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AGRO TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT OF RAINFED AND WATER SCARCE AREA

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India's total food production during 2020-21 is about 298.3 million tonnes. India attains self-sufficiency in food grain production, but still, we are importing some pulses as we are unable to meet the requirement of 25.5 million tonnes of pulses. The main reason for this is very less productivity in the agricultural field. About 58.5% of cultivated land is under rainfed farming. Increased productivity in this rainfed area makes India a self-sufficient country in food production. This can be achieved by applying novel agro-technologies like soil and water conservation techniques, alternative land use system, integrated approaches of crop management and drought management practices.

Agriculture is the primary source of livelihood in India, about 54.6 % of India's population engaged in agriculture and allied activities. Moreover, it accounts for 17.1 % of the countries gross value added for 2017-18. India's total geographical area is 328.7 m ha. Out of which, 140. 1 m ha is reported as Net sown area, and 198.4 m ha is the gross cultivated area. Out of 198.4 m ha, 115 m ha area is gross rainfed area. It is about 60% of gross cultivated area. And 83.4 m ha is gross irrigated area it accounts for only 40% of gross cultivated area. India stands first place among the rainfed agricultural countries of the world in terms of both extend and value of produce. The population of India is increased in geometric progression. In order to meet food security, productivity and production of the food grains should be elevated than the present production of 284.83 mt. But for increasing productivity, the main constraint is lack of irrigation facility. It is becoming a challenge for the government, Agricultural scientist and formers to increase the production at the water-scarce condition. Then new practice and technology should be a sustainable manner so that it should not hamper the existing nature in natural resources, and it should be available for future generations.

By utilising present practices and technology, our farmers are able to produce 281.37 mt of food grains. Out of which 114 mt of food grains are produced through rainfed

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agriculture, which feeds 44% of the Indian population. Still, agricultural scientists have huge scope to invent new agro technologies for increasing food production. Some types of crops like nutria cereals, pulses and oilseeds are grown majorly through the rainfed condition. Itis reported that 42.64 mt of nutria cereals, 31.50 mt of oilseeds and 24.02 mt of pulses are produced in 2018. Among them, most are grown in rainfed farming. By looking above statistics, it is possible to increase India's food production through the application of newly developed technologies and farmers income can be doubled at the time of 2022.

Strategies for sustained food production in rainfed region

Rainwater, land and crop management are prerequisites for improved crop production in rainfed farming. Our national food production can be increased by increasing the productivity of crop in the rainfed area, and this increased productivity can be achieved by practising the same strategies which are discussed below.

1. Soil and rainwater conservation techniques:

For successful dryland farming, efficient conservation of rainwater and soil is essential. Construction of contour bunds, graded bunds, grassy waterways is essential to prevent excess runoff water. And the construction of these structures depends on rainfall intensity, the texture of the soil and slope of the land. Application of proper watershed technologies like the construction of farm pond, rainwater harvesting, convey the excess runoff water to form a pond. Prevention of excess evapotranspiration by mulching, intercropping and mixed cropping is mandatory.

Borewell recharge: it is the concept of underground recharge by allowing an excessive run of water to the aquifer, so that water source in the underground is maintained for several years.

2. Timely sowing of crops and tillage practices:

Maintenance of proper soil moisture is necessary for good germination and proper crop stand establishment. This can be achieved by practising proper tillage practices. Medium and shallow tillage is practised for dust mulching, incorporation of FYM and phosphate fertilizers. Deep tillage is beneficial under alluvial and red soil for increasing water intake and holding capacity. Use of seed cum fertilizer drillers plays a vital role in rainfed farming, as it maintains the proper distance between seed and fertilizer placement and looked

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after soil cover over seeds and place the seeds and fertilizer at moisture zone so that proper germination and good crop establishment can be observed.

Timely sowing of crops helps in drought mitigation, and it helps in escaping pest, diseases and drought incidence.

Ex: terminal drought can be managed by early sowing and using short-duration varieties.

GPU-48 is short duration ragi variety complete is cropping period in 95-100 days.

3. Adaptation of improved varieties:

Use of drought-resistant crop varieties gives a stable production in rainfed farming. Formers should be aware of the use of drought-resistant high yielding varieties. And the use of hybrids in rainfed farming is not profitable, as it requires high nutrient and input supply for crop production and is not responsive to low water availability.

4. Use of efficient crop and cropping system:

Climate-resilient crops like neutri cereals are most suitable for rainfed farming. About 300 mm annual rainfall is sufficient for them to get a good yield. Moisture at germination and one or two life-saving irrigation or rainfall at seed setting is sufficient to reap good yield.

Based on the application of rainwater harvesting technology, soil depth, rainfall pattern, large rainfed areas can be put under intensive cropping system. That is, if annual rainfall is 750 mm with more than 30 weeks of effective growing season then double cropping can be effectively made.

Implementation of the mixed and intercropping system

In a rainfed area where annual rainfall is 500 to 700 mm mixed and intercropping should be employed to get higher returns to the farmers. Intercropping of cereals with legumes help in maintaining soil fertility, prevent moisture evaporation, helps in weed control, and effective land use can be made thereby legume supplement the yield of cereals.

Ex: sorghum + red gram, Pearl millet + Black gram, Maize + Soybean, Ragi + Red gram (8:1).

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The rainfed area receiving more than 800 mm rainfall can effectively be used for sequence cropping. In Bundelkhand region of Madhya Pradesh rice-wheat, rice-chickpea, Sorghum-chickpea, green gram- wheat sequence cropping is carried out.

5. Integrated approach of nutrient management:

Rainfed farming not only suffers from water scarcity but also suffer from nutrient deficiency. And hence the integrated approach to nutrient management is necessary. Intercropping of legumes with cereal crop gives 20 kg of N per hectare and providing green manure like gliricidia, Leucaena, Sesbania, Daincha fulfil 50% of nutrient requirement. Incorporation of FYM and biofertilizers and biocontrol agents like Azospirulum, Azotobacter, Trichoderma, and Pseudomonas with soil helps in maintaining good soil health. The recommended dosage of inorganic fertilizer should be applied at the time of sowing with the help of seed cum fertilizer driller helps incorrect placement of fertilizer and prevent nutrient losses and increases nutrient use efficiency.

6. Alternate land-use system:

Due to the current weather condition, rainfed farming suffers from instability in production and farm income. To provide stability in the farm income alternate land-use system and use of marginal land for production of fuelwood, fodder and fibre should be implemented. For this integrating annual crops with a perennial component in order to utilise the off seasonal rainfall. This includes Agri-silviculture, Silvi-pasture, Agri-horticulture, Alley cropping etc. By using this livestock like sheep and goat rearing can be practised which supplement the form of income.

7. Agronomic practices for rainfed farming:

Practising of seed hardening process before sowing will help in good germination and proper crop establishment and gives resistant to crop against drought. Process of seed hardening can be done by soaking the seeds in water for 12 hours, followed by sun-drying for1 day then they are subjected to seed treatment and sowing.

Mulching should be done after sowing helps to prevent evaporation and weeds. Intercropping of legumes with cereals acts as mulching material. Shallow ploughing with cultivator while sowing act as dust mulching prevents excessive water loss from soil.

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8. Drought management:

Drought can be defined based on meteorological, agricultural and hydrological criteria. When average seasonal rainfall in a region is less than 75% of the normal is called meteorological drought. If extended dry period results in insufficient moisture in the root zone of soil causing an adverse effect on crop such drought is known as agricultural drought. Hydrological drought is an extended dry period leading to substantial depletion of water sources.

Alternate crops for a different period of sowing that match the delay in sowing have been recommended to mitigate the effect of drought. Creating soil mulches, and minimizing weed population reduce evaporative loses, which extend the life of standing crops under drought. Mitigation of Agricultural drought is possible to some extent through alternate crop strategy, reduction in evaporative losses and better crop husbandry. Harvesting and storage of more rainwater in situ and in tanks can help in mitigation of droughts. Lifesaving irrigation from stored water under drought condition can save rainfed crops.

Conclusion

In India about 60% of cultivated land is comes under rainfed farming and Indians production can be increased by increasing the productivity of the rainfed area. This can be achieved by proper drought management practices, agronomic practices, rainwater harvesting, prevention of excess runoff water, borewell recharge, proper watershed management, use of climate-resilient crops like millets or nutria cereals, integrated nutrient management and integrated farming system. By proper application of these technologies helps in minimizing the constraints of rainfed farming.

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