

## 1. What are drought resilient farming techniques? Discuss. Assess their suitability for drought affected regions of India.

### Introduction

Drought is considered as a deficiency in rainfall/ precipitation over an extended period, usually a season or more, resulting in water shortage causing adverse impacts on vegetation, animals and people.

### Body

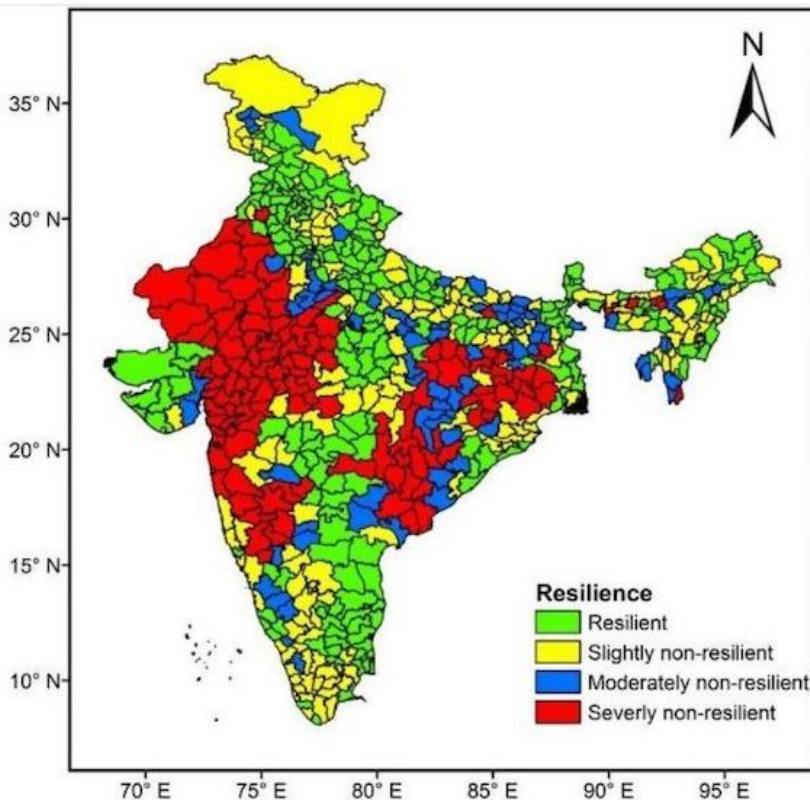
Dry farming is the profitable production of groups, without irrigation, of land with a low average or highly variable rainfall.

#### Different drought farming techniques:

- **Bunding:** the first essential step in dry farming is bunding. The land is surveyed and level contours determined every hundred feet.
- **Strip cropping:** strip cropping is a technique that serves to control erosion and increase water absorption thereby maintaining soil fertility and plant response
- **Stubble mulching:** it aims at disrupting the soil drying process by protecting the soil surface at all times, either with a growing crop or with crop residues left on the surface during fallows.
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- **Dirt mulching:** it aims at disrupting the soil drying process with tillage techniques that separate the upper layer of the soil from the lower layers, making the soil moisture film discontinuous.
- **Intertillage:** Crops sown in rows can take advantage of intertillage practices. This conserves moisture by the formation of dirt mulch.
- **Inter-cropping:** it is growing two or more crops simultaneously on the same field in a definite pattern. The crops are selected such that their nutrient requirements are different. This ensures maximum utilisation of the nutrients supplied, and also prevents pests and diseases from spreading to all the plants belonging to one crop in a field.
- **Crop and variety selection:** Short-stemmed varieties with limited leaf surface minimize transpiration, deep, prolific root systems enhance moisture utilization should be chosen. Quick-maturing varieties are important in order that the crop may develop prior to the hottest and driest part of the year.
- **Drought tolerant crops:** millets are high resistant to drought such cowpea, foxtail, maize, sorghum, bajra , ragi, can be grown along with some type of oil seeds.

**Issues:**

- About 42% of India's land area is facing drought, with 6% exceptionally dry--four times according to drought early warning system. Andhra Pradesh, Bihar, Gujarat, Jharkhand, Karnataka, Maharashtra, parts of the North-East, Rajasthan, Tamil Nadu and Telangana are the worst hit. These states are home to 500 million people, almost 40% of the country's population.
- Failed monsoon in recent years. The North-East monsoon, also known as 'post-monsoon rainfall' (October-December) that provides 10-20% of India's rainfall, was deficient by 44% in 2018.
- About 6% of the land area of the country is currently in the Exceptionally Dry category, which is nearly four times the 1.6% area at the same time last year.

**Drought farming techniques in various places:**

- The Indian hot arid zone covers an area of 31.7 m ha. (12% of country's total geographical area) in states viz., Rajasthan, Gujarat, Punjab, Haryana, Maharashtra, Karnataka and Andhra Pradesh and 7.03 m ha of cold arid zone in state of Jammu and Kashmir.
- In Rajasthan, in order to save water from evaporation and conserve water, plasticulture as a technique is used. The main crops grown are barley, wheat, ground nut, cotton, mustard and all type of millets.

- Dryland agriculture is important for the economy as most of the coarse grain crops, pulses, oilseeds, and raw cotton are grown on these lands. One hundred and twenty-eight districts in India have been recognized as dryland farming areas. Of these, 91 districts are spread in the states of Madhya Pradesh, Chhattisgarh, Uttar Pradesh and Tamil Nadu.
- Several districts have started taking up organic farming in order to conserve water and soil, HYV crops needs more water and some districts have moved towards millets farming replacing Paddy. In Maharashtra main crops grown are wheat, jowar, pulses, bajra, cotton, oilseeds, turmeric and tobacco.

**Note: Only a few techniques are mentioned here, in exam 3-4 techniques along with the regions where they are practiced will make it a complete answer.**

### **Conclusion:**

Dry farming technique is widely used in Israel. Israel is the example for the world in optimising the use of water in general and agriculture in particular. India has openly embraced Israel for this. Micro Irrigation Incubated in Israel and gradually spread worldwide, micro irrigation has proven to be a technology which has the potential to change the face of Indian agriculture.

## **2. With the help of suitable examples, examine the significance of decentralised water storage and irrigation techniques for India's agro-climatic conditions.**

### **Introduction:**

According to the Composite Water Management Index (CWMI) report released by the Niti Aayog in 2018, 21 major cities (Delhi, Bengaluru, Chennai, Hyderabad and others) are racing to reach zero groundwater levels by 2020, affecting access for 100 million people.

### **Body:**

India accounts for only about 4 % of global water resources, but supports 18 % of the World's human population and 15 % of its livestock, putting considerable strain on water resources. Agriculture consumes more than 80 % of the total usable water available in the country.

### **Significance of decentralised water storage and irrigation:**

- Decentralised storage systems offer the possibility to provide safe drinking water where centralised supply systems are not feasible due to technical, economical or institutional reasons. Ex: In rural communities or informal settlements.
- Small water bodies (mainly tanks) are less capital-intensive, user-friendly with fewer environmental problems and augment groundwater resources through

sub-surface recharge. Ex: Existence of decentralised water storage systems in (Hebbal) Bengaluru, etc.

- Decentralised supply offers the possibility to provide clean, reliable drinking water to rural or informal settlements where centralised systems are not economically or technically possible.
- Wide range of simple, relatively inexpensive and cost effective options are available so people can choose the technologies most appropriate for them. Ex: Drip irrigation, Sprinkler technique, etc.,
- In cities with grave water crisis decentralised water storage is the only solution and the society as a whole should make an effort in this regard. For Ex: Individuals and communities in Chennai have created a simple rainwater harvesting apparatus which can successfully collect 225 litres in just 10 minutes.
- Traditional irrigation techniques such as tankas, khadins, vav, ahar pynes are significant in areas such as arid and semi-arid regions. Ex: Bikaner, Jaisalmer, South Bihar.
- They are independent from an institutional set-up or centralised systems.

### Conclusion:

The World Bank, in its report India's Water Economy: Bracing for a Turbulent Future (2006), had outlined that dams in India have the capacity to store only about 30 days of rainfall, compared with 900 days in major river basins in arid areas of developed countries. Hence, more efforts need to be taken to develop water infrastructure in a decentralised manner by shifting the focus to cost-effective methods.

### 3. What measures have been taken to reform the agricultural marketing system of the country? Are they successful? Critically examine.

#### Introduction

Agricultural marketing system refers to the process of buying and selling agricultural commodities. Currently, it is governed by the Agricultural Produce and Marketing Act (APMC) in most states.

#### Body

##### Measures to reform:

- Electronic National Agriculture Market (e-NAM) to connect all APMC mandis across states through an electronic portal, thus benefitting both farmers and consumers.
- Model Agricultural Produce and Livestock Marketing Act, 2017 to assist farmers to directly connect buyers to enable them to discover the optimum price for their commodities.

- Model Contract Farming and Services Act, 2018 to integrate farmers with bulk purchasers including exporters, agro- industries etc. for better price realization through mitigation of market and price risks to the farmers and ensuring smooth agro raw material supply to the agro industries.
- Gramin Agricultural Markets (GrAMs) so as to promote 22,000 number of retail markets in close proximity of farm gate.
- Agriculture export policy, 2018 which aims to double agriculture exports from \$30 billion to \$ 60 billion by 2022.
- Pradhan Mantri Annadata Aay SanrakshAn Abhiyan (PM-AASHA) to ensure remunerative prices to farmers for their produce.
- Development and Strengthening of Grading and Standardization System: Assigning 'AGMARK' to graded products which ensure good quality and also command a better price in the market.
- Farmer Producer Organisation- SFAC has been promoting Agri-Business by encouraging institutional and private sector investments and linkages to ensure the empowerment of all farmers in the country.
- PM Kisan SAMPADA Yojana for creation of modern infrastructure with efficient supply chain management from farm gate to retail outlet.

**Success:**

- Direct marketing- There are some successful initiatives like April Mandi In Punjab, Uzhavar Sandhai in Tamil Nadu, Shetkari Bazaar in Maharashtra, Hadaspur Vegetable market in Pune, Rythu Bazaar in Andhra Pradesh, Krushak Bazaar in Odisha and Kisan Mandi In Rajsthan.
- Better price realization- Farmers are increasingly getting into contracts with companies like Pepsico giving them better returns and technological inputs.
- Increased profits- Reduction in middleman through initiatives like e-NAM have helped increase profits of farmers.

**Challenges:**

- **Lack of infrastructure:** open auction platforms exist only in two-thirds of the regulated markets; one-fourth have common drying yards. Cold storage units exist in less than one-tenth of the markets and grading facilities in less than one-third; electronic weigh-bridges are available only in a few markets.
- **Existence of Middlemen:** There are as many as 22,000 commission agents and innumerable middlemen in each market. According to Ashok Gulati, former chairman of the Commission for Agricultural Costs and Prices, commission agents in Delhi charge exorbitant fees ranging from 6 per cent to 15 per cent.
- **'Agriculture' in state list:** Many states fail to implement the guidelines of centre Eg: Model APMC act , eNAM are still not adopted by all states.
- **Lack of grading and standardization facilities** due to which they are not able to get better price and it weakens their bargaining power.

- **Lack of credit facilities** due to which a farmer has to sell his produce immediately after the crop is ready. Adequate credit facilities can enable him to withhold his produce and run his household till he gets a better price.
- **Lack of market information** by way of prevailing condition in the market as well as prices prevailing.

### Conclusion

The goal of doubling farmers income by 2022, can only be realized when farmers actually get a fair price for their produce. The measures have been good in spirit, but their implementation towards the objective is the key.

### Q4. Critically assess the storage and transportation infrastructure in the farm sector. What measures have been taken by the government to address the existing impediments?

#### Introduction:

India is an agrarian Economy. The Indian agriculture sector accounts for 18 per cent of India's gross domestic product (GDP) and provides employment to 50% of the countries workforce.

#### Body:

Currently, India is the major producer of many fresh fruits, vegetables, milk, fibrous plants. India is the world's largest producer of pulses, rice, wheat and spices. Despite being a mega producer of so many farm produce, India lacks terribly in transport and storage infrastructure which provide value addition to the produced.

#### Issues related to Storage and Transportation Infrastructure:

- **Regional Disparity of Storage Capacity:** The CAG report revealed serious imbalances in the availability of storage capacity and a huge shortage of storage space in consuming states:
  - Out of the total of 336.04 LMT of storage space available with FCI, 64% was located in the large procurement states like Punjab, Haryana, Andhra Pradesh, Uttar Pradesh and Chhattisgarh;
  - Only 13% of the total capacity of FCI was with the consuming states of Rajasthan and Maharashtra.
  - The remaining capacity of 23% was being shared by the other 24 states/UTs
- **Inadequate infrastructure for storage:** There is a gap between agri-warehousing supply and demand at 35 mn MT.
- **Low Private investment:** Due to low returns on investment, this sector is less attractive to private companies.

- **The skewed distribution of capacity:** Skewed distribution of this capacity is another issue, with North India having access to 60% of the total storage infrastructure.
- **Lack of cold storage infrastructure:** India's current cold storage capacity at 31 MT is barely sufficient for fruit and vegetables produced in the country. Most existing cold storages are single commodity storages, resulting in their capacities lying idle for up to six months a year. The cold-chain infrastructure is also unevenly distributed among states.
- **The poor condition of storage facilities:** Warehouses infrastructure having the poor built quality which may sometime lead to water percolation through ceiling and walls, which damage the produced.
- **Poor road connectivity:** Road connectivity is weak, especially in hilly areas. Poor maintenance of rural roads is a major constraint as well. Linkages with local and feeder roads remain sub-optimal. This unable farmer to connect to the market. Especially in case of a perishable item, it causes huge loss to farmers.
- **Minimum use of rail freight:** About 1.9 per cent of the perishable fruits and vegetables are transported through rail, while 97.4 per cent of the produce is transported through roads. This ratio needs to shift in favour of the rail network.
- **Cost:** The transportation and storage cost in India is very high compared to developed countries. High cost reduces the competitiveness of Indian agricultural produce both in domestic as well as the export market.
- **Lack of refrigerated Trucks:** Low investment is seen in refrigerated trucks which is a must for cold storage logistics.

#### Measures were taken by the Government:

Government has taken many initiatives to strengthen the storage and transportation infrastructure such as:

- Inclusion of agri-warehousing under priority sector lending by RBI.
- The tax incentive is given to private players so they take an active interest in this sector.
- Subsidy schemes for farmers to access privately owned warehouses.
- The Warehousing Act which will promote negotiability of warehousing receipts.
- The Private Entrepreneur Guarantee Scheme to incentivize private investment for construction of warehouses by private entrepreneurs, with an FCI guarantee to hire them for 10 years, assuring a fair return on investment by the entrepreneur.
- PM-Gram Sadak Yojna: To connect the hinterlands for better transport connectivity.
- Operation Greens: In the budget speech of 2018-19, a new Scheme "Operation Greens" was announced to promote agri-logistics, processing facilities and professional management. But it is only to seek to stabilize the

supply of Tomato, Onion and Potato (TOP) crops, excluding other farm produce.

**Conclusion:**

Unless some very drastic measures are taken to improve the storage capacity of food grains, the wastage of food grains cannot be curbed which otherwise could be utilized for feeding millions of poor people and to achieve SDG 2. Moreover, the development of storage and transportation infrastructure is a prerequisite for Doubling farmers' income by 2022.

**5. Various Indian states have employed innovative technology to improve farm productivity and increase farmers' income. Can you discuss two such case studies?**

**Introduction:**

India's farmlands today are at a critical juncture. Our population continues to grow, rapidly industrialising and there is fall in agricultural income and the sector is in danger of being left behind. The need has arisen for another revolution: a new phase in Indian agriculture which is being defined by innovation and technology.

**Body:**

Various states have adopted innovative techniques suitable for the topography and climatic factors.

**A unique irrigation technology called System of Water for Agriculture Rejuvenation (SWAR) in Telangana:**

- SWAR shifts irrigation from surface to measure moisture at plant root zone. Soil moisture content in the root-zone is an important variable in modelling hydrological and biophysical processes and agricultural applications and SWAR works on these parameters. The root zone also serves as an ecosystem to foster soil micro-organisms besides rationing plant water requirements.
- Technology used: The system involves storing of water in overhead tanks and sending it through a small diameter pipe to a customised locally-made clay pot that is buried near the root area. The clay pot contains micro-tubes that transmit water through a sand pouch, to prevent the roots from invading the pipes and the pot. The slow oozing of water provides moisture for a prolonged period, the level of which is calculated based on soil type, plant species and its age.

**Benefits:**

- SWAR uses a very less amount of water and there is zero wastage of water.
- The innovation has been highly recognised by the Andhra Pradesh and Telangana government. The government has placed orders for



implementation of the system in an extent of 400 acres in Anantapur, Kurnool and Chittoor.

- The system is suitable for the massive tree plantation programme. In 2015, this technique was also used to grow vegetables and flowers.
- This helped show immediate results in terms of both soil and plant health and farmers' incomes.
- In vegetables and fruits, where close planting is done, it was discovered that one eighth of the water suffices, compared to drip irrigation.
- The innovative SWAR system attained a global recognitions and awards. It was due to these promising early results that SWAR received the Global Champion Innovation Prize for Water and Forestry at the 2015 Paris International Agricultural Show.
- SWAR desires to bring more low-rainfall areas under irrigation.

#### **Protected Cultivation along with Plasticulture in Rajasthan:**

- Involves cultivation in greenhouses and shade-net houses and use of Plasticulture applications in drip irrigation systems and sprinkler irrigation systems.
- Technology used: Slim polyethylene hoses with small nozzles run along the length of the plantations; the jets shoot water mixed with fertilizer directly at the roots; climate-controlled greenhouses create balmy conditions, just right for the plants inside
- From 2014-15 to till now, 32.74 lakh Sq.M. area of Green House, 3.05 lakh Sq.M. area of Shade net, 255.10 lakh Sq.M. area of Plastic tunnel have been established and 16149 Ha, area covered under plastic mulching.
- The focus districts initially are Jaipur, Alwar, Ajmer, Chittorgarh, Udaipur, Kota, Sawai Madhopur, Sriganganagar and Bikaner.
- Cucumber, tomatoes, cherry tomatoes and strawberries are mainly cultivated and to increase farmers' incomes, facilitation has been provided to practice floriculture with flowers like Gerbera and Dutch Rose commonly grown.
- Rajasthan State government is also providing 20 % additional subsidy on Green House and Shade net so that Small /marginal/SC/ ST farmers could get subsidy up to 70%.

#### **Benefits:**

- Enhanced productivity and cost-saving: For ex: it is observed that Greenhouse cucumber production gives an average 50 tonne of average production. The average cost of cucumber is about Rs 20 per kg. So that's Rs 10 lakh in total revenue. If total costs are Rs 3-4 lakh, that means saving of around Rs 6 lakh.
- Yield improvement and water savings roughly about 50%- 60%.
- Fertilizer savings up to 30%-40%.
- Prevention of weed growth.

- Subsequent increase in farmers' income and additional income from floriculture.

**Note:** Many more examples of Zero-Budget-Natural Farming, Irrigation farming in Rajasthan etc. can be mentioned.

**Conclusion:**

India's Department of Agriculture says the pace of farm mechanization has been poor, thus the need for greater mechanization and innovation for higher productivity is sorely felt in the sector.

