WATER RESOURCES: AVAILABILITY AND UTILISATION IN THE TEL RIVER BASIN IN ORISSA

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MASTER OF PHILOSOPHY

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CERTIFICATE

I, **Prakash Chandra Dash**, certify that the dissertation entitled "**WATER RESOURCES: AVAILABILITY AND UTILISATION IN THE TEL RIVER BASIN IN ORISSA**" for the degree of **MASTER OF PHILOSOPHY** is my bonafide work and may be placed before the examiners for evaluation.

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Prakash Chandra Dash

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CHAPTER-I

INTRODUCTION

Of all the substances that are necessary to life, as we know it on Earth, water is by far the most important, the most familiar and the most wonderful, yet, most people know very little about it. - Thomas King

In general water seems to be an abundant resource on earth because three quarters of the entire surface of the earth is covered by water. However, around 98 per cent of this water is in the oceans and only 2.7 per cent each fresh water. Of this fresh water 75 percent lies frozen in the ice-caps; 22.6 per cent is present as ground water some of which lies very deep. Thus only a small fraction is available for human use which are found in rivers, lakes, atmosphere, soil, vegetation and exploitable ground water aquifers. There is a finite quantity of water on earth and this is neither added nor destroyed. The water available to the human civilisation as a whole today does not vary from what was available thousands of years ago in quantity. With the rapid growth of population and change in the lifestyle of people, a scarcity of water is apprehended as the quantity of water available to us is the same. However, with proper demand management economy use of water extensive local water harvesting and watershed development the crisis of this emerging water scarcity can be minimised to a great extent.

The very facts that India has a tropical location and enjoys a monsoonal climate, we the Indians, are destined to face fluctuating supply of water. Thus management of the country's water resources assumes paramount

importance. Water as a resource being closely associated with other natural resources as well as being a vital necessity of life (both biological and socio-economic), it demands an integrated approach in its management. "River basins because of their intrinsic ecological integrity were ideally suited territorial units for undertaking comprehensive programmes for economic development"[1]. In the later years, management of watersheds has been widely taken as an approach for the development of the river basin. "By capturing scarce water resources and improving the management of soil and vegetation, watershed development has the potential to create conditions conducive to higher agricultural productivity, while conserving natural resources."[2] (Kerr, John, 2002). Obviously watershed is a justified unit that can be taken up as a planning region for development because it satisfies both the essentials of formal and functional criteria of regions, by displaying homogeneity in terms of similar physiographic characteristics and functional linkages between various other factors, which are closely intertwined, alteration of one leading to a change in the others. This makes the integrated approaches of management still more important. "A truly integrated, holistic planning for a basin or a sub basin would involve an interdisciplinary planning, marrying land and water use, harmonizing diverse water use."[3]

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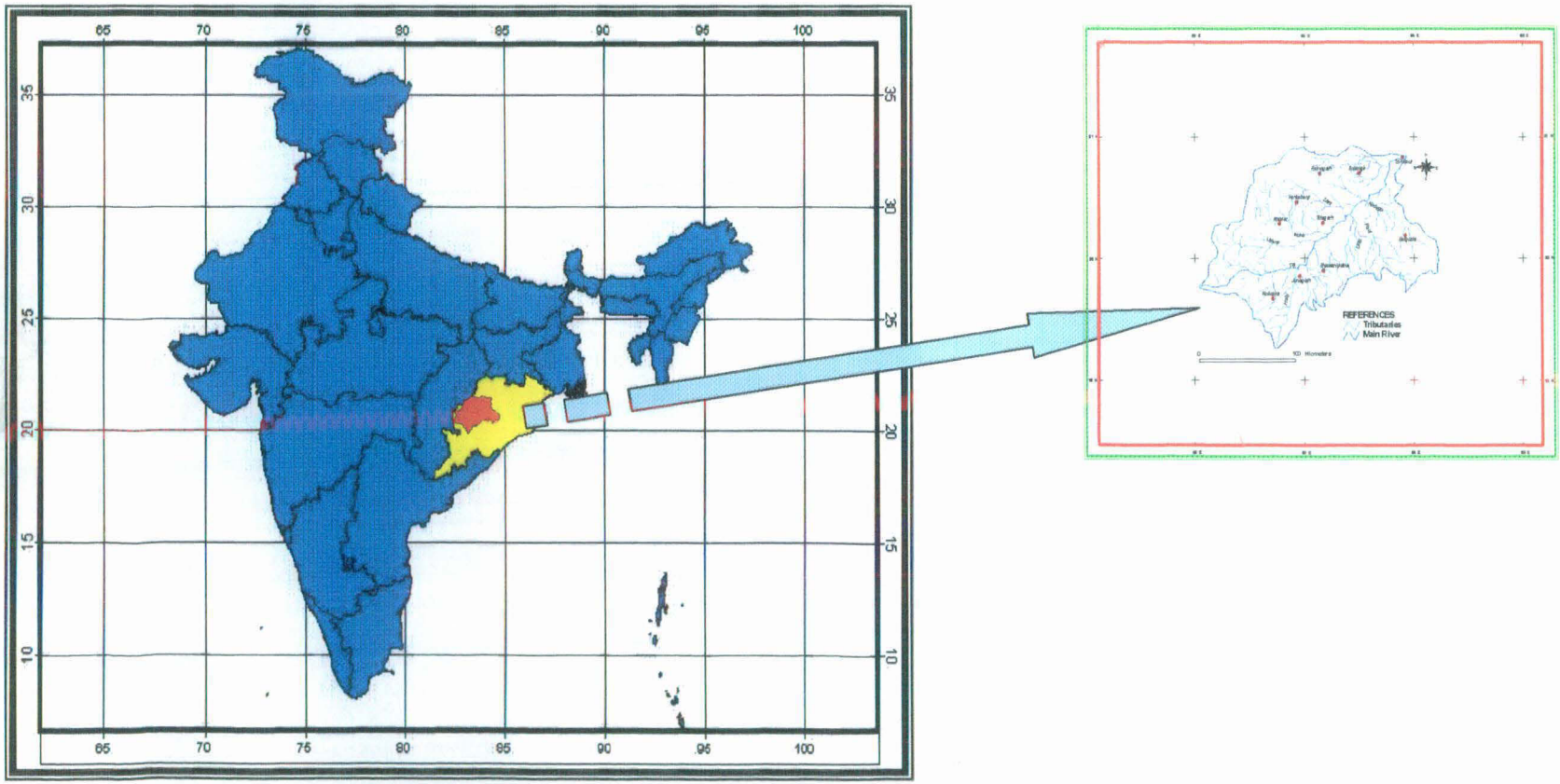
1 Barrow, Christopher. J & S.K Saha,(1987) *River Basin Planning –Theory and Practice* pp9

2 Kerr John (2002) , Water shed Development Projects in India, An Evaluation, Research Report 127. IFPRI, Washington DC.

3 Char, NNV (2000): *Development of River Basin Organizations*, Institute for Resource management and Economic Development, International Conference on Sustainable Development water Resources,

LOCATION MAP

TEL BASIN



1.1 The Study Area

The Tel river is the most important right bank tributary of the river Mahanadi. The catchment area of the Tel river spreads over the districts of most of Bolangir, kalahandi and part of Phulbani, covering a total area of more than twenty thousand square kilometers. The area has an undulating relief and characterized by semi arid climate. The average annual rainfall is 143, which comes mostly over a four months period from June to September. The hot season mean daily temperature is 41.4 degree celcious and daily mean minimum temperature is 27.5 degree celcious. Rainfall being highly erratic, people traditionally store water in tanks for its use (both for agriculture and domestic purpose) during the rest of the year. "Due to their ingenuity of design and location of Tanks continue to serve as a sustainable source of protective irrigation for crops. However, their usefulness is severely restricted by age and lack of maintenance."(Sengupta, 2000). Agriculture being the mainstay of the area water scarcity has to be taken care of, for this various watershed projects are being implemented both under govt. departments as well as non-governmental organizations.

1.2 Literature Review

Iyer (2001)[4] attempts to examine the criticisms to the World Commission on Dams and makes a plea for allowing a debate on the various issues raised rather than to move towards an uncompromising polarization of views. Iyer has raised doubts over the section of govt moves (in this case that

[4] Iyer RR (2001): "World Commission on Dams and India: Analysis of a Relationship" *Economic and Political Weekly* 23rd june 2001

of MoWR) to join and deliberately withdraw from the WCD and the way they tend to argue and reject out rightly a move that Iyer thinks is genuine. The main reasons for which large dams are protested are 1.expected benefits continually failed to achieve 2.the lopsided cost- benefit analysis 3. ultimate irremediable consequences 4. the vary acts of planning , construction ,implementation and operation for large dams have not been a contributor to equity and social justice 5. non consideration of alternatives, less hazardous. Iyer has clarified that the WCD is not anti-dam, as pointed out by MoWR but the WCD has points of criticisms against the manners in which projects have been planned evaluated approved and implemented in the past. The WCD advocates improving planning and decision making in the future, drawing lessons from past experiences. It re-stresses the Dublin –Rio principle of stakeholders' consultation and participation. It endorses the imperatives of sustainability. It urges the consideration of options and alternatives. Iyer rightly recognizes the fallacies in many of the arguments in favour of the dams as given by the MoWR, viz. 1. that the ethically neutral term of stake holders has been misused by the ministry in that it gives almost equal importance to stake losers (the land losers)and the stake gainers like those getting windfall gains in terms of irrigation, electricity etc 2.the simple argument of – in a parliamentary democracy , the interest of the masses is presumed to be taken care of by the representatives , govt. executive accountable to them .If so there would not have been so much efforts being

put to the empowerment of people or the concept of grass-root participation , the buzz words of modern developmental efforts .

Raising cautions regarding the prevalence of the spirit of intolerance in the air, Iyer pleads for rational thinking. He rightly points out, the anger of the dam builders has led them to rebel against even accepted principles such as equity, consultation, participation, consideration s of options and alternatives and sustainability etc.

Bandopadhyaya et.al(2002)[5] try to formulate an acceptable plan to break the dead lock created by the WCD and the outright rejection of it by the MoWR . The authors are of the opinion that the major cause of opposition has been the dismal and sometimes the inhuman record of resettlement and rehabilitation. Eighty percent of the displaced are due to development related projects and fifty eight percent are linked to water resource projects. In Orissa and Andhra Pradesh, only 27.69% and 25.85% of the dam displaced have been rehabilitated respectively. Since most of the displaced are the weaker section of the society it calls for the redressal of the displacement and compensation needs, through a widely acceptable distribution of losses and gains. Pointing to the inadequacy of the 2nd irrigation commission report 1969, which only outlined technical and administrative issues the authors call for a proper three set of guidelines viz. guidelines along social pathways, environmental pathways and, complete economic assessment and pricing of water pathways. The authors have accepted most of the guidelines of the

[5] Bandopadhya,j.,Mallik,B.,Mandal,M.,Parveen,S (2002): "Dams and Development, Report on a policy Dialogue". *Economic and Political Weekly*, vol 37(4), Oct, pp4108-4112.

WCD and in addition to these they have emphasized on the following points like 1.creation of an interdisciplinary knowledge base with a transparent process of comprehensive evaluation of technological interventions with reliable data, freely accessible to all stakeholders, where the local media like newspaper and radio can play a crucial part 2.proper EIA including impact on soil, genetic resource and habitat 3. Rehabilitation being a process leading to sustainable living, it needs to be based on the principle that the lifestyles of those displaced should be better off than before the project, and most importantly 4. Proper assessment of the technically viable and socially acceptable options to meet the growing need for the water before a dam opinion is accepted, to evolve a truly inter – disciplinary approach towards water resource management.

Bagchi (1995)[6] tries to trace the historical and social aspects of managing irrigation system in India since 229BC. The book examines the potentials and significance of user-friendly, ecologically compatible irrigation systems, which are part of our culture and tradition.

While big irrigation projects have definitely contributed to the manifold increase in our food production, they have also turned millions of hectares of agricultural land barren, saline wastelands. Bagchi opines it is high time we looked seriously the indigenous methods of management of water resources which used to be employed by our village level scientists (the farmers) and communities devoted to the development and maintenance of

[6] Bagchi Kathakali S, (1995): *Irrigation in India :History and Potential of Social Management* , Upalabdhi-Trust for Developmental initiatives, New Delhi

irrigation works. The book is presented in a well-structured discussion of the history, potentials of irrigation development in India. It presents a tabular presentation of the milestones in the development of irrigation in India since the pre historic period (7000-6500BC), when people started using bunds and canals (in Indus valley civilization) till the end of 1980s.The entire period of study has been divided into three periods viz. ancient, medieval and modern and each period's irrigation development initiatives have been elaborately discussed. Successful attempts as well as drawbacks of various irrigation practices both type and distribution wise has been lucidly presented. The last chapter of the book entitled community management of irrigation summarizes the history and management of traditional system of irrigation in India with special emphasis on Tank irrigation and the social institutional factors of irrigation management in the country.

Tube well capitalism refers to the investments in the power –driven extraction of water through progressively more advanced technologies culminating in deep tube wells. Iyer (2001)[7] detailed account of the miracles brought by the extraction and use of ground water .The strength of the book lies in 1. accounting the elaborate case studies, 2. the multifold interaction with repeated stress among nature, technology society and institutions, and 3. Multiple theoretical perspective to study .The book rightly takes note of the issue of depletion of ground water and calls for a broad framework of its management through neither solely by central or local initiatives rather by one

[7] Iyer RR (2001): review article of the book by Dubash Navroz K, "Tube well Capitalism: Ground water development and Agrarian Change in Gujarat", *Economic and Political Weekly*

emerging out of the close integration of these two that can stop the farmers who are preparing for the inevitable abandonment of agriculture in the not too distant future. This clearly underscores the point that water harvesting measures could have been wisely associated with a lesser technology of drilling (in stead of very deep drilling) and the process of development could have been made more sustainable, and the very unholy idea of abandoning the villages could have been shelved. Certainly in the land of Gandhiji this is not development, rather greed, perhaps.

Shah (1999)[8] holds a great hope from watershed development programmes and terms it as a way of taking the revolution of India's independence to rural areas especially due to its participatory approach. However he rightly points out some structural flaws in the ways watershed development is being persuaded. He calls for the structural revamping of the DRDA, creation of a monitoring system beyond the routine physical and financial reporting, right selection of NGOs for the execution of the projects and above all a dynamic system of monitoring and evaluation approach, more flexible and realistic

John Kerr (2002)[9] in collaboration with Ganesh Pangare and Vasudha Lokur Pangare has raised important issues related to water shed development practices , all derived from their study experiences , viz. the role of non governmental organization and NGO and government in devising locally

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[8] Shah Anil C., (1999): "Unique strength and Flaws in Water shed development", *Journal of Rural Development*, vol 18 (4)

[9] Kerr John (2002): *Water shed Development Projects in India, An Evaluation, Research Report 127*, IFPRI, Washington DC,

acceptable social arrangements for watershed interventions. Contrary to the long held views, they have opined that at times water shed development project can actually make women and land less people worse off by restricting their access to resources that contribute to their livelihoods. Kerr pleads for caution for those who take watershed projects as the panacea for all problems and has underscored the need for greater fulfillment of prerequisites for the successful implementation and optimum derivation of benefits from the projects.

Reddy and Rao(1999)[10] throw much essential light on the constraints found in the Watershed Development practices in the early (twenty years) period like its inherent nature of top down approach, supply-demand mismatch, unsustainability of the programmes, lack of a holistic and inter disciplinary approach, adoption of high water intensive crops in the watershed area etc .The authors have opined that it is high time we recognized our drawbacks and learn important lessons from our long past experience.

Char (2000)[11] presents a brief discussion on the concepts of sustainable and integrated development approach. The paper can be divided into four major parts viz. 1. Appraisal of water situation in each country or region 2.a retrospect of the existing organization for basin development 3.identifying the criteria for developing sustainable river basin management 4.evolve an organizational model for individual basin as applicable to each

[10] Reddy Sanjeeva, Rao Prasada, (1999): "Watershed Development Programmes in India, Experience, Issues and Future Agenda", *Journal of Rural Development,* vol 18 no.(3),pp335-358,NIRD,Hyderabad

[11] Char, NNV (2000): *Development of River Basin Organizations*, Institute for Resource management and Economic Development, International Conference on Sustainable Development water Resources.

country bilaterally or the region as a whole .The paper calls for giving due importance to both demand side and supply side of water use. Looking at the under utilization of the various past projects, Char opines that a better-integrated approach, if taken, in the project could have brought in a better result. The paper calls for inclusion of even non-statutory body like NWRC, if they are important in terms of influencing decisions and implementation of the models of development. It underscores the preamble to the office order of the (MOWR) that states, "Integrated water resource development of both surface and ground water can optimize benefits resulting in economic use of water". Char emphasizes on the greater need of including the participative approach of functioning and to make it more effective, stakeholders' representatives like MPs, MLAs should also be made members of any River Basin Organization, at whatever level. Highlighting the increasing demand – supply gap of water in the years to come, Char pleads strongly to make earnest attempts in the fruition of evolving effective RBO and making it integrated and sustainable. He calls for a more pragmatic approach of water resource management with the inclusion of the concept of partnership, computer simulation model and consumptive use of water etc.

Sengupta (2000)[12] has taken an earnest and honest effort to understand and explain the frequent occurrence of droughts in western Orissa in the last hundred years. Sengupta is of the opinion that the area has a long and rich history of tank irrigation, but are presently in a neglected condition, and if

[12] Sengupta, Sohini (2000): " Political Economy of Irrigation, Tanks in Orissa", *Economic and Political Weekly* 30 December, 2000,pp4695-4700

could be revived and maintained properly, it can greatly mitigate the calamity, provided equity in land distribution is ensured. Tracing the history of tank irrigation and stressing the importance of traditional knowledge Sengupta puts- the tribal agriculturists used the undulating topography to grow a diverse range of crops. They were expert water technologist and built small embankments on the highest level of land to harvest rainwater. In normal years agricultural lands gained from seepage, in years of erratic rainfall the dams walls were cut and water flowed to protect the growing crops. Above the uplands were the forests, which provided organic nutrients for the uplands and recharged the hill streams. She discusses history of ownerships of tanks in details and holds that the decline of tank to be a result of its change of ownerships to panchayat (which made people think that provision of irrigation is solely a task of govt.), and the completion of Hirakud dam (resulting in a stark disparity in productivity of rice in canal and tank irrigated area). This decline of tanks made the area vulnerable to drought in later periods, though there is little variation in rainfall in the kharif season (of 1899,1900,1935,1982,1987,1996). The author has categorically mentions about the rampant corruption and inefficiency prevalent in the various govt. programmes like EAS, DPAP, and IRDP etc. It is happy to note that tank irrigation has gained prominence in recent years. Tanks have various advantages over other alternatives as water harvesting structures, in terms of checking soil conservation, improvement in the moisture content of the soil and recharge ground water through seepage, attainment of multifarious

benefits at a very low cost, can be constructed and maintained by the local community, and unlike big dams they do not submerge valuable agricultural land and forest or displace local population. However the author rightly emphasizes the urgency of equitable distribution of land for the optimum success from the tanks to act as a protective mechanism for drought and water scarcity in Orissa.

"In drought years, the use and distribution of tank water has become a major bone of contention in many villages. The land less or marginal holders with no land in the command area object to the cutting of the embankment to irrigate kharif crop in scarcity years by the land owner class, rather they would prefer to retain it for bathing drinking and domestic use. The second kind of contention is again between those who want to do pisciculture in the tanks as against those who would rather raise a summer crop in the command area."

Selbourne(2000)[13] emphasizes on the notions of solidarity, social justice, equity, water as a common good and ecological stewardship of our time. The author opines that ethical guidelines should reflect the concept of sustainable development and environmental justice under pinned by equity: equity between geographical entities, between the industrialized and developing world, between rural and urban population, between generations and between the managed and managers. He says water scarcity is not absolute, but frequently an outcome of inequities of wealth, knowledge and

[13] Selbourne, Lord, (2000): "Guiding Principle on The Ethics of Fresh Water Use –A Survey" *UNESCO.*

resources, and alleviating it depends on tapping the potentials of local communities and making maximum use of their skills and experiences. Recognizing food security as a moral imperative it calls for ensuring that subsistence farmers have the right to water but it stressed for more efficient use of water agriculture, and gives a greater importance to the use of age old local expertise and techniques. In the context of protection of water Selbourne opines that maintaining ecological sustainability is one of the primary objectives of water ethics and hence natural environment has a right to water. It gives emphasis on the creation of a common platform and cooperation among various foras of society to induce water ethics in all.

Sharma (1999)[14] is of the opinion that Kalahandi has been the most favoured case study in point to showcase the dark side of India's story of development, studded with the most classic inadequacy of democracy albeit democratic values, institution and expectancy from it. It has been the window of typical problem like poverty amidst plenty and 'contributor-suffers-phenomena'. It has been another example of India being a follower rather than a leader. Some problems ailing the region is the dominant role of middleman, monopolized market, gross failure of Food Corporation of India, much needed but still unexploited resource potential, complete lack of empathy and respect for the traditional successful practices. It appears that India has a fascination for what is being followed in the west; running after the mirage even though some

[14] Sharm.Devinder (1999): " The Kalahandi syndrome", adapted from www.google.com.

factual evidences shows it to be fruitless. Prevalent irregularities in some echelon of bureaucracy have become the norm of the day. The most concerning and vital fact is that we are underplaying the case of starvation death and still claiming ourselves to be most democratic. Inspite of all these grey areas, India has many good things to offer too. There is very little in Kalahandi that the government can showcase as its success. However, the author concludes seeing and showing some rays of hope. If some steps like disbursing micro-credit, restoring the traditional irrigational practice, tuning in agricultural technology to the needs of the people and more importantly water conservation measures are taken up in earliest possible, the pride among a bruised and battered community can be brought back.

Shekharan(2001)[15] is of the view that be it long term unemployment, drought and crop failure, on displacement and chronic hunger, everything, in one of the poorest yet resource rich districts in India, is a struggle. The people and resource of the district have enriched the nearby urban centre Raipur as well as the wealth of the corrupt government officials. People out-migrate in order to access better economic opportunities and food security. Local NGO champions point that problem in the area range from long term unemployment to drought and crop failure compounded by the displacement and acute hunger.

[15] Shekharan.N (2001): "Drought: A way of life in Kalahandi", adapted from www.google.com.

Crop failure is an imported problem because it shoots out from the emerging and newly establishing wrong choice of cropping pattern with rapidly disappearing drought-resistant crop and lack of solid obtainable assistance from the state. Practice show that even during the year of insufficient rainfall, people managed to grow paddy with the help of one or two irrigation from traditional tanks. Now, scarcity of water both for drinking and irrigation is one of the biggest issues here. Whereas, the solution seems to be lying in smaller traditional tanks, the government stuck by the fancies of gigantism is taking up a vast tank digging at a cost of Rs. 7.5 lakh. According to the local experts this project is associated with unscientific choice of site with very hard soil. Shekharan concludes that well conceived projects, efficient planning and corruption free approach can only mitigate the problem of water scarcity in the region. Most importantly the participation of local people is a must and so is the restoration of their rights over the traditional resource.

Omvedt (2000)[16] opines that Kalahandi has never suffered any general or serious failure of crops and even in 1900, when all the neighbouring area were severely affected, Kalahandi knew only a slight scarcity. The devastating drought in Kalahandi infact began only after 1965. Kalahandi had been from the pre-independent times, a self sufficient district in food and in the 1960s & 70s, it was the third largest exporter of rice to other district of Orissa.

[16] Omvedt.G (2000): "Worst in a hundred years: The Kalahandi drought", Manushi, Vol XL.

Deprivation and marginalisation started with the transfer of rights over the traditional resources to the government. The drought situation aggravated with the pursuing of ill conceived and improper procurement price system of crops. The pervasive apathy of the state government to western Orissa has given rise to the most obvious and rightful separatist movement. Omvedt points to an important point that Kalahandi is poor due to lack of commercialization. There is lack of effective market and minimum visibility of MNCs. Rice and forest produce are solid but it is not their sale but the "low prices" people get from their sale, which keeps the people of Kalahandi district poor. Thus, omvedt opines that, the drought situation is not going to change by merely additional subsidies, rather the people of Kalahandi need more freedom to manage their lives and the process, but the near total state domination such as in western Orissa has proved disastrous.

Nayak (2004)[17] states that tribals live in forest, live with it and live on the forest produce. Thus, any unfavourable intervention on this resource and assoicated other natural resources has a big fallout on the tribals. Tribals account a sizable proportion in the district. The study of deforestation vis-a-vis the status of tribals assumes great importance as the satellite image show it to be only 10 percent. Although the region is a zone of ecological fragility, thousands of hectares of land and forest has been leased out to TNCs/MNCs for exploiting mineral resources. Though

[17] Nayak.K.B (2004), "Deforestation and Tribal Under-development: Facts from Kalahandi District of Orissa", *Social Action*, Vol.54, pp.77-92.

study done by NOAER suggest that the well known deposits of minerals in the district cannot sustain, as heavy mineral base industry and also that the exploitation of such resources has contributed little in terms of resource or employment generation as shown by Agrawal's study. Tribals in Kalahandi mostly depend on forest produce as the only source of livelihood for a period of 3-4 months viz. April-June during a normal year which is extended to a longer time during drought years. A recent sample survey shows changing trends viz. a large proportion of forest products which were earlier being collected for the purpose of consumption are now increasingly being sold in the market. It highlights the fact that how seriously and desperately the marginalised sections depend upon the forest produce for their existance. Even here the story of desperation does not end, as opined by Abani Panigrahi, Director Lok-drusti. About 40 percent of the income of the tribals is derived from forest produce; the prices paid to them for these items are lower than those paid in bordering state of Chhatisgarh. The situation is further aggravated by traders and Middlemen.

1.3 Objectives

1. To understand the physiographic set up of the basin vis-à-vis water resources in the Tel basin.
2. To study and analyse the rainfall characteristics and status of land resources in the basin.
3. To study the status of water resource development in the study area.
4. To look for the socio-economic-political aspects of under development in the basin.

5. To analyse the complex interplay of the above factors and suggests some measures to make the process of development a successful one.

1.4 Data Base

The present study mostly relies in the secondary source data such as

- Survey of India Toposheets
- Monthly and annual rainfall and rainy days-prepared by IMD, Pune.
- Indian Agricultural Statistics (1970-1999).
- Maps from National Atlas and Thematic Mapping Organisation (NATMO) and Survey of India- District Planning Map Series.
- Districts census hand book.

1.5 Methodology

The physiographic and other factors have been studied from the point of view of water resource development in the region. For the analysis of rainfall characteristics statistical techniques like standard deviation, coefficient of variation and for trend analysis moving average method have been used. For a better understanding of the basin area use and preparation of various thematic maps has been done using GIS techniques. To have an ease in understanding analyse data have been presented in graphical forms.

1.6 Organisation of Materials

The various aspect of the present study have been organised into various chapters keeping in mind availability and management of water resources in the Tel basin. The first chapter deals with the formation of a number of objectives that grows out of the previous works done on similar line, mostly based on the literature survey and personal understanding of the

problems grown out of meeting with some of personnels working in the region through some NGOs.

The second chapter deals with the physiographic characters like relief, drainage, climate, rocks and geology, soil, hydrogeology that forms a basic understanding regarding the water resource status of the basin.

In the third chapter detailed analysis on the pattern and variability of annual and monthly rainfall has been undertaken. This is essential because there are some who hold the view that the under development in the basin has nothing to do with the failure of rain fall rather it is purely of human factor.

The fourth chapter deals with the land characteristics mainly consisting of analysis on land use and land capability witnessed in the region.

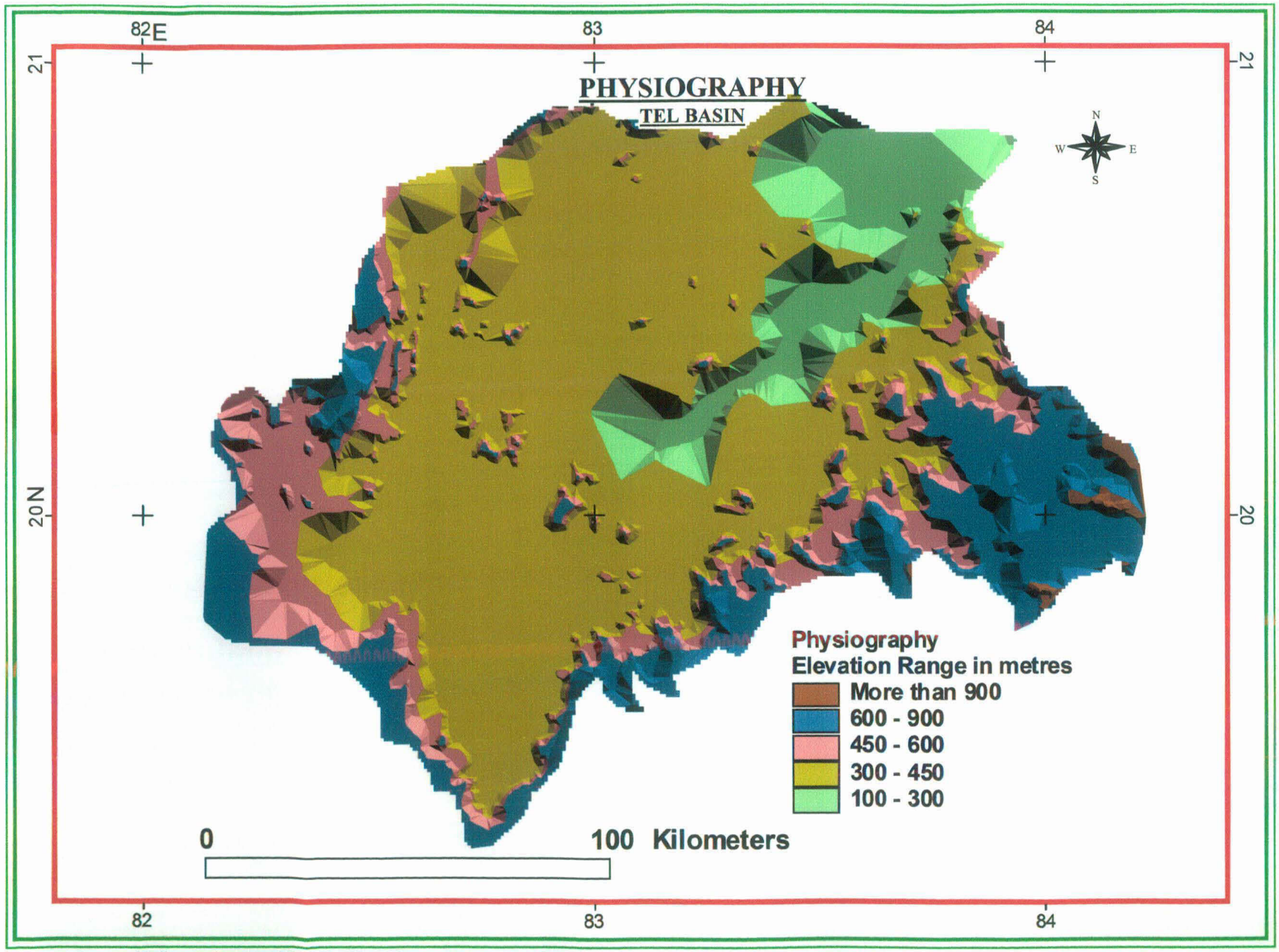
The fifth chapter deals with the status of water resource utilisation studied from two aspects such as level of irrigation development and provisions for the supply of drinking water in the region.

The sixth chapter is on the analysis of socio-economic political aspect of under development of the region.

In the seventh chapter titled discussion and conclusion and overall analysis of the entire work has been under taken and some suggestions have been attempted based on the limited knowledge gained from the above analysis, that are expected to be helpful for any kind of development planning for the region

CHAPTER II

PHYSIOGRAPHIC CHARACTERISTICS OF THE TEL BASIN

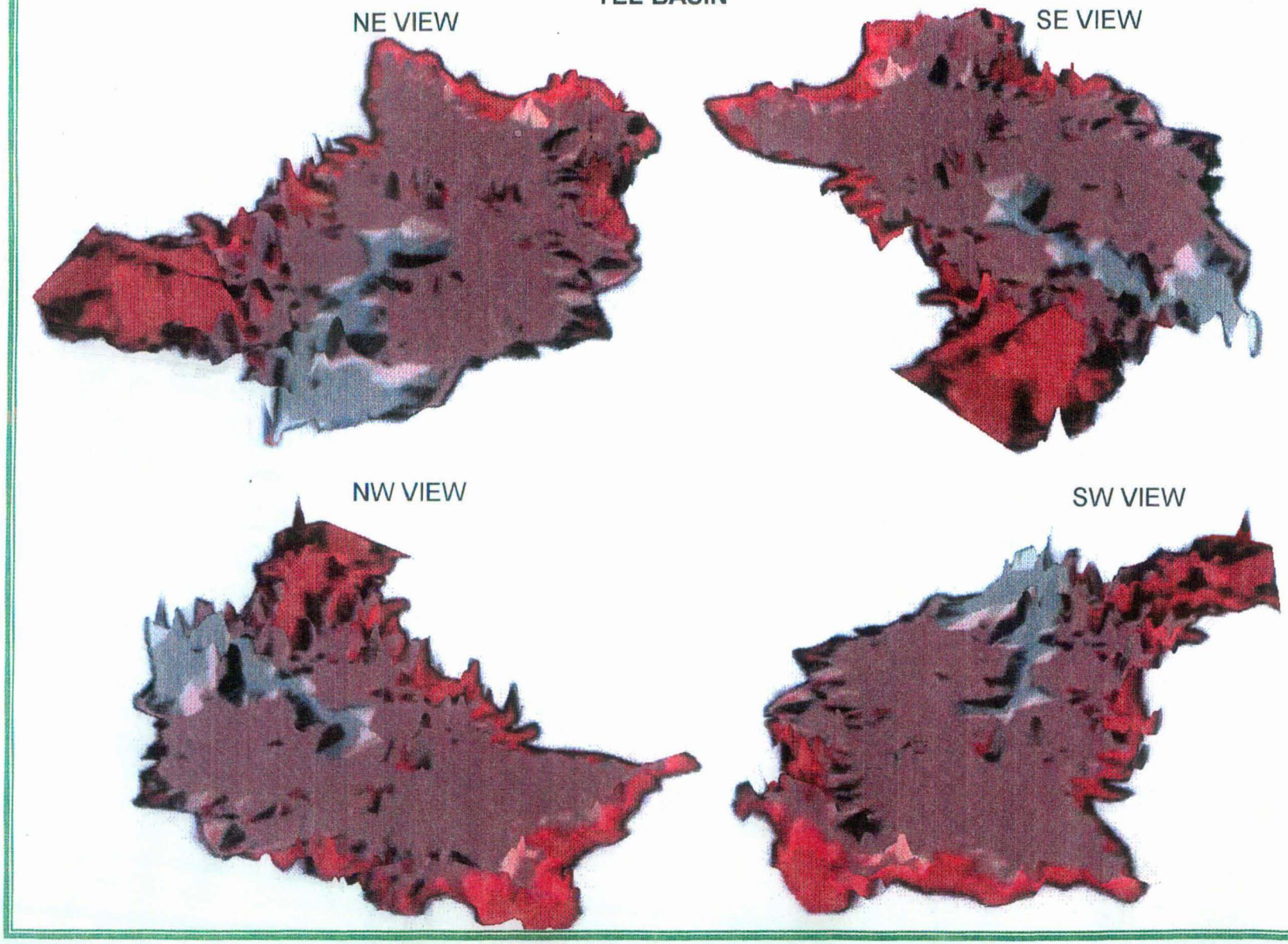


Source : Survey of India toposheets no. 64L, 64P, 65I, 65M

Map No. II(1)

DIGITAL ELEVATION MODEL

TEL BASIN



The Physiography of a region provides the crucial information about it, like the phases of development it has passed through, and various physical processes operating on the region. The physiographic characters of the Tel river can be studied with the help of relief, drainage, the climate, soil rocks the Geo-hydrology of the region.

The complex interaction among these internal, external forces are manifested broadly plain, plateau and hills.

2.1. Relief

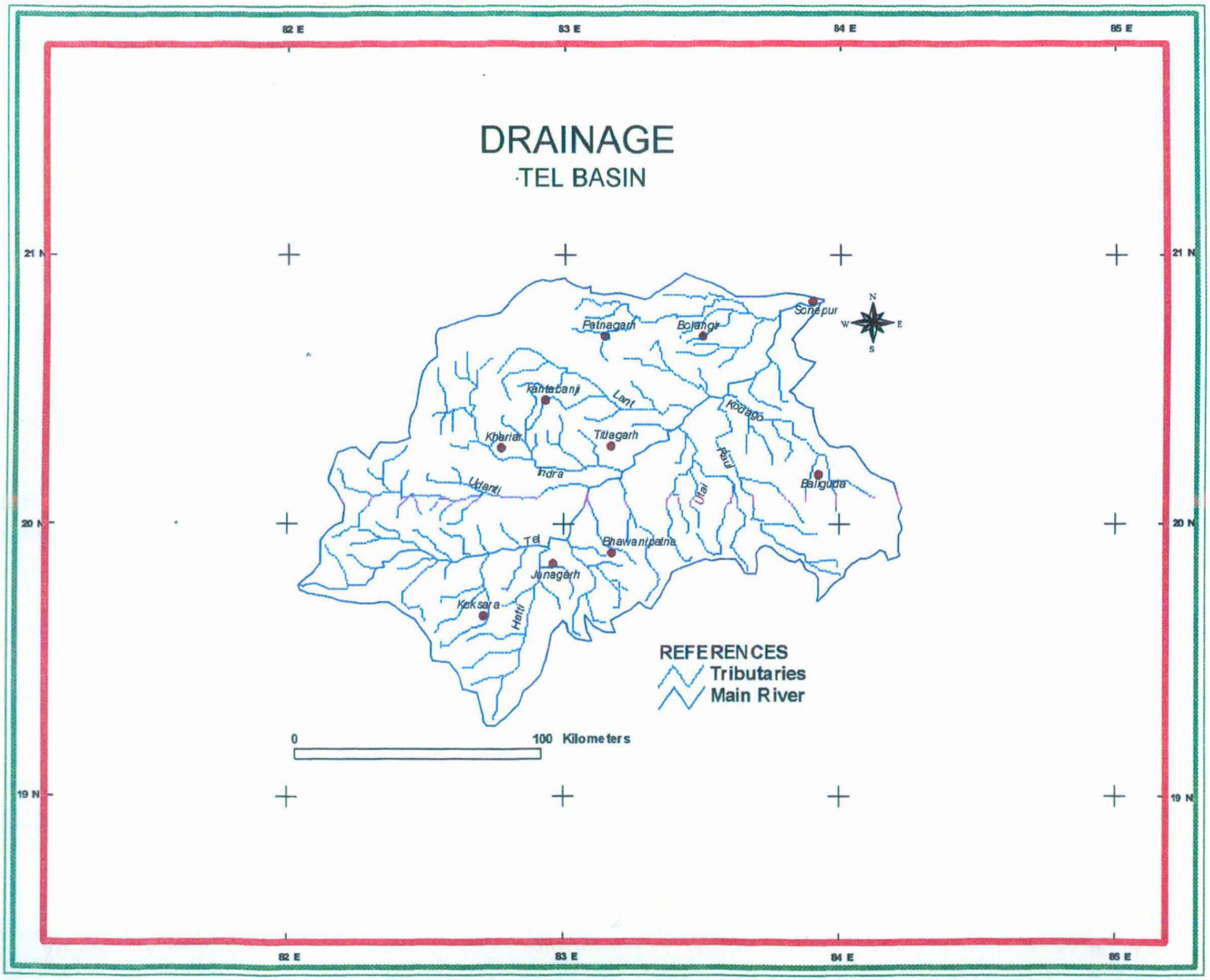
The intensity of operation of geomorphic processes depends upon the net energy available to the system. This energy, which is the sum total of the Potential and Kinetic Energy, according to the law of conservation of energy, remains constant in any system. So, higher the altitude, higher will the available Potential energy which in turn gets converted into Kinetic energy., during the operation of any geomorphic process.

Relief refers to the attitudinal difference but the highest and lowest point of an area. Besides, slope is also determined by the relief, thereby determining the rate of flow as well as percolation of water in any area. Thus the study relief of an area partially helps us to understand the probable water availability in the area.

The general relief of the Tel basin, as can be seen from the map II (1), has a general decline towards the northeast direction. From the high relief

DRAINAGE

TEL BASIN



religion of west south and south east region that is in the form of concave arch. Thus we find continuous hills in a semi-circular extension from the Northwest to the South east direction. Majority of the area is characterised by rolling upland and the plain area comprises the Bolangir basin in the middle portion of the area. The analysis of relief of the region indicates –

a) The steep slope break regions of the surrounding hill area are likely to cause low water percolation.

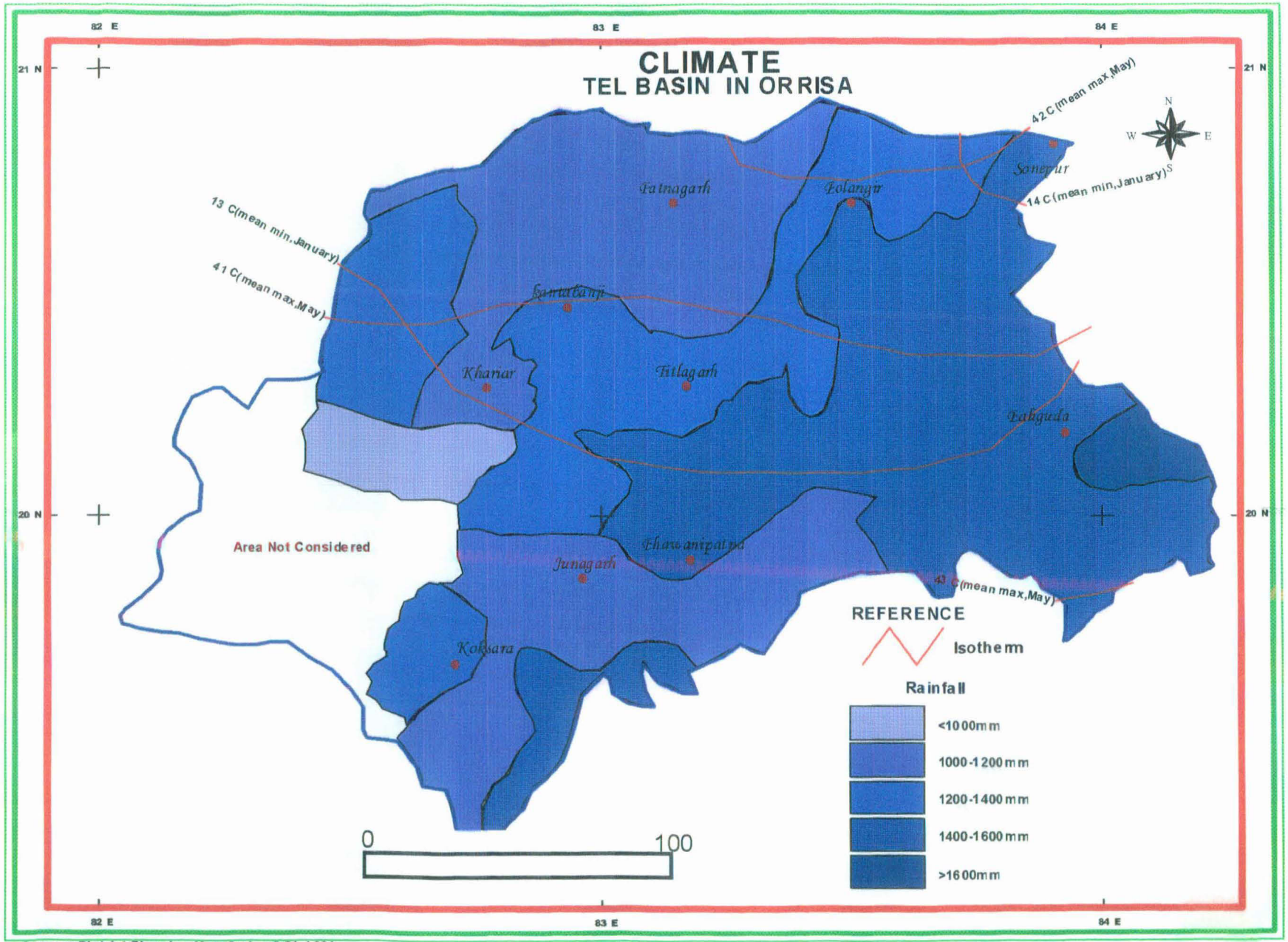
b) The general undulating topography points to the rapid flow of water in the region and may need careful ecological intervention.

2.2. Drainage

Drainage refers to the "natural run off of water from an area by streams, rivers" etc.[1] Drainage generally follows the general slope of the region, in the absence of any fault line. The drainage pattern also reveals the underlying rock structure and geology of the region.

Drainage pattern of the Tel River basin shows a dendritic pattern. The main river undertakes the middle path of the region and other tributaries after following a dendritic pattern join the main river. The important left bank tributaries of the Tel river are- Suktel in the northern part, Lant, Indra, Udanti etc. were as the perennial right bank tributaries include Hatti, Utai, Raut and

[1] Clark A.N. (1990): The Penguin Dictionary of Geography – Penguin boo



Source: District Planning Map Series,SOI, 1994.

Map II(3)

Kodago rivers. The general flow direction is from the west to north east direction.

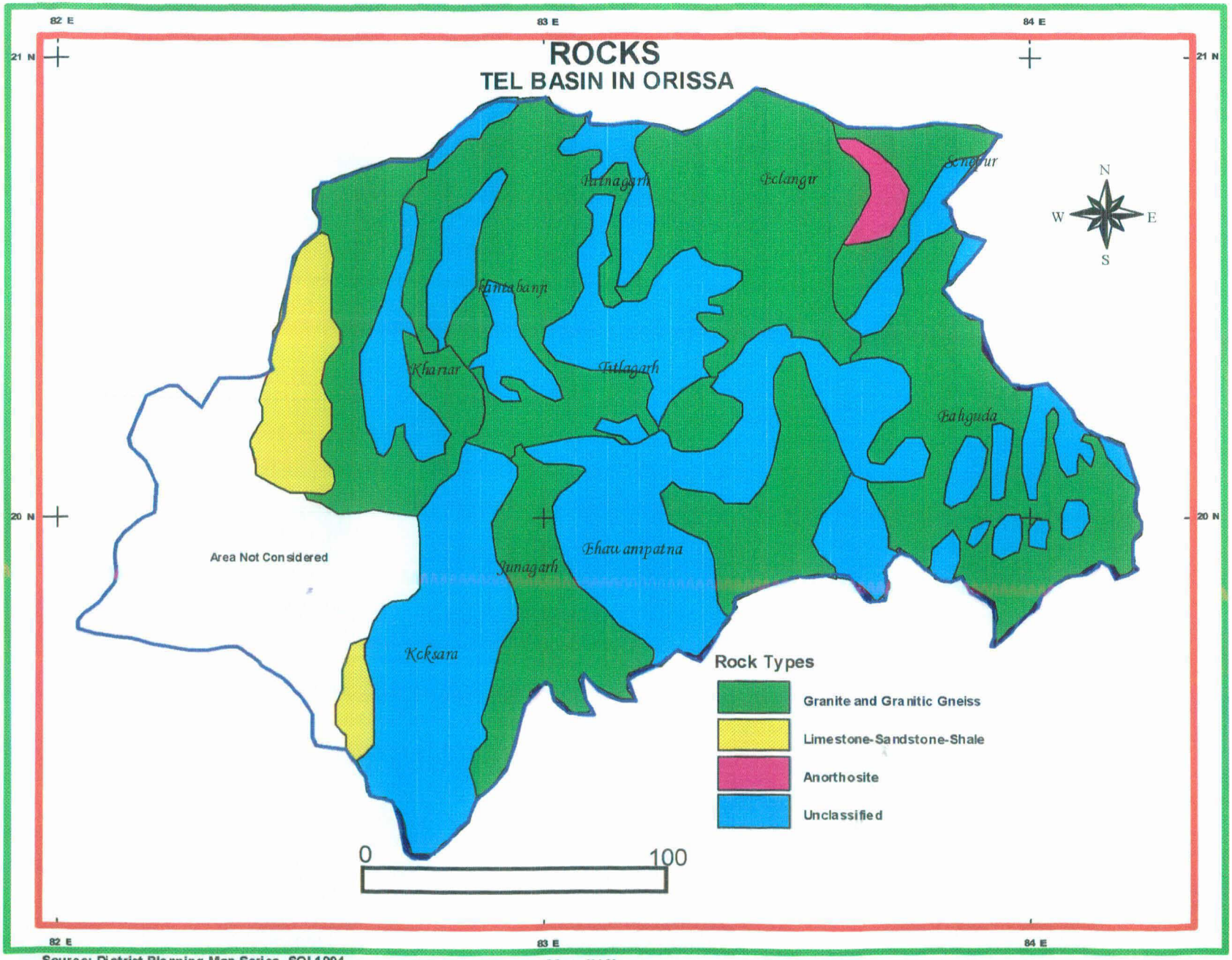
2.3.Climate

Climate refers to the average weather conditions through out the seasons over a fairly wide area and considered over many years (usually 30 to 35 years). The climate map of Tel basin indicates that the intensity of rainfall gradually declines as one travels from the southeast to the northwest direction. The Isohyet of 1400 mm divides the basin roughly into two parts, east of which receives higher than 140 km and west of which get below 140 cm. of rainfall. The very high rainfall portion in the basin with more than 1600 mm of annual average rainfall lies in a small portion to the east of Balliguda. A small portion to the south of Khariar i.e. around the Komna block region in the Nuapada district of Orissa, is the region where the average rainfall is below 1000 mm.

The isotherm analysis indicates that the basin is subjected to high temperature range. Here, it can be mentioned here that in Tillagarh, temperature rose to more than 50 °C during 2002 and recorded the highest maximum temperature that year surpassing Churu, Rajasthan. Thus the basin experiences a very high rate of evaporation in May (summer) even though good moderate rainfall soon follows during monsoon months.

2.4. Rocks and Geology

Geology refers to the study of the development of earth's crust and the composition of the rocks comprising them. The Tel basin falls under the part of the peninsular shield, one of the oldest and most stable land masses in the world. By and range it is underlain by Pre-Cambrian rocks. The rocks of



Source: District Planning Map Series, SOI,1994.

Map II(3)

Phulbani, Kalahandi, Bolangir are broadly composed of Pyroxene Granulite i.e. Khondalites-suit, garnet, silimonite gneiss, graphitic gneiss, garnetiferous Quartzite, calc-silicates guanulite etc. Broadly they are grouped into the Khandalite suit of rocks comprising the metamorphosed sediments of argillaceous, arenaceous and calcareous composition and Charnockite suit. Granite gneiss occupies large tracts of the Eastern Ghats next to Charnockites and Khondalites. Coarse grained anorthosites are reported from near Bolangir in Bolangir district over about 300 square km.

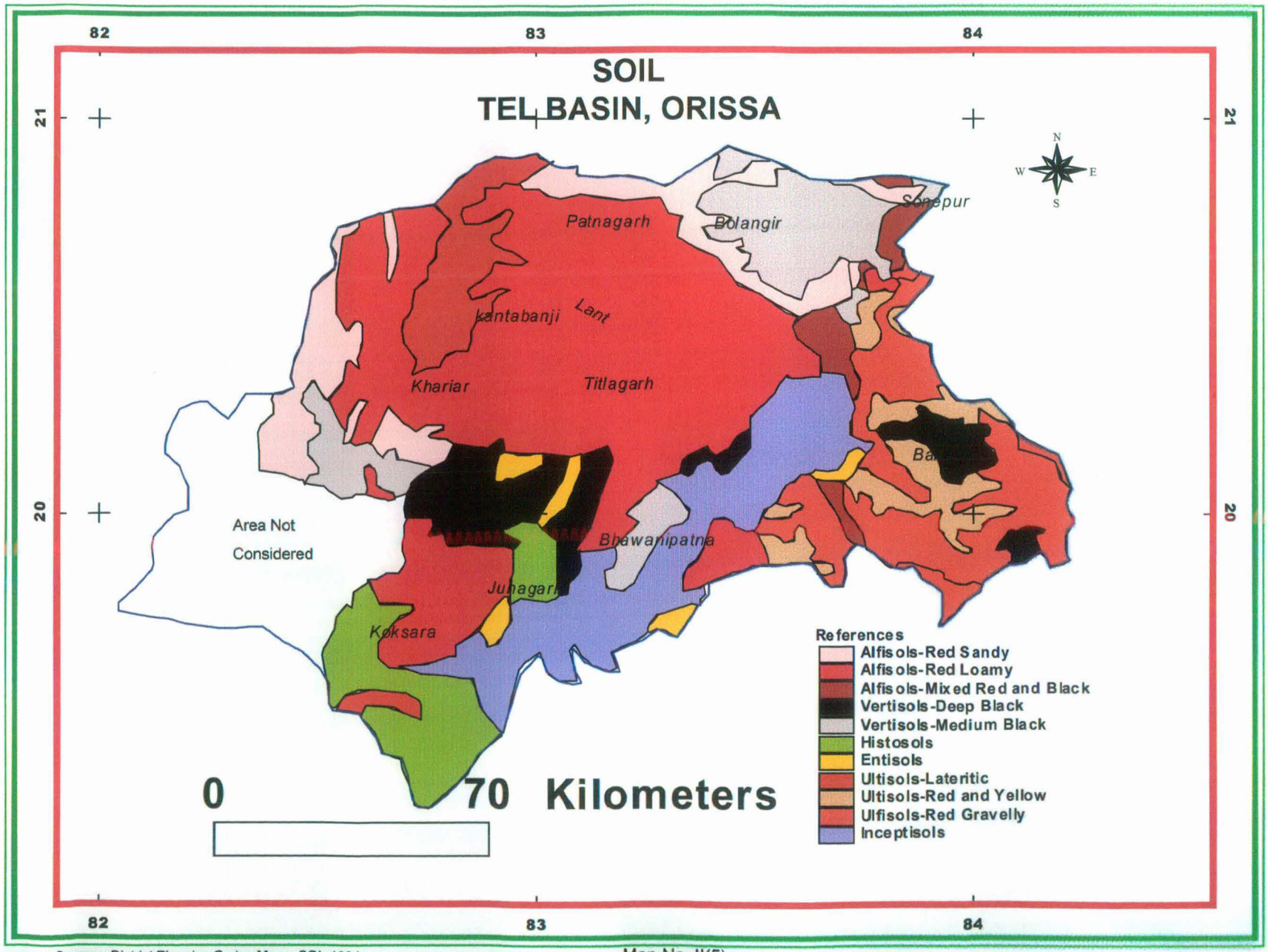
The map displaying various rock types in the Tel Basin shows that Granite and Granitic-gneiss is the major rock types in the region. Limestone-shandstone-shale is found in two zones in the western, southern eastern part of the Tel Basin in Orissa. A patch Anorthosite is found to the East of Bolangir. In the rest of the region the unclassified type of rock is found. The dominance of metamorphic rocks in the Granitic Gneiss indicates that the ground water potential of that area where it lies may not be very good.

2.5.Soil

Study of soil helps in assessing the kind of vegetation, soil-fertility and availability of fresh water to be found in a region.Soil fertility along with availability of fresh water is the basic measure of the potential of an environmental region to produce food for the human face.

2.5(1) Alfisols

Alfisol is the soil of humid and sub-humid climates. They have unique properties like –a grey, brownish or reddish horizon not darkened by gums close to the surface 2. A horizon of clay accumulation and 3. Soil water available to plants more than half the year or more than three consecutive



Source : District Planning Series Maps, SOI, 1994

Map No. II(5)

months during a warm season. The study area has three different textures type under alfisols.

2.5 (2) Vertisols

They have characteristics like 1. A high content of clay (montmorillinite) that shrinks and swells greatly with changes in soil-water storage (2) deep wide cracks at some season. There are two sub types of this soil in the study area which are located in two to three patches in western part of the Basin.

2.5 (3) Inceptisols

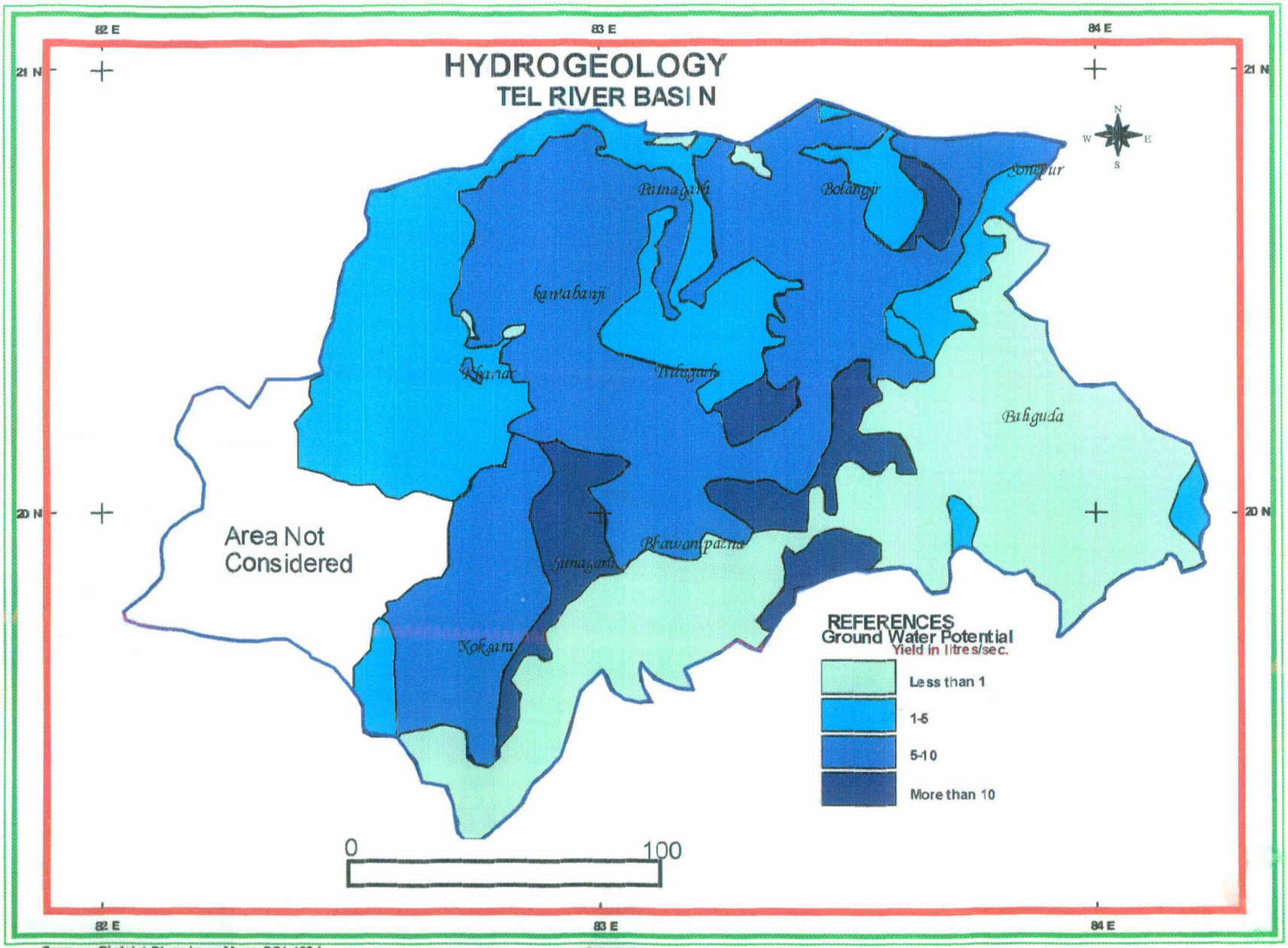
They are characterised by 1) soil water availability to plants more than half the year for more than 3 consecutive months during a warm season. 2) the soil contains some weatherable minerals etc. This type of soil is found in a south eastern strip in the basin closely surrounding the western slope of Eastern Ghat.

2.5 (4) Histisol

Histosols are unique in having a very high content of organic matter in the upper 80 cms. Histisols are found in the southern tip of the Basin mainly in the Hatti river basin.

2.5 (5) Entisols

They have in common in combination of a mineral soil and the absence of distinct pedagogic horizons that would persist after normal ploughing. Lack of distinct horizons in the Entisols may be the result of parent materials like quartz sand. This covers only a few scattered patches in the Tel basin.



Source: District Planniong Maps,SOI,1994.

Map II( )

2.5 (6) Ultisols:

The distinct characteristic properties like 1) the presence of an argillaceous horizon. 2) The mean annual soil temperature is greater than 8 ^{o}C. Ultisols characteristically form under forest vegetations in climates with a slight to pronounced seasonal soil-water deficit. Ultisols is found in the era part of the basin and also in the N.E. pact of the reason.

2.7.Hydrogeology

Hydrogeology refers to the water bearing geological formations below earth surface. The Hydrogeology map shows that there is very low potential for groundwater in the east-south-eastern part of the basin which is highly slopy and is the zone surrounding the western slope of the Eastern Ghats. Good ground water potentials are found near east to the Tel river and its tributaries moderate water potential is found in the central Bolangir basin and the North central part of Kalahandi district. The western part of the basin has low groundwater potential.

CHAPTER III

RAINFALL CHARACTER OVER THE TEL BASIN

3 .1Spatial and Temporal Variation

The spatial and temporal variation of rainfall is determined broadly by factors like location of the region, its altitude, the general physiography of the region, its distance from the sea and the moving weather system visiting the region.

Tel basin enjoys a tropical monsoon type of climate. It is characterized by all the typical features of a monsoon region like – highly imbalanced, temporal distribution of rainfall, with most of the rainfall being highly concentrated during the monsoon season alone and the rest of the year is characterized by little share of annual rainfall. The Tel basin receives more then 80% of the total annual rainfall during the rainy season alone. Thus it leads to the conclusion that cultivation during rest of the year is difficult proposition in the region due to lack of rain, hence it is enough to suggest that supply of irrigation water is of urgent necessity to facilitate double cropping.

3.1. 1 Rain-Bearing System

Orissa, being situated on the eastern coast of India, is not directly influenced by South – West branch of Monsoon since it doesn't come in the direct path of the prevailing South – West Monsoon, rather its situation is such that it is almost parallel to it. But the annual cyclones from the Bay of Bengal influence it and bring copious rain with two seasonal peaks – July to August and October to November.[1]

The cyclonic storms during the monsoon originate in the bay of Bengal and proceeds in a North–West direction. During their course of journey, they gradually

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[1] Sinha, B.N.(1999) *Geography of Orissa, NBT*, pp, 46-47.

weaken as they reach for west Orissa. The study area lying in interior Orissa doesn't get the high intensity yield from the cyclonic rain. There are two cyclonic peaks in the occurrence- one during May to July, and the other during October to November, when maximum cyclone visit the state, but most of them greatly weaken as they reach central – western part of the Tel basin. So far as the periodicity of occurrence of cyclonic storms is concerned, maximum number of cyclones come during the south – west monsoon (150), followed by the post – monsoon period in November-December(70)and pre-monsoon period(57).[2] Besides these, however, the Tel basin also get some rainfall due to intensification of local lows during the hot weather season from march to May.

3.2 Database

There are twenty rain gauge stations located in the basin area. The rainfall data for all these station were obtained from the IMD, Pune. The data procured is of two types – annual rainfall and monthly rainfall and rainy days. Data for the first half of the study i.e. 1901 to 1950 were obtained from "Monthly and Annual Rainfall and Number of Rainy Days: Period (1901 –1950), Government of India Press, 1966. These data were given in cents and were converted to millimeters. The data for 1950 – 2000 were directly procured from IMD Pune.

3.2. 1 Data constraints

The data obtained for the study period from the IMD, Pune is however not complete in all respects. Major problem was faced mostly with the monthly rainfall data. Since the monthly data were missing, hence the total value could not

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2 *Science and Culture*, volume 55 no.8, august 1989, p. 273.

be taken as annual rainfall and this prevented the undertaking of a detailed study of the rainfall analysis in the study region. There the study has to be limited to a selective few stations and that to only for those years for which data were complete. However incomplete data were interpolated from the trends of rainfall in the nearby stations.

3.3 Annual Rainfall: Spatial and Temporal Variation

The annual average rainfall of various stations points to the fact that most of the stations in the Tel basin receive an average annual rainfall which is more then the average annual rainfall of India which is about 1180mm.[3]

But this doesn't show us the complete picture. The broad temporal analysis of the average annual rainfall reveals that though the basin receives quite a good amount of rain, its distribution over time is far from the consistent.

Table 3.1: Variation of Annual Rainfall, 1901-2000

Years/avg/ stdev	Bolangir	Variance	Bhawanipatna		Titlagarh	Variance	Baliguda	Variance	Khariar	Variance	Sonepur	
avg01-30	*1464.13*		1405.32		*1326.99*		*1628.48*		*1330.77*		1391.35	
stdev01-30	*296.33*	20.24	*259.48*	18.46	279.44	21.06	*275.88*	16.94	243.12	18.27	330.10	23.73
avg31-60	*1334.39*		*1542.16*		1423.05		*1591.62*		1310.10		1415.02	
stdev31-60	*401.33*	30.08	*385.62*	25.00	225.57	15.85	*319.73*	20.09	272.86	20.83	373.96	26.43
avg60-90	*1293.61*		*1262.39*		1313.79		*1369.94*					
stdev60-90	*326.39*	25.23	*361.67*	28.65	366.94	27.93	*304.09*	22.20				
avg71-00	*1298.57*		*1257.66*		1306.52		*1410.74*					
stdev71-00	*380.79*	29.32	*432.05*	34.35	389.32	29.80	*402.09*	28.50				
avg 01-00	*1363.87*		1386.15		*1347.51*		*1528.69*					
stdev01-00	*354.54*	25.99	*370.17*	26.70	*301.14*	22.35	*334.53*	21.88				

Source: Monthly and Annual Rainfall and number of rainy days, IMD, Pune.

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3 Khullar D.R., (2000), India: A Comprehensive Geography page 106

From the above table it is clear that the standard deviation of rainfall is quite high for all the stations (studied), the highest being found during the period 1971-2000, for Bhawani patana and the lowest during the period 1931 –60 64-station Titlagarh.

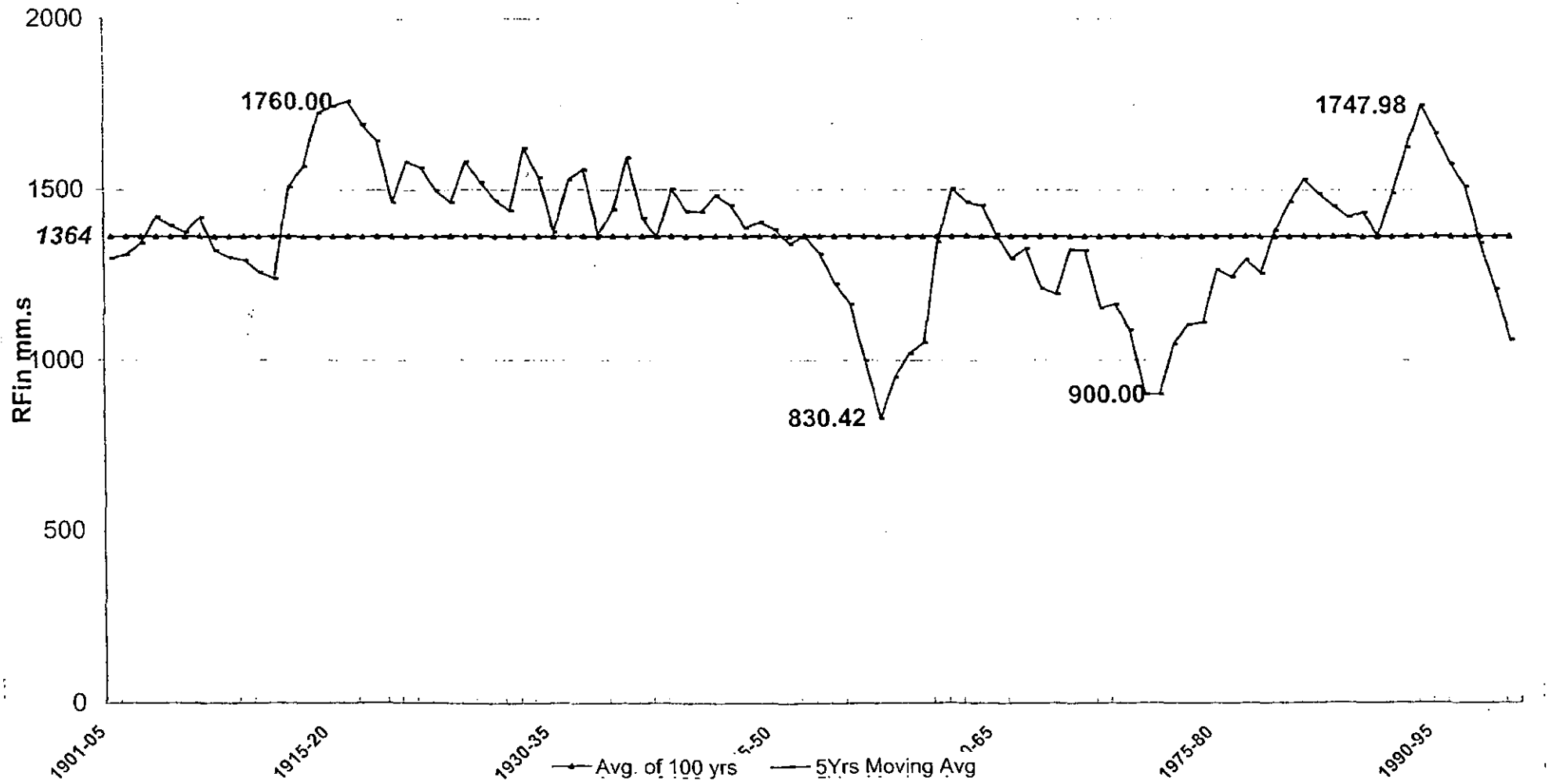
Another important finding on the trend of coefficient of variation reveals the significant variation of annual rainfall in the region. The variation ranges from 17% during the period 1901–30 in Balliguda to a very high variation of 34% during 1971 -2000 in Bhawnipatana.

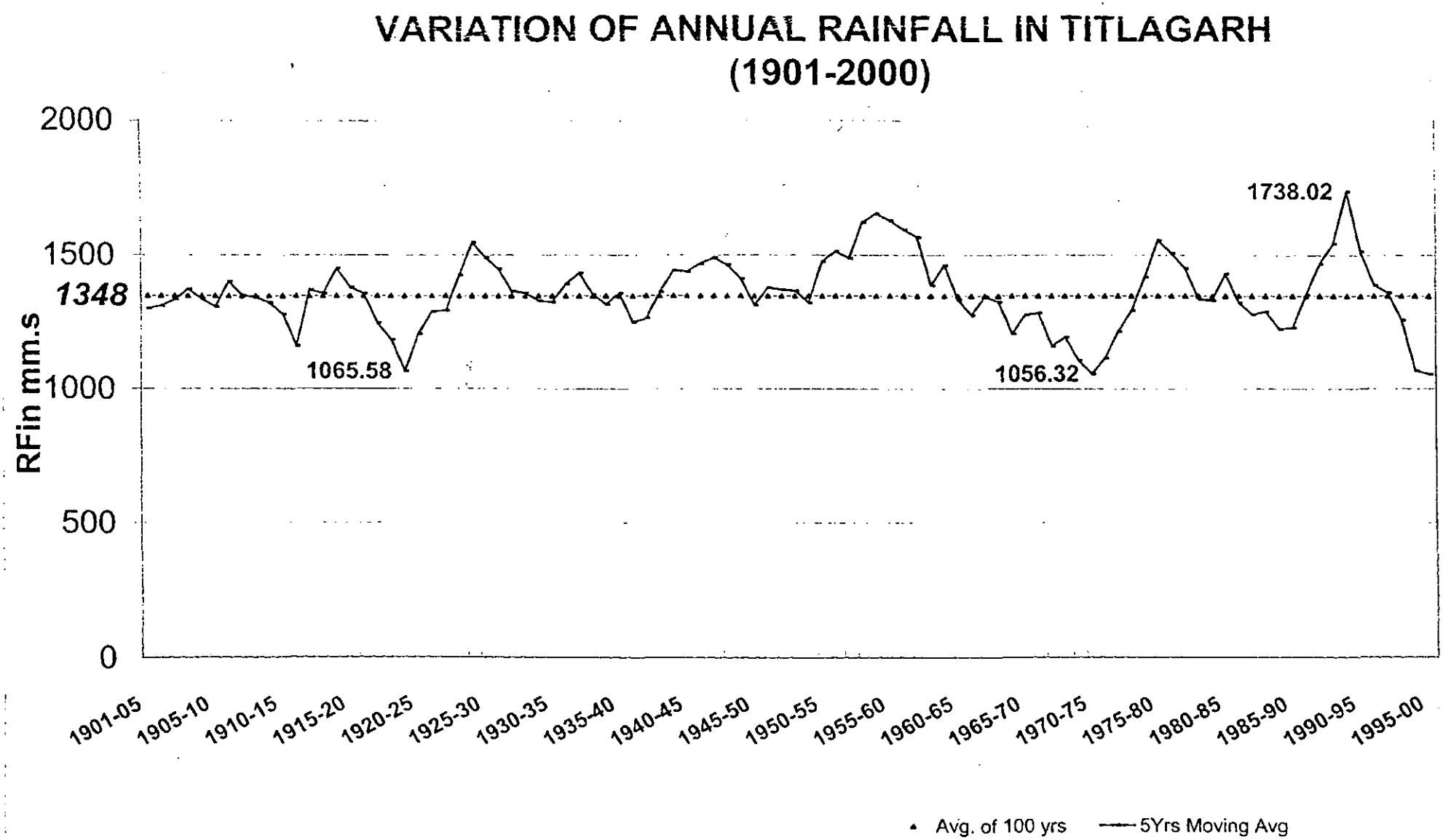
More importantly, we can see that the periodic variation of rainfall from the average has been showing overall increasing trend for all the stations, which is quite disturbing. This also calls for the immediate attention for the management of water resources in the region. This becomes more crucial as the general level of irrigation in the basin is low and rainfall is still the dominant source of water for the predominantly agricultural economy of the region.

3.3. 1 Temporal Variation of Annual Rainfall

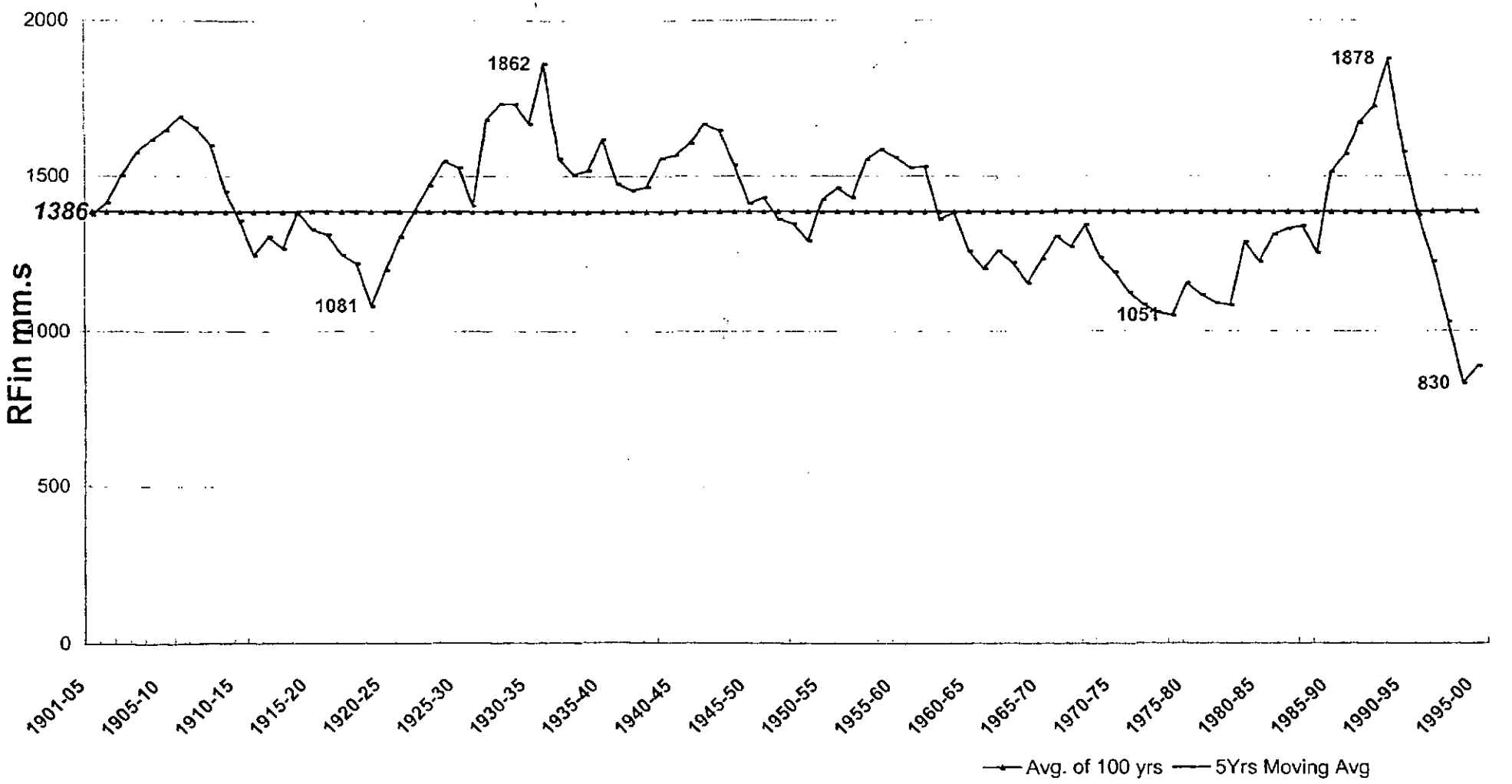
To get a still clear picture of the trend of variation of annual rainfall, the calculation of 5 years moving average has been undertaken and the findings for different stations have been graphically represented. The calculation of 5 years moving average has been done for the period of 100 years for the stations viz. Bolangir, Bhawanipatana, Titlagarh and Balligada whereas for Khariar it has been calculated for the period of 1901 – 50.

VARIATION OF ANNUAL RAINFALL IN BOLANGIR
(1901-2000)

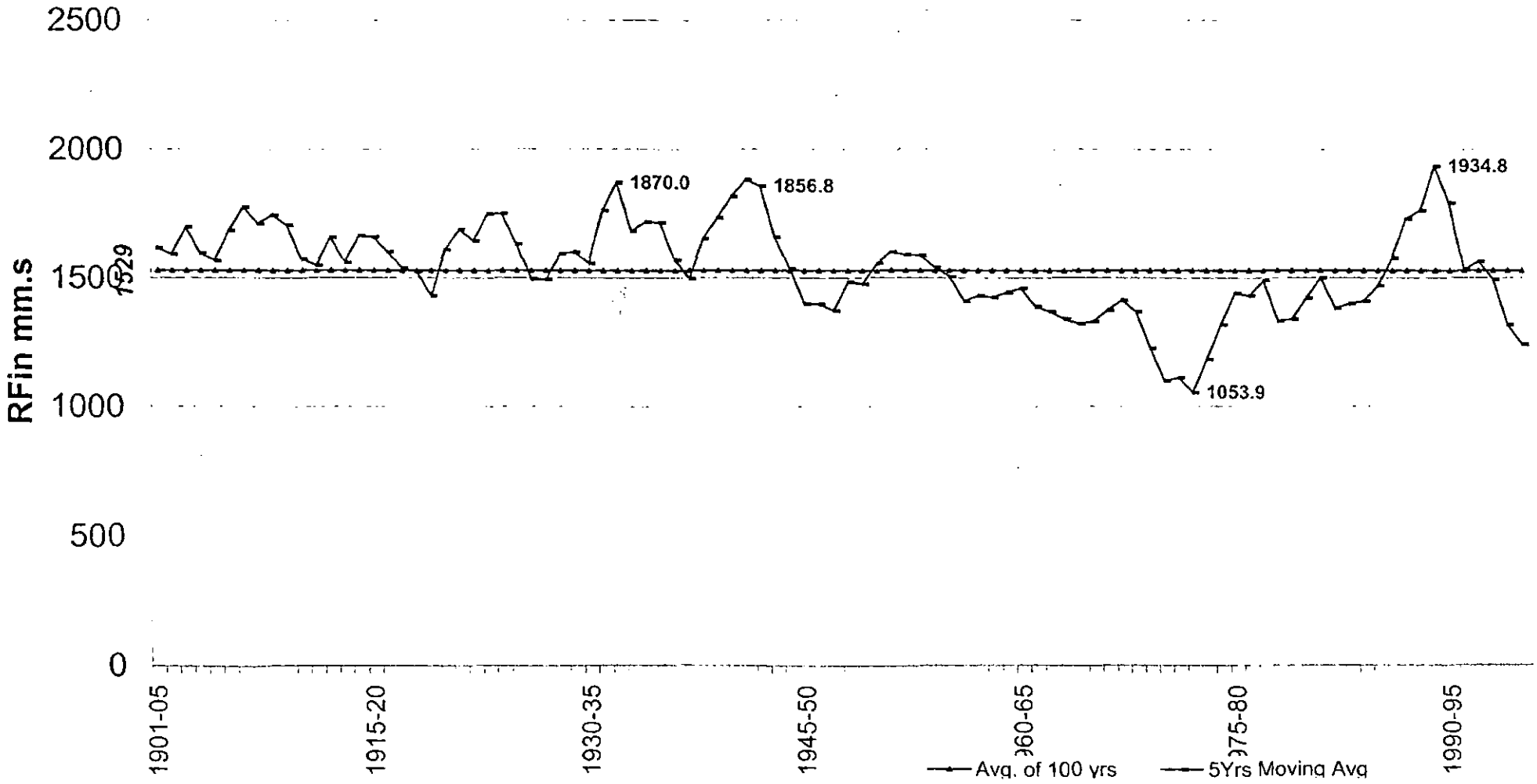



VARIATION OF ANNUAL RAINFALL IN TITLAGARH
(1901-2000)
2000
1500
1348
1000
500
0
RFin mm.s
1738.02
1065.58
1056.32
1901-05
1905-10
1910-15
1915-20
1920-25
1925-30
1930-35
1935-40
1940-45
1945-50
1950-55
1955-60
1960-65
1965-70
1970-75
1975-80
1980-85
1985-90
1990-95
1995-00
Avg. of 100 yrs
5Yrs Moving Avg

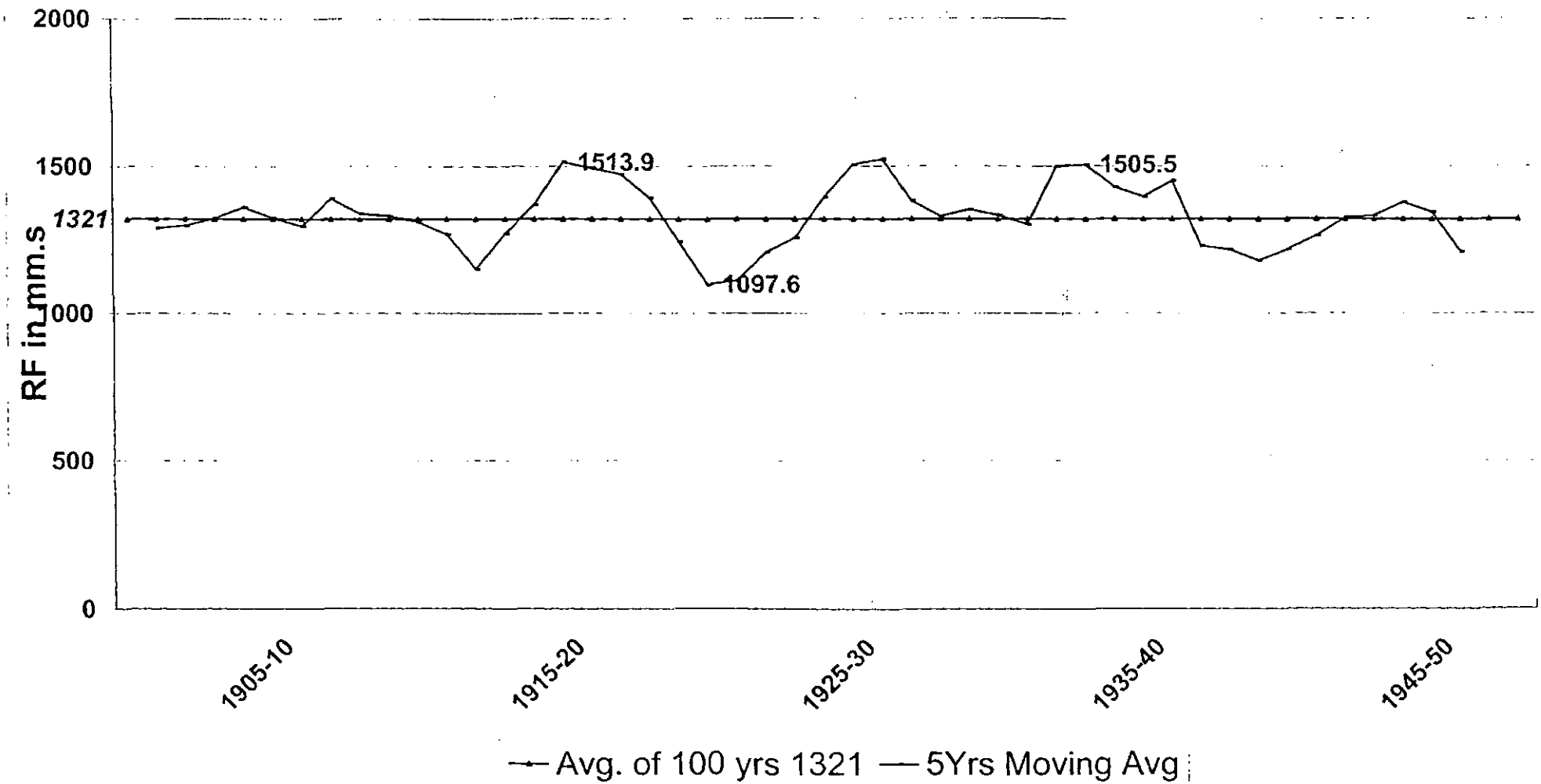
VARIATION OF ANNUAL RAINFALL IN BHAWANIPATNA
(1901-2000)



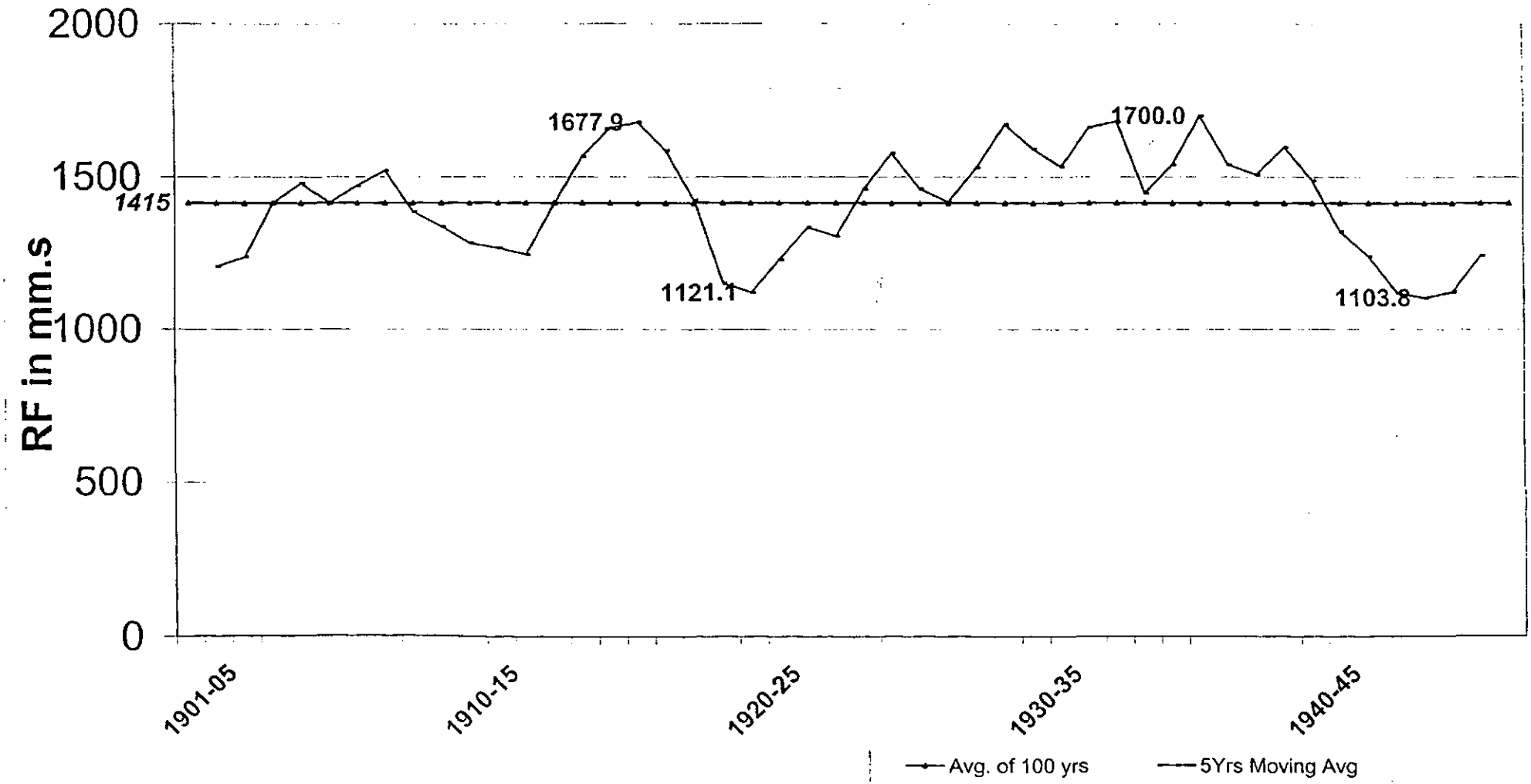
VARIATION OF ANNUAL RAINFALL IN BALIGUDA
(1901-2000)



VARIATION OF ANNUAL RAINFALL IN KHARIAR (1901-2000)



VARIATION OF ANNUAL RAINFALL IN SONEPUR
(1901-2000)



The moving average of annual rainfall shows different trends for different stations but almost all the stations show a general trend of increasing variation from past to recent time. For Bolangir, we see a significant variation in the initial period followed by a period of moderate variation in the period 1930 –1950, which ultimately has very high variation in the post 1950 period. Bhawanipatana also presents a similar picture but the variation is very high in the later period especially after the 5 year period 1985 – 1990. Ballinguda presents an increasing trend of variation and the increasing variation is more specific with the passage of time. The moving average of annual rainfall for Titlagarh is however not very erratic, although here too we find higher variation in the later phase of the period of study i.e. 1901–2000. Though not very prominent the variation in average annual rainfall in Khariarthe fluctuation is still there. The moving average curve is quite erratic but here (and in khariar) the study has been till 1950 and the variation in the post 1950 is not ruled out.

3.3. 2 Spatial Variation of Rainfall

An isohyetal map has been prepared from the average annual rainfall of the 6 stations. Isohyetal map clearly shows that rainfall in general has decreasing trend from east to west which is mainly due to the weakening of the intensity of the cyclone that moves from the eastern coastal plain to the western (interior) Orissa.

3.4 Monthly Rainfall and Rainy Days

The average monthly rainfall and rainy days for the selected rain gauge station is given below

Table 3.2: The Average Monthly Rainfall (in mm) 1950-2000

Raingauge Station	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Sonepur	8.26	13.46	14.65	14.30	23.12	180.84	424.58	410.48	276.63	64.33	2.71	3.11
Bolangir	8.89	16.84	20.68	25.99	36.03	192.98	377.19	369.54	202.08	59.37	16.50	6.62
Titlagarh	9.57	14.90	25.94	18.62	31.43	208.08	378.91	387.91	226.47	69.39	8.82	5.84
Balliguda	7.26	17.03	18.94	23.02	43.96	220.37	425.13	444.16	233.40	105.45	14.18	0.54
Bhawanipatna	6.08	14.47	15.38	27.09	37.03	236.16	328.14	339.32	211.34	71.07	22.14	2.13
Khariar	14.87	9.48	12.69	18.40	36.19	187.21	317.44	238.44	152.74	79.54	19.60	2.68

Source: Monthly and Annual Rainfall and number of rainy days, IMD, Pune.

The data underscores the characteristic rainfall variation (temporal) in a tropical monsoon region. The rainfall is highly concentrated to few months of the monsoon and rainy season; ranging from June to September. The number of rainy days also follow a similar pattern.

3.5 Seasonal Variation of Rainfall

Though locally the study area has 6 seasons, there are basically 4 main seasons viz.

1. The season of north – east monsoon (January to February),
2. The hot weather season (March to May).
3. The season of south – west monsoon (January to September) and
4. The season of retreating monsoon (October to December).

The beginning of the season of South–West monsoon is marked by the appearance of stratocumulus variety of cloud during early June which changes to cumulonimbus type during the middle of June and ultimately changing to Nimbostratus type during middle–late July. It should be pointed out that the monsoon wind doesn't blow and bring continuous rain but it comes at interval. Thus the 'Pulsator' characteristics of the monsoon wind are well revealed. The arrival of the season of retreating monsoon is marked by the change of the color of

the clouds from Black to White-Grey. They again become Strato-cumulus to cumulus. During this season, at times, several depressions may occur. These cyclonic depressions cause harm to the mature paddy and vegetable as their timings coincides with the time of harvest of crops. The season of north–east monsoon sets in the month of January. During this time the amount of cloud cover in the sky is low and this helps free radiation. In the evenings, stratus clouds appear in the horizon. Slight rainfall, however, during this season is a boon for the pulses. However rain comes in the form of hail storms during late February. It may prove detrimental to Rabi crops which are in their harvesting stage. Hot weather season follows it, when the mercury in the barometer falls while the mercury in the thermometer rises. The cloud type of cirrostratus to cirrus during March changes to Alto-cumulus during the end of May. Part of this season is the only slack season of the year; where-in paddy fields remain fallow, before the sowing for the next season, more so in the un-irrigated tract as in the Tel basin.

Table 3.3: Seasonal Variation of Rainfall (%age)

Rain Gauge Station	Years	N-E Monsoon	Hot weather season	S-W monsoon	retreating monsoon	annual
BOLANGIR	1901-50	2.32	6.03	85.87	5.79	*1460.09*
	1951-00	1.93	6.21	85.67	6.19	1332.72
SONEPUR	1901-50	2.26	3.66	86.04	5.24	*1410.93*
	1951-00	1.51	3.63	89.98	4.88	1436.48
TITLAGARH	1901-50	1.71	3.86	87.82	6.61	*1373.23*
	1951-00	1.77	5.48	86.69	6.06	1385.88
BALLIGUDA	1901-50	1.81	6.98	80.29	7.45	*1652.12*
	1951-00	1.56	5.53	85.17	7.74	1553.44
BHAWANIPATNA	1901-50	1.76	5.88	84.60	5.88	1498.22
	1951-00	1.57	6.07	85.09	7.28	1310.34
KHARIAR	1901-50	2.34	5.53	78.36	7.39	*1353.00*
	1951-00	2.24	6.18	82.24	9.35	1089.27

Source: Monthly and Annual Rainfall and number of rainy days, IMD, Pune.

The above table shows that the season of south – west monsoon accounts for overwhelming share (>80%) of annual rainfall. It ranges from 82.24% in khariar to almost 90% n. The next most important season of rain supply is the season of retreating monsoon. Its share ranges from 4.88% for to 9.35% for khariar. As pointed out earlier, this season accounts for the occurrence of other cyclonic peaks (besides one during May – July). The pre-monsoon season supply the least amount of rain in the region. However the temporal occurrence of this rain is very crucial for the sustenance of pulses and the nature of harvest of other Rabi crops. Some amount of rain comes during the period of hot weather season is during March- May. The temporal spacing of the rain during this season determines the earlier or delayed start of sowing season particularly that of paddy, which is practiced mostly under rain fed condition.

3.6 Heaviest Rainfall in 24 Hrs

Table 3.4 shows the data relating to heaviest rainfall with in a day. It gives us an idea on the maximum rainfall that occurred in the region during the period 1950-2000.

Table 3.4 Heaviest Rainfall in 24 Hrs

Years	heaviest rf in 24 hr in mm	dt of heaviest Rainfall	month of hv rf	Station name	no of yrs considered
1982	4016	30	8	BOLANGIR	56
1971	6000	10	9	SONEPUR	37
1967	2666	2	8	TITLAGARH	37
1991	2780	29	7	BALLIGUDA	25
1982	4840	30	8	PHULBANI	59
1991	3100	17	7	BHAWANIPAT NA	44
1977	2482	13	9	JUNAGARH	20
1952	2032	31	7	KHARIAR	20
1964	2042	5	7	KOMNA	25
1976	3210	1	8	MADANPUR RAMPURD	21
1973	2076	8	7	NAWAPARA	20

Source: Monthly and Annual Rainfall and number of rainy days, IMD, Pune.

Of all the above stations considered, we can see that the highest rainfall was recorded at Sonepur on 10 September 1971.

The findings after analysis of the rainfall distribution both spatial and temporal, point to the fact that though the area is endowed with a good supply of moisture, the rainfall is not consistent and shows significant variation from the normal.

The over dominance of a particular season in the share of annual rainfall and the preponderance of rain fed agricultural practice points to the fact that, a little failure in the south-west monsoon can damage the economy of the region. This is aggravated in a year if rain fails for two consecutive seasons.

However in this picture of despair, a spark of optimism is not far as the basin in general has a moderate to high supply of rain. If it can be managed properly, the deficiency, both temporal and spatial, can be minimized.

CHAPTER IV

THE LAND FACTOR

The development of any region starts and proceeds on the basis of two factors. These include resource endowment of the region and the outer investment it receives for the further utilization of this resource base, and in most cases it is in this order. The resource base consists largely of the natural resource endowment. Various kinds of natural resources being tied with very complex but close interrelations, for the successful development of an integrated approach to develop all these resources together is getting increasing important as per all the contemporary models of development. This has been rightly identified by various scholars[1]. Thus for the study of the status of water resources the study of the land resource becomes significant. Here in this chapter we will study land resources; dealing with the various kinds of use the land is put to i.e. through the analysis of trend of land uses, and secondly its capability study

4.1. Landuse

The term landuse refers to the human activity or economic function associated with a specific piece of land. (Lillesand and Kiefer, 1994) For devising a proper planning and management of landuse practice, information on the type of landuse is highly necessary. The analysis of landuse has been undertaken at the district level. The Tel basin more or less comprises of the

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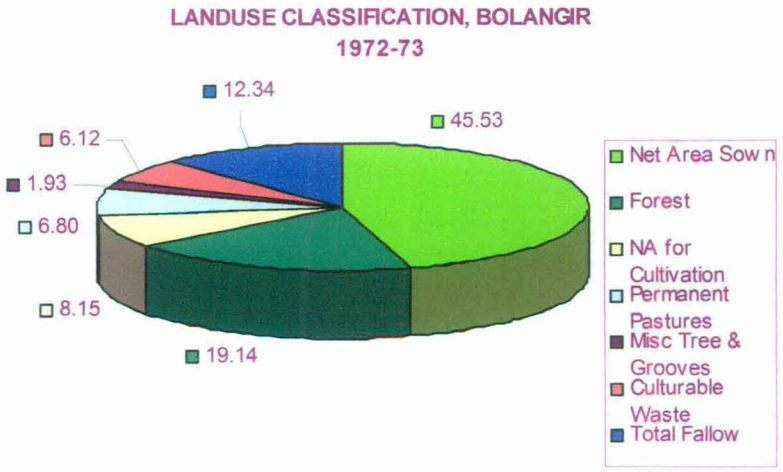
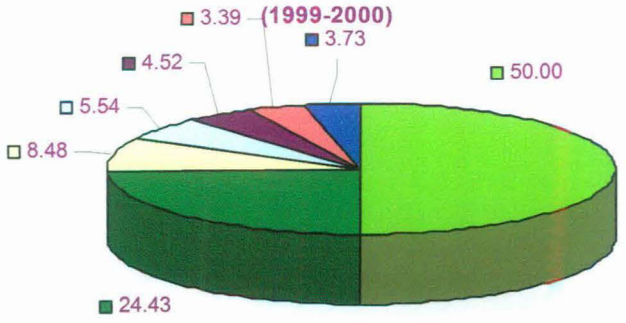
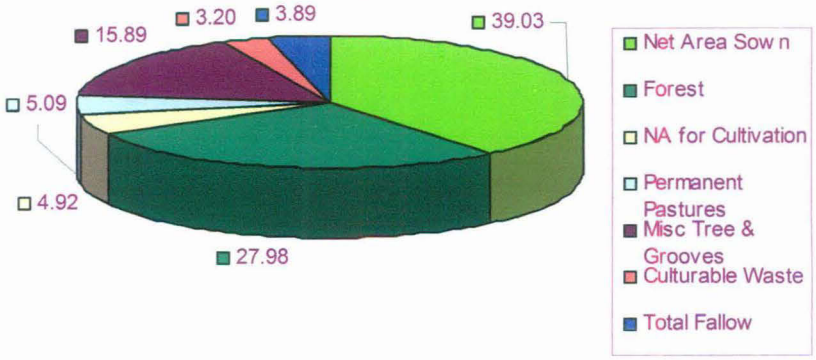
[1] "The management of the country's land and ground water resources is the responsibility of the ministry of Food and Agriculture, while the responsibility for the harnessing of her rivers rests on a separate ministry- the Ministry of Irrigation .This is an irrational arrangement, because land and water management contribute a single whole and cannot be handled in isolation of one another",(Vohra ,BB,2001)

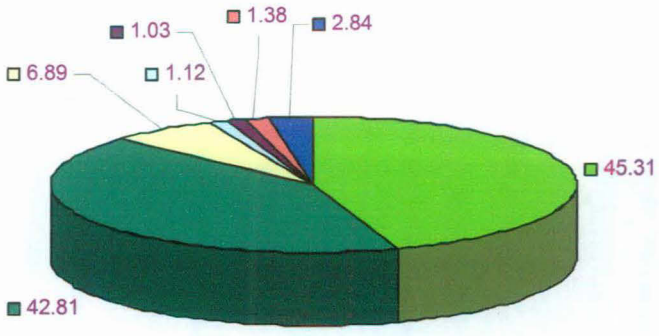

LANDUSE CLASSIFICATION, BOLANGIR
1972-73
12.34
45.53
6.12
1.93
6.80
8.15
19.14
Net Area Sow n
Forest
NA for Cultivation
Permanent Pastures
Misc Tree & Grooves
Culturable Waste
Total Fallow


3.39
(1999-2000)
3.73
4.52
50.00
5.54
8.48
24.43

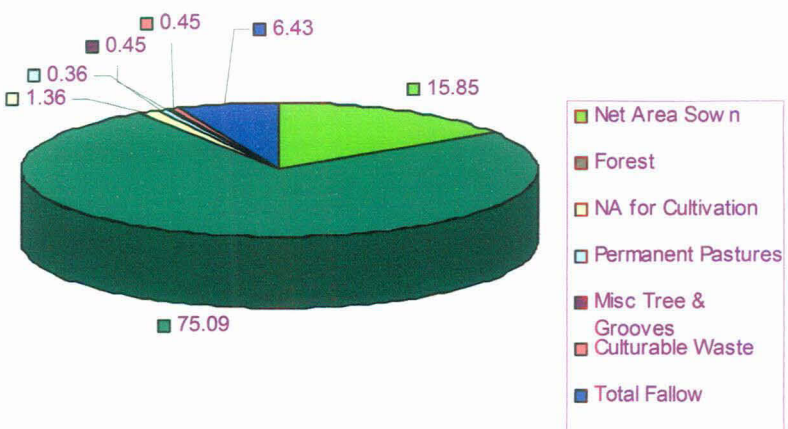
LANDUSE CLASSIFICATION,KALAHANDI
1972-73



(1999-2000)



LANDUSE CLASSIFICATION IN PHULBANI
(1972-73)



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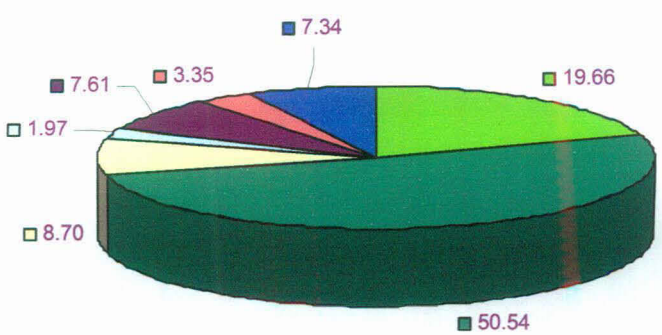

three districts viz. Bolangir, Kalahandi and Phulbani. Three new districts were created in 1993 .For the purpose of analysis the data for the new districts have been clubbed together to their parent districts for making comparison possible.

The areas under different landuse and their percentages to the total reporting area of the districts for the year 1972-73, 1982-83, 1991-92 and 1999-2000 are given in table 4 I.

Table 4.1

Landuse in the Tel River Basin, Orissa

LANDUSE																
Districts		forest	nona gr	bar uncul	tma for cul	per pastures	misc tree	cul waste	oth unc-fal	fal oth cur fal	cur fal	tot fal	nas/r a	gca/ra	nas/gca *100	arswn>1/gc a%
Bolangir	1972-73	19.14	3.51	4.64	8.15	6.8	1.93	6.12	14.84	3.96	8.38	12.34	45.53	51.64	88.16	11.84
	1982-83	24.12	4.42	3.4	7.81	4.53	2.27	5.32	12.12	4.64	6.34	10.99	44.96	61.83	72.71	27.39
	1991-92	16.31	4.42	3.96	8.38	6.57	9.4	3.4	19.37	2.38	0.45	2.83	53.11			
	1999-00	24.43	5.2	3.28	8.48	5.54	4.52	3.39	13.46	2.83	0.9	3.73	50	64.71	77.27	22.73
Kalahandi	1972-73	27.98	2.5	2.42	4.92	5.09	15.89	3.2	24.18	0.78	3.11	3.89	39.03	47.15	82.78	17.22
	1982-83	45.51	0.17	0.26	0.43	3.54	0.86	0.43	4.06	0.43	0.35	0.78	49.22	65.78	74.83	25.17
	1991-92	43.61	2.76	0.26	3.02	2.07	0.86	0.52	3.45	0.43	1.04	1.47	48.45			
	1999-00	42.81	4.39	2.5	6.89	1.12	1.03	1.38	3.53	0.86	1.98	2.84	45.31	65.63	69.03	30.97
Phulbani	1972-73	75.09	1.18	0.18	1.36	0.36	0.45	0.45	1.27	0.27	6.16	6.43	15.85	18.57	85.37	14.63
	1982-83	75.09	1.45	0.18	1.63	0.36	0.54	0.45	1.36	0.45	0.54	1	20.92	30.12	69.46	30.54
	1991-92	51	1.63	4.89	6.52	3.35	6.07	5.8	15.22	2.63	0.27	2.9	24.37			
	1999-00	50.54	3.99	4.71	8.7	1.97	7.61	3.35	12.93	3.8	3.53	7.34	19.66	24.91	78.91	21.09

Source: Indian Agricultural statistics.

In all the districts the Net Area Sown has increased from 1972-73 to 1999-2000 though the rise in not a steady one .The share of Net Area Sown is also quite different for the different districts.Whereas in Bolangir it has risen from 45.63%in 1972-73 to 50% in 1999-2000, in Kalahandi it has risen from 39.13% to 45.31%during the same period. However in the districts of Phulbani it is very low and the increase has been only from 15.85% in 1972-73 to 19.66% in 1999-2000.This low figure of N.A.S is due to the nature of

physiography of the district characterised by the hilly and rolling terrain of Eastern Ghats.

As per the data, except for Phulbani district the share of forest area has registered an increase during the period 1972-73 to 1999-2000. Interestingly during the same period the share of N.A.S has also followed a similar trend, so also has the trends of permanent pastures, miscellaneous trees and groves and the rising trend in the share of area unavailable for cultivation and total fallow, pointing to the fact that there is no evidence to the net gain of NAS from the decline from share of forests.

Though the data suggest quite a high share of forests, some scholars have raised doubt over the actual coverage. [2] Except for Kalahandi, the share of miscellaneous tree crops and groves has remarkably increased in the districts during the study period, the most significant growth being seen in the district of Phulbani where it has increased from 0.45% in 1973-73 to 7.61% in 1999-2000.

4.2 Land Capability

Land capability classification is undertaken on the basis of a number of geographical factors like- slope of land, soil texture and structure, availability of moisture, alkanality and sodicity of the soil, etc. NATMO has divided the

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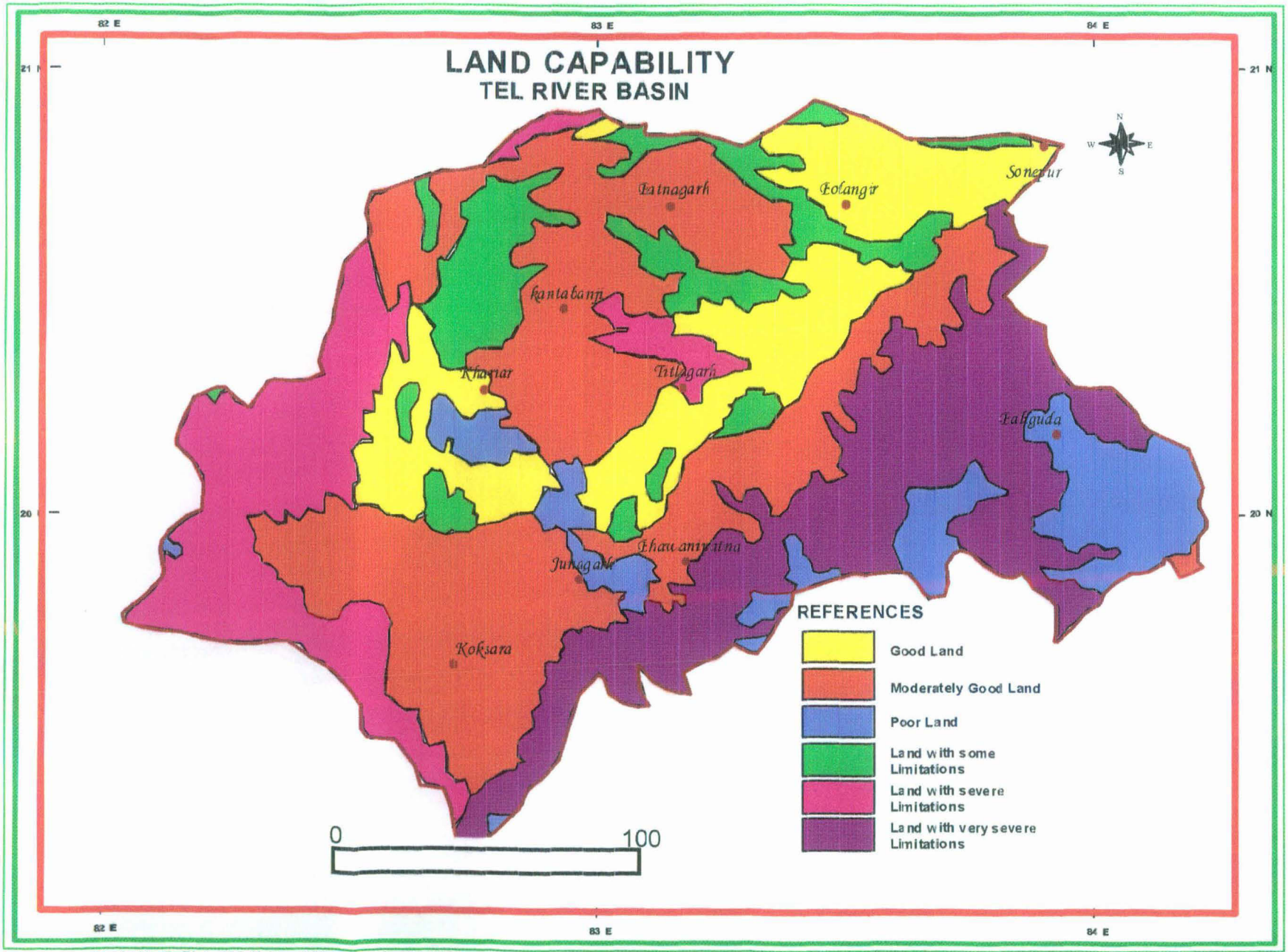
[2] Where as official estimation puts the present forest at 46.38 %.However satellite imagery shows that only about 10 % of the forest is left today.(Nayak, Kunja Bihari ,(2004)-Social Action,Vol54,pp77, "Deforestation and Tribal Underdevelopment : Facts from Kalahandi districts of Orissa."



Source: Central India Plate 222, National Atlas of India, NATMO.

Map IV(4)

various types of lands into 8 categories like – half of which are suited for cultivation and the rest unsuitable for cultivation. They are as follows:

(A) Suitable for cultivation

I- very good land;

II- good land;

III- moderately good land;

IV- poor land

(B). Land unsuitable for cultivation

V- Land with some limitations (suitable for forestry and grazing);

VI- Land with severe limitations (suitable for forestry and grazing);

VII- Land with very severe limitations (suitable for forestry and grazing);

VIII- Land suitable for wild life etc.

Land Capability data (map) was obtained from NATMO, Govt. of India, to get a broad view about the status of land resources of the basin. The Tel river basin falls in the central India plate No. 222. The map was geo-referenced with the help of ERDAS imagine 8.4 software and using GIS techniques. This helps us to find out the areas of various category of land capability classes.

In the Tel river basin, we find six categories of land ranging from class II to class VII, and the two extreme categories viz. category I- very good land as well as category VIII- land suitable for wild life is not found. The calculated area of various classes of land reveals that around 57.22% of the area in the basin is suitable for the cultivation, where as the rest 42.78% is unsuitable. Only about 16% of the area is under very good category and a large chunk of the area suitable for cultivation ie. 32.35% of the total basin area is under the category of moderately good land. Within the area unsuitable for cultivation, nearly 20% of the total basin area faces very severe limitation mostly covering the western slope of the Eastern Ghat Mountain. The category VI land that is the land with severe limitations also is the hilly region with abrupt slope changes.

Thus the study of landuse and land capability points to the greater importance that watershed management has to play in the region, and also the success of such management practice will depend on the crucial aspect of integration of land and water resources in the region.

CHAPTER V

THE STATUS OF WATER RESOURCE UTILIZATION

5.1 Introduction

The development of a region with its people predominantly engaged in agricultural activities largely depends upon the extent to which the water resource is utilized. The status of utilisation of water resources in the Tel river basin can be studied through – the level of irrigation development and the level to which provision of supplying drinking water has been achieved.

5.2 Level of irrigation development

The process of supplying water to crops by artificial means such as canals, wells tube-wells, tanks etc. from the sources of water such as rivers, tanks, ponds or under ground water is called irrigation[1]. In a tropical Monsoonal climate region the rainfall being very inconsistent in nature, irrigation plays a very crucial role for successful cultivation especially for double cropping.

5.2.1 Gross irrigated area

Gross irrigated area gives us the idea of the overall level of irrigation development in the region. Table 5.1 presents the Gross Cropped Area. Net area sown and the Gross irrigated area at four time period each representing the triennium average figure.

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[1] Khullar D.R.(2000): India- A Comprehensive Geography, *Kalyani Publishers,New Delhi*,pp275

Table 5.1: Gross Cropped Area, Net Area Sown and Gross Irrigated Area

District	YEARS	GCA	NAS	GIA	NAS % of GCA	GIA% of GCA
Bolangir	1962-65	561144	464848	82167	82.84	14.64
	1970-73	528962	386000	82167	72.97	15.53
	1980-83	555000	411000	113000	74.05	20.36
	1990-93	661810	496000	200730	74.95	30.33
Kalahandi	1962-65	1352321	1221473	35351	90.32	2.61
	1970-73	1399699	1157000	34351	82.66	2.45
	1980-83	1855000	1366700	122000	73.68	6.58
	1990-93	2007240	1324000	308620	65.96	15.38
Phulbani	1962-65	227973	194519	14000	85.33	6.14
	1970-73	239707	183000	14000	76.34	5.84
	1980-83	337000	231000	43670	68.55	12.96

Source: Indian Agricultural statistics.

From the table it is clear that Gross Irrigated Area (GIA) has a low share in all the districts through out the study period. The worst case is found in the Kalahandi district. In Bolangir the share of GIA has risen from a mere 14.64% in 1962-65 to 33.33% in 1992-93. In Kalahandi it was very low, 2.61% of GCA in 1962-65 and remained below 7% till 1980-83 which then increased to 15.38% in 1990-93, although agriculture is the mainstay of the population. In Phulbani too, the story is quite similar; it has risen from a mere 6.14% in 1962-65 to 12.96% in 1980-83. This low level of irrigation speaks largely for the reasons behind the low level of development and perpetual poverty persisting in the region.

Table 5.2: Share of Irrigated Area to Cultivated Area Under different Crop

Balangir		% irr-rice	%-irr-maze	%-total-cereal	%-tt-pulses	%-tt-f-grain	%-s-cane	%-g-nut	%-oil-seed	%-gia
	1972-73	30.32	4.14	27.84	0	23.68	99.86	7.24	1.95	21.55
	1984-85	30.04	12.70	30.32	3.35	22.80	87.07	7.57	2.69	24.67
	1990-91	34.49	25.64	34.43	7.70	26.40	100	38.02	16.80	-
Kalahandi										
	1972-73	5.62	0	4.58	0	3.48	61.73	0	0	3.24
	1984-85	10.61	1.85	8.77	0.07	6.14	100	1.32	17.39	12.30
	1990-91	18.11	6.55	16.59	0.81	9.71	100	10.59	4.04	-
Phulbani										
	1972-73	31.15	0.2	24.31	0	18.97	100	1.53	0.08	15.27
	1984-85	32.56	0.39	25.15	1.49	16.04	96.54	3.59	7.34	15.25
	1990-91	36.05	2.993	29.41	1.545	20.27	100	5.53	1.30	-

Source: Indian Agricultural statistics.

In the study Period (1972-73 to 1990-91) the share of irrigated area has risen under almost all crops (except for the percentage of irrigated area under oilseeds which have shown a decline lately after an initial rise). But what is to be noted here is that the level of irrigation under each of the crops is extremely low through out the basin area, the extreme case being witnessed in the Kalahandi (district) region.

Rice was cultivated under irrigated condition only in 34% of the area (of the total area of rice cultivation) in Bolangir till 1990-91 and in 36% in Phulbani, where as in Kalahandi the irrigated area under rice has risen from an insignificant 5.62% in 1972-73 to 18.17% in 1990-91 This is the case when more than 75% of the irrigated area under all crops is accounted by Rice in Kalahandi and Phulbani pointing to the fact that all other crops are mostly cultivated under un-irrigated conditions. This indicates the low level of productivity in the whole region resulting in high incidence of poverty.

Among the oilseeds, groundnut is the most important that is being cultivated under irrigated condition. However, its share is gradually declining over the study period (1970-73 to 1990-91) pointing towards some other kind of oilseeds bring put to irrigation. It can be pointed out here that out of the total area under groundnut, less than 10% of it was under irrigation till 1990-81 in the districts of Kalahandi and Phulbani, where as in Bolangir it is quite higher, where around 38% of groundnut is cultivated under irrigated condition.

5.2.2 Source of Irrigation

Water for irrigation is drawn from various sources. Broadly they are grouped under three categories of sources viz. canales (mostly operated by Govt.); minor irrigation projects, having limited scope in terms of their capacity to irrigate a smaller area at a time; and wells which can again be sub-divided into two categories like Tube-wells or lift irrigation and other wells owned and operated by private households or the community. All the types of sources have their scopes and limitations over one another in term of the areal extent to which they can irrigate at a time; their efficiency and the long range impact they bring into the environment of the region like change in salinity of soil, water logging, depletion of ground water table etc. Table 5.3 presents the source of irrigation for the basin in terms of their share from the gross area irrigated from 1972-73 to 1990-91.

Table 5.3 Source of Irrigation

Districts	Year	% Canal	%MIP	%tub/lift	Other-w-pvt
Balangir					
	1972-73	68.97	5.72	0.12	25.19
	1984-85	56.43	13.92	1.61	28.02
	1990-91	44.10	4.01	7.30	44.57
Kalahandi					
	1972-73	--	45.66	0	54.33
	198w4-85	21.067	30.88	5.17	42.87
	1990-91	22.89	28.11	18.1489	30.83
Phulbani					
	1972-73	65.28	16.59	0.09	18.02
	1984-85	50.96	25.61	2.38	21.03
	1990-91	31.16	25.22	14.11	29.49

Source: Indian Agricultural Statistics.

5.2.3. (a) Canals:

In all districts canal is the predominant source of irrigation. However expect for a marginal increase in the share of canal irrigation in Kalahandi (from 21.06% in 1984-85 to 22.89% in 1990-91), in the rest two districts, its share has significantly declined from 68.97% in 1972-73 to 44% in 1990-91 in Bolangir and from 65.28% to 31.76% in Phulbani during the same period. It can be said here that canal irrigation in not an efficient made or irrigation. Canal irrigation efficiency in India is just around 35 to 40 percent, well below international standards.[2] Further canal irrigation "being provided virtually free"[3] it often leads to over-application of water and encourages the water users to go for highly water-intensive crops selection.

5.2.3. (b) Minor Irrigation:

The share of minor irrigation has registered an overall growth in Phulbani, where as in Kalahandi, where its share was initially significantly high

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2 National Commission for Integrated Water Resources Development Plan.

3 Iyer, RR (2003): Water – Perspective Issues, Concerns" *Sage publication,* pp. 268-269

(45.46% in 1972-73), has registered a steady decline (to 28.11% in 1990-91). It has declined from 13.92% in 1984-85 to 4% in 1990-91 in Bolangir district.

5.2.3 (C) Tube-well/ Lift:

There is a significant increase in the share of irrigation under tube-well and lift through out the area during the study period. It is important here to point out that the greater use of this source of irrigation leads to rapid rates of ground water depletion. Thus to compensate for such loss of groundwater, rain water harvesting and other watershed management programs need greater promotion in the Tel basin region.

5.2.3 (d) Other Wells:

It is quite interesting to note that the share of irrigation under the "Other wells' category has registered impressive growth in Bolangir (from 25.19% in 1972-73 to 44.57% in 1990-91) and Phulbani (18% to 29%) but it has declined significantly in Kalahandi from 5.64% to 30%, where it has been the most important source of irrigation throughout the study period. However the rise in this category, that mostly constitute the private wells, may point to the increasing disparity in the access to irrigable water resources as private wells are mostly dug by the rich farmers chiefly to support their own crops.

5.3. Provision of Drinking water

Water being one of the vital necessities of life, its provision for serving the vital necessities can be thought of as a basic right of the people in a democratic country like India. Denial of this basic right is seen as a failure of the democratic character of the country. Most of the area in the Tel basin being drought prone, the scarcity of this basic amenity is often reported. Hence the study of the provision is often reported. Hence the study of the provision for drinking water is of due significance.(Table 5.4)It gives the information on

the sources of drinking water available in various CD blocks by no. of villages and their share from total No. of villages in the CD block.

Table 5.4: Provision of Drinking Water

	No. of Village	Tap	Well	Tank	Tube well	River	Fountain	Canal	Others	>one source	No Drinking facility
Bolangir											
Bolangir	122	0.00	44.26	76.23	96.72	51.64	0.00	0.00	1.64	79.51	0.00
Bongomunda	133	1.50	71.43	47.37	93.98	6.77	0.00	0.00	1.50	93.98	0.00
Deogan	126	0.79	44.44	74.60	79.37	19.05	0.00	0.00	13.49	93.65	0.00
Khuprakhol	132	0.00	76.52	9.09	100.00	0.76	0.00	0.00	0.76	84.85	0.00
Loisingah	107	0.00	87.85	80.37	59.81	21.50	0.00	12.15	10.28	95.33	0.00
Muribahal	157	0.00	100.00	40.13	56.05	0.00	0.00	0.00	0.00	96.18	0.00
Patnagarh	164	0.00	99.39	14.02	62.20	0.00	0.00	0.00	0.00	75.61	0.00
Puintala	134	0.00	68.66	70.90	85.07	5.97	0.00	0.00	0.00	89.55	0.00
Saintala	135	0.74	24.44	51.11	94.81	25.19	0.00	0.00	16.30	87.41	0.00
Tarabha	151	0.00	45.03	23.18	88.74	10.60	0.00	0.00	3.97	60.26	0.00
Tentulikhunti	91	0.00	100.00	63.74	14.29	60.44	0.00	0.00	7.69	92.31	0.00
Titlagarh	130	0.00	99.23	57.69	50.77	5.38	0.77	0.00	9.23	89.23	0.00
Turekela	109	0.00	90.83	83.49	90.83	6.42	0.00	0.00	10.09	90.83	0.00
total	**1691**	**0.24**	**72.86**	**50.68**	**75.87**	**14.61**	**0.06**	**0.77**	**5.38**	**86.16**	**0.00**
Kalahandi											
Bhawanipatna	239	0.00	85.77	68.20	50.21	30.96	6.69	0.00	48.95	92.89	0.00
Boden	86	0.00	100.00	77.91	52.33	25.58	2.33	1.16	29.07	95.35	0.00
Dharamgarh	71	0.00	98.59	100.00	88.73	32.39	4.23	9.86	1.41	100.00	0.00
Golmunda	122	0.00	98.36	74.59	54.10	28.69	0.00	0.00	8.20	88.52	0.00
Jayapatna	90	0.00	97.78	90.00	33.33	46.67	2.22	4.44	6.67	98.89	0.00
Junagarh	177	0.00	92.09	75.71	18.64	26.55	4.52	1.13	23.73	91.53	0.00
Kalampur	54	0.00	98.15	90.74	92.59	40.74	5.56	12.96	11.11	100.00	0.00
Kalamunda	60	0.00	96.67	95.00	95.00	40.00	1.67	1.67	13.33	100.00	0.00
Kesinga	99	1.01	100.00	98.99	96.97	44.44	1.01	7.07	5.05	100.00	0.00
Khariar	112	0.89	98.21	83.04	57.14	35.71	3.57	0.00	4.46	91.96	0.00
Koksara	64	0.00	100.00	92.19	29.69	40.63	0.00	0.00	15.63	98.44	0.00
Komna	153	0.00	98.04	72.55	80.39	35.95	0.00	18.30	23.53	96.08	0.00
Lanjigarh	422	0.00	52.84	15.17	22.51	39.34	29.15	0.00	71.33	76.78	0.00
M rampur	229	0.00	89.08	46.72	70.31	38.43	20.09	0.44	29.26	94.76	0.00
Narla	166	0.00	98.80	89.76	40.96	33.73	0.00	0.00	3.01	95.18	0.00
Sinapali	122	0.00	96.72	69.67	58.20	45.08	1.64	0.00	13.93	91.80	0.00
Total	**2266**	**0.09**	**87.16**	**65.27**	**52.12**	**36.14**	**9.31**	**2.56**	**29.17**	**91.39**	**0.00**
phulbani											
Balliguda	239	0.00	47.70	2.09	51.46	15.06	11.30	0.42	32.64	45.19	0.00
Daringibadi	259	0.00	23.55	2.70	62.93	0.00	95.37	0.00	9.27	72.97	0.00
Kantamal	390	0.00	97.95	64.87	2.82	10.77	0.26	2.31	0.00	70.51	0.26
Kotagarh	142	0.00	32.39	0.70	63.38	4.23	3.52	0.00	32.39	26.06	1.41
Nuagan	174	0.00	68.39	10.34	59.77	4.60	1.15	0.00	22.41	54.02	0.00
Tumudibandh	206	0.00	1.94	0.49	86.89	2.91	6.31	1.46	7.28	5.83	0.00
Total	**1410**	**0.00**	**51.49**	**20.21**	**47.52**	**6.95**	**20.92**	**0.92**	**14.33**	**50.71**	**0.21**

Source: District Census handbook, 2001.

Only six villages of the 5367 villages in the study area have tap water supply to be used as drinking water.

It can be perceived as a big failure on the part of democratic institution of the country that there are still some villages where not a single source of drinking water has been made available. There are three such villages in the study area, one in the Balliguda CD block and, the other two in the Tumuribandh CD block both of which lie in the south eastern part of the Tel basin. It can be pointed that, this part (S. Eastern) receives the highest amount of annual rainfall and still there is the paradox of village and without any drinking water provision. This under scores the need for the efficient and innovative methods of water management practices. As per the government statistics (as presented above) there is provision for drinking water for all the villages in the study area lying with in the Bolangir and Kalahandi district. But looking at the often reported scarcity of drinking water in many villages in these two districts, it would be interesting to further carry on researches on the various aspects of such provisions- like the distance the villagers have to travel to fetch drinking water, whether it is available throughout the year in all the months and the quality of such water available.

By far well is the major source of drinking water followed by Tube wells and Tanks. Around 73% of the villages in the study area have wells where as 58% and 49% of the villages rely on tube wells and tanks respectively. Here it may be noted that these are not exclusive figures that is

villages having wells may also have tube wells and tanks or any other source of drinking water.

Most of the villages of Kalahandi lying under the Tel basin, rely more on tank than tube wells (after wells), as their source of drinking water. In Bolangir too 50.68% of the villages rely on tanks as one of the sources for drinking water. As per the district gazetteers these two districts are known to have rich history of tank construction and management, which are of course in the declining trend due to their age neglect and ill management.

There are 4243 (79.06%) villages out of the total 5367 villages which have more than one source of drinking water. The share of villages with more than one source of drinking water in Bolangir, Kalahandi and Phulbani are 91.39%, 86.16% and 50.71% respectively.

CHAPTER VI

THE POLITICAL ECONOMY OF UNDER-DEVELOPMENT VIS-À-VIS WATER RESOURCE DEVELOPMENT

6.1 Introduction

The districts lying in the Tel basin have earned name for the wrong reasons. Even after the operation of the so called democratic institutions in the regions for a few decades and after pumping in huge amount of funds to the region, so much of media coverage, there are still new cases of starvation deaths, parents selling their children for a few hundred rupees, reported year after year in the region in the notorious KBK (Kalahandi-Bolangir-Koraput) region two (districts) of which constitute a larger portion of the Tel basin. However, a journey undertaken through the history (not very old), point to a rich and prosperous condition. Thus one conclusion is that the region paradoxically without any external help (financial) was rich, that gradually but steadily is being sunk in the poverty trap and vicious circle of many complex vices.

"Some call it perennially drought stricken others think that it is practically impossible to mitigate the human sufferings... from the region. But what remains unknown is that starvation and hunger exists amidst plenty" (Sharma, Devinder, 1996). Studies conducted by scholars and the various reports published by a few really good Non-Governmental

Organisations working in the region and other groups[1] point to the complex interplay of various factors, responsible for the under development in the region. Thus it is worth looking into the various factors in operation in the region and draw some lessons that could be crucial in the development planning of the region.

6.2 Historicity

The history of water resource development practices show that due to their efficient mode of harnessing and storing of water people of the basin area (albeit Western Orissa) could successfully avoid all major drought. Due to undulating terrain, water rapidly flows away after rainfall. Thus "design of the indigenous tanks seems to be the most appropriate for retaining surface water for use in the dry months."[2]

Some of these tanks still continue to serve as a sustainable source of protective irrigation for crops. However, these tanks' usefulness is severely restricted by age and lack of maintenance.

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1 "Poverty in Bolangir is not solely the by - product of Frequent national disasters, but a systematic fallout of large scale institutional failures and suppressive political dynamics at various level", The Politics of Poverty: A tale of the leaving dead in Bolangir, *Praxis* pp.ix (2000)

2 Sengupta S. (2000), "Political Economy of Irrigation: Tanks in Orissa", *EPW*, Dec. 30, p.4695.

The original inhabitants of this region were the tribals like Binjhals, Soora, Kondh and Gond tribes and the area was once covered with dense forests of sal, teak and bamboo. The forest and other agricultural land were managed and owned by these people. These people marginalised with the influx of people outside the region, which began in the rate 18th century and peaked in the next 100 years. In the early 18th century the Binjhals, Kondh and Gonds held most of the Zamindaries in the region, holding fertile and prosperous villages as hereditary Gountias. They used the undulating topography to grow a diverse range of crops carefully choosing most of the drought resistant species. "They were expert water technologists and built small embankments on the highest land levels to harvest rainwater."[3] The meticulous choice of crops ensured optimum food supply even in erratic rainfall years.

Between 1850-70, Cash-rich immigrants started displacing the original settlers. The British too gradually took over the rights over land and by early most of the Gountias were non-tribals. The alienation process started with the best-cultivated land resulting in the retreating of the tribals deep into the forests. This changing composition of the village tenant body also brought a significant transformation in the agricultural

[3] Sengupta S. (2000), Drought: Reaping Scarcity, www.indiadisasters.org.

practices. Large areas were brought under wetland cultivation and the crop-diversity shrank. By building private tanks, they were able to raise productivity of rice, most of which they exported via the newly constructed railways. By 1900 Kalahandi which hardly produced any exportable surplus till 1856 was trading in grain, pulses, oilseeds and timber.

The fluctuation of rainfall from 1896-1900 could not be resisted by the long duration, low lying bahalpaddy occupying most of the fertile lands. Rich farmers could save their crop by cutting the embankment and the bore fell on the marginal farmers. First drought occurred among the well to do farmers, the drought created for a demand for a lank, the tribals had to substitute rice with coarse grains.

By 1910, the development of road communications to the region from outside trading centers made traders settle in the prominent towns who conducted brisk trade in grain and timber. The consequence was price inflation of agricultural commodities.

By 1950 the tank ownership reverted to the elite private individuals who could no longer afford to maintain private irrigation structures leading to the dislapilation of tanks and resulting in the decline in their efficiency. Forest resources were leased out and the undulating

landscape turned bare and vulnerable to the onslaught of rain. Zamindari and Gountaihi were abolished but land distribution remained iniquitous. Sengupta rightly observes that "The land coiling acts, implemented in western Orissa in 1970, could salvage only wasteland and scrub forest for their distribution among the landless and the marginalised population. In this scenario, a rain-failure as in 1996, untimely rain (at the time of harvest) 1997, and delayed starting of rain (as in 1998, damaging short duration upland rice grown by the poorest), all an damage crop to the extent of drought. Thus agriculture is fast becoming an expensive gamble in the Tel river basin (and as a whole in western Orissa). Perhaps this explains the contradictory connotations used to address the land holders (and cultivating) and landless groups, the later being called sukhbasis, as they don't have the worries related to cultivational activities, even though they are the most deprived and suffering group, both during drought and non-drought period).

6.3 The Socio-Political Factors

We can also trace the basis of underdevelopment in the socio-political set up of the region. As we know the incidence of underdevelopment in the region is specific to both social and political aspects. It is the socially and politically marginalized section of the

population who are the representative face of the poverty in a region. Ironically this group, though quantitatively larger in number are not able to address their problems directly to the government due to the continuous suppression they have been subjected to and the resultant incapacity to cross the threshold of socio-political dynamism. Mostly the scheduled castes and the scheduled tribes constitute this deprived and marginalized section.

In the Teli basin region caste and tribe are important social institutions. Inspite of the various levels of cultural differences between tribals and caste groups, the close interactions, later on, with caste groups have brought tribals in the caste based social structure.[4] Mostly tribals find themselves at the lower end of the caste hierarchy, though at times some of the lower castes people are perceived to be still less acceptable even among some of the tribes. Social interaction between the groups is quite limited. Interestingly exclusion in social practices is more distinctly observed among the classes where it is hardly witnessed between the upper and middle caste groups. And this is one of the important reasons why they (the lower class) stay divided and cannot unite to form a political group and claim for their grievances to be addressed by the

[4] PRAXIS (2001), The Politics of Poverty; *Books for Change*, pp.9-10.

government institutions. While the lower class (especially the Gandas) is represented in Panchayati raj institutions as per the reservation policy, their participation is low and they are often marginalised. Rarely do they take part in the decision making process regarding the selection of beneficiaries of government programmes or involvement in other development works.

Status of woman in all castes has been found to be low in most of the cases. Their control over income (even what they themselves earn) and decision-making process is limited. Contrary to general belief, tribal woman also live in a sub-dued status in their families. This keeps the marginalised group to continue deprived over time. The psychological basis for the development of such attitude (overtime) as also not difficult to find out. The prevailing patriarchal set up both in the family as well as in the society - stifles the development aspiration of the women (living in a deprived state) in the family and the marginalised section of people in the society. This also explains the failure of rational participation of the other higher classes of people in decision making bodies related to water-shed study region (perhaps also applicable to characteristic Indian state of affairs), as compliance with any emerging decision is perceived as an

act of the weaker section, then preventing any unanimous decision to come out.

The political institutional set up is also not in the desired state at all levels viz. district level, block level, gram panchayat level or at village level. There is lack of transparency in the functioning of political institutions, grievance redressal mechanism as well as is bureaucratic discourse. There have been many declarations for the development of the region but the ground manifestations of these takes place very late. As Jagdish Pradhan puts it - "The main issue in the entire KBK is the lack of attention to local conditions and systems by the bureaucracy and government. The empowering of gram-sabhas by giving them control over non timber forest produce was promised by the state government but has not taken off." Jagdish Pradhan heads the Paschim Orissa Krushijeevi Sangh, (POKS) that works for the organizing of small farmers' and landless labourers in the study area. The land ceiling acts of orissa initiated during the 1970s is perceived as a failed initiative, if its outcome is analyzed. Even now there is inequity in the distribution of land among the rich and the marginalized both in terms of quantity and quality of land. Most of the "landless have been given aat land the high lands in which inadequate water coverage severely limits potential for

successful paddy cultivation, even during the monsoon period.[5] The continuing political apathy on the part of the state government for the region (the entire western Orissa) has fuelled infact "a fair amount of regional separatist movement " against the state, however, such occasional demands for a separate state have not so far been "coalesced into a movement, partly because of their high class and feudal leadership."[6]

6.4 The Economic Factor

The Tel river basin has been in news for the last few years for the extreme form of poverty persisting there, inspite of the huge amount of money being spent for the eradication of poverty in the region close look at the economic factors of under development reveals that the region suffers from inequitable land distribution, unfavourable terms of trade, under pricing of various commodities, rampant corruption in the bureaucracy, the greater role of monopolizing and dishonest traders, lack of the necessary ground work which the various programmes require to succeed etc.

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5 Curie, Bib (2000), The Politics of Hunger in India: A Study of Democracy, Governance and Kalahandi its Poverty, McMillan, London, pp.98-99.

6 Omvedt Gail (200), "Worst in a hundred Years: The Kalahandi Drought", Manushi.

Study shows that in one of the district (Bolangir) lying in the Tel river basin, though land holding (average) is 1.69 hectares and per capita food grain availability is 274 kg yet around 80% of the population live below poverty line. It is because there is absolutely skewed land distribution. While 9.6% (big farmers) of the total operational holdings have 37.3% of total cultivable land in possession, only 12.8% of the total cultivable land is held by a mammoth of section of 43.7% (marginal farmers) of the total operational land holding. Most of the irrigation protected lands are in the hands of the big farmers and most of the uplands belong to the marginal and small farmers.

The poor deprived section of the population are trapped in the vicious cycle of low yield, low income, mortgage, loan from money lenders, low input, low income etc. Though moneylenders vehemently deny informal sources put the annual rate of interest to about 460%.

Though the tribal people mostly depend on the forest produce at least for a part of the year, for their own consumption, a recent study indicates a changing trend in this practice, and that a large portion of the items which were earlier collected for personal consumption, are now being sold to the market, pointing to the fact that how seriously and desperately the marginalized sections depend on the forest produce for

their existence[7] The tribals are highly underpaid for the forest produce they sell to the middleman. For example "Chiroungi" an edible forest produce is purchased at prices varying between Rs. 5 to 12 a kg. At Raipur, the nearby urban centre and capital by Chhatisgarh it sells for a minimum of Rs.300 kg.

Even five decades after independence, an average family in Western Orissa survives on an annual income of less than Rs.5000/-. Hunger, malnutrition, disease and even starvation are therefore inevitable. The immediate task for the power that be, it's to go in for Capacity building among local communities. Micro-credit restoring the traditional farming practices, tuning in agricultural technology to the needs of the people has to be taken up to the earliest.

In preparation for the long reason of deprivation, people begin to eat less and start practicing the's early, so that little by little their systems can learn to cope. According to Sainath "rotating hunger within adivasi families is not uncommon Sainath P. in "Everybody loves a Good Drought"

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[7] Nayak KB (2004): "Deforestation & Tribal Underdevelopment", Social Action, Vol.54, Jan-march., p.83

Apart from low yield of rice, people hardly get the right price for the paddy they sell. Due to lack of initiatives on the part of FCI, people in Kalahandi had to sell their paddy for Rs.200-300 per quintal though the official price was Rs.340/350 lack when they had to buy rice for consumption; they had to by it at Rs.360/kg as observed by Gail Omvedt.[8]

Selling Kendu leaves and other forest produce that provides about 40% of the income of the poor and primarily gathered by women. It sells at a very low price. The trade was nationalized some years back but with so much of corruption there has been no basic difference. Prices of all forest produce are higher in nearby Madhya Pradesh[9] (now Chhatisgarh).

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[8] Omvedt Gail (200) "Worst in a Hundred Years: The Kalahandi Drought", Manushi.

[9] Panigrahi Abani (1991), Address in the Conference "Hunger and Underdevelopment: Is there a way out for Kalahandi?" held by "Lak Drusti" at Bhawamipatna.

CHAPTER VII

DISCUSSION AND CONCLUSION

In the recent few years, water has become an important subject. There is a sense of acute pressure on the available finite supply of this resource mainly arising due to the quantitative growth in the number of population and the qualitative change that has taken place in the nature of water use. But it is hardly possible to manage water resources successfully following an isolated approach. For this one has to consider all other resources, both natural and human and stick to an integrated approach.

Rainfall in a region can be seen as the basic source of water resource for the region. A river basin characterised by some kind of homogeneity provides a basic unit of study for studying the water resource dynamics. As evident from the study undertaken it could be seen that the Tel river basin receives quite a good amount of total annual rainfall. However, the higher coefficient of variation of annual rainfall raises the demand for searching out means to make temporal transfer of water from year of good or surplus rainfall to any consecutive year of monsoon failure. Again, the seasonal clustering of rainfall makes the situation still worse. The basin area receives more than 80% of the rainfall with in a few months of the year.

These two aspects call for the need to make temporal transfer of surplus water to the time of deficit rainfall for the successful practice of agriculture. This can be done when the water is in the transitional phase i.e. after falling on earth and before getting released out of the catchment area. In other words, one has to aspire for and devise water conservation design so as

to mitigate the water deficiency. The region having a long history of tank irrigation, it can be vigorously taken up. But for this proper site planning has to be completed first. Also, the institutional arrangement has to be devised that makes things hurdle free regarding the provision of the access to it and accountability aspects attached to its users.

The nature of use of water resources depend upon the kind of landuse in vogue in the region. So to assess the quantitative demand for water the study of landuse is usually preceded. The land use in the study area observe gradual intensification of the nature of landuse as revealed by the steady rise in the share of area under Net Area Sown category. It has also witnessed changes in the share of other types of land uses like area under forests or the area under miscellaneous tree crops and groves. However, such changes in landuse has to be studied in the back drop of land capability classes, so that necessary modifications can be made possible depending upon the potential of land to achieve the optimum output of each landuse category. Such integrated study makes the choice of landuse more scientific and appropriate by enabling use to concerete ly know, whether a particular area is suitable for the pursuance of a particular type of land use and if not, yet if its use inevitable, what necessary additional arrangement must be made so that the developmental activities be made profitable as well as environmentally sustainable. The study landuse and land capability point to the fact that the NAS is so far not unexpected but for the pursuance of profitable agriculture, increase in the level of irrigation is highly necessary and such provision of

irrigation may follow time tested traditional knowledge base. Any kind of intensification of irrigation however, is not necessarily to be followed rather; there should be greater emphasis on the preservation and development of drought resistant species of crops.

The level of irrigation in the Tel basin is very low, the lowest being in Kalahandi. Though almost all the crops are being cultivated more and more under irrigated conditions, the level of irrigation under each crop is abysmally low. Though it has registered a declining trend, canal is still the dominant source of irrigation. There is enough scope for the popularisation of other than canal irrigation source.

The drinking water provision is not found to be satisfactory in the villages of Tel Basin. There are still a few villages where there is not a single source of drinking water and these villages are located in the high rainfall areas in the basin. The urgency of water resource management can be judged from the above facts. This calls for some necessary steps.

The underdevelopment of the region as a whole and the deprivation and marginalisation of certain sections of people can be traced in the socio-economic- political set up of the region

8The development of the Tel basin region suffers not solely due to failure in rainfall rather due to the interplay of a large number of factors. But a deeper analysis will reveal that the entire process of under-development

started with the mismanagement of the crucial water resources ie. not synonymous with mere failure of rainfall and later has set in a vicious cycle of under development. The deprivation of the access to water resources has infact sown the seed of manrginalisation of a particular section of the community and has resulted in the cumulative poverty.

Any earnest attempt for the development of the region rain has to take care of a number of factors responsible for the underdevelopment. But who is responsible- is it the Government or society? Or the environment? We cannot blame any one of these factors solely. One has to take care of all these factors. But whatever be the approach of development, perhaps the management of water resource has to be the central theme of that approach. Water shed based development program can be pursued vigorously in the region because they provide all the inputs on the basis of which the process of development can be built upon and also because such approach can address to almost all the problems of the region.

Here it is important to point out that watershed approach too cannot be thought of as the panacea for all the problems of the region. For the fact that it compasses a wide range of factors operating with in the watershed, the watershed based development approach can serve as the vital link for them to make the development process more effective.

The following few things are considered important and can be taken up in the development planning for Tel basin: – They are

1. To mitigate the water scarcity in the non-monsoon period some kind of ground water storage mechanism must be integrated and conjunctive use of surface and ground water should be emphasised upon, without solely relying only on one source there by depleting the source and making one self vulnerable in time of need.

2. There has to be complete realisation that water is a highly finite resource, thereby discouraging inefficient (over) use of water.

3. More use of drought resistant varieties of crops to be encouraged especially under rainfed condition. Research should be undertaken for building a rich stock of such species.

4. Participation of the beneficiaries has to be there through out the process of development.

5. Necessary changes to be introduced into the institutional arrangement so that awareness among the people be kept high; grievance redressal system be strengthened, flexibility in the operation is ensured and these have to be done through the local bodies.

6. More research be undertaken to further innovate and concretise the above five factors to expedite the process of development.

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Annex-1

Bolangir		Bhawanipatna		Titlagarh		Baliguda	
	Annual				Annual		Annual
1901	1269	1901	1284	1901	1268	1901	1418
1902	1194	1902	1038	1902	1193	1902	1208
1903	1025	1903	1286	1903	1025	1903	2139
1904	1427	1904	1743	1904	1427	1904	1888
1905	1588	1905	1520	1905	1588	1905	1426
1906	1317	1906	1485	1906	1317	1906	1296
1907	1366	1907	1473	1907	1315	1907	1736
1908	1407	1908	1657	1908	1214	1908	1631
1909	1301	1909	1948	1909	1244	1909	1750
1910	1488	1910	1678	1910	1448	1910	2011
1911	1537	1911	1704	1911	1786	1911	1751
1912	884	1912	1305	1912	1057	1912	1415
1913	1297	1913	1365	1913	1179	1913	1798
1914	1268	1914	1201	1914	1140	1914	1554
1915	1307	1915	1212	1915	1235	1915	1339
1916	1447	1916	1137	1916	1192	1916	1633
1917	2223	1917	1606	1917	2104	1917	1962
1918	1608	1918	1183	1918	1110	1918	1307
1919	2047	1919	1787	1919	1605	1919	2076
1920	1411	1920	924	1920	883	1920	1314
1921	1498	1921	1055	1921	1080	1921	1344
1922	1893	1922	1277	1922	1550	1922	1644
1923	1372	1923	1046	1923	802	1923	1239
1924	1148	1924	1101	1924	1013	1924	1609
1925	2002	1925	1506	1925	1583	1925	2211
1926	1418	1926	1589	1926	1493	1926	1734
1927	1551	1927	1697	1927	1571	1927	1428
1928	1200	1928	1460	1928	1461	1928	1760
1929	1744	1929	1487	1929	1627	1929	1610
1930	1689	1930	1404	1930	1300	1930	1624
1931	1163	1931	974	1931	1279	1931	1053
1932	1399	1932	3077	1932	1161	1932	1417
1933	2116	1933	1716	1933	1424	1933	2261
1934	1315	1934	1490	1934	1481	1934	1646
1935	889	1935	1086	1935	1277	1935	1406
1936	1929	1936	1940	1936	1619	1936	2080
1937	1549	1937	1549	1937	1361	1937	1957
1938	1159	1938	1465	1938	1029	1938	1323
1939	1685	1939	1555	1939	1299	1939	1822
1940	1651	1940	1590	1940	1483	1940	1393
1941	1040	1941	1227	1941	1075	1941	1355
1942	1269	1942	1435	1942	1432	1942	1586
1943	1866	1943	1518	1943	1524	1943	2101
1944	1360	1944	2021	1944	1698	1944	2229
1945	1642	1945	1639	1945	1462	1945	1810
1946	1277	1946	1416	1946	1224	1946	1678
1947	1128	1947	1744	1947	1539	1947	1466
1948	1532	1948	1411	1948	1392	1948	1110
1949	1445	1949	1464	1949	1445	1949	1617
1950	1537	1950	1023	1950	963	1950	1130
1951	1066	1951	1510	1951	1550	1951	1668
1952	1245	1952	1400	1952	1505	1952	1336
1953	1268	1953	1335	1953	1371	1953	1668

1954	1000	1954	1190	1954	1222	1954	1583
1955	1244	1955	1687	1955	1732	1955	1528
1956	239	1956	1693	1956	1738	1956	1886
1957	400	1957	1246	1957	1381	1957	1284
1958	1869	1958	1953	1958	2035	1958	1658
1959	1347	1959	1349	1959	1385	1959	1349
1960	1403	1960	1563	1960	1605	1960	1349
1961	1714	1961	1529	1961	1570	1961	1409
1962	1188	1962	1256	1962	1240	1962	1388
1963	1659	1963	1109	1963	1138	1963	1626
1964	1310	1964	1459	1964	1758	1964	1447
1965	980	1965	939	1965	965	1965	1429
1966	1357	1966	1246	1966	1280	1966	1052
1967	1334	1967	1543	1967	1584	1967	1291
1968	1078	1968	921	1968	1046	1968	1487
1969	1223	1969	1125	1969	1158	1969	1341
1970	1632	1970	1334	1970	1316	1970	1474
1971	1346	1971	1600	1971	1314	1971	1281
1972	489	1972	1372	1972	966	1972	1486
1973	1136	1973	1277	1973	1213	1973	1255
1974	843	1974	600	1974	724	1974	636
1975	692	1975	1097	1975	1065	1975	841
1976	1367	1976	1272	1976	1606	1976	1340
1977	1203	1977	1177	1977	1462	1977	1199
1978	1419	1978	1154	1978	1608	1978	1899
1979	876	1979	554	1979	1350	1979	1312
1980	1468	1980	1617	1980	1750	1980	1450
1981	1255	1981	1085	1981	1365	1981	1291
1982	1457	1982	1046	1982	1181	1982	1493
1983	1224	1983	1115	1983	1033	1983	1109
1984	1501	1984	1575	1984	1333	1984	1355
1985	1887	1985	1299	1985	2246	1985	1859
1986	1587	1986	1525	1986	823	1986	1683
1987	1246	1987	1141	1987	962	1987	905
1988	1044	1988	1158	1988	1088	1988	1195
1989	1338	1989	1146	1989	1005	1989	1408
1990	1959	1990	2601	1990	2267	1990	2159
1991	1242	1991	1811	1991	1442	1991	2221
1992	1868	1992	1645	1992	1539	1992	1669
1993	1719	1993	1416	1993	1464	1993	1358
1994	1952	1994	1915	1994	1979	1994	2266
1995	1543	1995	1104	1995	1141	1995	1452
1996	803	1996	794	1996	820	1996	915
1997	1530	1997	885	1997	1400	1997	1828
1998	893	1998	450	1998	951	1998	1005
1999	1271	1999	918	1999	1030	1999	1386
2000	802	2000	1382	2000	1073	2000	1067
ANN AVG	**1364**		**1386**		**1348**		**1529**

Annual Rainfall in mm

Khariar		Sonepur		G Udaygiri	
	annual				annual
1901	1258	1901		1901	1508
1902	1184	1902	942	1902	1335
1903	1016	1903	1245	1903	1588
1904	1415	1904	1569	1904	1498
1905	1575	1905	1067	1905	1420
1906	1306	1906	1362	1906	1769
1907	1305	1907	1830	1907	1343
1908	1204	1908	1569	1908	1230
1909	1234	1909	1248	1909	1488
1910	1436	1910	1345	1910	1384
1911	1772	1911	1609	1911	1066
1912	1049	1912	1158	1912	1477
1913	1169	1913	1326	1913	1733
1914	1131	1914	974	1914	2035
1915	1226	1915	1264	1915	1677
1916	1182	1916	1505	1916	1981
1917	1655	1917	1994	1917	1625
1918	1650	1918	2096	1918	1039
1919	1857	1919	1441	1919	1843
1920	1124	1920	1354	1920	1033
1921	1080	1921	1048	1921	1214
1922	1249	1922	1180	1922	1252
1923	915	1923	733	1923	1277
1924	1120	1924	1290	1924	1319
1925	1192	1925	1895	1925	1678
1926	1560	1926	1573	1926	1611
1927	1500	1927	1038	1927	1203
1928	1604	1928	1506	1928	1635
1929	1676	1929	1876	1929	1270
1930	1279	1930	1311	1930	1497
1931	850	1931	1360	1931	1063
1932	1240	1932	1598	1932	1218
1933	1722	1933	2213	1933	2114
1934	1575	1934	1477	1934	1380
1935	1126	1935	1020	1935	862
1936	1838	1936	2002	1936	1482
1937	1267	1937	1698	1937	1367
1938	1338	1938	1038	1938	1423
1939	1414	1939	1944	1939	1473
1940	1394	1940	1829	1940	953
1941	728	1941	1196	1941	1270
1942	1206	1942	1530	1942	1332
1943	1153	1943	1490	1943	1288
1944	1602	1944	1397	1944	1813
1945	1629	1945	993	1945	1605
1946	1033	1946	788	1946	1465
1947	1245	1947	935	1947	1332
1948	1381	1948	1407	1948	1041
1949	1433	1949	1494	1949	1517
71950	955	1950	1590	1950	1060
ANN RAINFALL	1353		1411		1432

Annex-2

Provision of Drinking Water

	no of village	tap	well	tank	tb well	river	fountain	canal	others	>one source	no drnk fac
Bolangir											
Khaprakhol	132	0	101	12	132	1	0	0	1	112	0
Patnagarh	164	0	163	23	102	0	0	0	0	124	0
Turekela	109	0	99	91	99	7	0	0	11	99	0
Bongomunda	133	2	95	63	125	9	0	0	2	125	0
Titlagarh	130	0	129	75	66	7	1	0	12	116	0
Muribahal	157	0	157	63	88	0	0	0	0	151	0
Saintala	135	1	33	69	128	34	0	0	22	118	0
Deogan	126	1	56	94	100	24	0	0	17	118	0
Loisingah	107	0	94	86	64	23	0	13	11	102	0
Balangir	122	0	54	93	118	63	0	0	2	97	0
Tentulikhunti	91	0	91	58	13	55	0	0	7	84	0
Puintala	134	0	92	95	114	8	0	0	0	120	0
Tarabha	151	0	68	35	134	16	0	0	6	91	0
Kalahandi											
Komna	153	0	150	111	123	55	0	28	36	147	0
Boden	86	0	86	67	45	22	2	1	25	82	0
Khariar	112	1	110	93	64	40	4	0	5	103	0
Sinapali	122	0	118	85	71	55	2	0	17	112	0
Golmunda	122	0	120	91	66	35	0	0	10	108	0
Junagarh	177	0	163	134	33	47	8	2	42	162	0
Jayapatna	90	0	88	81	30	42	2	4	6	89	0
Bhawanipatna	239	0	205	163	120	74	16	0	117	222	0
Narla	166	0	164	149	68	56	0	0	5	158	0
Kesinga	99	1	99	98	96	44	1	7	5	99	0
M rampur	229	0	204	107	161	88	46	1	67	217	0
Kalamunda	60	0	58	57	57	24	1	1	8	60	0
Koksara	64	0	64	59	19	26	0	0	10	63	0
Kalampur	54	0	53	49	50	22	3	7	6	54	0
Dharamgarh	71	0	70	71	83	23	3	7	1	71	0
Lanjigarh	422	0	223	64	95	166	123	0	301	324	0
Phulbani											
Kantamal	390	0	382	253	11	42	1	9	0	275	1
Balliguda	239	0	114	5	123	36	27	1	78	108	0
Tumudibandh	206	0	4	1	179	6	13	3	15	12	0
Nuagan	174	0	119	18	104	8	2	0	39	94	0
Daringibadi	259	0	61	7	163	0	247	0	24	189	0
Kotagarh	142	0	46	1	90	6	5	0	46	37	2
TOTAL	5367	6	3933	2621	3134	1164	507	84	954	4243	3