3. Agriculture - A Modern Approach

Recall a little

- Agriculture is the back bone of Indian economy.
- Lack of technology adoption is the cause for low productivity in agriculture.
- Government is promoting organized farming in the form of Farmer Producer Organization / Company.
- Modern agricultural technologies have the potential to change this scenario.

Organised farming

Though India has agriculture as a major occupation, productivity and profitability is far below the expectations.

Organised farming is a group of producers coming together to pursue specific common interest of their members and developing technical/economical activities that benefit them.

Decrease in total land holding per capita is also a restricting factor for developments in agriculture. Need is to organise the farm and farmers for efficient farming. There are some patterns of organised farming which can be discussed.

Can you tell?

- Why farmers should be motivated to start organized farming ?
- Any example of organized farming in your region ?

3.1 Community farming

Meaning and Description

When number of individuals come together for collective farming on a certain piece of land, it is called as community farming. Here the land may be owned or leased by the participants.

Decisions and actual practices may be the responsibility of the group or of some authorised persons. Generally, the purpose of community farming is to reduce cost of cultivation, increase productivity and to harness the benefit of large scale farming. Farmers having small land holding also tend to unite for community farming.

Currently, people having interest in farming but do not have cultivable land also use to participate in community farming. Agencies providing such facility are active on websites. Here, the participants from different occupations can register their names, hire a piece of land and select the crops to be grown. Charges are applied according to crop selected. All operations are carried out by the agency, regular updates are provided on website and through messages. The participant can also visit the farm and enjoy actual working in the field. Produce from the hired land is delivered to the owner in the form of goods or money.

3.2 Farmers producer organization / company

3.2.1 Meaning

Farmers from a locality come together to form a Farmers Producer Organization (FPO). Through FPO, farmers adopt commercial practices like tie up with market, primary processing, branding, marketing, etc. For convenience of banking and to give professional framework, the FPO may be registered under company act as Farmer Producer Company (FPC).

3.2.2 Advantages

Following advantages can be obtained by formation of FPO / FPC

(1) Limitations of decreased land holding are eliminated.

(2) Minimizes cost of production by collective purchasing of inputs.

(3) Production of uniform quality crop as per demand and market linkage gives premium rates to the produce.

(4) Working together in the organization facilitate communication and exchange of ideas. This favours transfer of information and adoption of advanced technologies.

(5) Funding agencies and government departments give support on priority.

(6) Role and responsibilities can be devided among members.

(7) Resources and machinery can be utilized more efficiently e.g. lift irrigation, combine harvester, etc.

Key points for formation of FPO / FPC

Agency for Technology Management in Agriculture(ATMA) is a division of government agriculture department having authority to register such organization and support for further activities.

(1) As per current guidelines, group of minimum 20 farmers is eligible to form FPO.

(2) Application in format should be submitted to ATMA, Taluka Agriculture Office (TAO).

(3) Project Director, ATMA / District Superintendent Agriculture Officer (DSAO) issues letter of registration.

(4) Bank account can be opened in the name of registered FPO. Authorised signatories of the group can operate the account.

(5) FPO can purchase inputs or sale the produce and have transactions through this account.

(6) Registered FPO can apply for various schemes of government and avail the support.

(7) Different activities like field day, farmers rally, visit to research stations and successful entrepreneurs, training programs, etc. can be conducted.

(8) FPO can be registered as FPC under ministry of corporate affairs.

(9) While formation of FPC, digital signature of director having signing authority and Director Identification Number (DIN) are essential.

Try this

- Visit nearby office of the agriculture department
- Collect information regarding government schemes & projects supporting farmers for organized farming

3.3 Corporate farming

3.3.1 Meaning

When farming is done by a company on its own farm or leased farm, it is referred as corporate farming. Main objective is production of agricultural goods as per market demand. Because of corporate farming, there is fast dissemination of advanced technology. The corporate sector may also have some research activities from such farming.

3.3.2 Advantages of corporate farming

(1) Waste lands, uneconomic lands, fallow lands owned by farmers or government may be leased to a company and made productive.

(2) New patterns of cultivation are popularized in the region.

(3) Farmers may be demonstrated the advanced technologies applied at such farms.

(4) Corporate farming may also help in agricultural education, extension and research activities.

(5) There is overall increase in employment generation, productivity and economy of the region.

(6) Some infrastructure facilities like marketing, transport, processing can be developed by corporate farming.

(7) Availability of funds is not the limitation.

3.4 Contract farming

3.4.1 Meaning

In contract farming, an agreement is executed between the producer and the consumer / buyer. Certain parameters are fixed to define quality of the produce to be purchased. Stipulated time and quantity are also important aspects to be followed by both parties. Specific product or products are mentioned in the contract as per desire of the buyer and willingness of the producer to supply accordingly. In this way producer commits to supply agricultural goods and buyer commits to purchase it.

3.4.2 Contract farming business models

(i) Informal model - This model is short term and risky of all contract farming models, with a risk of default by both the promoter and the farmer. However, this depends on the situation - interdependance of contract parties or long-term trustful relationships may reduce the risk of opportunistic behaviour.

Special features of Informal Model are

(1) Small firms execute simple, informal seasonal production contracts with small holders.

(2) The success often depends on the availability and quality of external extension services.

(3) Some services may be provided and are limited to the delivery of basic inputs, occasionally on credit; advice is usually limited to grading and quality control.

(4) Typical products: requiring minimal processing / packaging, vertical coordination; e.g. fresh fruits / vegetables for local markets, sometimes also staple crops.

(ii) Intermediary model - In this model, the buyer subcontracts an intermediary (collector, aggregator or farmer organisation) who formally or informally contracts farmers (combination of the centralised/ informal models).

Special characteristics of Intermediary Model are

(1) The intermediary provides selected services (usually through services provided by buyers against service charges) and purchases the crop.

(2) This model can work, if well designed and if incentive structures are adequate and control mechanisms are in place.

(3) This model can bear disadvantages for vertical coordination and for providing incentives to farmers (buyers may lose control of production processes, quality assurance and regularity of supplies; farmers may not benefit from technology transfer; there is also a risk of price drop and reduced incomes to farmers).

(iii) Multipartite model - This model is development of the centralised or nucleus estate models. It involves various organisations such as governmental statutory bodies, alongside private companies and sometimes financial institutions.

Special characteristics of Multipartite Model are

(1) This model may feature as joint ventures of organizations/ community companies with domestic/ foreign investors for processing.

(2) The vertical coordination depends on the policy of the firm. Precaution is to be taken to avoid political interference.

(3) This model may also have additional agreements with third party service providers (e.g. extension, training, credits, inputs, logistics, etc.).

(4) Separate organisations (e.g. cooperatives) may organise farmers and provide embedded services (e.g. credits, extension, marketing, sometimes also processing).

(5) This model may involve equity share schemes for producers.

(iv) Centralized model - In this model, the buyers' involvement may vary from minimal input provision (e.g. specific varieties) to control of most production aspects (e.g. from land preparation to harvesting). This is the most common contract farming model.

Special characteristics of centralized Model are

(1) The buyer sources products from and provides services to large numbers of small, medium or large farmers.

(2) The relation / coordination between farmers and contractor is strictly vertically organised.

(3) The quantities (quota), qualities and delivery conditions are determined at the beginning of the season.

(4) The production and harvesting processes and qualities are strictly controlled, sometimes directly implemented by the buyer's staff.

(5) Typical products: large volumes of uniform quality usually for processing; e.g. sugarcane, tobacco, tea, coffee, cotton, tree crops, vegetables, dairy, poultry, etc.

(v) Nucleus estate model - In this model, the buyer sources both from own estates/ plantations and from contracted farmers. The estate system involves significant investments by the buyer into land, machines, staff and management.

Special characteristics of nucleus estate model are

(1) The nucleus estate usually guarantees supplies to assure cost efficient utilisation of installed processing capacities and to satisfy firm sales obligations respectively.

(2) In some cases, the nucleus estate is used for research, breeding or piloting and demonstration purposes and/ or as collection point.

(3) The farmers are at times called 'satellite farmers' illustrating their link to the nucleus farm. This model was in the past often used for state owned farms that re-allocated land to former workers. It is now a days also used by the private sector as one type of CF. This model is often referred to as "outgrower model".

(4) Typical products: perennials

3.4.3 Advantages of contract farming

Contract farming is looking towards the benefits both for the farm-producers as well as to the agro-processing firms.

(1) Makes small scale farming competitive - small farmers can access technology, credit, marketing channels and information while lowering transaction costs.

(2) Assured market for their produce at their doorsteps, reducing marketing and transaction costs.

(3) It reduces the risk of production, price and marketing costs.

(4) Contract farming can open up new markets which would otherwise be unavailable to small farmers.

(5) It also ensures higher production of better quality.

(6) Financial support is available in cash and /or kind and technical guidance to the farmers.

(7) In case of agri-processing, it ensures consistent supply of agricultural produce with quality at right time and lesser cost.

3.4.4 Limitations in contract farming

(1) Contract farming arrangements are often criticized for being biased in favor of firms or large farmers, while exploiting the poor bargaining power of small farmers.

(2) Problems faced by growers like undue quality cut on produce by firms, delayed deliveries at the factory, delayed payments, low price and pest attack on the contract crop which raised the cost of production.

(3) Contracting agreements are often verbal or informal in nature, and even written contracts often do not provide the legal protection in India that may be observed in other countries . Lack of)enforceability of contractual provisions can result in breach of contracts by either party.

(4) Single Buyer – Multiple Sellers (Monopsony) .

Try this

- Visit a nursery, polyhouse, etc. and observe the modern technology.

(5) Adverse gender effects - Women have less access to contract farming than men.

3.5 Commercial agriculture

3.5.1 Agriculture technology

Fast revolutions in technology are seen in the field of agriculture from last three decades. Though some technologies have contradictions regarding environment and sustainability, it is the need of time to feed the ever growing population of the world.

Advancements in technology include sensors, devices, machines, and information technology. Modern agriculture uses sophisticated technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology. These advanced devices, precision agriculture and robotic systems allow agriculture businesses to be more profitable, efficient, safer, and more environment friendly.

Importance of agriculture technology

(1) Instead of traditional farming, commercial agriculture is oriented to give maximum profit per unit area.

(2) All inputs are targeted for specific increase in returns.

(3) It helps to exploit capacity of the soil, crop variety and other resources and fulfill increasing needs of the population.

(4) It gives higher crop productivity and ultimately profitability.

(5) Judicious use of water, fertilizers, and pesticides keeps product prices down.

(6) Reduced impact on natural ecosystems.

(7) Less runoff of chemicals into rivers and groundwater.

(8) Increased worker safety due to mechanization and automization.

(9) Robotic technologies enable more reliable monitoring and management of natural resources.

(10) Logistic management in handling, transport, storage and marketing minimizes losses of the produce.

(11) Advanced processing and preservation technology allows value addition and increases profitability.

3.5.2 Innovations in agriculture

Innovative agricultural practices

Innovations in agriculture has opened new horizons for software industry and on the other hand, software has increased potential of modern agriculture in many folds. It involves use of data management, mechanization, automation, sensors, genetic engineering, drones, processing and packaging technology, logistics management, etc.

Declining natural resources and increasing population are alarming conditions to use advanced technologies for survival of human race.

Some of the innovative agricultural practices and technologies are :

1. Artificial intelligence and automation

The revolution of mechanization in agriculture helped farmer to get rid of tedious, labour consuming operations and also to curtail cost of cultivation. But still handling of the machines is main hurdle. Artificial intelligence (AI) is now used to command many farm operations. GPS based programmed tractors now make most of the heavy operations easy.

Sensor based equipments for irrigation, sowing, weeding, harvesting, etc. empowered with artificial intelligence eliminate human interference in agriculture. AI imparts accuracy and punctuality in operations resulting in the maximum utilization of inputs and increasing productivity.

2. Use of drones in agriculture

Foliar application of inputs like pesticides, fertilizers, growth regulators, weedicides, etc. is not only expensive but also full of risk for the operators. Restrictions in spraying due to wet soil, densely populated crops like sugarcane, can be overcome by the use of drones. Drones may be operated by remote control or by programming with GPS parameters. It is going to be a new opportunity of employment to provide drones on rent or contractual system.

Fig 3.1 : Use of drone for spraying operation

Drones are also used to get quick look of the field to observe attack of diseases and pest, nutrient deficiencies, water trace, etc. Very soon drones may be used for harvesting and delivery up to consumer.

Indiscriminate use of chemical pesticides has drastically decreased population of honeybees. Number of honeybee species are already became extinct and many are on the way. They are most important pollinating agents and in the absence of which human race can't get food for survival. In some crops drones are now used to pollinate the flowers by moving drones nearby the trees.

3. Urban agriculture

Because of crowding, pollution and hectic lifestyle, urban people are always in search of a hobby which can give scope for their creativeness and feel pleasure. Most of them have affection towards agriculture. But they have no agricultural land or other facilities. Novel concept of vertical gardening allows such people to grow flowers, vegetables and fruits also in their balconies, terrace, common places, etc. Use of cocopeat, hydroponics and aeroponic technologies are also adopted in urban agriculture. Municipal corporations, railway, corporate buildings, apartments, etc. are now covering their walls, pillars and terrace by vegetation. Here cocopeat is used as media for growing, as it is light in weight and having higher water holding capacity. Vertical gardens are expensive as compared with ground-level gardens. It requires panels and framework, specially designed pots, irrigation system and maintenance.

Fig 3.2 : Terrace garden

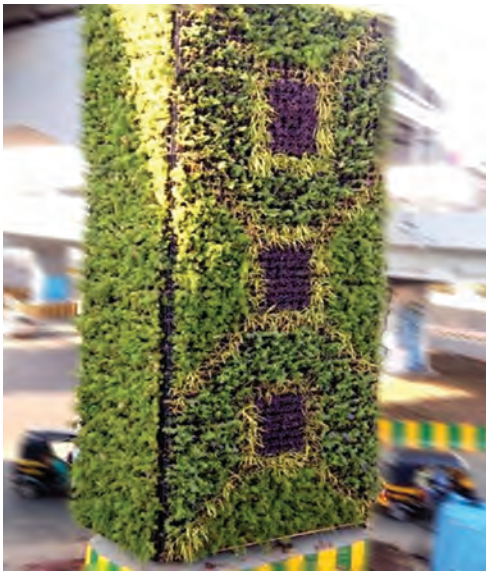

Fig 3.3 : Vertical garden

Advantages of urban agriculture

(1) It improves aesthetic value of the place to spread pleasure.

(2) Vegetation also helps to control temperature, absorb pollution, trap carbon dioxide and dust.

(3) It also absorb sound waves, avoids reflections ultimately decreasing sound pollution.

(4) Indirectly helps to maintain biodiversity in the urban region where it is under high risk.

(5) It gives scope for creativity to the urban people.

(6) It gives higher productivity per unit area which can inspire the traditional farming.

4. Hydroponics

Hydroponics is a technique to grow plants on a base of water i.e. hydro. As no soil is used in this case, essential plant nutrients are added in the water to nourish the plants. Nutrients can be sourced from organic substances or chemical fertilizers. Roots are exposed in this solution or may be supported by an inert medium such as perlite or gravel. Sub irrigation or top irrigation is provided for continuous circulation of media solution. Containers other than metal i.e. made from plastic or glass are commonly used. Whole root zone is excluded from light to avoid algae and fungal growth in the solution.

Hydroponic can be classified as per maintenance of the media solution as below

(i) Static solution culture

In static solution culture, media solution is stable in the container. Particular level is maintained to keep some of the roots exposed in air for availability of oxygen or the solution may be aerated by using aquarium aeration pump system. When concentration of nutrients in the solution is decreased, new solution is added or previous one is replaced periodically. Static solution hydroponic method is generally followed for home scale or small units.

Fig 3.4 : Static solution culture

Containers like used drums, plastic buckets, packing materials, pvc pipes, etc. are used at home. It is simple and low cost method.

Green fodder production by sowing seed of Maize is commonly used hydroponic by dairy farmers in India. Fodders including maize, barley, oats, sorghum, rye, alfalfa and triticale (hybrid of wheat and rye) can be produced by hydroponics. By this method, on an average, 1 kg of seed can be converted in to 6 to 8 kg green fodder within 8 to 10 days. It has been reported that about 1.5-2 liters water needed to produce 1 kg of green fodder hydroponically in comparison with 73, 85, and 160 liters to produce 1 kg of green fodder of barley, alfalfa, and Rhodes grass under field conditions, respectively. Under hydroponic systems this equates to only 2-5% of water used in traditional fodder production.

(ii) Continuous-flow solution culture

In this type continuous flow of solution is maintained to ensure supply of nutrients, water and oxygen for roots of all plants. . It is much easier to automate than the static solution culture because, sampling and adjustments to the temperature and nutrient concentrations can be made in a large storage tank that has potential to serve thousands of plants. A popularly used container is the 'Nutrient film Technique' (NFT). It is arranged with fix slope so as to maintain flow of solution at the rate of 1 to 2 liters per minute. Large tanks or trays made from cement concrete or plastic are also used. It has more efficiency to produce as compared with static solution method.

Fig. 3.5 : The nutrient film technique being used to grow various salad greens

(iii) Aeroponics

Aeroponics is a system wherein roots are continuously or periodically kept in an environment saturated with fine drops (a mist or aerosol) of nutrient solution. The method requires no substrate and entails growing plants with their roots suspended in a deep air or growth chamber with the roots periodically wetted with a fine mist of atomized nutrients. Excellent aeration is the main advantage of aeroponics.

Aeroponic techniques have proven to be commercially successful for propagation, seed germination, seed potato production, tomato production, leaf crops, and micro-greens. Since inventor Richard Stoner commercialized aeroponic technology in 1983, aeroponics has been implemented as an alternative to water intensive hydroponic systems worldwide. The limitation of hydroponics is the fact that 1 kilogram (2.2 lb) of water can only hold 8 milligrams (0.12 gr) of air, no matter whether aerators are utilized or not.

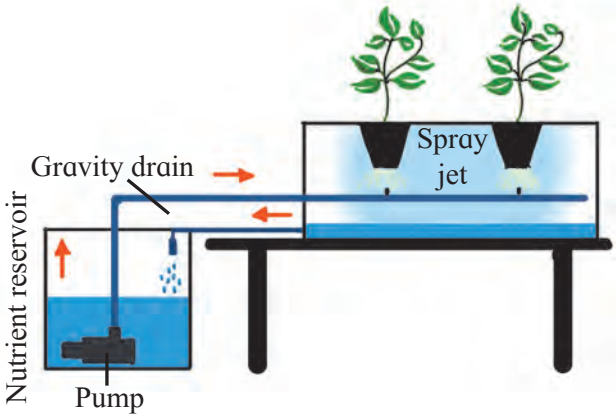

Fig 3.6 : Aeroponic technique

Another distinct advantage of aeroponics over hydroponics is that any species of plants can be grown in a true aeroponic system because the microenvironment of an aeroponic can be finely controlled. Suspended aeroponic plants receive 100% of the available oxygen and carbon dioxide to the roots zone, stems, and leaves, thus accelerating biomass growth and reducing rooting times. Aeroponics uses 65% less water than hydroponics. Aeroponically grown plants require ¼th the nutrient input compared to hydroponics.

(iv) Fogponics

Fogponics is a derivation of aeroponics wherein the nutrient solution is aerosolized by a diaphragm vibrating at ultrasonic frequencies. Solution droplets produced by this method tend to be 5–10 µm in diameter, smaller than those produced by forcing a nutrient solution through pressurized nozzles, as in aeroponics. The smaller size of the droplets allows them to diffuse through the air more easily, and deliver nutrients to the roots without limiting their access to oxygen.

v) Genetic modification

Genetically modified crops (GM crops or biotech crops) are plants used in agriculture, the DNA of which has been modified using genetic engineering methods. In most cases, the aim is to introduce a new trait to the plant which does not occur naturally in the species. Examples in food crops include resistance to certain pests, diseases, environmental conditions, reduction of spoilage, resistance to chemical treatments (e.g. resistance to a herbicide), or improving the nutrient profile of the crop. Scientists have also begun engineering crops that require less water and that grow more food. Currently available food derived from GM crops poses no greater risk to human health than conventional food but that each GM food needs to be tested on a case-by-case basis before introduction.

Though GM technology for food production is not yet allowed in India, GM cotton varieties are introduced from year 2002. Now it is commonly accepted all over India. Aim is to reduce use of pesticides for bollworm control and to increase production.

Examples in non-food crops include production of pharmaceutical agents, biofuels, and other industrially useful goods as well as for bioremediation. Of course, there could be unforeseen consequences when it comes

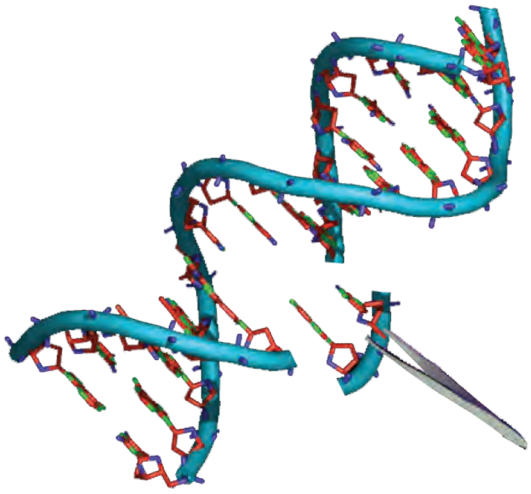

Fig 3.7 : Imaginary view of genetic engineering

to messing with genetics in any environment or ecosystem — we'll have to be extremely cautious that we don't create more problems in an attempt to solve a few.

These are just a couple of ways that innovative agricultural practices are changing our future, and making the world a more liveable place. Innovation in agriculture isn't just interesting — it's essential to our survival!

Internet my friend

- By knowing about advances in agricultural technologies, do you wish to get further education in this field ?
- Open the websites of different institutes related to agricultural education and acquire information of your interest.

3.5.3 Agricultural education

For survival of human race on earth, agriculture has prime importance. To feed growing population on our planet earth, continuous innovation and dissemination of agricultural knowledge and technology is necessary. In ancient period of India, agriculture was included in the curricula of Nalanda and Taxila Universities as one of the 18 arts.

The Indian Council of Agricultural Research (ICAR) is an autonomous body. It is under the Division of Agricultural Research and Education (DARE). Ministry of Agriculture, Government of India. The ICAR has its headquarters at Pusa, New Delhi.

The Council is the apex body for co-ordinating, guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences in the entire country. With 101 ICAR institutes and **71 agricultural universities** spread across the country, this is one of the largest national agricultural systems in the world. The ICAR has played a pioneering role in ushering Green Revolution and subsequent developments in agriculture in India through its research and technology development that has enabled the country to increase the production of **foodgrains by 5.4 times, horticultural crops by 10.1 times, fish by 15.2 times, milk by 9.7 times and eggs by 48.1 times since 1951 to 2017**, thus making a visible impact on the national food and nutritional security. It has played a major role in promoting excellence in higher education in agriculture. It is engaged in cutting edge areas of science and technology development and its scientists are internationally acknowledged in their fields.

Maharashtra government has established four agricultural universities. These universities are coordinated by 'Maharashtra Council of Agricultural Education and Research' (MCAER) established on 10th of September 1984.

Table 3.1 : Institutes and their websites

ICAR, New Delhi	http://www.icar.org.in/
MCAER, Pune	http://www.mcaer.org.in/
Government Of Maharashtra, Dept.	http://www.mahaagri.gov.in/
Mahatma Phule Agricultural University, Rahuri	http://mpkv.ac.in/
Dr. Punjabrao Deshmukh Agricultural University, Akola	http://www.pdkv.ac.in/
Vasantrao Naik Marathwada Agricultural University, Parbhani	http://www.vnmkv.ac.in
Dr. Balasaheb Savant Konkan Agricultural University, Dapoli	http://www.dbskkv.org
National Skill Development Corporation	https://nsdcindia.org
Maharashtra State Skill Development Society	https://kaushalya.mahaswayam.in/

Details regarding different courses, eligibility criterion, admission process, etc. are available on the websites of these organizations.

Most of the population in agriculture has lower educational level and don't have exposure to formal agricultural education. For this purpose different extension activities are conducted by agricultural universities, department of agriculture, research stations, Krishi Vigyan Kendra (KVK), etc. National Skill Development Corporation (NSDC), Maharashtra State Skill Development Society (MSSDS), etc. provides training to the farmers for entrepreneurship development. Details of agricultural extension education are delt in separate chapter.

Courtesy : Sahyadri Farmers Producer Co. Ltd.

Do yourself

Prepare a chart of Agricultural Universities in Maharashtra with respect to Research work in Agriculture (Crops and their varieties, Fruits, etc.)

Sr. No.	University details	Research work details

Do yourself

Prepare a concept map of organised farming with charatristic features.

Exercise

Q. 1 A. Fill in the blanks.

1. In vertical gardening, most commonly used media is ……...
2. Containers used for hydroponics are excluded from light to avoid growth of ……..
3. Apex institute governing agricultural education in India is ……
4. In India…… crop is commonly used for production of green fodder by hydroponics
5. When farming is done by a company on his own land or leased farm then it is called as .....

B. Make the pairs.

'A' group	'B' group
1. MCAER	a. Spraying of pesticides
2. GM Technology	b. Agricultural education
3. Drones	c. Cotton varieties in India
	d. Hydrophonics
	e. FPC

C. State true or talse

1. Limitations of decreased land holding are eliminated in farmer producer organisation.
2. All crops can be cultivated by hydroponics technology.
3. Drones are used for ploughing the soil.
4. Productivity in aeroponics is more than hydroponics because of ample aeration in the root zone.
5. In contract farming an agreement is executed between the producer and the consumer.

Q. 2 Answer in brief.

1. Describe in brief Farmer Producer Organization.
2. Why government is promoting for processing of agricultural produce ?
3. How hydrophonic fodder production saves water ?
4. State your view regarding further education in agriculture.
5. Write special features of informal model of conntract farming.

Q. 3 Answer the following questions

1. Explain the scope of technology in agriculture.
2. Describe importance of green fodder production by hydroponics.
3. Write advantages of contract farming.
4. Classify the hydrophonics as per the maintanance of the media solution.
5. Give the advantages of Urban agriculture.

Q. 4 Answer in detail

1. Explain advantages and disadvantages of contract farming.
2. Describe the use of drones in agriculture.
3. Write the advantages and key points for formation of farmer producer organisation.
4. Describe aerophonics and fogponics.
5. Describe about agricultural education in India.

Activity :

Obtain information on FPO, FPC, Agricultural Universities in Maharashtra by using internet.