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REVIEW OF AGRICULTURAL POLICIES

Unit structure:

1.1 OBJECTIVES

1) To study the Indian Agricultural policy and its objectives.

2) To understand the effects of agricultural policy on rural area.

3) To understand the concept of Green Revolution and its effect on weaker section.

4) To study the inter - relationship between Green Revolution and Rural Development.

5) To examine the problems in the spread of Green Revolution.

1.2 INTRODUCTION

Agriculture is a way of life, a tradition, which, for centuries, has shaped the thought, the outlook, the culture and the economic life of the people of India. Agriculture, therefore, is and will continue to be central to all strategies for planned socio- economic development of the country. Rapid growth of agriculture is essential not only to achieve self-reliance at national level but also for household food security and to bring about equity in distribution of income and wealth resulting in rapid reduction in poverty levels.

Indian agriculture has, since Independence, made rapid strides. In taking the annual food grains production from 51 million tonnesin early fifties to

206 million tonnesat the turn of the century, it has contributed significantly in achieving self- sufficiency in food and in avoiding food shortages.

Over 200 million Indian farmers and farm workers have been the backbone of India's agriculture. Despite having achieved national food security, the well-being of the farming community continues to be a matter of grave concern for planners and policy- makers. The establishment of an agrarian economy, which ensures food and nutrition to India's billion people, raw materials for its expanding industrial base and surpluses for exports and *a fair*and equitable reward system for the farming community for the services they provide to the society, will be the mainstay of reforms in the agriculture sector.

The National Policy on Agriculture seeks to actualize the vast untapped growth potential of Indian agriculture, strengthen rural infrastructure to support faster agricultural development, promote value addition, accelerate the growth of agro business, create employment in rural areas, secure a fair standard of living for the farmers and agricultural workers and their families, discourage migration to urban areas and face the challenges arising out of economic liberalization andglobalization.

1.3 INDIAN AGRICULTURAL POLICY

INDIAN AGRICULTURAL POLICY:

Indian agricultural policy has had the following main elements so far:

1.3.1 Technological measures: Initiation of measures to increase agricultural production substantially to meet growing needs of the population and also to provide a base for industrial development included steps to increase both extensive cultivation and intensive cultivation. For the former, irrigation facilities were provided to a large area on an increasing basis and area hitherto unfit for cultivation was made fit for cultivation. For the latter, new agricultural strategy was introduced in the form of a package programme in selected regions of the country in 1966. To sustain and extend this programme to larger and larger areas of the country, steps were initiated to increase the production of high-yielding varieties of seeds, fertilizers and pesticides within the economy and supplement domestic production by imports whenever necessary. As a result of these measures, agricultural production and productivity increased substantially. Food grains production which was merely 50.8 million tonnesin 1950- 51 rose to 199.7 million tonnesin 1996-97 and stood at 192.4 million tonnesin 1997-98. Largest contribution came from wheat. Its production rose from 6.4 million tonnes in 1950-51 to 69.3 million tonnes in 1996-97. In 1997-98, the production of wheat stood at 65.9 million tonnes.

1.3.2 Land reforms: Land reform measures to abolish intermediary interests in land (viz., zamindars, jagirdars, etc.) and transfer of land to actual tiller of the soil were expected to be taken up on a priority basis. Measures taken under this head include 1: (7) Abolition of intermediaries; (n) Tenancy reforms to *(a)* regulate rents paid by tenants to landlords, *(b)* provide

security of tenure to tenants, and (c) confer ownership rights on tenants; and *(Hi)* Imposition of ceilings on holdings in a bid to procure land for distribution among landless labourersand marginal farmers. These land reform measures weredesigned to eliminate the parasitic class of zamindarsand absentee landlords and abolish all types of exploitation of the tenants at the hands of these people. Thus, the attempt was aimed at changing the entire agrarian structure of the ruralareas.

1.3.3 Co-operation and consolidation of holdings: In a bid to reorganize agriculture and prevent subdivision and fragmentation holdings, the Indian agricultural policy introduced the programmesof co-operation and consolidation of holdings. The latter programme aimed at consolidating all plots of land owned by a particular farmer in different places of the village by sanctioning him land at one placeequal in area (or value) to his plots of land. Consolidation avoids wastage of time, land and energy employed in cultivation and also enables fanners to practice scientific techniques of production. Co- operation aims at bringing small and marginal farmers together to reap the benefits of large-scale farming. Under co-operative farming small and marginal farmers pool their land and resources (or only resources) and practice jointcultivation.

1.3.4 Institutions involving people's participation in planning: Bringing small and marginal farmers together to cultivate jointly is only half of the story. No planning in any country can be successful unless the masses are encouraged to join hands with the planning authorities in a bid to carry out the plans and programmes framed for their uplift and betterment. It was precisely with this end in view that the programme of Community Development was initiated in 1952 in this country. It was aimed to be a project of the people, by the people and for the people, wherein the role of the government and administrative authorities was defined as 'to help the people to help themselves.' The experience of the Community Development programme reads a sad story. It could never become thepeople's programmeand remained tied to the umbilical cord of government assistance. Another programme designed to encourage the participation of masses in the planning process (and political decision-making) was the programme of democratic decentralization, often known as Panchayati Raj. Its experience was no different from Community Development. Infact, it proved to be worse. It conferred power (howsoever limited) on local dadas and influential political elements to exploit masses to their advantage and indulge in all sorts of political bickering and corrupt practices.

1.3.5 Institutional credit: Another important measure was the expansion of institutional credit to farmers, especially through co- operatives and commercial banks. After nationalization of banks in 1969, nationalized banks have paid increasing attention to the needs of agriculture. Regional Rural Banks have been set up to deal specially with the needs of agricultural credit. A National Bank for Agriculture and Rural Development (NABARD) has also been set up. As a result of the expansion of institutional credit facilities to farmers, the importance of moneylenders has declined steeply and so has the exploitation of farmers at the hands ofmoneylenders.

1.3.6 Procurement and support prices : Another policy measure of significant importance is the announcement of procurement and support prices to ensure fair returns to the farmers so that even in years of surplus the prices do not tumble down and farmers do not suffer losses. This is necessary to ensure that farmers are not 'penalized' for producing more. In fact, the policy of the Commission for Agricultural Costs and Prices in recent years has been to announce fairly high prices in a bid to provide incentive to the farmers to expandproduction.

1.3.7 Input subsidies to agriculture: The government has provided massive subsidies to farmers on agricultural inputs like irrigation, fertilisers,electricity and credit. The objective of input subsidisationis to increase agricultural production and productivity by encouraging the use of modern inputs in agriculture. However, over a period of time, the subsidies have continued to increase continuously and many economists now feel that agricultural subsidies have reached 'fiscally unsustainable'levels.

1.3.8 Food security system: In a bid to provide food grainsand other essential goods to consumers at cheap and subsidized rates, the Government of India has built up an elaborate food security system in the form of Public Distribution System (PDS) during the planning period. PDS not only ensures availability of food grains at cheap prices to the consumers but also operates as a 'safety net' by maintaining large stocks of food grains in order to combat any shortages and short falls that might occur in some years and/or in certain areas of the country.

1.4 OBJECTIVES OF AGRICULTURALPOLICY

In addition to the measures mentioned above, the Indian agricultural policy contained a number of other elements, some of whichare outlined below:

1) Provision and extension of irrigation facilities through major and medium irrigation projects and of power for minor irrigation through the programme of rural electrification.

2) Improving the system of agricultural marketing through the establishment of regulated markets and introducing a variety of measures like standardization of weights and measures, grading and standardization of farm output, providing information regarding market prices to fanners, etc. Efforts have also been made to strengthen the co-operative marketing structure.

3) Provision and expansion of storage and warehousing facilities to enable the government to build up adequate buffer stocks to cope with the food problem in years of shortage of food grainsand save the farmers from indulging in 'distress' sales during surplusyears.

4) Initiation of steps to improve the economic condition of agricultural workers. In this category come measures to enforce minimum wages, abolition of bonded labour, grant of agricultural land to landless labourers, schemes for expanding rural employment,etc.

5) Promotion of agricultural research and training to discover new high-yielding varieties of seeds, avoid wastage of grains in storage, successfully counter the attacks of pests, insects and rodents, develop techniques for increasing productivity of soil and ensure optimum utilization of soil, water and sunlight resources. The triple function of agricultural research, education and extension is being implemented through the various research institutes, agricultural universities, project directorates, etc. At the apex stands the Indian Council of Agricultural Research(ICAR).

6) In an effort to extend green revolution to the Eastern Region of the country and develop dry landareas, the Seventh Five Year Plan introduced two specific programmes: *(a)* Special Rice Production Programme, and *(b)* National *Watershed* Development Programme for Rain fed Agriculture. The former was initiated by the government in the Eastern Region (comprising of Assam, Bihar, Orissa and West Bengal, eastern Uttar Pradesh and eastern Madhya Pradesh). Thelatter, introduced in 1986-87, lays emphasis on land and water management through introduction of optimal cropping system, dry landhorticulture, farm forestry, fodder production, etc. The aim is to develop areas under dry land agriculture since these areas are characterized by low productivity, high risk arid low income. The Ninth Plan also places special emphasis on agricultural development in the Eastern Region, "partly because of the presence of large untapped potential partly because this region accounts for a major proportion of the poor people in India and partly because this region isexpectedto contribute more than 50 per cent of the total incremental food grain production in the Ninth Plan."

7) In order to increase the production of pulses, a centrally sponsored National Pulses Development Programme was launchedin 1986-87. The basic objective of the programmeis to increase the production of pulses by adopting location specific technology. A centrally sponsored programmewas also launched in 1984-85 to increase the production of oilseeds. Known as National Oil seeds Development Project (NODP), this programme aims at providing to the fanners various services such as inputs, extension, credit, etc. so as to assist them in increasing the production of oilseeds. In addition to the above, an Oil seeds Production Thrust Project (OPTP) was launched in 1987. During 1990-91, the above two projects were merged under one programme, i.e., Oil seeds Production Programme (OPP).

8) A country-wide Comprehensive Crop Insurance Scheme was introduced from 1985 Kharif season. The objectives of the scheme are: *(a)* to provide a measure of financial support to the farmers in the event of crop failure as a result of drought, floods, etc.; *(b)* to restore the credit eligibility of farmers after a crop failure for the next crop season; and (c) to support and stimulate production of cereals, pulses and oilseeds. The scheme covers crop loans issued by all the agencies, *viz.,* co-operative credit institutions, commercial banks and regional rural banks. Paddy, wheat, millets, pulses and oilseed crops are covered

under the scheme.

9) A Rural Infrastructure Development Fund (RIDF) was set up within NABARD in 1996-97 to provide credit for medium and minor irrigation and soil conservation projects. A scheme of Accelerated Irrigation Benefit Programme (AIBP) was initiated during 1996-97 for providing assistance to States by way of loans for timely completion of selected large and multi-purpose irrigation projects. An amount of Rs. 500 crore and Rs. 952.2 crore was released under AIBP as Central Loan Assistance to the States during 1996-97 and1997-98.

1.5 EFFECTS OF AGRICULTURALPOLICY

1) Increase in Food grains Production and Productivity: We can say that the HYV programme has had a distinct impact on food production and what is even more significant; it has inspired confidence in regard to its promise for the future. The production of food grains reached 99.5 million tonnes in 1969-70 and the still higher figure of 108.4 million tonnes in 1970-71, a record till then. Only five years earlier, in 1965-66, it was 72 million tonnes. In 1978- 79 it attained the then all-time record of 130.5 million tonnes. In 1985-86, it scaled up what was till then the peak of 150.4 million tonnes. Still another much higher peak of 170 million tonnes was attained in1988-89.

The increase in the production of wheat has been the most remarkable: from the annual average of 11 million tonnesfor five years previous to 1965-66, it rose to 18.7 million tonnes in 1968-69, to 20 million tonnes in 1969-70 and further to 23.8 million tonnes in 1970-71 to 36.3 million tonnes in 1980-81 and 47.05 million tonnes in 1985-86. In 1988-89, it attained the all-time recordproduction of 54 million tonnes. The production of rice rose from 30.4 million tonnesin 1973-74 to 52.7 million tonnes in 1977-78 to 53.8 million tonnes in 1978-79 and further to 63.8 million tonnesin 1985-86. In 1988-89, the production of rice was at the peak, touching up the level of 70.67 million tonnes. Thus, it may not be unjustified to call this arevolution.

2) Increase in Regional Imbalance: So far the response to the new technology has been unevenly spread in respect of the different regions of this country. Punjab, Haryana, Western U.P., Gujarat and Tamil Nadu have been in the van. There appear to be twomain reasons for the inter-regional disparities. Much more is known about the response of alluvial soils to large use of fertilisers than is known about the response of the upland soils. The sub-soil water supplies for exploitation by tubewellsare predominantly in the Ganges-Jamuna plains, in the river estuaries of Gujarat, in the plains to the east of the Ghats in Southern India. According to a recent study, rapid agricultural growth in India has been confined to 17 per cent of the districts.

The regional imbalance in respect of the extension of the HYV programmes is far more pronounced when we consider that our agricultural scientists have yet todevelop a new technology that should be suitable for the extensive 'dry

farming' areas. There are about 84 districts in the various parts of the country which receive only40 cm to 100 cm of rainfall annually and where only one-fourth of the area is irrigated. They constitute nearly 36 per cent of the sown area in the country. On such areas the new technology has yet to make a significant impact. Dr. M.L. Dantwala has rightly pointed out that the technologyevolved during mid-sixties wassuited onlyto some specific regions, but not to other regions. No alternate technology which would have been applicable to all regions was available at that time.

3) Emergence of Unbalanced Cropping Pattern: The progress of the new technology, its 'spread has been *uneven in respect of the different crops too.* Wheat has been benefited the most, while jowar, bajra, maize and rice are the other four crops in which some progress has been registered, but unlike wheat, that cannot be described as a real'breakthrough'. Pulses, oilseeds, sugarcane, cotton, jute and plantation crops have yet to be launched on the HYV path and much research has yet to be accomplished before the new technology begins to bear fruit in respect of them. Thus, in its coverage overcrops, the 'green revolution' has been partial and lopsided. In fact, the enhanced profitability of growing food grains due to the application of the package of modern agricultural inputs has diverted acreage from commercial crops to food grains. The area devoted to the cultivation of food grainsrose from 74 per cent of total area sown in 1950-51 to 80 per cent in 1980-81. On the other hand, over the same period, the acreage under cash crops declined from 26 per cent to 20 per cent oftotal sown area. However, over 1980-81 to 1988-89, the acreage under cash crops has slightly increased from 20 per cent to 24 per cent of total area sown. Among food grains, the coarse cereals have recorded only a marginal increase in acreage. The acreage under pulses haverecorded a minimum increase. In short, the green revolution has been experienced more perceptibly in the case of wheat only.

4) Increase in Social Imbalance: In its first phase, the 'green revolution' has favoured the larger and richer farmer. The principal beneficiaries have by and large been the large land owners who have secured handsome dividends from farm inputs, bum per crops and attractive prices. They alone have had sizable surpluses to sell. The rich and middle farmers, who have enjoyed subsidized supplies offarm inputs, have earned profits. The majority of the peasants and farm laborers have remained outside the orbit of the new technology. Most of them continue passively to lead a precarious existence, though many among them may be quite conscious of the brighter prospects.The small size of their holdings and their limited resources do not permit them to share the prosperity.

It has thus been aptly observed, "with 47 per cent of farm families owning only one acre of land and 22 per cent owning no land at all, with only 3 to 4 per cent of big cultivators enjoying all power, wielding all influence, making all decisions in collaboration with governmental machinery and appropriating to themselves all the skill, the resources, the expertise governmental agencies offer, the poor halfof the village have little to think anybodyfor."[2]

In some areas, tenants are being reduced to farm laborersaslandowners discover the profitability of the new technology in the current economic

setting. Even though income to the landless may rise, the socio-economic gap between the land owner and the landless is tending to widen.

Economic in equalities in the rural society have thus been getting accentuated. It has been estimated that the percentage of rural population below the bare minimum level of living (i.e. consuming below Rs. 15 per month at constant 1960-61 prices) for different States as well as for India as a whole went up by 40 per cent between 1960-61 and 1967-68.[3] The Green Revolution is said to be 'capitalist revolution' in 'Socialist India' where the rich landlords are getting richer and richer, and a serious social imbalance or 'social polarization' is developing which may not only erode the traditional relationship in the countryside but may in due course create a politically explosive situation which would attract extreme leftist parties. A confrontation between the minority of prosperous landowners and the mass of share-croppers, tenants and landless labourcould then become a distinct possibility.

However, according to a shrewd observer, "It is not… the new technology which is the primary cause ofthe accentuated imbalance in the countryside. It is not the fault of the new technology that the credit service does not serve those for whom it was originally intended; that the extension services are not living up to expectations; that the panchayats are political rather than development bodies; that the security of tenure is a luxury of the few; that rents are exorbitant; that ceilings on agricultural land are notional that for the greater part tenuriallegislation is deliberately miscarried; or that wage-scales are hardly sufficient to keep soul and body together. These are man-made institutional inequities. Correcting all of these within the fore see able future is out of the question. On the other hand, even if only some of them are dealt with security of tenure, reasonable rent and credit to sustain production needs a measure of economic and social justice could be fused with economic necessity, thereby adding another essential dimension to the green revolution."

5) Impact on Rural Employment: The more intensive farming methods associated with the new technology requiresmore farm labour. The new varieties will not respond to traditional practice of planting the cropand then virtually forgetting it until harvest time. Substantial amounts of additional labour must be invested in applying fertiliser, weeding and the like.

Expansion of the area that can be multi-cropped is also resulting in a more effective use of the rural labour supply. This is a major economic gain. For the first time, significant local labour scarcities have been emerging. For example, the Punjab farmer is already experiencing a serious shortage of labour in peak periods, which is paving the way for further mechanisation of agriculture in the Punjab. A study of the working of the Intensive Agricultural Development Programme in Raipur district from 1964-65 to 1968-69 showed that the amount of labour employed went up three times in terms of labour days. This is in addition to the increased time the small cultivators devoted to their own land. The labour wage rates during the periods of peak demand in the crop season went up by 150 per cent and by about 100 per cent during the rest of the season. Dr. G.S. Bhalla's study on

labour absorption in Indian agriculture has revealed that the elasticity of employment per hectare with respect to yield was as high as 0.87 in high growth districts. But the overall situation of employment generation in rural areas has deteriorated. The growth rate of employment generation in the agricultural sector has declined from 2.32 per cent in 1972-73—1977-78 period to 1.22 per cent in 1983-88 periods.

1) Effect on Agricultural Labour : Sometimes a view is put forward that the only feasible and the surest way of improving the economic condition of the weaker sections of the rural population is to promote faster agricultural growth through chemical-biological break through or by making 'green revolution' greener still. But the Green Revolution does not seem to have benefited agricultural labour. There is no doubt that their wages have risen but since prices of commodities have risenmuch more, the real wages have gone down. An inquiry into wages in 15 districts in Punjab and Haryana has revealed that the weighted average daily wage rate for casual male agricultural labour went up by about 89 per cent between 1960-61 and 1967-68. But the consumer retail price index (general) in the same period (for agricultural labourers) went up by 93 per cent. Again, in the I.A.D.P. (Intensive Agricultural Development Programme) districts scattered throughout India, in which much of the efforts towards agricultural modernisationand development was concentrated, the real wage rate fell between 1962-63 and 1967-68. The real income (real wage) per agricultural labourer has declined from Rs. 445.6 in 1970-71 to Rs. 420.5 in 1988-89, whereas the real income of non-agricultural labourer has risen from Rs. 971.8 in 1970-71 to Rs. 1783.8 in1988-89.[8]

2) Increase in Investment through Plough-back of FarmIncome: A gratifying trend associated with the new farm technology is that the farmers benefiting from it are investing more and more of their increased farm income for the improvement of their farm organisa- tion. A recent study on farm family investment conducted in the Punjab Agricultural University showed that the fixed farm capital investments accounted for 18.47 per cent of the total farm family income, of which purchase and development of land constituted about 7.02 per cent. Again, a short-term investment in the use of modern inputs such as improved seeds, fertilizers, in secticides and irrigation charges and hired labour (cash costs) formed 36.23 per cent of the total farm family income. In other words, the farmers are ploughing back about55 per cent of their total family income for farm improvement.

1.6 GREENREVOLUTION

1.3.1. Genesis of Green Revolution:

Adoption of innovating techniques low user in a technological revolution for the transformation of traditional agriculture into modern farming is designated by the happy phrase ‘Green Revolution.’ It was William S. Gaud, former Director of A.I.D., who was the first to use the term ‘Green Revolution’ in a speech in March 1968 addressed to the Society of International

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Development[1] to describe significant changes in the agricultural sector in certain regions due to adoption of new farm technology. This new trend of agriculture is called more explicitly 'the Seed- Fertilizer Revolution'[2] as high-yielding variety of seed is highly fertilizer-responsive and capable of achieving a higher rate of yield.

M.L. Dantwala says, "The key factor behind the Green Revolution was a new technology with high-yielding varieties at its core."[3] The spectacular break through in food grain production which occurred between 1966-1971 in India marks the beginning of the Green Revolution. The new strategy includes a package of techniques, but the most important is the spread of high-yielding variety cereals over fairly wide areas.

In one sense, the origin of the Green Revolution could be traced back to the year 1960-61 when the Intensive Agricultural District Programme (IADP) was launched in seven districts in India, including West Godavari in Andhra Pradesh. Initially, pioneered by the Ford Foundation, the IADP stressed the need for providing the cultivator a complete package of practices consisting of new inputs, technical advice and credit. However, the improved variety of seed used could not achieve spectacular yield. It is generally believed that the Green Revolution in India began in 1965-66 withthe introduction of a new variety of Mexicanwheat.

The term 'revolution' implies a sudden change. But the change in agriculture in terms of application of crucial input like irrigationis not sosudden. Introduction of high-yielding variety requires irrigation. Since a long time, huge public investments have been made on major and medium irrigation projects besides investments of individual farmers on minor irrigation works. Further, the HYV seed is confined mainly to food crops like wheat, paddy, jowar, etc. In 1980-81, only 28.6 per cent of cropped area enjoyed irrigation in all-India[4]and in this limited area only, modern inputs could be used gainfully. The scope of the Green Revolution thus being confined to a limited area, the usage of the term 'revolution' isquestioned.

However, the introduction of HYV seed led to many changes with several linkages. Irrigation becomes a pre-requisite for the introduction of HYV and associated modern inputs. Therefore, the problem of water management now becomes important. Further, HYV seed is highly responsive to fertilizer and hence, there is a remarkable rise in the demand

for fertilizers. The HYV crop attracts pests and diseases, leading to demand for pesticides, sprayers, etc. There is now need for enlarged credit facilities to meet the growing credit requirements of different categories of farm producers. The new farm technology necessitates additional investment on the production of chemical fertilizer, pesticides, water pump sets, etc. Adoption of new farm technology results in higher levels of yield per unit of land. With higher levels of productivity, farm producers are able to achieve marketable surplus. In the process of marketing of farm products, the farm producers come into contact with the urban merchants and urban life and they would like to imitate urban life because of the 'demonstration effect'. Now the inclination for better living like that of the urban rich urges the farm producers to adopt new farm technology at a higher rate and achieve still higher levels of yield. These different changes in the agricultural sector due to the adoption of new farm technology, with HYV seed at its core, are described as the GreenRevolution.

1.6.2 Need for Green Revolution:

By 1960-61, a stage has been almost reached where we could no longer think of producing more of farm products through extensive cultivation in order tomeet the growing requirements of fast- increasing population. It has been well recognized that higher productivity is the only answer to meet the future requirements offood and other farm products. The improved variety of seed, no doubt, proved better in terms of yield. Yet, the improved variety of seed was not capable of achieving significant increase in the yield levels. It was recognized that the introduction of HYV seed associated with other modern inputs could only help to increase productivity and thereby meet the growing requirements of food and other farmproducts.

1.7 EFFECTS OF GREEN REVOLUTION ON WEAKER SECTIONS

The small and marginal farmer, tenant cultivators and agricultural labour come under the category of weaker sections.

1.7.1 Small Farmer and Green Revolution:

Such of those who own two hectares of land and below are described as small farmers and those with one hectare and below are known as marginal farmers. As discussed earlier, a higher proportion of small-size holdings enjoys irrigation facility than that of large-size farms. Basing on a study pertaining to West Bengal, B. Sen concludes that by using high-yielding variety seeds a small farmer is able to earn additional income. It is stated that the proportion of additional income due to HYV in the total income of a small farmer is higher than that of the large-size farmer.[16] According to different farm management studies, the productivity of small-size holdings is higher.

In monetary terms also, per acre income from the small farms may appear to be high. But in an analysis of this type, we have to note one important factor. Generally, small farms are cultivated with family labour and other on-farm inputs like seed, farmyard manure, etc. If the retained or imputed

costs are also taken into account, the net profits (after deducting from the gross farm income both paid-out costs and retained costs)may be negligible. In securing modern inputs like chemical fertilizers, pesticides, tractors, etc., the small farmers have their own problems. Also, in getting institutional credit and in marketing of products, the small and marginal farmers, tenant and mixed cultivators face many difficulties. The small farmer is always in pressing need for cash and is often forced to borrow from the local money-lender or merchant. Further, most of the small farmers do not have proper storage facilities. Under these circumstances, they are forced to sell away the produce immediately after harvest that too, to the local money-lending merchant and are denied a remunerative price. A study of the effect of the Green Revolution on small farmers and other weaker sections in Tamil Nadu reveals that large-size farmers have gained more than the small ones as a result of the Green Revolution.[17]Wolf Ladejenskywho made certain field trips in Punjab and Bihar in 1969 came to the conclusion that in the areas visited, there was significant agricultural development due to the Green Revolution. At the same time, it was stated that the weaker sections were not benefited by the new farm technology. But a difference was noticed in the conditions of agricultural labour in Bihar and Punjab. In Punjab, due to the development of agro-industries, the small-size farm owners are able to get supplementary occupations unlike in Bihar. Hence, it is concluded that the problems of weaker sections are not of aserious nature in Punjab. But, it was stated, the Green Revolution was not responsible for income in equalities in the rural areas; the social, religious, economic and political factors prevailing there were responsible for the state of affairs of the weakersections.[18]

Francine R. Frankel, who visited Ludhiana (Punjab), West Godavari (Andhra Pradesh), Tanjore (Tamil Nadu), Palghat (Kerala), Burdwan (West Bengal) districts where there was the IAD programme, came to the conclusion that as a result of the introduction of HYV and other modern inputs, the yield per hectare had gone up and consequently, almost all categories of farm producers were benefited. In Ludhiana district, where HYV wheat was grown widely, the different farmers were able to gain substantially. But it is stated that the additional gains from new farm technology were not properly distributed. Farmers with 5 to 10 acres of land were able to increase their net income to some extent. But those with 15 to 20 acres of land growing wheat were able to make adequate investment on the new inputs and achieved substantial gains. It was also noticed that in rice-growing regions, even though small farmers were able to gain to some extent, their real income did not improve because of considerable increase in the production costs. In the matter of yield per hectare of land,the large-size farmers didnot make any head way as compared to small farmers. It was also noted that in the rice- growing regions, the economic conditions of about 75 to 80 per cent of the farmers had deteriorated.[19]

1.7.2 Tenants and Green Revolution:

We do not have full records to show the extent of different categories of tenants in different parts of India. However, based on certain studies pertaining to some regions, we have to analysethis problem and draw certain

conclusions. The study of G. Parthasarathy during 1965-66 and 1971-72 pertaining to West Godavari district in Andhra Pradesh throws some light on certain important aspects.[20] It was observed that in the areas surveyed, certain tenant cultivators became agricultural labourers andin some cases agricultural labourers became tenant cultivators. Before the Green Revolution period, a certain proportion of the total produce was given to the landowner as rent. It was observed that rent was raised after the introduction of HYV seed. When traditional seed was used, only certain tenants used to give two-thirds of the produce as rent and after HYV seed came into practice the landlords are found to be insisting on two-thirds share from the produce. Even though land owners shared two-thirds of expenses on chemical fertilizer, pesticides, etc., in view of two-thirds rent the gains of new farm technology were not reaching the tenant cultivators. From the study, it is also found that three-fourths of the additional production due to new farm technology went to the landowners and only one- fourth to the tenant cultivators. This study reveals certain other things also. In view of the inability of the tenant cultivators to offer any asset as security, they were not able to get credit from the institutional sources. It was only the large-size farmers of dominating communities that were ableto secure credit from the Primary Agricultural Credit Societies. The tenant cultivators were found to be borrowing from the landlords or the local moneylenders paying nearly two times the interest rate charged by the institutions. Due to payment ofhigher rate of interest, the gains accrued to tenant cultivators from the adoption of new farm technology were found to be negligible. As a result of this situation, the already existing income inequalities have further widened. From this study, it appears that in equalities in the distribution of output rather than in equalities in the distribution of land assets are mainly responsible for income inequalities. The study of Mencher[21] reveals that for many tenant cultivators, there was no security. Only those tenants cultivating the lands of widows and aged persons were found to be cultivating the same lands continuously for about four to fiveyears. In other cases, tenants are changed almost every year and from one piece of land to another. Further, a survey conducted in Chingle put district of Tamil Nadu reveals that there was always conflict between landlords and tenant cultivators. Even though tenant cultivators had the support of some political parties, their conditions did not improve because of the dominating role of landlords and lack of security to the tenant cultivators. Francine R. Frankel, during his field trips, noticed the eviction of tenant cultivators and landowners taking uppersonal cultivation lured by the potential gains of the new farm technology.

Whether the tenant cultivator is making adequate investment and using modern inputs or not is being debated. In the absence of security of tenure and institutional credit the tenant cultivator may not have the necessary incentive to invest on new farm technology. There are some cases where new farm technology has changed the character of tenancy. For example, in Punjab some small farmers whoare not able to make adequate investment on modern inputs in and cultivate the land profitably are found to be entrusting their land to tenant cultivators. Such tenant cultivators are functioning like large-size farmers and carrying on the farm operations by adopting new farm technology. Even in this type of tenancy, the extent of adoption of new farm

technology is being debated. Lack of security of tenure and high rate of rent that the tenantcultivator has to pay are the disincentives in the adoption of new farm technology. While the Programme Evaluation Organisation Studies state that there is no difference between the landlords and tenant cultivators in the application of modern inputs, G. Part has arathyargues that such a conclusion is based on limited sample data. Further, in the areas chosen for PEO study, the tenant cultivators must be cultivating large- size holdings than the landowning class. If only a study is conducted with reference to pure tenants and tenants in subsistence cultivation,the real problems of tenant cultivators could be betterunderstood.

1.7.3 Agricultural Labour and Green Revolution:

According to the 1991 Census, of the total number of workers in rural areas, 32.2 per cent are agricultural labourers. With HYV seed, if only there is assured irrigation, more than two crops can be raised in ayear. In such cases, agricultural operations have to be carried onvery quickly. Ploughing of land, sowing of seed, transplantation, weeding, spray of pesticides, harvesting, threshing operations, etc., have to be carried on quickly and the field must be made ready for the next crop. Therefore, the demand for labour increases and employment can be for a greater period during a year. There is a general impression that due to the Green Revolution, the degree of seasonal unemployment is reduced and during the peak seasons when there is great demand for labour, the agricultural wages would go up. There are no adequate research studies relatingto the impact of the Green Revolution on agricultural labour. From a study of G. Parthasarathy[22] in West Godavari district of Andhra Pradesh, it can be seen that due to the use of IRS along with other inputs, the gross income has gone up. The additional income made possible by the new farm technology was pocketed mostly by landowners and those who supplied modern inputs. The share of agricultural labourin the additional income was found to be just 7 per cent. As in the case of different categories of workers, money wages of agricultural labour also have gone up in recent years. In view of the growing cost of living, it may be concluded that there is no improvement in the real wages of agricultural labourers.

The share of agricultural and allied activities in the net domestic product declined from 60.5 per cent in 1950-51 to 31.2 per cent in 1994-95. This implies fall in the income per agricultural worker and uneven distribution of incomes between rural and urban sectors. In view of the slow labour absorption capacity of the non-agricultural sector, increased population results in a large number of new entrants to the labour force seeking livelihood, though meagre, in agriculture. This development is bound to depress the level of agricultural wages in spite of the new farm technology bettering the agricultural incomes and the Minimum Wages Act inforce.

1.8 GREEN REVOLUTION AND RURALDEVELOPMENT

The Green Revolution has the potentialities of contributing to rural development in terms of generation of higher production, employment and incomes in the agricultural sector. However, *as* discussed earlier, the

Green Revolution is confined only to the irrigated areas. The scope of the Green Revolution, thus, being limited, high expectations concerning reductions in unemployment and poverty are perhaps unwarranted. In areas with satisfactory irrigation, there is demand for labour and employment and wages have risen and in areas with lack of irrigation understandably, such increases are not perceptible. B. Senrightly stated: "Without the high- yielding varieties, the problem of poverty and unemployment would have been more acute; without them, there may have been a deceleration in the growth rate of the output of some food grains... if the Green Revolution has not turned out to be a Cornucopia, neither has it been a Pandora's Box." It is sometimes argued that the new farm technology necessitated tractorization and it led to the displacement of hired labour. Tractorization of farm operations has been confined to a limited labour. As such, the criticism that tractorization has led to large-scale eviction of tenants or displacement of hired labouris unwarranted. The Green Revolution cannot be blamed for in equalities in the regional development and among individual incomes. Such in equalities are already there. New openings made available by new farm technology for the development of one region should not be a matter of frustration and envy for a neighboring region. On the other hand, what is relevant is how best the knowledge of new farm technology can be diffused and applied in all regions under different agro-climatic conditions. Under the given natural endowment, necessary steps have to be taken in less favourableareas to provide infrastructural facilities, institutional arrangement and to form economic organisations. G. Parthasarthy analysing the relationship between agricultural production and reduction in rural poverty observes: "Even though no firm relationship has been established between the rate of growth of agricultural production and reduction in poverty, the higher overall rates of growth with perceptible margins above the rates of growth of rural population should be expected to set the pace for sustained reduction in poverty. High rates of growth also help through their favourable effect on prices paid by the poor for food and also through employment linkage effects between agriculture and non- agriculture." [24] The Green Revolution must spread to all regions, including the dry tracts and along with this step, rural industrialization should receive adequate attention of the government. An increased emphasis on agricultural development and on dry land development has the potential to contribute to growth and equity simultaneously and also towards resolving the imbalances in crop productions. The HYV seed varieties suitable for dry crops have to be evolved and popularised. The small and marginal farmers in all regions need to be assisted to raise the levels of intensity of cropping and high-value crops. The problem of landless labour needs to be tackled more effectively. Employment guarantee must be provided to them and there must be a statutory permanent machinery at district level to arrange for regular employment to labour within the district. Through the provision of proper working conditions and remunerative wages, the landless labour must be encouraged to seek employment inthe rural sector. This step is necessary to ensure regular supply of labourto agricultural sector and prevent exodus of rural labour to urban areas.

1.9 PROBLEMS IN THE SPREAD OF GREEN REVOLUTION

For the spread of the Green Revolution, certain inputs become very crucial:

1.9.1 Irrigation:

An important requirement for the Green Revolution is irrigation. Only in the irrigated lands, HYV seed, chemical fertilizer, pesticides and other modern inputs can be used profitably.

Since irrigation facility is available to a limited area, the Green Revolution is also confined to some extent to this limited irrigated area. For the spread of the Green Revolution to different regions, creation of irrigation facility on a wider scale becomes necessary.

B. Sen argues that a higher proportion of small-size holding enjoys irrigation facility. He, therefore, concludes that small and marginal farmersare not ata disadvantage in adopting the new farm technology, although they have several other problems.

1.9.2 Capital:

Another problem in the spread of the new farm technology is in respect of investment capacity. The different categories of farmers must have investment capacity and only then they can use new farm technology leading to the Green Revolution. The small and the marginal farmers do not have their own funds to make adequate investment on modern inputs. Under these circumstances, timely and adequate supply of credit through institutions becomes necessary. Out of the total agricultural credit, only about 45 per cent comes from the institutional sources and still private agencies dominate the rural credit scene. The small and marginal farmers, the tenant cultivators, mixed cultivators and agricultural labourers are not able to secure adequate institutional credit. Lack of credit facilities, particularly to the needy persons, is a problem in spreading the Green Revolution.

1.9.3 Inadequate Extension Services:

For the spread of new farm technology, the farmers must have a clear knowledge about the soils, fertilizer requirements, crop choice, etc. In a situation where a majority of farmers are illiterate, technical know-how is very much lacking. The extension services available are inadequate. The village development officers who are in charge of extension are not fully equipped to provide the extension services needed. As stated elsewhere in this book, in advanced countries like Japan and America, for every 200 farmers, there is one qualified extension official. In India, each extension officer has to serve nearly 10,000 farmers requiring varied technical advice which he himself is not certain about. This, again, is a major problem in spreading the new farm technology, leading to the Green Revolution in India.

The different problems that crop up with the spread of the Green Revolution are analysed under three generation problems.[6]

1.9.4 First Generation Problems :

In the first stage, high-yielding varieties of seed for food and non-food crops for wet as well as dry cultivation have to be evolved. A much more important factor is the evolving of a new variety that suits the different agro climatic conditions and meets the consumer tastes. The grain of HYV like IR 8 is of a coarse type which is not acceptable to consumers. These problems of a technical nature demand realistic and practical solutions. Further, provision of irrigation water with efficient water management is of crucial importance. Also other inputs like chemical fertilizers and pesticides must be made available in adequate quantity and at right time to all categories of farm producers. The extension services become equally more important in the early stages of spread of the new farm technology. There must be institutional credit support, particularly to small and marginal farmers so as to enable them to invest on modern inputs and secure extension services. Thus, the first generation problems relate mainly to the technical matters of increasing the supply of new inputs and diffusion of knowledge for efficient use. In order to tackle the first generation problems there is need for- (a) increased public as well asprivate investment on expansion of irrigation facilities, (b) evolving of anew variety of seed in pulses, oilseeds, etc., along with the HYV seed of wheat and paddy, and (c) equally important is evolving of HYV that suits the different agro-climatic conditions. The consumers' acceptance should also be taken into account while evolving the HYV seed. Food grains grown with bio-fertilizer application are now gaining popularity particularly in International markets and hence this technology need to bepopularized.

1.9.5 Generation Problems:

With the adoption of a new farm technology, the yield per unitof land is bound to increase significantly resulting in more marketable surplus. Therefore, the second generation problems are concerned with marketing and matters associated with it. For an efficient marketing system, there is need for storage, transport, processing and grading facilities. Also, there is need for efficient market news system, which helps the large number of farmers spread over the entire country to have timely and correct information about the prices prevalent in different market centers for different commodities and thequality and standards expected in the foreign markets. Effective steps to ensure good quality of different agricultural commodities are necessary in a situation of globalization of trade in agriculture.

In case the price prevalent in the market is less than the 'minimum price', adequate facilities must be made available to sell at minimum prices. In case the prices of commercial crops are higher than the price of food grains, the farmers would naturally prefer to grow commercial crops. This would result in fall in the supply of food grains with all its adverse effects on the society. Therefore, price parity in between different

crops must be maintained. In order to tackle the second generation problems, the government must take certain steps:

1. Appropriate policy measures are required to provide milling, grading, storage, transport, etc. facilities to the farmers in adequate measure.

2. Co-operative marketing societies including co-operative processing societies have to be strengthened on the lines of 'Amul' in Gujarat.

3. Keeping in view the low per capita rural incomes, role of middle men in credit and marketing need to be eliminated through adequate institutional credit. Integrating credit with marketing is a measure that needs serious consideration.

The small and marginal farmers are at a disadvantageous position in securing remunerative prices for their products. Therefore, necessary steps have to be taken to create such favourable conditions to the less privileged farmers so as to enable them to sell at remunerative prices.

1.9.6 Generation Problems:

Large-size farmers with assured irrigation facilities are mostly benefited by the new farm technology. The Green revolution is confined to regions with assured irrigation facilities and it is found that rich farmers have become richer by adopting the new farm technology.

Therefore, the Green Revolution resulted in imbalances in the regional development and inequalities of income. The third generation problems, therefore, are those relating to equity or redistribution of wealth. From the study of G. Parthasarathy, it appears that 75 per cent of the additional income derived from the Green Revolution is enjoyed by the landlords only. The share of the agricultural laboureris found to be just 7 per cent only. Further, due to the Green Revolution, in many places, it is reported that the tenant cultivators are evicted from the land and in some cases rents are raised. Thus, the Green Revolution has not helped the weaker sections of the rural society. It is, therefore, argued that the Green Revolution may lead to a Red Revolution if corrective steps are not taken immediately.

In the opinion of Falcon,[7] the third generation problems arise mainly through four sources:

1. Higher rate of population growth in those regions where thereis already a high density of population;
2. Further widening of already existing inequalities in the individual incomes, wealth and political influence;
3. Limited employment opportunities in the non-agricultural sector in spite of its growth; and
4. Introduction of certain agricultural inputs like tractors which lead to the creation of unemployment.

In a developing country like India, population growth rate is higher than

the rate of increase of employment opportunities in the non-agricultural sector. With the HYV seed of short maturity period, it is possible to raise more than two crops a year and hence, there is possibility of providing employment to labour almost throughout the year. But, if instead of rising labour-intensive crops like cotton, wheat is grown, and the demand for labour would fall. The influence of HYV on employment potential depends upon different factors peculiar to different regions. Yet, the expert opinion is that HYV seed iscapable of increasing employment opportunities. Due to the Green Revolution, the supply of food grains would increase. This may result in a fall in the prices of food grains and such situation may facilitate more savings and increased investment. If such favourable development results in higher levels of investment, the Green Revolution certainly is helpful for the progress of the country. On the other hand, if the Green Revolution leads to unemployment and social unrest, this would result in agitationsand chaos in society. In the regions of assured irrigation, the impact of the Green Revolution is more significant and incomes for land owners in such regions would increase substantially. The agricultural price policy is also likely to benefit the land owning class. But such development would only further widen the existing inequalities of income and in equalities in the development of different regions. The large-size farmeris always in a better position in securing different modern inputs and in marketing of his products. Such farmer is in a position to own a tractor and use it profitably. The tractor may cause unemployment among agricultural labour. Also, with a tractor, the land owner himself may cultivate his entire land resulting, in some cases, in eviction of tenant cultivators. In the wheat growing regions, as a result of use of tractors in large-size farming, large-scale eviction of tenants and unemployment of labourcan easily benoticed.

In the light of the third generation problems, the following steps become necessary:

1. The benefits of the Green Revolution must be spread to all regions. Therefore, *HYV* seeds suitable for dry areas must be evolved andpopularized;
2. Labour-intensive type of farm practices must beadopted;
3. Through the development of cottage and small-scale industries, employment opportunities must be created in the ruralareas;
4. In developing countries like India, the economic development and distributive justice cannot be achieved through the spread of the Green Revolution alone. Along with agricultural development, there is need for achieving progress in other sectors of the economy;and
5. The benefits of the Green Revolution must reach all those who areassociated withit.

The small and marginal farmers and tenant cultivators must be helped to use the new farm technology and derive benefits from it. Necessary steps must be taken to ensure security of tenure and properreward for the efforts of the tenant cultivators. The agricultural labour must be assured of decent wages.

Progressive land tax or agricultural income tax becomes necessary to reduce the growing inequalities in individual farmincomes.

1.9.7 Adoption Pattern:

It is important to examine more closely the adoption pattern of new farm technology. As stated earlier, irrigation is a pre-requisite for determining the applicability of high-yielding varieties (HYV) on agiven farm. Therefore, the adoption pattern would be determined mainly by the distribution of irrigated farms in different size groups. Further more, the scope for a rapid extension of irrigation being limited, annual additions to the existing extent of irrigated farms are unlikely to change significantly the existing distribution of irrigated farms. Therefore, B. Sen rightly states that "There is no escape from the fact that the adopters of the high-yielding varieties would be the farms that are already irrigated and for a long time to come,these farms would also constitute the bulk, if not the entire set, of adopter farms."[8] However, irrigation is not the only factor determining the adoption of high-yielding varieties. Besides irrigation, the farmer must have the ability to purchase critical inputs like fertilizer, pesticides, etc. The adoption of HYV inIndia has been taking place under the influence of a government-initiated mass action programme called the High-Yielding Varieties Programme (HYVP). In HYVP, credit is channelled through the co-operatives, duly certified seeds are supplied by the State Governments and the National Seed Corporation and fertilizer supply is arranged by the Central Government. The goal of the HYVP is to cover the entire irrigated land under food grains. Therefore, the adoption pattern is based on distribution of irrigated farms in favouror against a specific size-class of farms.

The study of B. Senreveals that out of total 22.7 million irrigated farms in the country, about 14 million or 61.67 per cent are under small size group of 0.00 to 4.99 acres, while 7.73 million or 34.02 per centare within 5.00 to 24.99 acres, and 0.97 million or 4.35 per cent are within 25.00 to 50.00 acres and above. A look into the percentage distribution of irrigated farms against different size groups clearly reveals that small-size farms enjoy relatively higher proportion of irrigation than the large-size farms.

Irrigated large farms constitute 42.6 per cent of all large farms in the country, while the irrigated small farms form 45 per cent of all small farms. Irrigated medium-size farms constitute 46.5 per cent of the total medium-size farms. Therefore, the proportion of existing small-size and medium-size farms adopting the new varieties is likely to be greater than the large-size farms. B. Senafter examining the proportion of irrigated land out of the total holding of different size groups concludes that "The proportion of irrigated land per farm is greater for small farms and that this proportion is inversely related to farm size. It is, therefore, reasonable to expect that the smaller farms would have a greater proportion of land per farm under high-yielding varieties than any other farmgroup."[10]

1.9.8 Size Offarm And New Farm Technology:

The size of the farm figures prominently in the discussion of adoption of the new farm technology. The concepts of 'indivisibility of factors of

production' and 'economies of scale' are imported into the agricultural sector from the industrial sector, which has led a little controversy and confusion. But, "the theory of the firm is always difficult to apply to agriculture, as far as underdeveloped countries are concerned; it seems to have limited application."[11] To quote another expert, "Since land as a factor of production is perfectly divisible and since many inputs, e.g. labour, water, seeds, manures and pesticides, etc., are equally divisible, the improved methods can be applied to land, quite irrespective of its size."* Even equipment like a tractor "capable of being hired out (by hours) and livestock though indivisible, optimum utilization of them is possible by employing them on different farms on hire or exchange basis. Japanese agriculture reveals that small-size farm is no serious impediment to technological progress in agriculture. The reports of the Farm Management Studies in India show that productivity per acre is higher in smaller holdings." On this issue, A.K. Sen's remarks fortify the above conclusions: "In an economy with structural unemployment, non-wage family-based farming has several advantages that capitalistic farming does not have."[14] The small- size holdings in Japan or in India in States like Kerala have not stood in the way of higher productivity. This discussion may well be closed with the weighty remark of an eminent authority which clinches the issue: "It has often been suggested that the productivity of small-scale holdings is inherently low. But that is simply not true. Not only do we have the overwhelming evidence of Japan to disprove that proposition, but a number of recent studies on developing countries also demonstrate that given the proper conditions, small farms can be as productive as large farms."[15] All this clearly shows that new farm technology is neutral to scale or size of holding. In recent years, institutional credit is available fairly well to different categories of farmers. The regional rural banks are mainly intended for meeting the credit requirements of the weaker sections of the rural community. The supply position of different modern inputs is also encouraging. Further, there is pressing cash requirements for small farmers too. Therefore, the small-size farmers also, by taking advantage of institutional credit facilities, are quite encouraged to secure modern inputs and use them to their advantage.

1.10 EXERCISE

1. Explain the concept of Green Revolution and discuss the effect of green revolution on weakersection.
2. Discuss the various objectives of agricultural policy?
3. Explain the various problems in the spread of green revolution.
4. Explain the relation between Green Revolution and Rural Development.

2

INDIAN COUNCIL OF AGRICULTURAL RESEARCH (ICAR)

Unit Structure:

2.1 OBJECTIVES

1) To study the objectives and milestones of ICAR.

2) To study the organizational structure of ICAR.

3) To study the various salient achievements of ICAR.

2. 2 INTRODUCTION

The Indian Council of Agricultural Research (ICAR) is an autonomous organization under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers Welfare, Government of India. Formerly known as Imperial Council of Agricultural Research, it was established on 16 July 1929 as a registered society under the Societies Registration Act, 1860 inpursuance of the report of the Royal Commission on Agriculture. The ICAR has its headquarters at New Delhi.

The Council is the apex body for co-coordinating, guiding and managing research and education inagriculture 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 food grains by 5 times, horticultural crops by 9.5 times, fish by 12.5 times, milk 7.8 times and eggs 39 times since 1951 to 2014, 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 engagedin cutting edge areas of science and technology development and its scientists are internationally acknowledged in their fields.

2.3 OBJECTIVE OFICAR

To plan, undertake, aid, promote and co-ordinate education, research and its application in agriculture, agroforestry, animal husbandry, fisheries, home science and allied sciences.

To act as a clearing house of research and general information relating to agriculture, animal husbandry, home science and allied sciences, and fisheries through its publications and information system; and instituting and promoting transfer of technology programmes.

To provide, undertake and promote consultancy services in the fields of education, research, training and dissemination of information in agriculture, agro forestry, animal husbandry, fisheries, home science and allied sciences.

To look into the problems relating to broader areas of rural development concerning agriculture, including post-harvest technology by developing co-operative programmes with other organizations such as the Indian Council of Social Science Research, Council of Scientific and Industrial Research, Bhabha Atomic Research Centre and the universities.

To do other things considered necessary to attain the objectives of the Society.

2.4 MILESTONE OFICAR

Initiation of the first All-India Co-ordinated Research Project on Maize in1957.

Status of Deemed University accorded to IARI in1958.

Establishment of the first State Agricultural University on landgrant pattern at Pantnagar in1960.

Placement of different agricultural research institutes under the purview of ICAR in 1966.

Creation of Department of Agricultural Research and Education (DARE) in the Ministry of Agriculture in 1973.

Opening of first KrishiVigyan Kendra (KVK) at Puducherry (Pondicherry) in 1974.

Establishment of Agricultural Research Service and Agricultural Scientists' Recruitment Board in 1975.

Launching of Lab-to-Land Programmeand the National Agricultural Research Project (NARP) in1979.

Initiation of Institution-Village Linkage Programme (IVLP) in 1995 Establishment of National Gene Bank at New Delhi in 1996.

The ICAR was bestowed with the King Baudou in Award in 1989 for its valuable contribution in ushering in the Green Revolution. Again awarded King Baudou in Award in 2004 for research and development efforts made under partnership in Rice Wheat Consortium.

Launching of National Agricultural Technology Project (NATP) in 1998 and National Agricultural Innovation Project (NAIP) in 2005.

2.5 ORGANISATION OFICAR

Union Minister of Agriculture is the ex-officio President of the ICAR Society.

Secretary, Department of Agricultural Research and Education, Ministry of Agriculture, Government of India and Director General, ICAR is the Principal Executive Officer of the Council.

Governing Body is the policy-making authority Agricultural Scientists' Recruitment Board Deputy Directors-General (8)

Additional Secretary (DARE) and Secretary (ICAR) Additional Secretary and Financial Advisor Assistant Directors-General (24)

National Director, National Agricultural Innovation Project Directorate of Knowledge Management in Agriculture

2.6 SALIENT ACHIEVEMENTS OFICAR

A) Crop Sciences:

1) The division has played a pivotal role in ushering the era of green and yellow revolutions in the country. The national average productivity raised by 2-4 folds in foodgrains, rapeseed- mustard and cotton since1950-51.

2) Spectacular success has been achieved in introduction and improvement of new crops, such as soybean and sunflower; India is now the fifth largest producer of soybean in the world.

3) The division has supported the development of improved crop cultivars and appropriate crop production-protection technologies, along with promoting the basic/ strategic/ applied research in cereals, millets, pulses, oilseeds, commercial crops and foddercrops.

4) Developed and released over 3,300 high-yielding varieties / hybrids of field crops for differentagro-ecologies.

5) Facilitated development, evaluation and identification of technologies through the All-India Co-ordinatedProjects.

6) First in the world to develop hybrids in grain pearl millet, castor, pigeon pea and cotton in the 1970s; developed hybrids in other crops like rice, safflower and rapeseed-mustard.

7) Developed single cross hybrids of QPM (quality protein maize) having high nutritional value and yield, and high yielding baby corn.

8) Developed and introduced early and suitable plant types in rice, sorghum, cotton, pigeon pea, chickpea, green gram,black grametc.; these have opened upavenues for multiple cropping systems and helped in enhancing cropping intensity, early pulsevarieties have helped in claiming the new niche areas such as early chickpea varieties in Andhra Pradesh that led to high productivity in thecrop.

9) Some of the improved Indian varieties have acclaimed global spread in case of sugarcane, wheat, rice, pigeonpea, sorghum and mustard.

10) For the first time, successfully employed molecular marker assisted selection/pyramiding of xa 13 and × a 21 genes from the source variety IRBB 55 in the genetic background of Pusa Basmati I: thus developed bacterial blast resistant variety. Improved Pusa BasmatiI.

B) Horticulture:

1) Developed 721 high yielding varieties and production technologies in horticultural crops leading to the 'Golden revolution'. Through adoption of these technologies, India has emerged as the second largest producer of fruits and vegetables in the world. It has substantially improved the food and nutritional security.

2) Through the adoption of improved technologies, production increased up to 2.4 fold in banana and tomato, 1.6 fold in potato and 1.3 fold in cassava from 1991-92 to2005-06.

Released export quality red-peeled and regular bearing mango varieties PusaArunima and PusaSurya withlong shelf life; developed a regular bearing, anthracnose disease resistant, red colour fruit and high quality mango hybrid H39.

3) Developed early maturing and prolific bearer aonlacultivar ComaAishwarya and high input-efficient potato cultivar KufriPukhraj.

4) Developed technology for seed multiplication in potato through seed plot technique and micro- andmini-tubers.

5) Standardized micro-propagation technology for seedand planting material in potato and banana.

6) Developed technologies for producing disease free planting material in citrus through shoot tip grafting.

7) Standardized high density planting and suitable canopy architecture in apple, pear, pineapple, mango, citrus and guava for improving productivity.

8) Developed amicronutrient mixture. Banana Shakthi, for banana crop.

9) Developed high productive coconut and areca nut based multispecies cropping systems involving spice crops for enhancing productivity andprofitability

C) Natural Resources Management:

1) For sustainable land use, soil resource, degradation and fertility maps of different agro-ecological regionsdeveloped.

2) Assessed soil carbon stocks using the benchmark sites under different land use systems of the country.

3) Prepared integrated nutrient management packages for major cropping systems.

4) Resource Conservation Technologies (RCTs) such as zero tillage, furrow irrigated raised bed planting system and laser land leveling developed.

5) Mitigation and adaptation technologies to meet the challenges of climate change were promoted through a network.

6) Developed consortiaof bio fertilizers for major crops.

7) Standardized technologies for enriched composts/ vermicornpost.

8) Developed cost effective amelioration technologies for water logged, salt affected and acid soils.

9) Developed a network of 47 model watersheds that provided a basis for developing the National Watershed Development Programme for Rainfed Areas (NWDPRA).

10) Evolved rain water harvesting techniques for enhanced water and crop productivity.

D) Animal Science:

1) A unique National facility. High Security Animal Disease Laboratory with P-4 measures established that played a pivotal role in providing diagnostics services for avian influenza in the country besides developing vaccine using in digenous strains.

2) 80% of 140 in digenous breeds of live stock and poultry characterized phenotypically and genetically.

3) Five breeds of indigenous livestock and poultry were conserved and characterized both phenotypically and using molecular markers.

4) Vrindavani breed of cattle developed with production potential of 3,500 kg milk parlactation.

5) Graded Murrah buffaloes with 2.200 kg milk yield per lactation evolved.

6) Improved strains of sheep for fine wool (Bharat Merino), carpet wool (Chokla, Marwari, Magra) and meat (Malpura, Nellore, Mandya, Madras Red) developed.

7) Artificial insemination method standardized in mithun, yak, camel, goats, pig and equines; first mithuncalf born through artificial insemination in India; crystoscope device developed to detect accurate time for insemination in cattle and buffaloes.

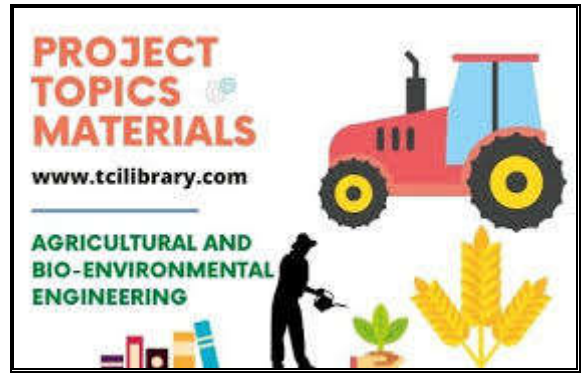
8) For promoting backyard poultry an early-maturing poultry strain, CARI-Nirbhik, producing 223 eggs by 72 weeks, developed.

9) Hormonal-modulation protocols developed to increase egg production inpoultry.

10) A new fungus genus Cyllamyces icons with better fibre degrading ability identified for the first time in Indian cattle and buffaloes.

E) Agricultural Engineering and Technology:

1) Developed over 150 agricultural tools, implements and machines for time liness of farm operations, drudgery reduction and efficient input use for various field and horticultural crops; of which 75 machines commercialized.



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2) Conductedergonomic and safety studies leading toreduced drudgery and improved safety of farm machines, particularly, to suit farm women.

3) Developed renewable energy source-based devices and gadgets such as solar refrigerator, low cost solar cookersand water heaters, solar concentrators for solar photovoltaic (SPY) panels, solar cocoon stiffer, high efficiency cook stoves, pyrolysis briquetted fuels, gasifies. Improved biogas plants, dewatering system for biogas slurry. Utilization of animals in rotary mode for operating different agricultural machines &equipment.

4) Developed structures, environmental control techniques and packages of production practices for raising nurseries, production of flowers, medicinal plants and off-season vegetables.

5) Developed plastic-lining for rainwater harvesting ponds and pond based micro-irrigation systems, plastic mulching of crops, carp hatcheries and transportation system for livefish.

6) Developed low cost improved storage structures for food grains, evaporative cooled structures for fruits and vegetables, machinery and pilot plants for value addition to agricultural produces.

7) Developed equipment for soybean processing and utilization - soybean DE hullers, extrusion expelling pilot plant, soy flaking machine, soy snack extruder, cottage level soupierplant, and okrafortified soy-cereal snacks.

F) Fisheries:

1) Developed database of 2,200 fin fishes and shellfishes in Indian waters.

2) Database of marine fishery resources of commercially important fish species developed.

3) Identified 31 new species of fishes from Western Ghats and north eastern region.
4) DNA bar coding of 75 species of Indian marine fishes completed.
5) PCR-based gender identification of marine mammals developed.
6) Micro satellite enriched genomic library developed for Pegasus.
7) Milt cryop reservation and breeding protocols developed for the conservation of yellow catfish. Horab agrusnigri collaris, an endangered fish of Western Ghats.
8) Early maturation and breeding of Indian major carp, rohu (Labeorohita) achieved through photo thermal manipulation.
9) Cloning and sequencing of genes, viz, gonad otropin GTH I and it sreleasingh or mone (GnRH)encodingc DNAs Accomplished in rohu.
10) Developed genetically improved rohu. CIFA IR I, with enhanced growth.
11) Achieved mass seed production of fresh water food fishes, viz. medium carps. Labeogonius, Labeoimbriatus,, Puntiussarana; Catfishes, Ompokpabda, Mystusvittatus; chocolate mahseer, Puntiushex agonolepis; and Chitalachitala, enabling diversification of culture practices.
12) Portable FRP carp hatchery designed anddeveloped.
13) Hatchery breeding techniques developed for marine and freshwater ornamentalfishes.
14) Giant freshwater prawn, Macro brachium rosenberg bred using inland ground salinewater.
15) Captive breeding of kuruma shrimp, Metapenaeusjaponicus carried out.
16) Breeding and larval rearing of sand lobster, Thenusorientalis achieved, for the first time in the country.

Agriculture Education:

1) Financial and professional support provided to Agricultural Universities (AUs) for modernization and strengthening of academic facilities, infrastructure and faculty improvement.
2) Accreditation Board established for quality assurance in agricultural education and several AU saccredited.
3) Norms, standards, academic regulations and under-graduate coursecurricula and syllabi revised and made utilitarian as recommended by the IV Deans' Committee and implemented by severalAUs.
4) Nicheareas of excellence established to augment strategic strength of AUs in specificare as including those in newand emerging cutting-edge technologies.
5) Over 180 units for experiential learning established in AUs for providing skill-oriented hands-on training to the studentsat

undergraduate level.

6) For quality upgradation, reduction of in breeding and fostering national integration in higher agricultural education, admission of students up to 15% of total seats in undergraduate and 25% seats in post-graduate programmes being centrally undertaken.

7) Faculty competence improved through 31 Centres of Advanced Studies.

8) About 2,400 scientists trained in emerging areas including cutting-edge technologies through about 90 summer/winter schools organized every year.

9) Awarded about 1,000 National Talent Scholarships for undergraduate studies, 475 Junior Research Fellowships for post- graduate studies and about 200 Senior Research Fellowships for Ph.D. annually.

10) Promoting excellence at national level through ICAR National Professor and National Fellow schemes.

11) Need-based capacity building of NARS through Foundation courses, refresher courses, workshops, seminars and international programme scarried out by National Academy of Agricultural Research Management. The Academy also provides policy support, facilitates national dialogues and undertakes consultancies, for performance enhancement of NARS.

12) Under the Indo-US Agricultural Knowledge Initiative, about 15 Borlaug fellows selected every year for training in USA; eight joint workshops organised; eight collaborative research projects undertaken, and visits of experts facilitated in the focus areas of (i) Education, learning resources, curriculum development and training; (ii) Food processing and use of byproducts and biofuels; (iii) Biotechnology; and (iv) Water management.

13) ICAR facilitates admission of foreign students in Indian AUs by considering the applications received through the DARE, Educational Consultants India Ltd. (Ed. CIL), and Indian Council of Cultural Relations (ICCR). About 200 students are admitted annually in various degree programmesin agriculture, horticulture, forestry, veterinary, agricultural engineering etc.

G) National Agricultural Innovation Project (NAIP):

1) Earlier the NATP Project was implemented by ICAR during 1997-2005. The project has contributed to the development of about 300 new technologies and their adoption by farmers besides several new research tools, methodologies and intermediate products.

2) The NAIP is being implemented in ICAR since July 2006 with the credit assistance of US$ 200 million from the World Bankand US$ 50 million Government of India share. Its main objective is to contribute to accelerated and inclusive growth through collaborative development and application of agricultural innovations by the public research organisations in partnership with private sector. NGOs and other stakeholders. By the end of December 2009, 187 sub projects

have been approved at a total outlay of Rs1,017 crores covering all the four components.

H) Knowledge Management :

1) The agricultural research information system of the Council show cases and markets the developed technologies to various stakeholders.
2) Disseminated information through flagship products such as research and popular periodicals, hand books, mono graphs, technical and text books, popular books etc.
3) About 200 publications brought out every year on topical issues related to agriculture.
4) Scrolling news - another hallmark - launched at ICAR website.
5) More than 1.5 lakh hits per month recorded forwww.icar.org.in
6) Accelerating ICT management in agricultural research through inter- and intra-net connectivity to narrow down the gap between technology developers and itsusers.
7) Participated in Technological Exhibitions and Book Fairs of Nationallevel / international level to create awareness about agricultural research and education.

I) International Co-operation:

1) Active collaboration with international agricultural research institutions including CG centres, CABI, FAO, NACA, APAARI, UN-CAPSA, APCAEM, ISTA, ISHS etc.
2) MoU/ Work Plans with over 30 countries for bilateral co-operation in agricultural research, training and studyvisits.
3) ICAR offers quality and cost-effective agricultural education to international students at under-graduate andpost-graduate levels. And need-based short-term training, programmes in specialized areas are also offered. Special concessions for SAARC students.
4) Strong support to CGIAR institutes. Total funding support in 2007-08 of US$ 2.65 million.

2.7 EXERCISE

1) Explain the objectives and milestones of Indian Council of Agricultural Research.
2) Describe the various salient achievements of Indian Council of Agricultural Research.

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3

KRISHI VIGYAN KENDRA (KVK)

Unit Structure:

3.1 OBJECTIVES

1) To study the concept of Krishi Vigyan Kendra (KVK)

2) To study the various objectives of Krishi Vigyan Kendra for Rural Development

3) To understand the various functions of KVK in Rural area

3.2 INTRODUCTION

Krishi Vigyan Kendra (K.V.K.) is a noble concept developed by Indian Council of Agricultural Research (ICAR) which was rest upon a solid base of transfer of technology from laboratory to farmer's field with respect to Agriculture, Horticulture, Animal Husbandry, Floriculture Bee Keeping, MushroomCultivation, Broiler Farming and allied subjects. As per the recommendations of Mohan Singh Meheta Committee during 1974, K.V.K.s were established in different states. Gradually working guidelines are prepared to make the K.V.K. as the light house for the rural people.

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Indian Council of Agricultural Research emphasized on theresearch on agriculture and allied subject during 1960's to generate new technology for increasing crop production in different agro climatic zones of the country. A lot of technologies were generated through constant effort of the scientists

to boost up the production. But the technologies so generated in the research field are not transferred through extension agencies of different State Government,it is observed that a lot of technologies could not reach the fanner due to high cost of adoption, lack of the interest of the extension agencies. Hence, the transfer of the technology was not complete and effective. Later on K.V.Ks were established for easy and active participation of fanners through Front Line Demonstration and on Farm Testing.

As per the mandate of Indian Council of Agricultural Research, K.V.K. will operate under the administrative control of State Agricultural University (SAU) or Central Institute situated in a particular area. Different scientists from different disciplines as per the specific requirement of that particular area are posted in the Krishi Vigyan Kendra as Training Associate. Generally there are six categories of scientists posted in the K.V.K. i.e. (i) Training Associate (Crop Production) to look after the experiment on field crops as well as provide training and advice on different field crops, (ii) Training Association (Horticulture) looks after the training and demonstration on horticultural crops such as vegetables, fruits and flowers. (iii) Training Associate (Plants Protection) Provides training and demonstration oncontrol of different pests and diseases in different crops. He also imparts training and advice on different types of pesticides and insecticides, their methods and time of application, (iv) Training Association (Animal Science) looked after overall growth and management of animal resource of that particular area. He also imparts training and advices on broiler farming dog rearing as well as rabbit rearing etc. (v) Training Associate (Agricultural Engineering) looks after the use of different agricultural implements in the field for different agricultural operations through training, demonstrations and on farm testing, (vi) Training Associate (Home Science) involved in the Improvement of skill and attitude of the fanners and farm women as well as provides advices and training on kitchen gardening preparation of nutritional food and different handicrafts. She also imparts training regarding the preservation and storage of fruits and vegetables for rural youths of the adopted village.

Training Organiser, head of the K. V. K. family co-ordinates the work of all scientists for smooth functioning of the K.V.K. as well as for the benefit of the rural people of that particular area. He is also liaising with other line departments for co-ordination and effective implementation of different programs of the K.V.K. in the adopted village. Every K.V.K. has adopted 4 to 6 economically, culturally and technologically backward villages situated within 10- 20 Kmsradius of the K.V.K. These villages are not too small or too large. Before adoption, a detailed survey of the village was conducted to study the socio-economic and cultural status of that village. Now-a-days Participatory Rural Appraisal (PRA) tool was used to conduct the survey in which the village people are actively participated in the process. The village map was drawn by the help of different color by the villagers themselves and different prominent structures of the village such as school, temple, river, club etc. were depicted in that map. These structures will help the scientists to conduct the survey easily and smoothly. Basing upon the survey the field crop maps, animal resource map and other

ancillary maps were prepared for future use. After the survey work, detailed plan of work was chalked out and depending upon the requirement different activities were undertaken in different are as by K.V.K. scientists.

3.3 THE OBJECTIVES OF KVK

a) To demonstrate the new improved technology to the farmers as well as to the extension agencies directly in the farmers field with their active participation.

b) To identify the important problems of that area as per the needof the farmers and prioritization of the identified problems as per their importance.

c) To collect feedback from the farmersand extension agencies and to communicate these message to research scientists for modification oftechnology.

d) To impart training on different topics to different groups of the villagers.

e) To provide new and important information to the extension agencies and NGOs for wider circulation in that locality to improve their economic condition.

f) To prepare different extension models and verify these models in the farmers field with their participation to create confidence amongthem.

To achieve the above mentioned objectives K.V.K. undertake following types of activities in the adopted villages:

1) Farm Advisory Service

2) Training programme for different categories of people.

3) Training programmefor the extension functionaries.

4) Front Line Demonstration (Fill) (5) On Farm Testing (OFT).

Farm Advisory Services:

Krishi Vigyan Kendra otherwise known as Farm Science Center. It provides solution to any problems related to agriculture and allied subjects as and when faced by farmers of that particular locality. Interested farmers / persons can get proper advices regarding the establishment of new entrepreneurshipon non- traditional sector. The main function of advisory service center is to provide continuous and constructive advice along with sound theory and practical knowledge to the contact villagers regarding agriculture and its allied subjects for their cultural and economical improvement. The objectives of the Farm Advisory Center are as follows:

a) To study the socio economic status ofthe villagers.

b) To keep close relationship between K.V.K. and villagers.

c) To prepare individual farm model for upliftment of rural people.

d) To provide training and advice to the rural people so as to enable them to take part in the agricultural planning of the villages, blocks as well asdistricts.

e) Formation of farm club, farm center or village committee for easy transfer of new information related to agriculture to the villagers in shorttime.

3.4 FUNCTIONS OF KVK

1) Training programme for different categories of people:

Training is one of the most important activities of Krishi Vigyan Kendra. Training is planned and systematic effort to increase the knowledge, improves the skill and change the attitude of a person towards a particular subject. Training need assessment is the first and foremost factor to be considered before conducting any training programme. Depending upon the need and categories of trainees.K.V.K. imparts mainly following three types oftraining:

2) Training to the practicing farmers and farmwomen:

Training on different subjects were conducted by the scientists of the K.V.K. as per the need of the local farmers of a particular area as well as the types of trainees and different audio visual aids are used to increase the efficiency of the training. As the trainees are practicing farmers and farmwomen, more emphasis was given on the practical than theory to improve their skill to change their attitude and increase their knowledge for that particulartopic.

3) Training to the Rural Youth:

This type of training was imparted to the rural youth (Both male and female) mostly those are left their education in midway i.e. school dropouts. The main objective of this training is to provide sufficient knowledge and skill regarding a new entrepreneurship so that they can start their own business singly or collectively and generate some income for their livelihood. The main thrust areas of this type of training are mushroom cultivation, bee keeping, preservation of fruits and vegetables, broiler farming, goat rearing, tailoring, wool knitting, hand crafts and exotic vegetable cultivation etc. for more profit. In this training more emphasis was given on the practical aspects and trainees were do the practical themselves to get more confidence. The scientists of the K.V.K. provide knowledge regarding the availability of the raw materials as well as the marketing of different products in that particular locality for the interested participants.

4) Training programme for the extension functionaries:

In this group, mostly government employees of agriculture along with extension functionaries of line department and members of different NGOs operated in that locality are trained in different aspects. The main objective of this type of training is to refresh the memory and upgrade the knowledge and skill of the extension functionaries by providing recent and new information regarding new techniques as well as new approach of solving different problems faced by fanners of that locality. As the extension functionaries of different department act like a bridge between the scientists and villagers, the refinement of the knowledge is highly essential and quite helpful for effective and efficient transfer of thetechnology.

5) Front Line demonstration:

Front Line Demonstration (FLD) is the field demonstration conducted under the close supervision of the scientists because the technologies are demonstrated for the first time by the scientist themselves before being fed into the main extension system of the state department of Agriculture in that particular area. In this method newly released crop production and protection technologies and its management practices are adopted in a block of two to four hectares in the farmer's field. Only critical inputs and training for this demonstration are provided by Krishi Vigyan Kendra. In FLD both farmers and extension functionaries are target audience. From the FLD, it is possible to generate some data related to factors contributing to higher yield and also constraints of production under various farming situations. Front Line Demonstrationis conducted in a particular area after thorough discussion and consultation with the farmers of that locality. Depending upon the requirement ofthat area highly efficient new proven technology with higher potentialities is selected for this programme. Generally, a field day is observed in the demonstration field when the crop is at maturity stage and interaction between the scientists, fanners and extension functionaries takes place in the field. The crop is harvested in the presence of the interested group of fanners so that they can visualize the importance of new technology easily and effectively.

6) On Farm Testing (OFT):

Testing of any improved technology along with the tanners practice in the fanner's field with active participation of both the scientists and farmers is known as OFT. In this method two to three improved varieties or two to three improved technologies are tested in the same field so as to compare the results of these treatments. As per the suggestions of the fanners as well as local soil and climatic conditions the improved technology may slightly be modified by the scientists of K.V.K. to get maximum return.

All these activities of the K.V.K. are undertaken as per the suggestion and approval of the Scientific Advisory Committee. This committee consists of representative from theVice-chancellor ofState Agricultural University or Director of the Institute, representative from the Indian Council of Agricultural Research, representative of the District Collector, representatives from Department of Agriculture, Horticulture, Animal Husbandry, Sericulture, progressive male and female farmers, male and

female social workers of that area and Training Organizer of the concern K.V.K.The Scientific Advisory Committee held once in a year to review the work of K.V.K. and provide suggestions for future plan of work. The future technical programme of the K.V.K. is prepared as per the suggestion of the farmers of that particular area.

Besides these activities each K.V.K. has got different demonstration units such as Mushroom unit. Biofertiliser unit, Vermicompost unit, Broiler fanning unit, Bee keeping unit, Fruit preservation unit etc. for the lagers.When a person will visit K.V.K., he will be able to see all the enterprise in the demonstration unit and he can interact with the scientists regarding the establishment of his own enterprise. These units will help the villager to increase his confidence on a particular enterprise.

From these discussions, itcan be concluded that the scientists of K.V.K. provide required knowledge, impart training to improve the skill and attitude of the people towards a particular subject, provide proper guidance to solve any problem faced by the people related to agriculture and allied topics. Krishi Vigyan Kendra provides inspiration, constructive and constant advice to the people of that area to start new entrepreneurship for their livelihood and show them proper way when need actual help as the light house help the sailor in the sea. So we can rightly say that KrishiVigyan Kendra is the light house for the rural people.

3.5 EXERCISE

1) Explain the concept of KrishiVigyan Kendra and state the various objectives of K.V.K.

2) State the various functions of Krishi Vigyan Kendra for Rural Development.

4

DEPARTMENT OF AGRICULTURE (GOVT. OF MAHARASHTRA) AND AGRICULTURAL UNIVERSITIES IN MAHARASHTRA

Unit Structure:

4.1 OBJECTIVES

1) To understand the structure of Department of Agriculture in Maharashtra.

2) To study the role and functions of agricultural universities in rural development.

3) To study approaches and various methods used for extension education.

4) To study in detail about visions and goals of agricultural Universities in Maharashtra.

4.2 INTRODUCTION

The need to grow more food was felt during the 19th Century because of the increasing pressure of population. According to the recommendation of Famine Commission (1881), Agriculture Department was established in 1883. Work started with the aim of helping the rural community to achieve higher productivity in agriculture. Agriculture and Land Records Departments were functioning together till 1907. After getting encouraging results in an effort made during 1915-16 to stop soil loss, Mr. Kitting, the then Agriculture Director started soil conservation work from 1922.

Agriculture Department took up various land development activities with the enactment in 1942 and subsequent enforcement of Land Development Act in 1943. For the first time in 1943, the then Government prepared a comprehensive Agriculture Policy considering the problems in agriculture and allied sectors. According to this policy, emphasis was given on use of water as irrigation for agricultural crops.

The post-independence period from 1950 to 1965 is recognized as pre Green Revolution period. During this period, several schemes were launched to boost growth of agriculture sector. Production of quality seeds through TalukaSeed Farms started during 1957. Emphasis was given onincrease in irrigated area along with cultivated area during this period. A special campaign was launched in 1961-62 to encourage use of chemical fertilizers.

Development of hybrid varieties of different crops since 1965-66 laid down the foundation of Green Revolution. Five year plans following this period specially emphasized development of agriculture. Nalabunding work was taken up along with land development work by the department since 1974, which led to increase in well and groundwater level. Introduction of intensive agriculture, comprising of large-scale use of improved seed, fertilizers, pesticides and available water helped increase in agriculture production. Later on, considering the need for providing guidance to the farmers for proper and judicious use of these inputs, Training and Visit Scheme was launched in 1981-82. Valuable contribution of this scheme through effective implementation of programs like Crop Demonstrations, Field Visits, Corner meetings, Workshops, Fairs, Exhibitions etc. aimed at transfer of technology from Agriculture Universities to farmer's fields was evident from the increased agricultural production.

Though we have become self-sufficient in food grain production in spite of the tremendous increase in population, self- sufficiency in agriculture is not the only aim of the State but assurance of more and more net income to the farmers throughthe efficient andsustainable use of available resources is more important. To achieve this, commercial agriculture should be practiced. Different schemes are implemented toincrease agricultural production, export promotion and to encourage the agro processing industry with a view to take advantage of liberalized economy

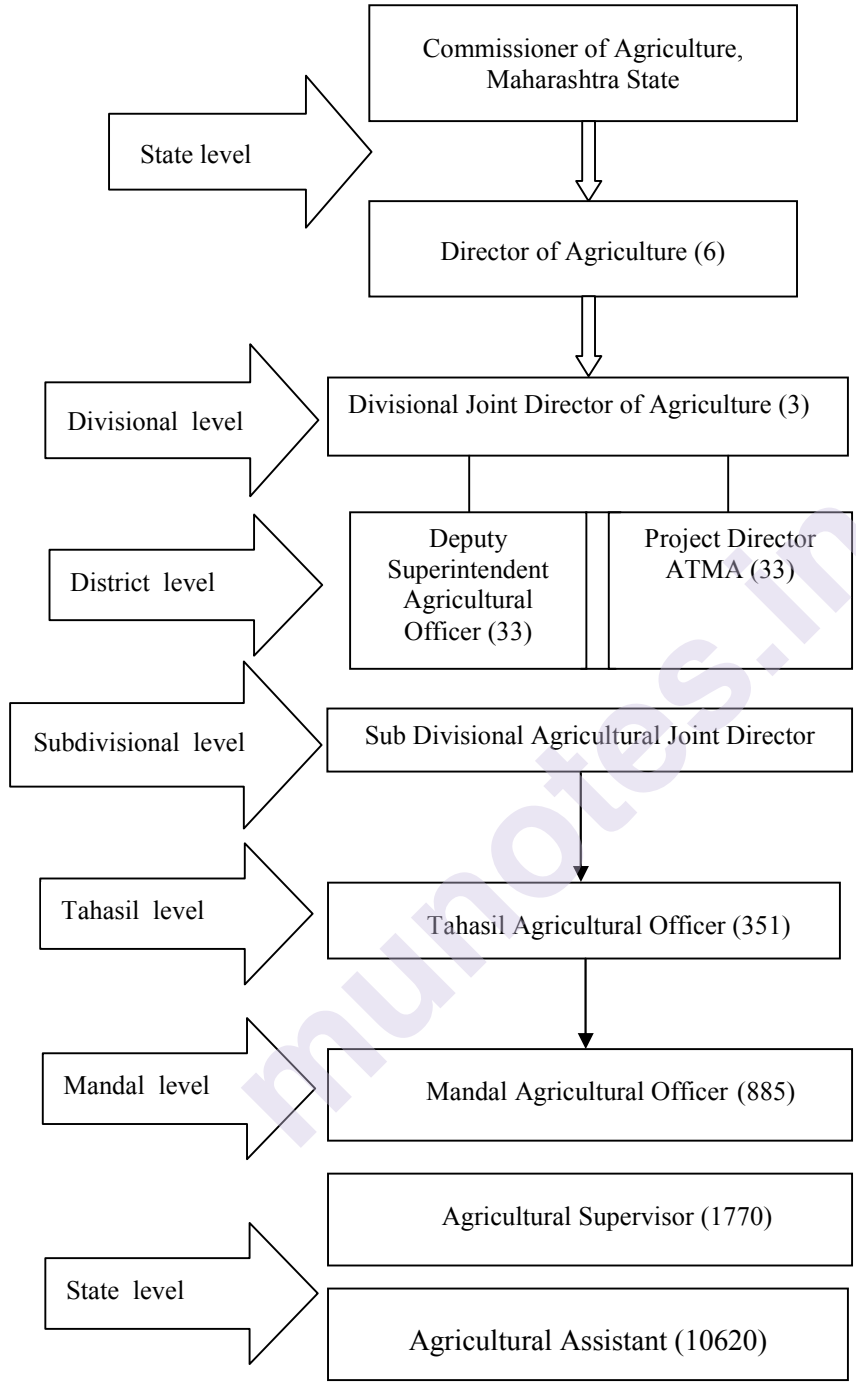
and Global trade. Thus, agriculture department is firmly stepping towards economic progress alongwith self-sufficiency through agriculture and to achieve important position in the global agriculture produce market. The innovative horticulture plantation scheme under employment guarantee scheme implemented by the State is a part of this policy.

Agriculture department considers farmer as the focal point and the whole department is organized in such a fashion that a single mechanism is working to facilitate the farmer for adoption of advanced technology and sustainable use of available resources. Every agriculture assistant working at villagelevel has a jurisdiction of three to four villages with number of farmers limited to 800 to 900, which facilitates more interaction foreasier transfer of technology.

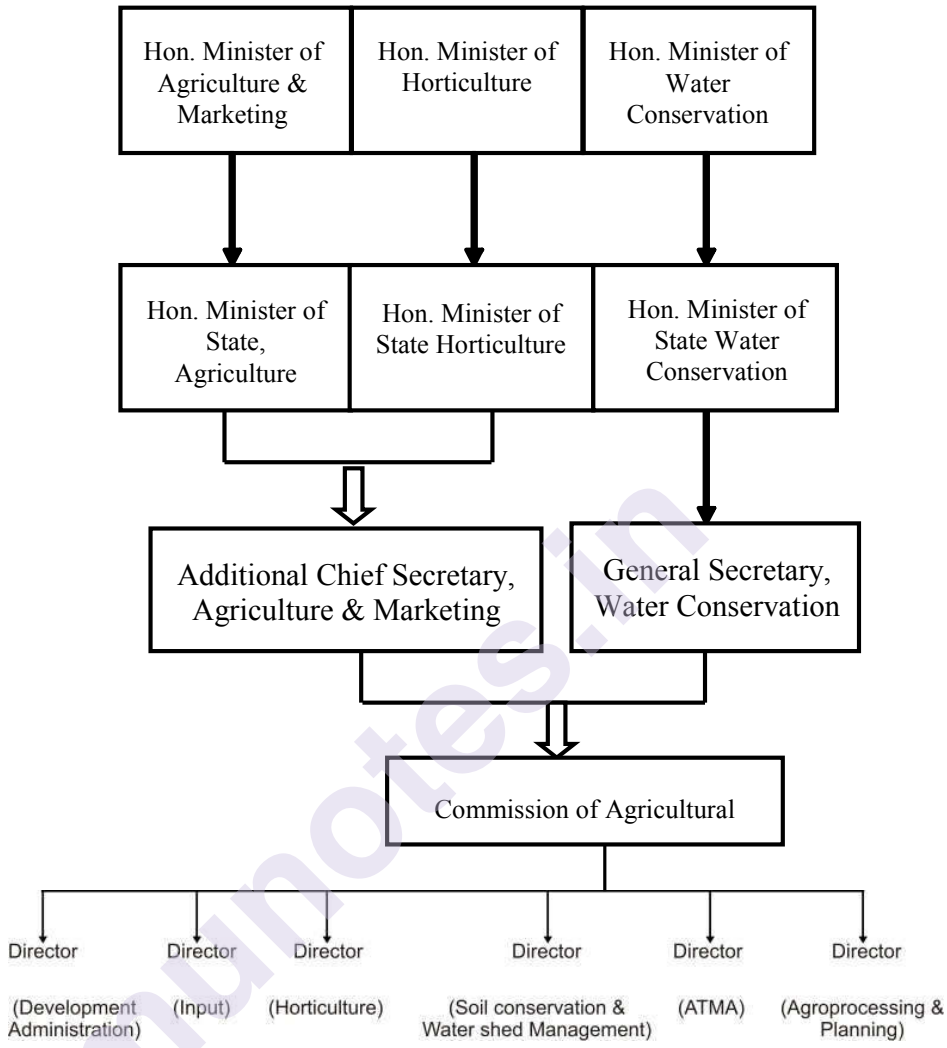
Agriculture Assistant at village level undertakes soil conservation work, horticulture plantation and various extension schemes. He is supervised by Circle Agriculture Officer at circle level. Administrative control, liaison with other departments, monitoring and training programs etc. are facilitated by Taluka Agriculture Officer at taluka level, Sub Divisional Agriculture Officer at sub-division level, District Super intending Agriculture Officer at district level and Divisional Joint Director at division level. In addition, Agriculture Officer at Panchayat Samiti level, working under Agriculture Development Officer, Zilla Parishad at district level also implements variousa gro-inputs related schemes.

All the schemes implemented in the field are supervised technically and administratively by respective directorates of Soil Conservation, Horticulture, Extension and Training, Inputs and Quality Control, Statistics, Monitoring and Evaluation and Planning and Budget at State level in the Commissionerate of Agriculture. Also, separate sections are there for the Establishment and Accounts related matters.

4.3 REGIONAL LEVEL STRUCTURE OF AGRICULTURAL DEPARTMENT

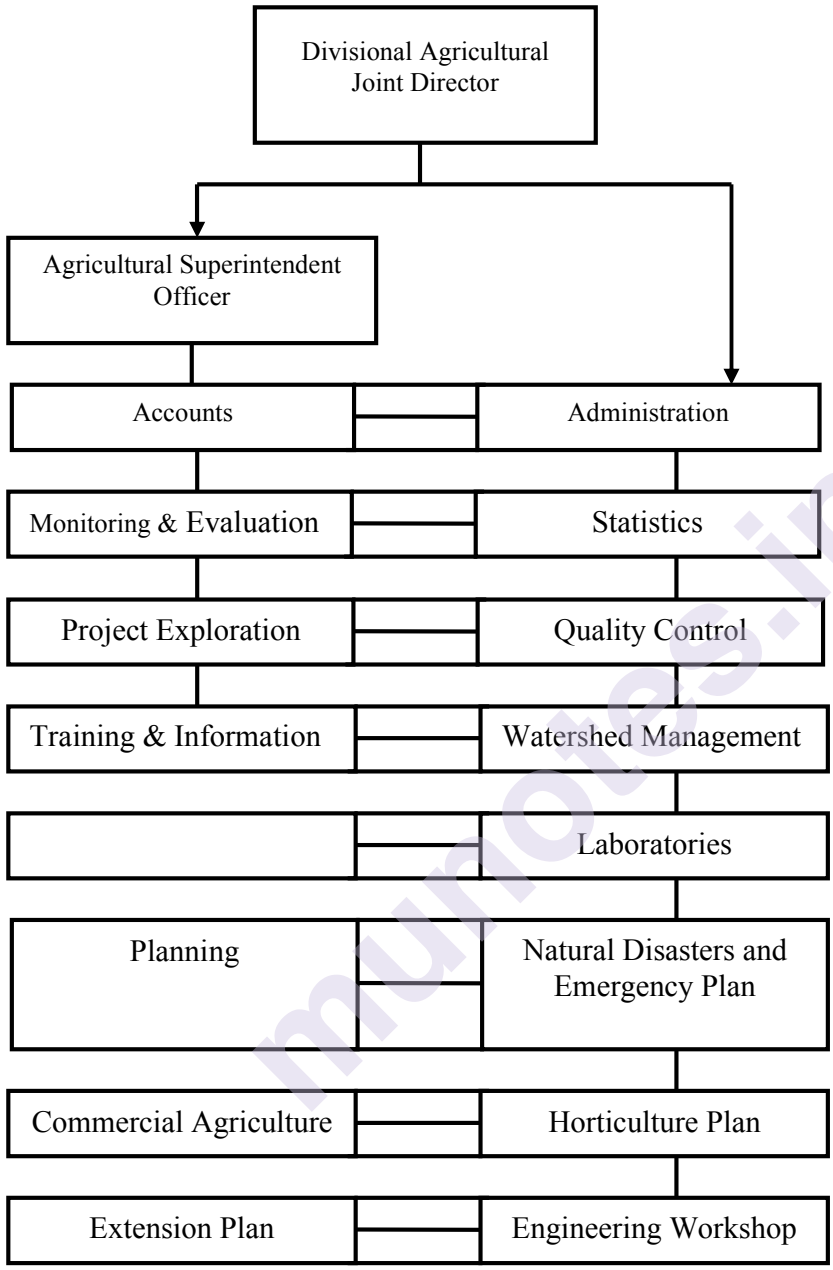


4.4 DEPARTMENT OF AGRICULTURE, GOVERNMENT OF MAHARASHTRA



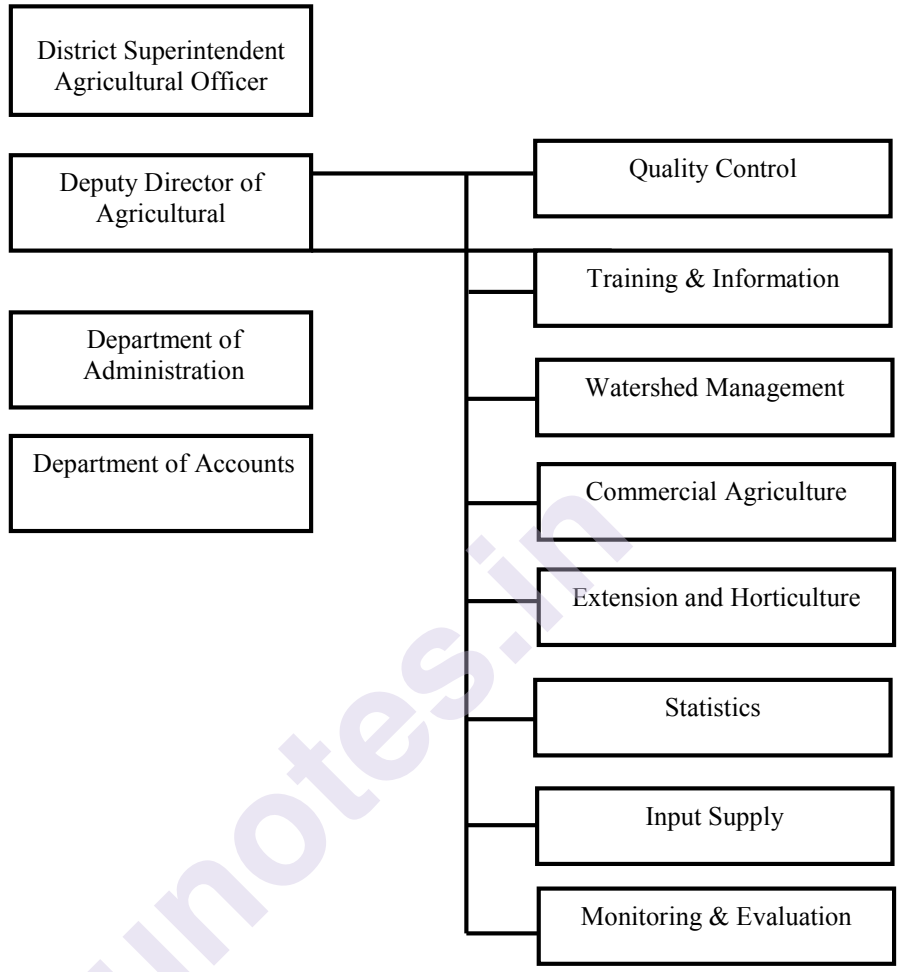
4.5 DIVISION LEVEL

Office of Divisional Agricultural Joint Director :



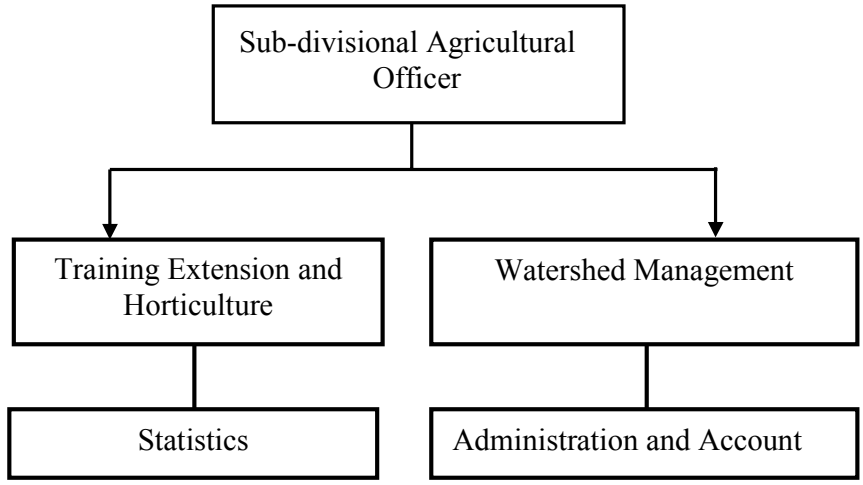
4.6 DISTRICT LEVEL

Office of District Superintendent Agricultural Officer :

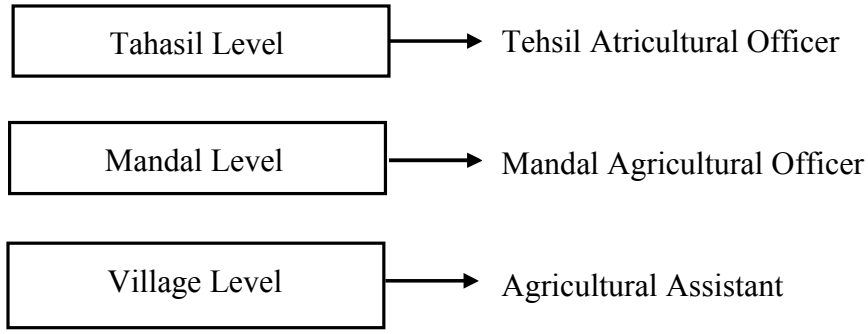


4.7 SUB-DIVISIONAL LEVEL

Office of Sub-divisional Agriculture Officer :



4.8 TAHASIL LEVEL



4.9 HISTORICAL DEVELOPMENT OF THE SAUs AND DOEE IN UNIVERSITIES WITH AGRICULTURAL FACULTIES IN INDIA

In its early phases, the Indian agriculture education system was in the domain of public-funded general universities. Agricultural research and education received major support in the first decade of the 20th century when Lord Curzon was the Viceroy of India. By 1905 only six agricultural colleges had been established in Pune (Maharashtra), Kanpur (Uttar Pradesh), Sabour (Bihar), Nagpur (Maharashtra), Faisalabad (Now in Pakistan) and Coimbatore (Tamil Nadu) with annual funding of Rs. 2 million by the Government of India. These staff and laboratories and mandated with research and teaching initiatives in 1926, the Royal Commission placed Emphasis on the importance of a strong research base for agricultural development inIndia.

The most significant milestone was the establishment of the imperial (new India) Agriculture Research Institute (IARI) at Pusa (Bihar) in 1905. Due to an earthquake in 1934, the Pusa Institute was shifted to New Delhi in 1936. The Royal Commission established the autonomous imperial (new Indian) Council of Agriculture Research (ICAR) in 1929. It was mandated to promote, guide and co-ordinate agriculture research with a non-lapsing fund of Rs. 5 million. The establishment of the ICAR empowered agricultural research in India. However, the ICAR had no administrative control on research institutions in theprovinces.

At the time of independences in 1947, only 17 agricultural and veterinary colleges were established to focus on training of students in agriculture, whereas the State. Departments of Agriculture and Community Development focused on research and extension. There were no close linkages between agricultural colleges and research departments to ensure maximum utilization of proven technologies instead of costly agricultural education and limited resources, regional interests pressed for the establishment of a large number of new agricultural colleges during the early past- independence period. From 1953 to 1960, the number of agriculture / veterinary colleges almost doubled in spite of inadequate financial support, rapid spread of agricultural colleges affiliated with traditional universities led in the downward slide of standards in education,

which became a serious problem. Accordingly, the pace of progress remained slow and production technology developed at these institutions did not keep pace with the fast changing requirements. Therefore, it was realized that both the system of education as well as the set-up of the agriculture / animal science institutions needed to be reorganized to serve as an effective vehicle for agricultural progress and developed. This necessitated a review of the existing system of agricultural education.

Reorganizing the weakness of the then existing educational system and need for linking programs of agricultural education with production programs, the University Education Commission (1948) headed by Dr. S. Radhakrishnan suggested the establishment of 'Rural Universities'. This recommendation was strengthened by the proposals made by two joint Indo-American Teams (1955 and 1960), which endorsed the establishment of State Agriculture Universities (SAUs).

The United States Agency for International Development (USAID) and American land-grant universities helped with the development of SAUs in India in some developing countries, especially in Asia, agricultural research and education is organized under an autonomous agriculture, university based on the pattern of the land-grant universities in the United States of America. The SAUs of India, Pakistan and the Philippines are based on this model as well.

In India the first SAU was established in 1960 at Pantnagar in Uttar Pradesh. The SAUs were given autonomous status and direct funding from the State Government. They were autonomous organizations with statewide responsibility for agricultural research, education and training or extension education. The establishment of the SAUs based on a pattern similar to that if the land-grant universities in the United States was a landmark in reorganizing and strengthening the agriculture education system in India. These universities become the branches of research under the ICAR and became the partners of the National Agricultural Research System (NARS). The green revolution, with its impressive social and economic impact, witnessed significant contributions from the SAU's both in terms of trained, scientific work force and the generation of new technologies.

The SAU's are headed by a vice-chancellor, governed by a board and advised by an advisory committee. The governing boards of the SAUs have representatives from government, farmers and agri-business. Being autonomous organizations, they are able to effectively integrate research and education and worry out their mandate. The SAUs receive core funds for research and education from the State Governments and substantial grants from the national institutes. The second National Education Commission (1964-66) at that time headed by the University Grant Commission Chairman, Dr. D.S. Kothari, recommended the establishment of at least one agricultural university in each Indian State. These universities imparted education on all aspects of agriculture on the same residential campus and integrated teaching with research and extension.

Subsequently, implementation of the recommendations of the Education Commission (1946-1966) and Review Committee of Agricultural Universities (1977-1978) streamlined their functioning and all matters related to agricultural research in the States were transferred to the Universities. According to Review Committee of Agricultural Universities (1978) an essential feature of the Agricultural University system is the acceptance of the philosophy of service to agriculture and to rural communities with the following mandates:

- State-wide responsibility for teaching, research and extension education.
- Integration of teaching research and extension at all levelsof the university administration.
- Multi-disciplinary teamwork in the development programs of education, research andextension.
- Acceptance by all concerned in the university of a philosophy of service to agriculture and the rural community and emphasison programs that are directly and immediately related to solving social and economic problems of the countryside.
- Quick communication of new knowledge to students in classrooms, to extension personnel and to farmers.
- Programs giving specialized training to the rural youth and adult men and women when are not candidates for degrees through departments involved in responsibility for the subject matter being taught.

To accomplish these commitments, there is a need for adequate and efficient extension to be set up for the speedy and effective communication of new knowledge and technology to extension agents and to farmers. As agriculture plays a very important role in the Indian economy. Setting up an adequate number of agricultural universities was considered very important. However, the responsibility for extension rests with the Department of Agriculture and Co-operation (DAC) and the Department of Animal Husbandry, Dairying and Fisheries (DADF), which are under the Central Ministry of Agriculture.

4.10 THE DIRECTORATE OF EXTENSION EDUCATION

The Directorate of Extension Education (DOEE) is the nodal agency of SAUs for promoting agricultural development in the State through quick transfer of technology by providing training, consultancy and farm information to line departments' professional extension personnel and farmers. It also involves the assessment, refinement and adoption of technology through on- farm testing and front-line demonstrations. The directorate provides guidelines, monitors and evaluates the extension programs of Krishi Vigyan Kendras (KVKs) functioning under SAUs. The directorate also extends its support to the State departments through disseminating farm information by publishing literature on different

agricultural disciplines and related subjects. Thus, the three principals, functional areas of the DoEE are training, consultancy and communication. The directorate has a team of multi-disciplinary scientists who work in participatory mode in close co-ordination with the Department of Agriculture, Animal Husbandry, Horticulture. Forestry, Co-operatives, PanchayatSamities and other agencies engaged in the betterment of rural people.

4.10.1 Mandate of the Directorate of Extension Education:

1. To formulate and impart in-service training to different categories of officers and functionaries from line departments of State and non-government organizations.

2. To conduct short and long-term vocational trainings for farmers, farm women, youth and school dropouts.

3. To assess and refine the latest agricultural technology through front-line demonstrations for their wider adoption.

4. To provide farm information services through various extension activities, including literature, for the quick dissemination of technology.

5. Through the DoEE, the university extension service maintains live and intimate links with the research departments' on one hand and with the field-level functionaries of different State departments, development agencies and farmers on the other hand.

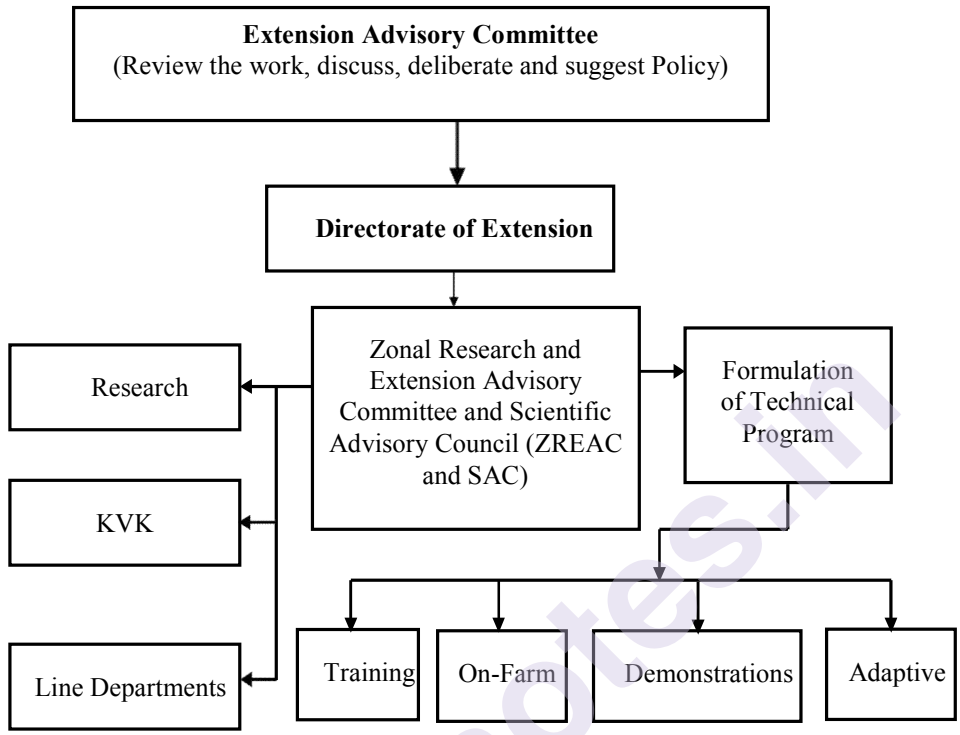
4.10.2 Organizational Structure of the Directorate of Extension Education:

The Directorate of Extension Education (DoEE) conducts its extension activities through its headquarters. KVKs, Krishi Gyan Kendras (KGKs) etc. The directorate disseminates the latest technological innovations through farm advisory, training, information and communication services by involving scientists from different departments of the university and research institutions. It aims to serve as a link between research, extension and farmers and provide critical feedback for university research as well as to the main extension system. A well-defined mechanism is followed involving the Directorate of Research, the line departments and extension education units while formulating technical programs for different units of the DoEE.

As per mandate, a Scientific Advisory Committee is constituted at each KVK for assessing, reviewing and guiding their programs and progress. The members of this committee comprise a cross-section of scientific and fanning communities' representatives of both government and non-government organizations who are directly or indirectly involved inthe process of agricultural training, production and development. The AT1C is a constituent unit of the directorate, which serves as a single-window delivery system to help farmers and other stakeholders by

providing solutions to location-specific problems and making all technological information, along with technology inputs, available. The organizational set up and extension mechanism of the DoEE is presented in Figures 4.1 and 4.2 (on the next page)

A Typical Organizational Set-Up of the Directorate of Extension Education at the State Agricultural University Level

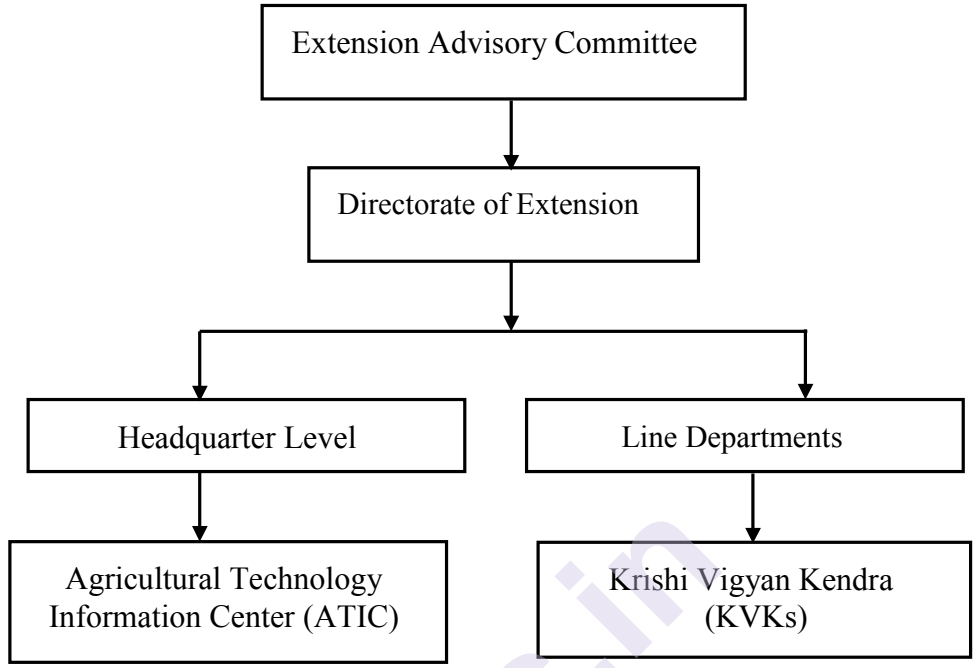


4.11 APPROACHESAND METHODS USED BY THE DIRECTORATE OF EXTENSION EDUCATION

1) Electronic Media Information And Communication technology (ICT)

ICT has a major role to play in all facets of Indian agriculture. The extensive use of ICT and its infrastructure would therefore be a critical component of the strategy to revitalize the national extension system. The directorate usually arranges radio talk discussion by university experts on All India Radio. The scientists from headquarters, KVK and KGK also deliver radio andTV talks regularly for the benefit of the farming community. Integrated use of both the conventional as well as upcoming electronic media like Intra and Internet, information kiosks, cable TV, mobile telephones, vernacular press and other print media is the way forward by pooling and effective use of ICTs. The radio andDoordarshan (public television broadcaster of India) cover special activities carried out by the university such as kisanmela, agricultural officer workshops, training, field days, kisangoshti.etc.

A Typical Extension Activities Mechanism of the Directorate of Extension Education:



2) Mass Media:

Among various extension methods, the use (if media is useful in creating awareness and stimulating interest, along with large coverage of the audience (Hussain, 1997; Okunade, 2007).New and improved agricultural technologies, developed in Agricultural Research Institutes, universities, the private sector and often by the farmers themselves, have to be disseminated among the masses in order to increase productivity and overcome hunger and poverty. In this context, farmers need adequate exposureto information on technologies that may be available. Research has shown that by-and-large farmers' exposure to information is an important factor influencing their technology adoption behavior. In South Asian countries, including India, it is primarily the public extension services that are mandated to disseminate new agricultural technologies.

3) Organizing Farmer's Fairs and Field Days:

The directorate is engaged in refining and disseminating agricultural knowledge to farming communities through a network of KVKs in various agro-climatic zones. The directorate orgazines farmer's fairs and field days for the active participation of farmers and farm women. These activities give farmers and the public the opportunity to witness the latest. Proven technologies Exhibitions on the laest technologies are organized for face-to-face interactions between farmers and scientists. The sale of the lastest varieties of plants and vegetables aplings creates alarge amount of publicity on the spot technical solutions are demonstrated at visits of experimental sites.

4) Capacity Building of Extension Staff and Farmers:

Human resources development is an important mandatory activity of the university's extension education system. The DOEE is organizing various national level, state-level and in-house personnel trainings, model training courses, faculty development courses, winter and summer schools, etc. The directorate is also organizing vocational trainings for economic empowerment and livelihood security for farm families' short-term trainings for farmers, farm women and rural youth on new production technologies are organized regularly at the directorate.

The DOEE organizes national level training programs, workshops and seminars for promoting the professional competency of the officials and extension personnel working in different time departments of government. Major training areas include oilseeds and pulse, cropping system approach, seed production technology post-harvest technology, integrated post management, arid horticulture, micro-irrigation systemsetc.

The directorate organizes short-term training courses for subject matter specialists of line departments on subjects like integrated pest management, organic farming, vermicompost, women in agriculture, aromatic and medicinal plants, etc. In these courses, the officials are exposed to emerging problems and their possible solutions as well as recent technologicaladvances.

To update scientist of SAUs on recent advances in science and technology the ICAR-sponsored winter / summer schools are being organized by the DOEE courses on communication technologies and extension methodology: innovates breeding methodology. For sustainable, higher production in course cereals; and advanced media communications, extension techniques and vocational entrepreneurship for sustainable livelihood by agriculture practitioners are being organized.

Scientists of the DOEE are provided trainings with the purpose of updating skills required for work effectiveness and efficiency. In recent years, scientists have been trained in the areas of on-farm testing, post-harvest management, tally accounting, impact studies, etc.

The DOEE is one of the recognized centers for agro-clinics and agri-business trainings in the country. These trainings are sponsored by the ministry of Agriculture and Co-operation. (Government of India, New Delhi) with these trainings, the DOEE is providing 60 day training these not yet employed in the agriculture sector. The purpose of such training is to teach entrepreneurial and managerial skills to agricultural graduates so as to enable them to establish their own enterprises and provide jobs to others as well. Major areas where participants establishes their own business are bio-fertilizers and bio-pesticide production, rural storage structures ('godowns'), agricultural input marketing, custom hiring fruit and ornamental plant nurseries, agro-clinics retail shops, etc.

5) Training Programs for Farmers:

The directorate is organizing inter-state and state-level short- term courses for practicing farmers and farm women on crop production, horticulture, plant protection, animal production, home science and other related disciplines. These training programs are sponsored by line departments of agriculture, horticulture soil water conservation and NGOs. These trainings not only provide the participants practical exposure but also give an opportunity for participants to raise their incomes by adopting new technologies. These trainings are organized on the principles of 'Learning by Doing' and 'seeing believes'.

6) Education:

The changes in agricultural research investment by center and State Governments are substantiated by the compound growth water in each period in Table 4.3. It show that public expenditure on research and education in India grew at 5.54% from 1960-70. 54.02% from 1971-1980. 5.3% from 1981-1990 and 7.18% from 1991-2004. The phases of changes in the real investment correspond to organizational changes in the research and education system. State research and education pending stagnated all declined marginally in almost all the States during the but two decades. From 1971-1980 it grew rapidly because of the establishment of several SAUs during the period in manyStates.

4.12 AGRICULTURAL UNIVERSITIES IN MAHARASHTRA

	Name of the University	Place	Working Area	Year
1	Mahatma Phule Agricultural University	At Post Rahuri, Dist. Ahemednagar	Pune, Satara, Sangali, Kolhapur, Nagar, Solapur, Dhule, Nasik, Jalgaon, Nandurbar	1969
2	Punja brao Deshmukh Agricultural	Dist. Akola	Akola, Amravati, Yavatmaal, Buldhana,	1969
	University		Vardha, Nagpur, Chandrapur, Bhandara, Gadchiroli, Vashim, Gondiya	
3	Kokan Agricultural University	Dapoli, Dist. Ratnagiri	Thane, Mumbai, Mumbai (Sub), Ratnagiri, Sindhudurga	1972
4	Marathwada Agricultural University	Parbhanee, Dist. Parbhanee	Beed, Jalna, Latur, Aurangabad, Parbhanee, Hingoli	1972

1) Mahatma Phule Agricultural University:

Introduction:

"The Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuriis the premier Agricultural University in Maharashtra that renders services to the farmers through Education, Research and Extension Education. In pursuance of the Maharashtra Agricultural University (KrishiVidyapeeth) Act 1967, initially, the Maharashtra Agricultural University (Krishi Vidyapeeth) was established for the entire Maharashtra State and started functioning in March 1968 with its office at Mumbai. The office was shifted to College of Agriculture, Pune in 1969. Later on in 1972, four agricultural universities were established in Maharashtra. Mahatma Phule Krishi Vidyapeeth, Rahuri is one of them established in 1969 for the western Maharashtra having jurisdiction spread over 10 districts viz. Jalgaon, Nandurbar, Dhule, Nashik, Ahmednagar, Pune, Solapur, Satara, Sangli and Kolhapur. The University is named after the great social reformer 'Mahatma Jyotiba Phule'.

Mandates:

1. To provide education in agriculture and allied sciences.
2. To have further advancement of learning and research in agriculture and allied sciences. To integrate and co-ordinate the teaching of the subjects in the different faculties of the university.
3. To co-ordinate the education, research and extension education activities for augmentation of agricultural production.
4. To provide integrated agricultural education activities at all levels for maximum effectiveness and at a minimum cost.
5. To undertake and guide extension education programmes.

Goal:

Sustainable growth of agriculture by interfacing education, research and extension education initiatives complemented with efficient and effective institutional, infrastructure! Support that will create a proper fit between humanity and its habitat.

Visions of MPKV:

To harness science to ensure comprehensive and sustained physical, economic and environmental access to food and livelihood security through generation, assessment, refinement and adoption of appropriate technologies.

1. MPKV-Recipient of 'Institution of Excellence Award (2008)' by Govt. of India-A Special grants of Rs. 100 crores.
2. MPKV bestowed with the 'Sardar Patel Best Institution Award' by the ICAR, New Delhi for excellence in the field of Education,

Research and Extension Education.

3. Born as per the Maharashtra Agricultural University (Krishi Vidyapeeth) Act 1967, in the year 1968 with its headquarter at Rahuri, Dist. Ahmednagar (M.S.).

4. The H. E. Governor of Maharashtra State is the Chancellor of the University, The Minister of Agriculture, Maharashtra State is the Pro-Chancellor, while, Vice-Chancellor is the Head of the University.

5. The highest policy-making body is the Executive Council. The Hon. Vice-Chancellor, MPKV is the Chairman of this Council. The Council constitutes of nominated peoples representatives, eminent members from Agriculture and Development Departments, Scientists, representative of ICAR and progressive farmers.

6. The University is assisted by Academic Council, Agricultural Research Council, Extension Education Council, Council for Co-ordination and Review of Seed Productionand Agriculture Development Programme.

7. The jurisdiction of MPKV consists of 10 districts of Western and North Maharashtra viz., Jalgaon, Dhule, Nandurbar, Nashik, Ahmednagar, Pune, Solapur, Sangli, Sataraand Kolhapur comprising of 5 Agro-climaticZones.

8. The irrigated area under MPKV jurisdiction is 12 lakhs hectares which accounts to almost 50% are a of the State. Nearly 80% of drought prone area in the State is under the jurisdiction of University.

9. MPKV consists of 27 research stations in 5 agro-climatic zones including 4 State level Crop Specialists, 4 Zonal Agricultural Research Stations and 17 Strategicand Verification Research Centres to conductresearch.

10. Three constituent Agriculture Colleges at Pune, Dhule and Kolhapur; 1 Horticulture College at Pune and 1 Agricultural Engineering College at Rahuri. 40 affiliated Colleges inthe jurisdiction of MPKV. A new constituent Agriculture College is sanctioned by the Govt. of Maharashtra for Nandurbar district.

11. MPKV offers Post Graduate education at Central Campus, Rahuri and Collegeof Agriculture. Pune, Kolhapurand Dhule; Ph.D. Programmeat Rahuri; M.Tech. (Agril.Engg.) at Rahuriwith high quality faculty and modern laboratories. Special infrastructure facilities for international students.

12. Faculty of Lower Agricultural Education offers Diploma courses in Agriculture through 9 constituent and 85 affiliated Agricultural Schools under MPKV.

13. Sixteen KVKs in the jurisdiction of MPKV. Four Krishi Vigyan Kendras (KVKs) under MPKV including 1 at College of Agriculture, Dhule and 3 additional sanctioned KVKs established at Mamurabad (Jalgaon), Borgaon (Satara) and Mohol (Solapur). 12 KVKs are under NGOs in the jurisdiction of MPKV for transfer of technology.

2) Dr. Balasaheb Sawant Kokan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri:

1) About University :

The Kokan region, inspite of being a generous gift of natural resources, has by and large reminded under-developed. This lad to the peculiar social problem of migration of able bodies and talented men to nearby areas like Mumbai and Pune in search of employment leaving behind old men, women and children to look after agriculture in traditional way. Following are the most primitive methods of cultivation.

2) The University:

The Kokan region is distinguished from the rest of Maharashtra State by virtue of its distinct agro-climatic conditions - soil types, topography, its location between the Sahyadriranges and the Arabian sea, crops and cropping pattern, land holdings and socio-economic conditions of the farmers. As such, the problems in agricultures and allied sectors are also entirely different from the other of Maharashtra. Due to this unique features the Government of Maharashtra established the Kokan Krishi Vidyapeeth on the 18th May 1972 to import education conduct research on location specific problems and disseminate the improved crop-production technologies amongst the farming community. The university was renamed as Dr. Balasaheb Sawant Kokan Krishi Vidyapeeth, Dapoli on 12th February,2001.

3) Jurisdictions:

In the Kokan region, there are in all 17 different constituent and private colleges which run UG and PG Programmes and every year 1550 students are admitted. Out of these 19 colleges, the Maximum number is in Ratnagiridistict (10) followed by Sindhudurg (4) Raigad (3) and Thane district (2)

4) Mandate and objectives:

1. To provide education in agriculture and allied sciences by integrating and co-ordinating teaching in different facilities and examine the students, conferdegrees diplomas, certificates and other academic distinctions.
2. To provide research base to improve the productivity of agriculture, horticulture, live stock, fisheries andagri-allied activities in Konkan region through basic, applied, adoptive and need based resealed for attaining economic growth and self- sufficiently at the State.

3. To develop appropriate plants for conservation of natural resources and their sustainable use.
4. To undertake and guide, extension education programmes including first line transfer of technology extend technological services for training conduct demonstrations and developed appropriate communication network.
5. To Standerised technologies for crop production, protection, harvesting, marketing, post harvest and also for live stock, poultry and fisheries for improving the standard of living of the farmers farm workers and women of Konkan in genital and rural womens in particular.
6. To provide necessary production support of nucleus breedess and foundation seed of important crops of the region and also generate revenue through large firms for sustainable growth of the university.

5) Vision:

To ensre comprehensive and sustained physical economic and environmental access to food and livelihood security, through generation, assessment and adoption of appropriate technologies.

6) Mission:

The mission statement as below to cater the need of the Konkan region with regards to education, research and extension education in agriculture.

3) Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola:

Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola was established on 20th October, 1969 with its headquarters at Akola. This Agricultural University was named after the illustrious son of Vidarbha Dr. Punjabrao (alias Bhausaheb) Deshmukh, who was the Minister for Agriculture, Govt. of India. The jurisdiction of this university is spread over the eleven districts of Vidarbha. According to the University Act 1983 (of the Government of Maharashtra), the University is entrusted with the responsibility of agricultural education, research and extension education along with breeder and foundation seed programme.

The University has its main campus at Akola. The instructional programmes at main campus are spread over in 5 Colleges namely, College of Agriculture, College of Agricultural Engineering & Technology, College of Forestry, College of Horticulture and Post Graduate Institute. At this campus 4 degree programmes namely B.Sc. (Agri.), B.Sc. (Hort.), B.Sc. (Forestry) and B.Tech.(Ag. Engg.), two Master's Degree Programme viz. M.Sc. (Agri.) and M.Tech. (Agri. Engg.) and Doctoral Degree Programmes in the faculties of Agriculture and Agril, Engineering are offered.

The University has its sub-campus at Nagpur with constituent College, College of Agriculture which offers B.Sc. (Agri.) and M.Sc. (Agri.) degree programmes. The Nagpur Campus is accomplished with a garden surrounded by its natural beauty and a well established Zoo which attract the general public and visitors to the city. A separate botanic Garden is

being maintained on 22 hectares with a green house for the benefit of research workers.

In addition there are 2 affiliated grant-in-aid colleges and 14 private non-grant-in-aid colleges under the umbrella of this University. A Central Research Station is situated at the main Campus which caters to the need of research projects undertaken by Crop Scientists of the principle crops of the region are Cotton Sorghum, Oil seeds and Pulses.

Agro-ecology of the region :

This region has been divided into four zones on the basis of precipitation, number of rainy days, soil group, physiology and cropping system. The zone receiving 700-950 mm. precipitation with less than 52 rain days having vertisols of varying depth has been identified as the Assured Kharif Crop Zone consisting of the district namely, Buldhana, Akola, Amravati and a part of Washim district while the districts Yavatmal and Wardha and a part of Nagpur are characterized by its precipitation in the range of 950-1250 mm., 52-62 rainy days having vertisol soils constituted the Moderate Rainfall Zone. The district, namely, Bhandara, Gondia, Chandrapur and Gadchiroli have been categorized as the High Rainfall (1250-1700 mm.) Zone. While hilly tracks of Amravati district receiving rainfall in the range of 950-1700 mm. have been categorized as Moderate to high Rainfall Zone. TheVidarbha region is endowed with rich forests. The region has an area of 27.5 lakhs hectares under forest which accounts for 52 per cent of the total forest area of the State and 28 per cent of the geographical area of the Vidarbha region.

4) Marathwada Krishi Vidyapeeth:

1) Introduction:

Established in 1972, on land grant pattern, Marathwada Agricultural University (MAU) Parbhani is one of the four Agril. Universities in the State of Maharashtra. Except some industrialization around Aurangabad and Nanded, the entire region has rural setting. The objectives of the University are : Education in agriculture & Allied Sci., Undertake Research based on regional needs and facilitate technology transfer etc.

2) History:

MAU is one of four Agril. Universities in the State of Maharashtra. Prior to original Maharashtra Agricultural University, it was established on May 18, 1972 to fulfilthe regional aspirations of agrarian growth. It is entrusted with the responsibilities to provide education in agriculture and allied fields, undertake research and facilitate technology transfer in Marathwada region of Maharashtra. The first collegeof Agriculture was established in this region at Parbhaniin 1956 by Hyderabad State Government just before State reorganization. DuringNizam'srule, however, agricultural education was available only at Hyderabad but crop research centresviz., sorghum, cotton, fruits existed in the region.The foundation of research was laid by the erstwhile Nizam State with commencement of the Main Experimental Farm at Parbhani in 1918 . The famous 'Gaorani' desicotton is the result of the research on cotton and local sorghumcultivars were improved by selection by

the then Economic Botanist. Since then Parbhaniremain the hub of educational, researchand extension activities in Marathwada.

3) Mandate :

Provide education in agriculture, allied sciences and humanities. Provide research base to improve the productivity of important agro-horticulture, livestock, fisheries and agri-allied activities of Marathwada region.

To develop appropriate plans for conservation of natural resources and sustainable use.

To undertake and guide extension education programmes, first line transfer of technology, extend services of training; conduct demonstrations and develop appropriate communication network.

Standardize technologies for crop production, protection, harvesting, marketing, post-harvest utilization as also for livestock, fisheries and allied agro-communities for improving the living status of farmers, farm workers.

Provide research base to improve the productivity of important agri-horticulture, livestock, fisheries and agri-allied activities of Marathwada region.

To develop appropriate plans for conservation of natural resources and sustainable use.

To undertake and guide extension education programmes, first line transfer of technology, extend services of training, conduct demonstrations and develop appropriate communication network.

Standardize technologies for crop production, protection, harvesting, marketing, post-harvest utilization as also for livestock, fisheries and allied agro-communities for improving the living status of farmers, farm workers and Women of Marathwada.

Provide the necessary production support of nucleus, breeders and foundation seed of important crops of the region and also generate revenue through large farms for sustainable growth of the University.

4.13 EXERCISE

1) Explain the importance and structure of Agricultural Department in Maharashtra.
2) Discuss the role of agricultural universities in Rural Development.
3) State the various approaches and methods used by Agricultural Universities for extension education.
4) Write detail note on Agricultural Universities in Maharashtra.

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5

SUSTAINABLE AGRICULTURE AND ORGANIC FARMING

Unit Structure:

5.1 OBJECTIVES

1) To study the concept, philosophy and goals of sustainable agriculture.
2) To study the parameters and strategies of sustainable agriculture.
3) To understand the distinguish between sustainable and conventional agriculture.
4) To understand the various problems of sustainable agriculture.
5) To understand the concept and principles of organic farming.
6) To study the various methods used for organic farming.

5.2. INTRODUCTION

The concept and philosophy of sustainable agriculture assumed global significance aftermath the adverse social and environmental impact of modern agriculture. Spearheaded with use of high yielding varieties/ external inputs and non-renewable energy; agricultural modernization was adopted as essential means for development and transformation of rural communities and nation's prosperity. However, the euphoria of its potential

benefits began to wane on account of regional imbalances and social inequity in development and rapid environmental degradation. Massive and injudicious application of synthetic fertilizersand toxic pesticides besides large-scale irrigation led to colossal damage to ecosystem and more importantly the human and cattle health. Disquieting impacts include.

https://www.krsf.in

1. Contamination of water by pesticide, nitrates and wastes, causing harm to wildlife, disruption of ecosystem and possible health problem.
2. Contamination of food and fodder by pesticide residues.
3. Damage to farm and natural resources bypesticides.
4. Contamination of atmosphere by ammonia, me thane etc.
5. Formation of ozone depletion, global warming and atmospheric pollution.
6. Overuse of natural resources causing depletion of ground- water.
7. Displacement of traditional varieties and breeds by modern varieties /breeds.
8. New health hazards due to agrochemicals - during field spray and working in manufacturing industries.

Injudicious and rampant use of chemical fertilizers has led to imbalance in soil nutrient status and thus food grainsare devoid of essentialnutrients leading to increasing levels of hidden hunger. Similarly, the injudicious and rampant use of pesticides has resulted in the problem of pesticide residues in blood as well as mothers' milk. Such effects have put the human and cattle in trap of deadly diseases and have also threatened the existence of other living beings. Realizing the catastrophic impact of pesticides, the famous American writer Carl Rachel in her famous book 'The Silent Spring' has warned that human being is an integral part of nature and any war against nature is the war against self. She further advocates that often the technological advancements become so antagonistic with the nature's activities and system that it is wise to lay them off.

However, the proponents of modern and exploitative agriculture still argue in their favorand advocate their continuance for food security and prosperity.

The debate is mounting between modernists and environmentalists and conservationists over issue related to sustainability and food security.

While ensuring food security to burgeoning population is the prime concern, conservation of natural resources and protection of environment for deriving benefits in perpetuity are equally important. Consequently vision and action towards balanced and sustainable development were recognized and accepted by the global community of scientists, policy-makers and development agencies.

5.3 CONCEPTS AND PHILOSOPHY

The word sustain, which has been derived from Latin word root 'sustainer' (sus- meaning from below and tenere meaning to hold), means to keep existence or maintain implying long-term support orpermanence.

Though the concept of 'sustainability' first came up during the energy crisis of 1970s in relation to supply of oil, when it was defined as 'maintaining the present without compromising the future' the term 'sustainable development' first appeared in the document 'The World Conservation Strategy" published in 1980 by the International Union for the Conservation of Nature and Natural Resources and the notion was been defined as an "integration of preservation (nature protection) and development to provide a planetary change which can ensure safe survival and welfare of all people." The principle of uniform distribution of resources, which was the cornerstone of Brunt land Commission Report and democratic participation, which was emphasized by the Second U.N. Conference on the Environment and Development in Rio de Janeiro are the important features for sustainability.

However, different societies have different conceptualization of sustainability as well as different requirements of sustainability based upon varying cultural expectations or environmental constraints. According to Brunt land, thecore of the idea of sustainability is the concept that current decisions should not damage the prospects for maintaining or improving living standards in future.

With mounting criticism and growing recognition of problems with modernists' approach to agriculture as well as increased public awareness about environmental issues,search for conceptualization, description and operationalization of alternative forms of agriculture intensified. Sustainable agriculture emerged as the term to describe the varied field of agricultural practices that differ from conventional concepts of modern agricultural production (Hauptli, et.al. 1990).

Keller cites the observation of the highly renowned agricultural scientist and thinker, Dr. M. S. Swaminathan that in a world where 30 million infants were born with mental impairment due to low birth weight and Third World countries like India had over 250 million people livingbelow the poverty line, sustainability in agriculture was no longer a choice, which was a necessity. According to Swaminathan the success of sustainable agriculture results from a combination of science, technology, service and public policy. He further quotes 'Varro', a Roman landowner as the earliest

proponent of sustainable agriculture, who said in the First Century B.C. :"Agriculture is a science which teaches us what crops should be planted in each kind of soil and what operations are to be carried on, in order that the land may produce the highest yields in perpetuity." Sustainable agricultural systems are those, which are capable of maintaining their productivity and usefulness to society indefinitely and such systems must be resource conserving, socially supportive, commercially competitive and environmentally sound.

Leopold Center in Lowa has defined sustainable agriculture as "farming systems that are environmentally sound, profitable, productive and maintain the social fabric of the rural community."

Many view sustainable agriculture as philosophy based on co- existence and communion with nature, where emphasis is upon understanding of long-term impact of our activities on the environment and on other species.

Brown defines sustainable agriculture as steward ship. It emphasizes steward ship of both natural and human resources. This includes concern over the living and working condition of farm laborers, consumer health and safety, and the needs of rural communities.

In attempt to describe the alternative forms of agriculture in contrast to modern agriculture many terms were used viz., sustainable agriculture, regenerative agriculture, eco-agriculture, low external input agriculture, low input sustainable agriculture, resource-conserving agriculture, organic agriculture, permaculture, etc., which led to confusion and misconception. The most common misconception about sustainable agriculture has been that it represents a return to some form of low technology or backward or traditional agricultural practices, which is un true. It envisages utilization of economically and ecologically viable old as well as new innovations. Sustainable agriculture does not mandatea specific set of agricultural practices, rather a basket of options and approaches according to need could be tried. However, the basic challenge with sustainable agriculture remains how best to optimally utilize the internal resources.

5.4 GOALS FOR SUSTAINABLE AGRICULTURE

According to Prettya sustainable agriculture is any system of food or fibre production that systematically pursues the following goals :

1. Thorough incorporation of natural processes such as nutrient cycling, nitrogen fixationand pest-predator relationship into agricultural production process.
2. A reduction in the use of off-farm, external and non-renewable inputs.
3. A more equitable access to productive resources and opportunities, and progress towards more socially-just forms of agriculture.

4. Productive use of the biological and genetic potential of plant and animal species.
5. An increase in self-reliance among farmers and rural people.
6. Long-term sustainability of current production levels.
7. Profitable and efficient production with an emphasis on integrated farm management, and the conservation of soil, water, energy and biological resources.

5.5 DIMENSIONS AND PARAMETERS OF SUSTAINABLE AGRICULTURE

In order to practice sustainability, it is imperative to have its holistic understanding. Swaminathan identified 14 major dimensions of sustainable agriculture covering the social, economic, technological, political and environmental facets of sustainability as technological appropriability, economic feasibility, economic viability, environmental soundness, temporal stability, resource-use-efficiency, local adaptability, social acceptability, political tastiness', administrative manageability, cultural desirability, equity and productivity. Lockeretz (1988) delineated following physical andbiological parameters for sustainable agriculture.

1. Diversity of cropspecies.
2. Selection of crops and livestock that are adapted to particular environment.
3. Preference for farm generated resources rather than purchased materials.
4. Tightening of nutrient cycles to minimize nutrientlosses.
5. Livestock housed and grazed at low stocking densities.
6. Enhancement of storage of nutrient in thesoil.
7. Maintenance of protective cover on thesoil.
8. Rotation that include deep rooted crops and control weeds.
9. Use of soluble in organic fertilizer.
10. Use of pesticide for crops protection only as a lastre sort.

5.6 STRATEGIES OF SUSTAINABLE AGRICULTURAL DEVELOPMENT

Today's economic growth is impoverishing growth or unsustainable growth is a type of economic growth when the economy has grown in quantitative terms but the economy's reproductive capacity has declined because of environmental and natural resource degradation and other associated problems in the economy. Following strategies can be suggested to the long term sustainable development:

1) Crop Rotations &Pest Management Techniques:
It mitigate weeds, "disease, insect and other pest problems; provide alternative sources of soil nitrogen; reduce soil erosion; and reduce risk of

water contamination by agricultural chemicals pest control strategies that are not harmful to natural systems, farmers, their neighbors or consumers. Which reduce the need for pesticides by practices such as scouting/ use of resistant cultivars, timing of planting and biologicalpest controls increased mechanical / Biological weed control; more soil and water conservation practices; and strategic use of animal and green manures use of natural or synthetic inputs in a way that poses no significant hazard to man, animals or the environment.

2) Group-based Technologies:

More and more emphasis will need to be placed on the group-based technologies. The areas where group action is called for include :

a) Synchronization of sowing schedules of certain crop to avoid synchronization with pest reproduction cycle in certain crops where this is a major problem.
b) Watershed management of both arable and non-arable land belonging to individuals as well as villages, forest and revenue department.
c) Synchronized sprays compel with pest reducing crop rotations and mixtures to minimize use of chemicals in the short run and total elimination in the long run.
d) Biological pestcontrol coupled with water management and drainage.

3) Agro-forestry and Rainwater Harvesting:

The shift from crop to trees (horticultural and/or timber) is taking place both for reducing the need for outside labour and also for reaping larger commercial gain by larger farmers. Agro- forestry for high and slow growth regions thus is an urgent priority. In many parts of the world, there is renewed interest in the traditional practice of rainwater harvesting as a method of combating increasing water scarcity. Water harvesting can be effective in arid, semi-arid and semi-humid areas where surface or ground-water supplies are not available or are uneconomical to develop. Run-off water can be collected over large areas (macro-catchments), from micro-catchments or in the form of floodwater, and is then stored in reservoirs, cisterns or in the soil. Adoption of this technology can allow crop production in areas where otherwise it would not be possible, reduce the risk of crop failure and generally increase yields in rain-fedagriculture.

4) Development of drought prone regions & Land Development:

The continued neglect of dry regions is really criminal. Hill areas or drought prone regions which are depend on domestic servant or a cheap labour. National Commission on Development of Backward Areas (1981, Planning Commission, New Delhi) went so far as to say that we should not try to create conditions by which supply of cheap labour for large irrigation projects is affected adversely. Need to maintain soil fertility and water purity, conservation and improvement the chemical, physical and biological qualities of the soil, recycling of natural resources and conserving

energy. Sustainable agriculture produces diverse forms of high quality foods, fibers and medicines.

5) Integration of Human, Science &Environment:
Need to use locally available renewable resources, appropriate and affordable technologies and minimizes the use of external and purchased inputs, there by increasing local independence and self-sufficiency and insuring a source of stableincome for peasants, family and small farmers and rural communities. This allows more people to stay on the land, strengthens rural communities and integrates humans with their environment. Sustainable agriculture respects the ecological principles of diversity and interdependence and uses the insights of modern science to improve rather than displace the traditional wisdom accumulated over centuries by innumerable farmers around theworld.

6) Equitable and Participatory vision of development:
Sustainable agriculture is a model of social and economic organization based on an equitable and participatory vision of development which recognizes the environment and natural resources as the foundation of economic activity. Agriculture is sustainable when it is ecologically sound, economically viable, socially just, culturally appropriate and based on aholistic scientific approach.

7) Forest Management:
The key point of forest managementis to convert resource potential into economical values, without affecting sustainability. Present problems are: too much high quality timber is used as fuel and brushes in marginal areas are collected exhaustively (by pulling roots, rather than cutting stems). Therefore, suggestions are- a) Save good timber from fuel wood collecting and alternative sources of energy must be found first, b) Save brushes in marginal land and planted fuel forest is strongly recommended to improve the way of collecting firewood, c) Policy and regulation of forest laws to implement and enforce the law. The first priority is to set a forest price and keep all licensed logging under control.

8) Climate change activities:
For facing the challenge ofclimate change following steps can be adopted:

a) making climate information more relevant and usable;
b) developing appropriate tools for prioritizing responses;
c) applying climate risk screening tools at the project level;
d) identifying and using appropriate entry points for climate information;
e) shifting emphasis to implementation, as opposed to developing new plants; and
f) Encouraging meaningful co-ordination and the sharing of good practices.

The strategies suggested above require strong, social and economic capabilities to be implementedeffectively.

5.7 COMPARISON OF CHARACTERISTICS OF SUSTAINABLE AGRICULTURE AND CONVENTIONAL AGRICULTURE

Sustainable Agriculture	Conventional Agriculture
General • Long term sustainability • Internal solution to internal problems • Emphasis on management solutions to problems • Responsive to feedback and participatory	• Short term benefits • External solutions to internal problems • Emphasis on technology solutions to problems • Detachment
Technical • Low internal input • To maintain soil fertility and productivity, rely uponcrop • rotation, recycling of residues, animalmanure • To manage insects, weeds and other pests utilizes natural cultural and biological controls • R & D emphasis on farming system and system approach • Diversified enterprises within the farm, crops grown and cultivars used; biodiversity • Emphasis is on working with natural process • Recognizes location specificity of technologies, • use of appropriate and indigenous technologies • Use of technologies that preserve and enrich the natural resource base.	• High external input • Use of synthetic compounded fertilizer • Use of pesticides, her bicide, growth regulators, Pharmaceuticals and live stock feed additives • Emphasis on individual crop • Intensive mono cropping Genetic erosion • Emphasis is on controlling Natural processes • Belief in universal technologies, e.g. pesticides, fertilizers, use of imported and packaged technologies • Use of technologies that exploits and destroys the natural resource base

Economic • Priority is foodsecurity • Relies on available indigenous farm resource self-reliant	• Export andprofit-oriented • Capital intensive, usually need credit • Emphasis on commodity exchange in the market
• Places high value on human fulfillment and the environment	
Socio-political • Belief in accountability and value laden	• Socio-politically detached and ignore consequences

5.8 PROBLEMS OF SUSTAINABLE AGRICULTURE DEVELOPMENT

Ecologically and environmentally, the continued use of chemical fertilizers has increased soil erosion and decline soil productivity. Increased resistance of weeds and insectsto herbicides and insecticides, combined with the destruction of wildlife and beneficial insects by pesticides may trigger a new vicious cycle both economically and ecologically. As a result of the intensive use of chemicals in agriculture soil and water are more and more contaminated, human beings are faced with the dilemma of consuming unsafe food and drinking polluted water or spending extra money to restore the damaged environment. From the natural resources perspective, fossil fuel and other chemicals are non-renewable, thus, the depletion of finite reserves of concentrated plants nutrients is only a matter of time. At present and in foreseeable future, there are no substitutes that can replace these depleted resources. Therefore, it seems sensible to consider alternative approaches, like sustainable agriculture. However, many developing countries have attempted to produce sufficient food to fulfill the needs of their increasing populations. This forces them to apply more chemicals to their land because it is effective in the shortterm.

Most parts of India, rains are seasonal. As a consequence, ground or stored water has to be used for irrigation, industrial and domestic use. Pressure on water resources is bound to increase in the future due to population growth, urbanization, increased industrial requirement and higher living standards. To enhance the productivity of dry land agriculture, some protective irrigation will have to be provided in the areas which receive low rainfall. The water-table in many parts of India is receding and over exploitation of ground water resources is a major threat to survival of future generations. Transgenic technologies have little to contribute towards all eviating the problems created by the over exploitation of water resources. However, if transgenic technologies can contribute towards enhancing productivity and yield stability of crops adapted to a low water requirement, the overall dependence on ground water for irrigation will be reduced.

Replacement of traditional mixed cropping patterns with mono cultures requiring unacceptable levels of pesticide use andnegative impactson bio-diversity, as well as irrigation induced problems of mineral contamination, increased salinity and the lowering of water tables. At the same time, the Green Revolution may have relieved pressure to expand agriculture into ecologically fragile areas and reduced the dependence of rural areas on unsustainable resource extraction activities.

The real problem will be the process of integration of the different technologies into the farming system. That is the process of sorting all the various legitimate factors that prevent or discourage farmers from accepting sustainable development and adjusting the socio-economic environment to overcome these. It will have to be largely a farm level diagnostic effort to make certain the required extra labouris in fact available. There is actually enough organic residues to justify the composting process and this could provide the desired nutrients for the entire intended area or, if not, the percentage of the area that can be provided. Likewise, the extra land for building leguminoushedgerows needs to be available and not already committed to subsistence cropping. In many intensive farming communities in Asia, villages are immediately adjacent to each other with all in-between land already allocated and in use. Thus, the extra land may just not be there.

The problems have increased dramatically in recent years. This includes contamination of water by pesticides and fertilizers, contamination of food and fodder by residues of pesticides, nitrates and antibiotic, workers and public, disruption of ecosystem and harm of wildlife, damage to farm and natural resources by pesticides, causing workers and public, disruption of ecosystem and harm of wildlife.

5.9 ORGANIC AGRICULTURE -INTRODUCTION

Introduction :

Organic agriculture has grown out of the conscious efforts by inspired people to create the best possible relationship between the earth and men. Since its beginning, the sphere surrounding organic agriculture has become considerably more complex. A major challenge today is certainly its entry into the policy-making arena, its entry into anonymous global market and the transformation of organic products: into commodities. During the last twodecades, there has also been a significant sensitization of the global community towards environmental preservation and assuring of food quality. Ardent promoters of organic farming consider that it can meet both these demands and become the mean for complete development of rural areas. After almosta centuryof development organic agriculture is now being embraced by the main stream and shows great promise commercially, socially and environmentally. While there is continuum of thought from earlier daysto the present, the modern organic movement is radically different from its original form. It now has environmental

sustainability at its core in addition to the founders concerns for healthy soil, healthy food and healthy people.

5.10 CONCEPT OF ORGANIC FARMING

Organic farming is very much native to this land. Who soever tries to write a history of organic farming will have to refer Indiaand China. The farmers of these two countries are farmers of 40 centuries and it is organic farming that sustained them. This concept of organic farming is based on following principles:

- Nature is the best role model for farming, since it does not use any inputs nor demand unreasonable quantities of water.
- The entire system is based on intimate understanding of nature's ways. The system does not believe in mining of the soil of its nutrients and do not degrade it in any way for today's needs.
- The soil in this system is a livingentity
- The soil's living population of microbes and other organisms are significant contributors to its fertility on a sustained basis and must be protected and nurtured at allcost.
- The total environment of the soil, from soil structure to soil cover is more important.

5.11 THE PRINCIPLES OF ORGANIC AGRICULTURE

To understand the motivation for organic farming, the practices being used and what we want to achieve, it is important to understand the guiding principles of organic agriculture. These principles encompass the fundamental goals and caveats that are considered important for producing high quality food, fiber and other goods in an environmentally sustainable way. The principles of organic agriculture have changed with the evolution of the movement and are now codified. The principles apply to agriculture in the broadest sense, including the way people tend soils, water, plants and animals in order to produce, prepare and distribute food and other goods. They concern the way people interact with living landscapes, relate to one another and shape the legacy of future generations. The principles of organic agriculture serve to inspire the organic movement in its full diversity. They are the roots from which organic agriculture grows and develops. They express the contribution that organic agriculture can make to the world and a vision to improve all agriculture in a global context. The Principles of Organic Agriculture serve to inspire the organic movement in its full diversity.

The International Federation for Organic Agriculture Movement's (IFOAM) definition of Organic agriculture is based on:

The principle of health
The principle of ecology

The principle of fairness and
The principle of care

Each principle is articulated through a statement followed by an explanation. The principles are to be used as a whole. They are composed as ethical principles to inspire action.

1) Principle of health:
Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible. This principle points out that the health of individuals and communities cannot be separated from the health of eco-systems - healthy soils produce healthy crops that foster the health of animals and people. Health is the wholeness and integrity of living systems. It is not simply the absence of illness, but the maintenance of physical, mental, social and ecological well-being. Immunity, resilience and regeneration are key characteristics of health. The role of organic agriculture, whether in farming, processing, distribution, or consumption, is to sustain and enhance the health of eco-systems and organisms from the smallest in the soil to human beings. In particular, organic agriculture is intended to produce high quality, nutritious food that contributes to preventive health care and well- being. In view of this it should avoid the use of fertilizers, pesticides, animal drugs and food additives that may have adverse health effects.

2) Principle of ecology:
Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and helpsustain them. This principle roots organic agriculture within living ecological systems. It states that production is to be based on ecological processes and recycling. Nourishment and well-being are achieved through the ecology of the specific production environment. For example, in the case of crops this is the living soil; for animals itis the farm eco-system; for fish and marine organisms, the aquatic environment. Organic farming, pastoral and wild harvest systems should fit the cycles and ecological balances in nature. These cycle sare universal but their operation is site-specific.

Organic management must be adapted to local conditions, ecology, culture and scale. Inputs should be reduced by reuse, recycling and efficient management of materials and energy in order to maintain and improve environmental quality and conserve resources. Organic agriculture should attain ecological balance through the design of farming systems, establishment of habitats and maintenance of genetic and agricultural diversity. Those who produce, process, trade or consume organic products should protect and benefit the common environment including landscapes, climate, habitats, biodiversity, air and water.

3) Principle of fairness:
Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities. Fairness is

characterized by equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings. This principle emphasizes that those involved in organic agriculture should conduct human relationships in a manner that ensures fairness at all levels and to all parties - farmers, workers, processors, distributors, traders and consumers. Organic agriculture should provide everyone involved with a good quality of life and contribute to food sovereignty and reduction of poverty. It aims to produce a sufficient supply of good quality food and other products. This principle insists that animals should be provided with the conditions and opportunities of life that accord with their physiology, natural behavior and well-being. Natural and environmental resources that are used for production and consumption should be managed in a way that is socially and ecologically just and should be held in trust for future generations. Fairness requires systems of production, distribution and trade that are open and equitable and account for real environmental and social costs.

4) Principle of care:

Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment. Organic agriculture is a living and dynamic system that responds to internal and external demands and conditions. Practitioners of organic agriculture can enhance efficiency and increase productivity, but this should not be at the risk of jeopardizing health and well-being. Consequently, new technologies need to; be assessed and existing methods reviewed. Given the incomplete understanding of ecosystems and agriculture, care must be taken. This principle states that precaution and responsibility are the key concerns in management, development and technology choices in organic agriculture. Science is necessary to ensure that organic agriculture is healthy, safe and ecologically sound. However, scientific knowledge alone is not sufficient.Practical experience, accumulated wisdom and traditional and indigenous knowledge offer valid solutions, tested by time. Organic agriculture should prevent significant risks by adopting appropriate technologies and rejecting unpredictable ones, such as genetic engineering. Decisions should reflect the values and needs of all who might be affected, through transparent and participatory processes.

In totality organic agriculture aims at a sustainable production system based on natural processes. Key characteristics are that organic agriculture:

- relies primarily on local, renewable resources;
- makes efficient use of solar energy and the production potential of biological systems;
- maintains the fertility of the soil;
- maximises recycling of plant nutrients and organic matter;
- does not use organisms or substances foreign to nature e.g. GMOs,

chemical fertilisers or pesticides);

- maintains diversity in the production system as well as the agricultural landscape;
- Gives farm animals life conditions that correspond to their ecological role and allow them a natural behaviour.

Organic agriculture is also a sustainable and environmentally friendly production method, which has particular advantages for small-scale farmers. Available evidence indicates the appropriateness of organic agriculture for small farmers in developing countries like India. Organic agriculture contributes to poverty all eviation and food security by a combination of many features, such as:

- increasing yields in low-input areas;
- conserving bio-diversity and nature resources on the farm and in the surrounding area;
- increasing income and/or reducing costs;
- producing safe and varied food;
- being sustainable in the long term.

5.12 METHODS OF ORGANIC FARMING

Introduction :

Organic farming methods combine scientific knowledge of ecology and modern technology with traditional farming practices based on naturally occurring biological processes. Organic farming methods are studied in the field of agro ecology. While conventional agriculture uses synthetic pesticides and water-soluble synthetically purified fertilizers, organic farmers are restricted by regulations to using natural pesticides and fertilizers. The principal methods of organic farming include crop rotation, green manures andcompost, biological pest control and mechanical cultivation. These measures use the natural environment to enhance agricultural productivity: legumes are planted to fix nitrogen into the soil, natural insect predators are encouraged, crops are rotated to confuse pests and renew soil and natural materials such as potassium bicarbonate and mulches are used to control disease and weeds. Organic farmers are careful in their selection of plant breeds and organic researchers produce hardier plants through plant breeding rather than genetic engineering.

a) Crop Diversity:

Crop diversify is a distinctive characteristic of organic farming. Conventional farming focuses on mass production of one crop in one location, a practice called monoculture. This makes apparent economic sense: the larger /the growing area, the lower the per unit cost of fertilizer, pesticides and specialized machinery for a single plant species. The science ofagro-ecology has revealed the benefits of polyculture multiple crops in the same space, which is often employed in organic

farming. Planting avariety of vegetable crops supports a wider range of beneficial insects, soil micro-organisms and other factors that add up to overall farm health, but managing the balance requires expertise and closeattention.

b) Farm Size:

Farm size in great measure determines the general approach and specific tools and methods. Today, major food corporations are involved in all aspects of organic production on a large scale. However, organic farming originated as a small- scale enterprise, with operations from under 1-acre (4,000m^2) to under 100 acres (0.40 km^2). The mixed vegetable organic market garden is often associated with fresh, locally-grown produce, farmers' markets and the like, and this type of farm is often under10 acres (40,000 m^2). Farming at this scale is generally labour-intensive, involving more manual labor and less mechanization. The type of crop also determines size: organic grain farms often involve much larger area. Larger organic farms tend to use methods and equipment similar to conventional farms, centered around the tractor.

c) Plant Nutrition:

Soil Fertility -

The central farming activity of fertilization illustrates the differences. Organic farming relies heavily on the natural break down of organic matter, using techniques like green manure and composting, to replace nutrient staken from the soil by previous crops. This biological process, driven by micro- organisms such as mycorrhiza, allows the natural production of nutrients in the soil throughout the growing season and has been referred to as feeding the soil to feed the plant. In chemical farming, individual nutrients, like nitrogen, are synthesized in a more or less pure form that plants can use immediately, and applied on a man-made schedule. Each nutrient is defined and addressed separately. Problems that may arise from one action e.g. too much nitrogen left in the soil are usually addressed with additional, corrective products and procedures e.g. using water to wash excess nitrogen out of the soil. Organic farminguses a variety of methods to improve soil fertility, including crop rotation, cover cropping and application of compost.

d) Pest Control:

Biological Pest Control

Biological control of pests in agriculture is a method of controlling pests including insects, mites, weeds and plant diseases that relies on predation, parasitism, her bivore or other natural mechanisms. It can be an important component of Integrated Pest Management (IPM) programs. Biological Control is defined as the reduction of pestpopulations by natural enemies and typically involves an active human role. Natural enemies of insect pests, also known as biological control agents, include predators, parasitoids and pathogens. Biological control agents of plant diseases are most often referred to as antagonists. Biological control agents of weeds include her bivores and plant pathogens.

Predators, such as lady beetles and lace wings, are mainly free-living species that consume a large number of preyduring their life time. Parasitoids are species whose immature stage develops onor within a single insect host, ultimately killing the host. Most have a very narrow host range. Many species of wasps and some flies are parasitoids. Pathogens are disease-causing organisms including bacteria, fungi and viruses. They kill or debilitate their host and are relatively specific to certain insect groups. There are three basic types of biological control strategies conservation, classical biological control, and augmentation.

e) Conservation:

The conservation of natural enemies is probably the most important and readily available biological control practice available to homeowners and gardeners. Natural enemiesoccur in all areas, from the backyard garden to the commercial field. They are adapted to the local environment and to thetarget pest and their conservation is generally simple and cost-effective. Lacewings, lady beetles, hover fly larvae, and parasitized aphidmummiesareal most always present in aphidcolonies.

Fungus-infected adult flies are often common following periods of high humidity. These naturally occurring biological controls are often susceptible to the same pesticide used to target their hosts. Preventing the accidental eradication of natural enemies is termed simple conservation.

5.13 EXERCISE

1) Explain the concept and Philosophy of sustainable agriculture.
2) Describe the strategies of sustainable agriculture development.
3) Distinguish between characteristics of sustainable agriculture and conventional agriculture.
4) State the various problems of sustainable agriculture in rural area.
5) Explain the concept and principles of organicagri culture.
6) Explain the various methods of organic farming.

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6

GREENHOUSE AND TISSUE CULTURE

Unit Structure:

6.1 OBJECTIVES

1) To understand the concept and working of Green houses.

2) To study the various types and uses of Green House.

3) To study the techniques use for plant tissue culture.

4) To study the various tools and equipment's used for tissue culture in aboratory.

6.2 INTRODUCTION

A green house (also called a glass house or, if with sufficient heating, a hothouse) is a structure with walls and roof made chiefly of transparent material, such as glass, in which plants requiring regulated climatic conditions are grown. These structures range in size from small sheds to industrial-sized buildings. A miniature green house is known as a cold

frame. The interior of green house exposed to sunlight becomes significantly warmer than the external ambient temperature, protecting its contents in cold weather.

Many commercial glass green houses or hothouses are high- tech production facilities or vegetables or flowers. The glass green house is filled with equipment including screening installations, heating, cooling, lighting and may be controlled by a computer to optimize conditions for plant growth.

6.3 WORKING OF GREENHOUSES

The explanation given in most sources for the warmer temperature in a greenhouse is that incident solar radiation (the visible and adjacent portions of the infrared and ultraviolet ranges of the spectrum) passes through the glass roof and walls and is absorbed by the floor, earth, and contents, which become warmer and re-emit the energy as longer-wavelength infrared radiation. Glass and other material used for greenhouse walls do not transmit infrared radiations, so the infrared cannot escape via radiative transfer. As the structure is not open to the atmosphere, heat also cannot escape via convection, so the temperature inside the greenhouse rises. This is known as 'greenhouse effect.' The greenhouse effect due to the infrared - opaque'greenhouse', including carbon dioxide (CO_2) and methane (CH_4) instead of glass, also affects the earth as whole; there is no convective cooling as air does not escape from the earth.

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However, R. W. Wood in 1909 constructed two greenhouses, one with glass as the transparent material and the other with panes of rock salt, which is transparent to the infrared. The two greenhouses warmed to the similar temperatures, suggesting that an actual greenhouse is warmer not because of the 'greenhouse effect' as described in the previous paragraph, but by preventing connective cooling, not allowing warmed air toescape.

More recent quantitative studies suggest that the effect of infrared radiative cooling is not negligibly small and may have economic implications in a heated greenhouse. Analysis of issues of near - infrared radiations in a

greenhouse with screens of high co-efficient of reflection concluded that installation of such screens reduced heat demand by about 8% and application of dyes to transparent surfaces was suggested. Composite less - reflective glass or less effective but cheaper anti-reflective coated simple glass, also saving.

6.4 TYPES OF GREENHOUSES

Greenhouses can be divided into glass greenhouses and plastic greenhouses.

In domestic greenhouses, the glass used is typically 3 mm (or 1/8") horticultural glass grade, which is good quality glass that should not contain air bubbles (which can produce scorching on leaves by acting like lenses)

Plastic mostly used are polyethylene film and multi wall sheets of polycarbonate material or PMMA acrylicglass.

Commercial glass greenhouse isoften high-tech production facilities for vegetables or flowers. The glass greenhouse are filled with equipment such as screening installations, heating, cooling and lighting, and may be automatically controlled by computer.

6.4.1 Dutch light: In the UK and other Northern European countries a pane of horticultural glass referred to as 'Dutch light' was historically used as standard unit of construction, having dimension of $28^{3/4}$ " □ 56" (approx. *730 mm □ 142 mm)* . This size gives a larger glazed area when compared with using smaller panes such as the 600 mm width typically used in the modern domestic designs which then require more supporting framework for a given overall greenhouse size. A style of greenhouse having sloped sides (resulting in a wider base than at eaves height) and using these panes uncut is also often referred to as of 'Dutch light design', and a cold frame using a full - or half - pane as being of 'Dutch' or 'half - Dutch'size.

6.5 USE OF GREENHOUSES

Greenhouses allow for greater control over the growing environment of plants. Depending upon the technical specification of a greenhouse, key factors which may be controlled include temperature, levels of light and shade, irrigation, fertilizer application and atmospheric humidity. Greenhouse may be used to overcome short-comings in the growing qualities of a piece of land, such as a short growing season of poor levels and they can thereby improve food production in marginal environments.

As they may enable certain crops to be grown throughout the year, greenhouses are increasingly important in the food supply of high - latitude countries. One of the largest complexes in the world is in Almeria, Andalucia, Spain, where greenhouses cover almost 200 sq.km (49,000acres).

Greenhouses are often used for growing flowers, vegetables, fruits and transplants. Special greenhouse varieties of certain crops, such tomatoes, are generally used for commercial production. Many vegetables and flowers can be grown in greenhouses late winter and early spring and then transplanted outside as the weather warms.

Bumblebees are the pollinators of choice for most pollination, although other types of bees have been used, as well as artificial pollination. Hydroponics can be used to make the most use of the interior space.

The relatively closed environment of a greenhouse has its own unique management requirements, compared with outdoor production, pests and diseases, and extremes of heat and humidity, have to be controlled and irrigation is necessary to provide water. Most greenhouses use sprinklers or drip lines. Significant inputs of heat and light may be required, particularly with winter production of warm - weather vegetables.

Greenhouse also have applications outside of the agriculture industry. Glass point solar, located in Fremont, California, encloses solar fields in greenhouses to produce steam or solar-enhanced oil recovery.

6.6 HISTORY OF GREENHOUSES

The idea of growing plants in environmentally controlled areas has existed since Roman times. The Roman emperor Tiberius ate a cucumber-like vegetable daily. The Roman gardeners used artificial methods (similar to the greenhouse system) of growing to have it available for his table everyday of the year. Cucumbers were planted in wheeled carts which were put in the sun daily, then taken inside to keep them warm at night. The cucumbers were stored under frames or in cucumber houses glazed with either oiled cloth known as specularia or with sheets of selenite (a. k. a lapis specularis), according to the description by Pliny the Elder.

In the 13th century, greenhouses were built in Italy to house the exotic plants that explores brought back from the tropics. They were originally called giardinibotanici (botanical gardens) 'Active' greenhouses in which it is possible for the temperature to be increased or decreased manually, appeared much later. Sangayorok Written in the year 150 A.D. in Korea, contained description of a greenhouse which was designed to regulate the temperature and humidity requirements of plants and crops.

One of the earliest records of the annals of the Joseon Dynasty in 1438 confirms growing mandarin trees in a Korean traditional greenhouse during the winter and installing a heating system on condole.

The concept of greenhouses also appeared in the Netherlands and then England in the 17th century, along with the plants. Some of these early attempts required enormous amounts of work to close up at night or to winterize. There were serious problems with providing adequate heat in these early greenhouses. Today, the Netherlands has many of the largest greenhouses in the world, some of them so vast that they are able to produce millions of vegetables every year.

The French botanist Charles Lucien Bonaparte is often credited with building the first practical modern greenhouse in Lieden, Holland during the 1800s to grow medicinal tropical plants. Originally only on the estates of the rich, the growth of the science of botany caused greenhouses to spread over the universities. The French called their first greenhouses orangeries, since they were used to protect orange trees from freezing. As pine apples became popular, pineries or pine apple pits, were experimentation with the design of greenhouses continued during the 17th century in Europe, as technology produced better glass and construction techniques improved. The greenhouse at the Palace of Versallies was an example of their size and elaborateness: it was more than 15 meters (490 ft) long, 13 meters (43 ft) wide, and 14 meters (46 ft) high.

The golden era of the greenhouse was in England during the Victoria era, where the largest greenhouses yet conceived were constructed as the wealthy upper class and aspiring botanists completed to build the most elaborate buildings. A good example of this trend is the pioneering Kew gardens.

6.7 GREENHOUSE VENTILATION

Ventilation in one of the most important components in a successful greenhouse. If there is no proper ventilation in greenhouse and their growing plants can become prone to problem. The main purposes of ventilation are regulates the temperature and humidity of the optimal level and to ensure movement of air and thus prevent build up of plant pathogens (such as Botrytis cinerea) that prefer still air conditions ventilation also ensures a supply of fresh air for photosynthesis and plant respiration and many enable important pollinators to access the greenhouse crop.

Ventilation can be achieved via use of vents - often controlled automatically via a computer and recirculation fans.

6.8 GREENHOUSE HEATING

Heating or electricity in on the most considerable costs in the operation of greenhouses across the globe especially in colder climates. The main problem with heating a greenhouse as apposed to a buidings that has solid opaque walls in the amount of heats lost through the greenhouse coversing since the coverings need to allow light of filter into the structure they converaly cannol insulte very well with traditional plastic greenhouse coverings having an R - value of around 2 a great amount of money amount of money is therefore spent to continually replace the neat lost most greenhouses, when supplement as heat is need use natural gas or electric furnaces.

Passive heating methods inputs solar energy can be captured from periods or relative abundance (day time/ summer) and released to boot the temperature during cooler periods (night time / winter) waste neat from heat generated by the chickenes which would otherwise bewasted.

6.9 GREENHOUSE CARBON DIOXIDE ENRICHMENT

The possibility of using carbon dioxide enrichment in greenhouse cultivation to enhance plant growth has been known for nearly 100 years. After the development of equipment for the controlled serial enrichment of carbon dioxide the technique was established on a broad scale in the Netherlands secondary metabatiberies e.g. caddice glycoside in Digitalis lantana, are produced in higher amounts by greenhouse cultivation at enhanced temperature and at enhanced carbon dioxide concentration commercial greenhouse are now frequently located near appropriate industrial facilities of mutual benefit.

For example Conner Ways Nursery in the UK is strategically placed near a major sugar refinery.

Consuming both need CO_2 form the refinery which would otherwise be vented to atmosphere the refinery reduce its carbon emissions whistle the nursery enjoys boosted tomato yields and does not need to provide its own greenhouse heating.

Enrichment only becomes effectives whereby Liebig's law carbon dioxide has become the limiting factor in a controlled greenhouse irrigation may be trival and soils may be fertile by default in less controlled gardens and one fields rising CO_2 levels only increases primary production to the points of solid depletion (assuming on droughts, flooding or both as demonstrated prima facieby CO_2 levels continuing to rise in addition laboratory experiments free air carbon enrichment (face) test plots and field measurements provide reliability.

6.10 TECHNIQUES IN PLANT TISSUE CULTURE

Introduction :

Plant tissue culture is not a separate branch of plant science like taxonomy, cytology, plant physiology etc. Rather it is a collection of experimental methods of growing large number of isolated cells or tissues under sterile and controlled conditions. The cells or tissues are obtained from any part of the plant like stem, root, leaf etc. which are encouraged to produce more cells in culture and to express their totipotency (i.e. their genetic ability to produce more plants). Cells or tissues are grown in different types of glass vials containing a medium with mineral nutrients, vitamins and phytohormones. Therefore, to carry out the experiments using tissue culture techniques, a well-equipped laboratory is first required.

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In recent years there has been a large increase in the number of research laboratories using tissue culture techniques to investigate many fundamental and applied aspects of higher plants. However, the use of these techniques is not confined to research alone. Tissue culture techniques are being exploited by many commercial laboratories. Even many horticultural companies are setting up small to multiply plants which are difficult to propagate by conventional means.

In this chapter, the general organization of a tissue culture laboratory and the basic techniques will be discussed under differentsubheadings.

6.11 TISSUE CULTURE LABORATORY

An ideal tissue culture laboratory should have at least two big rooms and a small room. One big room is for generally laboratory work such as preparation of media, autoclaving, distillation of water etc. The other big room is for keeping cultures under controlled light, temperature and humidity. The small room is for aseptic work for keeping autoclaved articles.

General Laboratory :

The general laboratory for tissue culture should be provided with the following articles and arrangements.

A Washing Area:

This is very important for a tissue culture laboratory. It should be provided with a large sink, running hot and cold tap water, brushes of various sizes, detergent and a bucket of single distilled water for a final rinse of the washed glass goods. A number of plastic buckets are required for soaking the glass goods to be washed. Another separate bucket with lid is also required for disposing off the used or infected media before cleaning. Only this bucket should be kept outside the room or clearing area and should be cleaned twice in aweek.

Hot Air Oven

It is necessary for drying the washed glass goods. For this purpose, a number of enameled trays of different sizes are required for keeping wet glass goods inside theoven.

Refrigerator

It is essential for storing various thermolabile chemicals like vitamins, hormones, amino acids, casein hydrolysate, yeast extract, coconut milk, etc. Stock solutions of salts are also kept to prevent contamination.

DistillationPlant

A single distillation and a double distillation water plant are indispensable. Two big plastic containers are required for storing the distilled water.

Weighing Balance

Three types of weighing balances viz. pan balance, chemical balance and electric balance are required for weighing chemicals, sugars, agar-agar and others.

pH meter :

It is necessary for the measurement and adjustment of pH of the nutrient medium Fig. 15.1.

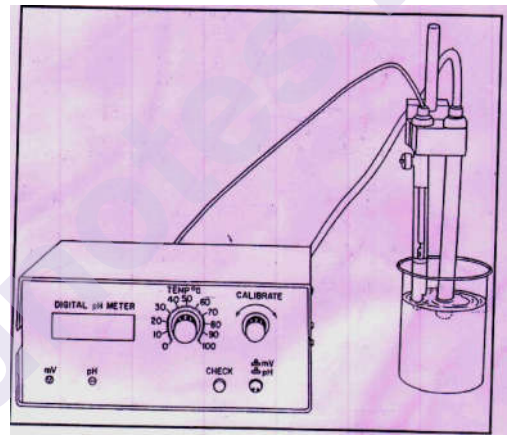


Fig. 15.1

Vacuum Pump :

It is required for filtering liquid media, sugar solution etc. through filter apparatus using air suction.

Autoclave :

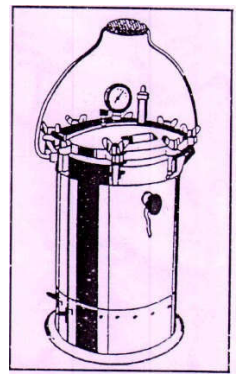
It is very important for sterilization of nutrient media, glass goods, instruments, etc.

Working Tables :

These are necessary for preparation of medium.

Heater :

It is needed for heating or warming the medium to dissolve agar to melt the agarifted medium.



Simple portable auto clave : Fig. 15.2

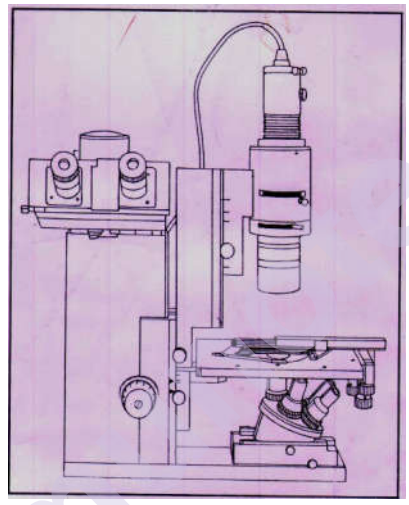


Fig. 15.3

An inverted microscope for the observation of living cell and tissue cultures during experiments

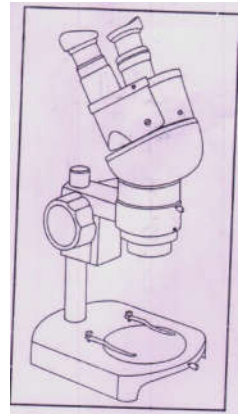


Fig. 15.4

A stereoscopic dissecting microscope

Microscope:

Simple, compound, inverted binocular dissection microscopes are essential for various purposes. Some of the microscopes (Fig. 15.4) should be fitted with a camera for taking photomicrograph.

Microtome:

It is needed for sectioning the cultured tissue.

Wooden Racks :

These are required for keeping the various chemicals.

LABORATORY FOR ASEPTIC INOCULATION:

This room should be without any window or ventilator in order to make it dust-free. The room should be provided with double doors. The doors should have a automatic door closer. In- side floor should be fitted with a rubber mat to facilitate cleaning. For entering into the room, shoes should be left outside. For aseptic work, a large wooden chamber *(Ca, 4'□ 4'□7')* is made forshort term work. Upper half of the sidewalls of the chamber is made of large glass sheets. The chamber should also have double doors provided with a door closer. The chamber is provided with two UV (one small, one big) sterilizing lamps and a fluorescent lamp. The switches to operate them are present outside the chamber so that the lamps can be safely switched on and off. Inside the chamber, the working table and shelves are made of thick glass sheets.

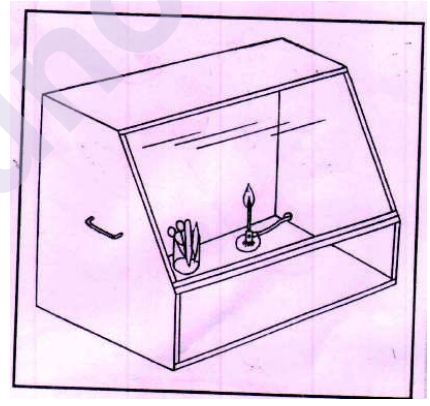


Fig. 15.5

For simple routine work such as aseptic seed germination, harvesting of cultured tissue from the aseptic stock for cytological work or for microtome preparations, a small inoculating hood may be used. This can be placed on a small table at the convenient corner of the room. The figure of an ideal chamber is given here 15.5.

Laminar airflow cabinet (Fig 15. 6) is the most suitable, convenient and reliable instrument for aseptic work. It allows one to work for a longer

period, which is not possible inside the inoculation chamber. Long hours of work inside the inoculation chamber may also cause suffocation and needs the interruption of work.

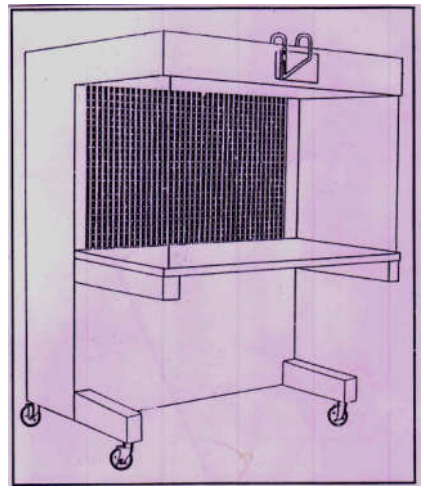


Fig. 15.6

One can work openly and easily for a longer period on the table of laminar airflow.

Laminar airflow has a number of small blower motors to blow air, which passes through a number of HEPA (high efficiency particulate air) filters. Such filters remove particles larger than *0.3* □*m* . The ultra-clean air which is free from fungal and bacterial contaminants, flows at velocity of about *27* □ *3m / minute* through the working area. All contaminants are blownaway by the ultra clean air and thereby an aseptic environment is maintained over the working area. Before starting work, laminar air flow is put on for 10-15 minutes. The flow of air does not put out the flame of a spirit lamp. Therefore, a spirit lamp can be used conveniently during the work.

CULTURE ROOM :

Fig. 15.7

Design for a skeleton rack for keeping culture vessels and Incubation of culture

The culture room means the room for keeping or incubating the culture under controlled temperature, light and humidity. The culture room is also fitted with double doors in order to make it dust-free and to maintain a constant room temperature. One should enter the culture room keeping the shoes outside the door. To maintain the temperature around $25 \square 2^0C$ inside the culture room, air coolers are used. This room is also provided with specially designed shelves (Fig. 15.7) to keep culture vessels. The shelves are made of glass or plywood. Flask, bottles, jars, petriplates can be placed directly on the shelves. Culture tubes can be kept on a support such as empty paper cover of fluorescent lamps. Cultures can be grown in light or in dark. For light arrangement, each culture rack is provided with fluorescent lamps which are photo- periodically controlled by an automatic timer. Racks covered with black curtains are suitable for dark incubation of culture. A thermometer and a hygrometer are fixed on the wall at the safety corner of the room to check temperature and relative humidity respectively. The relative humidity of the culture room is maintained above 50%.Some small shelves are placed in the culture room for temporarily keeping the autoclaved articles and the culture vials containing the medium.

The culture room should also have a shaker for suspension culture or single cell culture in moving liquid medium. The speed of revolution of the shaker can be controlled. The platform of the shaker is fitted with clips for holding conical flasks (150ml to 200ml).

GLASS GOODS AND INSTRUMENTS:

GLASS GOODS

Different types of glass goods are used to culture plant tissues. The conventional and some specific glass goods are required for culture work. Glass goods should be of Corning or Pyrex or similar boro-silicate glass. Measuring cylinder, conical flask, pipettes, beakers are required for preparation of media. Plant tissues are grown in wide-necked Erlenmeyer conical flask (100ml, 150ml, 250ml etc.), culture tubes (25mm in diameter and 150 mm in length), pretriplates (50, 90,140 mm in length), screw-capped universal bottle, milk bottle may also be used. Particular care must be taken to ensure that glass goods are properly cleaned before use. The traditional method of cleaning new or dirty glass goods is to soak these in soap water followed by brushing and washing well with tap water and finally rinsing with single distilled water. These are dried in the hot air oven and then the clean glass goods are stored in a dust-proof cupboard or drawer. In order to autoclave the culture medium and to culture the plant material, culture vessels particularly culture flasks and culture tubes must be fitted with cotton plugs which exclude microbial contaminants, yet allow free gas exchange. For this tightly rolled plugs of non- absorbent cotton wrapped in gauge cloth may be used. When in position the exposed part of each plug and the rim of the culture vessel should be covered by brown paper or a cap of aluminium foil. This will keep the plug and vessel rim free from dust and will protect the plug from wetting during autoclaving.

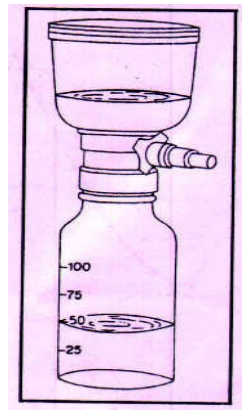


Fig. 15.8

A specially designed glass-made bacterial filtration system

In some laboratories, pre-sterilized, disposable plastic wares are used in order to culture plant tissues. Some of these plastic wares are autoclavable.

For the sterilization of medium containing thermolabile compounds or enzymes for proto-plast isolation a specially designed glass mad bacterial filter (Fig. 15.8) or an autoclavable plastic made bacterial filter isused.

A small spirit lamp made of glass will be required for the flame sterilization of instruments using methylatedspirits.

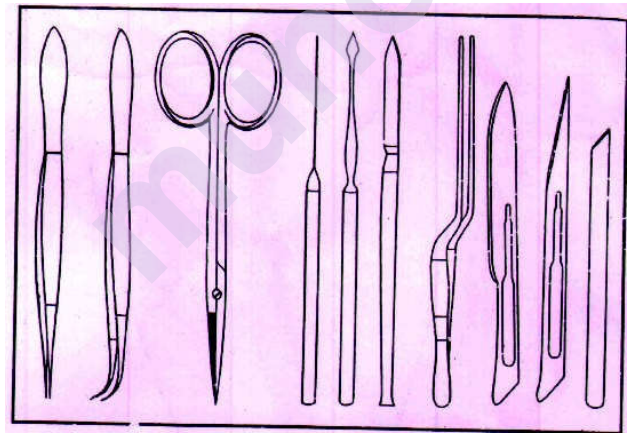


Fig. 15.9

A set of instruments used for tissue culture work

INSTRUMENTS:

Instruments routinely used for culture work include various sizes of scalpel and forceps, spatula, scissors, etc. (Fig 15.9). All instruments should be stainless steel.

Summary:

Plant tissue culture is a collection of experimental methods of growing large number of isolated cells or tissues under sterile and controlled condition. To carry out the experiments using tissue culture techniques, a well-equipped laboratory is first required. An ideal tissue culture laboratory should have a big room for general laboratory and a small room for aseptic work and for keeping autoclaved articles. The general laboratory should be provided with a washing area, hot air oven, and refrigerator, distillation plant, weighing balance, pH meter, and vacuum pump, autoclave, working table, heater, microscope, microtome and wooden racks.

Laboratory for aseptic inoculation should be without any window or ventilator in order to make dust-free. The room should be provided with double door having automatic door closers. For aseptic work, a large wooden chamber is made for short term work. For simple aseptic routine work a small inoculating hood may be used. Laminar air flow is the most suitable, convenient and reliable instrument for aseptic work. It has a number of small blower motor to blow air which passes through a number of HEPA (high efficiency particulate air) filters. Such filters remove particles larger than *0.3□m.* The ultraclean air is free of fungal and bacterial Contaminants.

The culture room means the room for keeping the culture under controlled temperature, light and humidity. To maintain the temperature around *25 □ 2*^{0} *C* inside the culture room, air coolersare used in tropical countries. This room is also provided with specially designed racks to keep culture vessels. The relative humidity of the culture room is maintained above 50%. The culture room should also have a shaker for suspension culture in moving liquid medium.

Different types of Corning or Pyrex or similar borosilicate glass goods are used to culture plant tissues. Plant tissues are grown in wide necked Erlenmeyer conical flask, culture tube (25mm in diameter and 150 mm in length), screw-caped universal bottle. In order to autoclave the culture medium and to culture the plant tissue, culture vessels particularly culture tubes and flasks must be fitted with cotton plugs which exclude microbial contaminants. Yet allow free gas exchange. For the sterilization of medium containing thermolabile compounds and enzymes, a specially designed bacterial filter isused.

Instruments routinely used for culture work include various sizes of stainless steel made scalpel, forceps, spatula, scissors etc.

Excised plant tissues and organs will only grow in vitro on a suitable artificially prepared nutrient gratified or liquid medium, which is known as culture medium. The Murashige and Skoog (MS) based culture media are commonly used for plant tissue culture and have proven effective for growth promotion of both mono- cotyledons and dicotyledons. A culture medium is composed of inorganic salts, an iron source, vitamins, amino acids, plant hormones and a carbohydrate supply. Inorganic salts are

supplied in two groups - as macrosalts and microsalts. The most commonly used phytohormones are synthetic auxins and cytokinins. The auxins are 2,4D, IAA, BOTA, NAA, IBA etc. and the cytokinins are Kinetin, 6 - BAP, Zeatin, 2 iPA etc. The concentration and ratio of hormones may vary from plant to plant and should be standardized for a particular plant tissue. Some plant tissues grow in the presence of complex natural additives such as coconut milk, casein hydrolysate, yeast extract, watermelon extract, maltextract, potatoextract, ripe tomato extract, orange juice extract etc. Diphenyurea, a growth factor found in coconut milk, exhibits cytokinin - like responses.

On the basis of constituents, culture media are of two types -

i) Chemically defined in which the composition and concentration of all constituents are known. ii) Chemically under- fined in which the exact composition and the concentration of all constituents are not known due to addition of natural additives.

It is not possible to weigh and mix all the constituents just before the preparation of medium. So it is convenient to prepare the concentrated stock solutions of macro salts, vitamins, amino acids, hormones etc. All stock solutions should be stored in a refrigerator for a limited period.

Several techniques have been adopted for in vitro plant tissue culture. Among them some are general techniques such as preparation of nutrient medium, sterilization, aseptic manipulation, maintenance of culture and some are specific techniques such as organ culture, callus culture, organogenesis, embryogenesis, suspension culture, anther and pollen culture, plant proto-plast culture, embryo cultureetc.

6.12 EXERCISE

1) Explain the concept and working of greenhouses.

2) Describe the various types and uses of greenhouses.

3) Explain the concept of tissue culture and write detail note on tissue culture laboratory.

4) Write short notes on following -

i) Greenhouse

ii) History ofgreenhouse

iii) Tissue culture

iv) Instruments used for tissue culture

7

GROUP FARMING

Unit Structure :

7.1 OBJECTIVES

- To know the nature Group Farming.
- To know the advantages of Group Farming.
- To understand the requirement of Group Farming
- To study the contribution of Women in Agriculture Sector.

7.2 INTRODUCTION

India is an agricultural country. 70% of our country's population is dependent on agriculture. Therefore, various schemes for agricultural development are implemented at the central and state levels. Group farming scheme is one of the important schemes. The government implemented the scheme "Group Farming" on 24th July 2017 to promote group farming so that farmers can develop themselves through group farming, develop the group, reduce the cost of agricultural production and make farming more profitable. According to the approach of the Central Government, the Group Farming Scheme is being implemented by the Government of Maharashtra to double the income of the farmers in the state of Maharashtra. As the land of farmers is less, planning of work under group farming schemes and modern farming technology is the need of the hour to increase their farm income. The Maharashtra government is working to encourage the farmers of the state through group farming schemes. Due to the increase in population, agricultural land is continuously being fragmented and inter-divided and its holding capacity is decreasing day by day. According to data from the 2010-11 report

published by the Census of Agriculture, the holding capacity in Maharashtra in 2070-71 was 4.28 hectares per holder. It steadily declined to 1.44 ha per account holder in 2010-11. In some places, the carrying capacity is as low as 11 to 15 knots only. Therefore, farming is not economically viable. Farmers find it difficult to earn income from such a small area. Group farming is a sure solution to all these problems.

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Group farming can increase agricultural production by using modern technology. Also, by adopting high technology, mechanization in agriculture, the agricultural business can be assuredly facilitated. Group farming can be helpful in getting a good price for agricultural produce by saving on production and transportation cost due to collective sale of agricultural produce.

Group farming is not only farming but also includes various businesses. The aim is to increase the income of the farmers by increasing their production. These include poultry farming, silk business, fish business, dairy business, nurseries, beekeeping, nurseries, etc.

Agricultural inputs, training, irrigation, mechanization, post-harvest technology, agricultural processing and marketing etc. are important to double the production of farmers, increase crop production according to the needs of the farmer group. Due to the low land holding of the farmers in the state, there is a need for modern methods and planning of collective farming for a substantial increase in the income of the farmers. In this regard, it is necessary to encourage group farming through farmers' groups.

7.3 DEFINITION

1) Farmers of a group come together to do collectively planned farming in Shiwar geographical areas, process and add value to the agricultural produce, buy and sell together, bring about the upliftment and development of themselves and the group through this professional way of life is group farming.

2) Group farming means that many farmers come together to farm collectively in contiguous geographical areas within the agricultural area without owning their own land, doing ancillary business, processing other agricultural products, adding value to them, marketing agricultural products and making economic progress through the group of farmers. Group farming yes.

3) Farmers in a group come together to do collective farming in the geographical area of Shivara, process and grow roots of agricultural produce, and bring about the development of the group by means of all these means of organizing the collective form for collective marketing is group or group farming.

4) Small and marginal landholding farmers come together to collect their land, agricultural produce and sell it communally and share the profit according to the proportion of their land and inputs from the profit they get for their labor is called group farming.

7.4 NATURE AND IMPLEMENTATION OF GROUP FARMING SCHEME –

In order to avail the benefits of Group Farming Scheme, it is necessary to register a farmer group as a farmer producer company as per the provisions of the Maharashtra Co-operative Societies Act, 1960 or Companies Registration Act, 1956. For information on where and how to register, inquire at the office of the Agriculture Officer in the Agriculture Department of your taluka.

- For group farming, the state government approves the implementation of various agricultural and supplementary activities in the form of projects through groups of 20 farmers on an area of at least 100 acres. 100 acre area where safe vegetables, safe flowers are produced. Groups are eligible to benefit from the scheme if the total area of polyhouse or shade net of one of their groups is 25 acres and the total area of 4 subgroups is 100 acres.
- Under the group farming scheme, a subsidy of maximum one croer rupees is given to each group in two years. A maximum of 200 eligible farmer groups are selected for this.
- After the approval of the project, the plan of the project is prepared and the grant installments are given to the groups in four stages namely 20%, 30%, 30% and 20%.
- The groups benefiting from the group farming scheme are given prizes as first place (Rs. 25 lakh), second place (Rs. 15 lakh) and third place (Rs. 5 lakh).
- A model of group farming is created for how to do group farming.
- Through group farming, model projects like animal husbandry, dairy business, fish business, etc. will be included with the aim of making the farmer group understand the importance of agriculture and marketing, along with agriculture, and farmers should follow it.
- Various types of implements, machines etc. required by the farmers for farming have been included in group farming.
- Farmers participating under this scheme will be required to register as Farmer Producer Group/Company under the provisions of

AtmaSanstha, Maharashtra Co-operative Societies Act, 1960 or Companies Act, 1958. Also, it will be mandatory for all the members of the farmer group to link their Aadhaar number with the bank account to avail the benefits under this scheme.

- Members - As group farming is being experimented on an experimental basis, farmers of a group come together in a contiguous geographical area in a Shiwar and the selection of the area is being approved.
- Under the scheme, collective irrigation facilities (e.g., creation of farms, micro-irrigation, sub-irrigation, private wells and pump sets, installation of pipelines, automation (automatic micro-irrigation system) by adopting micro-irrigation over the entire area, mass cultivation through mechanization, small farm machinery, As crop protection plant etc. can be done easily, priority will be given to row area first in group farming.
- Activities will be implemented in the form of projects under this scheme of group farming. The farmers group formed under the scheme should be given preferential benefits under the prevailing scheme for training and guidance as well as micro irrigation, agricultural engineering, post-harvest processing and handling technology and marketing of agricultural produce.
- The services of agricultural technical advisors will be provided to provide advanced farming technology to farmers' groups. For this purpose, under the guidance of experts nominated by the Superintendent of Agriculture Officer, Extension Officer of the Agriculture Department and the Vice-Chancellor of the concerned University of Agriculture, the farmer groups are provided with necessary training, technical guidance as well as collective facilities required by them, for example- collective irrigation facilities, agricultural machinery, post-harvest processing, • for storage. Requirement of godown etc. will be determined. Also individual benefit schemes like- micro-irrigation, private wells and pump sets, farms, small farm machinery, crop protection machinery etc. are expected to be determined with expert technical advice. Agricultural technical advisory services are proposed to be made available on a collective basis to impart advanced farming technology to groups of farmers. It will be necessary to get a recommendation from the experts of the agricultural universities that the technology recommended by the foreign experts is useful considering their climate and other factors for such a project to which the farmer groups will be provided the services of foreign technicians under the scheme of the government.
- Additional agricultural activities such as collective cowsheds, dairy processing equipment, fish farming, beekeeping, sericulture, poultry farming as well as mangrove farms, works of water resources department etc. programs should be made available by the concerned department related to agriculture on a priority basis as per the prevailing norms of that department. In this regard, if funds are not available from the concerned department as determined in the project, the fixed amount of Rs. Subsidy should be made available through this scheme within the fund limit of 1 crore.

- Dayavaya grant under this scheme will be given to the bank account of the group on priority basis only for the program of group nature. For individual project components as well as for individual benefit schemes, the subsidy payable as per the prevailing norms of the scheme will be disbursed directly to the members of the beneficiary groups through DBT in the Aadhaar affiliated bank account.
- For the implementation of the said scheme, a new head will be created soon for the scheme of promoting farmers' groups and group farming. 13) An ideal model project for group farming should be prepared by considering the cropping method and type of farming and it should include the ideal model project of animal husbandry, dairy and fisheries department and silk industry etc.
- Agricultural Equipment Bank should be included in the said scheme.

7.5 ADVANTAGES OF GROUP FARMING

1) As group farming is done collectively, high technology and modernization are adopted in agriculture.
2) Cost of production decreases and production increases.
3) Farmers get better prices for farm produce due to collective sale of produce.
4) Reduces transportation costs.
5) A large amount of capital can be raised.
6) Agricultural produce can be processed.
7) Value addition of agricultural produce can be done.
8) Additional agricultural businesses can be developed.
9) Intersection and fragmentation is prevented.
10) Credit is available through NABARD.
11) Grants are received through Govt.
12) Farm produce gets a good price.
13) Group farming helps businesses become profitable by adopting high technology and mechanization.
14) Collective sale of farm produce increases the profit by saving the cost of transportation of produce.
15) It is possible to add value to agricultural products by processing them.
16) Due to group farming, it is possible to do agriculture complementary businesses like animal husbandry, fish farming, silk business, and beekeeping.
17) Farmer's standard of living increases.
18) Group farming developed group power among farmers.
19) Group farming makes commercial farming possible.

20) Group farming enables efficient utilization of natural resources and various inputs required for agriculture.

7.6 REQUIREMENTS OF GROUP FARMING

1) The continuous division/fragmentation of land along with the increase in population, the carrying capacity of agriculture is decreasing day by day. According to the published report of Agricultural Census 2010-11, the holding capacity in Maharashtra from 4.28 hectares in 1970-1971 has steadily declined to 1.44 hectares per holder in 2010-2011. In some places, there are 11 to 15 gunthas and the contiguous area is left for farming. In such a situation, farming on such a small area and producing economically profitable products is becoming very demanding. All these problems are solved by the collective farming system and because of the combined area, it becomes convenient to impart modern technology in the groups.

2) Facilitation of agricultural business by adopting high technology and mechanization (Ease of Doing Farming) - Uncertainty of production in agriculture, as well as migration from rural areas to cities due to increasing urbanization, there is a shortage of skilled and unskilled manpower in the agricultural sector. Therefore, mechanization and technical guidance is required for that, it will be convenient to do it collectively. As the farmer's personal ownership of the land decreases, he cannot financially afford to personally adopt high technology and mechanization on his farm. This problem can easily be solved by doing collective farming and reducing the cost of production.

4) Adoption of a marketing system at the individual level, as the production of the farmer is low; he cannot properly market his produce. As a result, he has to sell his goods at a lower price. Therefore, his goods do not fetch a reasonable price. However, joint marketing of the produce produced by the collective farming system will enable it to capture distant markets by avoiding transportation and post-harvest losses and increasing savings in production costs.

5) Post-harvest processing Many times the support received from nature, tireless efforts of farmers and planning on the agricultural area, if the production of the farmer is more than expected, the market price falls and the farmer gets a lower price. Overstocking of perishable produce like vegetables, fruits, etc. is likely to cause damage, in which case post-harvest processing can help farmers get a fair price. Also, due to the processing industry, the experimental technology of the western country can be used in groups in our state and integrated agriculture can be developed.

6) Processing Industry and Value Addition - Due to lack of large capital and production, it is not possible for small farmers to process and add value to the produced goods. However, through collective farming primary processing as well as value addition of goods can be done on the farm itself and the investors will get raw material from the farmer group at one place to boost the processing industry.

7) Agriculture supplementary side business Animal husbandry, sericulture, fishery, dairy business, beekeeping and creating nurseries etc. along with production of various crops on cultivable land in collective farming. Items are required. However, due to lack of manpower as well as low carrying capacity of the land, the farmers have moved away from animal husbandry. As a result, farmers and agribusiness are trapped in a vicious cycle of decreasing availability of organic fertilizers, decreasing productivity of land, increasing use of chemical fertilizers and increasing production costs. This problem can easily be solved by collective management of livestock in the collective farming system.

The combined effect of all the above factors will help reduce the production cost of the farmers and increase the net income. Therefore, adoption of collective farming is becoming the need of the hour.

7.7 CONTRIBUTION OF WOMEN IN AGRICULTURE

7.7.1 Introduction: Agriculture is the main occupation in rural areas. Agriculture is a means of livelihood, a means of providing health care. In rural areas, women are mostly found working in agriculture. They are seen working as farmers or farm labourers. A large number of women work in agriculture but are not properly accounted for in the labor market. Also, the attitude towards women's agriculture is not scientifically and accurately recorded and properly evaluated.

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7.7.2 Features of approach to women labor force in general:-

1) The nature of women's work is partly part-time as they work in the remaining time after housework.
2) Women's labor power and time is spent to work on their own farm. It doesn't matter. It is not registered. Their work is neglected because they are not 'trees' or they do not get paid for working on their own fields.
3) Women's work status is considered inferior. They do it less efficiently than men.
4) As they are more interested in family responsibilities and child rearing, they are not adept at putting their full mind and energy into farming processes.
5) Women lag behind in physically demanding work.

6) They lack the skills and ability to use new techniques in agriculture and agriculture, modern changes in production, updated and modern machinery and technology.
7) Their position is secondary in agricultural work and its ancillary work.
8) Income from women's work is considered secondary and less important. It is accepted by the society that the family cannot be supported by their hard earned income alone.
9) Because women have less decision making power, there is a possibility of making mistakes in sowing, husbandry, harvesting etc.
10) Women have less power to take responsibility of agriculture in terms of economic self-reliance, independence and full responsibility.

Science and research have accepted that there is no difference between men and women intellectually. Although it is accepted that women have to withdraw themselves from agricultural work for some time due to pregnancy, childbirth and child care, it must be accepted that these activities are not unproductive. Also, women have now proved that the traditional view of women's productivity and efficiency in agricultural work is wrong. Women's 'creativity' is increasing. Quantitatively and qualitatively required amount of creativity is coming in women.

There are a large proportion of women in agriculture. It should also be noted that women's participation is always measured in a slightly different way in terms of statistics. The approach taken in all statistical analysis is always based on the conventional assumption that women are under-represented. Bhattacharya, S. 1985: Jain D. 1982.

Mistakes in interpretations add to biases in not trying women's participation indiscriminately. Because in the labor market the work done at home as a prerequisite for agricultural processes is considered unproductive. Cleaning, grading and storage of seeds for sowing is not recorded anywhere. At the time of sowing, the help of women is taken but it is also not measured. Women are doing the work of weeding, breaking the clods, weeding, building dams, removing the dried pre-crop pods, weeds and dirt in the field before sowing. They are also heavily involved in the harvesting process but are they being measured and evaluated properly? This should be noted now. But due to the lack of confidence in the ability of women to work, there is an attitude of giving them light work, low wages and seasonal work. Women are given daily work only. Big farmers refuse to employ permanent servants or as attached labour.

In the non-agricultural sector, the proportion of women workers is clearly decreasing (Ambhar 1975: Mina A 1979). As a result, the proportion of women dependent on agriculture and agriculture-related work is apparently increasing. This is because the number of women laborers has increased mainly in places where non-grain crops such as sorghum, millet, rice etc. are grown. Even where cash crops such as cotton, groundnut, tobacco etc. are grown, women are found doing labour. (Acharya and Panwalkar, 1989) A separate concept of women farmers has not yet developed. That is, there is a need to give the status of farmers separately to women and it is necessary to classify them accurately and precisely.

Women's participation in agricultural and non-agricultural activities is inevitable and increasing.

The role of women is also becoming important in the ancillary business related to agriculture. Women are becoming successful in the next agricultural sector by adopting entrepreneurship, use of technology, scientific methods and productivity.-

1) Poultry Farming
2) Cow Buffalo Rearing / Dairy Business / Dairy Farming
3) Piggery
4) Sheep Rearing
5) Angora Rabbits
6) Fish Farming
7) Bee-Keeping
8) Mushroom Growing
9) Horticulture
10) Floriculture

The contribution of women in agriculture should not only be broadly imagined and stated, but it should also be properly surveyed. How many labor hours are spent by women in agriculture and non-agricultural sectors? What is their productivity? What is the actual income from it? How much are they involved in agricultural production? What is the contribution of women labor force in agriculture based and agricultural processing industries? It is essential to conduct statistical and scientific research in the context of etc. In that sense, although the reports of the findings of women's participation are not available today, the work and contribution of women in the agricultural sector cannot be denied.

As agricultural laborers and women farmers are given a secondary position in the agricultural sector as in other sectors, information about technological changes and up-to-date knowledge in the agricultural sector is not taken seriously. It is necessary for the government to involve women in training and extension work, agricultural education, seminars and seminars, action programs and demonstrations, agricultural exhibitions etc. Globalization, liberalization, open economy, no import-export restrictions, foreign direct investment, entry of multi-purpose companies, scope for export of agricultural products and processed food etc. are having a great impact on rural life. Innovations in agriculture and agricultural processing, technological improvements and changes in production methods cannot be far away from our agricultural economy. For this reason, it will be very dangerous to keep the farmers and farm laborers women who contribute a lot to the agricultural economy from agricultural transformation.

Not only that the importance of agricultural economy cannot be denied in our country, even if the industrial sector develops, the importance of agriculture will not decrease. In a continental and highly populated country like India, agriculture plays an important role in meeting the demand for food grains and providing raw materials for industrial development.

That is why it is the need of the hour to educate rural farmers and women farm workers, to impart skills related to agriculture.

7.7.3 Importance of women in Agriculture:

1) More proportion of women agricultural labourers
2) Women farmers
3) Participation in agro processing industry
4) Participation in farm decision making process
5) Sale of agricultural produce
6) Participation in agribusiness
7) Involvement of women in animal husbandry
8) Involvement in fish farming and fishing business
9) Development of sustainable agriculture.
10) Food security and backyard
11) Participation in various agricultural activities - sowing, threshing, planting, irrigation, storage, harvesting etc.

7.7.4. Limitations/ Errors/ Defects/ Shortcomings for Women's Participation in Agriculture:-

1) The nature of women's work is partly part-time as they work in the remaining time after housework.
2) Women's labor is neglected without being recorded or paid.
3) Inferior quality of work - inefficient in the mind of a man
4) They are not adept in applying sufficient mind and latent energy in agricultural processes.
5) Women lag behind in physically demanding work.
6) Women do not have new technology, new changes, modern farming skills and abilities in agriculture.
7) The position of women in agriculture and ancillary work is secondary.
8) Women's income from agricultural work is meager. Therefore, the financial needs of the family are not fully met.

9) Decision making capacity is low; hence there is a high chance of mis-estimation of agricultural production.

10) Financial self-reliance and the ability to take responsibility for the family is less in women.

7.7.5 Measures to increase participation of women in Agriculture:-

1) To increase the number of women farmers

2) To impart technical and up-to-date knowledge in the field of agriculture to women

3) Agricultural education and agricultural extension

4) Crop demonstrations and training

5) Seminars and trips

6) Agricultural exhibitions

7) To increase the literacy rate of women

8) Gender equality

9) Financial independence and independence

10) Increase in agricultural income

11) Growth in agro processing industry

12) Agricultural University to try to increase the number of professional women

13) Increase in agriculture and home science education

14) To increase efficiency and productivity of women

15) To start agricultural science college in every agricultural university in the state and reserve 30 to 40% seats for women.

16) Agricultural study centers for women should be established at the regional level.

17) To create agribusiness women

18) With the help of media, women empowerment, economic and agricultural work should be disseminated for rural women.

19) Public awareness

According to the 2011 census, 65 percent of women in the country are engaged in agriculture. The same ratio is 49.8 percent for men... But what picture stands in front of our eyes when we say 'farmer'? It has to do with land ownership. In our patriarchal system, women are often deprived of the right to land and because of the rule of 'whose name is seven, it is a

farmer'; they are not recognized as farmers despite their hard work in agriculture. According to the 2015-16 agriculture censuses, the proportion of women landholders in the state is only 15 percent. Since they are not recognized as farmers, they cannot get the benefits of schemes, training, loans, tenders etc. The participation of women in agriculture is increasing day by day. Deforestation, increase in agricultural fertility, and overall decline in rural-tribal work availability have led to increased migration of men from rural to urban areas. As a result, the responsibility of agriculture on women increased. Basically, the burden of domestic work on women, restrictions on their activities outside the home, limited education, and employment opportunities are less for them. Due to this reason, they get stuck in their homes. There is a situation today where there is no responsibility for agriculture on one hand and no authority over resources on the other.

Not only this, women's participation in agriculture and water related institutions are also minimal. For example, the law has given women representation in the water utility bodies that are set up for canal water management. In spite of this, in most water utility organizations, women are appointed only as a matter of law, but in reality they are not involved in management. Of course, the proportion of irrigated agriculture in Maharashtra is not more than 20 percent.

Although the proportion of women in agriculture as a whole is increasing, where irrigated / horticultural agriculture is dominated by men and dry land agriculture shows a similar picture of women. As men migrate for work in dry land areas, women are often responsible for farming. Due to non-availability of irrigation facilities, wages are also not sufficient in this area. Previously, we used to get work for ten months in a year. The experience of farm laborers says that it has reached six months now... so often women also have to migrate in search of livelihood.

Also, it is often felt that women have different opinions than men about what crops to grow in agriculture. As the responsibility of food and nutritional security of the family rests with women, women try to grow at least some food grains and vegetables in agriculture. Also, many women prefer to use organic methods while growing food grains and vegetables. But this type of farming by women does not get any support from government schemes. This does not even count the invaluable work that women do along side agriculture such as fetching fodder and firewood, tending cattle, cooking and other household chores. The burden of all such work on women continues to increase manifold.

Of course, women farmers are not a unified group. When we say farmers here, it includes all women who depend on agriculture and agriculture-related livelihoods – farmers, farm laborers, forest harvesters, fisher folk, and herdsmen. Each of these groups has different questions. Also, the deprivation of small landholders, tribals, dalits and single women farmers is more compared to other women farmers. The proportion of single women farmers is high in Maharashtra. Especially in the suicide affected areas of Marathwada and Vidarbha many women are farming alone today.

It is not easy for these women to farm alone due to lack of adequate resources, opposition from family and society. Their options for loans, tenders, markets etc. are also less than other women.

This year, the corona epidemic showed how the basic deprivation of these women increases during the disaster. Due to the difficulties encountered in the lockdown, lack of employment, increased debt in agriculture, the damage caused due to the heavy rains, all these things have increased the plight of these women farmers today. There is a possibility that their situation will get worse due to the three laws implemented by the central government.

On the occasion of the ongoing farmers' movement against the new laws, many issues of farmers have once again come to the fore... but the issue of women farmers has been somewhat neglected in this discussion. The hardworking people who depend on agriculture, forest, fishing, animal husbandry are facing a great calamity. Increasing number of landless people and adding to it rural unemployment, agricultural barrenness and increasing indebtedness, farmer suicides, depletion of natural resources and privatization of resources in the name of development projects, looting of farmers are all due to various policies of the government and in the background there is also reference to changing climate.

These questions faced by the farmers today are not only in front of the women farmers... but at the same time they have different questions as women farmers. Demands have to be made keeping in mind that they have different problems as 'women farmers' due to lack of rights on land, lack of benefit from agricultural schemes, non-participation in the management of agriculture-water related institutions, the burden of housework along with agriculture and the restrictions placed on them due to the overall patriarchal system.

What women farmers need is institutional security. Their major needs are rights over resources and participation in decision-making processes in their management, provision of tenders, irrigation and credit to facilitate farming, market for their goods, guaranteed local purchase of their goods, promotion of sustainable agriculture, and availability of work in villages to avoid migration. By meeting their needs, it is necessary to create favorable conditions for them in the agricultural sector. Unless concrete measures are taken and implemented at the organizational level, the picture of women farmers as it is today will not change.

7. 8 EXERCISE

1. Explain the nature and implementation of Group Farming.
2. Write the various advantages of Group Farming.
3. State the various requirement of Group Farming .
4. Elaborate the contribution of Women in Agriculture sector.

7.9 REFERENCES

1) Bhise Pravin Shamsundar (Feb 2020): Need, Importance and Selective Materials Production for Agro Processing Industry, Unpublished Agricultural Science Degree Project, Y.C.M.M.V., Nashik

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8) ClearIAS Economics Notes

8

FOOD AND FRUIT PROCESSING INDUSTRY

Unit Structure :

8.1 OBJECTIVES

- To know the nature Group Farming.
- To know the advantages of Group Farming.
- To understand the requirement of Group Farming
- To study the contribution of Women in Agriculture Sector**.**

8. 2 INTRODUCTION

Agro industries are important in an agrarian country like India. Still 70 percent of India's population depends on agriculture. Approximately 67 percent of the population lives in rural area. For this, these agro processing industries are important to eliminate unemployment in rural areas. In a vast country like India, various climate based industries are found in different parts of the country. India is the world's leading producer of fruits and vegetables. Post-harvest management is very important in fruit marketing and includes grading, packing, pre-cooling, storage, processing, transportation and marketing. 1 Lakh Crores are being lost every year in our country due to errors in post-harvest management.

The rate of processing of agricultural commodities in India is 2 to 3 percent. While the same ratio is 40 percent in developed countries.

Agricultural processing is an important market service. Farmers get a better price (rate) if they process the produce and sell it instead of taking the raw material to the market for sale. From that point of view, agricultural industries are being given a big boost by giving subsidy (subsidy) to agricultural processing industries in India. Accordingly, agricultural processing industry should increase, agricultural production will double, employment will be available to workers, farmers' income will be helped to increase and farmers will get hopeful relief due to this, agricultural processing industries are important.

https://www.indiamart.com

8.3 DEFINITION

Agro-food and fruit processing industry means agro-processing industry.
What is agro-processing industry ? - Factories that process agricultural products or factories that use agricultural products as raw materials are called agro-processing industries. Sometimes industries that are complementary to agriculture are also included in agro-industries. Tawa, Rubber, Tea, Kalo, Cocoa are some of the agro-based industries.Jaggery, khandsari and sugar are produced using sugarcane. During the production of these goods, the 'waste' produced from it is used to produce secondary goods such as alcohol, paper, acetone, etc. Cooperative sugar mills have made a lot of progress in Maharashtra. In particular, the cooperative movement that creates equal opportunities for development and confidence of progress for the strong and the weak has spontaneously emerged in this industry.

8.4 SCOPE OF FOOD AND FRUIT PROCESSING INDUSTRY

India's current situation is favorable for agro-based industries. In European nations, a single crop is grown over a large area. Due to the state wise crop diversity in India, the availability of raw material for the processing industry in India is easy, so the farmer takes up the production of food grains with great determination and effort. Due to lack of post-harvest technology, 25 percent of agricultural produce is wasted every year, so adding processing industry to it will definitely reduce this amount and provide a new market for the farmers. Today, forest dwellers as well as

rural infrastructure have not been developed properly; many villages are still deprived of electricity, water, roads, that are why industrial businesses have not yet developed there. And hence employment opportunities are not available there. Agricultural materials are easily available in rural areas and we can start processing industries in small facilities. Through this we can provide employment to others along with us. Accordingly, the process industry sector is growing by 30 percent. Currently, various technologies are available for dehydration of vegetables. Similarly making pulp, juice, jam, squash etc. from fruits. Also, many options are available in agricultural processing such as making wafers, farsan, pickles, moram and marmalade. Similarly, soybean milk, milk powder, soy paneer, poha from rice, papad, and various processed products can be made from milk. As the lifestyle of Indian citizens is changing, ready to eat and ready to cook products are in demand. If entrepreneurs in the agro processing industry use packing techniques like vacuum U packing, nitrogen packing, retort pouch, flexi pack, tetra pack, Indian products can be sold worldwide. Also, processing industries should strictly follow food safety standards and WTO standards. A single farmer cannot become an entrepreneur due to small land holdings. For this, the farmers must jointly form a company through a group. If many people come together to set up a processing industry, the risks are reduced. If the farmers form a group and start the processing industry, it becomes more profitable in a cooperative manner.

Machinery and technology for processing industries is available through the Central Food Technological Research Institute (CFTRI).

8.4.1 Availability of fruits and agro-goods: Information about the climate of the area of the processing unit should be mentioned as to how it is suitable for the required agricultural produce. The goods proposed to be processed; Information should be given about the cultivated area under each crop, variety, total production, producer farmers, their average market price, if the purchase is to be made with guaranteed price, the exact market price. Apart from this mention should be made about the availability of other plants, preservative chemicals, food coloring, packing materials, labels required for the industry.

8.4.2 Availability of Capital: Before starting a processing industry, a large amount of financial provision is required, for which borrowing from government banks or co-operative financial institutions is the order of the day. Various loan schemes are available from central as well as state governments for educated unemployed for small scale industries.

There are many schemes of central and state governments for process industries. Also financial assistance, concessions are available through various schemes through various banks, NABARD to start processing industries.

NABARD provides financing for on-farm processing, grading, packing, cold storage houses for agricultural development, empowerment. NABARD is providing financial assistance to farmers, groups for study tours, training, capacity building.

Apart from agriculture, the government is implementing various schemes for the rural artisans for their business, product marketing.
Good credit schemes are also available through NABARD for group farming.70 to 80 percent loan of the project cost is definitely available from the banks if the required documents are completed.

8.4.3 Classification of Fruit and Vegetable Processing:

Mango: Pickle, Pane, Juice, Mango Powder, Pulp, Can Juice, Jam, Squash, Mango Flakes, Toffee.

Orange: Juice, soft drink.

Mosambi: Mosambi extract, acid, cosmetics from Mosambi bark.

Chikku : flakes, powder, milk shake, toffee, jam etc.

Pomegranate: Pomegranate, juice, powder, asthma and cough medicines, cosmetics.

Grapes: juice, currants, raisins, wine.

Papaya: Papain powder, Twoti Fruity.

Banana: wafers, powder.

Bor: Bor powder, Borkut, Alcohol

Lemon: juice, pickles, citric acid.

Jambhul: juice, syrup, jam, powder

Peru: powder, drink, jelly.

Potato: Wafers, finger chips, potato powder

Tomatoes: Purees, sauces, soups, powders

Drumstick: Seed powder, leaf powder, leaf juice, ben oil.

Onion: Onion Powder, Masala Powder, Masala Kanda.

Garlic: Garlic powder, garlic paste.

Okra: Okra powder

Chili: Chili powder, pickles, pickles.

Carrot: Carrot powder, vegetables etc.

Sitaphal: Powder, pulp, juice.

8.5 AGRO-PROCESSING INDUSTRY

8.5.1 fruit and vegetable Processing on the World level.

There are many countries that process fruits and vegetables in the world and among them the leading countries are Philippines 78 percent, Brazil 70 percent, America 65 percent, Malaysia 3 percent, and India 2 percent. Hence, the scope and importance of the agricultural processing industry in India is seen.

Table no. 1

Chart showing the status of the world's fruit and vegetable processing countries.

Sr No.	Country	%
1	Philippines	78
2	Brazil	70
3	America	65
4	Malaysia	3
5	India	2

(Source: Krishi Panan Mitra Magazine: June, 2019)

8.5.2 Agro-Processing Industry in India:

The scope of agro-processing industries is spread all over the world. In post-independence India, the scope of these industries is seen to have spread to semi-urban and rural areas. The number of agro-processing industries in India is 27,479 out of which the largest number of 6,313 (23 percent) industries is in Andhra Pradesh alone. Tamil Nadu has 4,000 (15 percent), Punjab has 2,285 (8 per cent) and Maharashtra agro-processing industry has 2,252 (7 per cent). This means that the industries of Maharashtra are seen to be backward today. While the production of fruits like bananas, mangoes, oranges, grapes, and pomegranates is increasing in Maharashtra, the lack of processing industries is causing the farmers to suffer. States like Andhra Pradesh have largely set up processing industries in the state due to the provision of concessions and infrastructure for this industry, but investors do not seem to be attracted to this industry due to lack of interest in creating an enabling environment for the processing industry. However, there is an urgent need for such industries for the rural development of India.

Table no. 2

Table showing number and percentage of agro processing industry in India.

Sr.No.	State Percentage	No. of Agro Processing Industries
1	Andhra Pradesh 23	6313
2	Tamil Nadu 15	4000
3	Punjab 8	2285
4	Maharashtra 7	2252

(Source: Krishi Panan Mitra Magazine: June, 2019)

Above table no. 2 shows the number and percentage of agro-processing industries in India. According to Krishi Panan Mitra, 2019 data, the total estimated number of agro-processing industries in India is 27,479.

It has become very necessary to give commercial status to agriculture through the agricultural processing industry. Agro-based processing industry can emerge only if agribusiness gets the concessions that are given to other industries. Due to this, good days will come for agriculture and it will contribute a lot for the overall development of Baliraja. So if a group of farmers come together and establish farmer production companies and start the processing industry, it will be more profitable in this way. If the agro-processing industry expands to rural areas on a large scale, the picture of the rural economy changes. In that sense, such industries are important. Raw materials, markets, customers and sales are the major factors for setting up an agricultural processing industry and for this it is necessary to study sales management and competitors in your field. Also marketing, advertising, and branding of farm produce is very important. Separate financial planning should be done for that. Also, farmers should take guidance from role models, techniques and experienced people in the business. Thus, proper planning will make it easy to set up an agro processing industry.

In our country, after harvesting, 25 percent of agricultural produce is destroyed or damaged due to technology. If this is supported by the agro processing industry, this will definitely decrease. In the current scenario, the Food Processing Industries (FPI) sector is witnessing rapid growth in the country. Around 31 lakh crores of rupees are being traded through this medium. By the year 2020, the turnover of agro-processed agricultural products is expected to reach approximately Rs 62 lakh crore, according to a private survey. Therefore, there will be huge demand for the agricultural processing industry in the future. There is no doubt about it.

Revolutions related to agricultural production and processing:-

1) Pink Revolution - Meat and Poultry Production.
2) Red Revolution - meat and tomato production.
3) Round Revolution - Potato Revolution.
4) Silver Fiber Revolution – Cotton Revolution.
5) Silver Revolution - Egg/Poultry Production.
6) White/White Revolution - Milk/Milk Production (Operation Flood).
7) Yellow Revolution - Production of Oilseeds.
8) Evergreen Revolution - Comprehensive development of agriculture.
9) Blue revolution - Fish production.
10) Brown Revolution - Leather / Cocoa Production.
11) Golden Fiber Revolution - Jute production.
12) Golden Revolution - Overall horticulture development/ honey production.
13) Green Revolution – Agriculture in general.

8.6 IMPORTANCE OF AGRO PROCESSING INDUSTRY

The agro processing industry is of unique importance in India as well as in Maharashtra. Because Maharashtra is known as an important agricultural state in India. Maharashtra produces a wide variety of agricultural products and this provides a large amount of raw material for processing. But there seems to be a shortage of processing industry. Due to this, the raw material from here is going abroad and the foreign entrepreneurs are increasing the income by five to ten times by producing various value added products from it. Due to this, the processing industry and the manufacturing of substances are of special importance.

In India, Mysore has done extensive research on food processing and agricultural production. This organization has proven that processing of fruits can produce various products.

Opportunities for agro processing industries:

1) India's position as a major food producer:- India ranks first in the production of milk, ginger, banana, guava, papaya, mango etc. India ranks second in the production of rice, wheat, potato, sugarcane, cashew nuts, tea etc. It is one of the top 5 countries in the production of coffee, tobacco, spices, seeds etc. With such a large raw material base, we can easily become the world's leading food supplier.

2) Resource advantage of India: - Different soil types and different climates for cultivation of different food crops, long coastline suitable for fishing, large source of domestic animals etc.

3) Employment generation:- More than 10 lakh new employment is expected to be created.

4) Prevention of Migration: - Provides employment in rural areas, thereby reducing migration from rural to urban areas. It is possible to solve the problems of urbanization.

5) Curb on food inflation: - Eliminates wastage or middle man problem. Food grains curb inflation. Indirect relief on non-food inflation as well.

6) Crop diversification: - Due to long shelf life, farmers can diversify their produce.

7) Demand Potential: - Expected to reach $250 billion by 2015 and $350 billion by 2020. A young population, middle class, rising incomes, nuclear families, access to mass media, etc. are considered positive factors.

8) Government initiatives to promote food processing:- Food processing has been promoted by various government initiatives like attracting FDI, reduction in excise duty etc.

9) Essential for Indian GDP growth: - Food processing production in the agriculture sector is about 10% of GDP. It has more potential.

By processing all the above fruits and vegetables, many types of by-products can be prepared. Moreover, there is a good demand for such items in the market. Food processing industry has huge scope and opportunity in rural areas. For this, agricultural universities, producers, manufacturers, food processing entrepreneurs, as well as expert professors and policy makers in the state of Maharashtra need to contribute. If India's rural economy is to be truly developed, the government's policy towards this agricultural processing industry should be generous. Moreover, decentralization of this agro-processing industry with emphasis on providing various facilities, concessions, infrastructure facilities, I feel that there will definitely be great expected changes in the rural economy of India and the state. That is why agro processing industry is an opportunity for farmers. Moreover, to save the farmers, to get them out of the economic crisis, building an agro-processing industry has become the need of the hour.

As the lifestyle of Indian citizens is changing, ready to eat and ready to cook products are in demand. If entrepreneurs in the agro processing industry use packing techniques like vacuum U packing, nitrogen packing, retortcher table pouch, flexi pack, tetra pack, Indian products can be sold world wide. Also, processing industries should strictly follow food safety standards and WTO standards. A single farmer cannot become an entrepreneur due to small land holdings. For this, the farmers must jointly form a company through a group. If many people come together to set up a processing industry, the risks are reduced. If the farmers form a group and

start the processing industry, it becomes more profitable in a cooperative manner.

8.6 OBSTACLES/ CHALLENGES FACED BY AGRO PROCESSING INDUSTRIES

1) Small size companies: Indian food processing companies are small and cannot compete with global multinationals that invest heavily.
2) Lack of good laboratories in India: High-quality standards are demanded for food exports. India lacks good laboratories for testing heavy metals and other toxic contaminants in food.
3) Lack of skilled manpower.
4) Lack of proper vision and lack of timely support from the government.
5) Lack of good transport facilities.
5) Lack of storage facilities and good production techniques.
6) Lack of organized retailing.
7) Constraints in supply chain.
8) Limitation in quality.
9) Lack of modern regulations.

8.8 EXERCISE

1. Define the termand scope of Group Farming in India.
2. Write various advantages of Group Farming.
3. Explain the contribution of Women in Agriculture Sector**.**

8.9 REFERENCES

1) Bhise Pravin Shamsundar (Feb 2020): Need, Importance and Selective Materials Production for Agro Processing Industry, Unpublished Agricultural Science Degree Project, Y.C.M.M.V., Nashik
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AGRICULTURE AND ITS SIGNIFICANCE IN RURAL DEVELOPMENT

Time 3.00 hrs Marks : 70

N. B. : 1. All questions are compulsory.

2. All questions carry equal marks.

Q.1 Explain the meaning of Green Revolution and explain its merits and demerits.

OR

Discuss the agricultural policies in the post Green Revolution era.

Q.2 Explain the role of Krishi Vigyan Kendra in rural development.

OR

Describe the structure and functions of the Department of Agriculture, Government of Maharashtra.

Q. 3 Define organic farming and explain its factors.

OR

Explain the concept of tissue culture and its importance.

Q.4 Explain the meaning of group farming and its importance.

OR

Explain the concept and importance of agro processing industry.

Q.5 Write short note any Two of the following.

a) Causes of Green Revolution

b) Functions of Indian Councial for Agricultural and Research

c) Certification of Organic Farming

d) Bacterial manure