Dryland Networks Programme

ISSUES PAPER

Drought Management: The Farmers' Strategies and Their Policy Implications

Dr N S Jodha

IIED
INTERNATIONAL INSTITUTE FOR ENVIRONMENT AND DEVELOPMENT

Paper No. 21
September
1990

Drought Management: The Farmers' Strategies and Their Policy Implications

Dr N S Jodha

Dr Jodha is currently head of the Mountain Farming Systems Division, International Centre for Integrated Mountain Development (ICIMOD), GPO Box 3226, Kathmandu, Nepal.

The original version of this paper was presented at the National Workshop on Management of Droughts organised by Department of Agriculture and Cooperation, Government of India and Indian Institute of Management, (Ahmedabad), July 4-5, 1989, New Delhi.

The paper synthesises N S Jodha's understanding of the farmers' coping strategies against drought and rainfall variability. This was acquired through sustained work on the subject since the mid 1960s. The work was conducted during association with the Central Arid Zone Research Institute, (Jodhpur), Agro-Economic Research Centre for Gujrat and Rajasthan, (Vallabh Vidyanagar), and International Crops Research Institute for Semi-Arid Tropics (ICRISAT, Hyderabad).

DROUGHT MANAGEMENT : THE FARMER'S STRATEGIES AND THEIR POLICY IMPLICATIONS

INTRODUCTION

The purpose of this paper is to submit that, in the search for innovativeness in drought management, public policies have by-passed an important source of insight - the coping strategies of farmers. In this paper I elaborate on these strategies and their policy implications.

This paper relates to arid and semi arid tropical areas, where high rainfall variability and droughts are a common phenomenon. Such areas account for nearly 40% of the total geographical area of India.

The key message of the paper is that dryland farmers (ie farmers and pastoralists in drought prone tropical areas) do not manage drought in isolation from the overall farming system. In keeping with the environmental complexity of the dry regions, farmers have developed their own coping strategies. These are under severe strain due to rapid changes in demographic, technological and institutional factors in dry regions. The major policy implications are:

- there is a need to revitalise farmers' strategies through technological and other means, as they are as relevant today as in the past
- learning from farmers as drought managers, public policies should not artificially isolate drought management from the overall development strategy for dry areas
- the rationale of farmer strategies should be made explicit concerns of integrated development and drought management interventions.

In the following discussion I will elaborate on the issues stated above. After a brief description of the production environment of drought prone areas, I will discuss farmers' adjustment strategies. This is followed by discussion of the ineffectiveness of these strategies under changing circumstances. The policy implications of the discussion include measures to reorient public policies and to strengthen farmers' strategies.

PRODUCTION ENVIRONMENT OF DRY TROPICS

Annual rainfall in the dryland areas of India in which this review is based ranges from less than 350 to 800 mm and has a high coefficient of variation. Within a season, rainfall varies significantly over short distances. Moisture availability falls short of its demand for 8 to 10 months a year in these seasonally dry areas. This in turn, in the absence of irrigation or moisture conservation, limits the period available for crop growth to roughly 60 to 180 days a year in most of these areas.

The farmer, through different coping strategies discussed below, tries to adapt both to good and bad rainfall situations. However, policy makers and administrators often respond only to drought situations (Jodha et al 1988). Protection of drought prone areas through periodic relief or through protective irrigation, has been the key focus of public interventions in these areas in the past. Moreover, various components of public policy drought management strategies (as well as development strategies) are not sensitive to the specificities of the resource base in these areas. This paper will hopefully highlight the need for making public policies more sensitive to the usable components of farmers' adjustment mechanisms in drought prone areas.

THE FARMERS' STRATEGIES

Farmers' coping strategies against drought are not confined to activities during the drought periods. Though farmers adopt specific devices for loss minimisation and loss management during droughts (Jodha 1981), they are closely linked to the overall harnessing of opportunities offered by agro-climatic conditions in dry regions.

The dryland farmer is able to adapt and adjust to both long term and short term behaviour of climatic factors (Jodha and Mascarenhas 1985, Walker and Jodha 1986). For instance, since the water constraint is a central feature of the production environment, moisture security and its management appear as a key strategy. Similarly, since grain production may often be inadequate and uncertain with a short and undependable growing season, the traditional efforts to ensure a livelihood in dry areas are linked to the overall availability of biomass. Diversification of activities, and flexibility of decisions and operations are age-old defences against risk and uncertainty. Finally, since the consequences of spatial and temporal variabilities of rainfall hit individual households more than whole communities, the inter-household differences in endowments and capacities can act as shock absorbers at a group level. Therefore collective means of providing food security to all (collective sustenance) forms an important defence against weather induced uncertainties and scarcities.

Moisture security, biomass stability, collective sustenance, flexibility and diversification are the dominant strategies through which farmers have historically sustained themselves in climatically unstable dry tropical areas.

Their relative importance varies according to inter-regional differences in agro-climatic conditions. Jodha et al (1988) illustrate this by comparing arid districts from Rajasthan with semi-arid districts from Maharastra and Andhra Pradesh. The importance of these strategies increases with increases in aridity and instability of rainfall.

The variety of measures through which the above strategies are operationalised are summarised in Table 1. Quantitative evidence of the extent of these measures and their intra-regional differences, is presented elsewhere (Jodha, 1975, 1978, 1981, Jodha et al 1988).

Most of the practices listed in Table 1 form part of traditional farming systems. The categories are:

- folk agronomy, to cover cropping and agronomic practices
- ethno-engineering, to cover traditional mechanical measures including those for moisture conservation
- indigenous agro-forestry, involving complementary uses of annuals and perennials
- occupational diversity, including a range of activities and practices often having flows of output/income and input requirements that are not dependent on each other
- self provisioning systems, implying greater dependence on own inputs and outputs for production and consumption
- collective sustenance, covering traditional forms of mutual self-help, dependence on common property resources (CPRs) etc.

Table 1 lists some of the important measures underlying each of the categories. Furthermore, the table also indicates the specific strategies served by individual adjustment measures falling under the above categories.

TRADITIONAL STRATEGIES UNDER STRAIN

The measures listed in Table 1 reflect farmers' experience accumulated over generations. While some of the measures are still effective, others are under strain. The circumstances under which they were developed have changed considerably. The important factors which directly or indirectly influence farmers' strategies relate to:

- technological changes
- public interventions (policies and programmes)
- rapid population growth
- increased role of market forces.

All these factors, except for population growth, have made some positive contributions to the economies of the drylands. But they also have a number of side-effects which make the traditional adaptation and adjustment mechanisms unfeasible or ineffective. Some of the important changes, with their implications for farmers' strategies, are summarised in Table 2. Some general inferences, based on a closer understanding of Table 2, may be stated.

Conventional approaches - impacts on traditional strategies

During the last two to three decades, the drought prone areas have, to some extent, benefited in terms of infrastructure, higher productivity agricultural technologies, linkages with wider markets, and resource transfers for relief and development. This has somewhat reduced their vulnerability to severe scarcities caused by periodic droughts. However, the environmental complexities characterising these areas have often been ignored by public interventions in these areas:

- In the field of agricultural technology, high grain yield was focused on, but flexibility of operations and input use, quantity of bio-mass, and potential for diversification and flexibility were ignored (Jodha 1986-b, 1989-a).

- Generalised institutional programmes (like land reforms, community development projects) were extended to these areas, without assessing their potential impacts on sub-marginal lands, common property resources, and various forms of mutual self-help, as bases of collective defence against droughts and uncertainty (Jodha 1986-a, 1988-b).

- Public relief strategies to help drought affected people have been pushed to such a level that they have displaced the people's own adjustment mechanisms and generated strong dependence on public relief (Jodha 1975, 1987, Chopra 1989).

- Irrigation facilities were developed in a few pockets but were allowed to be used on crops with high water requirements as in those areas well endowed with water. Dry crops, in the process, suffered (Jodha 1979, Jodha and Singh 1982).

- Market integration took place, but it had serious adverse effects on strategic self-provisioning systems and the fragile resource base (Jodha 1985).

- Special initiatives like the Drought Prone Area Programme (DPAP), were supposed to initiate development on the basis of particular watersheds. In practice the initiative followed the development norms and procedures evolved for other, better endowed areas.

All this indicates the need for understanding and explicit consideration of the complexity and variability of drought prone areas in both development strategies and drought management.

Erosion of land-extensive options

In the past, an important factor behind the sustainability of diversified farming systems in the dry areas was the relatively low pressure on land. Because of increased humans and livestock, most of the land extensive options are less feasible now (Jodha 1980, 1986-b, Walker et al 1983, Jodha & Singh 1989). Fallowing of land, crop rotations, choice of cultivars with long duration, high stalk component, and salvage potential (eg possibility of harvesting fodder in the event of crop failure), and provision of common property lands are specific cases to illustrate the point.

Decline of collective security mechanisms

Under traditional strategies against weather induced risk and drought, the measures designed for collective sustenance played an important role. Owing to the spatial variability of rainfall and inter-household resource differences, all households in a given cluster of villages are not equally exposed to crisis during a drought year (Jodha 1975, Walker and Jodha 1985). In such circumstances, when individual capacities are inadequate to combat drought, collective sharing arrangements help. These arrangements have been sustained by informal or formal understanding, enforced through social and, at times, religious sanctions. However, in changed demographic, socio-political, and economic contexts, the social sanctions are no more effective. They are either completely discarded or made to serve as rituals without substance. Increased differentiation of rural communities, introduction of formal institutions, legal and administrative frameworks, individualism injected by market forces, are all major factors responsible for these changes. In consequence, all adjustment mechanisms that derived their strength from social sanctions and community's collective approach are less feasible (Jodha 1985, 1986-a).

Besides decline of communal sanctions, the other factor which has adversely affected collective sustenance arrangements is public policies and programmes (Walker and Jodha 1985). The small-scale and need-based mobilisation of resources for intra-community transfers have been replaced by social transfers at the macro-level, through drought relief (Jodha 1975). Their focus has been on transfers of relief resources (even fodder and fuel) from outside, rather than generation, conservation and mobilisation from within.

Most development initiatives are focused more on individuals rather than on groups. Even for development of the collective assets, such as watersheds, rangelands or forests, the emphasis is on "technique", subsidy, and the project framework, rather than on people's involvement (Jodha 1988-b). Finally, common property resources (CPRs) which helped in collective sustenance and induced group participation in resource management, are privatised on a large scale (Jodha, 1986-a). This has also adversely affected migration as a device to escape localised scarcities.

Substitution of people's initiatives by public programmes

The state has appropriated several activities which traditionally formed part of people's own strategies. Though initiated with good intentions, the state's involvement in people's affairs has acquired its own logic and momentum. It expanded to a level of marginalising people's initiatives in fields as far ranging as choice of crop or input use to preferred migration route or choice of activity during drought. This is done not by coercion, but by state support for some options as against others. The bulk of incomes during drought periods,

recorded in different areas (Jodha 1987), came from public relief. This has resulted in the expansion of relief department bureaucracies and an ever increasing need for relief funds in different states (Rangaswamy 1989, Ganpathy 1989).

Rigidities of 'standards' and 'norms'

Flexibility in resource use in the areas of production, consumption and exchange has been an important risk adjustment mechanism. The extent of flexibility declines with the farmers' increased dependence on external resources and rigidities of standards or norms associated with new technologies and support systems used by them (Jodha 1989-b). In the past, dryland farmers operated in a largely informal social and economic environment, had farm and family as an integrated unit, depended on self provisioning systems, and used flexible methods and production techniques. Today, farmers are increasingly exposed to the environment where 'norms' and 'yardsticks' are standardised and fairly rigid (Jodha 1981). They are reflected through make-up of technological packages, terms and conditions associated with market transactions, as well as support received from public agencies. This restricts farmers' capacity to change their decisions and actions to face unpredictably rainfall patterns within the farming season.

Shrinking base of biomass

Because of the lower vulnerability of perennials - grass, shrubs and trees - on strict timeliness of rainfall, their performance, compared to arable annual crops, is less affected by early, mid-season or late droughts in the dry regions. Hence, their production is more stable than annual crops (Jodha 1988-a). Moreover, output flow of most of the perennials is not closely related to the output flow from annual crops. these factors form the basis of biomass stability. Biomass availability from perennials is also supplemented by a choice of crops and cultivars with high stalk content. The livestock component of farming systems, which, due to its mobility, has greater capacity to make use of spatial variability of rainfall, and can convert biomass availability into economic gains. Livestock also play an important role in biomass based nutrient recycling.

However, sources of biomass production are rapidly dwindling. Changed choice of crops and crop technologies with a low focus on fodder; decline of fodder-fuel producing resources such as : CPRs (community pastures, forests etc), periodically fallowed lands, and indigenous agro-forestry systems etc, have contributed to this process. New public initiatives, such as agro-forestry, silvi-pastoral systems, social forestry, as indicated earlier, are as yet largely confined to experimental areas or pilot projects. They are yet to make an impact at farm level (Jodha 1988-b, 1989-b). Furthermore, fodder and fuel have become important marketable products with improved transportation linkages. This has discouraged local storage and recycling.

DROUGHT MANAGEMENT : PUBLIC STRATEGIES

The focal points of drought management strategies in India since the 1890s have been 'drought proofing', through irrigation or cushions generated by surplus production, and the management of scarcities and crises by relief supplies. Table 3 lists the major milestones in the evolution of drought management strategies in India. Some of the major highlights (Jodha et al 1988) include:

- gradual recognition and use of non-irrigation options (eg buffer stocks from surplus producing dry areas) for drought proofing
- gradual shift away from largely ad hoc measures to more planned efforts under drought relief programmes
- supplementing of purely welfare activities (relief supplies etc) by productive components (social asset creation etc) in relief works
- improved expertise for management, coordination etc to implement the focused programmes during droughts (as demonstrated during 1987 drought).

As can be inferred from Table 3, several factors have contributed to this evolution. Important ones are:

- increased awareness of potential options for both drought proofing and relief
- better understanding and quantification of the phenomenon of drought and its implications
- lessons learned from the past experiences in handling droughts

Important gaps in the evolving drought management measures are also indicated in Table 3. One of them is neglect of farmers' coping strategies in the process of learning from the past.

Consequently, despite a number of positive changes, public drought management strategies (and also development strategies) continue to be insensitive to a number of environmental complexities of drought prone areas. A few specific aspects may be noted.

Unlike farmers' strategies, public policies for drought management are isolated from development strategies. The components of public policies (eg protective or relief works) do not have an explicit concern for diversification and flexibility requirements. The need for local biomass regeneration and conservation is often replaced by dependence on biomass (fodder etc) from outside. An important gap in public measures for drought management is a disregard of collective sustenance systems, strengthening of which can help reduce dependence on public measures.

Implications - required policy changes

i) At the public policy level effective drought management cannot be meaningfully separated from agricultural development strategies for drought prone areas. Just as farmers' strategies attempt to integrate long term adaptations to dryland environments with short term adjustments to specific rainfall situations, public interventions should also approach drought and non-drought situations with an integrated strategy. Farmers' approaches could serve as a rudimentary model for evolving new approaches.

ii) One of the easier ways to make development interventions relevant and effective in drought prone areas is to understand the rationale or goals of farmers' strategies (water security, biomass stability, diversification, flexibility and collective sustenance), and focus specific development interventions, such as new technology, infrastructure development, and institutional programmes on strengthening them.

REVITALISING FARMERS' STRATEGIES

A comparison of situations during the late 1940s and the late 1980s suggests that most of the drought prone areas in India are less vulnerable to drought induced crises today than in the past. The nexus between drought and famine has been broken (Bhatia 1989). But this is less because of these areas' capacities to withstand drought, and more because of the country's ability to spare and mobilise surpluses to help them. If the trends discussed earlier (Table 2) are any indicator, the farm capacity of most of these areas to combat droughts is on the decline. Hence, there is a need for revitalising farmers' adjustment strategies. However, before initiating this task, a few important questions need to be answered. This is essential to establish that our advocacy of the farmers' strategies is not guided by any 'romantic' view of this tradition.

Are traditional strategies relevant?

Farmers' strategies are a mix of responses to environmental complexity and variability (eg pattern of rainfall, low biomass productivity, undependability of individual options and narrow specialisations etc) which have remained unaltered, apart from a few irrigated pockets. Hence, the farmers' strategies are not less relevant today than before.

Despite better income and employment opportunities, due to relief and development interventions, the capacities to withstand drought are not strong enough as most of the development gains did not strengthen diversification, flexibility, biomass stability and other requirements.

Unless farmers' own coping strategies are improved, the present pattern of helping them through public relief may not prove sustainable in the long run. The rate at which relief machinery and relief requirements are expanding are a pointer to this.

Relevance and feasibility of operational components

As all the measures listed under different categories (Table 1) support the farmers' strategies, they should be considered relevant. However, there could be some components which, due to the availability of new and better substitutes, may be treated as redundant. The possibilities would include:

- new crop varieties, which produce more grain and equal or more fodder, when compared to the long duration traditional varieties

- drought-relief initiatives which depend on government supplies, but ensure group action leading to surplus generation in subsequent years.

Identification of relevant but less feasible components is relatively easy. The adjustment measures, whose bases are completely eroded, will fall in this category. For instance, in India, land extensive measures like crop rotation, fallowing, provision of vast areas of common property resources etc are less feasible due to increased pressure on land. The same applies to measures sustained by strong social sanctions. Similarly, measures which could survive only under complete isolation from markets are unfeasible in today's context.

On the other hand, components involving technological elements, better infrastructure, and support of formal institutional arrangements, can be strengthened. Compared to traditional, resource poor peasants, today's Indian society and state are well equipped with scientific knowledge and capabilities, institutional innovations, and back-up support of both skilled manpower and material resources. The only key requirement is that any development activity using the above resources, when extended to dry areas, should have an explicit concern for the strategies traditionally adopted by farmers.

Implications: new options for farmers

Revitalising farmers' strategies will require a consideration of the following issues:

Firstly, the advocacy for strengthening farmers' strategies, to complement existing development initiatives, is based on the premise that the latter, despite their ability to raise income and periodical surpluses, are not able to contribute sufficiently to flexibility, diversification, biomass stability, collective sustenance etc, which are essential for survival (and growth) in the climatically unstable environments of dry areas.

Secondly, new options to strengthen farmers' coping strategies (flexibility, diversification etc) should not only be more productive to take care of increased population pressure, but should try to minimise the negative side-effects of market forces, public interventions, and technology on farmers' coping strategies.

Thirdly, promotion of new public strategies for drought management and development of dry areas requires that public strategies be sensitive to the environmental complexity and variability of these areas.

Table 4 summarises the options for new directions for public interventions which will strengthen farmers' coping strategies.

The public interventions included in Table 4 include only potentially viable measure, ignoring ones requiring high land-man ratios or adherence to strong social sanctions or isolation from markets.

Options for public intervention

In the field of technology the focus should be on multiplication of options involving crops, varieties, management practices; complementarities between crop and livestock enterprises, between annuals and perenniels, and between crop centred and resource centred measures. This will help in widening the scope for diversification and flexibility. Specific measures to facilitate moisture conservation, biomass stability and collective sustenance are also listed in Table 4.

In the case of development programmes, the resource centred measures with a focus on collective sustenance and group action are emphasised. The potential implications of these measures in terms of biomass stability and resource management by involvement of user groups are also clear. The need for reorientation of water use policies in keeping with the specificities of dry areas is also indicated.

The focus of measures under relief strategies is on the greater role for people's initiatives, increased operational flexibility and greater accountability of relief operations. The search for productive activities to be integrated with relief works is one of the most important and difficult tasks indicated by Table 4.

The measures under the above three categories, when put together, can form a part of an integrated approach, whereby drought management and development interventions could be made more sensitive to farmers' circumstances and the environmental complexity of drought prone areas.

If the rationale behind the coping strategies of farmers highlighted by this paper is made an explicit concern of relief activities, identification and choice of productive components for relief and development works will be greatly assisted.

Table 1: Farmers' adaptation and adjustment strategies against drought and uncertainty in dry tropical regions of India

MEASURES (CATEGORIES)	STRATEGIES: Moisture security	Biomass stability	Collective sustenance	Flexibility	Diversification
FOLK AGRONOMY					
Crop varieties with:					
Varying maturity & combinability				*	*
Long duration; high stalk : grain ratio; yield stability		*			*
Cropping					
mixed cropping; role of minor crops				*	*
spatial, temporal variations in planting	*			*	*
crop-fallow rotations		*			*
Input use variations	*			*	
BIHO-ENGINEERING					
tillage practices, weeding	*				
moisture conservation/harvesting	*		*	*	
irrigation structures	*			*	*
INDIGENOUS AGROFORESTRY					
Farm forestry, shelter-belts		*	*		
Crop-bush fallow rotation		*			*
Annual-perennial linkages		*		*	*
OCCUPATIONAL DIVERSITY					
Crop-livestock mixed farming				*	*
Premium on stable earning/remittance				*	*
Acceptance of low-pay off options				*	*
Diversity of asset structure					*
SELF PROVISIONING SYSTEMS					
High dependence on own resources				*	
On-farm storage, recycling		*		*	
Flexible consumption/resource use				*	
Asset depletion - replenishment cycle				*	*
COLLECTIVE SHARING SYSTEMS					
Forms of mutual self help	*	*	*	*	
Common property resource (CPRs)		*	*	*	
Migration, spatial linkages			*	*	

* For further details and some quantitative evidence see Jodha (1975, 1978, 1980, 1986-a, 1988-a), Jodha and Mascarenhas (1985), Jodha et al (1988), Jodha & Singh (1988), Walker et al (1983), Walker and Jodha (1986).

Table 2: Factors and processes affecting traditional adaptation/adjustment strategies against drought and uncertainty in dry tropical regions of India* (– indicates negative change)

STRATEGIES/ GOALS	FACTORS AND PROCESSES OF CHANGES ASSOCIATED WITH:			
	Technology	Public policies/ programmes	Population	Market forces
MOISTURE SECURITY	In pockets improved access to irrigation, water harvesting; – Boring/blasting/ lifting tech and mining of ground water	Infrastructure & support for irrigation dev; – misallocation of scarce water due to water price policies no use regulation	Crop intensi– fication to meet rising demands	– concentration on high water using, high value crops, backlash on dry crops
BIOMASS STABILITY	– Reduced biomass due to concentration on grain crops and grain yields; neglect of resource centred technologies	– General neglect of biomass in R&D; decline of CPRs; pasture, forest, dev. dominated by "technique" without institutional focus	– Decline of land extensive biomass orientated practices, eg land fallowing; CPRs privatised	Rise of fodder/ fuel marketing, – draining of rural areas, neglect local storage & recycling
COLLECTIVE SUSTENANCE	– Promotion of individual oriented (crop, livestock) technologies; missing institutional component in resource centred (watershed, range land) technologies	– Public relief/ support systems replacing mutual self help; formal legal, administrative norms replacing social sanction; decline of common property resources	– Increased eco. differentiation, factionalism, indifference to group action, collective concerns	– market orientation and growth of individualism, erosion of group initiatives, neglect of low payoff but dependable options
DIVERSIFICATION	Gains HYVs etc. – backlash on minor crops, mixed cropping, land extensive crop varieties, practices; neglect of non-crop, resource centred activities	Relief, employment schems, special programmes (DPAP), – dependency on public relief, marginalisation of traditional diverse occupations	– Decline of land extensive activities, increased land fragmentation, negative attitude to some traditional occupations	Integration with wider market economy, – operational rigidities, new sources of risk, unfavourable terms of trade
FLEXIBILITY	– Reduced range of crops, technological rigidity of options, practices	– Dependence on public programmes and their logistic norms/ rigidities	– Land constraint reducing flexibility of options	– Decline of self provisioning and control over decisions; dependence on rigidities of market system

* For further details and some quantitative evidence see Jodha (1975, 1978, 1980, 1981, 1985, 1986-a, 1988-a), Jodha and Singh (1985), Walker and Jodha (1985).

Table 3 Major public interventions for drought management and development of dry tropical areas in India (1880s – 1980s)

Period of Initiation and Focus of Measures directed to:	
Drought Proofing	Drought relief
1880s	
Protective irrigation systems	Formulation of famine code to guide relief, but slow response
1930s-40s	
Bombay Dry Farming Technology and Soil Conservation Works	Relief guided by famine code
1950s-60s	
General rural development programmes: community development, land reforms, irrigation etc	Increased frequency and coverage of relief operations
1960s	
New Agricultural Strategy with focus on HYV technology for stability and surplus generation	Emphasis on income generation by relief works, social asset creation
1970s	
Special programmes for dry areas: a) Drought Prone Area Programme focussed on asset creation, employment and income generation, special funding b) R&D for dry lands: – Crop technology – productivity growth by high input technology – Soil-moisture centred technology – water harvesting, conservation etc – Biomass centred technology – silvi-pastoral, agro-forestry etc	Relief supported by buffer stocks, public distribution system; focus on employment schemes, productive components in relief works Attempt to use 'resource centred' technologies in relief works, uncontrolled growth in relief spending, continued centre-state friction on relief resources
1980s	
Extension of dryland technologies, focus on watershed approach, attention to neglected crops, problems, through 'technology missions'	Formalisation of need assessment, coordination, and monitoring; using past experiences; emphasis on 'productivity' and 'quality' aspects; use of NGOs

Table 4 Possible approaches to generate options to revitalise the farmers' adaptation and adjustment strategies against drought and rainfall uncertainty in dry regions*

Area of Intervention	Aspects to be focused to generate relevant options
TECHNOLOGIES	
Crops	Crop range: Multiple crop choice, minor crops, cropping systems; non-hybrid varieties. Crops with: Variable maturity, variable rate and date agronomy, high temporal and spatial adaptability, compatibility (for inter-cropping, agro-forestry), drought resistance, high stalk component, suited to organic recycling. Products with: high storability, recyclability, local processibility.
Resource centred	Conservation measures with multiple objectives (productivity etc), scale and group action neutrality, focus on lengthening growing season, and possibility of mid-season corrections.
Perennials	Fast growing, high ratoonability, non-competing and non-toxic, suited to cut and carry systems, complementarities with annuals; focus on biomass processing/storage/recycling techniques.
DEVELOPMENT PROGRAMMES	
Resource/Community centred	Silvi-pastoral/social forestry related initiatives: less emphasis on "technique", formal administration and subsidy; focus on: "user group" involvement, equity of access and gains; incentives for group action, usage regulation of CPRs, involvement of NGOs
Irrigation	Focus on low water requiring crops, arrangement for equitable access; water usage regulations
RELIEF OPERATIONS	Strong productivity components, multiple activities, emphasis on matching contribution in any form, incentive for voluntary action, involvement of NGOs, reduced domination of formal agencies, create accountability mechanisms

* For further details and some quantitative evidence see, Binswanger et al (1980) Jodha (1979, 1980, 1988-a, 1988-b), Jodha et al (1988), Walker and Jodha (1985).

REFERENCES

Binswanger HP, Virmani SM, Kampen J, 1980. Farming systems components for selected areas in India: Evidence from ICRISAT. Research Bulletin no 2. ICRISAT, Patancheru, India, 44pp.

Bhatia SM, 1989. 1987 - Drought in retrospect: Some policy issues. Paper presented at National Workshop on Management of Droughts, July 4-5, 1989, New Delhi.

Chopra R, 1989. Voluntary organisations in drought management. Paper presented at the National Workshop on Management of Droughts, July 4-5, 1989, New Delhi.

Ganapathy RS, 1989. Management of drought: An overview. Paper presented at the National Workshop on Management of Droughts, July 4-5, 1989, New Delhi.

Jodha NS, 1975. Famine and famine policies: Some empirical evidence. Economic & Political Weekly, 10(41):1610-1623.

Jodha NS, 1978. Effectiveness of farmers' adjustment to risk. Economic & Political Weekly, Quarterly Review of Agriculture, 16(1):A38-A48. (Limited distribution)

Jodha NS, 1979. Dry farming technology: Achievements and obstacles. Agricultural Development in India: Policy and Problems, (eds) CH Shah and CN Vakil. Orient Longman, Bombay, India, pp 487-507.

Jodha NS, 1980. Intercropping in traditional farming systems. Journal of Development Studies, 16(4):427-442.

Jodha NS, 1981. Role of credit in farmers' adjustments against risk in arid and semi-arid areas of India. Economic & Political Weekly, 16(42-43), pp 1696-1709.

Jodha NS, 1985. Market forces and erosion of common property resources. Proceedings of the International Workshop on Agricultural Markets in the Semi-Arid Tropics, 25-28 October 1983, ICRISAT Centre, Patancheru, (AP) 502 324, India, pp233-277.

Jodha NS, 1986-a. Common property resources and rural poor in dry regions of India. Economic and Political Weekly, 21(26):1169-1181.

Jodha NS, 1986-b. Research and technology for dry farming in India: Some issues for the future strategy. Indian Journal of Agricultural Economics, 41(3):234-247.

Jodha NS, 1988-a. Fuel and fodder management systems in the arid region of western Rajasthan (Report prepared for Study Group on Fuel and Fodder, Planning Commission, Government of India, New Delhi, 44pp.

Jodha NS, 1988-b. Land policies, programmes and environmental degradation in India. Paper presented to National Conference on Environment in India, December 15-17, 1988 (Ministry of Environment and Forests, Government of India), Dehradun.

Jodha NS, 1989-a. Dry farming research: Issues and approaches. Technology Options and Economic Policy for Dryland Agriculture, (ed) Jodha NS: The Indian Society of Agricultural Economics, Bombay, pp 187-218.

Jodha NS, 1989-b. Technology options and Economic Policy for Dryland Agriculture (ed), The Indian Society of Agricultural Economics, Bombay, 363pp.

Jodha NS, and Singh RP, 1982. Factors constraining growth of coarse grain crops in semi-arid tropical India. Indian Journal of Agricultural Economics, 37(3):346-354.

Jodha NS, and Mascarenhas AC, 1985. Adjustment in self-provisioning societies. Climate Impact Assessment: Studies of the Interaction of Climate and Society (eds) RW Kates, JH Ausubel and M Berberian. John Wiley & Sons Ltd, London, pp437-464.

Jodha NS, Virmani SM, Gadgil S, Huda AKS and Singh RP, 1988. The effects of climate variations on agriculture in dry tropical regions of India. The Impact of Climatic Variations on Agriculture Vol 2. Assessment in Semi-Arid Regions (eds) Parry ML, Carter TR and Konijn. Kluwer Academic Publishers Dordrecht, Netherlands, pp4503-578.

Jodha NS, and Singh RP, 1989. Crop rotations in the traditional farming system in selected areas of India. Economics Group RMP, ICRISAT, Patancheru (AP) 502324, India. 39pp.

Rangaswamy A, 1989. Financing in the management of droughts: policy perspectives. Paper presented at the National Workshop on Management of Droughts, July 4-5, 1989, New Delhi.

Walker TS, and Jodha NS, 1985. How small farm households adapt to risk. Crop Insurance for Agricultural Development: Issues and Experience. (eds) P Hazell, C Pomareda, and A Valdez. John Hopkins University Press, Baltimore. pp17-34.

Walker TS, Singh RP, Jodha NS, 1983. Dimensions of farm-level diversification in the semi-arid tropics of rural south India. Economics Programme Progress Report no 51, ICRISAT, Patancheru (AP) 502324 India, 20pp.

IIED

Dryland Networks Programme
INTERNATIONAL INSTITUTE FOR ENVIRONMENT AND DEVELOPMENT
3 Endsleigh Street, London WC1H 0DD, England
Tel: (44-71) 388.2117 Fax: (44-71) 388.2826
Telex: 261681 EASCAN G