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FACULTY OF AGRICULTURAL SCIENCES & ALLIED INDUSTRIES

Rainfed horticulture may be defined as the cultivation of fruit, vegetable, flower crops and plantation crops taking the advantage of monsoon and adapting dry land technology principles for harvesting rainfall and conservation of moisture in order to get satisfactory yield and returns.

Dry Climate

- It is a climate in which a deficiency of moisture restricts, but not necessarily inhibit plant growth. Water is always a limiting factor in this climate. Water deficiency is taken as the sum of the monthly differences between precipitation and potential evapo-transpiration in the months receiving lower rainfall than the normal.
- On the basis of rainfall, it has been defined to be a scanty rainfall area with 0-250 mm rainfall/annum.
- In arid zone/dry climate rainfall is very low and is continued to 2- 4 ½ months and remaining dry months. The rains are also erratic and often come in a few big storms of short durations which result in great sum off losses instead of charging the soil profile resulting into soil as well as atmospheric water stress during major part of the year.
- Soils in dry land or arid areas are coarse and structure less with very low water holding capacity. Thus, dry regions have peculiar eco-climatological features and they can exist in tropics, subtropics as well as temperate zones of the world.

Important Arid Fruit crops

Fruit	Botanical name
Ber	*Zyzyphus mauritiana*
Pomegranate	*Punica granatum*
Aonla	*Emblica officinalis*
Custard Apple	*Annona squamosa*
Guava	*Psidium guajava*
Date Palm	*Phoenix dactylifera*
Fig	*Ficus carica*
Phalsa	*Grewia subinaequalis*
Tamarind	*Tamarindus indica*
Losoda	*Cordia myxa*
Jamun	*syzygium cumnii*

Karonda	*Carissa carands*
Bael	*Aegle marmelos*
Wood Apple	*Feronia limonia*
Mulberry	*Morus spp.*
Kher	*Cappris apphylla*
Pilu	*Salvadora oleoides*
Rose Apple	*Eugenia jambos*
Lakooch	*Artocarpus lakoocha*
Carambola	*Averrhoa carambola*
West Indian Cherry	*Malpighia glabra*
Mangosteen	*Garcinia mangostana*

Importance and scope of arid and semi arid zones

About 1/3rd land surface of the world is in the grip of Arid zone & hot deserts. The man made desert alone covers 910 m.ha area. The scope of the growth of dry land fruit industry shall be determined by

- Incentives for farmers.
- Necessity
- Adaptability of the crops and
- Future scope for expansion depending on the availability of inputs, infrastructure for distribution.
- Marketing system and industrial support.

Nutritional Significance

The importance of fruits in providing valuable nutrients, particularly vitamins and minerals in human diet is well known, and according to dietary standards an individual must consume 85g fruits/day. After writing off 20 to 25 percent as post harvest losses and inedible portion of the fruits, the availability is estimated at 46 g/day, which is one of the lowest in the world.

- To bridge this gap of demand and supply the production will have to be raised through increasing orchard efficiency and by bringing more area under fruit crops.
- People inhibiting in dry land areas are known to suffer from a number of nutritional disorders owing to lower intake of protective foods like fruits & vegetables. Growth of fruit industry in such areas shall definitely increase their intake and helps in improving health hazards.

- Nutritionally arid/arid fruit crops are highly significant and comparable with major crops. Following are the mineral composition of different minor/arid fruit crops.

Nutritional value of arid fruits/100g edible portion.

Sl. No.	Fruit crops	Calories	P (%)	Ca (%)	Fe (%)	Vit A (IU)	Thiamine (mg)	Vit.C (mg)
1	Aonla/Amla	59	0.02	0.05	1.2	-	30	600
2	Bael	23	0.01	0.09	0.6	240	-	-
3	Ber	129	0.05	0.03	0.3	186	12	15
4	Bullocks heart	91	0.01	0.01	0.6	Trace	-	-
5	Custard apple	105	0.04	0.02	1.0	Trace	-	-
6	Dates	283	0.08	0.07	10.6	600	90	Trace
7	Fig	75	0.03	0.06	1.2	270	-	-
8	Jamun	83	0.01	0.02	1.0	-	-	-
9	Karonda	364	0.06	0.16	39.1	-	-	200-550
10	Pomegranate	65	0.07	0.01	0.3	-	-	16
11	Rose apple	43	0.03	0.01	0.5	-	-	-
12	Wood apple	97	0.11	0.13	0.6	-	-	-

Commercial Importance

The organized establishment of orchards with these fruit crops can offer better return and yield, which also helps in assured supplemented income to farmers, particularly the marginal farmers. ex. Ber a wild fruit a decade back has gained commercial importance in Rajasthan, Gujarat, Haryana & Punjab gives a net profit of Rs.10,000/ha, like wise Aonla – Rs.20,000/ha even in drought years when other crops fail.

- The sick saline and alkaline soils, which can't be put under cereal crops owing to greater sensitivity, can be successfully used for fruit crops like ber, date pomegranate and aonla and even their tolerance can be raised by using resistant root stocks.
- Growing of arid fruit crops ensures proper utilization of marginal land where growing of food/fruit crops is not remunerative and can help in employment generation.
- Ecological imbalance is a striking feature of Indian arid zone growing arid fruit crops in such areas shall not only provide sustained economy but help in improving the environment and strike an ecological balance.
- The need for adoption of a multiple land use system involving cultivation of multipurpose trees/shrubs along with agricultural crops provides food, fodder, fiber or fruits (4F's) which can provide alternatives and a basis for sound farm economy.
- Provide raw materials for processing and pharmaceutical industries.
- The processed products viz., Jam, Jelly, Juice, wine etc., have got international market and make a satisfactory contribution in the national economy with a annual turnover of several million dollars. These industries provide job opportunities & extend the export potentiality of the country.
- They also serve as a good source of organic matter/manures and also fuel – Eg-Ber, Cashew, Jack, Tamarind.
- Intercropping can also be possible in dry land horticulture due to wider spacing.
- Establishment of dry land orchard on rainfed areas serves as insurance against total or partial crop failures.

Resons for Dry Land areas

- Deforestation – indiscriminately felling of trees.
- Adaptation of inappropriate cropping systems & Agronomic practices.
- Over grazing of Grassland & trees indiscriminately by the cattle.
- Over exploitation of ground water resources & in-equitable distribution of surface irrigation are some of the important reasons for increased area in arid & semiarid regions.

Characteristic features of Dry land areas

- These area are proned with high temperature (>40^{o}C in summer)
- Delayed & erratic rainfall.
- High wind speed & hot wind
- Occurrence of drought & soil erosion frequent
- Deep water table
- Soils of dry land are very shallow & low in water holding capacity & fertility also.

Characteristic features of Arid /dry land horticultural crops

1. Dryland crop should be deep rooted & perennial crops.
2. Dry land crop should be of low water requirement crop.
3. The crop should have thick & small leaves & should be shiney.

4. Crops should be hardy & tolerant to rigorous monsoon
5. Crops should shed their leaves during summer & put forth flowering & fruiting during rainy season.

Run off water harvesting and recycling techniques

In India, about 70% of cultivated area is under rainfed 12 % arid & 48 % semiarid (60 %). For successful dry land/arid horticulture, besides planting, adoption of proper soil and water conservation techniques is of prime importance following techniques are adopted.

- Fall ploughing of land prior to onset of monsoon ploughing of land across the slope prior to onset of monsoon specially during summer helps in better infiltration of rainwater, conservation of moisture and also in reducing the intensity of weeds.
- Formation of bunds/terraces: In order to conserve top soil, reduce run off of water and help in conservation of moisture, bunds/terraces may be formed across the slope depending upon the gradient. This may be done before taking up planting or even in the existing plantations if the lands are sloppy. The terraces check the runoff water within the block/terrace, thus helping in better infiltration and conservation of water. On steep & undulating slopes, formation of crescent bunds at the lower side of pit-half moon shaped bund formation towards the slope.
- Opening of catch pits: Opening of catch or soak pits of size (1.5m length, 1.0m width and 1.0m depth) wherever land is sloppy and gully formation occurs, has been found to help in better conservation of soil and moisture resulting in better growth & establishment of the plants. After filling the pits with organic matter are removed and applied to the plants after monsoon.
- Formation of farm ponds and re-cycling: Formation of farm ponds for collection of excess rain water (monsoon) and subsequent re-cycling (summer) has been found to be a suitable technique in most of the dryland areas.
- Preparation of wider basins: Immediately after the onset of first shower, preparation of wide basins, would help not only better harvesting of the rain water but also in better infiltration of rain water, conservation of moisture.
- Providing mulch and shade: Mulching (5 cm thickness around the plant) with locally available materials like dry leaves, grasses black polythene film etc., will not only help in conservation of moisture and suppressing weeds but will also minimize soil erosion. Providing shade during summer in the initial years will also help in minimizing the mortality of plants under rainfed conditions.
- Timely planting – Planting during monsoon by taking the advantage of rainfall is advisable.
- Selection of grafted plants for planting.
- Planting of trees along the contours/trenches/terraces.

- Raising wind breaks around the borders of plantation with fast growing species like casuarinas, silveroak etc. will help in creating suitable micro climate for growth of crops inside the farm.

Planting techniques in Arid/dry land orcharding

I. Selection of crops: Selection of suitable horticultural crops depends upon different agro-climatic conditions – In Karnataka – 3 catagories of areas are prevailing.

- Maidan- The crops are Jack, Tamarind, annona, ber, Jamun, wood apple Amla, Fig, Phalsa etc.,
- Malnad – Early varieties of ramphal, sitaphal, Jamun, Jack etc.
- Coastal – Early varieties of Karonda, Jamun, Jack, bread fruit, butter fruit, Cashew, apple etc.

II. Wind breaks: like casuarinas, Silver oak help in demarcating the boundaries & also provides timber.

III. System of planting: Depending upon the level and slope of the land system of planting – Square, triangular, rectangular or contour systems of planting could be adopted.

IV. Planting of rootstocks & in-site grafting: In rainfed areas it is always desirable to plant seedlings and to takeup in situation grafting in subsequent season, helps in better establishment.

The unexploited fruit plants for watershed areas are – Tamarind, ber, karonda, pomegranate, Jamun, Jack, Aonla, Fig, Phalsa, Wood apple, Custard apple etc.

Distribution of Arid & Semiarid /Dry land regions or zones

The climatological data of the arid and semi arid regions of India have been analysed by Sarkar & Baswas (1980). The entire dry farming areas have been divided into four zones. Zone –D, E, F & G.

Zone-D

This zone has the lowest crop potential. It occurs at three places.

- The first starts from the Jamnagar district of Gujarat to Ferozpur in Punjab.
- The second includes part of Ahmadnagar, Pune, Satar, Solapur and Sangli districts of Maharastra.
- The third includes portions of Bijapur, Raichur and Bellary districts of Karnataka and Karnool & Anantpur districts of Andhra Pradesh.

ZONE–E

- This area extends from Rajkot in Gujarat along with east of Zone-D up to Punjab through Rajasthan and Haryana.
- This area also extends from Ahamadnagar (Maharastra) to coastal areas of Cadappah(Andhra Pradesh) through Stara, Pune, Solapur & Sangli districts of Maharastra and Bijapur, Bellary & Tumkur districts of Karnataka.

ZONE-F

- This zone is confied to two localities in the country.

- In the north, it comprises vast areas of Gujarat, Rajasthan, Uttar Pradesh and a portion of Haryana and Punjab.
- In the South, this zone stretches from the Nasik district of Maharastra to Kanyakumari of about 1/3rd land surface of world is in the grip of Arid zone and hot desserts.
- The man made desert alone covers 910m ha area.
- Tamilnadu. A large portion of Karnataka and Andhra Pradesh also fall within this zone.

ZONE-G

- This zone has the highest crop potential.
- This area consists of small portion of UttarPradhesh, Madhya Pradesh, Gujarat & Tamil Nadu and considerable parts of Maharastra and Andhra Pradesh.
- A part of Tamil Nadu receives the North east monsoon and the growing season, therefore differs significantly from the rest of localities.

Distribution of dry zone/Arid zone in India

- The Arid zones are characterized by sparse scattered and highly variable precipitation, extreme variation of day and night temperature and high evaporation.
- In India the arid regions occupy nearly 12 % of the land surface comprising 3,17,000 km2 (39.54 m.ha – 31.71 m. ha in hot arid and 7.83 m. ha in cold arid region) in the states of Rajasthan, Gujarat, Andhra Pradesh, Punjab, Haryana, Karnataka & Maharastra.

Statewise areas of arid zones of India

State	Area under Arid Zone (m/ha)	% age area out of total and zone.
Rajasthan	19.61	62
Gujarat	6.22	20
Andhra Pradesh	2.10	7
Punjab	1.45	5
Haryana	1.20	4
Karnataka	0.86	3
Maharastra	0.13	0.4

Thus the area in the arid zone, N-W India constitutes almost 90% of the total arid zone in the country.

Extent of arid region in India

Regions	Area (m.ha)	Important districts represents

A. Hot arid region	31.71	
a) North-West India	28.56	
- Western Rajasthan	19.61	Bikaner, Barmer, Jaisalmer, Jodhpur, Ganganagar, Churupali, Jalore, Nagor, Ajmer Sikar, Jhunjhanu
- North – Western Gujarat	6.22	Kutch, Amreli, Jamnagar Surendranagar, Jungadh Banaskantha, Mehsana
- South-Western Punjab	1.45	Ferozpur, Bhatinda
- South – Western Haryana	1.28	Hissar
b) Southern India	3.15	
- Andhra Pradesh	2.16	Anantapur, Kurnool & Cuddapah
- Karnataka	0.86	Dharwad, Chitradurga, Bellary and Raichur
- Maharastra	0.13	Dhulia, Nasik, Sholapur and Satara
B. Cold arid region	7.83	
- Jammu & Kashmir	7.00	Leh, Kargil, Ladakh
- Himachal Pradesh	0.83	Kinnaur, Chamba,
Total	**39.54 m.ha**	