

WATER RESOURCE MANAGEMENT



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NABARD GRADE A**

Water Resource Management for NABARD

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Crop Water Requirement

Crop-water requirement, often referred to as crop water demand or evapotranspiration, is a critical concept in agriculture and irrigation management. It represents the amount of water that a specific crop needs to grow and produce effectively during its entire growth cycle. This requirement varies based on several factors, including the type of crop, stage of growth, local climate, and soil conditions. Understanding crop-water requirements is crucial for sustainable and efficient water resource management in agriculture.

Components of Crop Water Requirement

Crop-water requirement primarily consists of two components:

1. **Evaporation (E):** Evaporation is the process by which water is lost from the soil surface due to direct exposure to sunlight and heat. It occurs when water turns into vapor and rises into the atmosphere. Evaporation depends on environmental factors such as temperature, humidity, wind speed, and solar radiation. It is a significant contributor to the overall water demand in agriculture.
2. **Transpiration (T):** Transpiration is the process by which plants release water vapor through tiny openings in their leaves called stomata. This loss of water vapor helps plants cool themselves and facilitates the uptake of essential nutrients from the soil. Transpiration rates are influenced by factors like plant type, leaf surface area, and the availability of water in the soil.

The sum of evaporation and transpiration gives the total crop-water requirement or evapotranspiration (ET). This value is typically expressed in units of millimeters (mm) of water depth per unit of time (e.g., mm per day or mm per month) or in terms of a depth of water required over the entire growing season.

Crop-water requirements can vary significantly among different crops and growth stages. Crops with large leaf surfaces, like rice or maize, tend to have higher transpiration rates, while those with smaller leaves, like wheat or barley, may have lower rates. Additionally, the climate and weather conditions in a region play a crucial role in determining the daily and seasonal fluctuations in crop-water requirements.

Farmers and water resource managers use information about crop-water requirements to make informed decisions regarding irrigation scheduling and water allocation. Properly estimating and managing crop-water requirements can help optimize water use, improve crop yields, reduce water wastage, and mitigate the environmental impact of irrigation practices.

Overall, Crop-water requirement represents the total amount of water, including both evaporation and transpiration, that a specific crop needs for optimal growth and productivity. It is a fundamental concept in agricultural water management, guiding decisions related to irrigation and sustainable water resource utilization.

Water Resource Management for NABARD

Grade A

Command Area Development

Command Area Development (CAD) is a concept and approach in the field of irrigation and water resource management, primarily applied in the context of agriculture and rural development. It involves the systematic planning and development of the command area or the land served by an irrigation project, with the aim of maximizing agricultural productivity and improving the socio-economic conditions of the people living in that area. Here is an explanation of the key aspects of Command Area Development:

1. **Irrigation Infrastructure:** CAD starts with the creation and maintenance of irrigation infrastructure, such as canals, reservoirs, and dams, which are designed to divert and store water from rivers or other water sources. These structures are essential for providing a reliable and controlled water supply to the agricultural lands within the command area.
2. **Land Development:** In addition to water supply, CAD emphasizes the proper development of the agricultural land itself. This includes activities like land leveling, drainage, and soil improvement to optimize land use and crop yields. The goal is to ensure that the land is in the best possible condition for cultivation.
3. **Water Management:** Effective water management is a cornerstone of CAD. It involves the allocation of water resources among different users within the command area, ensuring that each farmer receives an equitable share of water. Water management also includes efficient water distribution systems and techniques like drip irrigation to minimize water wastage.
4. **Crop Planning and Management:** CAD involves the promotion of crop planning and management practices that are suitable for the specific agro-climatic conditions of the area. This includes recommending crop rotations, selecting appropriate crop varieties, and providing guidance on planting and harvesting times.
5. **Infrastructure for Rural Development:** Beyond agriculture, CAD also aims to improve the overall rural infrastructure in the command area. This may include the construction of roads, schools, health centers, and other essential facilities that contribute to the well-being of the local population.
6. **Social and Economic Upliftment:** CAD programs often include components focused on the socio-economic development of the people in the command area. This can involve providing training and support for income-generating activities, promoting women's participation in agriculture, and addressing issues related to poverty alleviation and livelihood improvement.
7. **Community Participation:** Successful CAD programs often involve active participation and collaboration with local communities and farmers. Their involvement in decision-making processes and the implementation of development activities is crucial for the sustainable success of the program.
8. **Monitoring and Evaluation:** Continuous monitoring and evaluation of the CAD program's progress and outcomes are essential to identify any issues or areas that need improvement. This feedback loop helps in making necessary adjustments and ensuring the program's effectiveness.

Command Area Development is a holistic approach that combines irrigation infrastructure development, land improvement, water management, agricultural practices, and rural development efforts to enhance agricultural productivity and the overall socio-economic conditions of the people living in the command area. It is a multi-dimensional strategy that aims to create sustainable and inclusive growth in rural areas heavily reliant on agriculture.

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Grade A

Water Conservation Techniques

Water conservation techniques are essential to efficiently manage and utilize water resources for agricultural purposes. These techniques help minimize water wastage, improve crop yields, and reduce the environmental impact of irrigation practices. Here are several genuine water conservation techniques used in irrigation:

1. **Drip Irrigation:** Drip irrigation is a highly efficient technique that delivers water directly to the root zone of plants through a network of pipes, tubes, and emitters. It minimizes water loss due to evaporation and surface runoff, as water is applied precisely where it's needed.
2. **Sprinkler Irrigation:** Sprinkler irrigation involves spraying water over the crops in the form of droplets. This method can be adjusted to match the specific water requirements of different crops and reduce water wastage compared to surface irrigation methods.
3. **Subsurface Drip Irrigation (SDI):** SDI is a variation of drip irrigation where water is delivered below the soil surface directly to the root zone of plants. It reduces surface evaporation and eliminates water contact with leaves, minimizing disease risk.
4. **Precision Irrigation:** Precision irrigation utilizes technology, such as soil moisture sensors and weather data, to precisely schedule irrigation events. This ensures that crops receive the right amount of water at the right time, reducing water waste.
5. **Rainwater Harvesting:** Collecting and storing rainwater for irrigation purposes can significantly reduce reliance on groundwater or surface water sources. Rainwater harvesting systems can be as simple as rain barrels or more complex with storage tanks and filtration systems.
6. **Canal Lining:** Lining canals and irrigation ditches with impermeable materials, such as concrete or synthetic liners, reduces water seepage into the ground, ensuring more water reaches the intended fields.
7. **Furrow Irrigation Management:** Implementing efficient furrow irrigation techniques, such as leveling fields and using check basins, can reduce water runoff and improve water distribution within the furrows.
8. **Variable Rate Irrigation (VRI):** VRI systems use GPS technology to vary the rate of irrigation application across a field based on soil type, topography, and crop needs. This maximizes water use efficiency and minimizes over-irrigation.
9. **Crop Selection and Rotation:** Choosing drought-tolerant crop varieties and practicing crop rotation can help optimize water use, as different crops have varying water requirements.
10. **Mulching:** Applying organic or synthetic mulch to the soil's surface helps reduce evaporation, maintain soil moisture, and suppress weed growth, allowing for more efficient water use.
11. **Implementing Water-Efficient Technologies:** Using water-efficient pumps, filters, and irrigation equipment can further improve water conservation in irrigation systems.
12. **Monitoring and Maintenance:** Regularly inspecting and maintaining irrigation infrastructure helps identify and repair leaks or other issues that could lead to water wastage.
13. **Education and Training:** Providing education and training to farmers on efficient irrigation practices and water management techniques is crucial for sustainable water conservation.

These water conservation techniques play a vital role in addressing water scarcity concerns, improving agricultural sustainability, and ensuring that water resources are used efficiently in irrigation without causing undue harm to the environment.

Water Resource Management for NABARD

Grade A

Micro Irrigation

Micro irrigation, also known as drip irrigation or trickle irrigation, is an irrigation method that delivers water directly to the root zone of individual plants or crops in small, controlled amounts. This irrigation technique is designed to efficiently manage water resources by minimizing wastage and maximizing the utilization of water for agricultural or horticultural purposes. Unlike traditional irrigation methods like surface or furrow irrigation, which apply water broadly across a field, micro irrigation targets specific areas around the plant's root zone.

Key Components of Micro Irrigation

The key components of a micro irrigation system typically include:

1. **Emitters or Drippers:** These are small devices that control the flow of water and release it in a slow, consistent manner directly to the base of each plant. Emitters are placed along a network of tubes or pipes.
2. **Tubing or Pipes:** These transport water from the source to the emitters. The tubing can be made of various materials, including plastic or PVC, and is typically buried beneath the soil or laid on the surface.
3. **Filters:** Micro irrigation systems are equipped with filters to remove particles, debris, and sediment from the water supply, preventing clogs in the emitters.
4. **Pressure Regulators:** These components ensure that the water pressure in the system is consistent, which helps maintain uniform water distribution.
5. **Valves and Control Devices:** Micro irrigation systems often include valves, timers, and control units to manage the timing and frequency of water application.
6. **Main Water Supply:** This is the source of water for the entire irrigation system, which can be a well, reservoir, or municipal water supply.

Types of Micro Irrigation

Micro irrigation systems can be further classified into two main types:

1. **Drip Irrigation:** In drip irrigation, water is delivered drop by drop through emitters directly to the root zone of individual plants or along rows of crops. This method is highly precise and efficient, making it suitable for a wide range of crops, including fruit trees, vegetables, and ornamental plants.
2. **Sprinkler Irrigation:** Sprinkler irrigation, while not as precise as drip irrigation, involves the use of small nozzles or sprinklers that spray water over the crop canopy. It is often used for larger-scale agriculture and is suitable for crops like grains, grasses, and field crops.

Micro irrigation offers several advantages, including water conservation, reduced weed growth, minimized soil erosion, and improved nutrient management. Additionally, it can be automated, reducing the need for manual labor in the irrigation process. By directly targeting the root zone of plants, it optimizes water use and contributes to sustainable agricultural practices while potentially increasing crop yields.

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