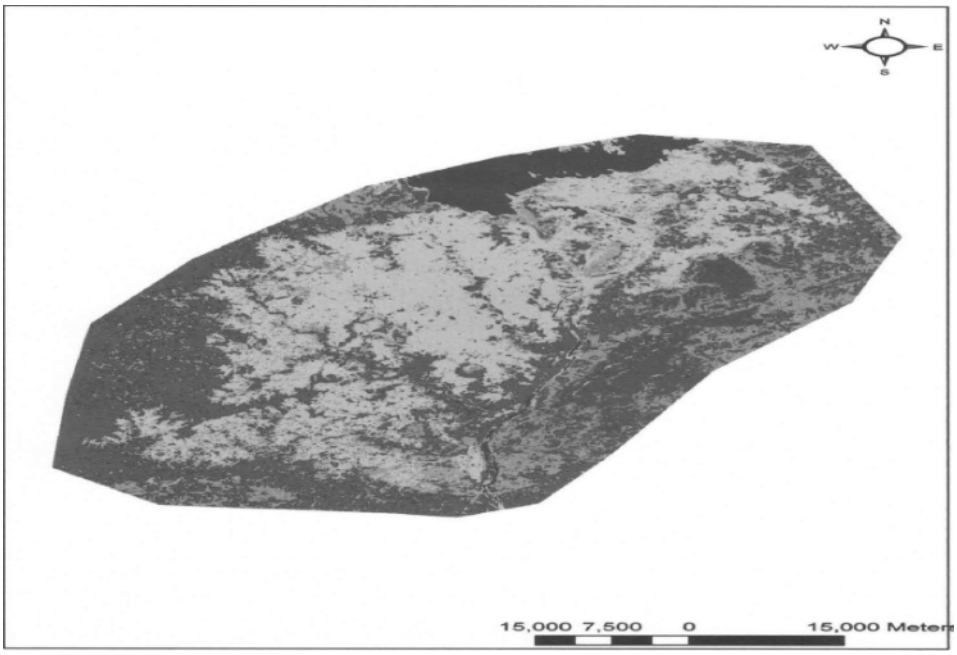

Fig. 3 : Unsupervised classification

-2002 was selected for the study. Agriculture data has been collected from Agriculture Department Government of Orissa for the study period (December 2001 to May 2002). Meteorological data has been collected from IMD station Sambalpur and Chiplima observatory of Orissa University of Agriculture and Technology (on daily basis for the study period). Irrigation Data has been collected from Water Resources Department, Govt. of Orissa (Fig.2).

Result & Discussion

Land use/Land cover analysis was undertaken using unsupervised classification (Fig.3). Four major Land use classes were identified. These are shown in different colours.

Water Body- Deep Blue; Forest – Green; Irrigated Paddy Field – Cyan;

Dry Agricultural Field – Brown.

Computation of NDVI from satellite image:

Normalised difference vegetation index (NDVI) suggested by Tucker (1979) was used to estimate vegetation cover. Its value ranges - 1.0 to 1.0

$$\frac{NIR - R}{NIR + R} = NDVI \text{——(1)}$$

where R and NIR are reflectance in red and near - infrared wave length regions.

Generally, NDVI values for vegetation, water, and bare soil are > 0.1, <0 and 0 to 0.1, respectively. Here, maximum NDVI value computed was 0.404, whereas minimum is -0.218. Therefore, most of this study area falls under vegetation condition, as the NDVI value is >0.1. From ground truth analysis also it is conformed that this study area consists of most of the rice crop cultivation. Table1 show different NDVI values generated for only one

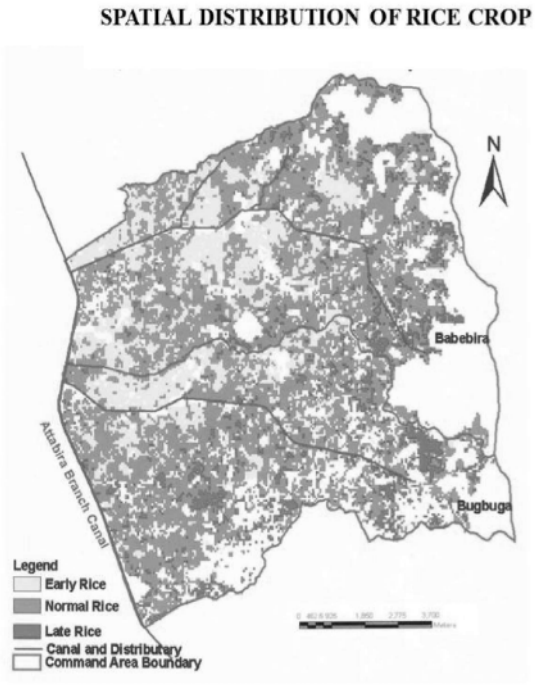

Fig. 4

land class i.e. Rabi (rice) crop which were obtained by clipping Rabi crop areas from base map. According to the signature, pattern and color of NDVI image and ground truth and observation, range of NDVI values has been selected for each of the stages of growth of rice namely early, normal & late, and finally map showing spatial distribution of various phenological stages of rice was generated (Fig. 4).

Computation of reference Evapotranspiration ETo

From CROPWAT Software monthly evapotranspiration (mm/day) was calculated. The input values which were used for the calculation are maximum and minimum temperatures, relative humidity, wind speed, sunshine hours, elevation and latitude longitude of the study area. The meteorological data of Chipilima was used to compute evapotranspiration. It is nearest to the study area among three meteorological stations situated in the entire command area. The non-availability of wind data of Chipilima observatory is overcome by using the data of other nearer

observatory, Sambalpur. The evapotranspiration for different months of the study area were calculated. The computed rd maximum ETo was 5.00 mm/day during the month of March and minimum was 2.53 mm/day during January.

Computation of Water Demand

The computation of water demand at distributary level has been done. The interval duration has been considered as 30 days. Crop water requirement of rice crop is computed for early, normal and late transplanted rice computed 10 days basis.

Steps to calculate crop water requirement:

1. Crossing of Block Map and Crop Map for calculating the area of paddy crop for each block.

2. Linking of crossed map with Kc table to introduce column Kc Harvest in the crossed table.

3. Multiplication of area of crop per block with KC harvest for calculating the crop water requirement per crop per block.

4. Crop water requirement, Irrigation water requirement, Irrigation Water supply were calculated using the formulae

Crop water requirement (cubic meter/ 30 days)

= ET0 x Kc Harvest x Area x 30/1000

Irrigation Water Requirement (cubic

Table 1 : NDVI Vs Crop Acreage

SN	NDVI	Crop Area in Ha	SN	NDVI	Crop Area in Ha	SN	NDVI	Crop Area in Ha
1	0. 202	63.599	19	0.269	4.792	37	0.336	0.731
2	0. 206	32.977	20	0.273	3.980	38	0.340	0.406
3	0. 210	31.759	21	0.277	3.980	39	0.344	0.487
4	0. 213	39.394	22	0.280	4.305	40	0.348	0.325
5	0. 217	25.992	23	0.284	2.924	41	0.351	0.406
6	0. 221	27.535	24	0.288	2.518	42	0.355	0.081
7	0. 224	27.454	25	0.292	2.680	43	0.359	0.162
8	0. 228	23.880	26	0.295	1.706	44	0.363	0.244
9	0. 232	17.788	27	0.299	2.843	45	0.366	0.081
10	0. 236	15.758	28	0.303	1.056	46	0.370	0.325
11	0. 239	15.595	29	0.307	1.218	47	0.374	0.081
12	0. 243	15.189	30	0.310	1.381	48	0.378	0.000
13	0. 247	11.128	31	0.314	1.300	49	0.381	0.081
14	0. 251	8.447	32	0.318	0.650	50	0.385	0.081
15	0. 254	8.935	33	0.322	0.569	51	0.389	0.000
16	0 .258	9.828	34	0.325	0.406	52	0.392	0.000
17	0. 262	7.716	35	0.329	0.569	53	0.396	0.000
18	0 . 266	6.823	36	0.333	0.569	54	0.400	0.081
						55	0.404	0.081

meter/30 days) = CWR / Irrigation Efficiency (85 %)

Irrigation Water Supply (LPS) = IWR x 1000/ (24 x 3600)

Rice crop coefficients

Values of rice crop coefficients for different growth stages are collected from the literature (Fig. 5). The crop coefficients suggested by Tyagi et al .(2000) for crop growth stages are taken into consideration for each of the stages of growth of rice namely early, normal & late.

Crop Water Requirement

In the month of January the crop water requirement for 30 days were estimated for Baberia Distributory having area 1658 Ha (Table 2). The total crop water requirement was estimated as 1448052.51cum/day and the irrigation water supply for 30 days was 695.79cusec. Similarly the crop water requirement for Bugbuga Distributory having area of 1107.96 Ha was estimated as 967079.01cum/day and irrigation water supply for 30 day was 464.68 cusec (Table 2).

Similarly the crop water requirement for 30 days were estimated for Baberia Distributory in the month of February also. The total crop water requirement was estimated as 238457.60 cum/day and the

Table 2 : Irrigation Water Requirement - In Hirakud Command Area

Month - January Kch 1.15 Eto 2.53 Efficiency 85

Sr No	Block	Crop	Perimeter Mtr	Area Sqm	Area Ha	Kch	ETo mm/day	CWR30 cum/day	IWR30 cum/day	IWS30 LPS	IWS30 Cusec
1.	1.	Paddy	6846.33	1837811.00	183.78	1.15	2.53	160413.33	188721.57	2184.28	77.08
2	2	Paddy	6977.20	1590459.68	159.05	1.15	2.53	138823.27	163321.50	1890.30	66.70
3	3	Paddy	7199.48	2156385.58	215.64	1.15	2.53	188220.12	221435.43	2562.91	90.44
4	4	Paddy	7810.69	1474821.73	147.48	1.15	2.53	128729.81	151446.84	1752.86	61.85
5	5	Paddy	13665.39	4932951.31	493.30	1.15	2.53	430572.66	506556.07	5862.92	206.89
6	8	Paddy	8643.02	2406920.70	240.69	1.15	2.53	210088.07	247162.44	2860.68	100.95
7	9	Paddy	8185	2190585.39	219.06	1.15	2.53	191205.25	224947.35	2603.56	91.87
	Baberia Distributary			**16589935.39**	**1658.99**			**1448052.51**	**1703591.19**	**19717.49**	**695.79**
8	6	Paddy	13474.20	5296050.32	529.61	1.15	2.53	462265.75	543842.06	6294.47	222.12
9	7	Paddy	9682.75	3779851.11	377.99	1.15	2.53	329924.30	388146.24	4492.43	158.53
10	10	Paddy	7027.81	2003654.19	200.37	1.15	2.53	174888.96	205751.71	2381.39	84.03
	Bugbuga Distributary			**11079555.63**	**1107.96**			**967079.01**	**1137740.02**	**13168.29**	**464.68**

C=Area*Kch*Eto*30/1000 X Y = X*1000/(24*36OO) Z = Y*(3.28) 3/1000

Table 3 : Irrigation Water Requirement - In Hirakud Command Area

Month- February Kch 1.23 Eto 3.9 Efficiency 85

Sr No	Block	Crop	Perimeter Mtr	Area Sqm	Area Ha	Kch	ETo mm/day	CWR30 cum/day	IWR30 cum/day	IWS30 LPS	IWS30 Cusec
1.	1.	Paddy	6846.33	1837811.00	183.78	1.23	3.9	264479.38	311152.21	3601.30	127.08
2	2	Paddy	6977.20	1590459.68	159.05	1.23	3.9	228883.05	269274.18	3116.60	109.98
3	3	Paddy	7199.48	2156385.58	215.64	1.23	3.9	310325.45	365088.76	4225.56	149.11
4	4	Paddy	7810.69	1474821.73	147.48	1.23	3.9	212241.59	249695.99	2890.00	101.98
5	5	Paddy	13665.39	4932951.31	493.30	1.23	3.9	709901.02	835177.67	9666.41	341.11
6	8	Paddy	8643.02	2406920.70	240.69	1.23	3.9	346379.96	407505.83	4716.50	166.44
7	9	Paddy	8185.03	2190585.39	219.06	1.23	3.9	315247.14	370878.99	4292.58	151.48
	Baberia Distributary			**16589935.39**	**1658.99**			**2387457.60**	**2808773.65**	**32508.95**	**1147.18**
8	6	Paddy	13474.20	5296050.32	529.61	1.23	3.9	762154.60	896652.47	10377.92	366.22
9	7	Paddy	9682.75	3779851.11	377.99	123	3.9	543958.37	639951.03	7406.84	261.37
10	10	Paddy	7027.81	2003654.19	200.37	123	3.9	288345.87	339230.44	3926.28	138.55
	Bugbuga Distributary			**11079555.63**	**1107.96**			**1594458.85**	**1875833.94**	**21711.04**	**766.14**

C=Area*Kch*Eto*30/1000 X Y = X*1000/(24*36OO) Z = Y*(3.28) 3/1000

Table 4 : Irrigation Water Requirement- In Hirakud Command Area

Month - March Kch 1.14 Eto= 5 Efficiency= 85

Sr No	Block	Crop	Perimeter Mtr	Area Sqm	Area Ha	Kch	ETo mm/day	CWR30 cum/day	IWR30 cum/day	IWS30 LPS	IWS30 Cusec
1.	1.	Paddy	6846.33	1837811.00	183.78	1.14	5	314265.68	369724.33	4279.22	151.01
2	2	Paddy	6977.20	1590459.68	159.05	1.14	5	271968.60	319963.06	3703.28	130.68
3	3	Paddy	7199.48	2156385.58	215.64	1.14	5	368741.93	433814.04	5021.00	177.18
4	4	Paddy	7810.69	1474821.73	147.48	1.14	5	252194.52	296699.43	3434.02	121.18
5	5	Paddy	13665.39	4932951.31	493.30	1.14	5	843534.67	992393.74	11486.04	405.32
6	8	Paddy	8643.02	2406920.70	240.69	1.14	5	411583.44	484215.81	5604.35	197.77
7	9	Paddy	8185.03	2190585.39	219.06	1.14	5	374590.10	440694.24	5100.63	179.99
	Baberia Distributary			**16589935.39**	**1658.99**			**2836878.95**	**3337504.65**	**38628.53**	**1363.12**
8	6	Paddy	13474.20	5296050.32	529.61	1.14	5	905624.61	1065440.71	12331.49	435.15
9	7	Paddy	9682.75	3779851.11	377.99	1.14	5	646354.54	760417.11	8801.12	310.57
10	10	Paddy	7027.81	2003654.19	200.37	1.14	5	342624.87	403088.08	4665.37	164.63
	Bugbuga Distributary			**11079555.63**	**1107.96**			**1894604.01**	**2228945.90**	**25797.98**	**910.36**

C=Area*Kch*Eto*30/1000 X Y = X*1000/(24*36OO) Z = Y*(3.28) 3/1000

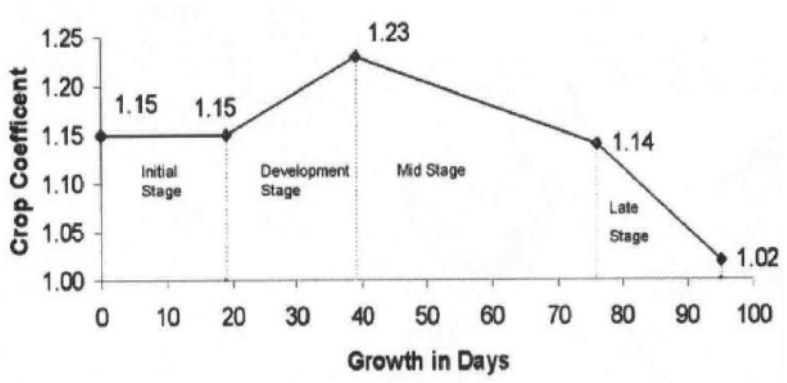

Fig. 5 : Crop Coefficient

irrigation water supply for 30 days was 1147.18cusec. The crop water requirement for Bugbuga Distributory was estimated as 1594458.85 cum/day and irrigation water supply for 30 days was 766.124 cusec (Table 3).

In the month of March the crop water requirement for 30 days were estimated for Baberia Distributory. The total crop water requirement was estimated as 2836878.95 cum/day and the irrigation water supply for 30 days was 1363.12cusec. The crop water requirement for Bugbuga Distributory was estimated as 1894604.01 cum/day and irrigation water supply for 30 days was 910.36 cusec (Table 4) .

Conclusion

After perusal of the data supplied by the Irrigation department for discharge of water in Bugbuga and Baberia distributory, it is concluded that in this command area more water should be supplied and discharged by the departmental authorities. It was found that irrigation water requirement highly correlated with crop water requirement due to absence of monsoon during rabi season in the study area. The present study proves that Remote Sensing and GIS integrated approach are useful for estimation of crop water requirement and irrigation water requirement.

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Spatial Analysis of Micro Regional Disparities in Level of Development: A Case Study of Saharsa District, Bihar

Nitin Kumar Mishra and M. B. Singh

The process of development is initiated with a change in the economic activities or structure of economy. The socio-economic change does not occur uniformly in different areas. This leads to regional disparities that are caused by a number of factors such as resources, infrastructures, services, skills, capital, government policies etc. On account of regional disparities several economic, social and structural problems take place in concerned area which needs launching of corrective policy measures. The present paper aims to analyse the imbalances in the level of development with spatial emphasis on the regional dimension. In order to analyze the regional disparities of ten blocks of the Saharsa district, twenty four variables have been selected and by using the Development Index (Z-Score Method) regional disparities have been assessed. In the analysis it has been found that Patarghat block attained the top position in overall development while the blocks namely Mahishi and Salkhua gained low level of development.

Keywords: Regional Disparities, Socio-Economic Development, Z-Score, Composite Standard Score, Correlation Matrix

Introduction

The process of development occurs due to a change in socio-economic activities that take place in a geographical space. In order to achieve balanced development every government makes the policies and programmes for proper allocation of amenities and facilities. In deed in true sense the facilities do not locate according to the plan in an organized manner. Owing to the presence of physico-cultural and socio-economic diversities as well as political constraint, the socio-economic facilities are distributed unequally leading to differential levels of development across the areas. Such unchecked and uncontrolled process of growth leads to regional disparities (Rao, 1984). Therefore it fails to extend its fruits of benefits equally to every parts of the region rather widens the gap of existing disparities and inequalities among the people.

After independence the centralized planning was implemented for eliminating regional inequality, but it remained a serious problem in India. Regional disparities in India have widened day by day (Joshi, 1997; Krishna,

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2001; Singh, 2006). Regional differences are to a large extent built in due to the large unequal natural resource endowment and lack of infrastructural facilities which form the basis for rapid economic growth (Krishnaiah, et al. 1998). Broadly, three factors i.e, historical, natural and man-made do attribute to the problems of regional disparities. The regions owing rich natural resources-fertile soil, water, minerals etc. enjoy better advantage for development. Besides, social, political and economic factors also create regional disparities in the nation.

Regional disparity in overall development is a common phenomenon in both developed and developing countries. But magnitude of disparity differs from country to country. In India, notable disparities in the socio-economic and cultural development are found at inter and intra region both. Although the government has made many serious efforts to reduce the regional disparities yet the present trend of economic development has not yielded positive result in this direction, rather it has widened the gap at every level. The reason may be attributed to the improper planning for development. The basic problems lie in our National Planning because before implementation of any plan it does not assess the nature of problems and productive potential resources of the concerned region at micro level.

The socio-economic facilities play significant role in the process of development of any area. They improve the social condition of the people of the area. This type of study is of utmost importance for developing countries like India as every section of the society and economy is influenced by these facilities. The study enables the development of agriculture by enhancing the use of new technology and the expansion of facilities like irrigation, education, health, and means of communication, electricity and capital generation. Assessment of the status of development at block level helps in identifying the position of the given block in relation to other. The study evinces the relationship of socio-economic development with the development in agriculture, industry and infrastructural facilities of different blocks of the district. The Green Revolution in agriculture sector and remarkable progress in industrial sector have certainly increased the overall total production, but there is no indication that these achievements have been able to reduce the regional inequalities in the level of development substantially. In spite of resource transfer in backward areas of the country, the regional disparities in terms of socio-economic development are not declining over time.

In view of the above noted facts, the present research work has been undertaken to evaluate the micro level regional disparities in Saharsa district at block level. The study also identifies the operational areas for different development programmes likely to be launched in order to overcome the problem of backwardness in this district.

Study Area

The Saharsa district is one of the thirty eight districts of Bihar and lies in the northern part. Saharsa is known for its Pan, Makhana and flood affected part of the river Kosi. The district lies between 25°35' to 26°4' North latitudes and 86°18' to 86°52' East longitudes. As per 2011 census, the study area is inhabited by 1,900,661 population spreading over 1,687 sq.km area. Saharsa district is divided into two sub-divisions and ten community development

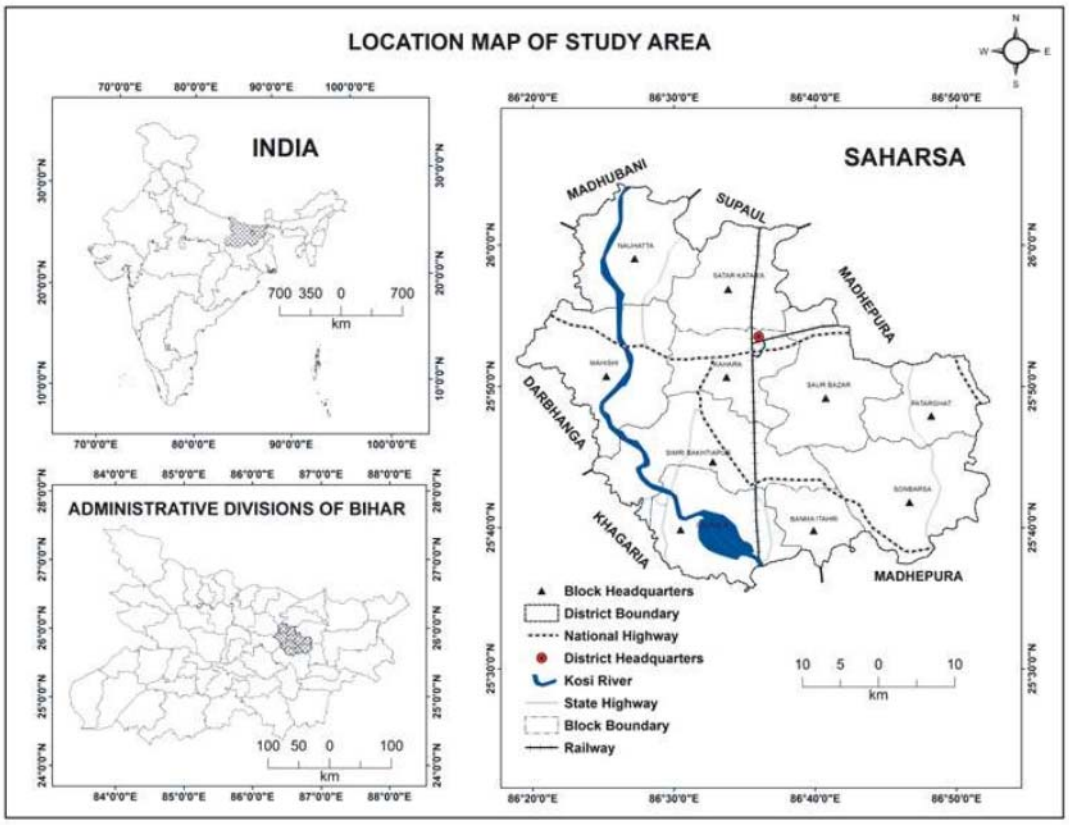

Fig. 1

blocks. About 95 percent population of the district depends upon the agriculture. Saharsa ranks 27th in terms of population (19, 00,661) and 31st in terms of area (1,687 sq.km.) in the state of Bihar. In terms of population density Saharsa ranks the 18th densely populated district in the state with 1,127 persons per sq.km as against the state's density of 1,106. In terms of sex-ratio (906) Saharsa comes on 27th position against the state's 918. Saharsa holds 21st position in terms of child sex-ratio (933) against state's 935. There are 23 uninhabited villages (out of 468 total villages) in the district of Saharsa.

Objectives

The main objectives of this study are as follows:

(i). To examine the level of micro-regional disparities in the level of socio-economic, infrastructural, agricultural and industrial development of Saharsa district.

(ii). To identify the socio-economically backward areas and categorise them into various levels of development.

(iii). To measure the extent of overall inter-region disparities in Saharsa district and finally find out the relationship between different factors which lead them to

development.

(iv). To suggest some policies for balanced regional development.

Data Base and Methodology

The present study is exclusively based on secondary data collected from the census of India, supplemented with information collected from Primary Census Abstract of Bihar (2011), District Census Handbook, Agriculture Report and District Gazetteer of Saharsa district. For this study all the indicators of regional development of the blocks of Saharsa district have been analyzed with the help of Z-Score technique as given below:

$$Zij = \frac{Xi - \bar{X}}{SD}$$

Where,

Zij = Standard score of the i^{th} observation

Xi = Original value of the observation

$\bar{X}$= Mean for all the value of x

SD = Standard Deviation

Further composite standard score has been computed to show the regional disparities in the levels of development of the blocks by using the following formula:

$$CSS = \frac{\sum Zij}{N}$$

Where,

CSS = Composite Standard Score

Zij = Z-Score of an indicator j of blocks i

N = Total no. of indicators

Mean and standard deviation method has been used for dividing the blocks into three categories i.e. high, medium and low based on the different levels of development.

High = Above (Mean + SD)

Low = Below (Mean – SD)

Medium = Between (Mean + SD to Mean – SD)

Finally coefficient of correlation has been calculated for analyzing the relationship among socio-economic, infrastructural, agricultural and industrial development with each other. Cartographic presentation of regional generalization has been made by using Arc GIS (Version 10.2) software.

Variables of Levels of Development

An attempt at reducing regional disparities must be carried out by proper measurement of the extent of disparities. This study conceptualizes regional development in terms of availability of various kinds of opportunities across the following sectors, i.e. socio-economic, infrastructural, agricultural and industrial sectors that play an important role in the process of development. There are several variables for measuring the regional disparities. In the present study 24 variables have been used to measure the regional disparities in the level of development in Saharsa district. These variables are broadly divided into four groups.

List of Selected Variables

Socio-Economic Development

X_1 Population Density

X_2 Percentage of decadal population growth rate

X_3 sex ratio

X_4 Percentage of literates to total population

X_5 Work participation rate

X_6 Percentage of non agriculture workers

X_7 No. of primary & middle schools

X_8 No. of Secondary & Senior Secondary Schools

X_9 No. of Primary Health Centres & Sub Centres

X_{10} No. of Maternity and child welfare centres

X_{11} No. of Family welfare centres

Infrastructural Development

X_{12} Percentage of villages connected with transports & communication facility to total villages

X_{13} Percentage of villages having bank facility to total villages

X_{14} Percentage of villages having agriculture credit societies to total villages

X_{15} Percentage of villages connected by pucca road to total villages

X_{16} Percentage of villages having power supply to total villages

Agricultural Development

X_{17} Cultivator Labourers to total workers

X_{18} Agricultural Labourers to total workers

X_{19} Percentage of total irrigated area to reporting area

X_{20} Percentage of Net Sown Area to total reporting area

X_{21} Percentage of cultivable area to total area

X_{22} Percentage of irrigated area to total cultivable area

Industrial Development

X_{23} No. of registered industries

X_{24} Percentage of household industry workers to total workers

Analysis and Discussion

In order to eliminate or minimize the disparities and formulation of developmental plans, the identification of backward blocks stands as prime concern. The blocks that are highly developed in terms of social, economic and demographic factors can also show significant growth and development in terms of optimum land use and agricultural efficiency (Joshi and Dube, 1979).

Disparities in the Level of Socio-Economic Development

Socio-economic disparities have many causes ranging from historical to present status in literacy, population density, work participation rate, sex ratio, non-agriculture workers, number of various schools and health services and other such amenities. Based on the combined index of 11 variables, the level of socio-economic development has been calculated. The pattern of spatial distribution accentuates inter-block disparities in socio-economic development in Saharsa district (Fig. 2). The composite index of all selected variables of socio-economic sector has presented an overall scenario of inter-block disparity and socio-economic development in the district. In order to explain the prevalent inter block disparities in socio-economic development, the blocks of study area have been divided into three categories.

Highly Developed Area

The highly developed area consists of two blocks namely Nauhatta (0.46) and Simri

Table 1: Levels of Socio-Economic Development, 2011

Category	Range	Name of the Blocks
High	> 0.35	Simri Bakhtiarpur, Nauhatta
Medium	0.35 to – 0.35	Sonbarsa, Kahara, Saur Bazar, Patarghat, Satar Kataiya, Mahishi
Low	< - 0.35	Banma Itahri, Salkhua

Source: Computed by Authors

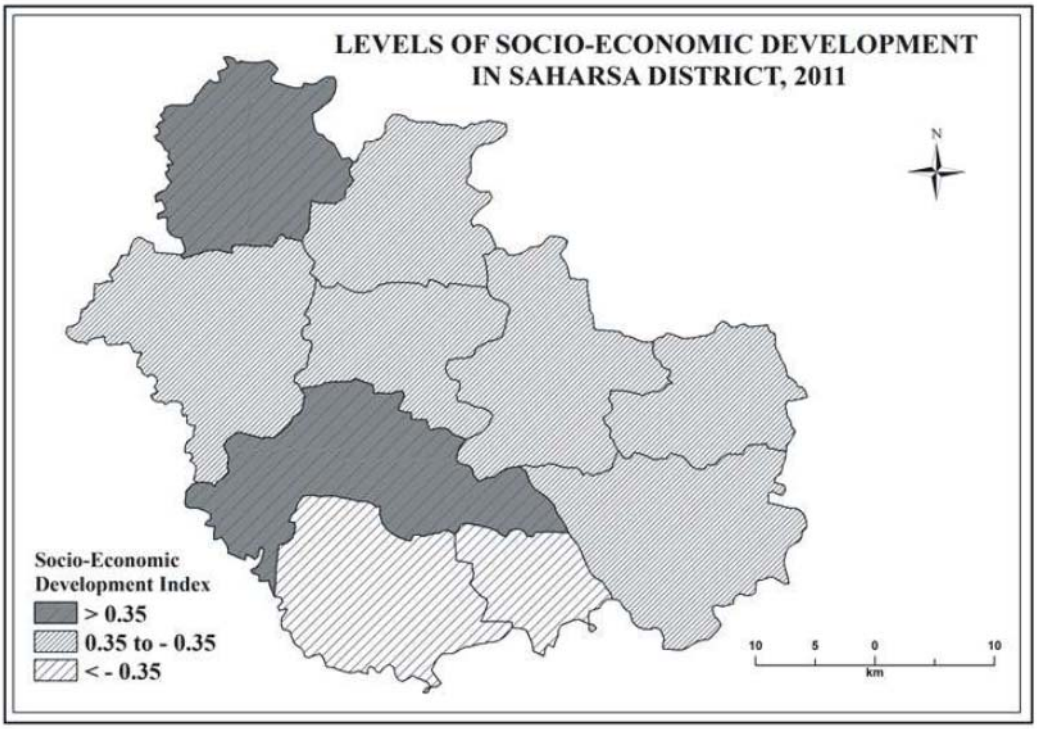

Fig.2

Bakhtiarpur (0.54). Number of primary schools, senior secondary schools, maternity and child welfare centres etc. are available abundantly in both the blocks. Most of the villages falling under these blocks are characterised by high percentage of literacy, work participation rate and adequate number of persons engaged in non-agricultural activities.

Moderately Developed Area

This category having the range score of 0.35 to – 0.35 includes Satar Kataiya, Mahishi, Kahara, Saur Bazar, Patarghat and Sonbarsa blocks. These blocks are endowed with moderate availability of amenities such as primary and secondary schools, sex ratio, population density, family welfare centres and work participation rate etc. The score of many indicators is of poor order.

Less Developed Area

This category encompassing two blocks namely Salkhua and Banma Itahri has less than – 0.35 score. The score of many indicators has been found of poorest order. The development is less due to small number of higher secondary and senior secondary schools. The health facilities are also less in numbers. Fig. 2 shows the disparities in the level of socio-economic development.

Disparities in Level of Infrastructural Development

Availability of infrastructural facilities is very important for socio-economic

Table-2: Levels of Infrastructural Development, 2011

Category	Range	Name of the Blocks
High	> 0.95	Patarghat
Medium	0.95 to – 0.95	Simri Bakhtiarpur, Nauhatta, Sonbarsa, Kahara, Saur Bazar, Satar Kataiya, Banma Itahri, Salkhua
Low	< - 0.95	Mahishi

Source: Computed by Authors

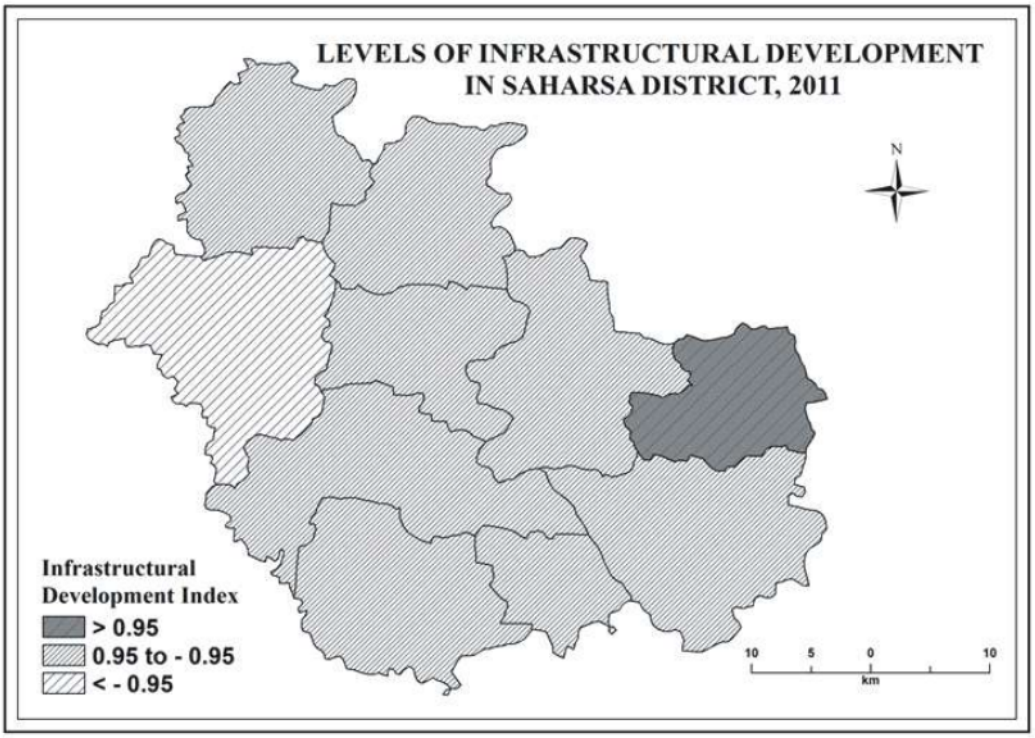

Fig.3

development. This facility includes bank, transport & communication, agriculture credit societies, approach by pucca road and power supply facility etc. The pattern of spatial distribution of such development range brings out the overall inter-blocks disparities in the level of infrastructural development (Fig. 3).

The infrastructural development varies considerably in different blocks of Saharsa district. A composite index of all indicators of infrastructural sectors shows the developmental disparity at the block level. In order to explain the existing inter-block infrastructural disparities, the district based on the combined index of 5 indicators has been divided into three following levels of disparities:

Highly Developed Area

Highly developed area consists of only one block that is Patarghat (1.86). This block

Table-3: Levels of Agricultural Development, 2011

Category	Range	Name of the Blocks
High	> 0.65	Satar Kataiya, Patarghat, Banma Itahri
Medium	0.65 to – 0.65	Simri Bakhtiarpur, Nauhatta, Sonbarsa, Saur Bazar, Salkhua
Low	< - 0.65	Kahara, Mahishi

Source: Computed by Authors

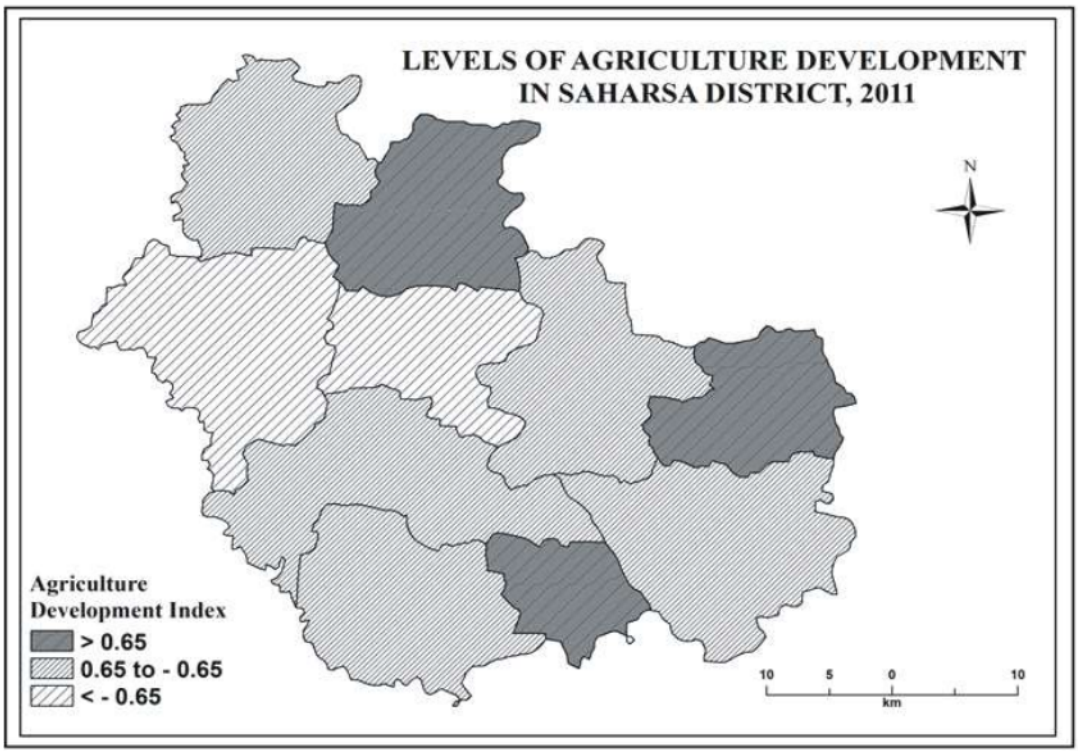

Fig.4

has better connectivity with the adjoining district namely Madhepura as well as different blocks of the existing district. This block is well endowed with these variables such as transport & communication facility, agriculture credit societies, approach by pucca road and power supply facility and they helped the above mentioned block to figure in highly developed area in the district in terms of infrastructural development.

Moderately Developed Area

The developmental blocks having range between 0.95 to – 0.95 are grouped as moderately developed area. Nauhatta, Satar Kataiya, Kahara, Saur Bazar, Simri Bakhtiarpur, Sonbarsa, Banma Itahri and Salkhua blocks come under this category. These blocks have moderate level of transport & communication, bank and percentage of village having power

supply facility etc.

Less Developed Area

In this category only Mahishi block falls. On account of poor infrastructural facilities Mahishi figured in low developed area. Fig.3 shows the disparities in the level of infrastructural development in the district.

Disparities in Level of Agriculture Development

Agriculture is backbone of Indian economy. The agriculture development is also an important criterion in order to gauge the level of development. Agriculture is the prime source of food, raw materials for agro-based industries as well as mode of employment for the rural people. It plays very important role for economic development of any area. The study area exhibits inter-block disparities in the level of agriculture development. The district has been divided into three categories, highly developed, moderate and less developed blocks, based on combined index of 6 indicators. The pattern of spatial distribution shows overall inter-block disparities in agricultural development (Fig.4).

Highly Developed Area

Highly developed area consists of three blocks namely Satar Kataiya, Patarghat and Banana Itahri. The developed area is characterized by higher number of cultivators, agriculture labourers and high percentage of total irrigated area to reporting area etc.

Moderately Developed Area

Five blocks namely Nauhatta, Saur Bazar, Simri Bakhtiarpur, Salkhua and Sonbarsa come under this category. These blocks have moderate percentage of net sown area; percentage of cultivated area to total area and percentage of irrigated area to cultivated area which resulted into moderate level of development in the these blocks.

Less Developed Area

Less developed category with index value below - 0.65 consists of only two blocks namely Mahishi and Kahara. The index value in this category is least due to poor level of indicators including moderate percentage of net sown area; percentage of cultivated area to total area etc. On the basis of foregoing discussion it can be concluded that there is high disparity in agriculture development in the district. Fig.4 shows the disparity in the level of agriculture development among the blocks.

Disparities in Level of Industrial Development

Industries play a crucial role in the economic development and for providing employment. Regional disparities in the level of industrial development have been examined on the basis of two variables namely the total number of registered industries and percentage of household industry workers to total workers. In order to explain the existing inter-block industrial disparities the district has been divided into the following three levels of disparities.

Highly Developed Area

The blocks having high level of industrial development (above 0.75) comes under highly developed area. Kahara is the only block falling in this group. Maximum number of registered industries, good connectivity by means of transportation and highest percentage of household industry workers attributed to the high level of industrial development in this block.

Moderately Developed Area

Medium level of industrial development

Table 4 : Levels of Industrial Development, 2011

Category	Range	Name of the Blocks
High	> 0.75	Kahara
Medium	0.75 to – 0.75	Mahishi, Simri Bakhtiarpur, Nauhatta, Sonbarsa, Saur Bazar, Salkhua, Satar Kataiya
Low	< - 0.75	Banma Itahri, Patarghat

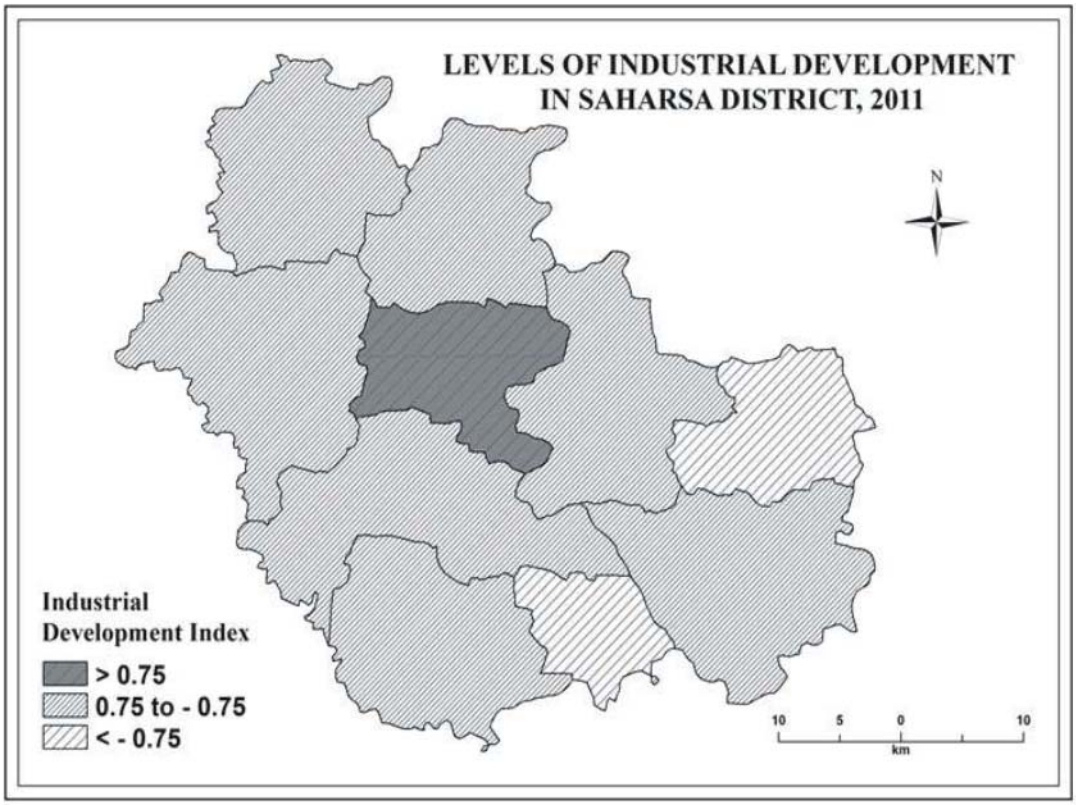

Fig. 5

(0.75 to – 0.75) has been observed in blocks of Nauhatta and Satar Kataiya in northern part, Mahishi in western part, Saur Bazar in eastern part and Simri Bakhtiarpur, Salkhua and Sonbarsa in southern part of the district. These bocks are spread all over the district and near to district headquarters.

Less Developed Area

The blocks characterised by low level of industrial development (below – 0.35) are Banma Itahri and Patarghat. Low level area lies in southern and south-eastern part of the study area. Low level of development may be attributed to the less participation of household

Table-5: Levels of Overall Development, 2011

Category	Range	Name of the Blocks
High	> 7.00	Patarghat
Medium	7.00 to – 7.00	Simri Bakhtiarpur, Nauhatta, Sonbarsa, Saur Bazar, Satar Kataiya, Kahara, Banma Itahri
Low	< - 7.00	Salkhua, Mahishi

Source: Computed by Authors

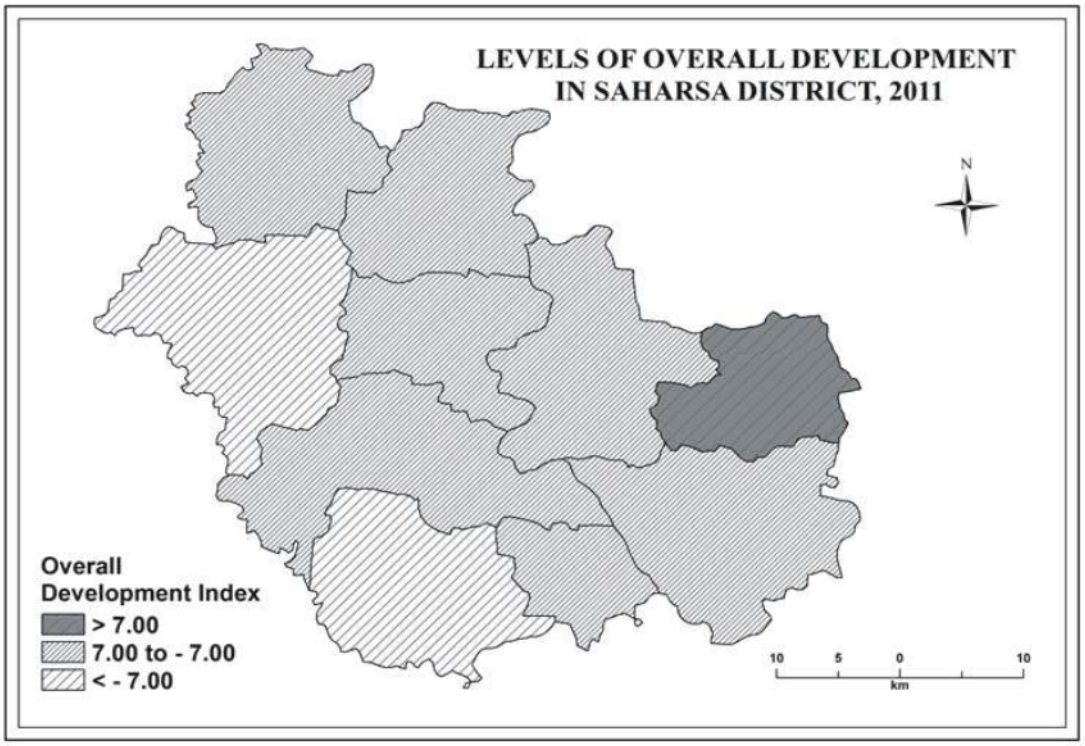

Fig. 6

workers and minimum number of registered industry in the area.

Composite Level of Disparities in Overall Development

To evaluate and assess the overall development all concerned variables have been clubbed together to find out the composite index for over all development. The spatial distribution of overall development is more comprehensive because it is assessed on the basis of development index of 24 variables (i.e. X_1, X_2 … X_{24}) and the index of overall development of each block of the district has been estimated. Blocks of the district on the basis of their development index have been grouped into three levels of overall development.

The analysis of sectoral development

in the preceding sections brought out the fact that by itself each sector does not have only one dimension of development across different blocks. Some blocks have high level of social-economic development whereas the others are well placed in infrastructural terms, while agriculture development altogether show different results. The preceding analysis of four sectors consisting of 24 variables need to be further analyzed, to find out whether there are any inter linkages among them and reflecting a definite pattern of overall development.

The district based on the composite index of 24 variables is divided into three categories, highly developed, moderately and less developed blocks. The patterns of spatial distribution of such range show inter block disparities in the level of overall development. The composite indexes of all the selected variables of socio-economic, infrastructural, agricultural and industrial dimension present overall scenario of inter block disparity in the level of development. The broad categories of developmental disparities have been shown in Fig. 6.

Highly Developed Area

The highly developed area consists of only one block that is Patarghat (8.72). This block has good transportation connectivity and is bestowed with the amenities like good number of schools, post offices, banking facilities, electricity facility, high density of population, length of roads, health facilities etc. All these indicators helped the above mentioned block to occupy the position of highly developed block in the district.

Moderately Developed Area

The seven blocks namely Nauhatta, Satar Kataiya, Kahara, Saur Bazar, Simri Bakhtiarpur, Banma Itahri and Sonbarsa with the index range of 7.00 to – 7.00 come under this category. The moderate distribution of various socio-economic indicators such as number of primary health centres, higher secondary schools, source of irrigation, total road length, electricity, means of transportation and communication facility etc. pushed more than half of the total blocks for coming in the moderately developed area in the district. This region stretches over northern, eastern and south eastern part of the study area.

Less Developed Area

The blocks possessing score below – 7.00 have been placed in less developed area (Fig.6). There are only two blocks namely Mahishi (-13.15) and Salkhua (- 10.34) which fall in this category. These blocks are basically spread over western and south western part of the study area which is worst affected by Kosi flood and as a result these blocks are less developed. In spite of this reason, other reasons responsible for low development are mainly related to less number of higher educational facilities, lack of communication and transport facilities, medical facility, less credit societies, commercial banks and power supply facilities that attributed to the low level of overall development. Besides, due to political biasness, the transfer of government funds and improper execution regarding local problems, people's demands as well as requirements for development are not being addressed at grass root level. That is why Mahishi and Salkhua blocks lag behind than other blocks in the study area.

Correlation Matrix of Major Developmental Variables

Correlation table indicates that socio-

Table 6 : Z-Score and Composite Index of overall Variables

Name of Block	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24	Composite Index
Nauhatta	-0.66	-1.30	1.62	-0.17	1.98	-0.08	1.88	-0.62	2.60	-0.42	-0.35	0.36	-0.01	0.74	-1.96	-1.26	-0.64	0.59	-0.37	-0.03	-0.05	-0.40	-0.44	1.42	2.42
Satar Kataiya	-0.27	-1.23	-0.41	0.05	0.10	-0.06	-0.57	2.47	-0.54	0.28	-0.35	-0.95	-0.19	0.85	0.90	0.92	0.98	-0.65	1.80	1.79	1.80	1.44	-0.60	-0.81	6.78
Mahishi	-0.74	-2.05	0.03	-0.62	0.70	-0.49	0.76	0.57	-0.20	-0.42	-0.35	-0.01	-1.79	-1.53	-1.08	-1.91	-0.35	0.92	-1.85	-0.88	-0.74	-2.12	0.26	0.77	-13.15
Kahara	2.82	0.46	-1.85	2.53	-1.94	3.03	-0.81	-0.86	-1.10	-0.42	-0.35	-0.59	0.15	-1.22	0.12	0.71	-2.00	-2.52	0.01	-0.15	-0.17	0.13	1.67	1.20	-1.15
Saur Bazar	-0.08	1.01	0.90	0.41	0.74	-0.60	0.32	-0.86	-0.31	-0.42	-0.35	-0.81	0.83	0.86	0.79	0.43	1.72	-0.49	-0.68	-0.34	-0.36	-0.70	0.37	-0.03	2.33
Patarghat	-0.26	0.85	0.46	0.44	0.04	-0.72	-1.57	1.05	-0.43	-0.42	-0.35	2.07	2.29	1.27	0.91	0.88	0.78	0.37	0.65	1.49	1.50	0.30	-0.95	-1.93	8.72
Sonbarsa	-0.13	1.10	1.33	0.07	-0.45	-0.21	0.82	-0.14	0.92	-0.42	-0.35	1.35	-0.35	0.44	0.91	1.11	-0.51	0.65	-0.07	-0.66	-0.68	0.21	0.71	-0.39	5.26
Simri Bakhtiarpur	0.47	0.34	-0.84	-0.55	-1.10	0.23	0.79	0.10	0.36	3.08	3.15	0.41	0.11	-0.46	0.82	0.33	-0.09	-0.24	-0.19	-1.61	-1.65	0.44	1.39	-0.89	4.42
Salkhua	-1.29	0.40	-1.13	-1.85	0.62	-0.62	-0.19	-1.09	-0.09	-0.42	-0.35	-0.78	-0.77	0.44	-1.02	-1.03	0.64	0.34	-0.65	-0.34	-0.36	-0.69	-0.88	0.77	-10.34
Banma Itahri	0.15	0.40	-0.12	-0.31	-0.68	-0.48	-1.42	-0.62	-1.21	-0.42	-0.35	-1.04	-0.27	-1.39	-0.38	-0.20	-0.53	1.03	1.35	0.72	0.71	1.39	-1.53	-0.11	-5.29

Source: Computed by Authors

Table 7 : Composite Index of Development of Four Major Secretors in Saharsa District, 2011

Name of Block	Socio-Economic Development Composite Index	Rank	Infrastructural Development Composite Index	Rank	Agricultural Development Composite Index	Rank	Industrial Development Composite Index	Rank	Overall Development Composite Index	Rank
Banma Itahri	-0.4027	9	-0.8201	9	0.7795	3	-0.8192	9	-5.2896	8
Kahara	0.2148	4	-0.2084	6	-0.7826	9	1.4362	1	-1.1504	7
Mahishi	-0.3082	8	-1.5820	10	-0.8390	10	0.5132	2	-13.1547	10
Nauhatta	0.4630	2	-0.5336	7	-0.1510	5	0.4926	3	2.4193	5
Patarghat	-0.1771	6	1.8556	1	0.8474	2	-1.4419	10	8.7218	1
Salkhua	-0.4472	10	-0.7908	8	-0.1744	7	-0.0564	7	-10.3353	9
Satar Kataiya	-0.2707	7	0.3846	4	1.1929	1	-0.7078	8	6.7760	2
Saur Bazar	0.1463	5	0.5254	3	-0.1438	4	0.1717	5	2.3349	6
Simri Bakhtiarpur	0.5389	1	0.3041	5	-0.5546	8	0.2540	4	4.4196	4
Sonbarsa	0.2428	3	0.8652	2	-0.1743	6	0.1576	6	5.2583	3

Source: Computed by Authors

Table 8 : Correlation Matrix Between Socio-Economic Development (X1), Infrastructural Development (X2), Agricultural Development (X3) and Industrial Development (X4) of the Saharsa District, 2011

	X1	X2	X3	X4
X1	1			
X2	.276	1		
X3	.455	.430	1	
X4	.519	.456	-.876**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Computed by Authors

economic, infrastructural and agricultural developments are positively and significantly correlated with each other in all the blocks. Better infrastructural facilities lead to the path of development which automatically increases the level of income and improves the socio-economic condition of the people in the study area.

Industrial development and agriculture development is negatively correlated. The basic reason is that most of the industries are located near to the towns, where agriculture practices are very low or negligible in Saharsa district.

Industrial development is positively correlated with infrastructural and social development. Infrastructural facilities such as better transport routes and banking facilities are prerequisite for the establishment of industries. In Saharsa district industries are generally located at favourable places where all these facilities are available. Infrastructural development and social development are positively correlated. Better infrastructural facilities such as roads, railway and banks enhance the socio-economic development.

Conclusion and Suggestion

Foregoing analysis reveals interesting insight of the regional disparities in terms of development in Saharsa district. Wide micro-regional disparities exist within the district. The whole blocks of Saharsa district depict enormous disparities in sectoral and spatial development. The analysis also reveals that Patarghat block of the study area comes under developed area while Mahishi and Salkhua blocks of the study area lie under the low level of development in terms of overall performance. These blocks have failed to infuse development at grass root level.

The regional disparities in the level of development have, by and large stimulated the divergent force leading to persistent depression of under developed areas. No doubt, certain areas are more conducive to fetch overall prosperity to the people in comparison to other areas. A concerted effort is needed to enhance the overall economy of all blocks of the district. In fact district is a very small region therefore much attention is not paid to reduce regional disparities in development. However, the analysis demonstrated that the issue cannot be ignored further. Therefore it is needless to say that thrust should be laid upon development of each sector. Having the real and equal attention to the development of each sector, fruits of overall development will percolate in the blocks of Saharsa district.

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Gender, Space and Development: A Theoretical Perspective

Neha Kushwaha and Jagadish Singh

Gender is defined as a socially constructed category that carries with it expectations and responsibilities that are not biologically determined. Space is constructed out of continuous co-existence of social inter relations. Women's space is defined as women's access to and control over material resources (food, income and land) and social resources (knowledge, power and prestige) within the family, in the community and society at large. Gender roles are thus seen as constructed in part through our culturally experienced bodies and the ways men and women experience their bodies becomes a part of their experience of gender and gender relations (Raju, 2001). The role of women and men in the development process has received much attention in the last few decades. This paper attempts to discuss conceptual framework of geography of gender and theoretical perspectives on Women in Development (WID), Women and Development (WAD), Gender and Development (GAD) and Gender and Space .The geography of gender explores the way space is implicated in articulated gender relationships.

Key words*:* Development, Gender, Space, Society and Women.

Introduction

In the 1970s and 1980s, the term 'gender' increasingly began to be used in discourse and debate that focused on social relations between men and women in public as well as private. Gender refers to how societies set the behavioral, social and cultural rules for man or woman. In other words, gender involves the way society creates shapes and rewards the notions of femininity and masculinity. One can even see gender as something we do within specific social constraints, making gender identities fluid over time and space (Bradley, 2007). The patterning of socio-physical spaces of women depends upon the social construction of that particular society. In other words, symbolism of space is usually formulated by patriarchy.

It provides an explanation of the pre-colonial experience of so-called Third World people, especially with respect to gender relations and the experiences of women and men in social, political and economic life. The discussion challenges simplistic characterizations and generalizations of pre-colonial societies and points to their rich diversity and differences. It clearly highlights male

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domination and power in the home as well as in society at large. It combines the force of male authority with the subtleties of parental care, thus, highlighting the way women's subordination rests on ideological and emotional power, personal relationships and physical force. Ardener (1981) in 'Women and Space' describes how spatial terms are indispensable to understand the gendered patterning of society. Societies generate their own culturally determined rules for drawing boundaries in the real world. The divisions, structure thus obtained, the given modes of perception and social interaction which gives birth to markers in our lives result in creation of the spaces. Gender is often mistakenly used to signify women only. It is argued that gender is not only about women or men as separate and independent categories, but is a relational concept .It focuses on how the terms of man and woman are mutually constituted and interdependent.

A contested landscape of theoretical and political approaches to gender, or the women question in development, where Women in Development (WID), Women and Development (WAD) and Gender and Development (GAD) emerged as major discursive fields, broadly paralleling liberal, radical and Marxist/ socialist feminist perspectives (Saunders, 2002). By the mid to late 1980s, the gender concept had become common in writings on development issues and had replaced the earlier Women in Development (WID) and Women and Development (WAD) approaches. While this move to replace 'women' with the more neutral term 'gender' has been questioned and still continues to be criticized by some feminist analysts of development process.

Theoretical Framework

The decades of the late 1970s and early 1980s may be seen as the beginning of gender concerns in geography. The early formulations based on liberal feminist ideas of gender equity argued for incorporating women at par with men both in the discipline as well as in research discourse (Raju, 2004). Research in this phase was primarily concerned with individual woman in private domain and their restrictive access to public domain and how they should be made visible.

It was socialist feminist scholars who argued that women's subordination must be viewed more collectively within the larger structures of capitalistic modes of production. As against Marxist feminists who place class location as the most appropriate predictor of women's position, socialist feminists see a more nuanced relationship between class and gender and argue that within class locations, gendered positions continue to marginalize women. In such interpretations as patriarchy, when admittedly simplified, can be seen as a set of formal and informal institutions that systematically work towards placing women in a subordinated position (Hubbard, *et al.*, 2002).

This sub-field of human geography draws its relevance from use of the gender as a lens to define, identify and explain spatial patterns of social phenomena. In other words, it is concerned with the spatiality of gender, i.e., how gender and space implicate each other. In the Anglo- Saxon world, the geography of gender is an established sub-field within geography. Its

growth, development and theoretical framework have been well documented. However, the incorporation of gender as an analytical lens within mainstream of human geography in India has been rather problematic and its growth trajectory is markedly different from its western counterpart.

Although the principle of equality of men and women was recognized as early as 1945 in the UN charter and UN declaration of Human Rights of 1948, several researchers have pointed out that development planners worked on the assumption that what would benefit one section of society would trickle down to other (women) and did as such they did not fully address women's position in the process of development. It may be underlined here that the focus in gender and development is not on women *per se* but on gender relations, i.e., the relations between women and men in a variety of settings. This approach views women as active agents and not passive recipients of 'development'.

Eva Rathgeber (1990) identifies three distinct theoretical paths in this field: Women in Development (WID), Women and Development (WAD) and Gender and Development (GAD).

Women in Development (WID)

The oldest and most dominant perspective, WID has manifestly influenced the course of the field. The WID subscribes to the assumption of modernization theory; its program generally stress western values and target individuals as the catalysts for social change. Modernization theory depicts traditional societies as authoritarian and male-dominated and modern ones as democratic and egalitarian; thus it seemingly shows sensitivity to the oppression faced by women. Liberal feminists have accepted and endorsed this world-view. In contrast, progressive feminist critiques of modernization theory find it implicitly gendered and its characterization of Third World women distorted and detrimental (Mohanty, 1991; Scott, 1995).

Boserup's (1970) documentation of the regressive impact of development on women's lives and livelihoods signaled the start of liberal feminists' advocacy of integrating women into development chronologically as workers and producers. It is important to note that the program directed at Third World women have long history. While surveying four decades of development policy Moser (1993) finds five distinct WID approaches that reflect policy evolution. Building on concepts developed by Molyneux(1985), Moser evaluates each approach chronologically in terms of its ability to meet those practical needs of women that require urgent attention and women's more strategic needs, which must be met to change their subordinate status in society (e.g. legal rights, gender-based division of labour and domestic violence).

Moser's first policy approach, the 'welfare approach', predates Boserup's land mark work. It focuses solely on women's reproductive roles. The 'equity approach', Moser's second approach, dominated the agenda of WID during the UN Women's Decade (1976-85) and represented the initial phase of feminist organizing, which called for gender equality. Her third approach was 'anti-poverty approach', and concentrated on enhancing women's productive role particulaly

through small-scale income generating projects. thereby neglecting strategic needs. 'Efficiency' is the fourth approach which recognises that development is more efficient and effective through women's economic contribution. The fifth WID approach, i.e., 'empowerment approach', represents third world feminist writings and grass-roots organizational experience.It acknowledgees ineqalities between men and women. However, feminists encountered continued resistance to their demand for equality with men; they changed their policy emphasis, therefore, to resonate with the general direction of development in the 1970s, when the goal of meeting people's basic needs was stressed.

Women and Development (WAD)

Marxist historians, beginning with Frederick Engels (1942), assert that the Agricultural Revolution through the establishment of stationary communities for growing crops and domesticating animals, led to hierarchical structures in societies presumed to have been previously classless. Engels argued that the institution of private property and consequent exaltation of monogamy contributed to the decline of women's status. This gender hierarchy intensified with the spread of capitalism. Production for direct use, which was a hallmark of more communal societies, was replaced by production for exchange and subsequently taken over by men came to be viewed as a 'public' function. The areas of reproduction and consumption associated with the 'private' domain were assigned to women.

In Jaquette's (1982) opinion, Marxist and liberal feminists share the view that structures of production determine women's inferior status; liberal analysts cite technological change as the casual mechanism, however, without considering its impact on class differentiation as do Marxists. Based on her research review, Bandarage (1984) argues that liberal feminists using a WID framework tend to focus narrowly on sexual inequality and ignore the structural and socio-economic factors within which gender inequalities are embedded. Examining structuralist perspective on women and development, Kabeer (1994) finds, like earlier critiques, that the Marxist have given scant attention to the sphere of reproduction and household-level relations between men and women. The dependency feminists, according to Kabeer, use the traditional Marxist- feminist framework and view the inequalities between women and men as part of the larger picture of the global economy. Similarly, this group sees sexual inequality as just another aspect of the inequality created by capitalist accumulation.

In Kabeer's formulation, the work of this group is dominated by the writings of the German anthropologist Maria Mies, who gives gender precedence over class analysis. She notes that Mies contributed significantly to the extension of the Marxist- feminist critique in identifying the female body as the site of patriarchal violence. According to Kabeer, the uncompromising stand taken by Marxist and dependency feminists for radical structural transformation underscores their strong ideological and ethical position. The rigidity of this position has, however, also restricted their involvement in official efforts to address third world women's immediate needs.

Gender and Development (GAD)

In the late 1970's and 1980's, a new 'Gender and Development' (GAD) analysis emerged which tackled not just the nature of women's various roles but also the interactions of those roles with men. GAD is an approach concerned not simply with women's roles but also with the dynamics and structures of gender relations. Gender relations are seen as central to social processes and social organizations and therefore, to development, which is defined as a complex process involving socio- economic, political and cultural betterment of the individuals and society itself.

The GAD represents the confluence of diverse feminist perspectives. It draws its heritage from feminist activism in the women's movement as well as from a schism in the ranks of Marxist feminists, many of whom challenged the notion that class analysis alone could explain women's oppression. The socialist feminists who dominate this track have incorporated lessons learned from WID failures and WAD limitations. The outcome provides an analytical framework that emphasizes gender relations in both the labour force and the reproductive sphere. According to Kate Young (1992), GAD focuses not just on women (as with WID and WAD), but also on the social relations between men and women, in the workplace as well as in other settings. GAD uses gender relations rather than 'women' as a category of analysis and views men as potential supporters of women.

The GAD model adopts a holistic approach and treats development as a complex process influenced by political and socio-economic forces. Young (1992) emphasizes that GAD expects the state to assume a critical role in providing program to support the work of social reproduction, namely the care and nurturing of children. They acknowledge women's concerns for economic independence and give weight to political activism advocating strategies such as community - organizing, transformative action, public education and coalition- building. There is a growing trend within the field to draw on the concept of gender because its social construction and cultural context provide a rich information base for understanding male-female relations and interactions (Ostergaard, 1992). Development planners and practitioners are taking the lead in creating gender-analysis frameworks for evaluating the distribution of household power, land and resources.

Gender and Space

Most of our lives in society are anchored by a certain perception of space. Such a perception views space, almost as an open receptacle within which material objects are located.

Radical geographers consider space to be a social construct. Thus, social relations and practices make space (Massey, 1992). In Niranjana's opinion (2001), gender and social relations are constructed and negotiated spatially. One of the earliest concerns as well as areas of research in the geography of gender has been the domain of work – the gendered construction of women's primary role as mothers, caretakers and home-makers meaning that their space of activity would be essentially confined to the domestic or private space of home and its surroundings in contrast to socially constructed roles of men as bread earners, politicians and paid workers. Subsequently, their

activity spaces are seen as located in the public domain. Feminist geographers point out that 'private' and 'public' are not just about spatial organization, but relate to power within which these spheres are constituted. This they explain by pointing to how home-based women's work remains invisible and undervalued, whereas market work that is dominated by men gets priority in monetized market economies. Some scholars argue that patriarchy is so strong a referential universe that the move to market for women means moving from private to public patriarchy- the market does not alleviate their subjugation or domination by men (Walby, 1990). The argument is that in this framework, more visible women in the workplace mean relatively more autonomous women. In interrogating this interaction, space not only acts as a mediator, but also provides a context in which patriarchy is reconstituted and expressed.

In India, social and cultural discourse on gender overwhelmingly refers to the North-South differences as the basic practice for regionalization in terms of a gender- egalitarian South, as compared to the North, which is characterized by a more restrictive domain for women. The common sense proposition that poverty should propel women into paid work for obvious reasons, the Indian experiences show that in certain parts of the country, even in the poorest of the poor segments of population, women's participation in the public domain of work is very much conditioned by the prevailing socio-cultural constructs. Their working as a direct threat to the family's honour and the concept of masculinity, assigns the role of family provider to men on the one hand and their domination of women on the other.

Conclusion

As a relational concept, gender identities are far from fixed. Also, the biological roles (sexual identities) and socially ascribed roles (gender identities) are intertwined in a complex manner and can vary over space and time (Niranjana, 2001). In this paper an attempt is made to trace the Gender, Space and Development approach. It discusses the gendered construction of patriarchal social structure. The WID and WAD approach tries to integrate and analyze women's overall roles into their participation in process of social change. GAD approach rejects the public/ private dichotomy. In this approach women are seen as agents of change rather than passive recipients of development whereas, the gender and space focuses on strengthening women's existing power relations in society, especially between men and women.

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Correlates of Socio Economic Status with Domestic Water Consumption Pattern in Chitrakoot District (U.P.)

Swati Yadav and Usha Singh

Domestic fresh water is a fundamental requirement for human welfare. The study determines the relationship of domestic water use with socio economic and other factors at household level in the plain and plateau area of Chitrakoot district. The main aim of this study is to improve the understanding of how local communities in the district relate to water, based on questionnaires and interview survey of 800 respondent from both the areas of plain and plateau. The study has examined the respondent's daily activity-wise water consumption, sources of water, distance of different water sources and frequency of water supply. The study remarked that the percapita daily water consumption for the area is found to be 74.52 litres per person per day with a standard deviation of 41.14. Water consumption was found to be correlated with socioeconomic factors like monthly per capita income, caste, source of water, distance of water source and time to collect water.

Key words: Domestic water, Rural households, Consumption, Monthly per capita income, caste.

Introduction

The United Nations has recognised access to water as a basic human right, stating that water is a social and cultural good, not merely an economic commodity since ancient times, water has been recognised universally as an invaluable resource. The Bible quotes ' I am the Alpha and the Omega, the beginning and the end. To the thirsty I will give water without price-Revelation 21:6'. In Islam, the Sharia law in Koran literally translates to laws of sharing water.

The demand of water is increasing both in urban and rural areas. In rural areas water is required for house holds and agricultural purposes. Information on the water uses pattern of rural settlements is vital in developing sustainable water supply system for the rural people. The domestic water can be classified according to its final use such as domestic, commercial, industrial public, loss and wastage (Steel & Mc Ghee,1979). Domestic water use varies according to the living standards of the consumers in urban and rural areas (Thomas,1998). The use of water for domestic purposes may be subdivided in drinking, food preparation and cooking, washing cloths and utensils, house cleaning and polishing, vegetable

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gardening, stock watering and other uses (Hopkes,1983).

The quantity of water is variable depending on the cultural habit, settlement pattern, type of supply, water sources etc. A study in Nicaragua showed that a decrease in distance to the water source from 1000 to 10 meters resulted in an increase in per capita water consumption of 20% (Sandiford *et al.*, 1990). There is a difference in the quantity of water used by piped and unpiped household (Thompson *et al.*, 2001).

In the present study an attempt has been made to find out the consumption pattern of domestic water in Chitrakoot District U.P.

Data base and Methodology

Chitrakoot is located in U.P. Bundelkhand region. It is one of the seven districts of this region(fig-1). Physically this district can be divided into two parts. Northern part is plain and whereas southern part is plateau and in this study rural areas of both the plain and plateau area are selected (fig-2). The economy of both the areas is mainly based on agriculture. Most of the people in this area are farmer by their livelihood. Data for this study have been totally acquired from field survey. In this study 800 respondents have been interviewed where one person has been taken from each house hold for interview. For collection of data, direct inspection filling of questionnaire and personal interview is used. Random purposive sampling technique has been employed to select the samples. 6 sample villages from plain and 6 sample villages from plateau have been selected for the analysis. The information obtained from the survey have been organised, categorised and analysed using simple percentage as well as standard statistical techniques through SPSS (16.0) and MS Office Excel 2007.

Observations and findings

800 cases are selected for the present study out of which 400 subjects are from plain area and rest 400 from plateau area.

In this study average water consumption was found 74.52 litres per person per day with standard deviation of 41.14. It is found 85.97 litres in plain and 63.08 litres in plateaus with standard deviation of 43.58 and 35.03 respectively. Statistical non parametric test (Mann whiteney Wilcox W Test Z= 6.10, P< 0.001, table.1) signifies the fact that there is highly significant difference in average per capita consumption of water per day between plain and plateau. Table-1 reflects that about half (50.8%) of the respondents have their per capita consumption of water/day is less than 50 litres while rest 38.0% and 11.2% of respondents are consuming per day in the range of 50-100 litres and greater than 100 litres respectively. Area wise distribution of per capita consumption of water/day indicates that those respondents who reported to consume less than 50 litres/day are maximum (64.8%) and belong to plateau whereas in plain area the consumption is 36.8%. It is also observed that in the level of 50-100 and greater than 100 litres consumption of water, the proportion of respondents from plain area is found to be higher than the plateau.

Some variables have been selected to know their effect on consumption pattern of water which are as follows :

Distance of water source

Source of water (type)

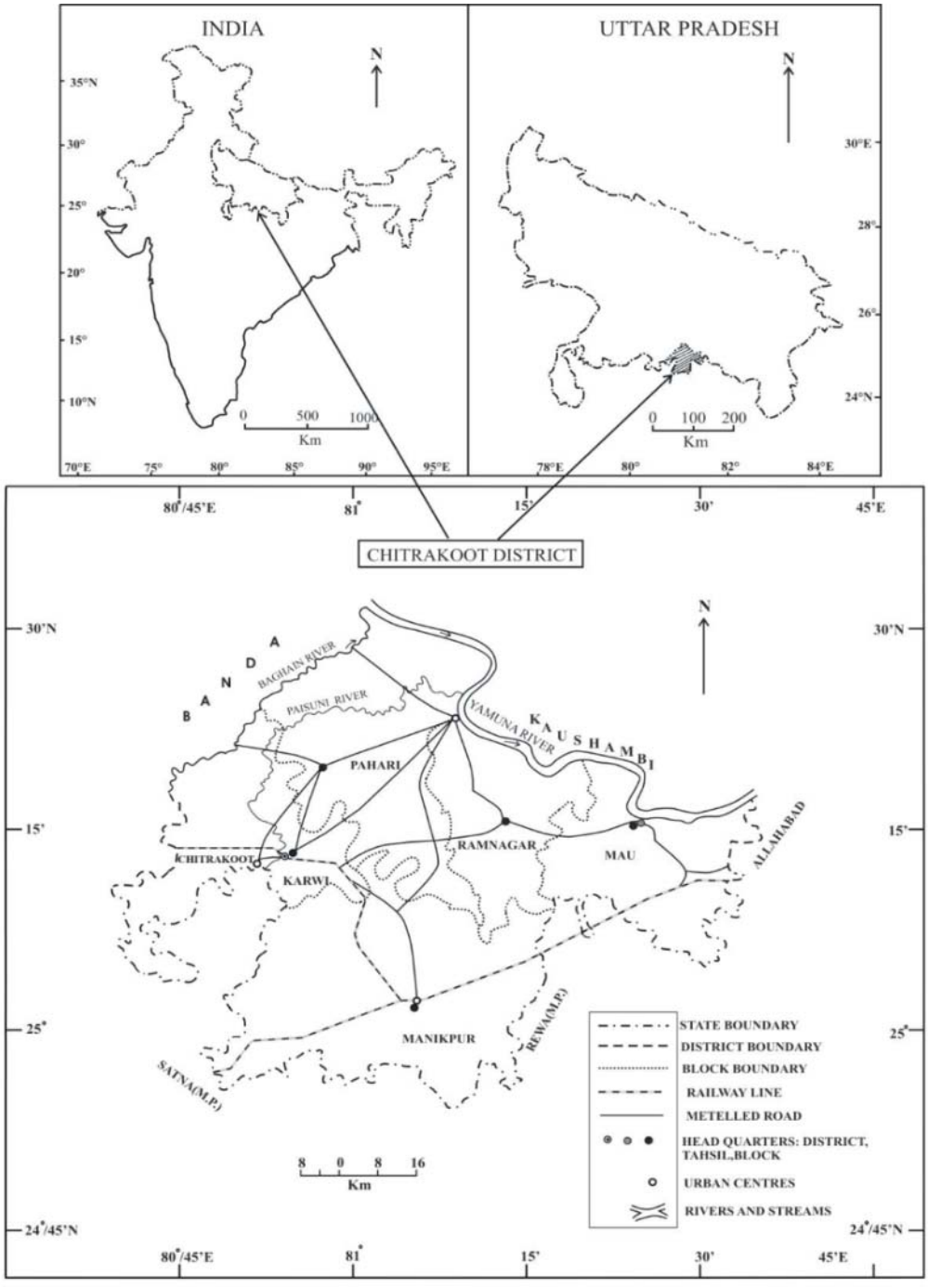
INDIA
UTTAR PRADESH
CHITRAKOOT DISTRICT
BANDA
KAUSHAMBI
BAGHAIN RIVER
PAISUNI RIVER
YAMUNA RIVER
PAHARI
RAMNAGAR
MAU
ALLAHABAD
CHITRAKOOT
KARWI
MANIKPUR
REWA(M.P.)
SATNA(M.P.)
STATE BOUNDARY
DISTRICT BOUNDARY
BLOCK BOUNDARY
RAILWAY LINE
METELLED ROAD
HEAD QUARTERS: DISTRICT, TAHSIL,BLOCK
URBAN CENTRES
RIVERS AND STREAMS
Km

Fig. 1

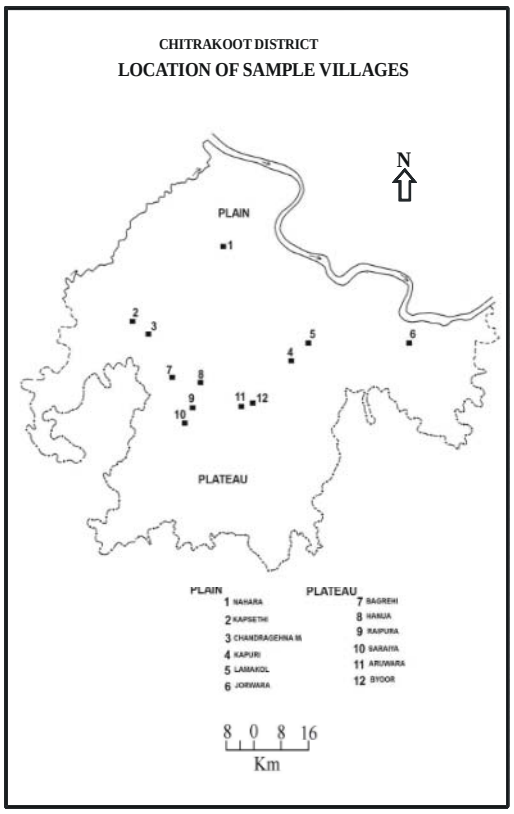

Fig. 2

MPCI(monthly/capita income)
Time to collect water
Family size and
Caste

The distribution of average amount of water consumed by the individuals for plain & plateau area according to the site of drinking water source is presented in Table -2. It depicts that the average consumption of water is 100.06 litres for those respondents family who have water facilities inside their houses or within campus whereas those respondents who have source of water facility outside the house/ campus they consume on an average 38.16 litres and this difference is found to be statistically highly significant. It is also observed that in plain area where source of water is inside the house/campus, the average consumption of water is estimated as 103.4 litres and it is 94.34 litres in area of plateau.

The difference in average consumption of water between plain & plateau area is obtained to be statistically highly significant in case of source of water inside the house/ campus. Those respondents family who are taking drinking water from outside the house/ campus the average consumption is 36.31 litres in area of plateau, it is 39.01 litres. This difference is also found to be statistically highly significant. The comparison regarding consumption of water has also been made between source of water inside & outside of house/campus in plain as well as plateau which reveals that there are statistically highly significant difference between two sources of water in both the area of study.

The average consumption of water in plateau is significantly more than the area of plain if source of drinking water source is outside the house may be because of this habitual status in plain by carrying drinking water from long distance in comparison to plateau. In spite of higher average consumption in plateau, in case of outside the source, the attitudes of plateau people are in position to make less consumption of water as a whole (Table-2).

The fact is true that the level of water consumption is universally proportion to the distance of water source. Therefore, involving this fact an analysis for the study area has been made to look the association between distance of water source and water consumed by the respondents/day which is also presented in

Table 1 : Per Capita Consumption of Water/Day in litres

Per Capita Consumption of Water/Day (in litres)	Area					
	Plain (400)		Plateau (400)		Total (800)	
	No.	%	No.	%	No.	%
<50	147	36.8	259	64.8	406	50.8
50-100	185	46.2	119	29.8	304	38.0
>100	68	17.0	22	5.5	90	11.2
Average ±SD	85.97 ± 43.58		63.08 ± 35.03		74.52 ± 41.14	

Mann-Whitney Wilcox W Test $Z = 6.10$, $P < 0.001$
Source: Computations based on personal field survey

Table 3. reveals that the average consumption of water is maximum 43.60 litres in case where the water facilities are 100 metres from their houses and minimum 31.46 litres in the cases where distance of water source is 500 meters. It clearly shows that as distance of water sources are increasing, the average consumption of water is in decreasing order and this amount of decrease amongst various distance group is found to be statistically highly significant ($F = 63.18$, $P < 0.001$). Similar type of pattern in connection with average water consumption was observed in area of plateau as well as in area of plain and statistical test proves this fact that average consumption of water is decreasing significantly as source of water distance advanced. The difference in average consumption of water in various water source distance group between plain and plateau is also found to be statistically highly significant with the exception of the water source distance >500 meters in present study (Table 3).

Like as distance the type of water source is also important variable which affects the average consumption of water in any type of area. Keeping this key fact in mind analysis has been done for average consumption of

Table 2 : Average Consumption of Domestic Water Consumed by the Individuals in Case of Position of Drinking Water Source.

Area	Inside the House/Campus	Outside the House /Campus	t	df	P
Plain	103.42	36.31	18.32	398	<0.001
Plateau	94.34	39.01	25.20	398	<0.001
Average	100.06	38.16	31.19	798	<0.001
Value of 't' between Plain and Plateau	t = 2.69 df = 468 P < 0.01	t = 3.55 df = 328 P < 0.001			

Table 3 : Average Consumption of Domestic Water in Plain and Plateau Area According to Distance of Water Source.

Distance in Meters	Plain	Plateau	Average	t	df	P
≤ 100	-	43.60	43.60	26.24	9	<0.001
100-500	38.08	40.36	39.71	3.80	251	<0.001
>500	32.31	30.69	31.46	0.78	65	>0.05
Average	36.31	39.01	38.16	3.55	328	<0.001
	t = 3.51	F = 89.06	F = 63.18			
	df = 102	P < 0.001	P < 0.001			
	P < 0.01	(All Groups)	(All Groups)			

Source: Computations based on personal field survey.

water according to their type of water source in plain and plateau area and is presented in Table-4. This table gives an idea that maximum average consumption of water is observed to be 113.69 litres for those respondents family where source of water is either from jet/ submersible or electric pumps while it is minimum 54.24 litres for those who are using to hand pump facilities (Private/Public hand Pumps). It is also seen that at the place where tap water facility is present the average consumption of water is placed on second position (103.30 litres). Statistically, it is determined that the difference in average consumption of water/day is highly significant only between the two type of water sources- tap water and hand pump facilities. By analysing the consumption pattern of water in plain and plateau area separately according to type of water source, it is observed that the maximum average consumption is 126.36 litres from other type of water source followed by 105.99 litres in tap water where as minimum 61.01 litres is seen in case of hand pump utilization in plain area. In plateau area the maximum average consumption is noted to be 98.24 litres in tap water facilities followed by 49.95 and 44.00 in hand pump and other type of water facilities respectively. In the plateau the average consumption of water is also found to be highly significant among different type of water sources.

It is evident from the statistical test that there is no significant difference in consumption level of water between tap water and other source of water in plain where as in plateau area this difference is also not found significant between the use of water facilities- hand pumps and other types (Table 4).

Table 5 shows the distribution of average consumption of water in plain and plateau area according to their monthly/capita income of the family. It is observed that the average consumption of water is found to be minimum 67.81 litres for those respondents who have less amount of MPCI and maximum 95.61 for respondents having higher monthly/capita income as a whole. The pattern of average per capita water consumption is in increasing order with increasing of their MPCI. It means average water consumption is directly proportion to the MPCI of the family. The difference in average per capita water consumption of various MPCI group is also

Table 4 : Average Consumption of Domestic Water in Plain and Plateau Area With Reference to Their Type of Water Source.

Type of Water Source	Plain	Plateau	Average
1-Tap Water	105.99	98.24	103.30
2-Hand Pump	61.01	49.95	54.24
3-Others	126.36	44.00	113.69
Average	85.97	63.08	74.52
	F =78.37	F=120.88	F=215.90
	P < 0.001	P < 0.001	P < 0.001
	Significant pairs-	Significant pairs-	Significant pairs-
	(1) 1 Vs 2(2)	(1) 1 Vs 2	(1) 1 Vs 2
	2 Vs 3	(2) 1 Vs 3	(2) 2 Vs 3

Table 5 : Average Consumption of Domestic Water in Plain and Plateau Area According to Monthly/Capita Income of the Family.

Monthly/Capita Income	Plain	Plateau	Average
1- $\leq$ 600	77.76	59.07	67.81
2- 600 - 1200	100.13	64.00	85.14
3- >1200	102.62	86.71	95.61
Average	85.97	63.08	74.52
	F =14.11	F=13.70	F=27.99
	P < 0.001	P < 0.001	P < 0.001
	Significant pairs-	Significant pairs-	Significant pairs-All
	(1) 1 Vs 2	(1) 1 Vs3	
	(2) 1 Vs 3	(2) 2 Vs 3	

Source: Computations based on personal field survey.

observed to be highly significant. In area of plain and plateau average consumption of warer is also maximum 102.62 and 86.71 litres in higher group of (> 1200) MPCI and it is minimum 77.76 and 59.07 litres in 600 MPCI respectively. Average water consumption in both type of area is in increasing order with increasing MPCI and this increase is found to be statistically highly significant. There are some variations in average consumption of water among different MPCI group but this variation is not statistically significant between MPCI group of 600-1200 and >1200 in area of plain whereas in plateau area it is not significant between MPCI group of 600 and 600-1200 respectively.

The analysis evidently shows that the average per capita water consumption per day is observed to be higher in plain area in comparison to the plateau for all MPCI group of the family (Table 5).

It is obvious that the distance of water source is positively correlated with time taken in collecting water from drinking water source.

Thus like distance of water source, duration of time may have important factor for assessing the level of consumption of water. Therefore it is necessary to take time factor into account for determination of water consumption. It is found that maximum per capita consumption of water is 103.30 litres and 88.43. litres in plain and plateau area respectively in those respondents who have water facilities either inside the house/campus and treated as very small time to collect the drinking water. Minimum average consumption of water was observed for the respondents (41.52 and 41.55 litres) who are collecting water far away from their house which takes <1/2 hour in both the areas. Surprisingly, it is observed that the average water consumption is 54.61 litres in plain and 43.43 in plateau area for the respondents taking time >1/2 hour for collecting drinking water from the source which is higher but not significant than ½ hour period of time. Similar type of trend is also observed by taking into account the respondents of both the area altogether. Statistically it is proved that there are highly significant differences among various time durations for the purpose of collecting drinking water in plain and plateau as well as altogether. The difference is insignificant between collecting time period < ½ hour and > ½ hour in the present study. It may also be noted that the average consumption of water per individual per day is lesser in plateau as compared to the area of plain in all duration of water collection period (Table-6).

Family size may be the most important yardstick to assess the average per capita consumption of water in any type of area because large family size had more hands which will be helpful for carrying water and other type of resources along with increasing the consumption of water by looking personal hygiene of other individual within the family.

Considering the facts, it is essential to know the average consumption of water according to the various family size groups in this present study. Table-7 reflects the average per capita water consumption per day in plain and the plateau area as well as for total which is assessed according to their family size. It reveals that out of total selected respondents the average consumption of water per individual is found to be more (77.67 litres) in family size 4-7 members and little less 77.28 litres in >7 family members, while ideal family size <4 members consume minimum water (68.33 litres). Statistically, it is depicted that there is highly significant differences in average per capita water consumption for family size <4 and 4-7 as well as <4 and >7 member respectively. Within the area of plain minimum average water consumption is 80.17 litres for those families who had <4 members and afterwards it is increasing with the increase of family size but this increase according to various group of family size is not found to be statistically significant. On the other hand, in plateau area the pattern is indifferent where maximum average consumption of water per individual is 66.94 litres for family size 4-7 members and slightly less (63.57 litres) in the family size >7 members and minimum 47.02 litres in <4 members of family size. The analysis of variance signifies the fact that significant difference regarding average water consumption per day is observed in the family size <4 and 4-7 member. It is also obvious that in each family size group of respondents the average per capita water consumption was observed to be more in plain area in comparison to average consumption of water in the area

Table 6 : Average Consumption of Domestic Water in Plain and Plateau Area According to Time in Collection

Time	Plain	Plateau	Average
1- No Time	103.30	88.43	97.49
2- ≤ ½ Hour	41.52	41.55	41.54
3- > ½ Hour	54.61	43.43	46.78
	F =127.68	F=155.21	F=308.67
	P < 0.001	P < 0.001	P < 0.001
	Significant pairs-	Significant pairs-	Significant pairs-
	(1) 1 Vs 2	(1) 1 Vs 2	(1)1 Vs 2
	(2) 1 Vs 3	(2) 1 Vs 3	(2)1 Vs 3

Source: Computations based on personal field survey.

of plateau in Chitrakoot district (Table 7).

In rural area, the status of caste is a very important yardstick which affects various kind of researches and other social matters. In this study too, the effort has been made to analyse the average consumption of water according to their caste status of respondents and collected information are analyzed and presented in Table 8. It is found that out of total studied respondents the average per capita water consumption is maximum (81.10 litres) in general caste family followed by 75.30 litres in OBC family whereas in SC families the average water consumption is minimum (68.67) litres. Statistical F test in ANOVA also verifies the fact that highly significant difference is observed only between SC and OBC as well as between SC and general caste respectively.

In the present study no significant difference is found between OBC and General Caste concerning water consumption level. Area wise level of water consumption shows that the average water consumption is more (92.11 litres) in general caste group in comparison to OBC 87.28 litres and SC 79.05 litres respectively in plain area whereas in area of plateau it is maximum 65.46 litres in general, followed by OBC category 65.36 litres and it is minimum 58.06 litres in SC caste group respectively. The analysis also shows that with increasing status of caste category the average per capita water consumption is also increasing in area of plain and plateau as well as both together. But the differences among various caste status group is not found to be statistically significant in area of plain as well as plateau and in total selected respondents it is obtained to be statistically highly significant between SC and OBC as well as between SC and general caste category respectively. Like as other variable, the average per capita consumption of water in all type of caste category group is estimated to be more in plain area as compared to the area of plateau of Chitrakoot district (Table 8).

A correlation matrix is constructed using above variables (Table-9). It can be seen from this table that water consumption per capita per day is appreciably correlated with time to collect water, distance of water source, MPCI(monthly/capita income), family size, caste and source of water.

Table 7 : Average Consumption of Domestic Water in Plain and Plateau Area According to Their Family Size

Family Size	Plain	Plateau	Average
1) < 4	80.17	57.02	68.33
2) 4 - 7	88.56	66.94	77.67
3) > 7	89.21	63.57	77.28
	F =1.70	F=3.30	F=308.67
	P > 0.05	P < 0.05	P < 0.001
	-	Significant pairs- (1) 1 Vs 2	Significant pairs- (1)1 Vs 2 (2)1 Vs 3

Source: Computations based on personal field survey.

Table 8 : Average Consumption of Domestic Water in Plain and Plateau Area According to Their Caste

Caste	Plain	Plateau	Average
1) SC	79.05	58.06	68.67
2) OBC	87.38	65.36	75.30
3) General	92.11	65.46	81.10
	F =2.81	F=1.90	F=5.05
	P > 0.05	P > 0.05	P < 0.01
	-	-	Significant pairs- (1)1 Vs 2 (2)1 Vs 3

Source: Computations based on personal field survey.

Table-9 reflects that the correlation co-efficient of water consumption with water

Table 9 : Correlation Between Water Consumption Pattern and Various Types of Variables in the Study Area.

Consumption of Water			
Variables	Plain	Plateau	Total
Time to collect water	-. 563***	-. 566***	-. 582***
Distance of water source	-.676***	-.784***	-.741***
MPCI	.171**	.167**	.186***
Family size	.072	.068	.091*
Caste	.116*	.083	.112**
Sources of Water	.451***	.509***	.507***

*** P <0.001 , ** P <0.01 , * P < 0.05

Source: Computations based on personal field survey.

Table 10 : Correlation Among Various Types of Variables in Plain, Plateau and Both the Areas.

Variables	Area	Time to collect water	Distance of water source	MPCI	Family size	Caste	Sources of Water
Time to	Plain	1					
collect	Plateau	1					
water	Total	1					
Distance of	Plain	.776***	1				
water source	Plateau	.784***	1				
	Total	.776***	1				
MPCI	Plain	-.167**	-.167**	1			
	Plateau	-.073	-.097	1			
	Total	-.135***	-.152***	1			
Family size	Plain	-.075	-.102*	-.193***	1		
	Plateau	-.076	-.126*	-.394***	1		
	Total	-.095**	-.136***	-.261***	1		
Caste	Plain	-.262***	-.256***	.219***	.021	1	
	Plateau	-.038	-.114*	.079	.258***	1	
	Total	-.148***	-.189***	.167***	.140***	1	
Sources of	Plain	-.469***	-.455***	.092	.090	.183***	1
Water	Plateau	-.431***	-.479***	.058	.152**	.087	1
	Total	-.467***	-.493***	.101**	.131***	.152***	1

*** P <0.001 , ** P <0.01 , * P < 0.05

Source: Computations based on personal field survey.

collection time and distance of water source from the houses is -0.563 and -0.676 in area of plain whereas in plateau, it is -0.566 and -0.784 respectively. In total study subjects it is -0.582 and -0.741. It is also evident that duration of collection time and distance of water source is negatively highly significantly correlated with level of water consumption in both area as well as combined together. The monthly per capita income is positively and significantly correlated with water consumption level which is accounted as 0.171,0.167 and 0.186 in plain, plateau and both respectively.

Number of family members correlation co-efficient is calculated 0.072 in plain, 0.068 in area of plateau whereas it is 0.091 in total area of study but significant correlation is observed on consideration of total respondents. water consumption level is significantly positively correlated with caste but in plateau area it is positively correlated but not significant and on considering total respondents in the study, a highly positively significant correlation is observed between caste and water consumption level. Source of water correlation coefficient is 0.451 in plain area, 0.509 in area of plateau while it is 0.507 in total area of study which clearly shows that this is positively and

statistically highly significantly correlated with amount of water consumption in plain, plateau as well as for total area respectively (Table-9).

The estimation of correlation coefficient amongst different type of effective variables which are responsible for the level of consumption pattern in different type of study area has been done and presented in Table-10. The present table also projects the pattern of multi co-linearity within each specified variables. It is found that time of water is positively & significantly correlated with each other in plain, plateau and for total area respectively.

Conclusion

Sustainable development of water supply system is totally dependent upon accuracy of estimation of water use. In the present study, the sources of water are negatively and significantly correlated with time to collect water and distance of water source over the entire study area while positively correlated with MPCI (monthly per capita income), family size & caste in both type of area but significant association is seen with caste in plain & with family size in plateau respectively. The correlation between caste & MPCI is found to be statistically significant in plain but not in plateau. Thus it may be concluded that all the effective variables are significantly or insignificantly correlated with each other. Multi co-linearity relation also exist amongst these variables. With the help of this study we can optimize the use of water. After getting the knowledge of consumption pattern we can give suggestions to provide water to needy population and check the water wastage too. Information dissemination, education, higher tariff may change consumption habits of the people.

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An Analytical Study of Traffic Volume and Noise Level in Lucknow City

Dipak Prasad and Srabani Sanyal

Increasing emission from vehicular traffic, industry and other human activities possess potential risks of increasing noise level in urban areas. In India, the number of registered vehicles was 0.3 million in 1951 which increased to 142 million by, 2011. As a result noise level in many Indian cities are above the permissible limit of NAAQS, like in Lucknow city, (26º30' N to 27º10' N latitude and 80º30' E to 80º13' E longitude) with average noise with of 78.5 dB(A).

According to recent epidemiological studies more than thousands of premature deaths and health related problems are attributed to increasing noise level. The assessment of noise pollution is important for understanding the nature of ambient noise and its relation with traffic volume. In this paper an attempt has been made to analytically study the traffic and noise level in Lucknow city.

It is obvious from the result acquired through the statistical analysis that traffic volume is positively correlated with noise generated in specific areas. It is apparent from the study that there is a need for proper traffic management, abetment of law and involvement of people in mitigating the problem.

Key Words: Vehicular composition, Traffic induced noise, Noise level.

Introduction

Noise pollution is not an entirely new phenomenon, but rather a problem that has steadily grown with time due to increasing population, urbanisation, industrialization and technological change. Noise, like odour, is a form of environmental stress that produces direct sensation. Environmental noise is unwanted or unpleasant outdoor sound generated by transport and industry (Singh, 2004). According to Shrestha (1985), Singh (2004), Sisman (2011), Tandal et al (2011) Vijayalakshmi (2003), vehicle engines, loud and prolong horns, road-tyre friction, gear box and exhaust system are major sources of noise pollution. Traffic related noise accounts for nearly two-third of the noise generated in an urban area. Traffic noise on existing urban road-ways lowers the quality of life and property values for persons residing in vicinity of these urban corridors. In India, many of the million- plus cities are anguishing from the problem of noise pollution on account of unacceptable growth in automobiles and other sources of noise pollutants. Cities like Kolkata, Chennai and Bengaluru have recorded noise level well above the permissible limit with 75

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dB (A), 66 dB (A), 57 dB (A) and 59 dB (A) respectively.

According to preliminary results from the Environmental Burden of Disease (EBD) study in six European countries in 2010, traffic noise was ranked second among the selected environmental stressors evaluated in terms of their public health impact. The effect of noise as studied by Joshi et al. (2003); Janssen et al.(2011); Maheshwari et al.(2012), Mead(2007); WHO (2011); Berglund (1999); American Council for Headache Education (2000); Barber et al. (2010); Cohen and Spacapan (1984); Dev et al.(2002); Goines and Hagler (2007), Hayes et al. (2010); Ismail et al. (2009); Kisku et al. (2006); Mishra et al. (2010) categorically identified the effects of noise on human health.

Material and Methods

Study Area

Lucknow is the '*City of Gardens*' of Uttar Pradesh owing to beautiful parks and gardens. The city is located in Middle Gangetic Plain, from 26º30'to 27º10' latitude and 80º13' to 80º30' longitude (Fig.1). The average slope is 123 mt. above mean sea level towards north-south and south-east with an imperceptible fall of 1' (one feet) per mile. The general monotony of the land is broken by the rivers Gomti, Kukrail, Loni and Beta etc. It has a sub-tropical climate with cool dry winter season (Dec - Feb) and hot & humid summer (Mar -Jun). The average temperature is about 45ºC in summer and 30ºC in winter, with annual rainfall of about 100 cm (Meteorological Centre, 2010). According to Census 2011, the total population is reported to be 2,815,601 persons. The geographical area of the city was only 48 sq. km in 1951 which increased upto 310 sq. km. in 2011. As the city is expanding, new streets are being built and added to the existing network. Today, Lucknow has become victim of noise pollution due to growth in number of registered vehicles (84,331 in 2013). This problem has exaggerated due to encroachments, heavy vehicles running through the city on National Highway 24, 25, 28 and 56 and location of four bus terminals e.g. Charbagh, Kaisherbagh, Alambagh and U.P.R.T. Corporation (Sanyal, 2012). Keeping in view the present status of Lucknow city, following are the major objectives of the study (1) to model noise levels based on traffic characteristics and (2) to investigate the changes in noise levels at different locations.

Noise level measurement and vehicular composition

It is important to illustrate noise level to facilitate better interpretation of the results so that responsible authorities can apprehend the extent of any problem or the potential impact of any mitigating counter measures. For this purpose modelling of noise levels based on traffic volume at different sample stations were carried out. In the current study 14 sample stations were studied. These sample stations are shown in Fig.1. The aim was to obtain and compare direct data and to identify how noise levels vary from one location to another. Two parameters were measured at each location:

- Noise level in dB (A)
- Traffic volume

Noise levels in dB (A) were measured using decibel meter. For each measurement, the instrument was fixed at a height of 1.5 m from ground level. Noise levels were measured during peak hour (between 9.00 am to 11.00 am and 05.00 pm to 7.00 pm) and non peak

hour (between 12.00 pm to 2.00 pm and 8.00 pm to 10.00 pm) for seven continuously working days.

The composition of vehicle is important for modelling the measurements (traffic volume and noise level) and for assessing the possible success of mitigating actions by encouraging alternative modes of transport. Consequently, traffic flow was determined for five vehicular types (i.e. cars, motorcycles, buses, trucks and bicycles) alongside the noise measurements. Motorcycles were found to be the predominant vehicle type (80.26%) followed by cars (13.69%) and trucks (1.60%),buses (0.24%) and other including bicycles (3.16%) in the Fig. 1 city. This shows that cars and motorcycles are a popular means for commuters and bicycles are used much less. In addition, public transport is probably under-utilised because of its limited efficiency and lack of infrastructure (road, connectivity bus stands etc.).

Modelling noise level

In order to model noise levels based upon traffic characteristics, an independent variable was assumed to have an impact on

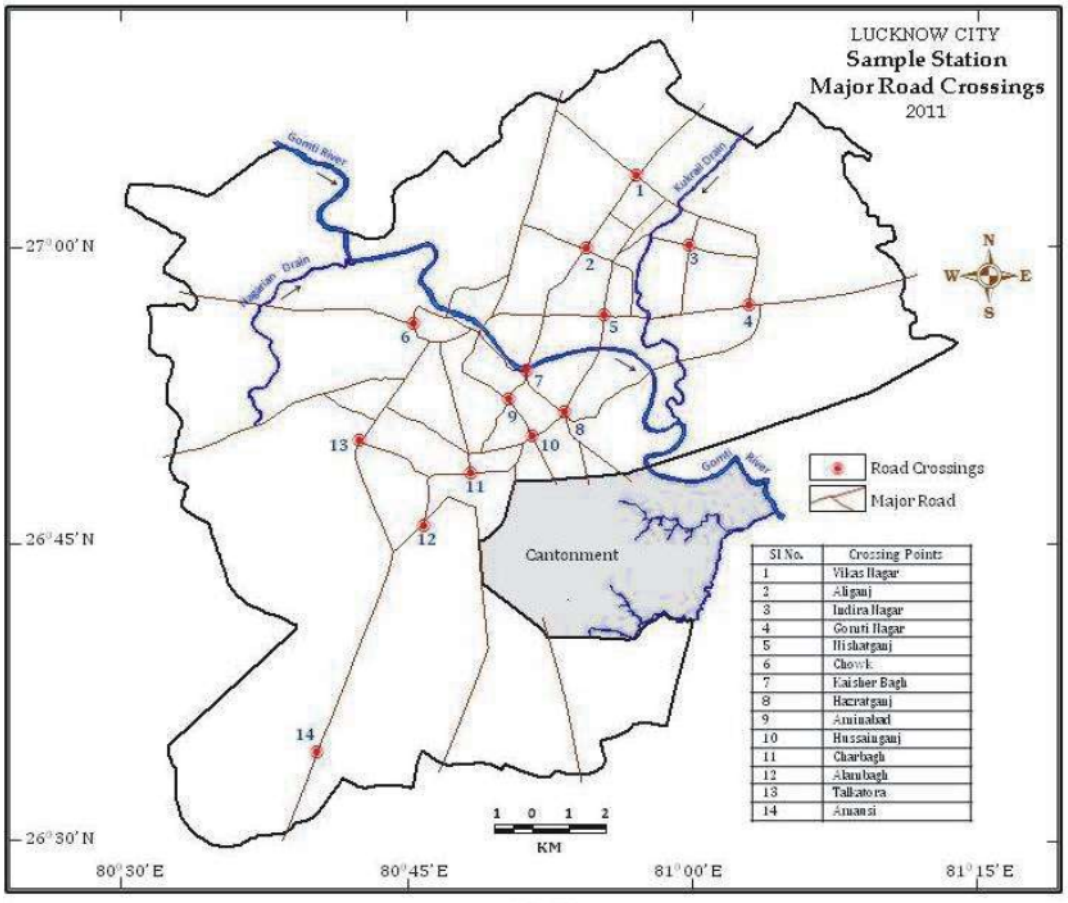

Fig. 1

Table 1: Correlation between variables

Traffic Volume/Noise Level		Vehicle /hr.	Day Peak hr.	Day Non-peak hr.	Night Peak hr.	Night Non-peak hr.
Vehicle/hr	r	1	.848**	.971**	.864**	.956**
	Sig.		0	0	0	0
Day Peak hr.	r	.848**	1	.886**	.894**	.818**
	Sig.	0		0	0	0
Day Non-peak hr.	r	.971**	.886**	1	.888**	.948**
	Sig.	0	0		0	0
Night Peak hr.	r	.864**	.894**	.888**	1	.897**
	Sig.	0	0	0		0
Night Non-peak hr.	r	.956**	.818**	.948**	.897**	1
	Sig.	0	0	0	0	

Source: *Personal Computation, 2012 ** Correlation is significant at the 0.01 level (2-tailed), r: Correlation, Sig.: Significant*

Table 2 : Statistical Results of Predicting the Dependent Variables

Variables		R	R^2	t	Significant (p)
Independent	Dependent				
Vehicle/hr.	Day Time (Peak hr.)	0.848	0.718	5.531	0
Vehicle/hr.	Day Time (Non-peak hr.)	0.971	0.944	14.183	0
Vehicle/hr.	Night Time (Peak hr.)	0.864	0.747	5.951	0
Vehicle/hr.	Night Time (Non-peak hr.)	0.956	0.915	11.351	0

Source:*Personal Computation, 2012*

the traffic induced noise levels. Statistical relationships between the variables were examined using the linear regression (i.e. stepwise method) in SPSS (version 20.0) (Table 1).

Result showed that there is a positive correlation between some of the independent variables (vehicles). Therefore, in order to omit collinearity, the most relevant variables were selected and the rest excluded. Noise level in dB (A) was then regressed against the independent variables using linear regression (Table 2).

Result

The present study investigate changes in noise level and assess traffic volume at different locations (road intersections). The table 2 depicts perfectly positive correlation between traffic volume and noise level.

The correlation between number of vehicle and day time noise level during peak hour is 0.848 whereas, coefficient of determination (R^2) is .718; therefore, about 71.8 percent of the variation in the noise level is explained by number of vehicle/hr. Constant

represents the y-intercept and the number of vehicle/hr represent our slope. The equation of the line found from the output is

Y (Peak Hour day time) = 72.544 + .004 (Vehicle/hr)

Value of 't' (5.531) is significant at the 1 percent level of significance.

Correlation between number of vehicle and day time noise level during non peak hour is very high (.971). R^2 value is .944 it means that proportion of variance in Y that is: explained by knowledge of X. For our data, approximately 94 percent of the variance in Y can be accounted for knowledge of X. Constant is equal to 63.008. This means that the least squares line touches the ordinate axis at a value of Y = 63.008. Equally it is also the predicted value for Y when X = 0. Hence,

Y (Non-peak Hour day time) = 63.008 + .006 (Vehicle/hr)

The values obtain for 't' is 14.183, which is significant only at 1 percent level of significance (Table 3).

Study on number of vehicles/hr and noise level during night time peak hour reveals that correlation between number of vehicles/hr and noise level at night time peak hour is highly correlated with each other (.864). R Square is computed as R to the power of 2 that is 0.747; therefore, about 74.7 percent of the variation in the noise level is explained by number of vehicle/hr. The regression equation appears to be very useful for making predictions since the value of R^2 is closer to 1 rather than 0. The constant represents the y-intercept and the number of vehicle/hr represents our slope. The equation of the line found from the output is

Y (Peak Hour Night time) = 69.275 + .005 (Vehicle/hr)

The tabulated values of 't' (5.951) at 1 percent levels of Significance for 12 degree of freedom (n-2, where n is 14) 3.01. It is obvious that our calculated value is significant at 1% level of significance. So we can say that the variable y (noise level) is associated significantly with number of vehicles/hr.

Correlation between number of vehicles/ hr and noise level during night time non peak hour is also found high (0.956). About 91.5 percent variation in the noise level is explained by number of vehicles/hr. The equation of the line found from the output is

Y (Non-peak Hour Night Time = 49.718 + .008 (Vehicle/hr)

Scatter plot shows the relationship between observed and predicted values of noise level (fig. 2).

Discussion

Lucknow city has grown all around in a radius of 25 km. However, transport infrastructure has not grown correspondingly and is therefore highly inadequate. Encroachments have further narrowed down the roads and result into slow traffic, heavy congestion and noise pollution in the city. The result reveals that the average noise level in the city has reached up to 74.4 dB (A) which is quite significant due to huge influx of vehicles.

The volume of vehicles recorded at Vikas Nagar, Aliganj, Indira Nagar, Gomti Nagar and Nishatganj sample stations in the residential areas are 1939, 1957, 2298, 2919 and 2995 respectively. Whereas, commercial areas like Chowk, Kaisherbagh, Hazratganj, Aminabad, Hussainganj, Charbagh and Alambagh have recorded 1939, 1957, 2298, 2919 and 2995 vehicles respectively. The Talkatora and Amausi industrial areas recorded 1521 and 1775 vehicles respectively.

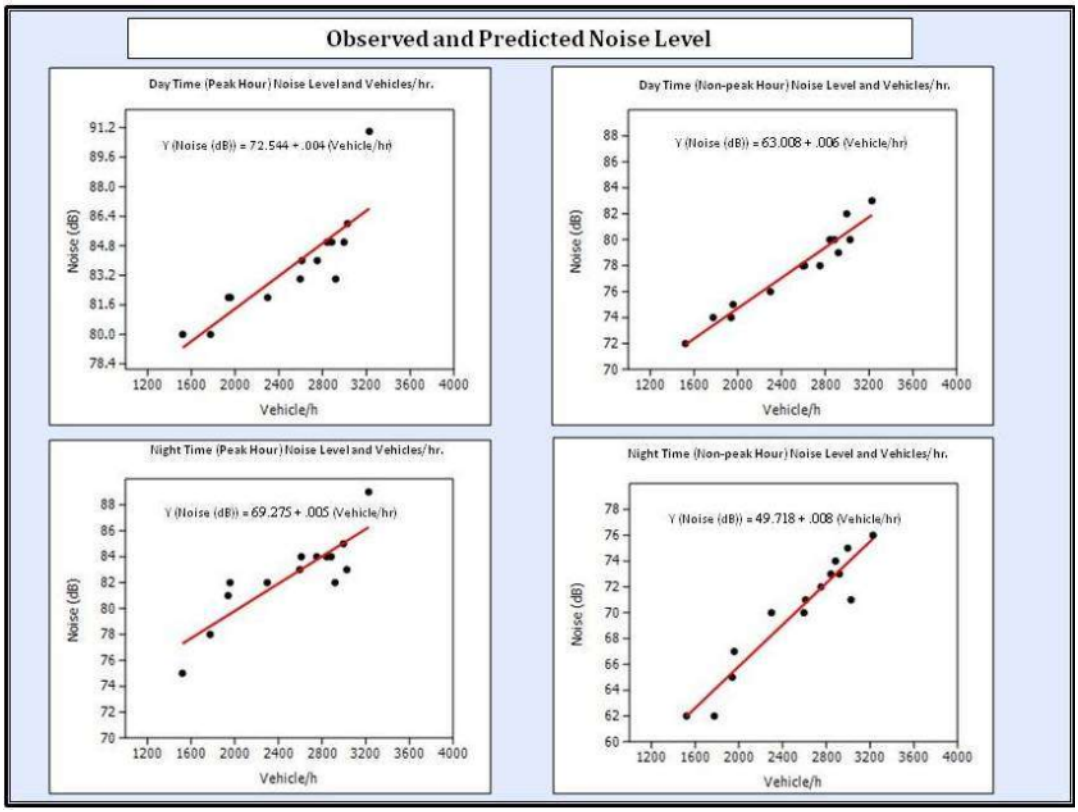

Fig 2

In residential areas, the day and night time noise level were recorded to be from 83.5 to 78.0dB (A) and 80.0 to 73.0 dB (A) respectively. The day time noise during peak hours ranged between 85.5 dB (A) at Nishatganj to 82.0 dB (A) at Vikas Nagar and non- peak hours ranged between 82.0 dB (A) at Nishatganj to74.0 dB (A) at Vikas Nagar, whereas, night time noise during peak hours ranged between 85.0 dB (A) at Nishatganj to 81.0 dB (A) at Vikas Nagar and non-peak hours ranged between 75.0 dB (A) at Nishatganj to 70.0 dB (A) at Indira Nagar. All these values were much higher than the prescribed limit of 55 and 45 dB (A) for day and night time respectively. In commercial and traffic area the day and night time noise levels were recorded from 87 to 80.5 dB (A) and 76.5 to 82.5 and dB (A) respectively. The day time noise during peak hours ranged between 91.0 dB (A) at Charbagh to 83.0 dB (A) at Kaisherbagh and non-peak hours ranged between 83.0 dB (A) at Charbagh to 78.0 dB (A) at Chowk, Kaisherbagh and Alambagh.The night time noise during peak hours in these areas ranged between 89.0 dB (A) at Charbagh to 83.0 dB (A) at Kaisherbagh and Hazratganj and non-peak hours ranged between 76 dB (A) at Charbagh to 70 dB (A) at Kaisherbagh. Noise in the commercial areas during day and

night time were found above the prescribed limit of 65 and 55 dB (A) respectively. In industrial areas the day and night time noise level was recorded between 76.0 to 77.0 and 70.0 to 68.5 dB(A) at Amausi and Talkatora sample stations respectively. Noise level in the day time were all above the prescribed limit of 75.0 dB (A) except during the non-peak hours, whereas, during night time except Amausi 78.0 dB (A) rest of the stations recorded noise level below the prescribed limit.

It is obvious from the result acquired that traffic volume is positively correlated with noise in specific areas. During day time peak hour coefficient of determination is .718; therefore, about 71.8 percent of the variation in the noise level is explained by number of vehicle/hr. whereas during night time coefficient of determination is 0.944, thus approximately 94 percent of the variation in the noise level is explained by number of vehicle/hr. The correlation between noise level and traffic volume during day time in peak hours is 0.848 while in night time it increased to 0.864. This may be due to activities such as construction of highways, city streets and buildings; industrial works such as noise fans, motors, and compressors; noise in building from plumbing, boilers, generators, air conditioners and fans. Due to fewer activities in the night time, noise level declines.

In summary, a conclusion can be drawn that it is essential to widen the roads along with one-way traffic in congested areas like Kaisherbagh, Nak Hindola, Rakabganj, Chowk, Aminabad, Hazratganj, Nishatganj, Lalkuan, Indira Nagar and Charbagh to avoid heavy influx of traffic and noise pollution. Although, local administration has constructed flyovers at Nishatganj and Rajendranagar, but still more flyovers are needed. The rail line and highways should be preferably routed away from the residential and commercial areas. Heavy vehicles should not be allowed to enter the city during peak hours. Further, improvement in traffic management and stringent execution of traffic rules should be applied where there is a need. Strict implementation of such rules can also help to reduce the load of vehicles and noise generated in Lucknow city.

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