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DROUGHT MITIGATION STRATEGY - A CASE STUDY IN THE KOLAR REGION, KARNATAKA

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ABSTRACT : Reviewing the different drought mitigation strategies that are in vogue in India, one finds that there is a dominance of irrigation and associated dry land agricultural programmes. Irrigation at a National level involves large scale river basin transfer. All these measures involve only the utilizasion of surface water. A new strategy is here suggested in the drought prone area of Kolar district, Karnataka, for the utilisation of groundwater by sinking deep bore wells along lineaments which carry water across the western ghats, from areas of surplus to an area of deficit. This method can be a more permanent measure to mitigate drought.

Introduction

The water resources in India depend on the monsoons, 70% of which is occurring during the monsoon season (June to November). Besides this, there are large tracts of land depending entirely on the localised showers for their water needs. While there is sufficient shift in the period of the more dependable monsoons, the localised showers are totally undepenendable. This will completely upset the rather rigid agricultural programme of the Indian farmer resulting in situations coming under the definition of drought. Drought in a general may be defined as 'lack of rainfall' sufficiently large, and for a sufficiently long period, as to effect adversely plants, water-supply for domestic purpose, operation of power etc. Drought though essentially a meteorological phenomena can be of three categories. (a) meteorological droughts (a situation when the actual rainfall is significantly less than the climatological expected rainfall); (b) Hydrological drought (associated with the depletion of surface water, consequent drying up of lakes, river, reservoirs etc. A hydrological drought may result if meterological drought is sufficiently prolonged); (c) Agricultural drought (when soil moisture is inadequate to support a healthy growth of crops to maturity).

Past records show that famines existed in India since the 11th century, some of which were very severe. But Bhatia (1967) has systematically worked out famine periods in India since 1799. From his study it is evident that fairly severe famines have occurred in some part of India or the other once in two to five years. Karnataka, especially the south and middle interior has been affected by serious drought.

A review of the action of the Government for the past 30 years can only indicate some minor irrigation projects coming into being in the chronically drought prone areas, except the Tungabhadra projects whose waters can flow into less than 5% of the chronically drought affected areas of Karnataka. The minor irrigation projects in the area appear to have been undertaken

more by way of providing employment to the local population during drought rather than a real mitigation strategy. Consequently recurrance of drought has become a regular feature. The present study is intended to focus the attention of the planners on the possible mitigation strategies which are more permanent in nature by selecting an area for the case study.

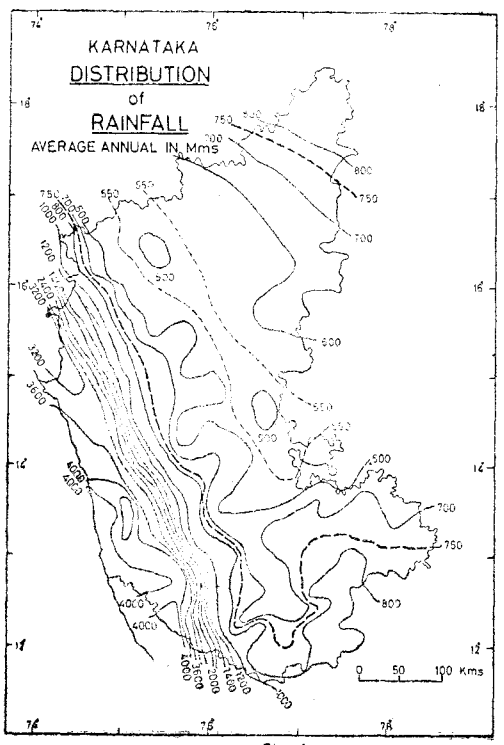

Fig .1

Study Area

Kolar region covering Kolar district is selected as the study area mainly because as per the classification of drought in Karnataka it has moderate drought (Barai & Naganna, 1978) with semi-arid conditions subject to dryness (Fig. 1). Kolar, Gulbarga, Raichur and Bijapur districts in Karnataka are the only drought affected areas which do not have an assured supply of water by any of the means of irrigation (Fig. 2). While the contemplated massive river valley projects in Krishna river basin can bring some relief to the drought affected areas if the northern districts of Karnataka, there appears to be no major attempt made to mitigate the drought condition in Kolar district. Kolar in 1980 had only 2 to 3% of the normal annual rainfall of 730.5 mms. In such a drought affected area an effective drought mitigation strategy is to be evolved so that some assured supply of water is made available.

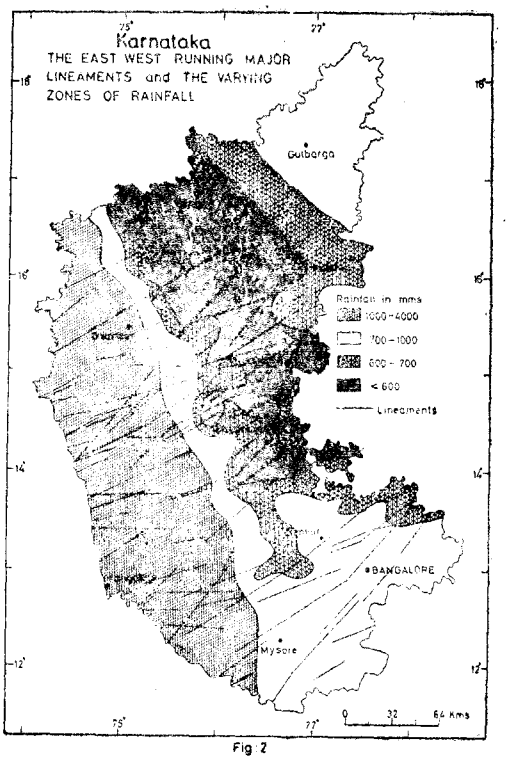

Fig 2

Location

Kolar district in South Maidan is situated between 12°46' and 13°58'N and 77°21' and 78'35'E. Kolar district has an area of 8,236.5 sq.kms. and 18,98,984 population with a density of 231 persons per Km° (Fig.2 inset).

Physiography

Kolar district is dotted by numerous hills and peaks of varying heights, particularly in the north. The principal chain of mountains is Nandidurga range in Chikballapur taluk with the peak at 1617 mtrs.

Other peaks include Kalauardurga, Bharmagiri, Harahareshwara betta and Divigiri. Further east is another range of hills of lower elevation forming a chain to the west of Kolar town. A third low line of hills lies to the south of Bangarpet.

There are no perinnial rivers in Kolar-Most of them are small and carry water only in the rainy season. Three important rivers are Palar, North Pinakini and North Pennar and several of their tributaries take their birth in the district and flow in different direction.

Geology

Kolar district has the following rock types.

The Dharwars forming the schist belt running north–south for a distance of 65 kms. and a width of about 6 kms., covering an area of about 400 sq. kms, lies close to K. G. F. The hornblende schists are believed to have been originated by the alteration of a series of basaltic lava flows. At the contact of this hornblende schist are the blue quartzite veins which are gold bearing. This is found on the western side by ferruginous quartzites, and on the eastern side by crushed conglomerates. The entire schist belt is surrounded by a gneissic complex made up of granites gneiss and granites. Numerous dykes which intrude the granitic complex and the schist are found running north-south and eastwest. The area has undergone lateritic weathering with exposures of laterites around. Siddaghatta, Srinivasapura, Jan gamkote and Malur with typical land form of flat topped hills.

Climate

The average rainfall of the district is 730.5 mm. about 70% of it occurring during the south-west monsoon. September–October usually record the highest rainfall. Rainfall is also associated with thunderstorms. There were wide variations in rainfall recorded over a 50 year period. In 11 out of 50 years rainfall was less than 80 of the normal. Though the district as a whole did not record two consecutive years with rainfall less than 80% of the normal, such occasions are known at indivdual stations.

Temperatures indicate a rise from March to May, recording the highest of 40°C (34.6° C at KGF, 28.7° C at Nandi Hills). With the advance of the south-west monsoons, temperatures decrease till September-October. The withdrawal of the south-west monsoon records the lowest temperatures in December 25°C (maximum) and 20.6°C (minimum). Relative humidity is high in the south-west monsoon period.

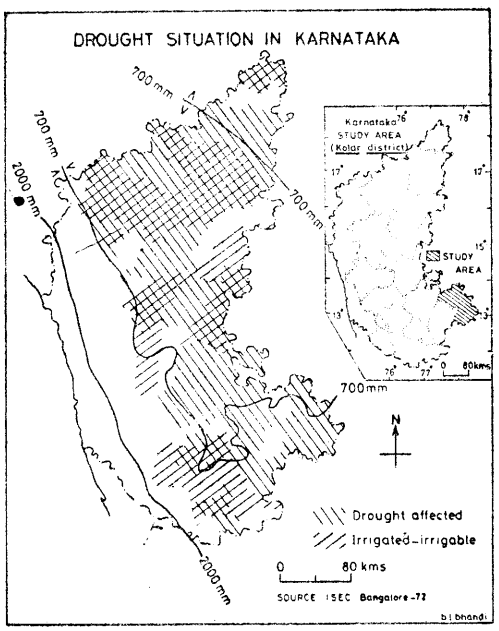

Fig 3

Drought Prone Areas of Karnataka

Drought prone areas of Karnataka have been delimited on the basis of annual rainfall, rainfall variability, soil moisture characteristics, annual potential evapotranspiration, water surplus and index of aridity (Barai & Naganna, 1978). The drought affected north-south zone comprising of 111 taluks of Bijapur, Belgaum, Gulbarga, Raichur, Chitradurga, Tumkur and Kolar districts with less than 750 mms. annual rainfall lie in the eastern part of the State (Fig. 3). This zone is further delimited into 4 zones of drought intensity, moderate, large, severe and disastrous drought conditions (Fig. 1).

Table I
Progress of Irrigation
Gross irrigated area in million hectares

	Major and medium	Minor	Total
Pre-plan period (1950-51)	9.5	12.9	22.6
End of First Plan (1955-56)	11.0	14.1	25.1
End of Second Plan (1960-61)	13.1	14.8	27.9
End of Third Plan (1965-66)	15.2	17.0	32.2
End of Annul Plans (1968-69)	16.9	19.0	35.9
End of Fourth Plan (1973-74)	18.8	23.5	42.3
End of (1977-78)	24.8	27.3	52.1

(B. Shivaraman, 1979)

Planning an Effective Use of Water

Since the pre-plan period (1950-51) there has been an increase in food production. The green revolution has brought the utilization of high yielding varieties adding to production. Planned irrigation has also made great strides in the development and use of water.

The National Commission on Agriculture has indicated that the present practice in the conntry is extravagant in water use. It has got an estimated potential to irrigate 140 million hectares and is expected to irrigate further by the turn of the century.

Several reservoirs in the country have been irrigating lands in drought affected areas but many of these irrigation schemes have proved to be costly though they have yielded substantial result. In fact future programmes should involve an intensification of groundwater utilisation and particularly combining ground and surface water in an integrated system (Shivaraman, op. cit.). The Narmada, Rajastan canal concept of brining water from Punjab, Ganga-Jmuna systems and Godavari-Krishna--Narmada could plan for inter basin transfer.

Shivaraman also has indicated that the lower reaches of rivers (deltas) are continuously over flooding their banks and depriving themselves of better agriculture. A balanced use of surface and groundwater could improve agriculture. Planned surface water irrigation could bring about a better distribution of water, with an understanding of water and moisture control. Canal irrigation could save loss of water through seepage. All these problems could be solved by Command Area Development Programme started in the Fifth Plan Period.

From this, it is clear that any drought mitigation strategy has to take into account not only the surface water but also the much neglected groundwater for an effective use.

Strategies for Drought Mitigation

Several strategies to mitigate drought have been suggested, both meterological and hydrological, but all these measures entail heavy costs. So far in India small scale irrigation and ecological environmental programmes such as increase in agricultural crops, community development programmes, rural industries etc. are in operation. A review of some of the strategies indicate the difficulty in putting them into operation.

Shivaraman (1979) has suggested three development strategies in agricultural ecological change. For a mono-cultural economy he suggests (a) Interculture, high yielding strains, deep ploughing and contour bunding (b) animal husbandary,

and (c) manufacturing and service production.

The strategy started by DPAP programmes which initiated the rural works programme, aimed at management of irrigation resources, reconstructing cropping patterns and livestock development. Misra (1977) in a Drought Prone Area Programme, studied for Chitradurga district in Karnataka, endorsed the developmental strategies suggested by the DPAP programme in irrigation, agriculture, animal husbandary and horticulture and suggested that emphasis is also to be laid on pisiculture. Bali (1979) has suggested water shed delimeation and planning for drought mitigation. Venkateswaran (1979) authorised the importance of irrigation in effectively mitigating the rigours of drought indrought prone areas. In his study, he has pointed out that there has been an uneven distribution of water in different regions and therefore, the Government should consider scheme for diverting waters from regions, having surplus to deficit areas (interlinking the various river systems).

Ranganath Rao (1979) stresses on the vital role of irrigation in mitigating the rigours of drought and suggests all conceivable means of utilizing surface and groundwater within the frame work of massive drought prone area programme. His optimum water resource development programme includes interbasin transfer. In view of river basin transfer a National Plan was suggested by Dr. K. L. Rao, the then Union Minister of Irrigation in 1972 for bringing the surplus waters of the Ganga at Patna to be taken across the Vindhyas to the Peninsular rivers by pumping over a height of 550 mtrs. It is estimated that the net power required to lift water will be 7 millions kwts Ramamurthi (1979) provides another drought mitigation strategy weather modification. He suggests cloud seeding with soidum chloride. Several such operations were carried out in South Florida, Oklahoma and Texas in 1975. In India cloud seeding experiments were carried out in Delhi, Poona (salt seeding), Bombay-Gujarat and Karnatka but the scope of this method is limited in the country.

All the above mentioned measures to mitigate drought involve several problems-financial, scoio-economic and political though river basin transfer if and when implemented could along with drought solve other problems like inland navigation, flood control environment and ecology, salinity, beach erosion, future changes in water needs, technological developments, growth of industries and urban development. In view of the broader scope of this strategy the authors do not consider this as most relevant to the present study.

Utilization of Groundwater Flowing Through Deep Seated Lineaments - A Hypothesis

A review of the drought mitigation on measures proposed early indicate that most of them deal with optimum utilization of surface water. Though some mention is made for an integrated utilization of surface and groundwater no specific proposal is made for the utilization of groundwater.

In view of the several problems faced-financial, socioeconmic and political by the several drought mitigation strategies a simple strategy is suggested by Naganna (1979) to mitigate drought.

Naganna (op. cit.) has hypothesised that there is a western belt lying along the western coast of Karnataka comprising of high mountains the Western Ghats. This region receives very heavy rainfall ranging from 1000 to 4000 mms. and this Ghat forms the water divide for the east and west flowing rivers (Fig. 3). Further, as confirmed by the exploratory work in Kudremuk, Bababudan and Kemmangundi and further north in Belgaum there is a thick weathered mantle providing a sufficient media for the formation of sub-surface water reservoir. During the non-rainy seasons water from the sub-surface water body through affluvent seepage

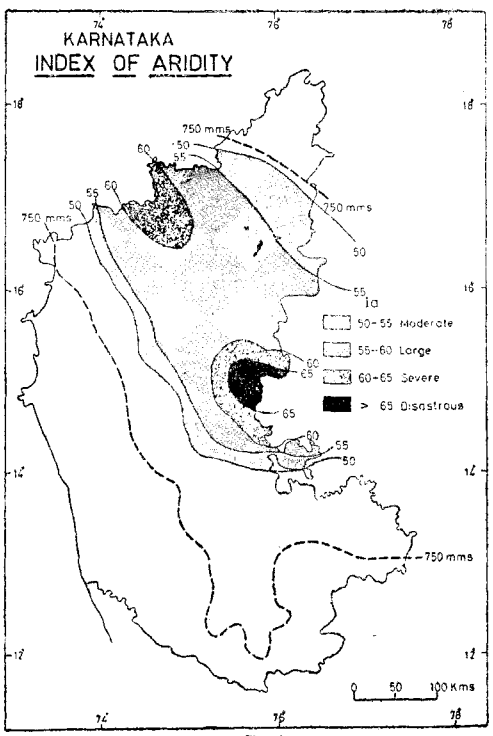

Fig. 4

gets discharged and flows as base flow in all the rivers. This accounts for the discharge of groundwater wherever the water table intersects the surface.

The existance of east-west running lineaments in Karnataka is established by the study of 'landsat' imageries though their exact location on the ground is yet to be established. These lineaments are found to exist all along Karnatka from north to south (Fig. 4). These lineaments must be transporting groundwater from the surplus western region to the east. A proof of this can be obtained by the large quantities of water that is being bailed out from the Kolar Gold fields, during their mining activity. As a part of the drought mitigation strategy one must carefully locate these lineaments on the ground and put deep bore wells on these lineaments. By following the groundwater tracer techniques, it is possible to establish the movement of groundwater from the surplus western belt to the drougth prone eastern belt. Once the groundwater movement along the east-west lineaments is established, detailed plans can be worked out for systematically drawing the groundwater in the drought prone areas along these lineaments.

Verification of the Hypothesis

The hypothesis explained above is verified for Kolar district. As seen from Fig. 2, Kolar, Gulbarga and Bijapur are the only three districts of the drought prone areas which are not influenced by any source of surface irrigation. Hence one of these regions namely Kolar is taken up for the verification of the hypothesis.

Fig. 4, indicates lineaments in Kolar district. The Kolar Gold Fields located in this district is facing a problem of bailing out water from thr mines each year. The amount bailed out in the rainy season being more than in the dry season. This fact is an evidence of a large reservoir of groundwater beneath the mines at great depths. Probably the mines are located over lineaments from where this water is bailed out. The quantity of water bailed out from each of the mines per month in K. G. F. is indicated below.

mine	Max: quantity bailed out (Gallons)
Mysore Mine	2,23,67,280
Champion South	1,43,18,209
Champion North	3,75,16,806
Nandi	4,00,11,817
Total :	11,43,53,106

Source : Records of Bharat Gold Mines.

The table clearly indicates that the quantity of water baild out from each of the mines in K. G. F. is enormous, considering the fact that it is located in a drought affected region in Karnataka. Scanning through the literature regarding the yield of water in wells in differant parts of Karnataka, it is seen that the yield in the K. G. F. mining region is abnormal on the

igher side. The only possible explanation for the abnormal high yield of water in these mines could be that the water is tapped at very deep levels, and deeper the pumping points the higher is the yield. From this one can construe that in these mines the shafts have intersected the deep seated water carrying lineaments running across the water divide transferring the water across the river basin thus accounting for the abnormal yield. While the water bailing is a problem in the mining area of K. G. F. it could be a boon in the adjoining drought prone regions if water carrying deep seated lineaments are recognised on the ground in the drought prone areas and deep bore wells are put to tap the ground-water effectively.

Conclusion

From this it could be concluded that the best drought mitigation strategy would be to locate the deep seated east-west lineaments which connect the water surlpus Western Ghats region and the easterly chronically drought stricken belt on the ground by detail geological investigation and to sink deep bore holes to tap the water flowing along the linaements. Incidentally this will also be a permanent drought mitigation strategy.

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