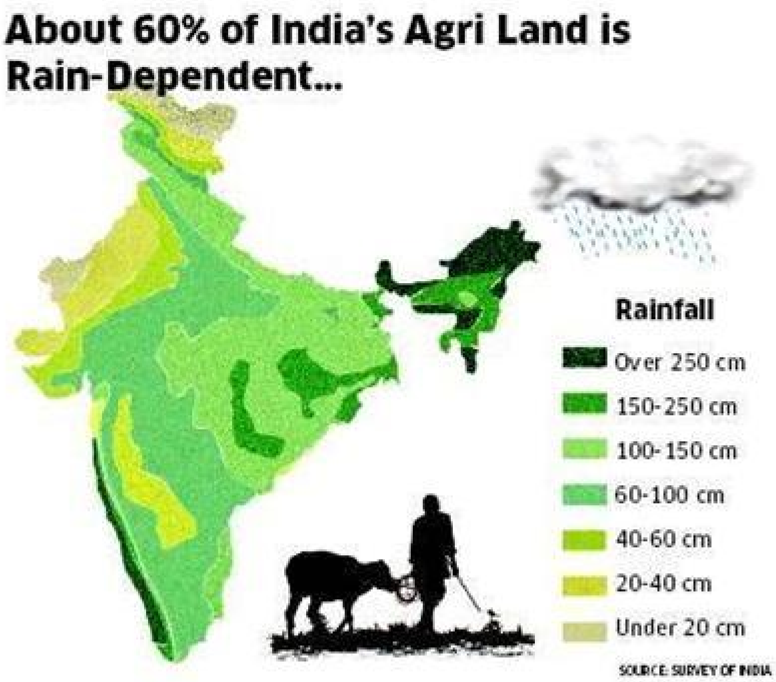
**O**n the basis of main source of moisture for crops, the farming can be classified as irrigated and rainfed. There is difference in the nature of irrigated farming as well based on objective of irrigation, i.e. protective or productive. The objective of protective irrigation is to protect the crops from adverse effects of soil moisture deficiency which often means that irrigation acts as a supplementary source of water over and above the rainfall. The strategy of this kind of irrigation is to provide soil moisture to maximum possible area. Productive irrigation is meant to provide sufficient soil moisture in the cropping season to achieve high productivity. In such irrigation the water input per unit area of cultivated land is higher than protective irrigation. Rainfed farming is further classified on the basis of adequacy of soil moisture during cropping season into dryland and wetland farming. In India, the dryland farming is largely confined to the regions having annual rainfall less than 75 cm. These regions grow hardy and drought resistant crops such as ragi, bajra, moong, gram and guar (fodder crops) and practice various measures of soil moisture conservation and rain water harvesting. In wetland farming, the rainfall is in excess of soil moisture requirement of plants during rainy season. Such regions may face flood and soil erosion hazards. These areas grow various water intensive crops such as rice, jute and sugarcane and practice aquaculture in the fresh water bodies.

Rain-dependent areas can be broadly split into two: ‘dry lands’, which receive less than 750 mm of rain a year; and rainfed areas, which receive more than 750 mm. Comprising arid and semi-arid ecosystems, dry lands stretch from Gujarat in the west till Eastern Madhya Pradesh; and from Rajasthan till the southern tip of India.



## Basic Facts- Extent of problem of Rainfed Agriculture

In India, about 60% of total net sown area comes under rainfed lands. Rainfed crops account for 48 percent area under food crops and 68 percent under non-food crops. India ranks first among the rainfed agricultural countries of the world in terms of both extent and value of produce. Due to population pressure on agricultural lands, the poverty is concentrated in rainfed regions. The climate in India's rainfed regions is characterized by complex climatic deficiencies, manifested as water scarcity for rainfed crop production. The climate is largely semi-arid and dry sub-humid with a short (occasionally intense) wet season followed by long dry season. Rainfall is highly unreliable, both in time and space, with strong risks of dry spells at critical growth stages even during good rainfall years. The fluctuations are due to numerous factors affecting the monsoonal climate including the atmospheric circulation and strong links to ENSO phenomenon in the Pacific Ocean.

## Characteristics and issues with Rainfed Agriculture

Rainfed areas in India are highly diverse, ranging from resource rich areas to resource-constrained areas. Some of the resource rich areas are highly productive and have experienced widespread adoption of technology. However, most of the areas are resource constrained and dry areas. In the resource constrained and dry areas, the farming is a survival mechanism rather than a growth oriented activity. Rainfed agriculture is practiced under a wide variety of soil type, agro-climatic and rainfall conditions ranging from 400 mm to 1600 mm per annum.

In the resource constrained and dry areas, the farming is a survival mechanism rather than a growth oriented activity. Rainfed agriculture is practiced under a wide variety of soil type, agro-climatic and rainfall conditions ranging from 400 mm to 1600 mm per annum. Rainfed Crops are prone to breaks in the monsoon during the crop growth due to water stress. This water stress may be due to variability of rainfall, delay in sowing, diversity in crop management practice and variability of the soil type. The prolonged breaks can result in partial or complete failure of the crops.

## Issues Related to Rainfed Farming

### Farmer suicides in Rainfed areas

In past, the Rainfed farming system was mainly dependent upon the locally available inputs (seeds, manures, animal draft) and used to grow a number of crops, which were able to withstand drought-like situation. However, in recent times, the cropping systems have changed and currently the farmers in these rainfed areas have limited options. Many of the farmers in these regions started cultivating high value crops which requires intensive use of costly inputs (chemical fertilizers/ pesticides, hybrid seeds, life saving irrigation, farm energy etc.) and find it difficult to manage the resources on their own. This is the major reason of growing farm suicides in rainfed areas.

### Green Revolution – Rainfed Areas – Groundwater Problem

Green Revolution bypassed the less-favored rainfed areas which were not the partners in this process of agricultural transformation. Green Revolution was designed around growing high-yielding varieties of wheat and rice, which needed plenty of water and chemical inputs. The entire agricultural research framework, incentive structure, price support, input subsidies, extension system were designed to ‘flow’ along with irrigation.

In the floodplains of the north, the farmers, realizing rainfall risk was a thing of the past, switched to HYVs because canals were there for irrigation. However, the story was different in the drylands. Here, seeds and fertilizers reached but water did not reach. Those who wished to adapt to the new seeds and fertilizers, created the predictable water supply for themselves. When electricity came, these farmers invested in groundwater pumps. The result was tube wells became the mainstay of irrigation in India.

**Green Revolution – Rainfed areas – Change in the Cropping patterns**

To reduce their vulnerability to rains, farmers in some areas grew crops such as jowar, bajra and pulses. These crops are low-yielding, but less affected by variations in rainfall. This saved the farmers from the risky nature of farming in rainfed and dry areas. In the same field, they planted multiple crops. For instance, Jowar or pulses, both drought-resistant, would be planted alongside wheat, which gave high yields in normal rains. They also maintained livestock or, if forests were in the vicinity, gathered minor forest produce. However, with the advent of green revolution and advent of electricity and groundwater tube wells, the cropping patterns also changed. For example, the farmers of Malwa (MP) used to grow jowar during the rains and Malwi Ghehu , a local wheat variety, after that till the advent of Green revolution. However, once the pumps came in, farming became a yearlong activity. Cash crops like soya displaced jowar. HYVs of wheat displaced Malwi Ghehu. This is the story of almost all parts of India, and that is the reason that cotton, maize and soya remain the major crops of the rainfed areas of India.

## Groundwater level

The too much exploitation of the groundwater by tube wells led to the depletion of this finite resource. For example, in some parts of Madhya Pradesh, the groundwater levels have plunged from 50 ft in the 1970s to 700 ft now. Today, it has taken a shape of acute crisis in six states of India. Note: If the ratio of groundwater extraction to groundwater recharge is less than 70%, it is considered safe; 70-90 %, semi critical; 90-100 %, critical; and more than 100%, overexploited. Between 1995 and 2004, the proportion of districts in semi-critical, critical and over-exploited has grown from 5% of the agricultural area and 7% of the population to 33% and 35% respectively. The six states where the level of groundwater is unsustainable are Punjab, Rajasthan, Haryana, Tamil Nadu, Gujarat and Uttar Pradesh. Ironically, these six states accounted for half the food-grain production in 2008-09.

### Dry Land Agriculture

Dry lands, besides being water deficient, are characterized by high evaporation rates, exceptionally high day temperature during summer, low humidity and high run off and soil erosion. The soil of such areas is often found to be saline and low in fertility. As water is the most important factor of crop production, inadequacy and uncertainty of rainfall often cause partial or complete failure of the crops which leads to period of scarcities and famines. Thus the life of both human being and cattle in such areas becomes difficult and insecure.

Despite all these improvements in agriculture, we have yet not been able evolve an appropriate package of practices for our dry land areas. The income of farmers of dry land regions is still very low land areas. The income of farmers of dry land regions is still very low. To feed our one billion population that we will have by 2000 A.D., we will require food grains 10 the tune of 240 million tonnes approximately. For achieving this target we will have to harness every inch of our cultivable lands, especially dry lands, with utmost care.

**Definitions**

Dry farming or dryland farming may be defined as:” a practice of growing profitable crops without irrigation in areas which receive an annual rainfall of 500 mm or even less. ”The different definitions of dry farming given by various express are described below.

Dry farming is an improved system of cultivation in which maximum amount of moisture is conserved in low and untimely rainfall for the production of optimum Quantities of crop on economic and sustames basis.

Dry farming in short, is a programme of soil and water management designed to conserve the maximum quantity of water on a particular piece of land.

Dry farming is the profitable production of useful crops without irrigation on land that receive annually a rainfall of 500 mm or less.

In a more specific way dry farming may be defined as an efficient system of soil and crop management in the regions of low land and uneven distributed rainfall.

Efforts are being made to bring more area under irrigated agriculture and thereby to increase cropping intensity. But, even when we achieve our target of 113 million hectares of irrigated area by 2000 A.D., we would still have about 45% area under rainfed cultivation. We continue to stress on intensive agriculture on irrigated land but we cannot afford to be complacent with our dry lands. Therefore, improved dry farming is necessary for equity and prosperity. As such we cannot achieve stability in food production with unstabilized dry land agriculture. Therefore, we are required to adopt improved technology especially developed for dry land agriculture.

**Dryland farming in India**

Dryland farming in India began centuries earlier than in North America. Scientific study of dryland farming was initiated by the Government of India in 1923. Early research focused on improving crop yields. Important practices included: (i) bunding to conserve soil and water; (ii) deep ploughing once in three years for better intake and storage of water; (iii) use of farmyard manure to supply plant nutrients; (iv) use of a low seeding rate; and (v) intercultivation for weed and evaporation control. These practices gave a 15–20 percent increase over the base yields (Hegde, 1995, Singh, 1995). By the mid-1950s, the emphasis had shifted to soil management. Soil conservation research and training centres were established at eight locations, focusing on contour bunding. However, negative results were often obtained because of water accumulation and runoff problems, particularly on Vertisols. Even where yield increases were observed, they were again not more than 15–20 percent above the base yields.

The importance of shorter-duration crops to match the soil-water availability period was recognized in the 1960s. It was also in the mid-1960s that high-yielding hybrids and cultivars became available that were responsive not only to fertilizers but also to management. An All-India Coordinated Research Project for Dryland Agriculture was established, and the research emphasis shifted to a multidisciplinary approach to tackle the problems. Similar efforts were initiated at the International Crops Research Institute for the Semi-Arid Tropics at Hyderabad in 1972.

Although many of the recommended practices for dryland farming in India are similar to those for North America, there are differences. A highly recommended practice for water conservation in India is the use of dust mulch, similar to that recommended in the North America in the early 1900s, which is commonly considered to have contributed to the Dust Bowl.

**Causes of Dryland Formation**

Lack of moisture to support the growth of plants and micro-organisms is the primary cause of dryland formation. Areas receiving less than 300 mm of rainfall per annum, face severe moisture scarcity during a major part of the year. It is very difficult to take up profitable agriculture on such lands without supplementary irrigation. There are many such regions where shrubs, herbs and grasses grow profusely and dry out in autumn. Sahelian region of Africa located on the edge of Sahara desert, receives only 250-300 mm rainfall and provides livelihood to millions of families through livestock husbandry. Even in Western India, the families living in Thar region of Rajasthan and Banni region of Gujarat are dependent on animal husbandry for their livelihood, only because of good growth of seasonal grasses and herbs. Such lands may not support perennial shrubs due to severe moisture stress in summer.

Arid lands, receiving an annual rainfall of 300-500 mm can easily support one crop. Such areas are found in the states of Haryana, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh and Karnataka. Some of these areas are now receiving irrigation and yielding 6-8 times more. With irrigation the employment potentials will also increase by 3-4 folds. The remaining dry areas still experience frequent crop failures, forcing the farmers to live in chronic poverty. Such poor farmers neither have resources to invest in critical agricultural inputs nor are they interested in taking any risk due to high chances of failure. Thus, the crop yields remain suppressed even in good years. It is a vicious cycle. Therefore, it is necessary to develop a sustainable model by introducing a mixed farming system with high stake in livestock husbandry to reduce the risk of failures. In such a system, even the failed crop residues turn out to be a boon for feeding livestock.

Apart from the lands suffering from moisture stress in arid regions, there are several other types of drylands located in different parts of the country. These are:

- ❖ Deep sandy soils with poor water holding capacity;
- ❖ Shallow and rocky soils which cannot absorb rain water;
- ❖ Deep soils with undulating surface, unable to hold rain water;
- ❖ Cold regions where plants cannot absorb water due to severe cold
- ❖ Sodic and saline wastelands, where plants cannot survive due to high salt content.

**Characteristics of Dryland Agriculture**

The following are the important characteristics of dryland agriculture.

- ❖ More on Dryland Farming
- ❖ Agronomic approaches in dryland farming
- ❖ Cropping systems for dryland agriculture
- ❖ Dryland Farming / Dryland Agriculture
- ❖ Principal dry farming zones in India

- Recommendations for dry farming areas in India
- Steps for raising productivity in dry farming
- Water harvesting systems
- Work on dry farming in India

**Dry land areas may be characterized by the following features;**

a) uncertain, ill-.distributed and limited annual rainfall;

b) occurrence of extensive climatic hazards like drought, flood etc;

c) undulating soil surface;

d) occurrence of extensive and large holdings;

e) practice of extensive agriculture i.e. prevalence of mono-cropping etc;

f) relatively large size of fields;

g) similarity in types of crops raised by almost all the farmers of a particular region;

h) very low crop yield;

i) poor market facility for the produce;

j) poor economy of the farmers; and

k) poor health of cattle as well as farmers.

**Problems of Dry Farming in India**

The major problem which the farmers have to face very often is to keep the crop plants alive and to get some economic returns from the crop production. But this single problem is influenced by several factors which are briefly described below.

**1. Moisture Stress and Uncertain Rainfall**

According to definition the dry farming areas receive an annual rainfall of 500 mm or even less. The rains are very erratic, uncertain and unevenly distributed. Therefore, the agriculture in these areas has become a sort of gamble with the nature and very often the crops have to face climatic hazards. The farmers also take up farming halfheartedly as they are not sure of being able to harvest the crops. Thus, water scarcity becomes a serious bottleneck in dry land agriculture.

**2. Effective Storage of Rain Water**

According to characteristics of dry farming, either there will be no rain at all or there will be torrential rain with very high intensity. Thus, in the former case the crops will have to suffer a severe drought and in the latter case they suffer either flood or water logging and they will be spoilt In case of very heavy downpour, the excess water gets lost as run-off which goes to the ponds and ditches etc. This water could be stored for providing life saving or protective irrigation to the crops grown in dry land areas. The loss of water takes place in several ways namely run-off, evaporation, uptake through weeds etc. The water could be stored for short period or long period and it can be preserved either in soil, pond or ditches based on situation and utilized for irrigation during dry periods.

**3. Disposal or Dry Farming Products**

In dry farming all the farmers grow similar crops which are drought resistant. These crops mature at the same time and the growers like to dispose off their products soon after the harvest. This results in a glut of products in the market and the situation is badly exploited by the grain traders and middlemen. Therefore, marketing becomes a serious problem in dry farming areas.

**4. Selection or Limited Crops**

Only drought resistant crops namely oilseeds, pulses and coarse grains like jowar, bajra, millets etc. can be grown in dryland areas. Thus, the farmers have to purchase other food grains and household commodities that unbalance their economic position.

**5. Careful and Judicious Manurial Scheduling Dryland Farming**

In case of irrigated farming the farmers are at a liberty to apply [manures and fertilizers according to their availability and facility but in case of dry farming they have to be very careful in fertilizer application. Due to lack of available moisture, broadcasting or top dressing becomes wasteful and meaningless. These can be applied ‘by only deep placement and foliar spray for an improved crop production. In this article, all the aspects of dry land farming including problems of dry farming and recommendations for raising productivity in dry farming have been fully discussed. This article is prepared mainly to help people working for socio-economic development of the rural poor farming classes: scheduled castes, scheduled tribes and women.

**6. Utilization of Preserved Moisture**

Judicious and purposeful utilization of preserved moisture water depends upon soil type, plant type and other factors. The amount of available water to the plants depends upon the depth of plant roots, their proliferation and density. In case of limited moisture condition, the yield directly depends upon the rooting depth. The rooting depth can be desirably increased by mechanical manipulation of the soil. If the planting is very dense and all the plants have same kind of rooting then there will be a tough competition among roots for moisture and scarce moisture condition will result in the wilting of plants. Therefore, utilization of preserved moisture is an art in dry farming. The water collected in ponds or brooks may be used to give protective or life saving irrigation. The widely spaced crops can be intercropped with oilseeds or pulses for increasing the productivity of the land per unit area and per unit time. Therefore, the water, collected during the rainy season need special technique and skill for its efficient utilization.

**7. Quality or the Produce**

The quality of the produce from dry farming areas is often found to be inferior as the grains are not fully developed or they are not filled properly; often mixed with other crop seeds owing to mixed .cropping system prevalent in these areas and the fodder become more fibrous. All these factors reduce the market value of produce and the farmers do not get the profit of their labour and Investment.

**Dryland Farming Techniques**

To increase water absorption by dryland the following techniques will be used.

**Prevent a Crust at the Soil Surface**

Probably the greatest deterrent to a high rate of water absorption is the tendency for soils to puddle at the surface and form a seal or crust against water intake. The beating action of raindrops tends to break down clods and disperse the soil.

- ❖ By tillage, create a rough, cloddy surface which lengthens the time necessary for the rain to break down the clods and seal the surface. For seed bed preparation in general, small seeds should have a finer, mellower bed than large seeds.

- ❖ After harvest, create a stubble mulch on the surface. Such material not only prevents raindrops from impinging directly on the soil, but impedes the flow of water down the slope, increasing absorption time.

**Reduce the Runoff of Water**

To the extent that waterlogging is not a problem, the runoff of water and its attendant erosion must be stopped.

a) Cropland should be as level as possible.

b) All tillage and plantings must run across (or perpendicular to) the slope of the land. Such ridges will impede the downward movement of water.

c) For every two feet of vertical drop or 250 feet of horizontal run, the field should either have bunds or contour strips (details of these practices are discussed later).

In order to reduce the Loss of Soil Moisture following techniques are useful.

**Reducing Soil Evaporation**

Water in the soil exists as a continuous film surrounding each grain. As water near the surface evaporates, water is drawn up from below to replace it, thinning the film. When it becomes too thin for plant roots to absorb, wilting occurs.

- ☞ Shelter belts of trees or shrubs reduce wind speeds and cast shadows which can reduce evaporation 10 to 30 percent by itself and also reduce wind erosion.
- ☞ Mulching reduces the surface speeds of wind and reduces soil temperatures.
- ☞ Shallow tilling can create a dirt mulch 2 to 3 inches deep which dries

out easily but is discontinuous from the subsurface water, preventing further loss. Tillage must be repeated after each rain to restore the discontinuity. This is most workable where rainfall occurs in a few major rainfalls with relatively long intervals in between.

**Reducing Transpiration**

All growing plants extract water from the soil and evaporate it from their leaves and stems in a process known as transpiration.

- ❖ Weeds compete not only for soil nutrients, but water as well and so their control is critical.
- ❖ Selection of crop is significant as well. Dwarf varieties have less surface and so lose less water. Some plants close their stomas when it is hot, reducing their water loss. Others, like corn, curl their leaves during hot afternoon and open them at night, effectively changing their surface area in response to conditions.
- ❖ In dry farming, the number and spacing of plants is reduced so that fewer plants compete for soil moisture. The exception to this occurs when allowances for insect, bird, and rodent loss must be made at planting.
- ❖ Where rainfall is frequently marginal to insufficient, drought "insurance" can be obtained by clear fallowing a sufficient area. An area clear of growing vegetation with a properly maintained stubble and soil mulch can retain 20 to 70 percent of the precipitation received until the next year. Where 5 to 6 acres each year per family have been so set aside in India, the specter of famine due to drought has been eliminated.

- ❖ Post harvest tillage will create stubble and dirt mulches and destroy weeds before the onset of the dry season.

**Food and Non-Food Plants**

Crop plants for dry regions are those that survive and produce in spite of aridity. However, in almost all of these crops, seeds must be germinated or cuttings must be rooted under conditions of almost normal water availability. Therefore, when one speaks of tolerance of dry conditions one is talking mostly about the drought tolerance of the growing or mature plant. In the following table 1.1 the food and feed crops as well as crops of other uses, and other plants that are useful in arid regions are considered.

**Table 1.1**

**Food Plants Tropics for Dry Regions**

| Scientific Name | Common Name | Degree of Tolerance* |
|---|---|---|
| **Cereal Grains** | | |
| *Zea mays* | Corn | 1 |
| *Sorghum bicolor* | Sorghum | 1.5 |
| *Pennesitum americanum* | Pearl Millet | 2.5 |
| **Grain Legumes** | | |
| *Phaseolus vulgaris* | Common Bean | 1 |
| *Vigna unguiculata* | Cowpea | 1.5 |
| *Cajanus cajan* | Pigeon Pea | 2 |
| *Dolichos lablab* | Lablab Bean | 2.5 |
| *Vigna radiata* | Mung Bean | 2 |
| *Phaseolus acutifolius* | Tepary Bean | 2.5 |
| *Vigna aconitifolius* | Mat Bean | 2.5 |
| *Tylosema esculentum* | Marama Bean | 3 |
| **Leafy Vegetables** | | |
| *Symphytum officinale* | Comfrey | 1 |
| *Manihot esculenta* | Cassava | 1 |
| *Cnidoscolus chayamansa* | Chaya | 2 |
| *Moringa oleifera* | Horseradish Tree | 2 |
| *Leucaena leucocephala* | Leucaena | 2.5 |
| **Root Crops** | | |
| *Dioscorea rotundata* | White Yam | 1 |
| *Manihot esculenta* | Cassava | 2 |
| *Sphenostylis stenocarpa* | African Yam Bean | 2 |
| **Fruit Vegetables** | | |
| *Citrullus lanatus* | Watermelon | 1 |
| *Cucurbita mixta* | Mixta Squash | 1.5 |
| *Abelmoschus esculentus* | Okra | 1.5 |
| **Miscellaneous Vegetables** | | |
| *Cynara scolymus* | Globe Artichoke | 1 |
| **Fruit Trees** | | |
| *Carica papaya* | Papaya | 1 |
| *Pouteria campechiana* | Canistel | 1 |
| *Psidium guyava* | Guava | 1 |
| *Spondias cytherea* | Golden Apple | 1 |
| *Olea europaea* | Olive | 1.5 |
| *Tamarindus indica* | Tamarind | 1.5 |
| *Zizyphus jujuba* | Jujube | 1.5 |
| *Carissa carandus* | Karanda | 2 |
| *Dovyalis abyssinica* | Dove Plum | 2 |
| *Punica granatum* | Pomegranite | 2 |
| *Anacardium occidentale* | Cashew | 2.5 |
| *Opuntia sps.* | Prickly Pear | 2.5 |
| *Phoenix dactylifera* | Date | 3 |

| Scientific Name | Common Name | Degree of Tolerance* |
|---|---|---|
| | **Oil Plants** | |
| *Pentaclethra macrophylla* | Owala Oil | 1 |
| *Helianthus annuus* | Sunflower | 1 |
| *Butyrospermum paradoxum* | Shea Butter | 2 |
| | **MISCELLANEOUS** | |
| *Catha edulis* | Khat | 2 |
| **NON-FOOD PLANTS** | | |
| | **Feed Legumes** | |
| *Gliricidia sepium* | Mother of Cacao | 1 |
| *Ceratonia siliqua* | St. John's Bread | 1.5 |
| *Prosopsis sps.* | Mesquite | 2 |
| *Leucaena leucacephala* | Leucaena | 2 |
| *Acacia albida* | Apple Ring Acacia | 2.5 |
| *Acacia tortilis* | Umbrella thorn | 2.5 |
| *Parkinsonia aculeata* | Jerusalem Thorn | 3 |
| | **Feed Grasses** | |
| *Cynodon dactylon* | Bermuda Grass | 1 |
| *Digitaria decumbens* | Pangola Grass | 1 |
| *Sorghum sudanense* | Sudan | 1 |
| | **Fiber Plants** | |
| *Gossypium barbadense* | Sea Island Cotton | 1 |
| *Agave fourcroydes* | Henequen | 2 |
| *Agave sisalana* | Sisal | 2.5 |
| | **Timber Plants** | |
| *Swietenia mahogoni* | Mahogany | 1 |
| *Acacia tortilis* | Umbrella Thorn | 2.5 |
| | **Plants for Alley Cropping** | |
| *Gliricidium sepium* | Madre de Cacao | 1 |
| *Cajanus cajan* | Pigeon Pea | 1 |
| *Leucaena leucacephala* | Leucaene | 1.5 |
| | **Ground Cover** | |
| *Dolichos lablab* | Lablab Bean | 2 |
| *Canavalia ensiformis* | Jack Bean | 1 |
| | **Windbreak** | |
| *Casuarina spp.* | Casuarina | 2 |
| *Eucalyptus spp.* | Eucalyptus | 1.5 |
| *Tamarisk spp.* | Tamarisk | 2.5 |
| | **Living Fence** | |
| *Gliricidia sepium* | Mother of Cacao | 1.5 |
| *Bursera simaruba* | Gumbolimbo | 1.5 |
| *Acacia nylotica* | Babul Acacia | 2.5 |
| *Euphorbia tirucali* | Pencil Euphorbia | 3 |

Source: Randy Creswell &Franklin W. Martin, “Dryland Farming: Crops & Techniques for Arid Regions”, 1993, pp.4-6..
*Rated from 0 (no tolerance) to 3 (high tolerance)

These plants vary in ability to tolerate aridity and in yields under arid conditions. Choosing the right crops for arid regions might involve considerable experimentation in a particular region, and, in fact, the development of suitable production systems might require years. This should come as no surprise. Native systems, as crude as they may appear, usually represent the accumulated wisdom of centuries of experimentation. If this is so, how can one hope to make an improvement? The answer is often in the introduction of species or varieties unknown in the region in question. In other cases it is related to the introduction of new technology developed in other regions. Fortunately, such new technology is now available.

**Problems of Dryland Development**

Among various types of drylands, it is only the arid regions where the productivity is affected by moisture stress. The other types of drylands are remaining idle due to lack of our interest and attitude and posing a threat to our livelihood, eco-system and biodiversity. Lack of technologies, limitation of resources and biotic pressure contribute further in conversion of these drylands into deserts.

Land has tremendous potential to support plant life. In India, there is hardly any location where the rainfall is less than 300 mm. Hence, there is no excuse for letting over 100 million ha drylands remain idle. This reflects on the lack of interest to manage these precious resources.

Fortunately, we have good success stories from India and abroad, where traditional land use practices have been providing sustainable livelihood to the local communities. Looking to these experiences, we need to develop a strategy for developing the drylands for generating gainful employment to our rural poor, while enriching the environment.

In semi-arid regions where the rainfall is over 600 mm, retention of rainwater in the field is the major problem. Increased infiltration of rainwater, assures good moisture to the soil to support plant growth. Thus, water is the lifeline not only for the survival of human civilisation but also for keeping the land resources in good health. Unfortunately, water is becoming a scarce commodity. We have already been witnessing inter-state disputes for sharing river water. Thousands of villages are dependent on tankers for water supply in summer. Rural women still spend several hours to fetch water every day. Drinking water is costlier than milk in cities. It has been predicted that in future, the world wars will be fought for water. This reflects a grave situation.

However, in India, we have been witnessing the negative impact of water, where water is a curse for many. Over 8 crore people are affected by floods every year in the country. Last year had the dubious record of many mega cities like Mumbai, Chennai, Baroda and Kolkata sinking in floods. This is an indication of heavy soil erosion and runoff of rainwater in the catchment areas. Hence, floods are warning signals of dryland formation in the catchment areas. Our inability to harness the precious water resources should be a cause of serious concern for all those involved in community development.

**Statement of the Problem**

Groundnut crop is extensively cultivated in Ananthapuramu district. It is a hardy crop that can withstand intermittent dry spells, the crop yields are affected when prolonged droughts occur at critical phenophases of the crop.

The agro-ecologically marginal conditions prevailing in Ananthapuramu district for the cultivation of rainfed groundnut. This district, as such, does not provide optimal conditions for a sustained production of groundnuts. Nevertheless, the farmers of the region continue to adopt groundnut-based cropping systems. Thus, the reasons for an increasing trend, unfortunately, appear to be related more to the lack of awareness of the farmer on the availability of better performing, more profitable, alternate cropping systems suitable for the region than to the motivation a sustained production would otherwise offer. Despite its shortcomings, this region represents a potential area for concerted efforts of interdisciplinary research for improving groundnut productivity. Groundnut is the most dominant oilseed crop grown in the region. Crop production in this low rainfall area is a high-risk proposition. The poor performance of the crop from year to year in terms of final yield is resulting in the self immolation of farmers.

**Objectives of the Study**

The main objectives of the present study are as follows:

1. To study different aspects of dry land farming including problems of dry land farming
2. To analyze the growth trends in the area, production and productivity of groundnut at national and state level.
3. To assess the agro-climatic Conditions of Ananthapuramu district and their impact on groundnut cultivation.
4. To analyze the impact of dry land farming on the livelihood of the people in the study area.

5. To suggest suitable measures to be adopted by the farmers to avoid the distress situation under dry land farming.

**Hypotheses**

1. Rainfall is a major factor causing spatial and temporal variations in groundnut yields.
2. There are various macro level factors such as agricultural and economic reforms, ineffectiveness of agricultural credit institutions and the political economy of agriculture, as well as micro level factors such as the caste and class system which have disrupted the livelihoods security of the small and marginal farmers in the study area and have driven them to take extreme steps like committing suicide.

**Methodology**

The study is basically descriptive and empirical in nature. Therefore, the data for the study were collected both from the primary and secondary data. Primary data were collected by administrating a structured interview scheduled among the selected respondent farmers. In order to collect detailed information the interview schedule was divided into four sections. Section one was intended to collect personal data of the respondents. Section two is intended to elicit the details regarding socio-economic aspects of respondents. Section three was intended to assess the awareness levels of the respondents on various aspects of dry land farming. Section four was designed with an intention to evaluate the impact of dry land groundnut cultivation on the livelihood opportunities of sample respondent households.

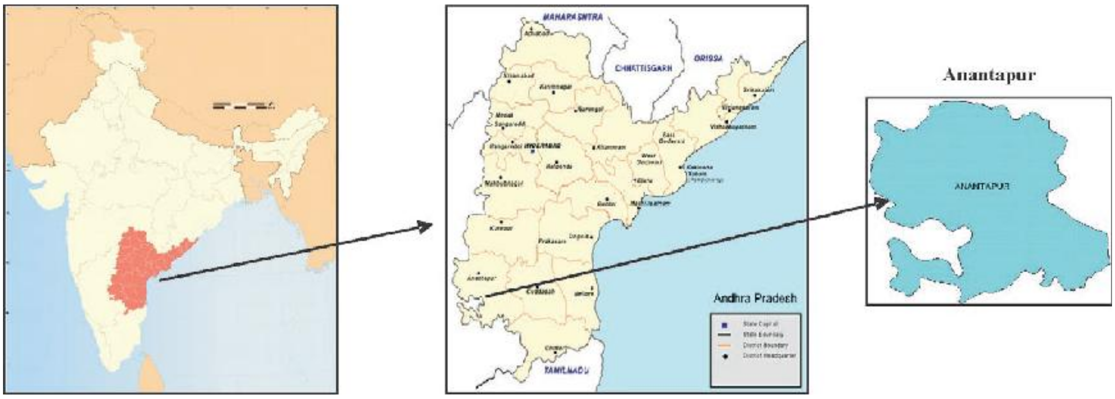
**Need for the Study**

The intra seasonal variability in crop yields is largely driven by the two parameters, rainfall and thermal regime in tropical dryland areas. The relative impact of these two parameters on crop productivity was not evaluated systematically. Therefore, a study was undertaken to assess the impact of varying rainfall and increasing seasonal temperature on the productivity of groundnut grown under rainfed conditions in Ananthapuramu district representing a typical arid region in Peninsular India.

**Study Area**

As per the agro-climatic classification adopted for India, Anantapur region is described as the scarce rainfall zone of Rayalseema in the state of Andhra Pradesh in the Indian southern plateau and hills region. The Anantapur region receives the least amount of rain in the state. Also, rain is highly uncertain and erratic. This leads to occurrence of severe droughts and crop failures. The region, in fact, represents a chronically drought-prone area in the state. Ananthapuramu is the driest district in the scarce rainfall zone of Andhra Pradesh with a predominance of Alfisols. These soils are shallow and have low fertility and low moisture-holding capacity. Soil erosion including sheet, gully, and wind erosion in some areas is a serious constraint. Most of the cultivated area is rainfed and is dependent on the southwest monsoon. Due to high variability of monsoons, crop productivity is low, uncertain, and unstable. The major crops grown in the region are groundnut, sorghum (Sorghum bicolor (L.) Moench), pearl millet (Pennisetum glaucum(L.) R. Br.)(and other millets), rice (Oryza sativa L), cotton (Gossypium sp), and coriander (Coriandrum sativum L). Hence, groundnut-, sorghum-, millet-, rice-, and cotton-based cropping systems predominate. Amongst the cereals, sorghum and rice are the dominant crops. In general, the yield levels in the Ananthapuramu district are lower by 10 per cent when compared to the state and national yields under the best case scenario. Under the worst case scenario, the yields are lower by 25 per cent of the state and national yields. The situation is much worse when compared to the yield levels of some of the leading groundnut producers in the world, e.g., China and USA where the yield levels are five-fold high. Such low yields in the Ananthapuramu region are attributed to severe production constraints posed by the natural resources as well as the socioeconomic conditions of the farming community.

**Fig. 1.1- Location map of study area**




**Sampling**

For a detailed study the entire district of Ananthapuramu is selected for analysis. The district is divided into three revenue divisions viz; Ananthapuramu, Dharmavaram and Penukonda. In all these three divisions there are 63 Revenue Mandals. For an in-depth study of the conditions of dry land groundnut cultivating farmers two Mandal from each of three revenue divisions were selected on the basis of highest and lowest acreage of groundnut cultivation. From each selected Mandal 2 villages were selected on the basis of highest and lowest irrigated area under groundnut cultivation. From each village 25 sample respondent farmers were selected by stratified random sampling method to collect the primary data. Care was taken to cover different categories of farmers namely marginal, small and big. Thus the total universe for the study constitutes 3 Revenue Divisions, 6 Mandals, 12 villages and 300 farmer respondents. Table 1.2 gives clear picture of sample.

**Table 1.2**

**Sample Framework of the Study**

| S. No | Name of the Revenue Division | Name of Mandal | Name of Village | No of Sample Farmers |
|---|---|---|---|---|
| 1 | Ananthapuramu | Peddavaduguru | 1. Konapuram | 25 |
| | | | 2. Kandlaguduru | 25 |
| | | Narpala | 1. Siddaracherla | 25 |
| | | | 2. Nadimidoddi | 25 |
| 2 | Dharmavaram | Ramagiri | 1. Nasanakota | 25 |
| | | | 2. Makkinavaripalle | 25 |
| | | Dharmavaram | 1. Thumparthi | 25 |
| | | | 2. Thummala | 25 |
| 3 | Penukonda | Chilamathur | 1. Chagaluru | 25 |
| | | | 2. Somaghatta | 25 |
| | | Gorantla | 1. Vanavolu | 25 |
| | | | 2. Devulacheruvu | 25 |
| **Total** | | **6** | **12** | **300** |

**Rationale of the Study**

The Ananthapuramu district in the state of Andhra Pradesh was chosen for simulating the response of groundnut to changing sowing dates. On-farm trials were simultaneously carried out in tandem. The district was chosen for the study for the following reasons:

a) The district alone accounts for nearly 10% of the groundnut production in the country and thus plays a major role in the regional economy;

b) The soil data and historical weather records from 1962 to 1998 are readily available for this region;

c) A number of cooperative farmers from this region were willing to participate in the research activity.

**Data Collection**

The yield data of groundnut from the field experiments conducted under the aegis of All India Coordinated Research Project on Agro-meteorology at Agricultural Research Station, Ananthapuramu was utilized in this study. The meteorological data recorded in the Meteorological observatory very close by was used in determining the weather scenarios.

The secondary data was collected from the Government of India publications, Government of A.P. Publications, Gazetteers, Magazines, Journals, Periodicals, Annual Reports, Half yearly reports, Quarterly reports, Daily Newspapers. Apart from this the relevant literature was collected from the institutions like National Innovations on Climate Resilient Agriculture (NICRA), Indian Council of Agricultural Research (ICAR), Central Research Institute for Dryland Agriculture (CRIDA), Indian Society of Dryland Agriculture etc. Besides, the information was collected from Libraries of various Universities.

**Analysis of Data**

The collected data is processed, analysed and tabulated keeping in mind the broad objectives of the study. Further the condensed information through tabulation has been summarized by using suitable statistics tools like percentages and averages.

**Chapter Scheme**

The study is divided in to six chapters.

Chapter-I- **Introduction-** it analyzes the characteristics of dryland agriculture, Dry farming areas, Constraints to Dry land Agriculture, type of rainfall in dry areas etc. It also elaborates the objectives, methodology, sampling, data collection, chapter scheme of the study.

Chapter-II- **Review of Literature-** it reviews the studies on dry land farming, groundnut cultivation and studies on groundnut cultivation in dry lands.

Chapter-III- **The Status of Groundnut Cultivation in India and Andhra Pradesh**- examines the trends in world groundnut area, production, and productivity. Similar trends for India and Andhra Pradesh State were also analyzed.

Chapter-IV**- Agricultural Profile of the Study Area**- presents the agricultural setting of study area with special emphasis on groundnut production environment. The groundnut yields and historical weather data from the Ananthapuramu district are presented in the fourth section.

Chapter V- **Problems and Prospects of Dry Land Farming: An Empirical Analysis**- analyzes the impact of dry land farming on the livelihood of the people in the study area. It also aims to understand the different mechanisms adopted by the households to avoid the distress situations.

Chapter-VI- **Summary and Conclusion**- it summarizes the whole study, presents the findings of the study and makes recommendations for profitable dry land farming with special reference to groundnut.

## References


- Bandaru, V., Stewart, B.A., Baumhardt, R.L., Ambati, S., Robinson, C.A. & Schlegel, A. 2006. Growing dryland grain sorghum in clumps to reduce vegetative growth and increase yield. *Agronomy Journal* 98:1109-1120.
- Brooks, K.N. & Tayaa, M. 2002. Planning and managing soil and water resources in drylands: role of watershed management. Arid Lands Newsletter No. 52, International Arid Lands Consortium.
- Cornish, P.S. & Pratley, J.E. 1991. Tillage practices in sustainable farming systems. *In* V. Squires & P. Tow, eds.*Dryland farming*: *a systems approach*, pp. 76–101. Sydney, Australia, Sydney University Press.
- Dregne, H.E. 2002. Land degradation in the drylands, *Arid Land Res. Manag.* 16:99-132..
- FAO, 2004. *Carbon sequestration in dryland soils*. World Soil Resources Reports No. 102. Rome.
- Han Siming, Si Juntung & Yang Chunfeng. 1988. Research on stubble mulch tillage on rainfed land. *In* P.W. Unger, T.V. Sneed, W.R. Jordan & R. Jensen, eds. *Challenges in dryland agriculture: a global perspective*, pp. 504–506. Proc. International Conference on Dryland Farming, Amarillo/Bushland, USA, 15–19 August 1988. USA, Texas Agricultural Experiment Station.
- Hegde, B.R. 1995. Dryland farming: past progress and future prospects. *In* R.P. Singh, ed. *Sustainable development of dryland agriculture in India*, pp. 7–12. Jodhpur, India, Scientific Publishers.
- Kerr, J., Pangare, G., Pangare & Pangare, P.J. 2000. An evaluation of dryland watershed development in India. EPTD Discussion Paper 68. International Food Policy Research Institute, Washington, DC, USA.

- Ma Shijun. 1988. Advances in mulch farming in China. *In* P.W. Unger, T.V. Sneed, W.R. Jordan & R. Jensen, eds. *Challenges in dryland agriculture: a global perspective*, pp. 510–511. Proc. International Conference on Dryland Farming, Amarillo/Bushland, USA, 15–19 August 1988. USA, Texas Agricultural Experiment Station.
- Mann, T.L.J. 1991. Integration of crops and livestock. *In* V. Squires & P. Tow, eds. *Dryland farming*: *a systems approach*, pp. 102–118. South Melbourne, Australia, Sydney University Press.
- Radder, G.D., Belgaumi, M.I. & Itnal, C.J. 1995. Water harvesting procedures for dryland areas. *In* R.P. Singh, ed. *Sustainable development of dryland agriculture in India*, pp. 195–205. Jodhpur, India, Scientific Publishers.
- Singh, R.P. 1995. Dryland agricultural research in India – a historical perspective. *In* R.P. Singh, ed. *Sustainable development of dryland agriculture in India*, pp. 1–6. Jodhpur, India, Scientific Publishers.
- Srivastava, J.P., Tamboli, P.M., English, J.C., Lal, R. & Stewart, B.A. 1993. *Conserving soil moisture and fertility in the warm seasonally dry tropics*. World Bank Technical Paper No. 221. Washington, DC, World Bank.
- Tow, P.G. 1991. Factors in the development and classification of dryland farming systems. *In* V. Squires & P. Tow, eds. *Dryland farming: a systems approach*, pp. 24–31. Sydney, Australia, Sydney University Press.
- Unger, P.W. & Baumhardt, R.L. 1999. Factors related to dryland grain sorghum yield increases. *Agron. J.*, 91: 870–875.