A MEMORANDUM OF RECURRING DROUGHT IN MAHARASHTRA — NEW APPROACH

SUBMITTED TO GOVERNMENT OF MAHARASHTRA

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Section I

Recurring drought in Maharashtra

1 Preamble :

1.1 Monsoon Variations -

The State of Maharashtra entirely depends on monsoon rains which alone sustains human, cattle and plant life. Monsoon rains being a natural phenomenon, there are year to year variations which are both of temporal and spatial nature. Thus variations of the rainfall parameters with respect to the total amount of rainfall, its duration and distribution, onset and recession and finally the intensity of occurrence together explain the temporal characteristics of monsoon rainfall. A further complexity is introduced on account of spatial variations of these variables in different parts of the State. In turn there are specific and well-established characteristics of regional nature which affect the prospects of agriculture in rural Maharashtra. Though the variables mentioned above present a complex situation, there are certain well-set patterns of this regionally differentiated parameter which we intend to study in this memoir.

1.2 Planning dilemma -

In particular there are two types of situations which are equally hazardous to stable rainfed agriculture. One is of deficient rainfall while the other is of excessive rainfall condition. These in turn result into scarcity or famine conditions and flood devastations respectively. Of these two hazards, Maharashtra is chronically afflicted by persistent drought conditions from time to time in one part or the other and consequently there are intense public discussions on the problem of drought and the methods of meeting this threat on a long term basis by way of developing resistance to drought. Inspite of elaborate public discussions in the past, the central question still remains unsolved. The drought repeats itself with monotonous regularity and there are inevitable disruptions in the normal development process. The intriguing question is why either drought or development comes up as a planning dilemma before the policy makers.

1.3 Lasting measures :

It is in the drought prone regions of the Maharashtra State where various aspects of rural life such as agriculture, ground water potential in terms of drinking water, fodder for cattle etc. are adversely affected and normal flow of life is dislocated at fairly frequent intervals. Now and then a crisis situation is generated and the problems of human and cattle survival occasionally threaten to get out of control. Under these situations resort to large scale relief measures in a routine predictable and traditional manner on the basis of the directions of the famine code becomes inevitable and unavoidable. The public debate is also led into a predictable course of management of these crisis situations and a wasteful public expenditure on a vast scale is made to undertake only the relie. measures. The entire Goverrment machinery is geared to such a crisis management and eventually with the arrival of next monsoon the whole administrative apparatus finds itself breathless and exhausted. At this stage a number of temporary works on hand are left unfinished due to several reasons with the result that their expected benefits are not realized in the subsequent years. As a result of this situation the normal development process in the rural area is severely dislocated and a bulk of the problem still continues to haunt the land and its impoverished peasantry. From time to time there dawns a certain realisation that the problem of persistent drought is not solved even peripherally and there is an ever present need to think of lasting measures that could contain and eliminate or atleast mitigate the threat of drought and in turn stabilise rainfed agriculture which covers the substantial part of the State.

1.4 Proposed strategy - a synopsis :

In the present memoir, we have concerned ourselves first in streamlining our ideas as to what is a drought condition of different degrees. Whenever there are failures of monsoon rains in different parts of the State, there are all pervading political compulsions to declare either scarcity or famine and it is fairly difficult to maintain an objective and rational level of public thinking and discussion on such occasions. Having defined what is drought in a more discriminating manner we have selected a local watershed in a drought prone area of Ahmednagar District and analysed the pattern of monsoon rainfall to illustrate the logic of our approach. Finally we have turned to the question of what are the possible solutions of a more durable nature which could meet the threat of drought on a more permanent basis without dislocating the normal development process. In this context, we have analysed and expanded the Naigaon development programme in Purandhar taluka, Pune District, undertaken in an acute pocket of scarcity by Gram Gourav Pratishthan a voluntary agency and the failure of the governmental planning system to absorb the positive achievements of this voluntary effort. In the context of permanent measures to tackle drought conditions we believe this failure to introduce suitable modifications in the local planning system for combat ing drought is more important and worthy of public debate. Any delay for adoption of action-oriented decisions of watershed planning according to the new strategy by Government, would prove disastrous.

Section 2

What is drought ?

2. Outline of drought situation :

2.1 Drought in a monsoon country is a meteorological phenomenon, pertaining to the failure of temporal characteristics of rainfall. However, this is of the nature of a cause, the effects of which are revealed over spatial regions where it occures. The degree of departure of the temporal parameters in any region determines the nature of the monsoon season. We emphasize that it is necessary to study the local/regional level patterns of monsoon rainfall in relation to its two major consequences over a region : (1) crop stand in rainfed agriculture and (2) status of ground water recharge on the basis of local watershed. All along there has been a pre-occupation only with the degree of failure of total monsoon rainfall and there is hardly any attention paid to the distribution pattern during the monsoon season. Further, no efforts seem to have been made to relate it to the critical stages of the seasonal crops of region. The crop stand suffers under two situations - (1) deficient soil moisture during the periods of growth stages of crops arising on account of lack of adequate rainfall at these stages and (2) excess of soil moisture arising out of incessant rainfall during intervening growth stages of the crops. Thus, the amount of rainfall and the rainy days together play a decisive role in the status of crop stand. Moreover, no attention is paid to the contribution of the seasonal intense rains occuring generally towards the middle and final stages of the seasonal crops and thereby in augmenting ground water recharge in the local watershed. In the absence of these finer considerations, the assessment of drought is inevitably done in a general way on the basis of qualitative reports about total rainfall from the districts. Also this assessment is under the persistent pressure

of public opinion which is entirely informed by the deficiency in rainfall at the commencement of the sowing season or its late onset. The study of distribution of rainfall in terms of the rainy and the intervening dry spells in relation to the critical stages of the standing crops, particularly in the kharif area, has a crucial relevance to the success of failure of crops. Secondly, the study of the incidence of heavy rains which we have tenta--tively defined as a rainfall of two inches or more during twenty--four hours on different occasions during the monsoon is equally important. These intense rains particularly during the closing period of the monsoon season have a definite bearing on the status of soil moisture and ground water recharge in the local watershed. The former has a close relevance with the rabi crops which are sown towards the end of monsoon and which thrive on the moisture held by the soil. The latter has a direct influence on the water table of wells in the area. An in-depth consideration of monsoon rainfall in relation to these two parameters viz. the critical stages of the crop stand in both kharif and rabi seasons and augmentation of ground water recharge should equip the policy makers to assess the situation in a more realistic manner. Of course these discriminating variables of rainfall over a region can be corroborated subsequently with the results of the crop annewari (paisewari) and/or the crop estimation surveys undertaken during the last stages of the standing kharif crop and during the harvest periods respectively. Similarly a reconnaissance survey of wells in the zone of influence of a rainguage station in respect of water table and quantity during the post-monsoon season would be very helpful in assessing the consequent effect of intense rains during monsoon season on ground water recharge.

In view of the previous discussions, it is pertinent to probe into the details of the monsoon rainfall - both temporal and spatial - obtaining in the Maharashtra State in order to assess the performance of the monsoon rainfall from year to year.

2.2 Monsoon in Maharashtra :

In Maharashtra State the monsoon rain has a peculiar pattern both temporally and spatially. Broadly, it changes from the West to the East. There are two regions characterised by very high and high rainfall. Of these, very high rainfall region in the West includes areas running North-South in narrow strips on either side of the Western Ghats, comprising the entire Konkan districts of Thane,Raigad, Ratnagiri and Sindhudurg, the Ghat area and the Mawal in the western strip of the districts of Kolhapur, Sangli,Satara,Poona,Ahmednagar,Nasik,and Dhule. The other viz. the Eastern region includes outskirts of Vidarbha districts comprising the eastern part of Nagpur and the entire districts of Bhandara and Chandrapur and the Eastern periphery of the adjoining parts of Marathwada. These two regions are characterised by rainfall which is mostly assured in occurrence. In a conventional sense these regions are practically free from the threat of drought. However, intervening dry spells can certainly affect the overall prospects of the standing kharif crops with predominance of paddy in these regions. What is meant here is that the possibility of total or partial failure of rainfall being negligible, there are definite lower limits to the possible damages to crops in the event of indifferent and deficient monsoon. The region comprising the rest of Western Maharashtra, the Western Vidarbha and more or less the Marathwada region receive medium to low rainfall with varying degrees of assuredness during the kharif and/or the rabi seasons. They have common problems arising out of variation of rainfall, may be less severe, in regions, in receipt of medium

rainfall of more or less assured occurrence, compared with the regions of low rainfall with higher degrees of uncertainties. Thus the drought conditions in Vidarbha, Khandesh districts and eastern part of Marathwada are few and far between as this region falls in assured rainfall region. The core section of the State is enclaved by a region of the medium rainfall of transition tract on the west by a region of medium to low but assured rainfall of the Vidarbha on the north and bulk portion of central Marathwada on the east. It is quite extensive and covers a one--third part of the State. According to Sukthankar Committee, it covers 87 tahesils of the 12 districts distributed over Western Maharashtra,Marathwada and Vidarbha. It receives low rainfall which is largerly unassured. It is exposed to frequent conditions of failure of rainfall of either of kharif or rabi or both seasons and the consequent drought situations in one part or another. This is in fact the problem area on which we propose to concentrate our analysis and recommendations.

2.3 Rainfall data :

We may note at the outset that even at the present level of technology we have not found any reliable technique of forecasting of the ensuing monsoon rainfall particularly the drought prone area under consideration. However, a more careful study of time series data over a longer period of monsoon, say about 60 to 75 years, does indicate a vaguely defined cycle of recurrence of drought and we have a fair amount of data recorded at the Tahesil Headquarters of the different districts and many other places to go by in this search.

2.4 Temporal pattern :

The temporal pattern of rainfall in Maharashtra State can be broadly categorised into four periods according to their occurrence during a year.

1. Pre-monsoon rains : occurring during April-May.
2. Kharif season rains : Occurring from June, July and part of August.
3. Rabi season rains : Occurring in latter part of August, September, October and part of November.
4. Post-monsoon rains : Occurring during remaining part of November, December.

2.5 Rainfall variations :

Temporal parameters of the monsoon rainfall call for the following four types of analyses, the results of which could then be associated with the spatial regions in order to complete the study of monsoon rainfall in Maharashtra.

1. Total quantity of rainfall of the monsoon period worked out as moving averages or normals based on data over a long time series.
2. Distribution of rainfall in terms of rainy and dry spells occurring during the kharif and rabi monsoon periods.
3. Rainfall in terms of intensity group-frequency during the monsoon period.
4. Assuredness of rainfall in terms of co-efficient of variation per cent of the monsoon rainfall or sea--sonal components and their relevance towards probable droughts expected.

2.6 Monsoon performance :

The exact period of occurrence of these rains would of-course vary from the West towards East in the State. The pre-monsoon and the post-monsoon rains are distinct in their performance characteristics and periods of occurrence. These rains are mostly uncertain and they occur in scattered localities. The pre-monsoon rains merely facilitate the cultural operations preceding the kharif crops while the post-monsoon rains act to augment the growth of rabi crop. We can conveniently isolate their influence on the schedule of monsoon cropping as such on the count that it is only marginal and uncertain.

2.7 Failure of late rains :

The monsoon rains on the other hand are more regular and cover definite periods viz. : (1) kharif season due to the South-West monsoon and (2) rabi season mainly due to the North-East or returning monsoon. Often these two phases overlap over a considerable period and region especially over the drought prone zone. While the kharif rains are generally of a moderate intensity, those of the late rabi season are characterised as mostly intense. In some parts of the drought prone area, the latter type of intense rains account for about fifty per cent of the total monsoon rains occurring in a relatively short period. A serious complication is introduced in a situation when the late rains fail and/or are delayed or received in deficient quantity. Consequently the standing kharif crops suffer perceptibly and the rabi crop sowing is considerably delayed. Also, more important, it severely affects the prospects of the ground water recharge of the local areas in subsequent months.

2.8 Rainfall regions :

We have mentioned earlier that the rainfall pattern varies generally from the West to the East in the Maharashtra State. On the basis of combined considerations such as the nature of onset duration, pre-ponderance of either kharif or rabi rains, the total amount and the degree of assuredness, the entire State of Maharashtra is divided into certain distinct rainfall regions. True, the rainfall pattern is a major chara-cteristics in delineating these homogenous regions. However, there are other equally valid considerations such as the nature of terrain, soils, the other climatic features, etc., which have to be superimposed in evolving spatial homogenous regions known as agro-climatic zones for any particular and dominent land-use and the cropping pattern. First we may list the broad categories of rainfall regions according to seasonal distribution as below :

1. Region with rains both in kharif as well as in rabi seasons,
2. Region with predominent rains in kharif only,
3. Region with predominent rabi rains only,
4. Region with uncertain rains both in the kharif and in the rabi seasons.

2.9 Rainfall ranges :

These rainfall regions may be further associated with consideration based on the total quantity of monsoon rains received with broad ranges such as very high, high, medium, low and very low quantity of rains.

2.10 Thus on this basis the monsoon rainfall can be grouped with respect to total quantity of receipt in the following manner:

1. Very high in quantity:-(250 and above upto 400 cms)
2. High in quantity :-(125 to 200 cms)
3. Medium to high in quantity. :-(90 to 125 cms)
   (70 to 90 cms)
4. Low to medium in quantity. (50 to 75 cms)
   :-(40 to 50 cms)
5. Very low in quantity :-(less than 40 cms)

2.11 Assured rainfall :

Another temporal characteristics of the monsoon rain--fall is associated with the dependability of occurrence of monsoon rainfall in terms of either the total average quantity or its relevant component received during the kharif and the rabi seasons. This factor is expressed as co-efficient of variation in per cent by working out a simple statistical calculation. Lower the value of this constant better is the dependability of the occurrence of the rainfall and vice versa. It is on the range of values of this constant that the degrees of assuredness for a homogenous tract of rainfall or a period of a season is reckoned. Tentatively we have accepted certain qualitative terms to indicate these characteristics. In turn incidence of drought frequency is found to be closely related to these categories. The above details are presented below with respect to dependa--bility of the total monsoon rainfall.

Sr.No.	Category of dependability.	Range of values of coefficient of variation (pc)	Probability of incidence of drought.
1.	Assured.	Less than 20.	Very low.
2.	Semi-assured.	20 to 25	Low to fair.
3.	Unassured.	25 to 30	Fair to high.
4.	Extremely unassured.	More than 30	High to very high.

Pattern of monsoon rainfall over Maharashtra State.

Sr.No.	Category of rainfall.	Range of rainfall. (cms.)	Region.	Range of coefficient of variation. (p.c.)	Probability of drought.
1	2	3	4	5	6
1.	Very high and assured - Predominently kharif.	200 to 300	a) Konkan Districts of Ratnagiri, Sindhudurg, Raigad, Thane and seaward westernmost strip of Kolhapur, Sangli & Satara.	Less than 20	Very low.
		200 to 400	b) Ghat region - Western strip of Kolhapur, Sangli, Satara, Pune, Ahmednagar and Nasik on the ridge of the Western ghats.		
		150 to 250	c) Maval - Leeward Western narrow strip of the districts of Dhule, Nasik, Ahmednagar, Pune, Satara, Kolhapur.		
2.	High and assured - Predominently kharif.	125 to 200	Eastern Vidarbha districts of Bhandara, Chandrapur, E-Nagpur.	Less than 20	Very low.
3.	Medium to high assured - Predominently kharif.	90 to 125	Wardha, Yavatmal, W-Nagpur, Amravati	20 - 25	Low to fair.
		70 to 90	East Jalgaon, E-Aurangabad, E-Beed, E-Osmanabad, Akola, West Amravati, Nanded and Parbhani.		

(continued)...

Sr.No.	Category of rainfall.	Range of rainfall. (cms.)	Region.	Range of co-efficient of variation. (p.c.)	Probability of drought
1	2	3	4	5	6
4.	Low to medium semi-assured. Predominently kharif with scattered rabi.	60 to 75	Mid-Western portion of Dhule, Nasik, Poona, Satara, Sangli, East Jalgaon, N-Solapur, Kolhapur, E-Osmanabad, W-Aurangabad.	25 to 30	Low to hig
5.	(a) Low - Unassured - Kharif and rabi.	40 to 50	Core portion of (a) Central part of W-Maharashtra, E-Satara, E-Pune, E-Nasik, E-Sangli, entire district of Solapur, Ahmednagar and E-Dhule, W-Jalgaon, (b) Western part of Marathwada - Osmanabad, Beed, Aurangabad.	More than 30	High.
	(b) Very low - extremely unassured - Kharif and rabi.	Less than 40.	Chronic pockets in the above regions situated in Eastern Nasik, Sangamner, and Karjat area in Ahmednagar, Sirur and Baramati in Pune, Man in Satara, Atpadi and Jath in Sangli.	More than 40.	Very high.

2.12 Spatial pattern :

The considerations that led to the evolution of agro--climatic zones of the Maharashtra State were directed to delineate homogenous regions. The basis for this was the combined consideration of prevalent cropping pattern, existing natural vegetation resulting out of rainfall pattern, soils, terrain and other climatic factors. It was done for facilitating research in agriculture leading to the zonewise common recommendations in respect of crops and their varieties, manurial doses, cultivation practices and water requirements of different crops in the agri--cultural lands and plantations for non-agricultural lands in Maharashtra State. The broad agro-climatic zones of Maharashtra are as follows:

1. Very high and assured rainfall zone comprising the Konkan, the Ghat and Maval regions which are a predominantly kharif crop growing areas.

2. High to very high and assured rainfall zone comprising the Eastern Vidarbha region which is a predominantly kharif crop growing area,

3. Medium rainfall region over the transition zone of Western Maharashtra, Vidarbha and Marathwada which is a predominantly kharif growing area.

4. Low to medium and unassured rainfall zone generally known as the drought prone area comprising 87 talukas identified by the Sukhtankar Committee, and growing both kharif or rabi crops.

5. Very low and most unassured rainfall zone known as chronic drought prone pockets in the fourth category representing the extreme type of situation identified in the drought prone area.

2.13 Identification of drought in past :

The fact finding committee (known as Sukthankar Committee) appointed by the Government of Maharashtra in their report in the year 1973 have objectively defined drought in an area as a situation in which a total of elevan out of twentytwo weeks of the monsoon rainfall from June to middle of November, received rainfall which was below the weekly normal. This was the first attempt to probe into the distribution of the rainfall during

the monsoon in a study of drought conditions.

2.14 The Committee compared weekly rainfall of the twentytwo weeks of the monsoon seasons of fifteen years with the rainfall of the corresponding weeks computed theoretically as normal weeks for raising seasonal crops. The data for the normal rainfall weeks necessary for raising normal kharif or rabi crop was obtained from Agricultural Research Farms of the Department of Agriculture, Maharashtra State. The weeks which recorded lesser rainfall by about half than that of the corresponding normal weeks were designated as sub-normal rainfall weeks. The average number of such sub-normal weeks of rainfall during 15 years worked out to eleven weeks out of a total of twentytwo weeks of monsoon season from June to middle of November. This situation was assumed to be associated with drought condition in the context of rainfed agricultural crops. However, this is a sort of theoretical exercise for defining drought related to the kharif and the rabi crops that can be conducted only during post-monsoon season period. Although it covers the study of the sea--sonal crop of the kharif and rabi, it does not relate the sub-normal situation with the critical phases of the crop life of the kharif and the rabi crops separately. It may be pointed out here that in the drought prone zone the monsoon rainfall period covers the entire life span of the kharif crops. On the other hand it ends just about the time of sowing to a little after germination of rabi crops. Thus while the kharif crop stand during the monsoon season may undergo fluctuations with respect to the occurrence or otherwise of rains at the different critical phases of the crop, the rabi crop stand is predominantly regulated by the original soil moisture reserve held by the profile which may be supplemented by late monsoon rains if any, and the weather conditions conductive for the formation of dew in the middle stages of the rabi crop. Hence, departure from normalcy of rainfall alone

has distinct functions towards control of crop stand of the crops of these two seasons. Thus the Sukthankar Committee's approach does not specify which exactly are those eleven weeks when the receipt of rainfall could be considered as deficient with a reference to the standing crop. In our view the sequence and the situation of these deficient weeks in the totality of twentytwo monsoon weeks is more important than a mere general statement of deficient weeks. The question as to how many weeks out of these eleven weeks of sub-normal rains occur during the kharif and rabi cropping period is not specified. It has a vital effect on the standing crops and is of special importance during certain critical phases of crop life. In the rabi growing areas sowing is usually undertaken during the receding phase of the monsoon. In this sense, it is difficult to correlate the weeks of sub-normal rains with the rabi crops in deciding the drought condition that may prevail in a rabi tract. In this context another important characteristic of rainfall viz: its intensity and its incidence or frequency especially during the late monsoon season is also completely left out of consideration by the Sukthankar Committee. Similarly an equally important influence of these intense rains on their contribution to recharging of ground water potential of the area is also not taken into consideration. Augmentation of ground water is important from the point of view of availability of drinking water during the subsequent months of dry season till the onset of the next monsoon. Also these rains can afford a qualitatively better insurance cover to the rabi crops sown in the latter part of monsoon season. In this position paper we have incorporated these vital considerations in estimating the situation which is a proper drought condition.

2.15 Effect on crops :

The temporal parameters of rainfall discussed earlier have a special significance when considered in the context of rainfed agriculture prevalent in any region. There are four major factors which either singly or together decide the kind of agricultural performance of the season, and indicate the occu--rrence of drought in any area. These situations arise on account of varying degree of deviations from the normalcy of parameters of rainfall. Conventionally these are related to the following factors :

1. Delay in commencement of the kharif monsoon rains affecting the sowing operations of kharif crops.
2. Too early withdrawal of monsoon affecting the maturity of kharif crops.
3. Timely commencement but interspersed with long and frequent dry spells in between affecting the vegetative growth or physiological transformations of crops.
4. Lack of incidence of intense rains during monsoon and especially in the later period of monsoon affecting final boost to kharif crops and/or sowing operations of rabi crops if any.

The limits of deviations from the normalcy of these parameters cannot be defined in advance of any monsoon year but still can be assessed in terms of experiences in the past for future guidance. Also we may note that an adverse condition of drought may be created on account of deviation of any one of the parameters or factors mentioned above or on account of collective influence of their deviations.

2.16 Commencement of monsoon rains :

The probable dates of sowing of kharif crops in different agro-climatic zones and the commencement of monsoon rains are closely related. This specific sequence has been studied in depth by Mr.C.R.V.Raman in his paper "Analysis of commencement of monsoon rains over Maharashtra State for agricultural planning". The

flexibility in adjustment of sowing dates is a crucial consi-
-deration that has improved our understanding. However, we humbly believe that these rainfall studies could yield better corroboration with the dates of sowing of kharif and rabi crops with reference to the system of 'Nakshatras' (Constelation) which is traditionally in vogue amongst the rural peasantry and which could be better related to the dates of sowing in practice. The traditional cultivation practices are closely linked up with the system of 'Nakshatras' and need to be studied in their proper sociological settings in different agro-climatic zones of the State. Apart from the commencement of the monsoon and the related dates of sowing, the distribution of rainfall can be closely related to the critical stages of especially kharif cropping. These critical stages are tillering, flowering, and grain formation. Also the sowing dates of rabi crops can be tentatively anticipated in relation to the 'Nakshatras' for different agro-climatic zones. The important point to note is that it is true that a certain amount of adjustment in the commencement of monsoon and the subsequent sowing of kharif crops is certainly possible. However, it is equally important to look closely at the subsequent critical stages of tillering, flowering and grain formation of the crop life during monsoon in the kharif tract and the sowing of the rabi crops in the rabi tract. Whenever the close correspondence between the receipt of rainfall during the monsoon and the critical stages of crop life mentioned earlier is disturbed, the standing kharif crops are adversely affected and so also the schedule of sowing of the rabi crops is upset. As far as the possibilities of successful rabi crops are concerned, timely pre-sowing intense rains, at the beginning of rabi season say in September-October are essential. Further this has to be followed by a continuous spell of favourable local weather condition conducive to the formation of dew during

the middle of rabi crop life say in the months of November-Devember. This kind of environment of weather favourably reacts with the rabi crops. Any deviation in these conditions during any year adversely hurts the rabi crops and gives rise to situations of anxiety.

2.17 Intense rains :

In addition, continuous and/or intermitant dry spells particularly of longer duration at the critical stages of crop life drastically lowers the crop stand even when timely sowing has been accomplished. Also we may note that the incidence of occasional intense rains which act as supplementary to the soaking rains during the season favourably boosts the kharif crop stand. Secondly, these occasions of intense rains are also crucial for augmentation of ground water recharge in the local watershed. Thus if intense rains are not received on a few of occasions during monsoon and particularly in the later part and in sufficient quantity, not only the crops but also the ground water potential are adversely affected in the local catchment.

2.18 From the above discussion it is evident that a detailed study of monsoon would have to include the specific considerations as above to be able to assess a drought condition more purposefully. Failure of monsoon rains in a general sense cannot be taken as a precise indication of drought. Also apart from the general failure of total monsoon rains there could be quite a few more years when the kind of monsoon rains mentioned above may adversely affect the crop life. A more informed public opinion could then take suitable policy measures to alliviate the miseries of the peasantry.

2.19 Rainfall disposal :

In the drought prone area of Maharashtra, the rainfall is low in amount and highly variable. Even the disposal of this meagre receipt of monsoon rains over an area of watershed through (1) uptake

by crops and vegetabion (2) surface runoff (3) infiltration, and (4) evaporation. A few climatic conditions such as high tempera--ture and low humidity prevailing in this zone affect evaporation. These adverse conditions are conducive to creating desiccating condition. These combine to produce a situation in which there is proportionately a greater loss due to evaporation over the area. Secondly, the incidence of intense rains and an undulating terrain of local watershed result into greater surface runoff. Also infiltration is relatively restricted due to predominant presence of shallow soils underlaid by hard substratum in many watersheds. Hence these three factors of disposal of rainfall namely evapo--ration, surface runoff and infiltration over influence the crop uptake. Also thereby development of ground water potential is hampered. Therefore even a perceptible small deviation from the normal distribution of rainfall can disturb the crop stand and the ground water recharge in the region to a considerable extent.

2.20 Crop stand :

In the drought prone area a good monsoon year is one in which both the seasonal distribution and the intense rains are at a level above normal. On the other hand a good crop year may result due to well distributed rains during the crop life, although the total rainfall may be far below normal. Perhaps such an year may not necessarily be a year of good ground water recharge and the vice versa. In the extreme case, an unfavourable situation in respect of both these factors of rainfall either in the kharif or in the rabi season or for that matter during an entire monsoon is a decisive indication of a bad crop year as wel. as a year of difficult drinking water situation giving rise a serious drought situation.

2.21 Chronic scarcity pockets :

In chronic parts of drought prone area there are certain local tracts where kharif rains are most uncertain and low in amount. Moreover, the soils in the tract are also shallow with low moisture retentive status, Hence the failure of crops and also of ground water recharge are a very common phenomenon and it is matter of common anticipation. The rabi crops in such areas are more or less insignificant due to absence of moisture reten--tive soils on large scale and/or lack of rains in the later mon--soon phase. Hence it is open for consideration whether any realignment of land-use from traditional crops to growing of plantation as visualised in social forestry and horticulture is more worthwhile in such tracts.

2.22 Relief measures :

Whenever drought conditions prevail, Government machinery is immediately mobilised to meet the situation. As an emergency situation relief works/measures are initiated by preference immediately from the humaniterian point of view to ameliorate the hardship of the human and cattle population in the tract by providing the following facilities:

1. Provision of employment by starting relief works,
2. Provision of drinking water for human and cattle population through tankers,
3. Provision of fodder and grass procured from other areas to cattle.
4. Provision of foodgrains procured from other areas.

2.23 Depending upon the severity of situation, besides Govern--ment system, other voluntary agencies are encouraged to join in these efforts.In other words, normal developmental measures are interupted and adhoc relief measures tend to dominate the situation of drought.

Section 3

Illustrative analysis of monsoon in a local watershed.

3. INTRODUCTION :

3.1 The foregoing discussion in respect of identifica--tion of drought was directed to a search for more realistic set of temporal parameters of monsoon rainfall leading to drought situation. For this purpose it became necessary to assess the drought situations in the zone of influence of any one particular rainguage station. In this context, a concrete study of analysis of rainfall as recorded at Sangamner, Dist: Ahmednagar was undertaken to illustrate the new approach outlined in the earlier section. This was part of a development plan of Chinchola nalla watershed situation near Sangamner in Ahmednagar district undertaken in another context. The details of this rainfall study are presented in this section. On the basis of this study we hope that a methodology for a clearer understanding of drought in the drought prone areas of Mahara--shtra State could be formulated for designing a new strategy to mitigate substantially the conditions of drought in the years to come. Although the results presented here pertain to a local catchment defined as a watershed it is quite representative of the situation in the typical drought prone area in the State. This line of analysis is open for more critical estimation and rigorous scrutiny as and when data extending over a large number of years and locations is analysed both for local and regional interpretation of drought. It is only then that the methodology and conclusions in respect of estimation of drought, its intensity and extent could be really formulated. Perhaps, it would be nece--ssary to study a few other parameters of local climate such as temperature, humidity and wind in order to modify and supplement

the conclusions on drought arrived at from the analysis of rainfall data alone. This we have not attempted at this stage due to immediate limited purpose in view.

3.2 Rainfall - Salient features -

For this study daily and monthly rainfall data as recorded at Sangamner for thirty years from 1953 to 1982 were taken into consideration. The salient features of this rainfall data are presented below :

		mm.	Inches.
1.	Annual average rainfall (average of 30 years) ...	450	18.0
2.	Monsoon average rainfall (from June to November) ...	417	16.7
3.	Off monsoon average rainfall ...	33	1.3
4.	Distribution of monsoon rainfall		
	a) Kharif (June to August) ...	230 (55%)	9.2
	b) Rabi (Sept. to November) ...	187 (45%)	7.5

5. Monthly averages of rainfall and rainy days of monsoon months (Average of 30 yrs.):

Month	mm	Rainy days.
June	84	4.9
July	81	6.2
August	65	5.4
September	109	6.3
October	53	3.4
November	25	1.3
Total :	417	27.5

6. Total number of monthly occasions of intense rains (defined as 37 mm or more in 24 hours) during thirty years :-

Months	No. of occasions.
June	11
July	14
August	8
September	15
October	16
November	1
Total:	65

7. Degree of variability of monthly and seasonal rainfall :

	Months.	Percentage.	Season.	Percentage.
a)	June	111.0		
	July	59	Kharif	49
	August	82		
b)	September	63		
	October	99	Rabi	43
	November	149		

3.3 Some preliminary observations from the above salient features of rainfall and that from other records are presented below :-

a) The average annual rainfall is 450 mm (18.0 inches), of which 417 mm(16.7 inches) occurs during the monsoon months from June to November.

b) Rainfall generally starts by about middle of June but many a times as late as middle of July.

c) Occasions of intense rains (37 mm and above during 24 hours) are few and far between. There are three years when no intense rains were received at all. In another seven years there was only a single occasion while in still another ten years there were only two occasions. Thus out of 30 years as many as 20 years may be consi--dered as bad years from this point of view.

d) Spells of rainy days are short and of meagre quantity.

e) Long spells of dry days, sometimes over 30 days, leading to desicating conditions are quite common during the monsoon season.

f) Last few rains which affect the prospects of the standing crops and recharge of ground water are most uncertain.

g) In general rainfall is highly uncertain and irratic as revealed from the distribution and variability indices.

3.4 Other climatic features in the area and particularly temperature and humidity are also as unfavourable as the rain--fall pattern. Summer months usually record long spells of high temperature ranging from 38° C to 42° C. The humidity status is also low throughout the year. These two conditions prevail over long periods in the region and thus add to creating desi--cating conditions throughout the year which are highly unfavourable to rainfed crops.

3.5 In view of the above observation, it is noticed that the average annual rainfall of 417 mm (16.7 inches) during the monsoon has certain unfavourable characteristics of occurrence which directly influence the crop growth during the kharif and rabi seasons. It has also a significant effect on the process of infiltration and surface runoff in the region which in turn has a definite influence on the consequent ground water recharge in the area. Cummulative effect of these features are reflected on the crop stand of kharif and rabi and the recharge of ground water during any year.

3.6 Rainfall categories -

Data in respect of annual monsoon rainfall in terms of its daily and monthly quantities, seasonal distribution and intensity were, therefore, analysed in order to arrive at con--clusions regarding the effect of uncertainties in rainfall on these factors in individual years from 1953 to 1982. For this purpose the rainfall data of the monsoon season of each year was first of all broadly grouped into five categories. The proposed categories were based on the total quantity of annual monsoon rains and the same are given below :-

1. Above normal rainfall year.	..	When the quantity of rain received is more than 25 percent of the average monsoon rainfall(521 mm and above).
2. Normal rainfall year.	..	When the quantity of rain received is more than the average (417 mm) upto 25 percent above average (417 mm to 520 mm).
3. Subnormal rainfall year.	..	When the quantity of rain received is less than average upto 25 percent below the average(313 mm to 416 mm)
4. Scarcity rainfall year.	..	When the quantity of rain received is below average by more than 25 % upto 50 % (209 mm to 312 mm).
5. Famine rainfall year	..	When the quantity of rain received is below average by more than 50%(less than 209 mm).

3.7 The rainfall years and their number falling in each of these five categories are recorded in columns 2 and 3 of Table 1.

3.8 Further, the data of monthly rainfall of each of the 30 monsoon years grouped under the above categories has been reviewed with respect to the average rainfall of the corres--ponding months of kharif season viz. June,July and August and also of the months of rabi season viz. September, October and November. The same is recorded in columns 5 and 6 of Table 1.

3.9 The actual rainfall of each of the monsoon months of the thirty years was compared with the average monthly rainfall of the corresponding month and categorised on the same lines as the classification adopted for the monsoon rainfall of the year. The months were accordingly categorised on their performance based on that account into :

(i) Well distributed (W) : When the monthly rainfall was above normal for two individual months out of three months of the kharif and the rabi season and normal or subnormal in the remaining one month.

(ii) Fairly distributed (F) : When the monthly monsoon rainfall was normal or subnormal for atleast two individual months out of three months of the kharif and the rabi season, while the remaining month was any one of the other categories.

(iii) Ill distributed (I): When the monthly monsoon rainfall was below 25 percent of normal(either scarcity or famine category) for two individual months out of three months of kharif and rabi season.

The relative data is presented in columns 4,5 and 6 of Table no.1.

3.10 Another supplementary study for the classification was made to locate an earliest possible sowing date for the kharif crops during the month of June and first fortnight of the July. This was based on the examination of daily rainfall data. Receipt of about 50 mm of rain on one or more consequtive days was accepted as a rainy spell sufficient for sowing. Hence a possible date of sowing was assumed in the following couple of days of this rainy spell. This was followed by examination of the rainfall of the subsequent months of July and August in the case of kharif crops. The final classification of the crop year was made on both these considerations. Similar study was made for the crops of the rabi season in respect of the months of September, October and November.

3.11 The kind of seasonal distribution of rainfall for each of the thirty years as given in columns 5 and 6 of the Table 1 was then related to the corresponding crop stand expe--cted by inspecting the kind of rainfall distribution during the seasons as stated in para 3.9. The crop year was then classified as good, fair and bad corresponding to three cate--gories of rainfall distribution of seasonal monsoon months in relation to the probable date of sowing. The data on this is presented in column 7 and 8 of Table 1.

3.12 Intensity pattern -

The rainfall data was also reviewed for the number of intense occasions of rainfall and their amounts during the kharif and rabi seasons as also for the entire monsoon season. The intensity pattern of the seasonal rainfall of each of the thirty years was classified according to its performance of this count. As stated earlier receipt of about 37 mm and more of rainfall during 24 hours has been assumed as an occasion of intense rain.

The number of such occasions during each monsoon month of the thirty years has been actually arrived at from the study of daily rainfall data of the monsoon months. The total occasions of such intense rains during the kharif, the rabi and the entire monsoon season of each of the 30 years are indicated in columns 9,10 and 11 of Table 1.

3.13 In respect of performance of ground water recharge in the area the incidence of intense rainfall was related to consequent expected replenishment of ground water during the following period of the year. For this purpose five or more occasions of intense rains during the entire monsoon season were assumed to indicate a good year in respect of its effect for augmenting ground water potential during the subsequent period. Thus three and four occasions indicate fair and two less occasions indicate bad years respectively. The actual quantity of daily rainfall of each monsoon month was examined with a view to finding the number of occasions of intense rainfall. These occasions were then summarised for both the kharif and rabi season as also for the entire monsoon season of each of the thirty years. The relevant findings of this study are presented in columns 9 to 12 of Table 1.

3.14 The various details of the study of rainfall explain-ed above and an abstract thereof are presented in Table 1 given below :

Table 1

Analysis of rainfall pattern at Sangamner, Dist: Ahmednagar in relation to crop stand & groundwater status.

S.No.	Type of monsoon year based on total quantity of monsoon rainfall.	Total no. of yrs. of each type.	Seasonal rainfall based on monthly precipitation			Classification of the year based on crop-stand.		Occasions of intense rains.			Classification of the year based on ground water recharge.
			Year	Kharif: June to Aug.	Rabi Sept. to Nov.	Kharif	Rabi	Kharif	Rabi	Total	
1	2	3	4	5	6	7	8	9	10	11	12
1.	Above normal : Quantity of monsoon rainfall - -more than 25 percent and above the average. (521 mm and above).	6	1980	Fd	I	F	B	5	-	5	G
			1979	I	Fd	B	F	1	1	2	B
			1976	W	I	G	B	4	-	4	F
			1975	I	Fd	B	F	1	1	2	B
			1974	Fd	Fd	B	F	3	-	3	F
			1956	W	Fd	F	F	3	3	6	G
2.	Normal : - upto 25 percent above the average. (417 mm to 520 mm)	8	1981	Fd	Fd	B	F	-	-	-	B
			1969	Fd	I	F	B	2	-	2	B
			1962	I	Fd	F	F	1	2	3	F
			1959	Fd	Fd	F	B	1	1	2	B
			1957	Fd	I	F	B	2	1	3	F
			1955	I	Fd	B	F	-	4	4	F
			1954	W	I	G	B	1	2	3	F
			1953	I	Fd	B	F	-	2	2	B
3.	Sub-normal : - upto 25 percent below the average. (313 mm to 416 mm)	11	1982	Fd	I	B	B	-	1	1	B
			1978	I	Fd	B	F	-	1	1	B
			1977	Fd	I	B	B	2	-	2	B
			1971	I	Fd	B	F	-	4	4	F
			1970	I	I	B	B	-	1	1	B
			1968	I	I	F	B	-	1	1	B
			1966	I	Fd	F	F	1	1	2	B
			1964	Fd	I	B	B	1	1	2	B
			1963	Fd	I	B	B	-	2	2	B
			1960	I	I	B	B	1	2	3	F
			1958	Fd	I	F	B	2	-	2	B
4.	Scarcity : below average by more than 25 percent and upto 50 percent (209mm to 312 mm)	3	1973	Fd	I	F	B	-	-	-	B
			1967	I	I	B	B	-	1	1	B
			1961	I	I	B	B	1	-	1	B
5.	Famine : Below average by more than 50 percent (less than 209 mm)	2	1972	I	I	B	B	-	-	-	B
			1965	Fd	I	B	B	1	-	1	B

Note : Explanation to abbreviations used in columns 5,6,7,8 and 12 is given below :

Columns 5 and 6 : Three categories as W,Fd and I (refer para 3.9)

i) (W) - Well distributed : When the monthly monsoon rainfall was above normal for two individual months out of three months of the kharif and the rabi seasons and nor--mal or subnormal in the remaining one month.

ii) (Fd)- Fairly distributed: When the monthly monsoon rainfall was normal or subnormal for atleast two individual months out of three months of the kharif and rabi season while the remaining month was any one of the other categories.

iii) (I) - Ill-distributed : When the monthly monsoon rainfall was below 25 percent of the normal (either scarcity or famine category) for two individual months out of three months of kharif and rabi season.

Column 7 and 8 : Three categories as G,F and B of crop stand.

G - Good; F- Fair and B - Bad. These categories are presumed by classifying the crop year corresponding to three categories of rainfall distribution in columns 5 and 6 in relation to the probable date of sowing.(Refer para 3.10 and 3.11).

Column 12 : Three categories as G, F and B.(Refer para 3.13)

i) (G) - Good : Five or more occasions of intense rains (37 mm and more in 24 hrs.)(Column 11)during the entire monsoon season are assumed to indicate a good year.

ii) (F) - Fair : Three or four occasions indicate Fair year.

iii) (B) - Bad : Two or less occasions indicate Bad year.

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3.15 Observations :

The salient points that have emerged in the previous discussions and presented in Table 1 are reproduced in the following abstract :

1. Total monsoon rainfall criterion :

Kind of monsoon year.	Frequency.	Percentage.
1. Above normal	6	20
2. Normal	8	27
3. Subnormal	11	36
4. Scarcity	3	10
5. Famine.	2	7
Total :	30	100

2. Performance of crop stand presumed in respect of kharif and rabi crops.

Kind of crop year.	Kharif.		Rabi.	
	No.	Percent.	No.	Percent.
1. Good	2	7	0	0
2. Fair	10	33	11	36
3. Bad	18*	60	19*	64
Total:	30	100	30	100

* Out of these years, sowing would not have been generally possible in 10 kharif and 14 rabi seasons due to inadequate soil moisture during sowing periods. Again there are 10 years of bad crop performance common to both kharif and rabi seasons.

3. Performance expected in respect of ground water recharge :

Kind of year.	Frequency.	Percentage.
i) Good	2	7
ii) Fair	8	27
iii) Bad	20*	66
Total :	30	100

* Includes three years when not a single occasion of intense rains has been recorded.

3.16 Some salient points borne out from the analysis of the rainfall data as presented in Table 1 and the abstract thereunder reveal vividly the extremely precarious and undependable characteristics of the rainfall and the related factors of crop stand and ground water of the area dependent on them. These

details bring out subtleties of the situation than what could be inferred from a study of total rainfall of the area in any year and its departure from the normalcy. There are certain pecularities of the rainfall of the tract which have a bearing on the definition of the drought and can be stated as under :

(i) Above normal : When the receipt of rainfall is well above normal, distribution of rainfall is generally 'fair' atleast in either seasons. The situation with respect to crop stand is also fair in either of the seasons. The ground water potential appears to be generally good to fair. However, the number of such occasions of favourable monsoon years in this area is found to be only six out of the 30 years (i.e. 20 percent) under observation.

(ii) Normal : In the normal monsoon rainfall years, distribu--tion of seasonal rainfall is found to vary generally between 'fair' to 'ill' categories. Out of the eight years in this group (i.e. 27 percent) two years fall under fair category for both the seasons. In the remaining six years the distri--bution of rain is ill to fair in either of the seasons. The crop stand is found to be fair only in either of the seasons. However, it does not seem to be closely related to the type of distribution of the seasonal rainfall. As regards incidence of intense rains of this group it is found to be 'fair' and 'bad' for four years each.

(iii) Subnormal : In the case of subnormal monsoon rainfall years the distribution of seasonal rainfall is more or less of 'ill-distributed' category. The number of such years is eleven out of thirty years (i.e. 36 percent). The crop stand is 'bad' during most of the years. In the case of this group

of eleven years 'fair' years occur twice in respect of ground water recharge and as many as nine years occur as 'bad' years.

(iv) Scarcity and Famine : In the case of three scarcity and two famine monsoon rainfall years, the performance of distri--bution of rainfall, crop stand and ground water recharge is entirely unsatisfactory. Of the five years of this category crop stand is 'fair' in only one kharif season and 'bad' during all the other seasons. As regards ground water recharge status all the five years belong to 'bad' category. This kind of monsoon years account for 17 percent out of 30 years.

3.17 Concluding observations :

In what has been stated above it is necessary to qualify the conclusions arising as they are on account of limited time series data used for the detailed study. It is true that it is necessary to undertake analysis of rainfall data for a still longer time series as well as in greater details in terms of occurrence of rainfall during rainy spells and the duration and positions of dry spells during the monsoon season. Further, it is also necessary to undertake such studies for a widely spread over rain-guage stations so as to obtain more realistic picture of the situation in the zone of influence of the rainguage station in the tract. In addition, the data could be more meaningfully interpreted with respect to crop stand if the corresponding data on crop anna (crop paise) valuation and/or the results of crop cutting experi--ments of the same season in the area are available for corroboration.

3.18 As regards the observations made on the estimation of ground water replenishment during different kinds of monsoon years it is evident that a follow-up survey of wells in the area in respect of water table and duration of availability of water in the following post monsoon months would help to corroborate the above conclusions.

In this sense therefore the present analysis is lacking in presenting a complete picture of the conditions of drought or otherwise in the area. Nevertheless the methodology of undertaking rainfall analysis indicated in the present study should help in a large measure to expose more clearly some of the less evident scarcity conditions which do not attract sufficient attention.

3.19 Apparently there are six years of 'above normal' monsoon rainfall group. Their monthly and/or seasonal distri-bution is not necessarily satisfactory viz. of 'well' or 'fairly well' type. However, the corresponding seasonal crop stand even during these years varies from 'good' to 'bad' as indicated below :-

	Kharif crop.	Rabi crop.
Good ..	1	Nil
Fair ..	2	4
Bad ..	3	2
Total ..	6	6

At the other end during five scarcity and/or famine monsoon rainfall years, another five years from a comparatively better i.e. subnormal rainfall group must be considered in effect as equally bad in terms of their effect on crop stand and ground water status in view of the occurrence of obviously

very low and ill-distributed rainfall during these years. Thus virtually in all there are nine bad years with respect to both crop stand and ground water in a time series of 30 years. This has been revealed only on account of the detailed study under-taken here. As regards kharif crop stand alone there are only two good, another ten fair while the rest viz. 18 are bad years. In respect of rabi crop stand alone, the corresponding figures are nil, eleven and nineteen years respectively. Viewing as a whole for 30 years there are as many as 18 years of bad crop stand during kharif season and 19 bad years during rabi season. These include some years when sowing would not have been normally possible due to lack of initial soil moisture status during sowing periods (i.e. 7 years in kharif and 11 years in rabi season).

As regards ground water status there are only two good and eight fair years, while as many as 20 years belong to 'bad' category in the study of 30 years. These include three years when not a single occasion of intense rain (37 mm and above in 24 hours) was recorded which must have resulted in an extreme shortage of drinking water.

It is also noticed that there are nine years when the crop stand of both kharif and rabi seasons as well as ground water status had been 'bad' simultaneously. Such years obviously call for being classed as famine years.

3.20 As stated earlier these conclusions are more or less qualitative and are based on inspection of the monsoon rainfall of a single station for a limited number of 30 years. Even then it clearly reveals the most unfavourable characteristics of the monsoon rainfall in the area around Sangamner. This information

about the real nature of unfavourable character in the context of rainfed agriculture and ground water would not have been revealed otherwise. When a more detailed analysis as in this study is attempted, it may more clearly reflect the charact--eristics of the monsoon rainfall and its effects on crop stand and/or ground water recharge for the region, as compared to the overall consideration of rainfall. The present study has conclusively shown that the local watershed near Sangamner is an extremely chronic drought pocket in the scarcity prone zone of Maharashtra State.

3.21 If we probe only the individual years in terms of total monsoon rainfall, then only five years could be classed as scarcity and famine years. On further and closer examination of the subtleties, it became apparent that two kinds of situa--tions leading to scarcity may be set out viz. crop failure and shortage of ground water status, depending on the receipt of monsoon rainfall. Further, these two situations may occur simul--taneously or separately. The first viz. pertaining to crop failure again may be in respect of the kharif or the rabi crop or both depending upon timely receipt of adequate rains (50 mm in one to four days at least) sufficient for sowing of kharif or rabi crop. Further, even when the seasonal sowing operations, either timely or delayed, have been possible, it was the rain--fall during subsequent months particularly at the critical stages upto grain formation which decided the success or failure of the crops in any year.

3.22 The other situation of the scarcity pertains to the shortage of ground water recharge as revealed in the difficulty of drinking water during the post monsoon period of the year

upto the next monsoon season. This situation arises when incidence of intense rains sufficient in number and quantity especially during rabi season are lacking.

3.23 Although, the monsoon rainfall at Sangamner extends over both the kharif and the rabi seasons, the co-efficient of variation for both the season is very high (above 40 percent). The seasonal rainfall is therefore most undependable both in respect of the crop stand and ground water status which is borne out by the detailed rainfall analysis. Besides, the rainy spells are few and of small quantity. In addition the intervening dry spells far exceed the rainy spells, which being short and low in amount, are not in a position to compensate the ill effects of the dry spells on crops.

3.24 Thus, in conclusion, it can be said that the above rainfall characteristics make the Sangamner area an extreme chronic pocket in the drought prone area.

3.25 In the foregoing methodology developed as a pilot study we have probed into the intricacies of monsoon data which does lead to a better understanding for defining drought conditions. A study of monsoon rainfall data on the above lines needs to be done as a routine activity every year at the District Collector--ate and extended to all the rain guage stations of each district and particularly of those situated in the scarcity tract in Maharashtra State. It should then enable Government to prepare relevant maps and charts at the district or the tahasil level showing the annual onset and withdrawal of monsoon rainfall, its seasonal distribution and intensity pattern and their relationship to crop stand both during kharif and rabi seasons and the ground water status of the area during the post

monsoon season. Such a comprehensive presentation of the most important parameters of rainfall and their influence on rainfed agriculture and ground water in the Maharashtra State would provide more scientific and realistic criteria for assessing the drought situation or otherwise in the area during any year.

References :

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3. Broad Soil Zones of M.S., Deptt.of Agril.1969.

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5. Watershed Development Programme for Chinchola nalla, Tal:Sangamner,District: Ahmednagar, Development Group,Pune, 1982.

Section 4

Watershed Development - Naigaon Experiment.

4. Context :

4.1 In the preceding three sections we have first attempted to define drought in Maharashtra in a more discriminating manner. For this we have moved away from a gross consideration of failure of total monsoon rainfall and we have introduced the consideration of critical stages of crop life and the need of monsoon rainfall during those specific stages and secondly we have tried to relate the temporal distribution of monsoon with two specific variables viz. the crop stand and the recharge of ground water potential in a given catchment. In the second and third sections we have chosen to illu-strate the logic and the validity of this approach and we have analysed the rainfall data of sixteen years over a local catchment situated near Sangamner taluka, Ahmednagar district, Maharashtra State. In this illustrative exercise we have been able to bring out the intricacies of monsoon rainfall to a limited extent and there are definite possibilities of shaping this methodology further with deliberate organisation of suitable data system.

4.2 In this section now we come to the central public concern agitating our minds during this year of severe drought in Maharashtra. We have mentioned earlier that drought has been visiting us with monotonous regularity over a long period of this century. From time to time certain ideas have been developed in respect to challenges of this recurring threat of nature. However, the administrative capabilities of Government have not crossed the boundaries of the system worked out by the British administra-tion and it is embodied in the Famine Code. Of course it is not suggested here that we have not made any improvisation in respect to field level experiences in tackling the drought conditions from time to time. What is suggested here is that the administrative

system at the best of the times has not moved beyond the crisis management stage. Corresponding to this is a failure at political level which has reinforced the lack of new ideas and new approach--es to tackle the persistent drought conditions in Maharashtra. At verbal levels and always being caught unaware in the wake of crisis the public life is aroused repeatedly to the fact that the conditions of drought have to be tackled on a permanent basis so as to be able to resist the drought with a more lasting effect. However, all the energies are singularly devoted to meeting the threat on a short term basis and with the arrival of next monsoon we realise that nothing of lasting nature has been either contem--plated or initiated and naturally practically nothing is accom--plished to end the conditions of drought once for all. We are addressing to these public concerns in the context of this current debate in which the possibilities of permanent solution to drought are being once again energitically discussed and debated.

4.3 Naigaon development programme :

In this respect we humbly believe that in Maharashtra we already have a basis to formulate such a approach which would advise the more lasting solution to resist the drought conditions. We hold this belief in the context of our earlier reference that as soon as we have to tackle drought as the crisis situation the normal developmental activities are dislocated inevitably on a fairly large scale and unproductive expenditure is incurred which naturally results into delaying the tempo of development planning.

4.4 The present discussion of Naigaon experiment is an attempt to focus the attention on evolution of ideas on development of watershed at the village level in a drought prone area. Gram Gaurav Pratishthan is a voluntary agency registered as a trust and has been operating in Naigaon village of Purandhar taluka, Pune District, Maharashtra State over last 10 years. Purandhar taluka is characterised by persistent drought conditions and the trust began interacting with local people in the wake of relief operations during the widespread drought in 1972-73. The entire theme of the village development programme centres around the conservation of water and land resources in relation to the population situated in the extreme drought prone area. Water being a more scarce resource has been treated as a community asset and an attempt has been made to work out an equitable basis of sharing of this critical resource for a small unit of holding in order to stabilise the dry farming nature of agriculture with an elaborate net work of conservation measures undertaken on a farm catchment. An experimental farm budget has been worked out for an irrigated unit of family farm of 2.5 acres (one ha.) in a village community by the Gram Gaurav Pratishthan after undertaking cropping and irrigation experiments for about four years. Provision of supple--mentary irrigation has been made in such a manner that every village household would be able to cover atleast the minimum needs of subsistence from the produce of his holding. The conceptual emphasis on conservation programme for optimisation of land and water resources and the equitable basis of sharing of benefits arising out of protective irrigation are the salient features of Naigaon experiment.

4.5 The pattern envisages comprehensive and integrated planning of the natural resources over the catchment for optimisation and its execution with explicit emphasis on the programme of local water harvesting for the benefit of the entire village community. In this strategy, it is felt that merely constructing the water impounding structures does not solve the problem of the farmers. This poor village society lacks the means, the method and the motivation for using the available water thus impounded for their fields. Hence, it becomes an integral part of programme to formulate water utilisation and crop management plans alongwith the technical aspect of water harnessing projects all undertaken in close association with the cultivators themselves who wish to be benefitted by this development. One major premise of this approach is the emphasis on conservation and augmentation of ground water potential on a watershed basis. The corollary is emphasis on protective irrigation rather than liberal flow irri-gation through canals which is the present day practice in vogue.

4.6 Equity in development :

Apart from the crucial technical aspects of conservation and development of water resources in the catchment, the Naigaon experiment envisages a novel attempt to introduce social commit-ment to equity in the development process and thus involve the local people in these sharing arrangements. For this motivation of the beneficiaries is considered as quite important and suitable organisational development is evolved to involve the local bene-ficiaries. So also suitable training is provided to strengthen maintenance management.

4.7 Water received in the form of rain over the catchment has been reckoned as a community asset and the best way of sharing has been suggested on the basis of its equitable distribution tentatively at the rate of irrigation of half an acre per capita for all in the village community or two and a half acres (one ha.) for an average family of five members. The Naigaon experiment has thus visualised the central principle of social justice and underlined the psychological sensitivity of rural mind to sharing of water resources amongst the entire village community for protective irrigation, instead of the conventional practice of its entire use by a few cultivators in the compact block situated under the command of the local lift.

4.8 Basically what has been demonstrated effectively in the Naigaon experiment is essentially a comprehensive approach to "total conservation programme" of land and water resources development and management of the consequent benefit on a community basis. In no way it is comparable with conventional notions of flow irrigation implicit in the existing irrigation systems. This emphasis on conservation and relative to this, protective and insurance type of irrigation towards assurance of production in order to cover the subsistence needs of village community is an important characteristic and social assumption of Naigaon experiment under discussion here.

4.9 Government thinking :

In recent years there have been occasional references and public discussions on the Naigaon Experiment and it is in various stages of evolution and enlargement in the drought prone pockets. Government have taken note of this experiment and there have been halfhearted attempts to absorb the lessons of this experiment into our local planning systems. In our opinion what is alarming is the failure of these attempts to enlarge on the

strength of Naigaon experiment. It is true that a closer examina-tion of Naigaon experiment in Government both at the bureaucratic and political levels did encourage a thinking in the direction of watershed development. Atleast on a pilot basis the Government accepted the relevance of the Naigaon experiment and initiated some thinking in this direction. A more crucial point to note is that there is a persistent failure to evolve suitable package of planning methodology for watershed development. In this context we would draw the attention of public to two recent Government Resolutions, one dated September 8,1981 and another dated July 20, 1982 and this journey of thinking on the part of planners in Government fully illustrates the kind of failure of planning we have mentioned above.

4.10 Government Resolutions : Sept.8,1981.

We first refer to the Government in Planning Department Resolution No.EGS.1080/264/Desk-33 dated September 8, 1981 which is now being referred in Government circles as COWDEP. Government for the first time made number of innovative admissions in their thinking and we may briefly list them as below :

i) Government recognised the need to enlarge the defini-tion of small farmers and the present definition from 7½ acres was enlarged to 15 acres of dry farming.

ii) Government provided for a subsidy component upto 80 percent for meeting the cost of mechanical component of lifting the water for community lift schemes which have been set up to share the water equitably on per capita basis amongst the beneficiaries. We may note that at present only 50 percent of the community lift scheme is being considered as eligible for subsidy. Of course corresponding to this provision of 80 percent subsidy, there is a prior commitment of beneficiaries to contribute 20 percent which is again based on the experience of Naigaon develop-ment programme.

iii) Government for the first time provided for the possi-
-bility of entrusting the execution of this watershed development programme to a voluntary agency either in the form of a trust or registered under the Societies Registration Act of 1860.

iv) Government for the first time stipulated that no beneficiary would be allowed to take sugarcane crop and whatever irrigation is available for equitable sharing would be only towards the protective irrigation. This again is entirely based on the experience of Naigaon development programme.

4.11 Admittedly this Government Resolution was drafted in the most clumsy manner and virtually makes an impossible reading for any purposeful execution by field level functionaries. In fact during the entire year of 1981-82 and subsequently 1982-83, nowhere this programme of watershed development with reference to equitable sharing of gains of irrigation development has been taken up for execution. In the budget speech for the year 1983-84, a provi-
-sion of Rs.3 crores has been made for this programme and going by the past performance there is enough ground for scepticism. Leave aside the execution so far even the planning documents on selected whatersheds are not ready for public discussion. We are making a specific reference to public discussion since we believe that this methodology of watershed development is as yet in an exploratory stage and lot more studies and experimentation would have to be carried on before an operational format on watershed development could be completed which could be taken up in a routine manner for execution.

4.12 Government Resolution : July 20, 1982.

The failure of this Government Resolution dated September 8, 1981 is adequately demonstrated by another Government Resolution No. EGS.1082/91/D-33 dated July 20,1982 issued by the Government in Planning Department. In a way this resolution makes curious reading.

Ostensibly this Government Resolution of July 20, 1982 was issued as a simplification of the Govt.Resolution dated September 8, 1981. Of course there was no disagreement on the need to make a simple reading to facilitate its understanding and eventual execu--tion. However, this was not the main hurdle in any case. The original words are " However, no Government funds should be provided under the project for the mechanical component such as electric motor/diesel engine, pipe lines, pump set, their insta--llation and ancillary skilled work." Government have quietly withdrawn the subsidy of 80 percent for the mechanical component of community lift scheme and in our opinion, have done definite damage to the spirit in which the Govt.Resolution dated Sept.8, 1981 was issued. The most crucial element of Naigaon Development Programme was related to the provision of 80 percent subsidy towards the cost of lifting the water which was to be shared equitably on a per capita basis. It is contended in Naigaon experi--ment that the beneficiaries having agreed to share water equitably have by implication accepted a ceiling on their own income since they have agreed not to take sugarcane and also in effect agreed to take only protective irrigation. Also a more important assumption of Naigaon experiment relates to the contribution of 20 percent as the beneficiary's share of total cost of sharing the water. This has an important bearing on the motivation of the beneficiaries and works as a binding factor in the working of these community lift irrigation schemes. In contrast the experience of the working of the lift irrigation schemes elsewhere in Maharashtra is quite dispairing and in this background the assumption of Naigaon experiment must be treated as quite important.

4.13 Government failure :

We have made elaborate reference to these two important Government Resolutions in the context of ongoing discussions to find permanent solution to meet the recurring threat of drought in Maharashtra. In our opinion the experience of Naigaon develop--ment programme should have provided one conceptual possibility for organising the development programmes in drought prone area of Maharashtra. Since the last widespread drought of 1972-73 massive investments in impounding water by way of percolation tanks and minor irrigation works have been made in the entire drought prone region. However, the irrigation potential created at such a heavy cost and on a massive scale has not been adequately exploited for stabilising agriculture which is exposed to the recurring threat of drought. It is estimated that not even onethird of this irrigation potential is being actually used to stabilise dry farming agriculture. In this context the Naigaon experiment was one possible line of break-through provided we were sincerely committed to the concept of equity in the development process. Also it would have provided insurance against drought in Maharashtra on a more lasting basis.

Section 5.

CONCLUSIONS.

5.1 In section two of this memorandum we have attempted to define drought in Maharashtra in a more discriminating manner. We have pleaded that instead of going by a gross consideration of delay or failure of total monsoon rainfall we should take into consideration the temporal distribution of monsoon during the critical stages of crop life. More specifically two crucial variables of crop stand and ground water recharge should be related to this temporal distribu--tion of monsoon.

5.2 In the third section, we have selected a local water--shed for illustrating the logic and validity of the methodo--logy elaborated earlier. With reference to illustrative analytical exercise of monsoon data for thirty years in a local watershed from drought prone area, we could see that there are five years out of thirty which could be described as drought/scarcity years if we go by the conventional criter: of failure of monsoon rains. As we adopt the more discrimina--ting variable of temporal distribution of monsoon in relatio to crop stand and ground water recharge, we find that over and above the obvious drought year, there are :

i) Ten bad years in respect of crop stand (Both kharif and rabi)

ii) Twenty bad years in respect of groundwater rechar

iii) Nine bad years common in respect of crop stand and ground water recharge.

5.3 Thus it is evident that apart from the five obviousl drought/scarcity years there are another five bad years which are in effect comparable to drought in varying degrees. This conclusion could be derived only when we moved away from the gross considerations of monsoon to a more specific data base of crop stand and ground water recharge.

5.4 In the fourth section we made reference to two Government Resolutions dated September 8,1981 and July 20, 1982 to illustrate the failure of a Government planning system to absorb the valid experiences of Naigaon village development programme. In our opinion these experiences are of critical significance for the current discussion of finding a lasting solution to the recurring threat of drought. As it is even during last 10 years we have made massive investments in creating the irrigation potential in a drought prone area and yet we have more or less failed to use this irrigation potential more purposefully to stabilise the dry farming in the drought prone pockets of Maharashtra. In our humble opinion, there are sufficient grounds why a more informed public opinion and public debate should take place now to avoid wasteful expenditure on drought and so also the inevitable dislocation in the normal development process.