

DROUGHT IMPACTS ON SOCIO-ECONOMIC ASPECTS-A CASE STUDY

NATIONAL INSTITUTE OF HYDROLOGY
JALVIGYAN BHAWAN
ROORKEE - 247667 (U.P.)
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PREFACE

The primary objective of any drought area management plan would be to prevent dislocation of the economic activities in that area. In this context, the activities which are less dependent on use of water should be the most preferred ones. Commercial activities such as shops, schools, offices require very little support of water other than for drinking and domestic needs. Many industries like cotton Mills, toy making, structural fabrication, PVC pipe industries also do not need much of a support from the water resources. All such commercial and industrial activities in the society should, therefore, stand preferred to the other water consumptive activities.

One of the basic problems of Indian drought affected regions is that of socio-economy. The interesting feature of the sence is that inspite of generally low level of income and quality of life, there are rich contrasts in across regions. The occasional droughts caused by wide spread failure of rains and marked by large scale failure of agricultural crops and acute shortage of drinking water for the human as well as the bovine population. Various studies on drought have been conducted for different regions from various angles and yielded a number of recommendations aimed at mitigating the sufferings of drought affected population. All these studies are mostly concerned around the definition of drought, its effects, causes, prediction, relief measures and policies etc. The present study has been taken up in the context of local stresses, economic affects of drought proneness and social structure in district Khargone of state Madhya Pradesh.

It is an investigation in to how and what extent drought proneness affects socio-economic conditions and level of development. It attempts an assessment of by hydrological drought on agricultural, industrial and social aspects. It covers nature and extent of economy affected, villages and population affected, social changes including social and economic values, disturbances in agrarian sector, landuse changes, area sown, crop grown, predominant subsistence oriented cropping pattern, drought impact on agricultural production, changes in live stock and animal husbandry, and level of social and industrial development etc. The study has been carried out by Shri R P Pandey, Scientist 'B', Shri V K Lohani, Scientist 'C', Shri Yatveer Singh, R.A., of Drought Studies Division by using the data obtained from on-the-spot survey and published documents of district Khargone of state M.P. The manuscript has been typed by Mrs Marry D'Souza, stonographer.

Satish Chandra
(SATISH CHANDRA)

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ABSTRACT

The District Khargone of Madhya Pradesh was seriously affected by drought during 1985-86 and 1987-88. A study has been carried out to assess the socio-economic impacts of drought in the district. Both the qualitative and quantitative assessments are based on the data/informations provided by Government departments and other agencies in the district, and the sample survey conducted. The crop yield, irrigation and extent of area sown (in rabi) were greatly affected during the drought. The double cropped area was reduced by 30% as compare to base year. The agriculturists having complete dependence on lands were most adversely affected than the non-agriculturists who had diversified economic base also. More than 70% of private irrigation sources (open well, tube wells etc.) yielded deficient water for irrigation. The occurrence of drought during recent past years caused serious effects on cattle feed and grazing resources and therefore the livestock population (mainly milch animals) got reduced. The moisture stress and increased grazing pressure during drought caused serious forest and wildlife losses. The domestic and small water using industries of rural areas were badly affected due to drought whereas the medium and large industries located in urban areas were affected least. The drinking water scarcity, increased prices of food commodities, and unemployment of local labours in farming activities were seriously felt during drought. These conditions also forces the local people to migrate towards adjoining districts (Khandwa and Indore). The marriages, festivals, religious and other life-cycle ceremonies received less importance during drought. The drought impact was comparatively positive in connection to development of social facilities like drinking water sources, roads, tanks, schools etc. during last drought.

1.0 INTRODUCTION

Aspirations for higher standards of living and the steady increase in population have continuously increased the demand for food, fiber, raw materials, energy, industrial products, water use and various services. The inevitable concomitant has been an increase in demand for virtual all types of uses. Drought is a problem because, obviously, the supply of this renewable, natural resource fluctuates; even though on an average over a long period of time it has been and continues to be constant. Hence increases in water demand in many places leads to the shortages. Particularly sensitive in this regard is the relationship between water supply, food production and water borne industrial production.

One of the basic problems of Indian drought affected regions is that of socio-economy. The interesting feature of the scene is that in spite of generally low level of income and quality of life, there are rich contrasts in socio-economic conditions and level of development and poverty across regions. The occasional droughts caused by wide spread failure of rains and marked by large scale failure of agricultural crops and acute shortage of drinking water for the human as well as the bovine population. Various studies on drought have been conducted for different regions from various angles and yielded a number of recommendations aimed at mitigating the sufferings of drought affected population. (Famine, 1880, 1901; Jadhav, 1975; Singh 1975, Bhurara 1980 etc.) All these studies are mostly concerned around the definition of drought, its effects, causes, prediction, relief measures and policies etc.

Drought leads to reduction in streamflow, reservoirs and tank level, depletion in soil moisture and ground water, and consequently leads to scarcity of drinking water, decline agricultural production, economy and social developments. It not only leads to economic consequences but it also leaves behind untold human misery. It is estimated that about 29% of the population of the country (spread over 99 districts) are affected due to drought. The drought characteristics and associated problems vary from area to area, depending upon the variability of available water supplied and demand for specific users.

The Institute is involved in studying hydrological aspects of drought for recent past years (1985, 86, 87 and 88) for different drought affected districts of the country. In this pursuit efforts have been made by the Institute for analysing rainfall, groundwater levels and stream flow data obtained from various Government and other organisations. These results have been highlighted in reports brought out for years 1985-86, 86-87 and 87-88. While these studies led to study hydrological impacts of drought, it was felt to carryout a study to evaluate socio-economic impacts of drought.

The present study was, therefore taken up in context of local stresses, economic affects of drought proneness and social structure in Khargone district in Madhya Pradesh. The study attends to the nature and extent of economy affected, villages and population affected, social changes including social and economic values; disturbances in agrarian sector landuse changes, area sown, crop grown, predominant subsistence oriented cropping pattern, drought impacts on agricultural production, changes in live stock and animal husbandry, and level of social and industrial development etc. The study has been carry out using data obtained from on the spot survey and published documents.

All the interpretations and impacts are based on the data provided by State Government Departments/other government agencies working in the study area.

2.0 REVIEW OF DROUGHT RESEARCH APPROACH

Though definitions and concepts of hydrological, meteorological and other types of droughts have already been presented by various research workers, a short review is given herein. Hoyt(1938) stated that drought condition might permit even when the annual precipitation is as high as 85% of the mean. Mcguire and Palmer (1957) defined drought as the condition of monthly or annual precipitation less than a fixed percentage of the average. Thomas (1962) used the definition of drought as a meteorological phenamenon occuring during a period when the precipitation is less than a long term average. Yevjevich (1967) defined hydrologic drought as the deficiency in water supply in comparison with water demand. Herbst et al (1966) developed a technique for evaluating droughts by using monthly precipitation. The technique determines duration and intensity of droughts as used as months of their onset and termination. It permits the comparison of drought intensities irrespective of their seasnol occurance.

Social and economical aspects of droughts with all their political implications represent a symthesis of drought analysis and control. They are less amenable to being measured by description variable and mathematical modeling, but they are currently being analysed by description of various impacts. There have been several studies dealing with or related to the socio-economic impacts of drought, such as those by Tannehil(1947), Saorinen (1966), Campbell (1968), Russell et al. (1970), Myrick (1970), Lovett (1973), Newman (1975), White and Haas (1975), Warrick (1975), Zobler et al.(1969), Miri (1971), Harrison (1977), California department of water resources (1977), Crawford et al. (1977), Buchanan et al. (1977), institute for policy Research (1977), and white house drought working group (1977).

• Various earlier (Famine commission report, 1880, 1901, Erskine, 1909) and recent studies (Sawminathan, 1972; Singh, 1975; Jojha, 1975; Mann et al., 1977) have been under taken on droughts in arid and semi-arid regions from various angles. All

these studies are mostly concerned around the definition of drought, its effects, causes, prediction, relief measures and policies.

In social terms, drought is a community problem with many characteristics of Hardin's (1968) famous tragedy of the commons. In Hardin's example, the optimum policy for each peasant herdsman utilizing a common or community pasture land is to stock as many animals there on as he is able, since there is no benefit to the individual from optimizing or conserving behaviour.

Jaime Millan (1972) presented a comprehensive model to determine the total impact of drought on a regional economy. The main characteristics of model is that it permits accounting for the direct and indirect effect of drought in both space and time. A programming formulation of a dynamic type interindustry model is used to simulate the regional economy over a selected time horizon in order to allocate drought shortages and compute its losses following a consistent procedure. The Monte Carlo method of generating large numbers of hydrologic samples is used with the model of regional economy to make probabilistic statements about the different impacts of drought.

The intelligent drought policies cannot be formulated until the severity of drought impacts is known (Charles W. Howe-1977). A socially optimum human adaptation to drought generally involves some investment in water supply facilities and bearing some residual risk of drought. During a drought, impressions of severe impact are widespread, but the impressions seems to dissipate rapidly after the event. Impressions can be very misleading, too. In their study of 1960's drought in California, Russell et.al. (1967) found that a large part of the industrial costs attributed in the press to the drought were, infact, profitable investments in water system improvements undertaken after the drought has focussed attention on water use. In order to determine drought impacts on regional economy, a comprehensive model has been presented by Jaime Millan (1972). The main characteristics of the model is that it permits accounting for the direct and indirect effect of drought in both space and time.

A multidisiplinary study of drought prone area programme (DAPP) was carried out by AFC (1989-90) to evaluate the impacts of drought as well as DAPP works for Khargone district on water resources, agriculture, horticulture, animal husbandary, fisheries, forest and soil conservation etc. Various recommendations have been made by the experts for regional economic development of the district. Bharara (1978) conducted a case study on socio-economic consequences of drought for an arid tract.

3.0 DESCRIPTION OF THE STUDY AREA

3.1 General

The district Khargone belongs to Nimar Plateau Zone of Madhya Pradesh. It encompasses an area of about 1.35 m.ha., and.

occupies south-western fringe of Madhya Pradesh. The district is divided into 13 tehsil namely; Barwah, Kasrawad, Khargone, Bhikangoan, Sendhwa, Segooan, Rajpur, Barwani, Maheswar, Bhagwanpura, Jhirnya, Thikri and Pensemal. The details of management and development structure of the district has been presented in table No. 3.1. Khargone is an agricultural based and industrially backward tribal district in the state. Almost entire tribal population has switched over to agriculture in the district. There are no mineral resources within the district except lime stone. Cotton and groundnut are main cash crops of the area. The district was identified by Irrigation Commission (1972) as drought prone district of the state.

Table 3.1: Management and Development Structure of Khargone District.

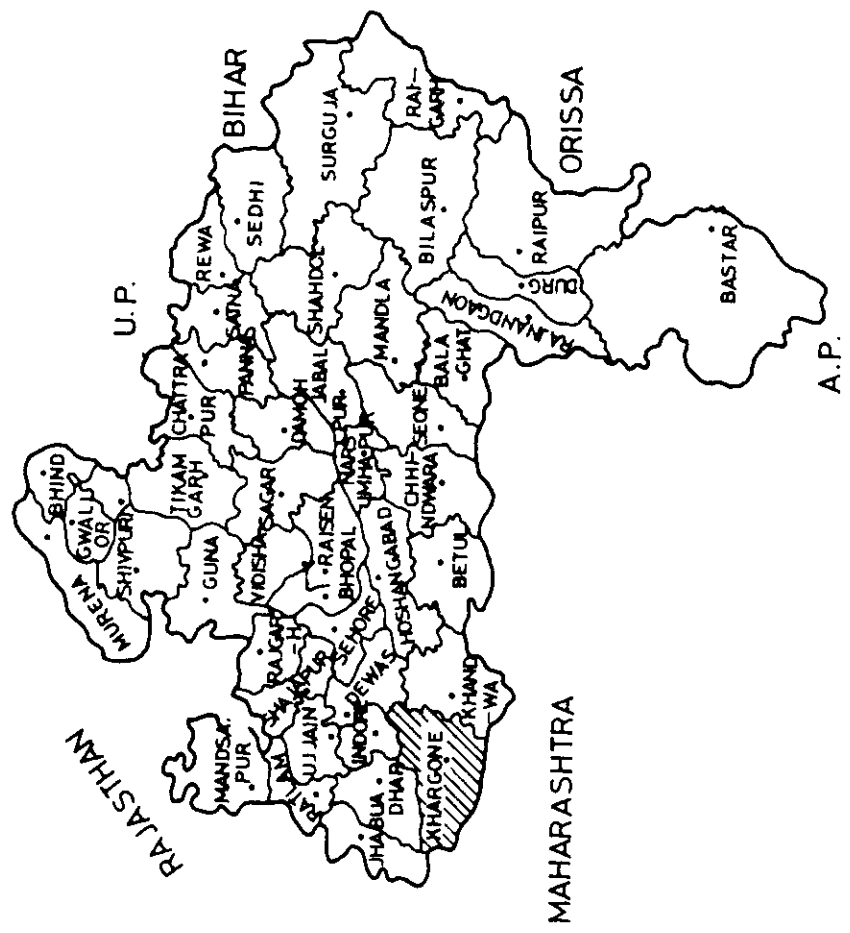
S.No.	Particulars	No.	Remark
1.	Tehsil	13	Barwah, Barwani, Bhikangoan, Segooan, Thikri, Jharniya, Kasrawad, Khargone, Maheshwar, Sendhwa, Rajpur, Pensemal, Bhagwanpura.
2.	Block	16	14 block are tribal blocks Pati, Niwali, Gooan and all tehsil headquarters.
3.	Revenue Inspector Circles	18	
4.	Patwari Circles	356	
5.	Police Stations	27	
6.	Municipality	12	
7.	Special Area Development Authorities	1	
8.	Janpat Panchayat	16	
9.	Grampanchayat	699	

Source: District statistical office.

3.2 Location and Physical Features

The district is located at south-western fringes of Madhya Pradesh. It lies between latitude 21°-22' to 22°-35' North and longitude 74°-25' to 76°-14' East. The district boundaries share borders with the districts Jabua in north-west, Dhar and Indore in north, Dewas in north-east and Khandwa in east. The entire southern border including south-west corner of the district, joins Maharashtra state. The location of the district can be described to be in the Mahakosal region. Fig. 3.1 shows the location of the district in the state map. For most of

STATE - MADHYA PRADESH



REFERENCE

- STATE BOUNDARY ———
- DISTRICT BOUNDARY - - -
- DISTRICT H/Q .
- DISTRICT TAKEN FOR STUDY ▨

FIG. 3.1-LOCATION OF DISTRICT KHARGONE TAKEN FOR STUDY

its length, the district boundary is delineated with natural features. The southern boundary runs along Aner, Manial and Tapti rivers and Northern boundary is formed by watershed lines of Vindhyan scarp, Narmada river and some of its tributaries. A part of western boundary is formed by Jharkal river, a tributary of Narmada from the south, only eastern boundary is marked by an artificial demarcation. The district can be divided into three distinct tracts namely Satpura plateau (south-eastern border) marked by slopes with shallow soil interspersed by silt deposits, Narmada valley (centre plains of the district) with rich alluvial deposits and vindhyan scarp (North vindhyan plateau) with a gently sloping area overlooking west Nimar with an array of high peaks which scarp down to Narmada valley.

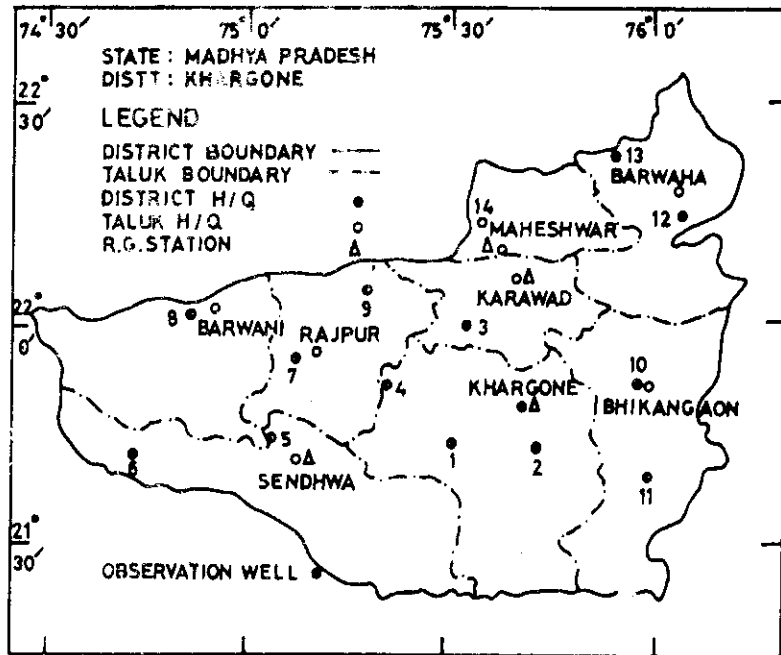
3.3 Climate

The entire Nimar region falls under sub-tropical semi-arid climatic zone of the country. The average seasonal rainfall of the district has been computed as 792.74 mm which is below average annual rainfall of the state. The normal rainfall of the district ranges from 780 mm to 940 mm. About 91.23% of annual rainfall in the district is received from south-west monsoon during monsoon season (June-October). The variation in temperature in the district is recorded between 41 to 47 C during summer and between 4 C to 11 C in winter season (December to February). The relative humidity in the region is high during monsoon season (about 70%) while it varies from 14% to 65% during summer season and 23% to 60% in winter. Evapotranspiration losses in the district varies from 131 to 173 mm. The winds generally flows from south-west or west in monsoon season, while North-East prevails during post-monsoon period. The locations of the existing raingauge stations and observation wells in the district is shown in Fig.3.2.

3.4 Topography, Soil and Geology

The district has an irregular and highly undulating topography with three distinct tracts Narmada valley, Satpura Plateau and Vindhyan scarp. The central tracts (Narmada Valley) of the district are having rich alluvial deposits. However, proximity of spurs of Satpura, at places also gives representation to sandy, gravelly or rocky soils. The general height of this tract is 228.6 m above MSL. The southern and western tract (Satpura plateau) is marked by slopes with shallow soils interspersed by silt deposits in the depressions. Boulders and gravels dominate the land scape. This tract covers about 33% of the district area and it stands at an average height of 457.2 m above MSL. The northern tract (Vindhayan plataeu) is a gently sloping area overlooking west Nimar with an array of high peaks which scarps down to Narmada valley. This area has poor soils supporting denuded forest on hills and slopes.

The district Khargone is drained by major river Narmada. About 87% of the district lies in Narmada basin and rest 13% lies in Tapti basin. The soils of the district have been classified as



DISTT. KHARGONE

FIG. 3.2- LOCATION OF RAINGAUGE STATION & GROUNDWATER WELL

medium black cotton soils containing nearly 50% clay and silt together. The soils on both the banks of Narmada river and in some patches of its tributaries are comparatively deep, fertile and well drained where as the soils of the rest of the tracts are shallow with poor fertility. The soils of Narmada and Tapti basins are derived mainly from trap rocks, composed of grained mixture of felspar and agnits. The soil colour range varies from red to deep brown and black cotton.

3.5 Landuse

The district Khargone encompasses a land area of about 1348981 ha. The maximum gross sown area of the district at present is about 691287 ha.

The average area sown more than once (5.06% of the district area) is very low as compared to land use of 18% and 15.4% of India and Madhya Pradesh respectively. A highly undulating topography and a badly denuded forest covers about 35% of total land area. Most of the forest cover is too poor to meet the need of population or to allow commercial exploitation. The district depends upon neighbouring district of East Nimar (Khandwa) for fuel wood and timber. Pasture lands are also over grazed and almost completely devoid of any grass cover. Infact pasture lands and forest areas have lost most of the soil cover on account of heavy soil erosion over many year landuse pattern of the district can be seen in annexure I.

3.6 Cropping Pattern

The traditional cropping pattern was evolved by the farmers of Khargone district on the basis of existing soil type and rainfall received. As per traditional crop zone the district falls in the cotton jowar zone of the state. The kharif crops account for a major portion of acreage (91% of gross sown area) where as the rabi crops cover only 9% of gross area sown. The cropping intensity of the district is estimated about 110% for the year 1988-89. The crops mainly grown in the district are cotton, jowar, maize, bajra, groundnut, arhar, urad, moong, wheat and gram. Erosion permitting crops like cotton, jowar, maize and bajra etc. share over 70% of kharif cropping. Soyabean crop, which is a blessing for most parts of Madhya Pradesh, has not caught up in Khargone yet. A brief summary of cropping pattern of Khargone district has been given in Table 3.2. Yearwise cropping pattern of selected blocks is given in Annexure II.

Table 3.2: Cropping Pattern of District Khargone (1988-89)

S.No.	Crop Season	Crop	Area Sown (ha.)	% age to total	Remark
1.	Kharif	Cotton	185502	27%	
2.	Kharif	Juar	186462	27%	

3.	Kharif	Maize	40622	6%	
4.	Kharif	Bajra	26677	4%	
5.	Kharif	Ground nut	48361	7%	
6.	Kharif	Soyabean	5932	1%	
7.	Kharif	Urad	33969	5%	
8.	Kharif	Moong-moth	22590	3%	
9.	Kharif	Arhar (Tuar)	21131	3%	
10.	Kharif	Rice	11689	2%	
11.	Kharif	Other	45232	6%	Including fodder, Veg, etc.

I		Total Kharif	628157	91%	
12.	Rabi	Wheat	49097	7%	
13.	Rabi	Gram	8159	1%	
14.	Rabi	Other	9864	1%	Including fodder, Veg, etc.

II		Total Rabi	63120	9%	
Grand Total	I + II	=	691287	ha.	
Net Area sown		=	629301	ha.	
Double Cropped area		=	61986	ha.	
Intensity of Cropping		=	11%		

The area covered and yield rates of some important crops are shown in Annexure III.

3.7 Population and Literacy Ratio

The district Khargone has in all 2111 number of villages. There are 1836 inhabited (1676- revenue and 160- forest villages) and 275 uninhabited villages in the district. In addition there are 13 towns. As per census 1981, the population of the district was 1630943 with a density of 121 persons per Sq.M., out of this the population belong to urban and rural areas are 14.78 % and 85.22 % respectively. As much as 53.46 % of total population belong to S.C. (10.21 %) and S.T. (43.25 %). Total number of literated people in the district is 374949, which accounts to 35.18 % of total population. The literacy distribution among males and females are 22.99 % and 12.19 % of total population respectively. There are 954 female for per 1000 male in the district. Particulars of data in respect of population is furnished in table 3.3.

Table 3.3: Population Details (census 1981)

S.No.	Particulars	No.	% to total Population	Remark
1.	Total Population	1630943	100 %	
	a. Urban	241176	14.78 %	

b. Rural	1389767	85.22 %	
c. Schedule Cast	166459	10.20 %	
d. Schedule Tribe	705424	43.25 %	
2. Total number of workers	624279		
a. Agriculturist	333688		
b. Agricultural labour	187986		
c. Domestic, Industrial servising and maintainance worker	12193		
d. Other workers	90422		
3. Total literated people	374949	35.18 %	
a. Male	277902	22.99 %	
b. Female	97047	12.19 %	
4. Population Density	121 Persons per Sq. K.m.		
5. Sex ratio	954 Female per 1000 Male.		
6. Population growth rate			Decrease
a. 1971 (census)		29.72 %	in growth rete
b. 1981 (census)		26.92 %	by 2.8 %

3.8 Livestock

The Khargone district is rich in livestock wealth. The total cattle population of the district accounts to be 1232368 (1988-89) out of this figure milch animals (like cows, buffaloes and goats) was 277644. Gneral growth rate of cattle population was estimated negative (-2.37%) and there was more decrease in growth rate of milch animal (-6.61%) in respect of previous year.

Most of the farmer families of the district have a pair of the bullock, a buffalo and a cow. The cows are of Nimari bread, which normally do not give more than 2.0 litter milk per day. The cattle feed production in the district is at a low level and therefore the peoples are always under pressure of increasing bovine population. Green fodder production in the entire district is negligible. It is grown only on some small irrigated patches therefore milk yield of the cattle is poor. In order to improve cattle breed in the district the state department of veterinary services have provided some facilities of artificial insemination units (11 A I Units) .Cattle breed extension units (one improved Nimari bull and murreh buffalow at each of 67 centres), goat, sheep and wool , extensive units etc. The abstract of livestock situation in the district is shown in table 3.4.(details can be seen in Annexure IV).

Table 3.4 : Livestock Situation in the district.

S.No.	Particulars	Livestock Situation		Percentage increase/dcrease
		88-89	89-90	
1.	Milch Animal	277694	259340	- 6.61

2.	Non-Milch Animal	954674	943849	- 1.13
3.	Total	1232368	1203189	- 2.37

3.9 Water Availability Status :

Ordinarily projected socio-economic development of a region involves an increase trend in water use. Since the total annual water availability as a random variable is a stationary series, a point in time will be reached at which water availability sets an upper limit to the development of some intensive water using economic sectors.

The soil cover as well as forest cover provide the most dependable anchor to hold rainwater within the land mass. District Khargone provides a typical example of progressive loosening of grip over the scarce resources of water despite an overall rich soil cover and a reasonably satisfactory average annual precipitation of around 792.53mm. Therefore an imbalance between ground water exploitation and recharge/replenishment of ground water is being experienced in the region. It is a case of vast spans of areas of discharge in a freely draining topography suffering from lack of the areas of recharge in the shape of surface water storages. Such an imbalance between surface water storage and the ground water exploitation has been caused by lack of coordination between activities of providing dug wells/tubewells and those concerning construction of irrigation tanks, percolation tanks, stop dams etc. besides in sufficient soil and water conservation measures.

On the basis of available data and catchment lying within the district for Narmada and Tapti basins, the state Irrigation department (1988) has estimated surface water resources at 75% dependability as 3416.30 million cubic metres. But this theoretical surface water resource is not being exploited entirely in practice at present.

The ground water resource balance has also been assessed by State Irrigation department as 873.84 million cubic metres at 75% dependability. The total water availability from both surface and ground water comes to 4290.14 million cubic metres at 75% dependability. The surface water from outside the district is approximately 1017 million cubic meters. If this is accounted for then the total water availability in the district can be taken as 5307.14 million cubic metres at 75% dependability. The annual rate of development of surface and ground water have been rapid in Khargone district (approx. 1.41%). Blockwise ground water resources balance and annual rate of surface and ground water development is shown in Annexure

3.10 Irrigation Facilities :

Irrigation facilities are limited in Khargone district. Main sources of irrigation are open wells, tanks and canals.

There is no any major project in existence in the district. The entire existing irrigation potential has been developed through medium, minor and lift irrigation schemes. The total irrigation potential of the district at present is 148473 ha. Sourcewise irrigation potential of the district is given in Table 3.5.

The State Irrigation department has completed two medium and 140 minor irrigation projects. Through these projects about 26090 ha irrigation potential have been created. One medium and 56 minor irrigation schemes are under construction which will create an additional irrigation potential of about 22051 ha. The medium scheme namely Dejla Devda project is under advance stage of construction(Completed-Canal 75%, dam 99%). It is proposed to be irrigated about 9000 ha. area from this project. Specially in DPAP blocks (7 blocks), the impact of development of irrigation facilities has been substantial accounting for 21% of irrigation potential created.

The proposed major irrigation projects (multipurpose schemes) as Indira Sagar and Omkareshwar project in the adjoining Khandwa district will create a substantial irrigation facilities in 1.76 lakh hectare in Khargone district in future.

Table 3.5: Sourcewise irrigation potential of Khargone district

S.No.	Sources of Irrigation	YEAR				
		1975-76	1979-80	1985-86	1988-89	1989-90
1.	Canal	2101	3731		12380 ha	16584 ha
2.	Openwell	42450	71813		73374 ha	96557 ha
3.	Tubewell	-	-		3069 ha	3427 ha
4.	Tanks	4672	6823		4626 ha	11379 ha
5.	Others	2746	8266		33612 ha	20516 ha
TOTAL		51991 ha	55818ha	95065ha	131061 ha	148473 ha

3.11 Water Requirement:

The deficiency of water both in quantity and time results the drought area to remain socially and economically backward. In order to economical and social development of the area the ways and means have to be explored to meet the deficiency by exploration of its own water resources and also by importing water from the surplus basins. But before it is done, it is necessary to assess the requirement of water for the area. Water demand is a function of the reasonable needs of the people of the area with respect to availability of the resources, technical feasibility and economic viability. Similarly, the demand for irrigation may also vary from bare minimum to an absolute maximum depending upon the above mentioned factors. This creates stress upon the planner and as a result there of he is to explore a suitable yardstick to work out the reasonability of the demand of the area. Thus the recommendations and assessment of demand made by various authorities/agencies from time to time provide a good

guide in resource planning.

Central Water Commission(CWC) in 1982 made an attempt to assess the water requirement of Khargoane district. The water requirements for different purposes, domestic, Industrial and irrigation assessed by CWC, has been presented in table 3.6. The total water requirement for Khargoane district for all purpose has been estimated as 1401.25 mcm, where as the same calculated by CWC (1982) was 1540.77 mcm. which is due to negative cattle growth in the district. A maximum value of delta of 0.61 m has been considered for major and medium irrigation projects for working out the water use (for the irrigation projects existing and under construction) in the Khargoane district. The CWC has also made an attempt to project the future water demand (2001 and 2025 AD) for irrigation, Industrial and domestic uses.

Table 3.6: Water requirement in Khargoane district

S.No.	Purpose	Water requirements (million cubic metres)	Remark
1.	Domestic use	64.077	on the basis of human population (1981) & cattle population (1989-90).
2.	Industrial use	64.077	
3.	Irrigation	1273.100	on the basis of gross cropped area in 1989-90
TOTAL WATER REQUIREMENT		1401.254	

3.11 (a) Domestic Water Requirement:

In accordance with the standard laid down by Ministry of works and housing, Government of India, the rate of consumption of water "Per capita perday" for urban and rural population are considered as 125 litres and 70 litres respectively. Also for the purpose of assessing the water requirement for consumption by live-stock a per capita figure of 40 litres percapita per day suggested by experts Committee, Ministry of works and Housing, New Delhi, has been adopted. The district population as per census 1981 is 16,30,682 with growth rate of 2.69% (from 1971-1981). For working out the quantum of present water use for domestic purpose this figure of human population have been adopted.

The present water consumption for human and live-stock population in the district workedout to 46.511 mcm and 17.566 mcm respectively. The total water requirement for domestic purpose i.e. for human and live-stock population comes to 64.077 mcm. The assessment of present domestic water use is given in table 3.7.

Table 3.7:- Domestic Water consumption in Khargone district

Sl. No.	Particulars	population	Rate per capita ltrs./day	water consumption ltrs./day	Water requirement (MCM)
1.	Human use (census 1981)				
	Urban	241176	125	39147000	11.003
	Rural	1389767	70	97283690	35.508
	Total	1630943	-	127430690	46.511
2.	Cattle use (1989-90)				
		1203189	40	48127560	17.566
TOTAL DOMESTIC WATER CONSUMPTION				175558250	64.077

3.11(b) Industrial Water Requirement:

Water requirement for each type of industry is not possible to assess in the absence of data regarding water need for unit product processing and production target of each industry. The visiting team of the institute contacted few industries for getting such type of information. But these information can't be projected for the district as a whole to estimate Water requirement in industrial sector. Therefore in the absence of suitable data for project the requirement of industrial use, the quantum of industrial use has been kept the same as that of domestic use, which works out to 64.566 mcm.

3.11(c) Irrigation Water Requirement:

The gross area shown in Khargone district is 695684 ha.(1989-90). According to recommendation of Irrigation Commission (1972), in order to afford reasonable projection against drought, the provision for irrigation facilities may be made for a minimum of 30% of gross cropped area of the district. Thus the water equipment for irrigation has been worked out as shown in table 3.8.

Table 3.8:- Water requirement for Irrigation

S.No.	Year	Gross sown area in the district (ha)	30 % of the gross sown which is to be irrigation (ha)	Delta (m)	Water requirement (mcm)
1.	1988-89	691287	207386	0.61	1265.05
2.	1989-90	695684	208705	0.61	1273.10

3.12 Social Facilities:

The district is backward also in the sense of overall social facilities. Since past few years there have been some developments in social facilities like drinking water supply, road transport, Educational institution, health services, banks,

electrification etc., but the social facilities are still inadequate (Annexure VI). The present status of some primary social facilities has been presented with the help of 12 indicators. These are as follows.

1.	Length of road per 100 Sq.km.	- Pakka	20.78 km.
		- Kachcha.	2.10 km.
		- Total	22.10 km.
2.	Number of post offices per lakh population	-	17.84
3.	No. of telephone connections per 1000 population	-	19.29
4.	No. of Educational institutions per lakh population.	-	36.91
		Primary	- 24.71
		Middle & Higher Secondary-	11.53
		College	- 0.67
5.	Percentage of literacy - Overall	-	22.91%
		- Urban	- 50.47%
		- Rural	- 18.13%
6.	Number of health centres per lakh population	-	39.85
7.	Number of veterinary service centre per lakh cattle population.	-	6.48
8.	No. of Artificial insemination centre per lakh milch animal.	-	4.2
9.	Commercial/Rural/Cooperative banks per lakh population.	-	11.83
10.	Cooperative Societies per lakh population	-	8.33
11.	Percentage of electrified villages	-	7.00%

4.0 HYDROLOGICAL ASPECTS OF DROUGHT:

In general droughts are associated with water deficits of prolonged duration and large areal with large impacts on a region. Deficit can be related to lack of water of a given place for a given time interval with relatively moderate consequences. Shortages are differences between water demand and water supply, often of a temporal character, which can eventually be readily accepted by users with small economic consequences. Periods of drought, deficit and shortage must be measured by the analysis of such factors as rainfall, riverflow, plant and soil moisture condition, Surface and ground water storage, and similar water phenomena plus water usages patterns and expectations.

In view of the gravity of the drought situation in years 1985-87, the National Institute of Hydrology got involved in studying the status of hydrological aspects of drought for recent past years (1985-86, 86-87 and 87-88) and yearly reports have been brought out by the Institute. Referring these reports, the results of various analysis of rainfall, groundwater level and other hydrological data have been presented in this chapter.

In rainfall analysis the daily, monthly and annual rainfall data have been subjected to various types of analysis viz. seasonal departure analysis from 1970 to 1988, monthly departure

analysis for 1985-86, 86-87 and 87-88, probability analysis of annual rainfall from 1901-88, Herbst's analysis of monthly rainfall of monsoon seasons from 1951-88 and dry spell analysis of daily rainfall data from 1981-88. The analysis has indicated that in general the Khargone district was affected by drought during the years 1985-86, 1987-88. The recorded seasonal rainfall deficit was more than 20% of normal.

The ground water level data of 13 years (1976-88) have been analysed and a trend of premonsoon and post monsoon ground water level have been worked out which have been compared with the trend of rainfall. In general a decline trend of water level has been observed in Khargone district.

4.1 Rainfall Analysis:

One representative raingauge station from each taluka has been selected for the study. The location of raingauges in various taluks on a district map has been shown in fig.3.2. The raingauge stations selected for the study are same which were selected by Central Water Commission(CWC) for carrying out the studies on identification of drought prone areas in 1982.

The rainfall analysis carried out by National Institute of Hydrology is based on data from 1901 to 1988. The data from 1901 to 1980 have been taken from CWC report. The rainfall data for 1981 to 1988 have been collected during visits of scientific team to State/district concern.

4.1.1 Rainfall Departure Analysis:

4.1.1.1 Seasonal Rainfall Departure

Rainfall departure analysis has been carried out on seasonal basis from 1970 to 1987. Percentage departure on seasonal basis have been worked out based on rainfall and normal values from June to September. The seasonal normal has been worked out by multiplying the normal rainfall values of the taluks by their respective the thiesen weights and summing the product up. The seasonal rainfall and percentage departure from its normal is given in table 4.1 and to make more clear for study purpose the results have also been presented in fig.4.1. The major infrences that could be drawn from the seasonal analysis are as follows.

- (a) The seasonal rainfall deficit recorded greater than 20% in the years 1972,74,80,82,84,85,86 and 87.
- (b) The district recorded seasonal deficits greater than 20% continuously for four years, (1984,85,86 & 87) indicating towards relatively severe drought conditions.
- (c) The seasonal rainfall deficit recorded greater than 30% in the year 1982, 85, and 87.

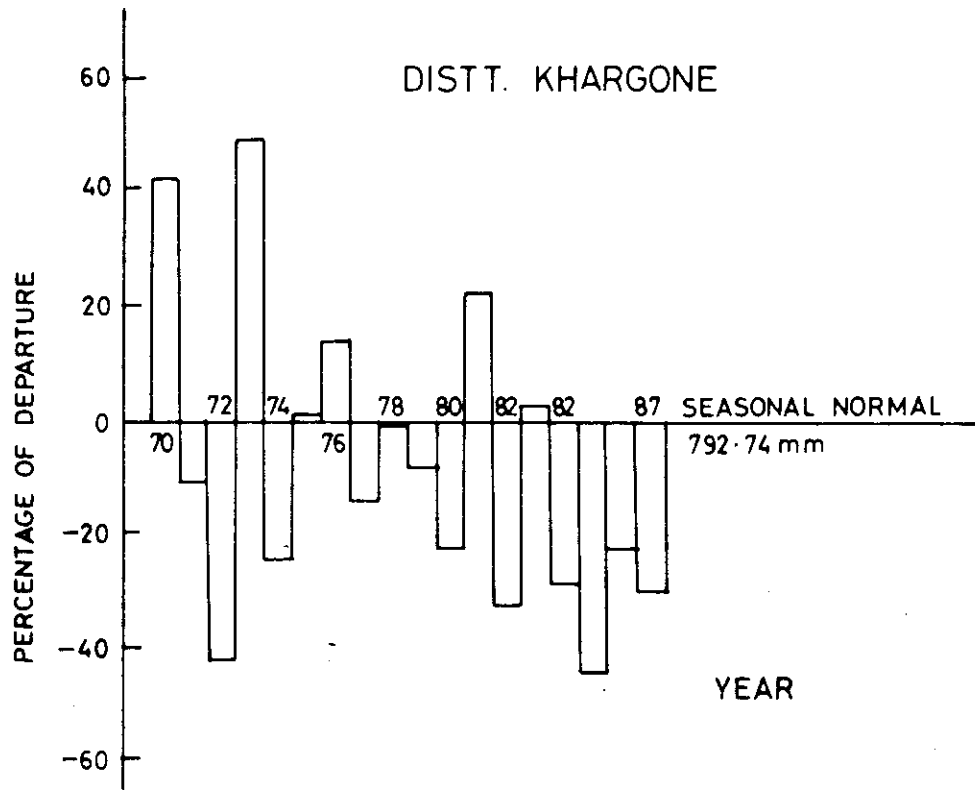


FIG. 4.1-SEASONAL RAINFALL DEPARTURE

- (d) The seasonal rainfall recorded greater than 40% deficit in the year 1985 was the severest drought year.

Table 4.1: Seasonal Rainfall Analysis of the district Khargone (M.P.)

Year	Seasonal Rainfall	Seasonal Normal Rainfall	Percentage Departure
1970	1132.89	792.74	+42.92
1971	698.47	-do-	-11.89
1972	457.13	-do-	-42.34
1973	1186.00	-do-	+49.61
1974	592.19	-do-	-25.30
1975	801.68	-do-	+ 1.13
1976	907.96	-do-	+14.53
1977	679.77	-do-	-14.25
1978	790.69	-do-	- 0.26
1979	726.31	-do-	- 8.38
1980	609.99	-do-	-23.05
1981	976.60	-do-	+23.19
1982	530.90	-do-	-33.03
1983	819.10	-do-	+ 3.33
1984	561.80	-do-	-29.13
1985	440.70	-do-	-44.41
1986	619.83	-do-	-21.81
1987	536.74	-do-	-32.29

4.1.1.2 Monthly Rainfall Departure

Monthly rainfall values from June to May (One year cycle between consecutive years) for the year 1985-86, 86-87 and 87-88 along with respective monthly normals of various taluks (rain gauge stations) have been considered for analysis. Monthly rainfall values of district for different water years (June 85 - May 86, June 86-May 87 and June 87 - May 88) have been taken as weighted average rainfall of the taluks based on their respective weights.

In order to study variability of rainfall monthwise, monthly rainfall and corresponding normals have been plotted for each water year (1985 - 1988) to visualise the departure of monthly rainfall from their respective normals. These plots are shown in fig.4.2. The value of monthly rainfall departure for year 1985-86, 1986-87 and 1987-88 for the district as a whole is given in table 4.2. The following inference can be drawn from analysis.

- (a) Water year June 87-May 88.
 * Monthly rainfall was deficit by more than 50% in July, Sept., Jan., Feb., March, April and May.
 * Rainfall recorded in Dec. was Surplus by 31.00%
- (b) Water year June 86-May 87.
 * Monthly rainfall was deficit by more than 50% during Sept.,

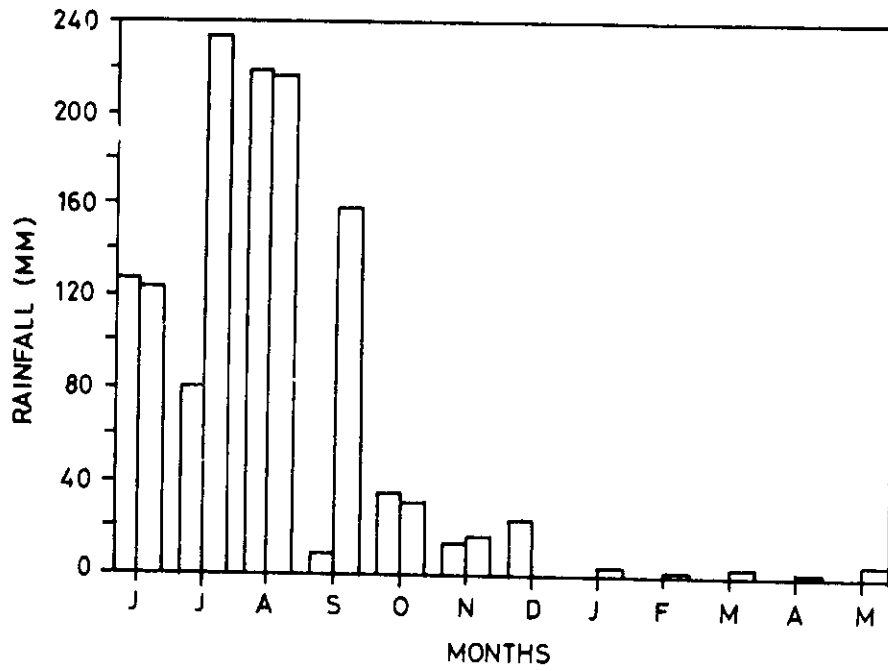


FIG. 4-2-MONTHLY RAINFALL DEPARTURE FOR YEAR 1987-88

Oct., Nov., Dec., March., April while it was within 20% to 50% during June, July, August and December.

* Rainfall received in the month of July was surplus by 10%.

(c) Water year June 1985-May 1986.

* Rainfall recorded during all the months are deficit except in Oct.

* Rainfall deficit of more than 50% was recorded during August, September and Nov.

Table 4.2:- Monthly departure of rainfall from their respective normals
+ EXCESS
- DEFICIT

S.No.	Month	Monthly normal of rainfall	% of departure		
			1985-86	1986-87	1987-88
1.	June	124.16	- 29.48	- 8.89	+ 2.23
	July	233.91	- 42.27	- 7.80	- 65.46
	August	216.85	- 54.54	- 14.68	+ 1.13
	Sept.	158.76	- 69.07	- 77.90	- 94.34
	Oct.	31.45	+136.36	- 83.33	+ 10.40
	Nov.	16.64	-100.00	-100.00	- 19.06
	Dec.	0.75	NA	-100.00	+ 31.48
	Jan.	3.12	NA	+ 50.00	- 100.00
	Feb	1.75	NA	+ 60.00	- 100.00
	March	3.02	NA	-100.00	- 100.00
April	1.68	NA	-100.00	- 100.00	
May	6.10	NA	+ 40.10	- 100.00	

4.1.2 Rainfall Frequency Analysis:

4.1.2.1 Probability analysis of annual rainfall

In order to predict reasonable accuracy the relative frequency of occurrence in different group ranges of annual rainfall, the probability analysis is useful. It is also possible to work out probability of occurrence of 75% of annual rainfall or more for identification of drought proneness of the district. The analysis has been carried out based on the data available from 1901 to 1987 and probability expressed both in number of years of occurrence and the percentage of years for each group interval. The group interval of 100mm has been considered for the analysis.

The probability distribution curves have been drawn by plotting the values of percentage of cumulative probability in respect of various groups at their corresponding mid-point. The cumulative percentage have been worked out starting from the maximum rainfall group downwards adding the successive percentage. The probability graph is shown in fig. 4.3. It could be seen that district Khargoane has 75% or more probability of getting rainfall in group range of 400-500mm.

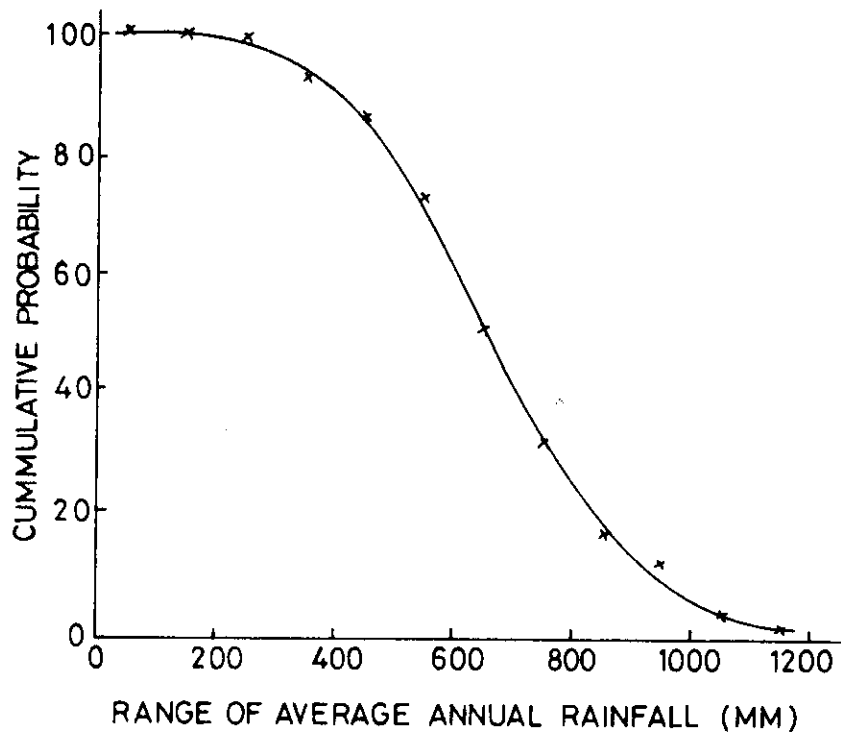


FIG. 4-3 PROBABILITY DISTRIBUTION OF ANNUAL RAINFALL

4.1.2.2 Probability of occurrence of rainfall equivalent to 75% of the normal rainfall

In order to identify drought proneness of the region, the percentage probability of occurrence of rainfall equivalent to 75% or more normal rainfall has been worked out from figure 4.3. As per IMD criteria, an area would be classified as drought prone if probability of rainfall equivalent to 75% of normal is below 80% indicating that more than 20% of years, the area experienced scarcity of rain. From this analysis it is found that probability of occurrence of 75% normal rainfall in Khargone district is 60%. The scarcity of rainfall was experienced for 40% of years, which is indication of severe drought conditions.

4.1.3 Excess/Deficit Rainfall using Herbst Approach

The excess/deficit rainfall analysis have been made using Herbst (1966) programme. The input data in this programme is long term monthly rainfall (1951 to 1987) and output is obtained in the form of monthly rainfall deficit, on set continuation and termination of a drought. Carry over effects of rainfall from month to month are used to calculate effective monthly rainfall. The negative differences between effective rainfall and mean rainfall for a month is taken as deficit. These deficits alongwith zero values for surplus months are used to calculate mean monthly deficit(MMD) and mean annual deficits (MAD). In this analysis it is presumed that major portion of annual rainfall falls during monsoon season. Therefore rainfall data for monsoon season (June to September) have been used for analysis. The severity of drought is identified by using drought intensity index.

From the analysis it is observed that all the taluks of the district experienced drought continuously for four years (1984 to 87). The drought intensity was higher during 1985 and 1987. Beginning and termination of drought in various years and their corresponding drought intensity has been shown in fig.4.4.

4.1.4 Dry Spell Analysis

The dry spell analysis is important for rainfed agriculture point of view. Even if the total amount of rainfall is within normal range, the agricultural drought may be experienced due to occurrence of dry spells during various crop growing stages. Here an attempt has been made to identify the dry spell of two or more than two weeks duration during monsoon season (4th June to 15 September). This analysis has been made for one taluk (Bardwani) of the district.

A day with rainfall 5mm or less has been considered as non rainy day (as a day is assumed as rainy day if daily rainfall exceeds 5mm). The continuous non rainy days at least for two weeks (i.e. 14 days) or more has been considered as one dry spell. The

DISTT. - KHARGONE

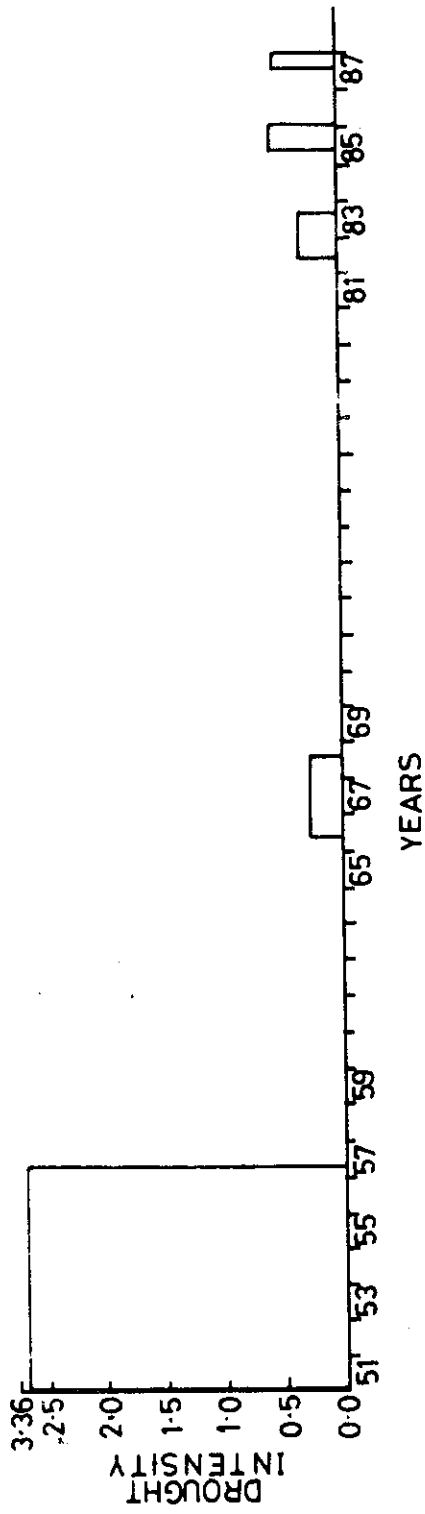


FIG.4.4 OVERALL RANGE INTENSITY OF DROUGHT

number of dry spells have been counted during rainy seasons for the years 1981 to 1987. The number of dry spells with duration and time of occurrence is given in table 4.3. The maximum number of dry spells have been experienced in the year 1985.

The number of spells for different ranges of duration of spell (duration ranges of dry spells in days) were counted. The number of spells falling in various ranges of duration were represented as percentage of total number of spells occurring from 1981-87 and cumulative percentage were obtained. The probability curves have also been drawn showing range of duration of dry spells as abscissa and cumulative percentage of number of spells as ordinates. The plot is shown in fig. 4.5.

Table 4.3:- Duration and number of dry spells during monsoon (4th June to 15th September) Badwani (Kharagone)

First day of Monsoon	Date of beginning of dry spell	Duration of dry spell (in days)	Total no. of dry spell in (a year)
24.6.81	4.6.81	20	2
	21.7.81	16	
20.6.82	4.6.82	16	3
	21.6.82	20	
	17.8.82	24	
16.6.83	31.8.83	15	1
15.6.84	16.6.84	15	1
24.6.85	4.6.85	20	4
	27.6.85	20	
	15.8.85	14	
	30.8.85	17	
15.6.86	26.6.86	22	2
	17.8.86	30	
16.6.87	18.6.87	21	3
	16.7.87	14	
	2.9.87	16	
TOTAL			16

4.2 Ground Water Deficit

The change in groundwater storage is a seasonal phenomenon reflected by change in ground water level. The over exploitation of ground water during drought (due to increased demand) results the drop in ground water levels particularly in shallow and unconfined aquifers. As a policy, the withdrawal of ground water should be restricted to average annual recharge.

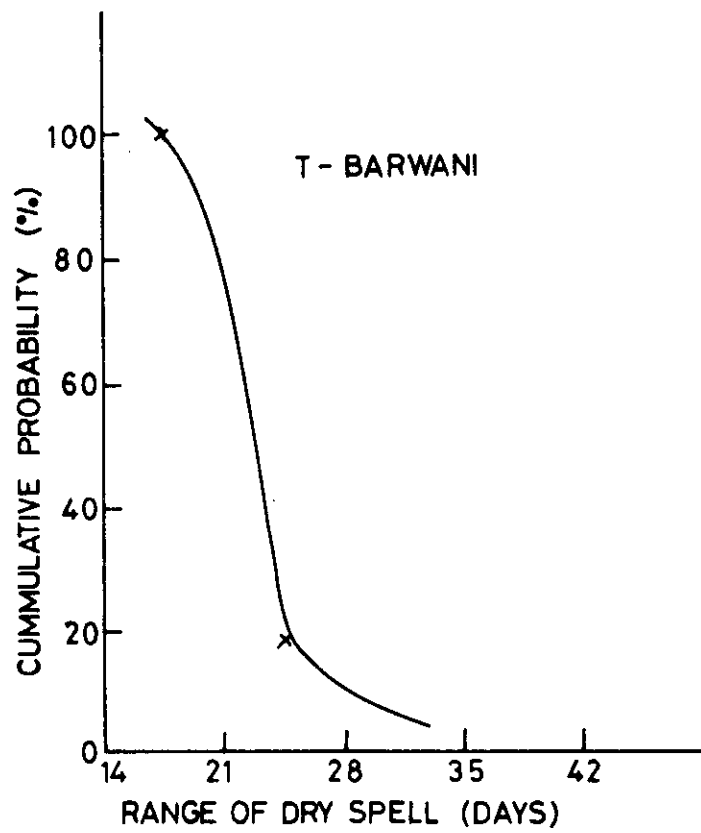


FIG. 4.5 PROBABILITY DISTRIBUTION OF DRY SPELLS

STATE - MADHYA PRADESH
 DISTT. - KHARGONE

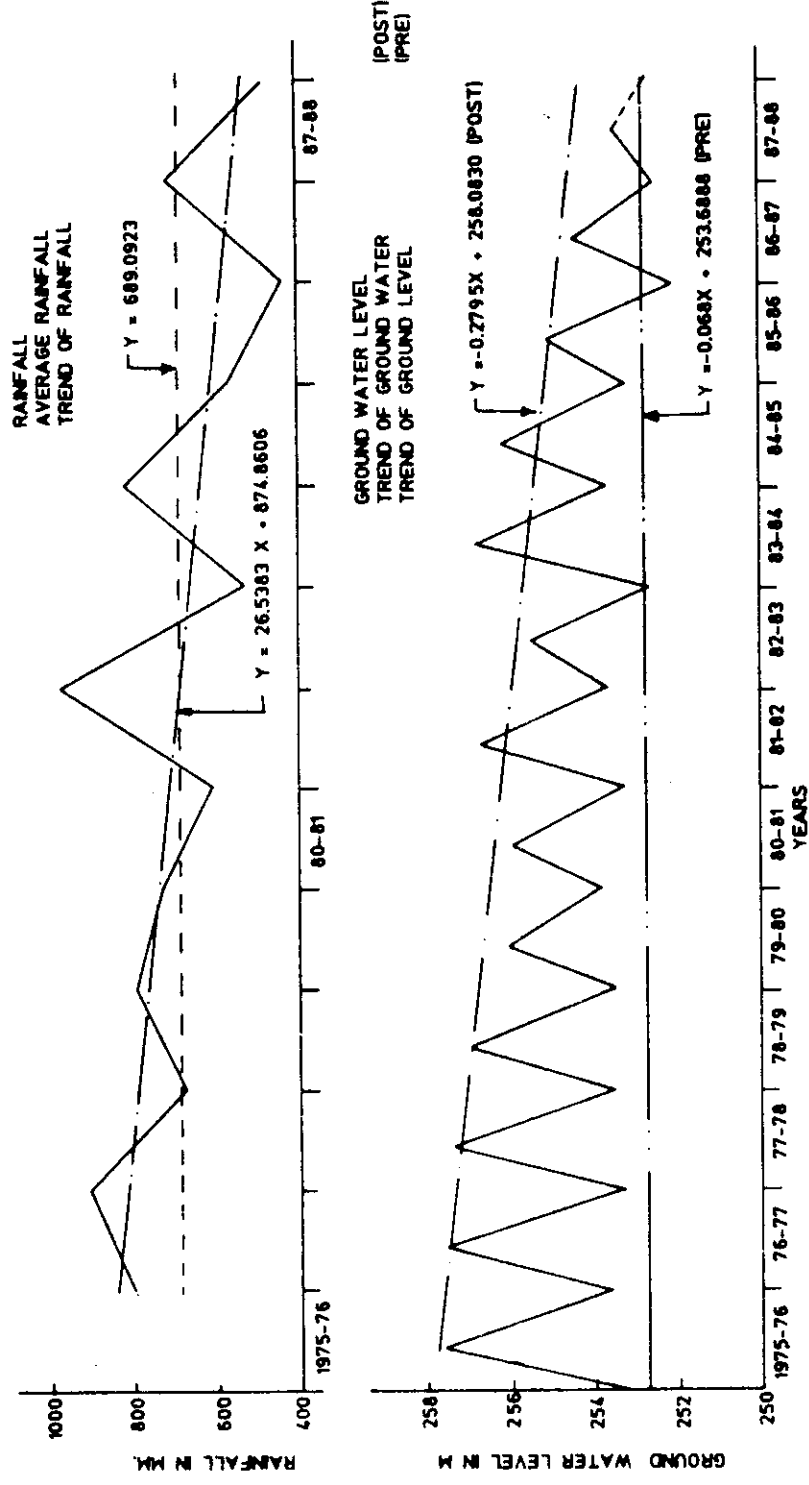


FIG. 4.6 GROUND WATER LEVEL FLUCTUATIONS AND RAINFALL AND TREND ANALYSIS

This will be a good step in the direction of groundwater conservation and to meet the demand of over exploitation during drought conditions.

With a view to study the effects of successive droughts on ground water regime, an analysis of ground water levels has been made on the basis of data obtained from State Ground Water Board for pre and post monsoon seasons. The average ground water level established for the district as a whole has been estimated using Theissen polygon method in respect of time unit. The average values of ground water levels (w.r.t., M.S.L.) were plotted against time and trend of ground water fluctuations has been worked out by simple regression analysis. The location of groundwater observation wells selected for analysis have been shown in fig 3.2. The trend of rainfall for corresponding time unit (corresponding water year 1974-87) has also been worked out and simple regression line was fitted (using least square method). The trends of rainfall over the period of seasonal rainfall and ground water levels is presented in fig. 4.6. From the figure it is clear that the ground water levels are going down continuously. It is also supported by declining trend of rainfall, which led to reduced ground water recharge and therefore resulting declines in ground water storage. It is observed from figure that there is a decline in ground water levels in both pre and post monsoon period. The decline in ground water levels is relatively higher during post monsoon period. It is also clear that there is a continuously deficient in rainfall after 1983-84. The regression equations (i), (ii) fitted for post and pre monsoon period respectively are as follows:

$$\begin{aligned} Y &= 0.2358 x + 257.3338794 \quad (\text{Post-monsoon}) \quad \text{---} \quad (\text{i}) \\ Y &= 0.0585 x + 253.5888 \quad (\text{Pre-monsoon}) \quad \text{---} \quad (\text{ii}) \end{aligned}$$

5.0 WORK PLAN & METHODOLOGY:

The collection and analysis of data in respect of hydrological and socio-economic characteristics of past droughts, with special emphasis on more recent drought have been carried out to investigate the impacts of drought on socio-economic status of Khargone district. It is difficult to identify drought impacts to the economy with a single figure because drought affects many facets of the economic activities (production, consumption and their inter-relationships) in agricultural, industrial and social sectors etc. Attempts have been made to identify drought impacts on various sectors of water use separately.

In order to collect required data from different sources a team visited the Khargone district during February 1991. A field survey was carried out by the visiting team for selected units. It was considered that in sample survey, the appropriate unit for stratification is the block. It was felt that it would

provide adequate representation of various areas in geological sense and also permit reflection of the social and economic progress made by different blocks in the sample.

Three blocks namely Khargoane, Segoan and Barwah were selected as sample blocks for this study. The nine villages (three from each sample block) were selected for field investigation in such a way that there was a sufficient diversity in their social status and irrigation facilities. This diversity was necessary for investigating how the village types were associated with different levels of development and also different kinds of structural features. The general informations of selected blocks and details of sample selected are shown in Annexure VII and VIII respectively.

The village sampled including all three types like highly irrigated, moderately irrigated, and rainfed. Here a diversified village economy means that it is not dependent on cultivation alone, also on other income sources like dairy, sheeps and goat husbandary, rural and domestic industries etc. These sample villages were selected by visiting team randomly on the basis of discussions with local officials of irrigation and agriculture departments and block development officers etc. The names of selected sample villages has been presented in table 5.1.

Table 5.1 :- List of selected sample villages

S.No.	Block	Villages
1.	Khargone	Dongargoan Lonara Ghegoan
2.	Segoan	Bhikar-Kheri Domwara Golwari
3.	Barwah	Jhingari Selda (Patali) Khangwara

The survey was conducted to collect information on population, literacy, occupational classification, drinking water facilities, land utilization, size distribution of land holdings, cropping pattern, area under irrigation, livestock, social facilities etc. A separate questionnaire each for agriculturist, industrialist, and service people were prepared according to the information needed for drought impact assessment. Copies of questionnaires are enclosed as Annexure IX.

A total of 80 farmers (including large, medium and small), 6 industrialists and 10 service people were interviewed by the visiting team during field survey. During interview the

main emphasis has been given to the water availability and demand for drinking purpose, cattle and domestic uses, irrigation and other uses during drought as well as normal years.

The hydrological & climatological characteristics of Khargone district were previously analysed by the Institute separately. The status of hydrological aspects of drought for the district as a whole has been presented in chapter 4. The water requirements for different purpose (drinking purpose, irrigation & industrial requirement and other uses) have been estimated on the basis of census 1981 and it is presented in section 3.11.

The observation of local economic and social status and effect of occurrence of drought on these are based on secondary data provided by district statistical office, block offices and others. Both quantitative and qualitative impacts of drought have been assessed on agriculture, irrigation, industries and social facilities, according to the suitability of data available. The informations collected during interview of individuals and discussions of visiting team with local officials and knowledge persons at village level, have been utilised to draw only qualitative impacts of drought condition in the district.

6.0 GENERAL OBSERVATION:

The general views expressed by the respondents and the opinions of the local officials are summarised and presented here alongwith observations of the visiting scientific team. These views/opinions are narrative and based on data available.

The economy of the most of the respondents is based on agriculture. There are least opportunities in the region for part time job/business. Therefore the earnings are not adequate enough to have a better standard of living. The general causes observed are low fertile lands, traditional agronomic practices, lack of water resources systems and high erosion hazards. The poor fertility of land is attributed to low water retaining capacity of soils in this area. The surface soils are generally washed away in the rainy season due to steep and even slopes and high undulating topography. Major portion of crop cultivation is dependent on rain water. Therefore the drought conditions create economical crisis in the region.

It is felt that the poor transport (road) facilities is also a factor discouraging development activities of the district. Lack of a convenient and well connected road transport system will go a long way in spreading technology to the villages. This also limits the contacts of village community with the urban areas.

The sources of surface irrigation in the district are very limited. The both officials and respondents believe that more area could be brought under irrigation through medium and minor project. Most of the respondents and officials expressed their views in the favour of check/stop dam and percolation tank

construction schemes to increase rainwater conservation and ground water recharge. The respondent also opined that the irrigation potential could be increased by deepening and widening of diameter of their wells.

The poor transport and market facilities are also responsible for low prices of farm products. The absence of regulated markets in the vicinity of villages was felt to be the reason for the active role of local traders in the tribal areas.

The educational status of the sample villages is found very poor. Very few persons are found educated above high school level particularly in tribal and interior villages.

Forest is the only source of extra earnings only for most of the schedule cast and schedule tribe communities. In the lean period, the labourers pick leaves, fruits etc. and sell them in the market. Hunting activities by SC & ST communities increase during drought period. Thus, drought is also creating a serious problem in loss of wild life. The tribes are completely dependent on forest for firewood, fodder, and minor forest produce.

7.0 IMPACT ASSESSMENT:

The analysis of rainfall and ground water level data indicate that the khargone district was affected by drought during recent past years 1985-86 and 1987-88 as per meteorological criteria of drought. The magnitude and intensity of drought revealed a quite distressing situation during past drought. On an average annually over 35-50% of the area, villages and population were directly affected by droughts. These droughts brought change in nature and extent of the socio-economic values in the district. The drought impact assessed for the district on the basis of availability of quantitative / qualitative informations/data and sample survey of selected villages and it is presented in this section.

7.1 Agriculture

As an impact of drought on agriculture, changes occurred in the nature and extent of area sown, crop grown, crop yield, irrigation etc have been drawn from the available data, considering the year 1986-87 as a base year (or normal year). The impact on land use analysed during drought and normal year does not indicate significant difference on net area sown during kharif season. The drought leads to increase in area under culturable fallow to some extent during rabi season. As an impact of drought area coverage under wheat crop reduced from 33600 ha. to 23400 ha. The double cropped area was greatly affected by drought. It decreased from 50623 ha. to 33431 ha. (see table 7.1). The intensity of cropping was affected from 8.6% (normal year) to 5.3% (drought year). The cropping pattern in the sample villages followed by the farmers (Jowar, Wheat, Gram, Cotton,

Urad, Groundnut, Moong, Soyabean, Maize, Bajra, Arhar and Rice in unirrigated conditions, and wheat, cotton, gram in irrigated conditions) during drought was more or less same as in normal year. The irrigation potential of the district decreased during drought from 108499 ha. to 86418 ha. More than 70% respondents in the selected villages faced the scarcity of water for irrigation from their private sources (open wells/Tube wells). The respondent expressed that their irrigation sources (open wells/nala/tube wells) yielded 30% to 90% (roughly) less water during drought.

Table: 7.1 Drought effects on Agriculture in Khargone District

S.N.	ITEM	UNIT	YEARS				
			85-86	86-87	87-88	88-89	89-90
1.	Net area sown	ha.	NA	NA	627397	629301	629348
2.	Area Coverage under Major Crops						
i	Jaur	ha.	186300	187600	191900	186400	182300
ii	Maize	ha.	40400	38400	37100	40600	41700
iii	Cotton	ha.	181100	187100	181700	185500	188800
iv	Wheat	ha.	25800	33600	23400	45000	48100
3.	Area coverage under Oil Seeds						
i	Groundnut	ha.	38400	39500	41300	48300	49300
ii	Soyabean	ha.	9600	7800	7200	5900	6700
4.	Fertilizer Dis- tribution						
i	Nitrogen	Tons	13213	17094	14297	21216	29571
ii	Phosphorus	Tons	5301	6557	5108	7791	11411
iii	Potash	Tons	2116	2562	1150	3049	4463
5.	Total Irriga- tion	ha.	77971	108499	86416	131061	131000
6.	Double Cropped Area	ha.	43407	50623	33495	61986	75000
7.	Intensity of cropping	%	6.9%	8.6%	5.3%	9.8%	11.9%

The average yield of various crops were affected during drought as compared to the normal year. The total yield of the crops wheat, gram, cotton, maize, bajra, tuar, moong and groundnut was significantly less during drought. The total wheat production in the district was obtained 11%-24% less than a normal year production, where as the yield rate per hectare of wheat was good during drought also. (See Appendix-III). The highest affect of drought was observed on yield rate per hectare of bajra (79% less). Considering the discussions based on

questionnaire the respondent opined qualitatively that more than the half of the crop yields reduced during drought as compared to a normal year. The respondent mentioned that their income from agriculture got affected 20-70% during drought in comparison to normal year.

Out of three selected blocks the most adverse affect of drought on agriculture was observed in Segaon block of the district, whereas the least affect was in Barwah block.

7.2 Live Stock

The animal husbandary occupies an important place in economy of the region. The milch animals are about 22 percent to the total livestock population in the district. The livestock population of the district have a negative growth rate of 2.37% (1988-89-1989-90). Considering the area under cultivation the proportion of milch animals in the district is low. The proportion of milch animals in the district is 38 per 100 ha. of cultivated land and 15 per 100 population. The proportion of nonmilch animals are 143 per 100 ha of cultivated land and 57 per hundred population. The forest lands provide grazing to a sizeable percentage of livestock. The grazing pressure on the forest has been on an increase during drought.

According to respondents of the selected sample villages, the decrease in cattle population is mainly due to lack of adequate feed resources and provisions for health cover. The continuous occurrence of drought in the recent past years caused serious lack of cattle feed materials. About 85% of selected respondents expressed that they have serious scarcity of fodder during drought, where as the 15% have sufficient fodder resources to meet their requirements during drought also.

The respondent opined that the droughts caused adverse impacts their milch animal health and ultimately affected the domestic milch production by 30%-60%. Not only the quality of grazing and supplimentary feed available from crop residues was poor but even the total dry matter is not being met their need during drought.

The stock watering facilities are seriously lacking in the district. Poor grazing resources and lacking stock water facilities forces the breeders to resort to distant places during drought.

7.3 Forest and Wildlife

Since no quantitative information was available in connection to impact of drought on forest and wildlife, the qualitative assessment of drought impacts on forest and wild life is made based on the oral discussion with the local officials and knowledgeable villagers.

As an impact of drought the severe moisture stress caused

the drying up of new brushes and timbers. As the forest is an addition source of earnings of SC & ST Communities, they cut the green timber and fire wood from the forest and sell them in the market. During drought the theft of timber and firewood increased and contributed towards fast destruction of forest. They also pick leaves and fruits etc. from the forest to sell them in the market, but during droughts the lack of leaves and fruits affected their earnings badly. During drought, the hunting activities of wild animals by local tribal people was increased and thus caused fast loss of wild animals. The wild land fire losses increased during drought. Also the fire fighting became difficult due to lack of water in local streams, rivers, tanks, ponds etc. for combating against the fire.

7.4 Industries

There is no any water-borne large industries in the district. Only few medium and domestic water using industries are in existence. Some of these industries were contacted during sample survey and it is observed that about 60% of them were more or less unaffected due to drought. A substantial or critical effect was felt in production of 20% industries which are all domestic industries and production of rest 20% was affected to some extent specially during summer in a drought year. The water using medium industries like tile industry, RCC pipe industry, cement pipe industry etc reported that their input expenses increased by 3-4 % during drought. Few other partially water-borne like pvc pipe industry experienced positive impact of drought (income increased by 2-3 %) due to increased demand of their product in the market.

As an impact of drought the production of cotton mills (non-water-borne) was affected indirectly due to reduced yield of cotton crop in the district.

The water using domestic industries (like brick kilns, soil vessel kilns etc.) were greatly affected due to drought. The production of these industries became dead stop during summer season of drought year due to drying up of local water sources. These conditions also created the problem of employment of local labours and ultimately forced them to migrate for some time.

7.5 Migration

There are two cases of migration of backward class peoples in the district. As per verbal discussion from the respondents during the course of interview, one case is at the time of Rabi crop harvesting (land less people) and other during summer. All of them migrate to work as labourers either in agricultural or in non-agricultural jobs due to poor yields in their farms. Generally the migration of the SC & ST are more during drought years. This shows that their economic position has compelled them to migrate towards adjoining districts (Indore & Khandwa) and other urban areas. No particular figure can be given on this aspect due to unavailability of concern data.

7.6 Social and Other Economic Aspects

The low level of social facilities existing at the village level of the district could be related to its economic backwardness also. Among the selected villages except a few most of the villages are not having any social facilities at all. Present status of social facilities in the district is discussed in Section 3.12). During last drought year (1987-88) few social facilities (like drinking water sources, health centres, tanks, roads etc) have been created in some villages through Block Development Schemes and Drought Prone Area Programme works by State Govt. agencies/departments. As an impact of drought the following observations have been drawn from the selected villages .

- * The drinking water was seriously deficient, in few of the selected villages of Segaon and Khargone blocks specially during summer season of a drought year. The drinking water scarcity was felt 10 to 40% in some sample villages.
- * Through the drought relief works, conducted during drought (for construction of Handpump, Tubewell, tanks, stopdam, schools, panchayat buildings, laying roads, repairing old roads etc.) some social facilities have been created. Thus the impact of drought was positive in development of these facilities and local employment of labours.
- * Some respondent mentioned that the prices of food commodities increased in district as the consequence of drought.
- * The marriages, life cycle ceremonies, religious and agro-postal activities (sowing, harvesting, shearing) and festivals received less importance during drought year.
- * The landless respondent (9% of total respondents) faced a serious problem of unemployment in farming activities during drought.
- * Most of the respondents expressed that the drought relief works implemented by Govt. departments/agencies were proved helpful for getting food materials and local employment.

8.0 CONCLUSIONS AND RECOMMENDATIONS:

The drought in Khargone district affected the agriculture and related activities greatly. The agriculturists having complete dependent upon lands were more adversely affected than non-agriculturists who had diversified economic base also. More than the half of the crop yields get reduced during drought as

compared to normal year. Out of three selected blocks the Segaoon block was most adversely affected by drought.

The continuous occurrence of drought in the recent past years caused serious lack of adequate cattle feed and grazing resources, and therefore livestock population (mainly milch animals) have negative growth rate. The increased grazing pressure and moisture stress caused serious destruction of new brushes and timbers during drought. The fast losses of wild life and increased wild land fire due to drought are becoming serious problems in the district. Increased forest destruction activities by SC & ST communities during drought would create an environmental imbalance in the region in near future.

The large and medium industries located in urban areas are not much affected due to drought, but domestic water-borne industries faced serious lack of water availability from local, water sources. The lack of employment in farming and other local activities during drought forced the people to migrate towards adjoining districts (Indore and Khandwa) and other urban areas in search of employment.

The development of social facilities like drinking water sources (Handpump, tubewell, schools, panchayat buildings, roads, tanks, stopdams etc.) have been developed to a little extent in some rural areas during drought is a good sign of development of drought strategies. These facilities are still inadequate to minimize the affect of drought in the district.

The following recommendations are made to minimize serious drought affects in the district.

* The traditional farming practices should be changed through demonstrations and pilot crop producing schemes, introduction of high yielding crop varieties suitable for rain fed regions and training of local farmers etc.

* Fast completion of on going and proposed medium/ minor irrigation schemes will be helpful to minimize the severe drought affects in the district in the near future. Therefore priority needs to be given to complete medium and minor irrigation works and also certain types of works like construction of approach roads, headworks, tanks, stop dams, afforestation in the catchment areas etc.

* Soil & water conservation activities need more attention to reduce serious impacts of drought on farm produce and grazing fields.

* Medium and small scale industries are required to be established in rural localities to create employment opportunities for local public and to minimize migration during drought.

* Water supply schemes of various types deserve to be given high priority in the drought situations. Such schemes may include deepening of wells, digging of wells and tubewells, and

digging of river beds etc. The hand pumps which generally become out of order during drought need careful attention to bring in working condition immediately.

* It may be ultimately necessary to safeguard the livestock population in the district by development of suitable feed and fodder resources. Dairying may be promoted as a subsidiary occupation to supplement income of small and marginal farmers and to cope with uncertainties under drought situation.

* It may be desirable to establish drought service centres for livestock, which may provide watering facilities as well as may have reserved fodder available for holding the animals for a few days and providing such fodder during drought scarcity conditions.

* The natural range land/receded grass land may be improved in their nutritive values by introduction of perennial legumes suitable for the region.

* It may be necessary for the district to introduce nonagriculture based income sources to a large extent.

REFERENCES

1. AFC (1989-90) Evaluation studies of Drought prone Area program-District Khargoane; A report submitted to Department of Rural development Govt. of M.P.
2. Bharara, L.P. (1978) Socio-economic consequences of drought in an arid tract - A case study. An international Symposium on Arid zone Research and Development, organized by the Arid zone Research Association of India at CAZRI, Jodhpur, Feb. 14-18, 1978.
3. Buchanan, J.J. and B.K. Gilbert, 1977. "The Drought" Water Spectrum Vol.9, No.3, pp.6-12.
4. Campbell, D., 1968 "Droughts Causes, Effects, Solutions F.W.Cheshire pub.Co., Melbourne, Australia.
5. Charles W. Howe (1977) 'The Socio economic context of drought'. Drought Research Needs, a Conference proceeding, Dec. 12-15, Colorado USA.
6. Crawford, A. Berry, 1977. "State and Federal Response to the 1977 drought" unpublished report, Western Governor's task force on Drought, Denver, Colorado.
7. Department of Water Resources, 1977. "The Continuing California Drought", The Resources Agency of the State of California, August, Sacramento, California.
8. Erskine, K.D., 1909. The western Rajputana states residency and Bikaner Agency. Rajputana district Gazettters. Vol.

3A, pp.342-345, Allahabad pinner press.

9. Famine Commission Report, 1880. vol.III, Appendix I, conditions of the country and the people, pp.33.
10. Famine Commission Report, 1901. Printed at the NWQ and outh Govt. Press. Camp Branch, Nainital.
11. Gumbel, E.J., 1963. "Statistical Forecast of Droughts" Bulletin, IASH, Vol.VIII, No.1 pp.5-23.
12. Harrison, R.1977, "Response to Drought" water spectrum Vol.9, No.3, pp.34-41.
13. Herbst, P.H., K.B.Bredonkamp, and H.M.G. Barker, 1966. A Technique for the Evaluation of Drought from rainfall data". Journal of Hydrology, Vol.II, No.3, pp.264-272.
14. Hoyt, J.C. 1938. "Drought of 1936 with discussion of the Significance of Drought in Relation to Climate, U.S. Geological Survey, Water Supply Paper No.820,62 p., Washington, D.C.
15. Institute for Policy Research, 1977. "Dirctory of Federal Drought Assistance 1977", Western Governor's Policy Office, Western Region Drought Action Task Force, Denver Colorado.
16. Jaime Millan, 1972. "Use of regional economic model in the evaluation of drought impact". Flood & Drought, an international Symposium in hydrology, Sep. 11-13. Colarado USA, pp. 534-550.
17. Jodha, N.S.1975. Famine and Famine policies: Some empirical evidence. Economic and Political Weekly 10(4) 1909-1623.
18. Lovett, J.V., 1973. " The Environmental Economic and Social Significance of Drought" Angus and Robertson Publishers, Cremorne Junction, Australia.
19. Mann,H.S., S.P.Malhotra and K.A.,Shankanarayan.1977. International land use and desertification in Rajasthan desert. Ann. Arid Zone, 16(3): 387-394.
20. McGuire, J.D. and Palmer, W.C., 1957. "The 1957 Drought in Eastern United States" Monthly Weather Review, Vol. 85, No.9, pp.305-314.
21. Miri, A. Joseph, 1971. "The Policies of Water Supply in Northern New Jersy," Hydrology paper No.50, Colorado State University, Fort Callins, Colorado.
22. Myrick, D.K.,1970. "All Risk Crop Insurance; Principles, Problems, Potentials," Bulletin No.620, Montana Agricultural Experiment Station, Montana State University

Bozeman, Montana.

23. Newman, J.L., 1975. "Drought, Famine and Population". Maxwell School of Citizenship and Public Affairs, Syracuse University. Syracuse, New York.
24. Russell Clifford S., Devid Arey and Robert Kates, 1967. Drought and Water Supply, Baltimore; Johns Hopkins press 1967.
25. Russell C.S., D.G. Arey and R.W. Kates, 1970, "Drought Hazard of the Great Plains", Research paper No.106, Development of Geography, University of Chicago, Chicago Illinois.
26. Singh, K.S., 1975. "The Indian Famine 1967", A study in crisis and change. Peoples publishing House, New Delhi.
27. Swaminathan, M.S., 1972, " Can be faced wide spread drought again without food imports ? Dr. Rajendra Prasad Memorial lectures. Journal, Indian Society of Statistics. 24(1): 21-46.
28. Tannehill, I.R., 1947. "Drought, Its Causes and Effects," Princeton University Press, Princeton, New Jersey.
29. Thomas, H.E., 1962. " The Meteorological Phenomenon of Drought in the Southwest", U.S. Geological Survey Professional Paper, No.372-A, Washington D.C.
30. White, G.F. and J.E. Hass, 1975. " Assessment of Research an Natural Hazards," MIT press, Cambridge Massachusetts.
31. White House Working Group, 1977. "Drought Appraisal," Special Report prepared by Water Resources Specialists from 10 Federal agencies, March Washington, D.C.
32. Zabler, Leonard et.al, 1969. " Benefits from Integral Water Management in Urban Areas, The case of New York Metropolitan Region, " National Technical Information Service, PB 184019, Springfield, Virginia.

ANNEXTURE - I

LAND USE PATTERN OF KHARGONE DISTRICT

S.No.	Particulars	Area(ha)	Percentage of Total	Remark
1.	Area Under Forest			
	(i) Reserved & Protected	369652		
	(ii) Revenue forest	101238		
	Total Forest	470890	35 %	1998-89
2.	Land not available for cultivation	109564	8.1 %	
3.	Fallow land	11124	0.8 %	Including 71 ha of miscellaneous trees
4.	Pasture land	96623	7.2 %	
5.	Culturable waste	31479	2.3 %	
6.	Net sown area	629301	46.6 %	
	TOTAL	1348981	100 %	

(Source : AFC Report on Evaluation studies DPAP - 1989-90)

ANNEXURE - II

Year wise Cropping pattern of selected Blocks

- A.S. → Area Shown in H.a.
 - % Total → Area

S.No.	Name of Year Block	Dharif										Rabi																					
		Cotton		Jawar		Maize		Bajara		Gr. Mat		Soyabean		Brad		Moong		Tobar		Rice		Wheat		Gram		Mustard		Linseen		Masoor		Barley	
		AS	%	AS	%	AS	%	AS	%	AS	%	AS	%	AS	%	AS	%	AS	%	AS	%	AS	%	AS	%	AS	%	AS	%	AS	%	AS	%
1.	Dargose	85-86	10373	27.7	10970	29.4	840	2.2	-	4789	12.6	186	0.5	-	1026	2.7	1916	5.1	2180	5.8	525	1.4	-	61	0.1	36	0.09	-	-	-	-	-	-
		86-87	11188	29.9	11199	31.2	740	1.9	-	3879	10.4	163	0.4	-	1125	3.0	1890	5.0	2680	7.2	578	1.5	-	60	0.1	25	0.06	-	-	-	-	-	
		87-88	10451	28.0	11926	31.8	604	1.6	-	4549	12.1	145	0.3	-	1080	2.9	1736	4.6	1445	3.8	419	1.1	-	50	0.1	18	0.04	-	-	-	-	-	
		88-89	11427	27.4	11655	28.5	736	1.7	943	22.6	5033	12.0	131	0.3	-	6059	14.5	1811	4.3	3393	8.1	739	1.7	82	0.2	-	-	-	-	-	-	-	
2.	Segoan	85-86	5213	20.6	9943	39.4	920	3.6	-	1288	5.1	123	0.5	-	583	2.3	590	2.3	505	2.0	169	0.6	-	03	-	-	-	-	-	-	-	-	
		86-87	4869	19.2	10028	39.5	713	2.8	-	1365	5.3	106	0.4	-	601	2.4	609	2.4	930	3.6	288	1.1	-	22	0.08	01	-	-	-	-	-	-	
		87-88	4905	19.3	10207	40.1	1104	4.3	-	1266	4.9	98	0.38	-	522	2.0	528	2.0	613	2.4	203	0.8	-	11	-	02	-	-	-	-	-	-	
		88-89	5591	21.9	9549	3.7	1016	4.0	-	1579	6.2	105	0.4	-	737	2.8	535	2.1	1319	5.2	400	1.5	-	18	-	05	-	-	-	-	-	-	
3.	Bednaha	85-86	31637	44.36	15984	22.4	1630	2.3	-	4556	6.4	870	1.2	-	2877	4.0	1579	2.2	4843	6.8	1053	1.4	-	93	0.12	06	-	-	-	-	-	-	
		86-87	30525	43.0	16760	23.6	1407	2.0	-	4901	6.9	868	1.2	-	2747	3.8	133	0.1	5885	8.2	911	1.2	05	125	0.17	13	-	-	-	-	-	-	
		87-88	32284	45.2	17547	24.6	1274	1.8	-	4164	5.8	611	0.8	-	2841	3.9	1142	1.6	4024	3.6	566	0.8	-	106	0.15	13	-	-	-	-	-	-	
		88-89	32811	45.7	17243	24.0	1455	2.0	-	4442	6.2	586	0.7	-	3010	4.2	1193	1.5	6813	9.5	801	1.1	-	98	0.13	18	-	-	-	-	-	-	

ANNEXURE - III

AREA COVERED & YIELD RATES OF IMPORTANT CROPS IN DISTRICT KHARONE
1969-70 to 1988-89
(as per availability of figuree)

Area : *000ha
Yield : Kg per ha

Sl. No.	Year	Area and Yield of Various Crops																							
		Rice	Wheat	Juar	Maize	Bajra	Arhar	Moong moth	Urad	Gram	G*Nut	soyabear	Cotton	Area	Yield	Area	Yield								
1.	1969-70	13.3	435	34.1	987	196.3	634	30.2	583	NA	NA	21.7	509	30.2	NA	48.5	NA	6.2	561	51.8	807	-	-	119.7	233
2.	1970-71	14.7	478	35.5	1200	198.2	392	29.6	919	NA	NA	22.0	627	25.1	NA	48.6	NA	7.0	510	66.3	1010	-	-	113.5	218
3.	1971-72	17.0	563	38.7	841	197.3	606	34.4	834	41.6	326	20.4	692	22.4	321	39.5	321	9.6	652	87.8	603	-	-	113.4	483
4.	1972-73	16.7	354	33.2	932	184.3	617	29.3	593	48.3	176	20.3	552	21.1	221	45.5	217	4.5	568	71.6	596	-	-	123.9	324
5.	1977-78	18.4	532	37.6	1203	142.3	720	38.5	702	34.4	202	22.6	492	25.9	216	46.0	271	9.8	491	65.5	566	0.8	371	162.3	298
6.	1978-79	19.5	514	41.2	1360	150.4	674	39.7	653	31.6	124	22.7	386	22.3	150	43.9	179	13.1	464	38.8	578	1.7	304	173.6	258
7.	1979-80	20.0	261	44.3	1373	159.4	348	42.6	714	30.7	92	22.6	330	23.9	178	44.3	217	11.6	485	52.1	626	2.9	344	169.1	237
8.	1980-81	19.1	461	33.1	1502	167.7	588	42.9	696	31.3	204	23.4	315	24.5	173	45.4	201	7.8	502	46.2	561	2.9	283	163.3	243
9.	1981-82	18.9	567	39.5	1523	169.8	768	38.8	933	30.4	138	22.5	671	24.2	304	44.1	363	11.6	591	46.8	818	3.4	804	170.2	290
10.	1982-83	17.9	400	29.7	930	170.5	674	39.6	1066	28.8	231	22.2	306	25.2	221	44.1	263	11.8	402	50.9	616	4.3	494	170.3	256
11.	1983-84	17.7	577	40.6	1355	180.0	825	40.9	1907	27.7	295	22.1	748	24.7	235	43.5	271	13.3	594	49.8	762	6.1	587	155.1	232
12.	1984-85	17.8	335	37.5	2548	133.4	531	40.0	1402	26.5	667	21.6	418	24.2	174	42.4	239	10.8	590	46.1	355	9.9	477	173.2	217
13.	1985-86	15.2	354	25.8	1888	183.3	665	40.4	737	24.5	232	20.5	365	23.7	135	40.3	72	8.0	413	38.4	360	5.6	424	181.1	240
14.	1986-87	14.2	340	33.6	1927	187.6	765	38.4	1002	25.5	219	20.0	497	24.6	276	38.1	173	6.9	512	39.5	1007	7.8	369	187.1	226
15.	1987-88	12.3	310	23.4	2464	191.9	754	37.1	1059	26.8	45	20.3	316	23.2	181	37.1	180	4.7	374	41.3	732	7.2	381	181.7	213
16.	1988-89	11.6	489	45.0	3194	186.4	846	40.6	1627	26.6	368	21.1	865	22.6	-	33.9	NA	8.1	610	48.3	1184	5.9	622	185.5	393
17.	1989-90	12.3	NA	48.1	NA	182.3	NA	41.7	NA	25.4	NA	21.3	NA	22.6	NA	NA	NA	8.7	NA	49.3	NA	6.7	NA	188.8	NA

(Sources : District Statistical office)

ANNEXTURE - IV

LIVE STOCK POPULATION IN THE DISTRICT KHARGONE

S.No	Particulars	1974-75	1980-81	1986-87	1989-90
Non - milchAnimals					
1.	Bull/Bullocks (above 3 years)	287000	268700	291600	295058
2.	He - Buffaloes	3000	2000	5000	10061
3.	Horses	400	2800	2300	1828
4.	Pigs	2000	3100	5800	8573
5.	Others	277000	291200	299500	311144
Milch Animals					
6.	Cow	194000	198500	185700	183310
7.	She-Buffaloes	94000	87100	99000	97878
8.	Goats	275000	266900	272100	287646
9.	Sheeps	10000	10900	21400	15764
TOTAL CATTLE POPULATION		1146000	1131700	1172400	1203189

Source : District Statistical Office

APPENDIX - IV

Blockwise Ground water resource balance and surface and groundwater development in Khargone district.

Sl.No.	Name of Blocks	Groundwater balance (million cubic metres)	Annual rate of development (Percentage)	Remarks
1.	Khargone	39.49	2.61	Annual rate of resource development in Gogoan, Khargone, Bagwanpura, Thikri and Maheshwar is maximum where as it is minimum in Rajpura, Sendwa and Pati.
2.	Gogoan	33.02	2.90	
3.	Segoan	22.54	1.33	
4.	Bhagwanpura	14.29	2.20	
5.	Bhikangoan	103.69	0.72	
6.	Jhirnya	76.60	0.75	
7.	Barwah	88.91	1.90	
8.	Kasrawad	111.13	1.21	
9.	Thikri	27.09	2.60	
10.	Rajpura	81.45	0.01	
11.	Barvani	39.82	1.70	
12.	Pansamal	25.22	1.10	
13.	Niwali	36.99	0.40	
14.	Sendwa	93.95	0.12	
15.	Pati	27.38	0.19	
16.	Maheshwar	-	2.90	

ANNEXURE-VI

SOCIAL FACILITIES IN DISTRICT KHARGONE (N.P.)

S.No.	Particulars of facilities	Block - Khargone YEARS				Block - Segoa YEARS				Block - Barwah YEARS			
		85-86	86-87	87-88	88-89	85-86	86-87	87-88	88-89	85-86	86-87	87-88	88-89
1.	Drinking water Supply (total villages)	-	66	66	-	-	53	53	53	-	224	225	227
	- Hand pump	-	62	-	-	-	45	45	53	-	129	129	227
	- P.H.E. supply	-	14	16	-	-	6	6	7	-	18	12	12
	- Others (openwells)	-	-	-	366	-	-	-	-	-	-	-	-
2.	Health-total	29	33	33	26	10	16	20	20	26	26	35	30
	- Allopathic	4	3	3	-	1	1	1	1	3	3	3	3
	- Others	2	2	2		1	1	1	1	2	2	2	2
3.	Education (school)												
	- Primary	118	116	116	168	72	74	74	74	250	241	238	238
	- Middle	36	37	41		12	12	12	12	49	49	53	53
	- High school/Inter B	9	9	11		2	2	2	2	14	13	13	13
	- Colleges	2	2	2		-	-	-	-	2	2	2	2
	- Others	2	2	2		-	-	-	-	1	1	1	1
	- Adult edu. centre	-	100	100		-	100	100	100	-	-	-	-
4.	Communication												
	- Post office	24	24	26		19	19	19	19	42	42	42	42
	- Telegram	1	1	1		0	0	0	0	2	2	2	2
5.	Housing	252	7	7		305	23	23	38	283	-	-	20
6.	% of Electricity in villages	73.11	81.90	81.72		77.36	86.79	96.22	98.11	116.30	97.52	97.52	97.52
7.	Finance												
	- Banks	17	17	21		4	5	6	6	12	23	23	23
	- Agriculture Society	10	8	10		3	3	3	3	26	25	26	26
8.	Road/Transport												
	- (in km.)	189.8	192.0	194.0	204.0	88.0	91.0	98.7	99.0	204.2	211.8	242.9	256.0
9.	No. of Rly. Station	-	-	-	-	-	-	-	-	4	4	4	4
10.	Others												
	- Police Station	2	2	2		1	1	1	1	3	3	3	3

General Information of District Khargone

&

Block - Khargone, Segoon, Badwaha

Sl.No.	Particulars	District Khargone	Khargone	- Blocks - Segoon	Badwaha	Remark
1.	Geographical Area	13490001 ha.	54100 ha.	35700 ha.	121100 ha.	
2.	Total no. of villages	2111	117	53	323	
3.	Total population (as per 1981)	6,30,943 (as per 1981)	73251	46030	153269	The population record as 1981 census.
	- Male	834646	37705	23202	79150	
	- Female	796297	35466	22828	74119	
	- Total no. of Farmers (as per 1981)	333688	16570	15606	30949	
	- Agricultural labours	187986	10621	4378	24472	
	- Domestic Industries	12183	823	301	1445	Marginal works
	- Marginal workers	-	2090	1407	6725	
4.	Average annual Rainfall	804.2 mm	724.0 mm	949.0 mm	878.0 mm	
5.	Agriculture					
	- Cultivated land	6,66054 ha	41699 ha.	25512 ha.	71705 ha.	
	- Forest land	101258 ha.	1998 ha.	-	-	
	- Pasture & Grass land	94838 ha.	3123 ha.	-	-	
	- Waste land	60042 ha.	2879 ha.	-	-	
5.	Irrigated Area Total	1,48,474 ha.	7151 ha.	3690 ha.	25443 ha	
	Sourcewise - Canals	16584 ha.	344 ha.	1663	4341	Canals Tanks
	- Tanks	11379 ha.	20 ha.			
	- Wells	96568 ha.	7900 ha.	2527 ha.	10337	
	Tubewells	3427 ha.	140 ha.			by self sources : wells and tubewells
	- Other	20516 ha.	71 ha.			

- Blockwise Distribution of Samples
 - Interviewed during field survey

Sl.No.	Name of Block	No. of villages	Total	Agriculturists	- No. of Samples - Industrialists	Servicemen	Remark
1.	Khargone	3	29	20	4	5	
				Large - 6 Medium - 8 Small - 6			
2.	Segoan	3	25	25	1	4	
				Large - 5 Medium - 8 Small - 7			
3.	Badwaha	3	26	18	2	6	
				Large - 7 Medium - 5 Small - 6			

Questionnaire

ANNEXURE IX

Information from District Head Quarter/Block(s) Khargoan

DSD-NIH

Date

1. Geographical Area: -----
 - a. Cultivated Agri. land:-----
 - b. Forest land:-----
 - c. Pasture and Grass land: -----
 - d. Waste land:-----

2. Gross Irrigated area sourcewise
 - a. Total
 - b. Canals
 - c. Tanks
 - d. Wells/tubewells
 - e. Other sources

3. No. of Tehsil/Taluka/Blocks:
4. No. of Villages :
5. No. of Towns:
6. Population:
Past Survey year () Current year ()

Male
Female
Child

7. Land owners and Industrialists -----&-----
1. No. of small farmers
 2. No. of marginal farmers
 3. No. of large farmers
 4. No. of small industries
 5. No. of large industries
 6. No. of domestic industries

8. No. of houseless people-----

9. No. of labours

	Total	Male	Female
i. Forest and agricultural labours			
ii. Mining and industrial labours			
iii. Other labours			

10. Literacy Ratio:

Male

Female

11. Average House holdings.

12. Line stock population

Milch animals

Non-Milch animals

Cows
She-buffaloes
She-goats
Sheep
Others

Bullocks
He-buffaloes
He goats
Horses and Ponies
Pigs
Camels
Others

13. Availability of fodder:

- For rural areas:
- For Urban areas:

14. Cropping pattern and yield

Crops	1984-85		1985-86		1986-87		1987-88		1988-89	
	AS	Y	AS	Y	AS	Y	AS	Y	AS	Y

Rice

Wheat

Gram

Linseed

Soybean

Cotton

Vegetables

Groundnut

Barley

Jawar

Maize

Bajra

Mustard

Tuar and other pulses

Sugarcane

Others

Note : AS - area sown , Y- Yield

15. Per capita income and expenses:

Year	Income		Expenses	
	Male	Female	Male	Female
1985-86				
1986-87				
1987-88				
1988-89				

16. Development in social facilities

Total	1986-87	1987-88	1988-89

School educational
Institutions, etc.

Health

Transport/road

Electrification

Drinking water supply

Others

17. Whether Govt. has provided any drought relief measures for
Khargoon district: Yes/No

If yes what are those measures

- 1.
- 2.
- 3.
- 4.

18. Drinking water sources and demand in the district/Block

Sources	No:	Remark
---------	-----	--------

-
1. Tank/stop dam etc.
 2. Open well
 3. Tube well
 4. Hand pump
 5. River/Nalla
 6. Other

Demand:

1. Human use
2. Cattle use
3. Other domestic uses

19. Details of arrangements made by Govt. for drinking water during drought years and expenditure there of.

Sl. No.	Item	No. approx. Qty. %	Expenses	Remark
---------	------	-----------------------	----------	--------

-
1. Tank/stop dam etc.
 2. Tube well
 3. Open Well
 4. Hand pump
 5. River/Nalla supply
 6. Supply by road
 7. Other
-

20. Information regarding any other studies on drought on the district.
1. Topic
 2. Name of the study agency
 3. findings
 4. Suggestions/recommendations

21. Details of the Govt. administrative structure for action against drought

22. Labour movement in search of employment

	Male		Female	

	Total	Rural	Urban	Total Rural Urban

- a. During normal year
- b. During drought year

23. Import and export of foodgrains:

	Quantity
--	----------

- | | |
|---|--|
| <ol style="list-style-type: none"> a. During normal year: <ol style="list-style-type: none"> i. ii. iii. iv. b. During drought year: <ol style="list-style-type: none"> i. ii. iii. iv. | |
|---|--|

24. Opportunities of employment started by Govt. Local bodies and big employers:

S.No.	employment sector	year,	Govt. Local-bodies,	Big employers	Other sector
1.	Civil/admn.	86-87			
		87-88			
		88-89			
2.	Educational/ research	86-87			
		87-88			
		88-89			
3.	Industrial/ Mine	86-87			
		87-88			
		88-89			
4.	Business	86-87			
		87-88			
		88-89			
5.	Other sector	86-87			
		87-88			
		88-89			

25. Water level in various reservoirs of the district:

Sl.No.	Name of reservoir	1986-87 max. min.	1987-88 max. min.	1988-89 max. min.	Remark
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

26. Relief information during drought year

- 1.
- 2.
- 3.

INFORMATION FROM AGRICULTURISTS

DSD-NIH

DATE:

Tehsil/Block/Taluka

Village /Town

1. Name of the Farmer
2. a. Size of holding
b. Category small/marginal/larger/other
3. Occupation
 - a. Main occupation
 - b. Secondary occupation
 - i. Agricultural farming
 - ii. Agricultural labour
 - iii. Trade and business
 - iv. Artisan
 - v. Dairy
 - vi. Industrial/Mine labour
 - vii. Other

4. Composition of the family

Sl.No.	Name of the members	Relationship with head of the family	Age	Sex	Edn. Occupa- tion, if any
--------	---------------------	--------------------------------------	-----	-----	------------------------------

- 1.
 - 2.
 - 3.
 - 4.
 - 5.
 - 6.
 - 7.
 - 8.
 - 9.
 - 10.
-

5. Land owned

- a. Total land (ha/acre):
- b. Cultivated land (ha/acre):
 - Irrigated
 - Unirrigated
- c. Uncultivated land (ha/acre):
 - Grass land (ha/acre)
 - Pasture land (ha/acre)
 - Usar/Waste land (ha/acre)
 - Revenue forest pvt land (ha/acre):

Revenue forest pvt land (ha/acre):

Other land (ha/acre):

6. Irrigation facilities

Source of irrigation area irrigated

1. Canal (ha/acre):

2. Lift irrigation

 Open well

 Tubewell

 River/Nalla

3. Other

7. How many irrigation you provide for different crops.

Sl No.	Crop	Normal year before drought	Drought	Normal year after drought
--------	------	-------------------------------	---------	------------------------------

1. Rice

2. Jowar

3. Bajra

4. Maize

5. Wheat

6. Barley

7. GRam

8. Mustard

9. Linseed

10. Tuar and pulses

11. Cotton

12. Sugarcane

13. Ground nut

14. Others

8. Whether your well(s) /tubewell(s)/river yielded sufficient water for required irrigation

a. During normal year -----yes/no

b. During drought year ----- yes/no

If deficient then by what percent ?

9. Details of crops grown:

Sl.No.	Year	crop	Area sown	Fertilizer used	Irrig. yes/no	Yield	Remarks
--------	------	------	-----------	-----------------	---------------	-------	---------

1.	1985-86	Rice Soybean Wheat Gram Mustard Linseed Jawar Maize Barley Bajra Tuar/other pulses cotton sugarcane groundnut others					
----	---------	---	--	--	--	--	--

2.	1986-87	Rice Soybean Wheat Gram Mustard Linseed Jawar					
----	---------	---	--	--	--	--	--

Maize
barley
Bajra
Tuar other
pulses
cotton
sugarcane
groundnut
others

3. 1987-88 Rice
Wheat
Gram
Soybean
Mustard
Linseed
Jawar
Maize
barley
Bajra
Tuar and
other pulses
cotton
sugarcane
groundnut
others

4 1988-89 Rice
Soybean
Gram
What
Mustard
Linseed
Jawar
Maize
barley
Bajra
Tuar & other
pulses
cotton
sugarcane
groundnut
others

10. Line stock

Sl.No.	Year	Particular	Total numbers	Purchase	House breed	Remark
1.	1985-86	Bullocks Cows He Buffalo She buffalo Goats Sheep pigs Camels Horse & ponies Other				
2.	1986-87	Bullocks Cows He buffalo She buffalo Goats Sheep Pigs Camels Horses & ponies other				
3.	1987-88	Bullocks Cows He buffalo Goats Sheep Pigs Camels Horses & ponies other				
4.	1988-89	Bullocks Cows He buffalo She buffalo Goats Sheep				

Pigs
Camels
Horses &
ponies
other

11. (A) Details of Drinking Water Availability and consumption
normal Drought Year

(B) Sources of drinking water

12. Fodder Need Y= yes
N= no

Normal year Drought year

1. Whether fodder production in your own farm is /was sufficient for cattle feed consumption
2. If it surplus from your use
3. Do you purchase it from market or other farmers
4. Cattle rate of feeding

13. Income & Expenditures

<u>Income</u>		<u>Expenditure</u>	
Normal	Drought	Normal	Drought
year	year	year	year

-
1. From farm production
 2. Secondary sources
 3. Cattle
 4. Others
-

14. What is/was the supplementary sources of your income

- | | Normal year | Drought year |
|------------------------|-------------|--------------|
| i. Part time | | |
| ii. Part time business | | |
| iii. Other | | |

14. How have you compensated your income from other sources during drought year

- 1.
- 2.
- 3.

15. Any other remark

- 1
- 2
- 3

INFORMATION FROM INDUSTRIALISTS

DSD-NIH

DATE:

Block:

Village:

1. Name of the industrialist:
2. Occupation:
 - a. Main Occupation
 - b. Secondary Occupation
 - c. Category: Small/medium/large/other
3. Name and type of industry:-----
waterborne/partially waterborne/
non-waterborne/other
4. Products name
 - a. Main Products:
 - b. By Products:
 - c. Any other products:
5. Capacity of production:

	Name	Quantity	Cost
a. Main Products:			
b. By products:			
c. Other products:			

6. Raw material (Inputs) to your industry

Sl. No.	Name of input	Source	Rate of input	Cost
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

7. What are the water sources utilized for your industry

- 1.
- 2.

8. Are you getting sufficient quantity of water from the above sources to meet your requirements:

- a. During normal year :
- b. During drought year :

If no then how much quantity is deficit and how do you manage it.

- c. During normal year:
- d. During drought year:

9 In case of deficit water, how your income and expenses gets affected

+ increase

- decrease

o-unaffected

Year	Expenses(%)	Income (%)	Remark
1. Normal year			
2. Drought year			

10. What are the positions of market demands of your product

Year	Main products d(+,-,o %)	By products (+,-,o %)	Other products (+,-,o %)	Remark
1. Normal year				
2. Drought year				

12. Have you taken any loans from Govt/bank to tackle the problem of drought/nondrought in this region --- yes/no

If yes, then, please tell

Year	type	of	loan	amount	purpose	return	remark
						payment	

13. Are you having any problems regarding repayment of loans - yes/no

If yes, please specify the problem, whether it is due to drought or due to some other reason.

1.

2.

3.

14. In your opinion what would you need to tackle the problems of droughts

1.

2.

3.

15. What type of industries may be successful in this region (in case there is always a shortage of water)

16. Any other remark.

INFORMATION FROM SERVICE PEOPLE

DSD-NIH

DATE:

Block/ Tehsil:

Village/Town:

1. Name of Employee
2. Occupation
(Govt/SEmi Govt/Private/Autonomous/other)

3. Family Composition

Sl.No.	Relation of the members with head of the family	No	aGe	Occupation	Remark
--------	--	----	-----	------------	--------

1. Mother
 2. Father
 3. Wife
 4. Daughter(s)
 5. Son(s)
 6. Other
-

1. Have you faced any problem due to drought in the region

If yes what problems you faced

1.

2.

3.

5. Whether you got sufficient water for drinking and other domestic uses

a. During normal year -----yes/no

b. During drought year -----yes/no

In case of no, please tell, how much water you got and how much was deficit

c. During normal year Available Deficit

d. During drought year

6. In case of deficit water supply, how did you manage with this condition

1.

2.

3.