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Rural Livelihoods in Dry Land Areas: Strategies and Outcomes - A Review



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Introduction

Though Indian economy is highly diversified with fast growing manufacturing and services sectors, agriculture is of primary concern. This is because of high proportion of workers depend on agriculture. There has been a substantial rise in India's food production in the last few decades. Nevertheless, yield levels are very low in dry land areas. According to Millennium Ecosystem Assessment Report (MA, 2005), dry lands are characterized by scarcity of water which constrains the production of crops, forage and other plants and has great impact on livelihoods of rural people¹. In these areas, the natural moisture (precipitation) is counter balanced by moisture loss through evaporation from surface and transpiration by plants (evapotranspiration). This moisture loss affects both natural and managed ecosystem. Substitution between different kinds of assets and activities in response to the risks imposed by environment is the key feature of livelihood strategies in dry lands.

According to Chambers and Conway (1991) livelihoods comprise of capabilities, assets and activities required for a means of living². The term capability refers to the ability of individuals to realize their potential both in being and doing. According to Amartya Sen, increased access to resources can improve the welfare of the users only if they are capable of utilizing them effectively. Many researchers (Scoones, 1998, Ellis Frank, 2000) used the definition of Chambers and Conway with slight modifications.

Population in dry land areas lags behind the rest of the world on human well-being and development. A satisfactory integration between conservation of eco-system and human well-being has not yet been achieved either in theory or in practice (Michael Mortimore et al, 2008).

The studies on dry land areas focus mainly on three issues. The first is the so called environment-development debate. The debate raises the question whether development

¹ The terms dry lands and rainfed areas are used interchangeably in the literature. A portion of dry land which may not have any source of irrigation and depends on rainfall is called rainfed area. Dominant forms of land use and land cover in dry lands are irrigated, rainfed agriculture and range lands (UNEP, 1997).

² From the debate of past few years they have taken three concepts- capability, equity and sustainability. They have adopted Amartya Sen's concept of capability.

has adverse impact on environment. Many studies show that environment is damaged with development. Nevertheless there are studies which argue that lack of development and problem of poverty are responsible for environment degradation. The second issue is related to the problems in dry land areas. To identify problems, it is necessary to define and classify the dry land areas. The third issue focuses on the strategies adopted in dry land areas to tackle the problems identified.

The review addresses the above three issues. It consists of four sections. The contradictory goals of the governments of developed and developing countries and the evolution of the concept of sustainable development are presented in section I. The main goal of governments of developing countries is to remove poverty and inequality. Their endeavor to eradicate poverty led to the development of various approaches and recent development in this regard is sustainable livelihoods approach. A detailed description of the framework of sustainable livelihoods is also presented. Section II focuses on the definitions of dry lands and classification of dry land areas in India from various programmes and studies. This section also gives an account of prevailing problems in dry land areas of India. The debate on environment and poverty and the status of human well-being in dry land areas of India are also discussed in this section. Agriculture is the important livelihood of rural people in dry land areas. Section III is devoted to the issue of sustainability of agriculture in dry land areas and policy interventions for agricultural development. The importance of other alternative livelihood strategies adopted by people of dry land areas are also discussed in this section. Summary is presented in Section IV.

1.1 Environment and Development Debate

Alan Grainger (2005) presents the historical evolution of the concept of sustainable development. He says that the concept of sustainable development was evolved as a compromise between the two contradictory aims of developed and developing countries. From the perspective of developed countries, sustainable development is about conserving the environment while from the perspective of developing countries it means continued pursuit of development with the aim of reducing poverty. The author presents how the political goals of their governments in the 1960s and 1970s reached a compromise at Brundtland Commission and further developments of the issue. He also describes the development of the theoretical concept of sustainable development. The summary of the entire discourse is presented below.

Widespread environmental impacts of human population growth and industrialization led to environmental protection being accepted as a goal by governments of developed countries during the 1960 and 1970s. However, they regard a healthy environment as something different from economic activity. There was a realization in the 1980s that

the environmental impacts of economic activity could rebound on the whole community through stratospheric ozone depletion and global climate change. However, the conservationists soon realized that in developing countries conservation was incompatible with development as there was a great demand for more space to accommodate the rising population and exploit natural resources for achieving economic development. This led to the launch of new integrated conservation and development projects such as Man and Bio-sphere Programme of United Nations Educational Scientific and Cultural Organisation (UNESCO) and the World Conservation Strategy published in 1980 by the International Union for the Conservation of Nature (IUCN). Sustainable development was recommended as a development path that would not lead to environmental degradation due to industrialization. However, it was expressed in general terms and lacked both definition and guidance as to how it might be operationalised.

Political leaders in developing countries had a different agenda during the 1980s. The 'top-down' modernization strategies of the 1950s and 1960s which relied on the centrally directed expansion of industry and commerce to generate more income for the whole country had not been successful. The 'bottom-up' strategies were introduced in 1970s to meet the basic requirements such as water and sanitation, food, fuel, income and employment. The growth in income that stemmed from the increase in prices had been short lived. Many developing countries faced a debt crisis because they could not repay the massive development loans they had taken out in the 1970s. Therefore, they wanted a new type of development strategy that could be sustained over a long period of time. They believed the developed countries should offer greater compensation to the developing countries for the exploitation suffered during the colonial era.

In an attempt to reconcile these two perceptions of development, the United Nations (UN) General Assembly established the World Commission on Environment and Development (WCED) in 1987, chaired by Gro Harlem Brundtland, the then Prime Minister of Norway. The solution proposed in the 'Brundtland Commission' was to aim for sustainable development, which is defined as, 'development that meets the needs of the present without compromising the ability of the future generation to meet their own needs.' This gave a new meaning to the term 'sustainable development' as distinct from the one identified by IUCN seven years earlier. It recognised the need to ensure inter-generational equity by minimizing the harmful environmental impacts of human activities, in deference to the concerns of the developed countries. However, its primary aim was to meet the needs of the developing countries by reducing poverty. It argued that environmental degradation would continue until the problems of poverty and inequality in developing countries were addressed. Poor people who are desperate for food, fuel and income cannot afford to have regard for the environmental

consequences of their actions. Consequently, economic growth must continue in order to alleviate poverty and maintain development. The Brundtland Commission, however, states that this economic growth should be of a 'new form' with less harm to the environment and should not deplete the Earth's remaining stocks of natural resources. Both developing countries and environmentalists and conservationists from developed countries could agree with this new form of growth. However, it has two basic flaws. First, it did not say how continued economic growth could in practice be balance against the need to conserve resources and natural environments. Second, it was too ambiguous to enable each of the two interest groups to interpret the meaning of sustainable development in a way that reflected their own agenda. So, governments in the developed countries believed that sustainable development would mean better environmental protection. Their counterparts in developing countries, on the other hand, believed that it would bring them more development.

This ambiguous compromise established common ground between developed and developing countries for them to agree to meet in the Brazilian city of Rio de Janeiro in June 1992 at the UN Conference on Environment and Development (UNCED). It succeeded in translating the ideal proposed in the Brundtland Report into a universal ideal for all countries. In spite of this, the basic contradiction remains between the two interpretations of the political ideal of sustainable development. Developing countries want more development while developed countries want better environment. Ten years after UNCED, the two interpretations persisted at the World Summit on Sustainable Development (WSSD), held in Johannesburg, South Africa, 2002. However, the Summit pointed out that the definition was easy to understand but too vague to use as the basis for operational monitoring.

Over the past ten years a considerable amount of academic effort has been invested to translate the political ideal of sustainable development into a more rigorous theoretical concept. It builds upon and extends two other key concepts – economic growth and economic development. Both the concepts of economic growth and economic development take no account of the environmental impacts of activities needed to generate income. Environmental economists defined sustainable development as one which 'leads to non-declining human welfare over time.' It offers great scope for monitoring sustainable development.

Lack of universal agreement over the definition of sustainable development resulted in different interpretations both as a political ideal and a theoretical concept. Political and theoretical discourses are actually two sides of the same coin. Each needs the other as reference point, and taken alone, each offers only a partial explanation of sustainable development. Equity is at the heart of sustainable development, yet current

economic theories focus only on inter-generational environmental equity within countries and between countries. Intra-generational equity between developed and developing countries is central to the political economy theories of development. Nevertheless, countries can still aim to move their actual development path closer to the ideal of sustainable development and thereby increase the degree of sustainability of development.

The 'sustainability' debate has created a great deal of concern in recent years. However, 'sustainability' continues to be a much used metaphor, with only very little progress in making the concept operational. Various definitions of sustainability largely describe the situation rather than define the term (Jodha, 1991).

Given the debate and trade-off in sustainable development and rural livelihoods, Acharya (2004) has identified the following needs: food security of present generation is more important than the needs of future generations; economic development policies should not ignore environmental damage; environmental policies should not ignore economic welfare losses of poor; the improvement in livelihoods of farmers is difficult without causing some damage to the natural resources; sustainability of agriculture is a matter of degree and complete prevention of damage is neither feasible nor socially desirable and hence attempt should be confined only to reduce the damage.

1.2. Sustainable Livelihoods Approach

Eradication of poverty and sustainable development are considered as important dimensions of development. After decades of limited success in eliminating rural poverty, a number of international funding agencies revised their rural development strategies. The agencies felt for the development of an accurate and dynamic picture of rural life and identification of constraints to livelihood development and poverty reduction.

In order to achieve the target of reducing the poor by one-half by 2015, Department for International Development (DFID) consulted widely to understand the nature of poverty and how it should be addressed. As a result of such efforts, it has brought out a sustainable livelihood framework. The sustainable livelihoods approach (SLA) based on this framework supports poverty eradication by making enhancement of poor people's livelihoods (John Fanington *et al.*, 1999).

The sustainable livelihoods approach is used by a number of governments and international development agencies including Department for International Development (DFID), United Nations Development Programme (UNDP), and International Fund for Agricultural Development (IFAD) and research institutes such as Institute of Development Studies (IDS), Non-Governmental Organisations such as CARE and Oxfam as their overarching framework for poverty reduction.

The Chambers and Conway (1991) definition on livelihoods is very popular. They define livelihood 'comprises the capabilities, assets and activities required for a means of living'. Krishnaraj (2007) argues that it does not adequately specify the composition of livelihood needs and does not bring in explicitly the role of natural resources. Frank Ellis (2000) opines that the meaning of the term capabilities overlaps assets and activities. Assets contain economic categories of different types of capital and claims and access. The followers of Chambers and Conway have identified five categories of capital namely, natural, physical, human, financial and social capital³. An important element of livelihood included under assets is the access that households have to different capitals. Access is defined by rules and social norms that determine ability of people to own, control, claim or make use of resources. Frank Ellis (2000) made slight changes to the Chambers and Conway definition by giving more stress to the concept of access. His definition recognises the importance of social relations and institutions in mediating the capacity of a household to achieve its consumption requirements. He defines 'a livelihood comprises the assets, the activities, and the access to these that together determine the living gained by the individual or household'.

1.3 A Framework for Livelihoods Analysis

A framework on livelihood analysis originates from the work on vulnerability and famines, gender analysis, poverty-environment interactions and sustainable rural livelihoods. These approaches regard asset status of the poor households as fundamental to understand the options open to them, strategies they adopt for survival and their vulnerability to adverse trends and events. The framework can be as a guide to micro policies on rural poverty reduction and to trace the local level impact of macro policies. It can be used to understand the livelihood circumstances of individuals, households, villages, communities, even district or large geographical zones that share important features in common (Frank E, 2000).

1.3.1 Assets

The starting point of framework is assets owned, controlled and claimed, accessed by the household. Based on assets, households are able to undertake production, engage in labour markets and participate in exchanges with other households. Different researchers have identified different categories of assets. Swift classifies assets into investments, stores and claims. According to Maxwell and Smith, assets are in the form of productive capital, non-productive capital, human capital, income and claims. Reardon and Vosti classified assets into natural resource assets, human resource assets, non-farm physical and financial resources, off-farm physical and financial resources. Moser divides assets

³ Political capital was also added afterwards.

into labour, human capital, productive assets, household relations and social capital. All these classifications have some common and some new elements. The framework suggested by Chambers and Conway (1991) contains five capitals/asset categories – natural, human, physical, financial, social.

Natural capital comprises of land, water and biological resources that are utilized by people to generate the means of survival. It is not confined to gathering activities such as collecting wild vegetables and hunting wild animals. It is not static. It is enhanced when it is brought under human capital. There are renewable and non-renewable resources.

Physical capital consists of assets that are created by the economic production process. All production goods that create flow of outputs come under physical capital such as buildings, irrigation canals, roads, tools and machinery.

Human capital refers to the labour available to the household, its education, skills and health. Human capital is increased by investment in education and training and skills acquired through pursuing one or more occupations.

Financial capital refers to stocks of money to which a household has access, savings and access to credit. Neither savings nor loans are productive forms capital directly. They owe their role in asset portfolio of households to their convertibility into other forms of capital or into consumption.

Social capital refers to claims which individuals and households have by virtue of their belonging to a social group.

1.3.2 Mediating Processes

Translation of assets into livelihood strategies is mediated by a great number of social, economic and political considerations. Scoones (1998) divides these into two categories: conditions and trends on the one hand and institutions and organizations on the other. Conditions and trends are exogenous factors. Institutions and organizations are endogenous to social norms of which households are a part.

Examples of trends are rate of population growth, density of population, rates of out-migration from rural areas, agricultural technology and its evolution over time, growth of non-farm activities in rural areas, relative prices, national economic trends, international prices, macro policies etc.,. The relative importance of these trends for different rural locations is likely to vary tremendously. Trends may be fortuitous or adverse. The former category includes economic growth, slow down in population

growth rate, reduction in poverty and development of non-farm sector. The latter includes shocks that pose a challenge to livelihood sustainability such as drought, pests and diseases. Shocks destroy assets directly and they result in erosion of assets indirectly.

Social relations are distinguished from institutions and institutions from organizations. Social relations refer to the social positioning of individuals and households within the society. The social positioning comprises of factors such as gender, caste, class, age, ethnicity and religion. Institutions are formal rules, conventions and informal code of behavior such as laws, land tenure arrangements, markets. They change slowly and incrementally. Organisations are groups of individuals bound by some common purpose. Government agencies, administrative bodies, NGOs and associations are examples. Social relations, institutions and organizations are critical mediating factors for livelihoods because they encompass the agencies that inhibit or facilitate the exercise of capabilities or choices by individuals or households.

1.3.3 Activities and Livelihood Strategies

The household adapts to various livelihood strategies when its asset status is mediated by social factors and trends or shocks. Livelihood strategies are dynamic. They respond to changing pressures and opportunities and adapt accordingly. They consist of activities that generate the means of household survival. They divided into natural resource-based and non-natural resource based.

Scoones (1998) identified three livelihood strategies: agricultural intensification or extensification, livelihood diversification and migration. The first type corresponds to continued and increasing reliance on agriculture either by intensifying resource use with a given land area or by bringing new land into cultivation. The key asset here is land and for agricultural intensification, attention is directed towards the institutions and organizations that facilitate technical changes in agriculture. The second type directs attention to non-farm rural employment as a key policy issue. The third type directs attention to migration and remittances.

1.3.4 Outcomes of Livelihood Strategies

The outcomes are divided into livelihood security and environmental sustainability aspects. Livelihood security is defined as containing some combination of attributes related to income level, income stability, reduction in adverse seasonal effect and reduction in overall risk profile of the income portfolio. This in turn leads to people becoming less vulnerable or more vulnerable in terms of their capability to manage adverse trends or cope with shocks. Environmental sustainability refers to changes in the resilience and stability of resources such as soils, water, rangeland, forests and biodiversity.

Frank Ellis (2000) argues that this framework does not provide a set of solutions for poverty reduction. It does suggest a way of organizing the policy that identifies assets, mediating processes, activities and the links between them. Carney proposes a schematic approach for comparing the asset status of different social groups. Scoones (1998), as quoted in ICRISAT (2005), suggests a checklist for taking forward an asset-based analysis of rural livelihoods. The checklist consists of a series of key questions to be asked about household asset portfolios such as sequencing, substitution and clustering of assets (ICRISAT, 2005).

2.1 Dry Lands⁴

World Atlas Desertification (UNEP, 1997) defines dry lands as areas with an aridity index value of less than 0.65. ratio of long term average annual precipitation and average annual evapotranspiration is termed as aridity index. Using index values, the Millennium Ecosystem Assessment Report (MA, 2005) recognized four dry land subtypes: hyper-arid, arid, semi-arid and dry-sub-humid. Dry land subtypes can also be described in terms of their land uses as rangelands, croplands and urban areas.

World's dry lands occupy an area of around 54 million square kilometers. Asia and Africa have the largest areas under dry lands amounting to 18 and 13 million square kilometers respectively. Central America and Europe have the least extent of dry land. Among the countries, Kazakhstan has 99.2 percent of its total area as dry land followed by Iran and Australia with 90.3 percent and 85.7 percent respectively. With 59.8 percent of area under dry lands, India occupied 8th position in the intensity of dry land (ESRI, 1993 and UNSO/UNDP, 1997).

Dry lands support 40.0 percent of world's population. In terms of absolute population 2 billion people live in these areas. As mentioned earlier Asia and Africa have the highest proportion of dry land areas in the world and also largest population living in dry lands. In Asia 42.0 percent and in Africa 41.0 percent live in dry land areas (UNSO/UNDP, 1997).

2.2 Dry Lands of India

India occupies an area of 328 million hectares which accounts for 2.4 percent of world's total area and has 102.86 crores of population (2001 Census) comprising of 16.2 percent of world's population. It has only 0.5 percent of world's grazing land but supports 18.0 percent of world's cattle population. India is endowed with a variety of soils, climate, bio-diversity and ecological regions: the Himalayan foothills in the north, the well-

⁴ The extent of area under drylands vary from source to source. This is because of lack of integration between organizations working on this issue.

irrigated areas in the north-west, deserts in the west, hill tracts in the east, the heavily populated Gangetic plain, the semi-arid Deccan Plateau and tropical coastal areas in the south.

As per Thornthwaite classification, 69.0 percent of geographical area i.e. 228 million hectares out of 328 million hectares fall in the category of dry lands. Of the total cultivated area of 142 million hectares, 97 million hectares, constituting nearly 68.0 percent of net cultivated area is rainfed (NBSS & LUP, 2000).

There is no official delineation of dry land regions in India except that those adopted for identifying the districts to be covered under the Drought Prone Area Programme (DPAP) and Desert Development Programme (DDP). State-wise area, number of districts and blocks in semi-arid and arid categories are given in Table 1 and Table 2 respectively.

Table 1: State-wise Semi-arid Areas in India: 2009-10

State	Semi-arid (sq.km)	Percentage to the Geographical Area	No. of Districts	No. of Blocks
Andhra Pradesh	99218	36.1	11	94
Bihar	9533	10.1	6	30
Chhatisgarh	21801	16.1	9	29
Gujarat	43938	22.4	14	67
Haryana	-	-	-	-
Himachal Pradesh	3319	6.0	3	10
Jammu and Kashmir	14705	6.6	6	22
Jharkhand	34843	43.7	15	100
Karnataka	84332	44.0	17	81
Madhya Pradesh	89101	28.9	26	105
Maharashtra	194473	63.2	25	149
Orissa	26178	16.8	8	47
Rajasthan	31969	9.3	11	32
Tamil Nadu	29416	22.6	18	80
Uttar Pradesh	35698	14.8	15	60
Uttaranchal	15796	29.5	7	30
West Bengal	11594	13.1	4	36
Total	745914	22.7	195	972

Source: Annual Report of Ministry of Rural Development, 2009-10.

According to the above classification, 13.9 percent of area is under arid and 22.7 percent of land is under semi-arid. The area under semi-arid region consists of 7.46 lakh sq.kms

fall under Drought Prone Area Programme and 4.58 lakh sq.kms of area fall under Desert Development Programme. The percentage of semi-arid to the total geographical area is highest in Maharashtra at 63.2 percent followed by, Karnataka with 44.0 percent and Jharkhand by 43.7 percent (Table 1). Under hot arid category, Rajasthan occupies 58.0 percent and Haryana has 47.0 percent of area (Table 2).

Table 2: State-wise Arid Areas in India: 2009-10

State	Arid (sq.km)	Percentage to the Geographical Area	No. of Districts	No. of Blocks
Andhra Pradesh	19136	7.0	1	16
Bihar	-	-	-	-
Chhatisgarh	-	-	-	-
Gujarat	55424	28.3	6	52
Haryana	20542	46.5	7	45
Himachal Pradesh	35107	63.1	2	3
Jammu and Kashmir	96701	43.5	2	12
Jharkhand	-	-	-	-
Karnataka	32295	16.8	6	22
Madhya Pradesh	-	-	-	-
Maharashtra	-	-	-	-
Orissa	-	-	-	-
Rajasthan	198744	58.1	16	85
Tamil Nadu	-	-	-	-
Uttar Pradesh	-	-	-	-
Uttaranchal	-	-	-	-
West Bengal	-	-	-	-
Total	457949	13.9	40	235

Source: Annual Report of Ministry of Rural Development, 2009-10.

Several attempts have been made in India to classify the country into agro-climatic zones. Delineation of climatically homogeneous regions has been an important aspect of agro-climatic analysis. Rainfall and soil types have been considered in the attempts made by the National Agricultural Research Project (NARP) in 1979. The agro-climatic regions are

1. Western Himalayan Region.
2. Eastern Himalayan Region.
3. Lower Gangetic Plains Region.

4. Middle Gangetic Plains Region.
5. Upper Gangetic Plains Region.
6. Trans Gangetic Plains Region.
7. Eastern Plateau and Hill Region.
8. Central Plateau and Hill Region.
9. Western Plateau and Hill Region.
10. Southern Plateau and Hill Region.
11. East Coast Plains and Hill Region.
12. West Coast Plains and Ghat Region.
13. Gujarat Plains and Ghat Region.
14. Western Dry Region.
15. Island Region.

The National Bureau of Soil Survey and Land Use Planning (NBSS &LUP) of Indian Council of Agricultural Research (ICAR) classified the country into 20 agro-eco regions (AER) and 60 agro-eco sub-regions on the basis of soil, bioclimatic type and physiographic situations (AESR) (Mandal et al. 1999).

The agro-ecological regions fall into six major bio-climatic regions. They are

1. Arid
2. Semi-arid
3. Dry-sub-humid
4. Moist-sub-humid
5. Humid
6. Per-humid

The areas shown under arid, semi-arid and dry-sub-humid together constitute dry lands according to NBSS & LUP, which is same as that of Thornthwaite classification. A large number of States fall under this category. However, the entire north-Indian region covering the States of Assam, Meghalaya, Nagaland, Tripura, Manipur, Mizoram, Sikkim and Arunachal Pradesh and the State of Uttarnchal of north India do not fall under dry lands. In addition to them, parts of Jammu & Kashmir, Himachal Pradesh, Coastal areas of Karnataka, Maharashtra, Goa and major parts of Kerala, Orissa, West Bengal and Andaman and Nicobar Islands and Lakshadweep also do not fall within dry land region. Major part of the dry land region in the country is rainfed.

Arid region

This region occupies 50.8 million hectares of total geographical area of the country consisting of 15.8 percent. It is divided into hot-arid and cold-arid regions. The hot-

arid region consists of major parts of western Rajasthan, Gujarat, southern part of Punjab and Haryana, a small portion of Deccan Peninsula in the States of Andhra Pradesh, Karnataka and Maharashtra. Cold-arid region occupies 15.2 million hectares in Jammu Kashmir and Lahul and Spiti in Himachal Pradesh (NBSS & LUP, 2001).

Semi-arid region

About 37.6 percent of geographical area of the country belongs to semi-arid region accounting for 123.4 million hectares. The semi-arid of the country further categorized in to dry and wet.

Dry-sub-humid region

Out of total area of the country 54.1 million hectares account for 16.5 percent falls within dry-sub-humid region.

Gulati and Kelly (1999) as quoted in ICRISAT (2005) report, have used a slightly modified version of agro-ecological region (AER) classified system used by NBSS & LUP. They delineated semi-arid tropics (SAT) by superimposing the AER map on the all-India district map, districts which had 50.0 percent or more of their land area falling within the AERs 2 through 10, were considered as constituting SAT. A report on poverty by ICRISAT (2005) has developed four Agro-climatic Zones i.e. humid, semi-arid temperate, semi-arid tropic and arid. The length of crop growing period and mean monthly temperature are considered for classification of agro-climatic zones. It defines humid areas with a length of growing period of more than 180 days, semi-arid temperate area with a length of growing period ranging between 75 and 179 days and with less than 18^o C temperature, semi-arid tropic with same length of growing period as in case of semi-arid temperate but mean monthly temperature of more than 18^o C. and arid areas with a length of growing period of less than 75 days (Table 3).

There are many definitions of dry land areas in India. Because of the differences in the criteria followed, the area reported under zones is not same. Moreover, the type of classification of areas also varies between them and hence comparison is not possible. The Millennium Ecosystem Assessment Report (MA, 2005) argues that provision of ecosystem services is crucial for the attaining sustainable human livelihoods. It categorized ecosystem services into supporting, provisioning, regulating and cultural services. The report gives a detailed explanation of difficulties that arise in the process of generating the services for the welfare of human beings in dry land areas.

Table 3: No. of Districts by Agro-Climatic Zone

State	Humid	Semi-arid temperate	Semi-arid tropic	Arid
Andhra Pradesh	6	-	15	1
Assam	23	-	-	-
Bihar	25	6	16	-
Gujarat	-	-	17	1
Haryana	-	12	-	4
Himachal Pradesh	11	-	-	
Karnataka	7	-	12	1
Kerala	14	-	-	-
Madhya Pradesh	6	9	29	-
Maharashtra	14	-	21	-
Orissa	24	-	-	-
Punjab	-	8	-	5
Rajasthan	-	10	11	9
Tamil Nadu	4	-	15	-
Uttar Pradesh	14	44	1	2
West Bengal	15	-	-	-
Total	163	89	137	23

Source: Appendix 1.2, ICRISAT (KPC Rao et al. 2005)

2.3 Conditions and Trends in Dry Lands of India

According to the ICRISAT (2005) report, the semi-arid tropic (SAT) covers total geographical area of 1.2 million sq.km, which constitutes for 37.2 percent of the total geographical area of the country. It accommodates 37.0 percent of total population. In 1997-98, SAT areas accounted for 46.2 percent of total net area cultivated in the country. SAT cultivates around 59.0 percent of area under total cereals and 60.0 percent of area under total oilseeds. Around 60.0 percent of total area under sugarcane and cotton is grown in SAT. The conditions in the dry land in India can be divided into bio-physical, technological, economic, institutional and public policy related. These are summarized in the subsequent paragraphs.

2.3.1 Biophysical problems

2.3.1.1 Water scarcity and droughts

The total usable water resources in India are estimated at 1086 cubic kilometers (ckm) and the present rate of utilization is estimated at 600 ckm per annum (Raju, 2005 as quoted in Rao, 2008). The report further says that in less than two decades from now

the water use jumps from 600 ckm to 1000 ckm per annum leaving only a thin margin to future generation. Water scarcity has been the most critical constraint in the SAT agriculture. This is caused by the low and erratic rainfall, lack of proper harvesting, storage and conservation of rain water, increased over-exploitation and pollution of both surface and groundwater, lack of proper allocation and inefficient use of water, lack of well-defined property rights in water backed by law and short comings in design and implementation of drought relief programs (ICRISAT, 2005). The destruction of vegetation and the removal of crust by trampling in arid and semi-arid dry lands lead to increased surface reflection of radiation and reduced rainfall. Lower rainfall further reduces soil moisture and vegetation cover and induces further degradation in service provision (MA 2005). The SAT area in India is prone to drought once in every three years. The areas which are most vulnerable to droughts include western Rajasthan, eastern Rajasthan, Saurashtra, Kutch and north Gujarat, western Uttar Pradesh, Tamil Nadu and Rayalseema and parts of Telangana in Andhra Pradesh.

Recent trends in irrigation show the distortion in the development and utilization of water resources for agricultural purposes. Two-thirds of net irrigated area in the country is under wells and tube wells. The reasons for growing dependence on ground water resources could be decline in public investment in irrigation in 1990s, extension of Green Revolution technologies to rain-fed and dry regions and neglect of small surface water harvesting systems such as tanks (Reddy D and Srijit Mishra, 2009). Another dimension of this problem is that the regions with high groundwater potential remain under utilized due to availability of cheap canal water while in dry regions there has been over exploitation of groundwater. The authors argue that watershed programmes have not made much progress except in few pockets and an added problem is that the traditional water harvesting structures have become defunct.

2.3.1.2 Land degradation and poor quality of soils

According to the United Nations Convention to Combat Desertification (UNCCD) (1992), land degradation means reduction or loss in the biological or economic productivity of rain-fed crop land, irrigated crop land, range lands, pastures and forests resulting from land uses or from processes arising from human activities and habitation patterns. The natural process of nutrient cycling through macro decomposers that are less water sensitive is disturbed by excessive use of land for livestock grazing and crop production. The moisture in soil which is an important factor for nutrient cycling is affected by slow process of soil formation in dry land areas. The soils have low water holding capacity and are deficient in organic matter and several nutrients and therefore cannot support high crop yields on sustained basis. Both pastoralism and farming and their combination are often implicated as drivers of degradation. The sensitivity of dry

land ecosystems to human impact increases with aridity. On the other hand, human population pressures and the associated pressure of livestock decrease with aridity (MA, 2005).

Land degradation is a serious problem in India. The extent of human-induced soil degradation in India has been estimated at 188 million hectares which accounts for 60.0 percent of total geographical area. The magnitude of loss is high in Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Madhya Pradesh, Rajasthan, Tamil Nadu and West Bengal. Most the states mentioned above have extensive semi-arid areas (Sudhakar Reddy (2007). India has been giving priority to watershed development programmes which are crucial for reversing land degradation and raising land productivity in rain-fed agriculture. However, evaluation studies on this programme expressed doubts about the sustainability of the programme (Deshpande et al. (1999).

Increasing demographic pressure on land had resulted in undue stress on land resources and reduced the size of holdings to uneconomic levels. The proportion of marginal farmers operating less than one hectare of land is increasing at a faster rate. This has resulted in wide variations in income and living standards of cultivators. Excessive and unbalanced use of fertilizers and pesticides cause adverse effect on soil fertility (Reddy D and Srijit Mishra, 2009).

2.3.2 Technological issues

2.3.2.1 Low Productivity

The SAT agriculture is characterized by low land and labour productivity. The average crop productivity in terms of value for major crops in the SAT is Rs.16,195 per hectare while it is Rs.23,534 per hectare in the non-SAT region during 1997-98 (ICRISAT, 2005).

2.3.2.2 Low level of adoption of new technologies

There is a wide gap between the average yield obtained in research plots and the farmers' fields. The gap is due to the inability of farmers to buy new inputs, their risk aversion, lack of adequate extension and other support systems such as access to market and credit and the risk involved in the adoption of new technologies.

2.3.2.3 Increasing importance of livestock and feed grains

Livestock rearing has been an integral part of farming in India especially in SAT. Now the demand for livestock products in India is increasing at a faster rate than the demand for foodgrains. Besides, the growth of livestock sector will create growth in the derived demand for feed grains and stover crops such as sorghum and millet. Livestock research and development has not received as much attention as it deserves.

2.3.3 Economic Problems

2.3.3.1 Low public investment in agriculture

Public investment in agriculture had limited coverage of infrastructure components such as roads, markets, rural electrification.

2.3.4 Institutional and organizational problems

2.3.4.1 Inappropriate property rights and tenures in land and water

Land tenure and land leasing systems are not yet reformed as a result of which there are no incentives to the tiller to invest in land development including soil and water conservation. It is necessary to legitimize the land tenure in India. This would not only provide the needed incentives to the tiller to use new technologies and investment in land development, but also enable him to access institutional credit. Similarly, most of the problems relating to the use and management of water arise from the lack of well-defined property rights in water (ICRISAT, 2005).

2.3.5 Public policy related problems

2.3.5.1 Food and nutrition insecurity

It is rightly stated that India is no longer facing food insecurity, but continues to suffer from nutrition insecurity. But SAT area suffers from food insecurity as well as nutritional insecurity.

2.3.5.2 Lack of access to markets and marketing facilities

The marketing of farm produce has been the most neglected dimension of agricultural development strategies followed in India. In the wake of new world trade regime ushered in by the World Trade Organisation (WTO), the government is likely to withdraw from procurement, storage and distribution of food grains. Restrictions on storage, sale, movement of agro-products, exports, and expansion of futures and forward trading in agro-products have been removed. The impact of these changes on the farm produce markets in the SAT is not yet clear.

2.3.5.3 Weak support system

Five major crops viz., oilseeds, cotton, pulses, wheat and sorghum account for nearly 75 percent of the gross cropped area (GCA) of SAT. The remaining area is highly diversified with a wide range of crops. A glance through the schemes and programmes in operation in SAT indicates that the interventions in the SAT are very limited. Consequently, the impact of the interventions is not visible. The existent support systems are weak and farmers face lots of problems in accessing their services. For example, the regulated markets, particularly those located in remote areas, are thin with low trade volumes and few buyers and sellers.

The SAT areas in India are highly heterogeneous in terms of natural and human resource endowments, types of farming systems, levels of living, livelihood patterns and infrastructure. In view of this no uniform strategy would be appropriate for the SAT as a whole.

2.4 Poverty and Environment

A prevalent view during the mid 1980 to the mid 1990s was that poverty and environmental degradation were intimately connected. Poverty was seen as both a cause and an effect of natural resource depletion, in a downward spiral. Increasing population density and consequent landlessness push people into marginal zones that cannot sustain permanent cultivation. People tend to depend more on gathering activities from the environment. The downward spiral occurs because of soil erosion and over-grazed pastures. Poor management of watersheds further intensifies the degree of poverty experienced by marginal groups and drives them to more intensive exploitation of the resources (Ellis F, 2000).

According to 1997 UNDP Human Development Report poverty is worse in the dry zones than in the wet zones. To understand the link between poverty and desertification, UNDP categorized countries into three clusters on the basis of human development index (HDI) and percentage of productive land vulnerable to desertification (PLVD). Cluster I is defined as low HDI and high PLVD (more than 35 percent) and cluster II with medium HDI and high PLVD, the remaining countries are categorized as cluster III. According to this study, India falls in cluster I and China in cluster II.

The poor are charged with over-exploitation and consequent degradation of natural resources. But this view has been seriously challenged by some scholars. A report of four case studies in Pakistan, India, Bangladesh and Nepal by Gary Roger reveals that the exploitation of natural resources is not because of poverty but due to 'pre-existing pattern of inequality and exploitation' (V.S.Vyas, 2003). Though population growth and poverty are still significant factors, the real threat is due to the pressure of demand from the affluent. The poor are increasingly becoming the victims of natural resource degradation in the form of shortage of fuel, fodder and drinking water rather than being responsible for such degradation (Rao, 2005).

The incidence of poverty is more in humid and SAT areas in India, where the density of population is high. Based on unit level data of the 55th Round of National Sample Surveys on Consumer Expenditure for the year 1999-2000, the ICRISTAT study (2005) shows that the poor are concentrated in the humid and semi-arid tropics with a share of 24.0 percent in each. The incidence of poverty is 14.6 percent in semi-arid temperate zone, 12.6 percent in the arid zone. The arid zone has lower incidence of poverty than

the other zones and its share in rural population is 21.1 percent. The reason for low incidence of poverty in the semi-arid temperate zone is that major parts of this region which includes Punjab and Haryana have benefited from the Green Revolution and high irrigation. The reasons for low incidence in arid region are less population pressure, more non-farm activities and less employment in agricultural sector. The incidence of poverty in dry land areas is transient in nature and the present situation might get transformed into severe and long duration poverty if the wide spread over-exploitation of ground water is not checked (Shah, and Baidyanath, 2003). Dry lands characterized by intense poverty must receive more attention in sustainable development strategy.

2.5 Human Well-Being in Dry Land Areas

The Millennium Ecosystem Assessment Survey (MA, 2005) defines human well-being as a composite of the basic materials for a good life viz., freedom and choice, health, good social relations and security. These are directly linked to the availability of ecosystem services. The report points out that human well-being in dry lands is low because the natural rate of provision of ecosystem services is inherently low. The greatest pressure on ecosystem services occurs at intermediate aridity and not in the least arid areas where population density is highest or in the most arid areas, where population density is lowest. The report finds out that sustainable use and overexploitation depend more on socioeconomic drivers than on the degree of water constraint and the resultant provision of ecosystem services. It suggests that with policies based on socio-cultural and socio-economic considerations, all dry land livelihoods (pastoral, farming and alternative) can contribute to alleviation of the current high relative poverty and improve human-well being of dry land people. On the similar ground, another study points out that poverty is not a static destiny, but is often episodic in nature as people fall in and out of poverty (Krishnaraj, 2007). Social vulnerability is a more important parameter for consideration than income or food deficiency. Recent studies on chronic poverty and malnutrition bring out the stark reality that decline in poverty has not eliminated multiple deprivations. Poverty reduction may work at least as a necessary, if not sufficient, condition for attaining nutrition/food security (Shah, A 2007). The analysis of Radhakrishna and Ray (2005) shows that a 10 percent reduction in rural poverty leads to a 6 percent reduction in malnourishment. Another study also shows a strong correlation between agricultural growth and incidence of poverty (Anil Rai et.al, 2008). The authors have developed a livelihood index for different agro-climatic zones of India. A total of 57 variables have been considered for constructing six sub-indices representing status in infrastructure, agriculture, nutrition, economic condition, health and sanitation and food availability. Finally, a composite livelihood index has been developed which indicates the livelihood status in the fifteen agro-climatic zones identified by the Planning Commission of India. Most of the tribal regions pertaining to Bihar, Madhya Pradesh,

Orissa, North-Eastern states and Jammu and Kashmir fall under the category of low livelihood status. The regions covering South India, Gujarat, Haryana and Punjab are in the highly developed category and the rest of the country occupies middle position. Maximum number of low agricultural productivity districts are found in Madhya Pradesh, Rajasthan, Orissa and Chhatisgarh. The study has shown that there was a high positive association between backwardness in livelihoods and agricultural backwardness..

Some micro studies revealed that sustainable livelihoods could be attained in dry land areas if irrigation is provided. One such study (Ponnarasi and Sita Devi, 2008) was conducted in ten villages each of Kovilpatti and Aruppukottai blocks from dry farming areas of Tamil Nadu covering a total of 300 households. The households are classified into three categories viz., households with some irrigation source (category I), households who practiced only dry farming (category II) and other worker households (Category III). The authors have computed index of standard of living and index of deprivation. It is found that that standard of living is lowest in the rainfed farming areas. Similarly, the index of deprivation also reveals that the households in the rainfed areas are the most deprived. For instance, while there are no households in the not deprived category in the rainfed areas, 80.0 percent of the households in the areas with some irrigation and 35.5 percent of the households in the other category are not deprived. On the other hand, in the rainfed areas 56.0 percent of households are in the moderately deprived category and 44.0 percent of households are in the most deprived category. There are no households in the most deprived category in irrigated and only 10.0 percent belong to this category among other worker households. They have estimated the logit model to identify the factors that make a household poor considering literacy, irrigation, employment, percentage of earners and income of the household as independent variables. All the coefficients are negative and statistically significant indicating that the probability of a household being poor declines as improvement occurs in these variables.

Another study by Ratna Reddy and Soussan (2004) argues that the sustainable rural livelihoods (SRL) framework provides a more comprehensive assessment of the watershed impact when compared to traditional approaches. Another study by V.Ratna Reddy et al. (2008), attempts to examine the influence of watershed policy on livelihoods. The five capital framework viz., natural, financial, physical, social and human capital of SRL is adopted in this study. Three villages from Anantapur district in Andhra Pradesh, were selected for the study. The analysis brings out the importance of irrigation in sustaining rural livelihoods. The main quest of this particular study is that whether watershed interventions would be effective in the absence of the critical resource namely water and concludes that proper implementation of watershed development programme along with strengthening of water bodies and creating new water harvesting structures would help in ameliorating the conditions in these regions.

A study carried at the Center for Economic and Social Studies (CESS, 2002) used the SL framework for better appreciation and understanding of poverty status and correlates of poverty in the District Poverty Initiation Programme (DPIP) project area. The baseline survey in the DPIP area in Andhra Pradesh covering three districts showed that the poorest of the poor and the poor possesses lower levels of each of the six capitals viz., human, natural, financial, physical and social capital. It has highlighted the emerging role of private sector in the fields of education and health. Inequalities in enrolment rates are due to inadequate public provision of primary schools. The study also revealed inadequate levels of physical capital in terms of roads, communication, and marketing infrastructure. One important finding of the study is that clustering of human and natural capital with financial capital makes a difference in the livelihoods of the poorest of the poor. The study has also pointed out that substituting agricultural land with livestock contributes positively to the livelihoods of the poorest of the poor and the poor provided they have access to common grazing land. The outcomes of their strategies are examined through income poverty, non-income poverty and gender empowerment. Poverty was more prevalent among SCs and STs in the programme areas. Lower private expenditure on health and education results in shows low level of human capital formation. Poverty and food insecurity are strongly correlated in all the districts.

3.1 Sustainability of Agriculture in Dry lands

According to FAO, sustainability of agriculture is defined as 'the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations'. Sustained agricultural growth is a crucial prerequisite if India wants to take advantage of liberalization. The capacity of 'Green Revolution' areas to sustain agricultural growth is doubtful. Investment in irrigation is posing serious ecological and environmental problems.

Raising agricultural productivity without endangering sustainability poses a serious challenge from two factors namely, the growing pressure of population on land and deteriorating quality of land resources (Vyas V.S. 2003). In the course of growth and diversification of agriculture, intra-sectoral differences have been emerged. The 'Green Revolution' areas have acquired considerable capacity to adopt technological changes at a fast pace. The modern corporate sector is capable of giving a big thrust to production and exports of special crops such as horticulture and floriculture. However, these two sub-sectors account for a small proportion of agricultural population and resources (Rao V.M., 1996).

The prospects of sustainability for agriculture in the fragile areas are severely constrained by the specific features of their natural resource endowments. Every land resource is

fragile, i.e. vulnerable to irreversible damage, when subjected to intensive use beyond its carrying capacity. The threshold limits to maintenance or enhancement of agricultural performance seem to have been reached in many parts of these areas. Further efforts to improve output levels imply over-exploitation of the biophysical resource base and initiation of the irreversible process of resource degradation. The conflict between short-term intra-generational issues of poverty and inequality and long-term inter-generational issues of sustainability are quite apparent in these areas (Jodha, 1991).

Due to features such as fragility, marginality and inaccessibility, agriculture in the dry land areas has limited possibilities of production and surplus generation. Because of these factors, scope for resource manipulations through higher input use is quite limited. However, owing to the heterogeneity of habitats, agriculture in these areas is also endowed with a complex of varied opportunities for land-based activities. But being too diverse and narrow and being constrained by marginality and inaccessibility, they cannot impart the benefits of large-scale operations. Benefits from the experiences of other ecological zones are also less likely, because the heterogeneities restrict the replication of other experiences to a substantial degree. In dry tropical areas, various forms of resource degradation including increased salinity of both surface and ground water, deepening of water tables, disappearance of plants from pastures and community forests and increase of areas under shifting sand are quite visible. Further, decline in overall biomass availability, substitution of cattle by sheep and goats and the extension of cropping to sub-marginal areas to meet production deficits have been observed (Ibid, 1991).

Rao (2005) has emphasized three important issues of sustainable agriculture in dry lands areas: declining level of ground-water, deforestation and decline in fodder availability. The decline in ground-water-table is due to higher rate of extraction of water than the rate of recharge and poor (only 30.0 percent) conservation of rainwater. With declining fodder availability, the carrying capacity of land for animals has also declined. He has pointed out that the number of cattle has been going down and the number of sheep and goat has been increasing. He further adds that animals which are more efficient converters of feed into meat or milk are becoming popular. Growing urbanisation and export demand are identified as reasons for increasing unsustainability of agriculture in dry land areas. Further, new institutions failed to preserve the natural resources and the price/subsidy policy does not provide any incentive to conserve natural resources. Dry lands farmers face the problems of low wage, high rents, high interest rates and high poverty. In such a situation poor place a higher value on using the resources intensively for present consumption needs. They do not have enough financial resources to invest either for augmenting these resources or for improving the productivity of the existing resources.

Researchers have identified three major growth depressing characteristics of dry land agriculture: harsh physical conditions, low priority for these areas in developmental policies, and inability of these areas to compete with modernized and dominant part of the economy (Jodha, N.S., 1989 and Rao, V.M., 1991). The widely diverse and fragile ecosystem requires an approach different from Green Revolution strategy. The Sustainable Livelihoods Approach (SLA) suggested in the study of ICRISAT for the analysis and understanding of poverty and designing interventions in the semi-arid tropic (SAT) agriculture (ICRISAT, 2005). The study proposed some additions to the classic livelihood framework. These are markets, agricultural research and technology and power. Normal SLA is weak in market analysis. Markets are more likely to be imperfect in SAT regions they create constraints to livelihoods. Although the record of technology development for SAT is impressive, the uptake has been poor. Technologies such as irrigation, pest management and livestock vaccinations can reduce vulnerability. Human capital in the form of knowledge and skills, is necessary to make proper use of technology. An important dimension of vulnerability in SAT areas is lack of power, voice and social networks which can help the poor to access resources, institutions, technology and markets. The ICRISAT study, therefore emphasized the significance of social capital and also added a sixth dimension known as political capital.

3.2 Agricultural Strategy for Rainfed Areas

India has a long history of government intervention in dry land agriculture. Some of the interventions reported are:

- Establishment of dry land research stations in the 1930s
- Establishment of the Central Soil and Water Conservation Research and Training Institute at Dehradun in 1954 and its regional centers.
- Establishment of the Central Arid Zone Research Institute (CAZRI) at Jodhpur in 1959.
- Establishment of the Central Research Institute for Dry land Agriculture in Hyderabad, Andhra Pradesh in 1984
- Development of 47 model watersheds in the 1980s and 1990s
- Launching of the National Watershed Development Programme for Rainfed Areas in 1990s.

In addition, several national level programs such as the Drought Prone Area Programme (DPAP), Desert Development Programme (DDP) and poverty alleviation and employment generation programs were also launched by the Government of India. Despite all these interventions, dry land agriculture did not attain much progress. The

period of 1960s to 1990s witnessed a lot of changes in SAT agriculture. The average value of crop and livestock outputs was lesser in SAT areas as compared to non-SAT regions. There has been shift in the cropping pattern in the SAT from coarse grains to wheat, paddy and oilseeds (ICRISAT, 2005).

The initial management of un-irrigated region lacked focus on integrated resource development and harnessing social capital. Initially, the programmes of Ministry of Rural Development were implemented by the Non-Government Organisations (NGOs) which did not have experience. Because of this, implementation was shifted to Panchayat Raj Institutions (PRIs). Programmes of the Ministry of Agriculture are continued to be implemented by the line departments. However the Ministry of Agriculture lacked experience in mobilizing communities and accepted the participation of NGOs. National Rainfed Area Authority (NRAA) observed that there have been similarities in the development processes of various Ministries and service providers. The main task of NRAA is to pool all these programmes on watershed development and rainfed agriculture and evolve common guidelines. While presenting a theoretical perspective on policy making, Deshpande and Raju (2011) argues that India never had a formal and comprehensive policy on agriculture since Independence. The policy is always a problem solving step taken in the context of severity of the issue. The policies did not address any long term issue facing the sector. They say that there was no serious effort to formulate a policy till the New Agricultural Policy (NAP) came into being in 2000. Interventions in agriculture by different levels of government are well documented but there has been a lack of coordination between the Centre and the States to achieve a well-defined set of policy objectives. Mechanisms are not properly designed for implementing the NAP.

Commenting on the recent policy documents on agriculture, Rao (2008) says that the coarse cereals which are important in the food basket in rainfed areas find no place in the National Food Security Mission (NFSM). He also mentions about Rashtriya Krishi Vikas Yojana, which makes preparation of a District Agricultural Plan, mandatory for drawing funds from the Central government. The author is skeptical about operational aspects of this programme since such plans prepared in the early nineties under Agro-Climatic Regional Planning (ACRP) were lying in the shelves. The author argues that the solution lies in not only raising the growth rate but in identifying the constraints and policy distortions that resulted in yield gaps in rainfed areas. On the National Policy for Farmers- 2007, the author argues that there is a need to focus more on the socio-economic well-being of the farmers, rather than just on production. There are evidences of success of schemes but failures of strategies. The reason for this is that our policies and strategies are implemented through a wide range of schemes undertaken by different departments without any coordination. There is increased centralization in the design of the programmes (Deshpande, 2008).

3.3 Livelihood Diversification – Alternative Strategies for Dry Land Livelihoods

In dry land areas, diversification is one of the strategies for survival and this strategy is the result of necessity or choice. Necessity refers to reasons such as eviction of a tenant, fragmentation of farm holding on inheritance, environmental deterioration leading to declining crop yields, natural disasters such as drought, floods and inability to undertake activities due to ill health. Choice refers to seeking out seasonal wage employment, migration and investing in non-farm business. Diversification for distress reasons is considered as a last resort rather than an attractive alternative livelihood. It is not possible to divide the reasons for diversification into necessity and choice. Households and individuals move between choice and necessity seasonally and overtime. Seasonality of employment, failure of labour and credit market may be grouped as providing practical reasons for diversification (Ellis, 2000).

Diversification can be on-farm diversification or move away from farm into non-farm sector. On farm diversification is of two types. One is the adoption of inter-cropping and mixed cropping. The other is combining crop and livestock activities.

Vyas (1996) distinguished diversification into macro and micro level. Diversification at the macro level can be understood as a movement away from agriculture to industries and services. But there is lack of clarity when it comes to diversification at micro level or within agriculture. There could be changes which are in the nature of shift from one crop to another crop, or from one enterprise (crop) to another enterprise (livestock). Thus diversification could suggest any one or all, of the three situations: a shift from farm to non-farm activities, a shift from less profitable crop or enterprise to more profitable crop or enterprise and use of resources in diverse but complementary activities.

Many studies have demonstrated that mixed cropping reduces the adverse impacts of unseasonal temperatures and rainfall failure. The farmers on their own have tried product mix by introducing crops or engaging in enterprises which could enable them to spread out the risks and ensure a steady flow of income. Not all of them succeeded in achieving this objective. In the absence of steady flow of income, the non-poor households suffer destitution and deprivation in different seasons. This gives rise to the problems of transient poverty (Vyas, 1996).

Livelihood diversification is an important adaptive strategy in the dry land areas for raising incomes and reducing risk. Agro-ecological, socio-economic, technological and institutional factors influence spatial patterns of diversification. These factors can be classified into demand side and supply side factors. The former include per capita income, urbanization, tastes and preferences, while the latter consist of rainfall, technology, land and infrastructure (ICRISAT, 2005).

Agriculture in dry land areas is diversifying at a rapid rate. Between 1980-82 and 1996-98, the share of high value commodities such as milk, meat, fruits and vegetables in total agricultural production of these areas has increased. The share of cereals in total value of crop production declined from 51.0 to 40.0 percent, while the share of oilseeds increased from 13.0 to 21.0 percent, and fruits and vegetables from 14.0 to 17.0 percent during the same period. This process of diversification to high value crops seems to be a natural choice. However, any horticultural development programme must be accompanied by the creation of markets. Many studies show a high price elasticity of supply of various crops.

People in SAT areas face droughts quite often and adopt many strategies to cope with the droughts and their consequences. The evidences from micro-level studies show that on-farm diversification is not seen as a prominent strategy during drought in many of dry land areas. Laxmaiah and Vijayaraghavan (2003) studied the strategies adopted by households in coping with adverse situations. The study is based on data collected from three States viz., Andhra Pradesh, Gujarat and Rajasthan covering 30 villages from each State. The study concluded that the drought-affected people, in three States, mainly resort to borrowing, draw down of stocks, reduced consumption, shifting to low cost food items and migration. However, the ranking of these strategies differ across the States.

The data from VLS of ICRISAT shows that the probability of occurrence of drought is 0.52 in the SAT villages of AP. The average shortfall of income in a drought year was 44.2 percent. About two-thirds of the farmers adopted alternative coping strategies to face the shortfall of income in a drought year. The most common strategies are borrowing, shifting to non-farm labour work, reduced consumption expenditure and migration. Another study conducted in Andhra Pradesh (CESS, 2002) also shows the similar coping strategies adopted by the people during the drought conditions. Borrowing, selling and mortgaging assets were the dominant risk management responses. All the risk management responses were coping rather than reduction and mitigation in nature. In the SAT villages of Maharashtra, the drought incidence is less with 0.25 probability. The average shortfall of income is also less at 23 percent and only 36 percent of farmers have reported that they are adopting some strategies to cope with the drought. Cutting down expenditure, changing cropping pattern and reducing input use are the measures adopted by them. Participation in Employment Guarantee Scheme is also adopted as one of the strategies. When farmers face drought for more than one year, they avail loans to dig bore-wells, lease out their lands, shifting to non-farm occupations and migrate to distant places for work. They have also resorted to sale of gold and animals.

4 Summary

The concept of sustainable development created an interest among sociologists, economists, policy makers and environmentalists. There is no consensus regarding the impact of development on environment in developed and developing countries even after two decade of debate on this issue. The conflict between inter-generational and intra-generational issues has not yet been resolved. The definition of sustainable development does not provide any explanation about its applicability to developing countries. However, it is argued that these countries can still aim to move their actual development path closer to the ideal of sustainable development.

As a result of the failure of earlier strategies in reducing poverty, attempts are made to identify the constraints to livelihoods and a sustainable livelihood framework has been developed. It is thought that identification of constraints to livelihoods would enable us to understand the causes of poverty. Basing on the definitions of livelihoods, by Chambers and Conway and Scoones developed this framework with assets, mediating processes, activities and outcomes as important elements. However, this framework does not provide any solution to reduce poverty but it can suggest ways of organizing the livelihood policy that identifies the assets, mediating processes and activities and the links between them and identification of constraints in utilizing the assets productively. This framework does not bring in the role of natural resources.

Dry land area is defined on the basis of aridity index. Based on this index dry land areas are classified into hyper-arid, arid, semi-arid and dry-sub-humid. According to the Thornthwaite classification, 69 percent of geographical area in India falls in the category of dry lands. Two important programmes such as Drought Prone Area Programme and Desert Development Programme classified semi-arid and arid districts as dry land area. While the DPAP classified semi-arid districts as drought prone areas, the DDP identified arid districts as desert prone areas. Maharashtra, Karnataka, Jharkhand and Andhra Pradesh have a major proportion of their area as semi-arid. Rajasthan and Haryana have shown greater proportion of area under arid. In addition to the above, various attempts have been made from time to time to classify the country into agro-climatic zones. The Planning Commission of India classified the country into 15 agro-climatic zones on the basis of rainfall and soil types. The National Bureau of Soil Survey and Land Use Planning (NBSS & LUP) of Indian Council of Agricultural Research on the basis of soil, bio-climatic type and physiographic situations classified the country into 20 agro-ecological regions. As against these attempts to classify the area into a large number of regions, ICRISAT has adopted a narrow classification into four agro-climatic zones namely, humid, semi-arid temperate, semi-arid tropic and arid on the basis of length of crop growing period and average monthly temperature.

The main problem in the dry land areas is the obstruction of the natural process of provision of ecosystem services by the conditions and trends that prevail in these areas. Over exploitation of vegetation leads to increased surface reflection of radiation and reduced rainfall. This lower rainfall further reduces the soil moisture and induces degradation of service provision. As a result, water scarcity and drought are the important constraints in the development of agriculture in dry land areas. Too much dependence on groundwater together with improper maintenance of watershed and traditional water harvesting structures are further intensifying the problem in dry land areas. Because of high population growth, the land has been used intensively for the crop production and livestock grazing. As a result of this, the natural process of nutrient cycling is disturbed. All the above problems and constraints finally led to degradation of land. Around 60 percent of total geographical area has been estimated as degraded in India. The loss is high in Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, Gujarat, Madhya Pradesh and Rajasthan. In addition to the above natural factors, inadequate extension and other support systems such as access to market and credit, technology have compounded the constraints of agricultural development in dry land areas.

The debate on poverty and environment degradation shows high positive correlation between the two. Poverty and environment degradation are highly correlated. The poor are charged with over exploitation and consequent degradation of natural resources. The incidence of poverty is high in humid and semi-arid areas and high population density results in concentration of poor in these areas. However, high positive correlation between population and poverty is spurious and the real threat to environment is coming from increasing demand from the affluent. It is significant to note that though the incidence of poverty is high in dry land areas, it is transient in nature. However, it becomes severe and chronic if over-exploitation of ground water is not checked. When the intra-regional variations in poverty in dry land are examined, it is found that poverty is higher in areas with no irrigation facilities as compared to the areas with some irrigation facilities. However, socio-economic factors like education and employment would reduce the probability of a household becoming poor. These results show that strengthening watershed programmes along with socio-economic development would reduce poverty in these areas. In order to make the programme effective there is a need to adopt the strategy of clustering, sequencing and substitution of livelihood capitals.

The threshold limits of agricultural performance have been reached and further efforts to improve output levels result in over-exploitation and resource degradation. Despite many State interventions, dry land agriculture did not achieve much progress. This is due to lack of focus of these programmes on integrated resource development. Coarse grains which are important in the food basket of rainfed areas are not included in the

National Food Security Mission. Further, policies are implemented without any coordination between the Centre and the States and there is an increased centralization in the design of the programmes, though dry land areas require location specific programmes.

People in dry land areas adopt several alternative livelihood strategies as a result of necessity or choice. Diversification is one such strategy. It can be on-farm diversification or a move away from farm to non-farm sector. People in these areas face drought quite often and adopt many strategies to cope with droughts. The evidence from micro-level studies shows that on-farm diversification is not seen as a prominent strategy during drought in many dry land areas. The drought affected people resort to borrowing, draw down of stocks, reduced consumption, shifting of low cost food items and migration. All these risk management responses are coping up strategies rather than mitigation in nature.

The above review shows that the issue of the relation between development and environment is not yet settled. However, the disturbance to the environment in the developing countries is caused more by the affluent than the poor. The major problem in the dry land areas is the scarcity of water and excessive use of groundwater. Proper implementation of watershed development with a focus on maintenance of traditional water harvesting structures will solve most of the problems in dry land areas. The strategy for dry land development has to be location specific. Interventions are needed to provide coping-up mechanisms as those adopted by the people are not really useful for mitigating the adverse affects of drought. In order to achieve this, the status of assets of households in these areas has to be examined. The assets constitute a crucial part of sustainable livelihoods framework. A research study which focuses on examining the variations in socio-economic conditions across different sub-groups of dry land areas of the country is required.

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