



Drought, Deprivation and Sustainable Development:

Why are the public policies so weak?¹

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abstract

National capacity to deal with the deleterious consequences of the drought has certainly increased in the recent years. But the 'absence of death' as an indicator of success of public policies for drought mitigation is not very dignified or creditable. This precisely was the claim of a national document on drought brought out by the Government of India in 1987. Why do we consider sustained social deprivation, ecological degradation, learned helplessness, lack of basic necessities, etc. as inevitable features of a drought prone region. National Commission and Development of Backward Areas (NCDBA), Planning Commission, (1981), went to the extent of suggesting that development efforts in drought prone regions should not check the out migration too much lest the supply of cheap labour for large infrastructural projects elsewhere is checked. It is not surprising that the social discontent is increasing in some of the backward regions (particularly hill and forest regions) on account of such a definition of the developmental goals by the dominant elite. It may not be too long when people in drought prone regions also realise that the only available alternative to attract the attention of the planners is to use agitational methods.

Science and technology help in transforming the relationship between the resources and the people. Planners have not drawn much upon the indigenous scientific wisdom while developing the long range plan (if any at all) to reduce misery of the affected people on account of the natural disasters. Links between peoples' knowledge system about conservation and utilization of natural resources and formal R & D have continued to be weak. Only a few professional associations have so far come forward to organize full fledged sessions in their annual conferences on indigenous technological innovations developed by the people. Dialogue on sustainability has not yet included adequately the discussion on ethical and value dilemma on tapping local knowledge without maintaining peoples' rights over the rent extracted from utilizing it. The linkage between post graduate education and emergent research needs for coping with stress in different disciplines continues to be of an ad hoc nature. Community of scientists may like to reflect upon such a situation in science management.

The paper is divided into four parts. In part I, the conceptual framework linking micro and macro aspects of drought and consequent social deprivation are discussed. The socio-ecological paradigm for analysing development options in dry regions is described. In part II, the key issues for science policy for mitigating and preventing the effects of natural stresses like drought are identified. The inadequacies in the public policies for drought mitigation are discussed in part III. In part IV, the need for further research and action is identified.

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Context

The problem of drought is an issue of uncertainty as far as the exact timing and the severity are concerned. However, drought becomes a risky problem from spatial dimension. We know which regions are likely to suffer drought year after year and yet our response is always of the fire fighting type. Why should we convert a problem of risk into an uncertainty? Is it because it helps us in avoiding accountability and generating a long term perspective. Budget exhaustion and avoidance of death may be useful index to measure achievements for public bureaucracies. Can this be a justifiable consideration for a scientific community which addresses the problems of long term nature by generating technological and institutional mechanisms for 'drought mitigation and prevention'.

The GOI report on 'The Drought of 1987: Response and Management' did claim extraordinary achievements in "saving life from the threat of widespread starvation during such a natural calamity" and providing not just "access to food to the affected people but also maintaining their quality of life" (Ministry of Agriculture, GOI, 1989). The reality however, was far from these claims. Not only the relief provided during 1987 was late but also insufficient. It did nothing to prevent long term trends for degradation of natural resources or impoverishing the human resources. There is no guarantee that next drought would cause any less injury or hurt to the pride of people in these regions who have unfortunately learnt to live on doles in the bad years. The aim of the new policy to meet "the food and nutritional needs of all sections of the people keeping in view their normal energy requirements, supply of drinking water, provide adequate health care and fodder for the cattle (1989: 9)" even if achievable is not an ethically sufficient goal. Why should just the physical survival be a major goal? What happens to the families of the people who have to migrate year after year in search of work? The literacy rates in one of the central Indian drought prone districts had changed from 5 per cent to 7 per cent over the last decades. Where from our domestic servants and low paid workers-men, women and children- come? Have some people in our society been destined to serve other sections? Does the degradation of natural and social structure in backward high risk environments not have any bearing on the long term sustainability of present life styles and opportunity matrix in other regions?

Why have structural issues of these kind been consistently ignored in the public policy. Why should the public policy for drought prone regions aim at just the survival of people and cattle? Is that the aim which we would cherish for rest of the society and our own communities? Are drought prone regions only the receptacle for relief, doles and charity? Do not these regions like the other backward hill and forest regions contain germ plasm or genetic diversity which is likely to prove most crucial for survival in future. Do these regions deserve support for maintaining diverse designs, crafts, cultural core of our society and mineral and livestock resources necessary for development elsewhere. Why should the pricing mechanism value the resources of people inhabiting these regions so low? And finally why should the development of technologies aimed at conserving and adding value to natural resources receive such poor response from the scientific community?

I do not aim at providing answers to all these questions in this paper. I do hope that the issues raised in this paper would trigger debates in various disciplines of science particularly the engineering sciences.

Part I

Conceptual Framework:

How does an ecological stress generate difference survival prospects for people having varying access to factor and product markets³ over a period of time. How is that some people accumulate surplus and others stagnate⁴, surrender and subjugate their free will to those who find this as an opportunity for accumulation. During the drought of 1987, large number of people disposed of livestock and other assets at throw away prices. In the process their savings in the form of livestock wealth were liquidated without any policy intervention to recoup this loss.

Minhas Committee has suggested way back in 1973 that restoration of ecological balance should be the primary purpose of drought prone development programmes. It was recognised that in many of these regions evidence of thick vegetation and wild life suitable for such a niche existed. However, numerous studies have shown that the public interventions for restoration of ecological balance never really took off notwithstanding the constitution of technology mission on so called waste land development. The decline in the support for Drought Prone area Programme (DPAP) only confirms the trend. The drought of 1987 showed that many areas which had never received drought in past were also becoming vulnerable to this stress in recent times. Inability to develop institutional mechanisms for soil and water conservation on sustainable basis and judicious use of natural resources has meant expenditure on drought relief increasing year after year.

Socio-ecological characteristics of drought prone regions: The population density is low, average size of land holding is large, the proportion of households headed or managed by women is high due to male emigration, due to recurrent droughts the household economy of majority of the small and marginal farmers and agricultural labourers is in chronic deficit leading to shortening of their time frame and economic activities are predominantly dependent upon livestock, trees, craft activities and to a limited extent agriculture. The majority of the households are mobile for part or full year though most of the developmental organisations are sedentary that is having fixed address. The market forces are weak and so are the public institutions such as banking, public distribution system (PDS) and transport.

The political articulation is quite weak as evident from the analysis of the debates in the parliament and state assemblies. By and large the policies demanded are not very different. More relief is an inevitable demand in drought after drought. The self-help potential of the people has been considerably impaired with the result that most of the additional soil and water conservation measures have come under strain. Even for desiltation of tanks

3. Anil K Gupta 1986, Drought and Deprivation: Socio Ecology of Stress, Survival and Surrender, Paper presented at the Seminar on Control of Drought, Desertification and Famine, India International Centre, New Delhi, May 17-18, 1986.

4. P. Spitz, 1980, Drought and Self Provisioning, UNRISD, Geneva.

and deepening of drinking water wells people depend upon the government aid. The budgetary position of most western Indian states being extremely weak (except Gujarat and Maharashtra) the public investment for long term natural resources management is nearly absent. The ground water table is declining and soil erosion is assuming alarming proportions.

The technological basis of traditional farming systems is poorly understood by the formal Research and Development system. The agricultural scientists try to emulate green revolution model implying developing technologies which can diffuse widely. The experience has obviously been very disappointing. Ecological variability at a short distance makes development of such technologies impossible. Development of location specific technologies requires tremendous investments in the facilities for dispersed on station and on-farm research. The technological gap even with existing technologies developed by ICAR or CSIR scientists is very large because of inappropriately designed extension system. No differentiation in designing technology transfer system is made between high population density, low risk regions vis-a-vis the low population density and high risk regions. The extension system for livestock, non farm and industrial technologies is almost non existent.

The scientific research agenda even for such regions is not adequately oriented towards the problems of disadvantaged groups in drought prone regions. The inter disciplinary research though much acclaimed is very rare. It is well known that the intersection of different discipline generates opportunities for emergence of new concepts. Any discipline has its own limits which cannot be transcended by using the assumptions of the same discipline. The Godel's theorem of logic suggests that science is possible only within a larger framework of non scientific issues and concerns⁵. It is this context of science with which we are concerned in this paper.

Socio-ecological paradigm⁶

The precise relationships between the eco specific nature of stress and survival mechanisms evolved by different social classes through simultaneous operations in factor and product market are explored in this framework.

The human ecological school (Park & Burgess 1921 and Hawley 1950, Minar & Teune 1978) has tried to link what are called POET variables i.e. population, organizations, environment and technology. However, the major limitation of this framework is that every thing is related to every thing else. Further, the causal and temporal sequence of relationships is not specified. The result is that hypotheses derived from it are not easily testable. Detailed evidence in support of Socio-Ecological framework which does not suffer from above limitations has been presented elsewhere (Gupta, 1981a, 1984a, 1984b, 1984d, 1986a).

5. Weiskopf V.F., 1984, Frontiers and Limits of Science, *Daedalus*, June, pp.177-198.

6. Anil K. Gupta, 1985, Socio-ecological paradigm for analysing problems of poor in dry regions. An Indian contribution, *Ecodevelopment News* No.3233, March-June 1985, pp.68-74.

Anil K. Gupta, 1984, Small Farmer Household Economy in Semi-Arid Region, Centre For Management in Agriculture, Indian Institute of Management, Ahmedabad.

The main assumptions of the socio-ecological framework are: Ecological conditions define the mix or portfolio of enterprises which can be sustained in a given spatial context or a watershed. The scale on which different social classes maintain these enterprises, however, is a function of their respective access to factor markets (land, labour, capital, technology and information) and product markets (different crop and livestock species and varieties); kinship networks and extended family system; public, private, and communal risk mitigation or adjustment strategies that have historically evolved, etc. The mean return-variance characteristics of the portfolio of enterprises influence the risk perception and response patterns of different classes.

The mix of enterprises i.e. portfolio of economic activities like livestock rearing, cropping, raising tree species, crafts, etc. varies within a narrow range in an ecological context of a local watershed area. Which crops can, for instance be grown in a region is largely defined by the edaphic (soil related) and climatic variables. However, who will grow which crop or maintain which livestock species more is not a function of ecology, but of access to factor and product markets and of kinship networks. Historically the poorer ethnic and socio-economic classes have come to own more of browsers, that is sheep and goat, while the better endowed groups have cattle, buffaloes etc. The social exchange relations that evolve around these enterprises are also quite specific to the biological needs of these enterprises on one hand and the constraints imposed by the evolution of market forces on the other hand.

The way to test these hypotheses is to study the access that groups with different asset portfolios have to product and factor markets and extensive kinships. The return-variance matrix can be used to classify a large range of the resulting portfolios. Thus we can have high return - high variance, high return - low variance, low return - high variance and low return - low variance types of portfolios. These portfolios will have distinctive implications for future investment options of different classes of households. The access to various risk adjustment (RA) options will influence the perception and response to risks. These options could exist at the level of the household, and also common property or communal or public institutions such as drought relief or public works programmes. The household options can further be divided into intra and inter household ones. The intra-household options imply reduced or modified consumption, migration, asset disposal etc. The inter-household options are entry into credit, labour, tenancy contracts, etc. Some options in different combinations of returns and risk are shown in Exhibit 1.

Exhibit - 1
Mean Return

	Low	High
Low	Local varieties of millets, cattle, long gestation multi-purpose tree species etc.	Mexican varieties of wheat, well adapted small scale vegetable cultivation.
Variance		
High	Pulses, oilseed crops, sheep herd etc.	Crossbred cattle, hybrid varieties of millets, cotton, other cash crops etc.

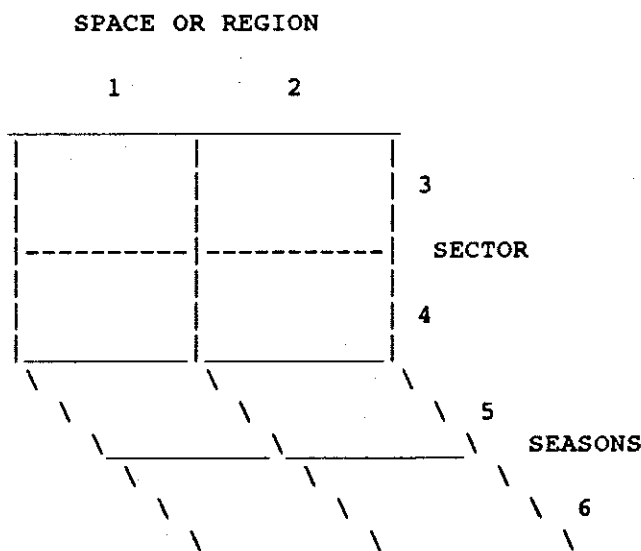
The consequence of differential risk perception and response could be a deficit, subsistence, or surplus household budget. This in turn would influence the ecological conditions through the aggregation of household choices.

The options in designing public organizations to match these household survival systems can then be systematically pursued. Since ecological characteristics vary a great deal even between short distances in semi-arid and arid regions, the task of designing public systems becomes all the more complex. Sedentary organizations to serve mobile people cannot be very useful to them. Likewise organizations which use a short time perspective for assessing the demands of clients in a risky environment may end up supporting only those portfolios of activities which may pay off in such a time frame. We should not be surprised if such portfolios are the ones chosen by better endowed people having high return - high variance or low variance portfolios. The poor with limited capacity to absorb risks due to low mean-high variance portfolios have needs which market responding organizations simply do not register. The time frame and the discount rate which different household classes use while appraising investment choices in different resource markets are thus a function of various variables and processes described in the S-E Paradigm. The managers of public developmental organizations, by adopting the same time frame regardless of household classes, sectors, or markets make a fundamental error in defining client needs.

Those households that have low return - high variance type of asset portfolio accumulate deficits in their household budgets. The deficit induced indebtedness generates dependencies in exchange relations which limit the "freedom to choose" (Friedman and Friedman, 1980) who are dependent. At the same time the choices of the dominating social partners are widened in the same proportion. The ability of a majority of marginal producers in risky ecologies to articulate their demand for various products and services is also constrained by the psychological environment of deprivation (D. Sinha, 1982). The biotic variables thus directly shape the options of different social classes. Ecological conditions and human settlement systems are also quite correlated. The result is that transportation costs to cover the same number of clients vary between

differentially populated regions. The negative incentives for private organizations to service such dispersed, small, and erratic demands can well be imagined. Some argue that voluntary organizations could meet such needs. However, not many voluntary organizations may evolve in risky ecological contexts. The public delivery systems are obviously obliged to serve different classes in such regions on a uniform basis. However, the paradox is that the designs of such organizations, suitable for low risk - high return, high population density regions, are often chosen (on grounds of familiarity and so called proven success) to deliver resources in contrasting ecological contexts. The result is a mismatch between national goals of achieving an egalitarian social structure and organizational strategies of achieving short term viability by catering to only viable clients in relatively affluent regions. Thus, cross-subsidization will have to be an essential attribute of any viable developmental organization strategy.

The diagram below can help the designers of public developmental organization to identify various niches in the client environment:



Each dimension can be dichotomized for ideal typing purposes. For instance, "space" can be dichotomized in terms of population density, or low lands and high lands, or undulated and plain topography, etc. "Sector" can be dichotomized as agriculture or industry; public or private; specialized or diversified; single crop or diversified crop region; cash crop or food crop dominated asset portfolio, etc. "Season" can be dichotomized into unimodal or bi-modal rainfall regions, arid or humid, low rainfall or high rainfall, low seasonality or high seasonality region, etc.

Given any two dimensions, the third can be anticipated. In regions with low rainfall or high seasonality with low population density, one can anticipate the absence of private organizations, a specialization based economy, and single or specialized crop conditions. The diversification of the household portfolio in risky conditions over time i.e. (over seasons), space (through migration, pastoralism, etc.) and sectors (crop mixtures as against single crop, crop-livestock-craft interlinkages as against either as a dominant

enterprise) can thus be understood.

Social stratification and the consequent process of the conversion of household needs into demands can also be derived from the above scenario. Given a low level of surplus generation, credit markets may not be as competitive as in surplus regions. The high rates of interest and interlinked factor-product markets may result in continuous impoverishment, generating a highly non-egalitarian and dependency based social structure.

Two features of social structure can be anticipated: (i) Individual households may have strong informal pooling mechanisms (of resources, information and trust) reinforced by caste as well as kinship; (ii) The articulation of market demand may be very low due to the lack of purchasing power and the small scale of aggregate demand of those who have a surplus for market even in such regions. Thus, in regions where private market forces are strong today due to historical factors, favourable ecological conditions, public investments in irrigation, transport and other services, public management of resource delivery may not be warranted. The state may merely perform the role of regulation and reinforcement of social accountability of private and voluntary organizations. In regions where private market forces are weak, and demand and supply of different resources do not clear at reasonable prices due to various imperfections in the mobility of factors and dispersal of information, public organizations have an important role to play.

There are two implications of above discussion for design of public policy and developmental organizations:

(i) Given ecological endowments and the state of agricultural technology, the evolution of market forces triggered by the demand generation process is quite eco-specific. In low risk ecological niches, historical accumulation of capital enables articulation of demands which can be responded by market forces quickly and perhaps even efficiently. Given political propensities to show results in short time frames, public organizations reinforce the preferences of market forces rather than counter-balance them (Ali, 1977). The well-off, "concentrated" segments of society having high level of development "are coherent, consolidated, and inter dependent; they concentrate functions and power, and they control and concentrate resources"; "dispersed" segments on the other hand, "are geographically dispersed, but they are also loosely connected, easily fragmented, sectionalised, mutually independent, performing few functions and powers and lacking control of resources" (Gerlach and Palmer, 1981: 355). Greater precision in defining the client environment of developmental organizations should lead to better servicing of dispersed segments.

(ii) The distribution of resources over time, space and sectors in the rural environment is not random in nature. Studies by the author in several South Asian countries (Gupta 1984a, b; 1985, 1986) indicate systematic interactions between space, season, sectors and stratification in society. There is thus a great need to include ecological variables in a theory of organizations. We deal with the conceptualization of the socio-ecological environment in the next section so that implications for organizational design can be drawn.

Development in an essentially agrarian society of mostly poor peasants and landless labourers with chronic deficits in their household budgets (Gupta, 1981(b)) is essentially a process of lengthening the time frame of their investment decisions. The extension of this time frame is a necessary condition for ameliorating poverty. The provision of organizational support to help the poor perceive and facilitate viable long term choices may be a sufficient condition for the purpose. This requires public delivery organizations to play a market creating role as much as a resources dispensing role. It requires effort on their part to strengthen the capacity of the poor to make demands on these organizations. Despite the inequalities in the existing income and asset distribution and their social and political implications, autonomous public delivery organizations can play a significant role in converting the 'needs' of poor people into 'demands'.

Part Two: Science Policy for Drought Mitigation :

The science policy is based on a belief that the scientists if allowed to pursue their own research goals without any interference or restraint, would develop technologies of wider social significance. However, in our country while we take pride in the number of scientists we can not have the same satisfaction when it comes to quality and relevance.

The clients or users of research can influence the agenda of research directly by submitting their problems to the scientists concerned or indirectly by writing, petitioning or influencing through market forces. Scientists also seek feedback through formal and informal channels. However, the extent to which the research agenda gets organically linked with the expectations and needs of the people depends upon the translation or interaction arrangements. By translation I mean the conversion of a problem of survival into an experimental problem or project. The nature and the platform of interaction also may influence the type of questions which are posed to the scientists. I strongly disagree with those (Chambers, 1982) who believe that people can demand what they need in all cases. Our ability to demand depends upon our prior experience of such demands having been fulfilled by the supply side for us or others. If we have not ever imagined a technological possibility how would we demand it. The role of scientists thus lies in broadening the horizon of thinking and generating demand from the disadvantaged people on them. I recognise that not all scientific endeavours can be utility oriented. It is understandable that certain questions of fundamental nature have to be pursued just to understand the mysteries of nature or seek patterns in its operations.

The match between curiosity and application oriented technologies has to be arrived at through informed debates by any scientific group. I am mentioning below some questions which to my mind have remained less well understood or analysed despite considerable research thrust so far. While I will refer to some of the technical problems my major emphasis is on the organisational and management aspects of research for high risk environment.

Agenda for research:

a) Natural Resource Management in dry regions: There are several institutions pursuing research on soil and water conservation, agro forestry, livestock management and other aspects of farming systems for dry regions. Most of the scientists are competent and committed. However, certain conceptual inadequa-

cies persist partly because of the way research is organised.

In agriculture research most of the experiments on crops are evaluated on the basis of only grain yield despite knowing that majority of the households manage their livelihoods through livestock related activities. It is not that scientists are unaware of the importance of harvest index as a measure of grain to straw ratio. However, lack of institutional linkages between livestock and crop research streams generate such gaps. The result is that scientists complain about farmers' irrationality when crop technologies do not diffuse because of negative or inadequate positive linkages with the livestock system. Likewise I can give several other examples of similar mismatch between the farmers' needs and the scientists research objectives (Gupta, 1989, 1987, Gupta, Patel and Shah, 1985).

Research on funding out the effect of stress fodders on long term productivity and reproductive efficiency of the livestock in drought and post drought years has not progressed much. During the last drought despite the fact that millions of cattle and their owners were in the cattle camps, no efforts was made to learn from the pastoralists about their knowledge base or to transmit available technological options for conserving range and livestock resources in the specific context of the villages from where they had come. ICAR indeed set up a committee in response to our appeal to look in to the availability of good breeding bulls in the camps and management of nutrition during the drought. Much follow-up action is yet to take place.

While lot of research has been done on watershed management the linkage between soil and water conservation and grazing land and other common property management have remained weak. The institutional aspects of natural resource management are unfortunately not being pursued. How people manage the distribution of conserved resources determines whether those who benefit less directly will continue to supply restraints in use of fragile resources. There are any number of examples where good projects have foundered after the withdrawal of the scientists or project authorities. Research on institution building is yet to occupy centre stage in biological or physical research institutions. To expect such research to be done by the social science institutions is also not reasonable. Because even in social sciences this issue has not received much attention.

Considerable work has been done on the development of technologies which are targetted at the individuals. On the other hand most of the sustainable technologies whether for plant protection, soil and water conservation, or indigenous seed production etc., require group action. The technological and institutional issues need simultaneous attention.

b) Agro-mechanical technology: Studies have shown that many indigenous innovation may independently evolve at different places at same time (Basant, 1990). Formal research, hand tools as well as bullock drawn implements has been very weak. Recently we organised two workshops of innovative artisans in Gujarat and Karnataka to understand the process of innovation and its adaptation in to commercial products. A carpenter in Gujarat workshop asked a question as to whether anybody could make a square hole in a wood column of more than nine inches. Nobody could answer this question. Apparently this was a frontier level problem which did not receive the attention of engineers who believed that the illiterate carpenters had hardly anything to teach or to ask at a fundamental level. In Karnataka workshop an artisan had developed a seed

drill which combined manual and mechanical operations. Another artisan had devised a way of recycling the waste spring iron of the heavy automobiles to develop plough shears for used wooden plough. In both the cases the agricultural scientists acknowledged the intellectual genius of the concerned artisans.

The scientists acknowledged the limitations of the formal approach to resolve problems of developing appropriate tools for dry regions. There has been a feeling that engineers have given much more attention to development of technologies for transferring energy from small gears to large gears. The traditional technologies in contrast required the opposite as in case of chaff cutter, prussian wheel, air blower for blacksmiths furnace etc. (Ajay Kumar, 1984). The studies on mechanisation have ignored the problem of agro-forestry system in dry regions. The use of tractors in such regions makes it almost impossible to by-pass the spontaneously sprouted seedlings of the trees. The parallel streams of research on mechanisation and agro forestry may continue without realising the contradictions at the users level.

c) Livestock: The research on small ruminants has been much weaker compared to the research on large ruminants. We know very little about the impact of herds having different compositions of species on the rangelands. Here again the national research institutes responsible for developing grasslands ignore the common property/open access nature of the property rights. The knowledge of indigenous veterinary medicine exists with the pastoralists but not so much with the scientists.

d) Farming systems research: The methodologies of on-farm research developed at international centres of agricultural research have proved inadequate in the context of rainfed environments (Gupta, 1986, 1987). Even though it is admitted that location specific technologies have to be developed, the system of environmental characterisation remains geared to only formal data base on climatic and edaphic variables. At long last international institutions like ICRISAT are recognising the scientific validity of indigenous soil classification in semi-arid tropical India. The farmers soil categories were found to be very distinct and organised non-hierarchically on multiple criteria. The indigenous system was found to provide better basis for indexing variation in the plot quality than the model system. The laboratory analysis of the soil sample worth found to be generally supportive of the farmers classification (Devorak, 1988). Our own studies on soil fertility index and plotwise varietal maps have shown that farmers can identify distinct niches in rainfed regions. Location of trials in these niches to compete with the local best might provide rich insights about the farmers criteria about choice of technology and definition of niches. K.M. Munshi, (1952) had exhorted Indian scientists to study 'the Gospel of Dirty Hand' but without much success.

The non-scientific context of science:

Why is it that a discipline ignores a particular line of enquiry almost totally. One possible explanation could be that the professional peers don't give. Singh had faced this dilemma way back in sixties when he guided probably the first two M.Sc. thesis on indigenous knowledge of the animal husbandry people at then Punjab Agricultural University. The examiner of these theses in discipline of agricultural extension felt that the students had gone beyond the boundary of discipline. The extension should include studies which look in to the problems of extending knowledge from the research labs to the

fields. The students had in this case had done the opposite. They had looked at the problem of bringing peoples' knowledge from outside in to the university.

Buseh and Licy (1984) showed that in the germ plasm bank of Sorghum at ICRAF-SAT, Hyderabad, no information was included on the storability, food quality, cropping practices etc., in the varietal descriptors. Those who have seen the quality of sorghum distributed under Employment Guarantee Scheme (EGS) in Maharashtra can immediately recognise the implications of ignoring certain crucial parameters in the technology development. The hybrid sorghum has short table life and thus quality goes down after storing the grains for more than six months.

Recent interest in the indigenous knowledge about local herbs in dry regions has meant danger of extinction of certain herbs due to excessive extraction. The ethical, scientific and value aspects of such reduction in bio diversity are not on the agenda of ethno botanists or other scientists.

Dr. Swaminathan had pointed out long time ago that India has had an efficient famine code but we had failed to develop a 'good weather code'. The bureaucracy is quite efficient in averting a disaster. But it has proved inadequate in utilising opportunities for technological or institutional innovations. The idea was that in good rainfall years there should be a systematic protocol for each region of the country to utilise opportunity for good agricultural production. Contingency cropping practices have indeed been developed on limited scale in some of the southern states. The idea on the whole was never given due attention.

Dr. Krishnamurthy, former Coordinator of All India Coordinated Research Project, Hyderabad had developed the concept of 'the tiers of technology' to emphasise the point that farmers did not adopt all the components of a package of technology in dry regions. They recombined various components according to their needs and endowments. The package approach continued to hold sway over the scientists till recently when even the international centres started expressing doubts about this approach.

There are many other examples where an insightful research direction for reducing risks in dry regions was missed by the scientists. The organisation of research leaves little scope under the present dispensation for long term research programmes to be established. There are very few experiments which have continued for more than 30 to 40 years. It is a moot question as to whether sustainable technologies for high risk environments can ever be developed without a longitudinal research.

The annual conference of livestock scientists may not have any crop scientists and vice versa. How do we expect the missing links to be established.

We look at the problems in adapting public policy for high risk environments in the next part. The scientific knowledge can be generated or disseminated only if supportive public policies and organisation structures exists.

Part Three: Public Policy for Managing Risk & Uncertainty

Under crisis, such as a drought or flood, bureaucracies are known to rise to the occasion and provide succour to the affected people within the parameters drawn by the policy makers. The bureaucracies regain quickly their original inertia once the crisis is over (Mathur and Bhattacharya, 1975, Mathur and Gupta, 1984). Whether a problem is defined as a crisis or not depends upon what is considered 'normal'. In a seminal contribution which has not attracted attention it deserved, Prof. Mathur argued that change in the role of bureaucracy after independence was aimed not in the structure of public administration but the attitudes, behaviour and achievement orientation of civil servants (Mathur, 1972:2).

If the definition of what is normal or not-so-normal in terms of eco-development becomes a function of behavioural styles of the administrators, I am doubtful if we will ever be able to unravel the politics inherent in what Sen called 'Description as a Choice' (Sen, 1980; Gupta, 1985c). Thus, widespread malnutrition or vulnerability to occupational hazards in mining or quarrying activities or large scale disposal of assets to cope with drought or flood damage may be considered 'normal'. The report by Government of India on Drought of 1987 does not even once discuss the policy framework for arresting the income transfer from poor to rich in drought years.

How do we conceptualise the way public administrators treat a phenomena as 'normal' or 'abnormal'. If defined as 'abnormal', the issue arises whether the event is just worthy of some extra attention or calls for reformulating the whole strategy?. Whether it is a crisis or catastrophe? Can it be anticipated in terms of location, timing, intensity and consequences for different social classes?

Answers to these question will depend upon how administrators deal with risky and uncertain events. The risk is defined as a situation when probability of an event can be anticipated. The uncertainty is when chances of an event can not be anticipated.

How does one learn to cope with such events. Whether the coping strategies suitable for risky events work for uncertain one too? Whether individual learning leads linearly to organizational learning (Gupta, 1984).

Public administrators would want to perceive the problem of 'uncertainty' as a 'risky' problem when they want to exercise strong control. On the other hand, they will do the opposite when they wish to reduce the zone of their responsibility.

The public policy cannot be considered analogous to the growth of scientific knowledge (Wittrock, 1977). By implication the learning could be planned to be low just in order to justify the poor or weak assumptions behind public policies. This is the oft repeated defense of public administrator in the event of being confronted with evidence which he/she could have used but did not.

The 'learning by doing' could be preferred over an informed and analysis based solution of social problem (Lindblom and Cohen, 1979 in Wittrock, 1977). However, the counter view is that learning by doing could be preferred if the cost of the error was not very high and also if the 'risk makers' of the public

policy were not the same as 'risk takers' of the potential error or disaster. Further,

it makes supreme sense to argue for trial and error, and sometimes it may be legitimate to deride risk-aversion in policy planning which talks about trial but does not allow for error. However muddling through by way of 'interaction' may sometimes be just a euphemism for error without trial; if you do not have any idea of what you are doing, there is all error and no trial and therefore no learning (Wittrock, 1987:23).

The cost of not paying heed to the warning issued about the possibility of disaster in Union Carbide Plant at Bhopal was not paid by the administrators and the politicians who believed in 'learning by doing'. One wonders whether appropriate lessons were even learnt after the disaster (Gupta, 1984 a).

The report of CSE (1982, 1985), Lokayan Bulletin (1985), Gupta (1981, 1985c, 1988d) records several experiences of persistent refusal to learn by the public administration in government as well as science and technology institutions in case of soil conservation, irrigation management, dams and most importantly the Bhopal disaster.

We analyze response of public policy to environmental uncertainties taking the case of drought. Numerous studies have been done on short and long term impact of drought on social systems (Jodha, 1975, 1978, 1983, Rustamji, 1979, Bhatia, 1988, Gupta, 1980a, b, 1981, 1982 a,b,c,d, 1983 b,c, 1984 a,c,d, e,f,g,h, 1985 a,b,c; Mathur & Gupta, 1984, 1988). There are few studies which have tried to look at the way households adjust with the risks vis-a-vis the organizational adjustment with risks (Gupta, 1984d, 1986 a,b,c, 1987 a,b,c 1989).

I will discuss first the report of National Commission on Development of Backward Areas (NCDBA, Planning Commission, 1981) and contrast the perceptions in the report with a recent report on 'Drought of 1987: Response and Management' brought out by the Department of Agriculture and Cooperation, Government of India.

The NCDBA report reviews the organization of Administrative and Financial Structure for backward areas development (1980) and notes several important limitations of the existing set up. The gap between intention and implementation is found to be particularly high in backward areas. The recommendations to overcome the limitations are : use of Project Approach; merger of all programmes under District Monitoring and Coordination Cell, and appointment of Director General for Development of Backward Areas at Central level. Among the issues affecting personnel policy the report notes: elements of punishments to be replaced by compensation; large scale vacancies to be avoided; the selection should be institutionalized at all level; first posting on promotion should be in backward areas; enhanced travelling allowance should be provided; special leave for research and study in academic settings; facilities for educational and medical needs; the posting orders in these regions should not be cancelled unless there is an exception.

Regarding approach to planning the report puts considerable reliance on the internal administrative expertise instead of relying on academic experts. The involvement of NGOs is considered necessary but any attempt to form federations at district or higher level are sought to be avoided. These federations, it is feared, may 'politicise' the development process.

The report also observes that routing of grant-in-aid through the political system at local level can lead to lack of any strict accountability in using funds. Often the criteria for disbursement of funds were provided but seldom were these implemented. Following the line of least resistance the administrators provided limited funds uniformly to everybody.

Now contrast these recommendations and the perception of problems with the experience of Jawahar Rojgar Yojana - a nation wide public employment programme with uniform criteria, and allocations in many cases being higher for more developed regions. It has been ignored that need for employment can not be similar in regions with varying level of growth and wage rates.

NCDBA report (1980:25) had noted that the exact conditions in backward areas were neither uniform nor fully known. A similar feeling of inadequacy of uniform policies has been expressed in the annual report of National Bank for Agricultural and Rural Development (1987-1988). And yet public policies have tended to become more and more standardized over the years. Worse, the report on Drought '87 does not draw upon the earlier reports like that of NCDBA(1981); debates in the parliament on the subject and recommendations of various finance commissions.

It also is true that many of the recommendations of NCDBA were based on an inadequate understanding of the situation. For instance it was recognized that these regions were used as punishment postings and that many positions remained vacant however, the suggestions were half-hearted. Undoubtedly the compensation might help but it would not correct the distortions that arise because of the monitoring and performance appraisal system. As long as the parameters on which bureaucracy was monitored were as crude as the 'exhaustion of budget', no amount of professional incentives would be able to correct the demotivation stemming from unachieved 'targets'.

The cost of delivery of goods and services in low population density regions was inherently high. The financial and budgetary allocations on per capita basis intensify regional imbalances (Gupta, 1983a, 1985c, 1987d,e). The delivery system in these regions is expected to perform more efficiently because the markets are weak and the uncertain rainfall necessitated greater degree of preparedness and resourcefulness on the part of farmer and administrators. The practice was just the opposite.

The uniformity of allocative criteria is one of the most fundamental ironies of equity (Schaffer, 1982, Gupta, 1985c). Comparing non-comparable can lead to one of the most unfair administrative practices. Stationary organizations for mobile populations are another example of mismatch between what people want and what they get (Gupta 1981a, 1984e, 1985a). It is well known that market forces coordinate the choices of consumers having surplus in their own interest. If administrative coordination did not exist in developed regions, the market forces would organize it through demand system (Gupta 1985c, 1987d, 1989). After all the various associations of Industrial Houses are heard before finalising the budget proposals every year. In the same way many other forms of networking between capital and administration exists. It is in high risk ecological regions that the need for administrative coordination is particularly more (Gupta, Parashar and Sanwal, 1988; Rao, 1984). The field officers often feel that these regions are not on the travel itinerary of the top administrative leaders. In the process the reverse 'Hawthorne' effect is

witnessed. The lack of attention gives a signal that development in these regions is not important.

The NCDBA report as also the recent report on Drought (1987) have ignored that the proportion of women headed households was highest in drought prone regions or hill areas because of male emigration (Gupta 1985 a, b, c, 1987). What type of administrative systems would match such social ecological realities has not been looked into?

The norms of locating bank branches are uniform for all the regions. For instance 17,000 people were supposed to be served per branch of commercial branch in the regions with population density varying say, from 1500 persons per square kilometers to 35 persons per square kilometer. One does not have to imagine the problem of physical access and institutional access faced by the people as a result of this policy (Gupta 1981, 1984c, 1989a).

Highly diversified households in such regions would require highly diversified administrative repertoire (Gupta 1981, 1985, 1989b). To what extent has the Government of India document on Drought 1987 (1989) reflected the lessons learnt so far is discussed next. Whether the variability in administrative approaches has matched the expectations of people will also be looked into.

It is claimed that every major drought contributed towards bringing about "Qualitative changes with regard to drought management policy" (GOI, 1989: 9). The Public Distribution System was strengthened after the droughts of 1965-66. Massive employment problems were organised after the droughts of 1972. The drought of 1979-80, "underlined the need for taking (sic) durable and productive assets to enable the people of the affected area to withstand future droughts better" (1989:9). The relief manuals were supposed to include the latest approach to Drought Management. It is worthwhile to note that the focus of the strategy to deal with the drought of 1987 was on

the need for providing access to food to the affected people, but also to maintaining their quality of life. It is no more a question of saving life from the threat of widespread starvation during such a natural calamity. The central theme of relief today is to meet the food and nutritional needs of all sections of the people keeping in view their normal energy requirements, supply of drinking water, providing adequate health care and fodder for the cattle" (1989:9).

It is against this claim that the research on survival systems should be examined to look at the efficacy of public measures.

A study on "Small Farmer Household Economy In Semi-Arid Regions: A Social Ecological Perspective on Risk Adjustment" (Gupta, 1984) had looked into the drought and the post drought recovery of the losses by the concerned households during 1979-1982. Earlier, Jodha (1975) had looked at similar changes during and after the drought of 1967. These are the only two studies to our knowledge which have looked at the drought loss-replenishment process.

One of the major findings of the study by Gupta was that the importance and sequence of asset disposal in the risk adjustment repertoire of households had undergone basic change in the last few droughts. Livestock disposals remained an important means of risk adjustment as also the income transfer. Accordingly, a warning of the continued loss of livestock assets was issued in January 1988 so that the Government could find ways of preventing (a) liquidation of

the savings of the pastoralists still available and (b) increase in the surplus generating potential of richer pastoralists and cultivators (Gupta and Kumar 1988). Much of the damage had been done by January 1988. However, all was not lost. The policies of Government of India did not include then or later any measure to arrest such immiserization. Discussions were held with most of the concerned officials at senior level.

The fact that drought did not affect all the classes equally has been known to the planners for quite a long time. But, the persistent bias towards preventing absolute and visible misery but ignoring the short and long term ecological and economic losses for the poor continued. Several suggestions were made based on earlier research referred above. For instance it was recommended that the policy for drought management should discriminate among those who had deficit in their budget, who could just subsist and those who had surplus in their budget. It was suggested that people who had lost their assets may become muted and not raise their voice in any political institutions. Suggestions were made regarding (a) scheme for calf rearing and support price for calf buy back scheme, (b) since the proportion of infant bovine was far higher in dry regions compared to the rest one had to devise suitable fodder concentrate combinations and prevent distress disposal of good quality calves, (c) a large number of measures were suggested which were necessary in case the rains were good in the coming season, (d) in view of the special skills of women particularly in non-farm activities the drought relief should include organisations of production and marketing of these goods, (e) the interest subsidy would need to be given to those who could not pay their debts to the Banks in addition to rescheduling and rehabilitating finance, (g) cattle camps to be used for mass vaccination and popularisation of improved livestock and range management technologies, (i) the implications of stress fodder, fuel and food needed to be shared with the people along with the remedial measures to be taken in the post drought period to overcome the adverse effect, also see, Mahar Homji, 1988, (j) the beneficiaries of the relief programme should be made conscious of their responsibility towards less fortunate pastoralists, (k) mobilisation of science and technology institutions for improving drought proofing mechanisms, (l) documentation of indigenous knowledge for survival, (also see, Gupta 1988b,c, 1989b), (m) restriction of PDS only for the affected regions so that rest of the society could pay higher prices and save public resources which would have been necessary if everybody was to be subsidised.

Despite the fact that relief Commissioner and relevant secretaries to the Government were contacted nothing much happened. So much for the claims for improving or maintaining the 'quality of the life' of the affected peoples. Despite widening budget deficit and increasing balance of payment problem Government maintained that, "the central theme of relief today is to meet the food and nutritional needs of all sections of the people" (GOI 1989:9). Government has to recognise that just the way everybody was not equally affected by the drought, everybody did not need to be subsidised equally. This simple lesson has not been learned.

There are studies on Famine Foods (Bhandari 1974), stress fodders (Rangnekar, 1989) and Veterinary Medicines evolved by the people (Varma and Singh 1969) which deserved to be drawn upon while drawing the public policies for drought affected regions.

Contrasting the Gujarat Government's perspective (Koshy, 1987) with that of voluntary organisations, Bhatia (1988) very perceptively records the misery that poor women and man had to bear during the drought of 1987. The labourers

to be hired for public works had to report at 8 O' clock in the morning and they were marked absent if they were slightly late. Those who did not have ration-cards suffered just as in case of Bhopal tragedy. If the ration-cards would not be available with the poor did it require a great imagination or administrative acumen to anticipate who would suffer under such guidelines. There was no way by which a person who was sick could be substituted by another family member. There were many other anomalies which were documented by Bhatia and others.

Sanjeev Shah(1987) made a very imaginative film on drought of 1987 entitled 'The Famine, 1987' which recorded among other things the instances of abandoned cattle in the camps being sold for Rs.50 each. The amount of income transfer could be imagined by the fact that cost of a dead animal is around Rs.400 including the cost of carcass and hides.

Rao (1989) refers to example from Maharashtra where drought, deprivation, caste, class and gender got related. She raises a very provocative issue about the possibility that, "activism on part of the women, especially without the involvement of men, threatens to divest them of their identity as women". Ecological crisis such as droughts she felt not only provided the pretext and the context for struggles of women for defining their identities but were intimately related with them. She hoped, "scarcity of ecological resources have the potential of both encouraging as well as hampering movements of women for access to production conditions and for self-definition". I believe that emphasising gender conflicts too much among the poor could be a sign of false contradiction. In a study on "Impoverishment in Drought Prone Regions" we observed that the poor women were often more articulated than the men in the dry villages. There were certain economic exchanges where she had greater control understandably because of their greater involvement ,for example in the case of collection and marketing of grass/weeds.

All these examples bring out the need for analysing the reasons for non-utilisation of research by the policy makers. The cost borne by the society has to be worked out. I also suggest that researchers should venture into being 'marginalised ' if that is the price for speaking out (Gupta 1985, also see, Murishwar and Fernandes, 1988).

The management of risky situations makes policy makers vulnerable on account of the possibility that their judgment either way may be questioned. One way to avoid, such dilemma is to provide equal attention to everybody. Other way is to convert risk into uncertainty and thus express helplessness. Still another way is to anticipate and define the problem in such a manner that success can be ensured. Thus, lack of human deaths is an achievement of drought of 1987. The disposal of assets, malnutrition induced sickness in animals and human beings, non-sustainable harvesting of trees and other biomass and indebtedness induced dependency and deprivation are not the issues which are relevant and thus no accountability need be exercised. It is this frame work of public administration which explains such a slow rate of policy reform. I may add that there were certain positive moves made by the Government during the drought. To illustrate the procurement price for green fodder was declared and enforced, close monitoring of distress was done to avoid problem of food, fodder, drinking water etc., in most of the villages. However, given the wastage and inefficiency of resource use and lack of adequate advance planning these positive features lose part of their significance.

Eco-Politics of Sustainable Development: Managing Eco-diversity

The response of the state to ecological diversity has been studied primarily in a spatial sense. There too, the space has been conceptualised as a constraint rather than as an opportunity. In a socio-ecological perspective the relation between space, season, sector and social systems is studied in such a manner that the ecological characteristics of the environment can be related to the design criteria used by resource delivery organisations (Gupta, 1985, 1989).

It is inevitable that the articulated demand for resources rather than administrative design should take precedence over other needs of the people. A separate study on The Political Articulation in Backward Regions (Mathur and Jayal 1989) has brought out that members of Parliament from drought prone districts of Western India simply demanded more resources rather than different designs of public policies and administrative structures.

If organisations were to take a short time perspective as is apparent from the reports of NCDBA and GOI on Drought '87, only those portfolios of activities may be supported which could payoff in short time frame. We should not be surprised if we noticed that the portfolios of the better endowed people with high variance-high return or low variance high return were selected.

The transition from the socio-ecological perspective to eco-political perspective requires incorporation of several other dimensions which we discuss next.

If the diversity in ecological endowments influences the type of occupations in which poor peoples are engaged in, then the nature of support the state provides to different markets dealing with each of the occupations would make a substantive difference to the survival of people. For instance, if poor people survived primarily through reliance on common property resources (Gupta 1984, Jodha, 1985, Kalla and Ananth Ram, 1988) and through non-farm activities, a weak response of policy makers and public administrators would reflect on the nature of the state. The changes in political perception of the needs of forest dwellers and artisans may have to be inferred by looking at not just the policy statements but also the organisational arrangements. The policies have to be interpreted by analysing the institutions (Clay and Schaffer 1984) that act as filters or conveyor belts. There is no point in drawing a false contradiction between policy and implementation or between regulatory and development administrations.

The articulation of ethnic and regional identities, I have shown elsewhere, may emerge from the administrative neglect of the underlying diversity. The permeability of institutions to the interest of such ethnic and regional groups depending upon natural resources has to be built into the political framework of society. Various ecological movements in developing and developed countries are slowly growing into political formations after finding the doors of existing political institutions closed or not sufficiently open. The other aspect of ecological diversity and weak market forces is to design organisational space where development does not become contingent upon availability of voluntary initiatives or organisations. This is a very serious fallacy being reinforced by supporters of voluntary activism. It is ignored that historical deprivation experienced by the people in high risk environments does generate a feeling of 'learned helplessness' which may prevent emergence of voluntary initiatives.

At the same time Non Governmental Activism triggered by the outsiders has in many cases opened new avenues for enforcing accountability of the administration towards deprived populations (Sethi and Kothari , 1981-1989).

Most ecological processes involve simultaneous changes in several resource systems. The commodity oriented single - activity or enterprise organizations work well with surplus producers. These organizations may be suitable also for those commodities which are in high demand domestically or abroad . However, such organizations or sectoral departments are seldom successful in reaching people involved in survival through simultaneous involvement in several markets. Budgetary and administrative systems are particularly suited for sequential implementation of public programmes.

Simultaneity of ecological processes also implies that a small change in one sub-system has to be followed up with several simultaneous ones in other sub-systems (Mathur and Gupta 1984). That such a process of change is seldom conceptualised in hierarchical bureaucracies is now well known. We have shown in this review that when conflicts arise around natural resources the administration may also use several and simultaneous strategies to prevent mobilization and organization. In the period of crisis such as drought or flood the simultaneity substitutes the sequential response (Mathur and Bhattacharya 1975). The dysfunctional part of the administrative assimilation has been the resilience of administration to revert back to its original sectoral and sequential nature once the crisis is over.

The mechanisms for open negotiation are rare. Unwillingness of state to receive and act on orderly feedback has led to the ecological movements acquiring militant character. Most social groups in hill and forest regions recognize the message of states's response to the agitation for autonomy say by Gorkha National Liberation Front. There is increasing trend towards setting up of regional development boards in such regions but without any fundamental difference in the pattern of people-administration interactions. Whether such a response to diversity and complexity will help is doubtful.

One of the reasons for the likely failure of such approaches is the absence of attention being paid towards the information processing capacities of these administrative bodies. They collect and process information in the same manner as a sectoral agencies.

The short time frame taken by the administrators and politicians makes it impossible for sustainable technological choices to compete with the ecologically undesirable but commercially profitable technologies. The former type of technologies also tend to attempt simultaneous changes in many of the biological systems.

The problem of wide spread vacancies and short tenure of administrators in backward regions prevents introduction and maintenance of sustainable interventions. People also recognize this and thus their demand on the system merely mimics what they think government wants to deliver (Gupta 1985, 1987). The implication of declining tenure and its implications for sustainable development have not been drawn in literature adequately.

It follows that with such a system of appraising developmental options the accountability of the system to future generations is compromised considerably.

The time perspective has also been seen to vary at different levels in the

administration -longest being at the local level. As one moves up in the hierarchy the reach of civil servants becomes global and their concern more divorced from the local realities.

The slightest change in the resource use system in the given structure of subsidies and patronage generates strong reactions. People in the regions which had gained in seventies and eighties and where yield frontiers may have been reached do not relish the idea of having to bear greater economic burden when the margins are decreasing. The political economy of peasant movements almost always emerging in high growth regions and for high value commodities has not been related to ecological changes. Declining ground water tables, diminishing returns from the soils, depletion of micronutrients, increasing resistance of pests to chemical pesticides with high residual effect, greater vulnerability to disease epidemics due to narrowing of the genetic basis and other related problems are outcomes of short term solutions to long term problems. The pressure of these changes is increasing the demand for subsidies. The ecological security of a society is closely related to the politics of ignoring such signals.

It is the bias towards such regions which results in the recommendation that one should not try to check migrations from the backward regions too much lest the supply of cheap labour for large 'developmental' projects is disrupted (NCDBA 1981).

Part IV: Implications for Future Research and Action:

The role of science and technology in mitigating drought has been looked in to several times before. State Government, Karnataka had organised a national symposium on the subject way back in 1985. A drought monitoring cell was set-up. The tragedy was that it was transformed in to basically a cell for collecting data on rainfall in different regions. We have to move beyond such symbolism. The cabinet committee on drought in 1987 did not include the secretary, DARE and DG, ICAR as a member. And yet a claim was made that the strategy developed during 1987 was a breakthrough in organisational dynamism.

Unless we develop atleast 25 to 30 year plan for each drought prone region nothing substantial is going to change. The absence of long range planning is one major reason for lack of any permanent dent on the problem of drought. The fire fighting approach may convince people about the earnestness of the government in the short run. In the long run people are going to see through the game and protest.

a) Linking Science and Technology with Banking and other Developmental Agencies: For coordinating various rural development programmes, coordination committees exists at central, state, district and block level. The banks which provide capital and administration which provides subsidy or other inputs are members of these committees. The science and technology institutions are not represented at any level in any region including the high risk environments (Gupta, 1989, Khanna, 1990). It is necessary that science and technology institutions are not only involved in identifying developmental opportunities but also in understanding the indigenous knowledge systems developed by the people. The traditional wisdom underlying water and soil conservation structures or indigenous veterinary medicine or other risk adjustment options have to be catalogued, analysed and upgraded wherever possible.

For watershed development such a linkage is all the more relevant because demand for new technologies is contingent upon (i) availability of long term assurance of banking and other input support, (ii) ability of group action or collective rationality to emerge and (iii) retention of as much share as possible of the value addition in the local products. Bali (1979) had rightly suggested that in dry regions the concept of watershed should really be, 'agro industrial watershed'. The ICAR and CSIR scientists may like to form a task force so that agro industrial watersheds can be developed in dry regions by adding value to local products. The scarce moisture when conserved becomes even more precious. Cultivation of medicinal and aromatic plants will add greater value. However, any diversification of this kind would require a strong public distribution system of food and fodder so that people are not constrained to grow crops for self consumption.

b) The household portfolios are diversified and therefore, strategies of development aiming at anyone sub-system or enterprise are unlikely to succeed. There is a need to take portfolio approach to technology development and diffusion.

c) The review of post-graduate research in several agricultural science disciplines has shown a serious neglect of inter-disciplinary problems. The issues of sustainability and risk adjustment have also been neglected. There is a need to develop a system so that students don't suffer if experiments on risky problems fail to produce expected results. A long term research programme must be developed networked into a national research plan so that cumulation is possible across sectors, spaces and seasons.

d) The bio diversity has been known to be higher in the regions where the environmental stress is high. The people maintaining this diversity have remained poor because of unfavourable markets, technologies and institutions. The price of genetic erosion will have to be paid by future generations if urgent measures are not undertaken to compensate the local communities maintaining this diversity.

e) The public policies have been biased against dry regions. The scientific community has to counteract the pressure for neglecting problems of disadvantaged regions and the people. The professional scientific associations have to provide scope for discussion on technologies suitable for risk adjustments in every scientific congress or meeting. Likewise, institutionalised efforts for building upon peoples' own technical innovations have to be made.

The strategies of coping with drought at household level have to be matched with the strategies of risk adjustment chosen by public officials and the scientists. It is understood that at the current level of articulation, it is unlikely that pressure from people will increase to bring about a major change in the public policies for these regions. After all there has not been any major peasant agitation around the crops or enterprises managed by the people in drought prone regions.

Whether the social concerns of the scientific community will generate these pressures remains to be seen. My purpose will be well served if not only the science congress but also other scientific associations keep these issues on their constant agenda.

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