01. DEVELOPMENT OF IRRIGATION IN INDIA - WATER RESOURCES, IRRIGATION POTENTIAL AND IRRIGATION SYSTEMS OF INDIA AND TAMIL NADU

IMPORTANCE OF IRRIGATION MANAGEMENT

Irrigation

Simply, irrigation can be stated as application of water to the soil for crop growth and development. The application of water to plants is made naturally through rainfall and artificially through irrigation.

Irrigation is defined as the artificial application of water to the soil for the purpose of crop growth or crop production in supplement to rainfall and ground water contribution.

Management

Regulating, the activities based on the various resources for its efficient use and better out put. i.e., allocation of all the resources for maximum benefit and to achieve the objectives, without eroding the environment is called management. Otherwise it can be stated as planning, executing, monitoring, evaluating and re-organizing the whole activities to achieve the target.

Irrigation Management

Management of water based on the soil and crop environment to obtain better yield by efficient use of water without any damage to the environment.

Management of water, soil, plants, irrigation structure, irrigation reservoirs, environment, social setup and it's inter liked relationship are studied in the irrigation management.

For this we have to study

- The soil physical and chemical properties
- Biology of crop plants
- Quantity of water available
- Time of application of water

- Method of application of water
- Climatological or meteorological influence on irrigation and
- Environment and its changes due to irrigation

Management of all the above said factors constitute **Irrigation Agronomy**: Management of irrigation structures, conveyances, reservoirs constitute **Irrigation Engineering**; and social setup, activities, standard of living, irrigation policies, irrigation association and farmer's participation, cost of irrigation etc., constitute **Socio-economic** study.

Except Economics and Engineering all the other components are grouped under Agronomy. Sociology has a major role in irrigation management in a large system. Hence Engineering, Economics, Social science and Agronomy are the major faculties come under Irrigation Management.

Irrigation management is a complex process of art and science involving application of water from source to crop field. The source may be a river or a well or a canal or a tank or a lake or a pond.

Maintaining the irrigation channels without leakage and weed infestation, applying water to field by putting some local check structure like field inlet and boundaries for the area to be irrigated etc., need some skill. These practices are the art involving practices in irrigation management.

Time of irrigation and quantity of water to be applied (when to irrigate? and how much to irrigate?) based on soil types, climatic parameters, crop, varieties, growth stages, season, quality of water, uptake pattern of water by plants, etc., and method of application (How best to irrigate) includes conveyance of water without seepage and percolation losses and water movement in soil, are the process involving scientific irrigation management.

Simply, it is a systematic approach of art and science involved in soil, plant and water by proper management of the resources (soil, plant and water) to achieve the goal of crop production.

Importance of Irrigation management

Water is essential not only to meet agricultural needs but also for industrial purposes, power generation, live stock maintenance, rural and domestic needs etc. But the resource is limited and cannot be created as we require. Hence irrigation management it very important:

- To the development of nation through proper management of water resources for the purpose of crop production and other activities such as industrialization, power generation etc., which in turn provides employment opportunities and good living condition of the people.
- To store the regulate the water resources for further use or non-season use
- To allocate the water with proper proportion based on area and crop under cultivation. (Balanced equity in distribution)
- To convey the water without much loss through percolation and seepage (Efficiency in use)
- To apply sufficient quantity to field crops. (Optimization of use)
- To utilize the water considering cost-benefit (Economically viable management)
- To distribute the available water without any social problem (Judicial distribution)
- To meet the future requirement for other purposes like domestic use of individual and to protect against famine (Resource conservation).
- To protect the environment from over use or misuse of water (Environment safe use).

Impact of excess and insufficient irrigation water in crops

Avoid excess or insufficient water to the crops

Excess irrigation leads to wastage of large amount of water, leaching of plant nutrients, destruction of beneficial microbes, increase of expenses on drainage, accumulation of salt leading to salinity and alkalinity, water logging leading to physiological stress and yield loss or crop failure.

Insufficient irrigation leads to reduction in quality of food grains, loss in crop yield or crop failure, poor soil environment etc.

Water becomes a limiting resource due to the multi-various demand from sectors like agriculture, livestock, industries, power generation and increased urban and rural domestic use. The increasing population increases the needs of industrial complexes and urbanization to meet the basic requirement and also to provide employment opportunities. So the demand for water is increasing day by day and hence, it is essential to study water potential and its contribution to agriculture which is turn is going to feed the growing population.

Sources of water

Rainfall is the ultimate source of all kind of water. Based on its sources of availability it can be classified as surface water and subsurface water.

Surface water includes precipitation (including rainfall and dew) water available from river, tank, pond; Lake Etc., Besides, snowfall could able to contribute some quantity of water in heavy snowfall area like Jammu, Kashmir and Himalaya regin.

Subsurface water includes subsurface water contribution, underground water, well water etc.

Rain fall

Seasons of rainfall can be classified s follows

1. Winter (Cold dry period	-	January – February
2. Summer (Hot weather period	-	March – May
3. Kharif (South-West monsoon)	-	June – September
4. Rabi (North-East monsoon)	-	October – December

South-west monsoon

It comprises the month June, July, August and September which contributes about 70% of rainfall to India except for extreme North of Jammu and Kashmir and extremes South of Tamil Nadu. Hence the success of agriculture in India depends on timely onset, adequate amount and even distribution of this South West Monsoon (SWM). This season is also called as Kharif season.

North East monsoon

It comprises the months of October, November and December. North East Monsoon (NEM) contributed rainfall to South Eastern part of peninsular India Tamil Nadu receives its 60% of rainfall from NEM (North East Monsoon). This season is also called as Rabi season.

Winter

It comprises of the month of January and February. It contributes very little rainfall.

Summer

Comprises of the months of March, April and May and contributes little summer showers.

Characteristics of good rainfall

1. Quantity should be sufficient to replace the moisture depleted from the root zone.
2. Frequency should be so as to maintain the crop without any water stress before it starts to wilt.
3. Intensity should be low enough to suit the soil absorption capacity.

Indian rainfall does not have the above good characteristics to maintain the crop through rainfall alone.

Characteristic features of Indian rainfall

- Annual Average rainfall is 1190 mm
- There is wide variation in the quantity of rainfall received from place to place. Highly erratic, undependable, variation in seasonal rainfall either in excess or deficit are the nature of Indian rainfall. For example a place in Rajasthan receives practically nil rainfall at the same time Chirapunji about 3000 mm rainfall.
- Rainfall is not uniformly distributed throughout the year. It is seasonal, major quantity is in the South West Monsoon, (SWM alone contributing 70% of total rainfall) i.e. in the month of June to September followed by North East Monsoon (NEM) from October to December. It summer and winter the amount of rainfall is very little.

- With in the season also the distribution is not uniform. A sudden heavy downpour followed by dry spell for a long period is common occurrence.
- Rainfall distribution over a large number of days is more effective than heavy down pour in a short period, but it is in negative trend in India
- Late starting of seasonal monsoon
- Early withdrawal of monsoon and
- Liability to failure are the freakish behaviour of Indian rainfall. Timely and uniform distribution of rainfall is important for better crop planning and to sustain crop production.

IRRIGATION – HISTORY AND STATISTICS

Irrigation has been practiced since time immemorial, nobody knows when it was started but evidences say that it is the foundation for all civilization since great civilization were started in the river basins of Sind and Nile.

This civilization came to an end when the irrigation system failed to maintain crop production.

There are some evidences that during the Vedic period (400 B.C) people used to irrigate their crops with dug well water. Irrigation was gradually developed and extended during the Hindus, Muslims and British periods.

The Grand Anaicat (KALLANAI) constructed across the river Cauvery is an outstanding example for the irrigation work by a Chola king the great Karikala Cholan during second century. The Veeranarayanan Tank and Gangai Konda Cholapuram tank was constructed during 10^{th} century in TN. Anantaraja Sagar in AP was constructed during 13th century.

Early Mauryan king Samudragupta and Ashoka took great interest in the construction of wells and tanks. Later Moghul kings or North India and Hindu kings of South India focused their attention, in the establishment of canals, dams, tanks etc. British Government initiated their work during 19th century in remodeling and renovation of the existing irrigation system. The Upper Ganga canal, Krishna and

Godaveri delta system, Mettur and Periyar dams are the great irrigation structures built by the British rulers. After independence, Irrigation activities have been accelerated and number of multipurpose river valley projects like Bhakrea-nangal in Punjab, Tungabhadra in Andraprdesh, Damodar Valley in Madya Pradesh were established.

Irrigation Development during five year plans

In 1950 – 51 the gross irrigated area was 22.5 million ha. After completion of 1 five year plan the gross irrigated area was enlarged to 26.2 million ha. Further it was gradually increased to 29, 35.5, 44.2, 53.5; 75 million has respectively over the II, III, IV, V, VI & VII five years plans. The expected increase through VIII and IX five year plans area 95 and 105 m ha respectively.

Classification of irrigation work or projects

The irrigation projects can be classified as 1. major 2. medium 3. minor based on financial limits or expenditure involved in the scheme.

1. Major – more than 50 million Rupees : It covers cultural command area of more than 10,000 hectares
2. Medium – 2.5 million to 50 million Rupees : It covers cultural command area of 2000 – 10,000 hectares
3. Minor – less than 2.5 million Rupees : It covers cultural command area of 2,000 hectares.

The minor irrigation work consists of irrigation tanks, canals and diversion work for the welfare of small of farmers.

Indian has may perennial and seasonal rivers which flow from outside and within the country. Among this some important rivers of different states are given below.

Important irrigation projects in India

State	Project Name
A.P.	Godavari delta system, Krishna delta system, Nagarjuna sagar (Krishna)
Bihar	Gandala

Punjab	Western Jamuna, Bhakranangal Sutlej, Beas
Gujarat	Kakrapare – Tapti Narmada
M.P.	Gandhi sagar (Chambal, Ranap setab, sagar
Maharastra	Bhima Jayakwadi (Godavari)
Kerala	Kalada, Mullai Periyar
Karnataka	Ghataprabha, Malaprapha and Turga
Orissa	Hirkand and mahanathi
U.P	Upper ganga canal, Ramaganga
W.B	Damodar Valley
Rajasthan	Rajasthan Canal (Sutlej)
Tamil Nadu	Mettur – Lower Bhavani Project
	Parambikulam Alliyar Project
	Periyar Vaigai, Cauvery delta
	Tamiarabarani, Other river basins in TN is given in Map

India's water budget

Total geographical area = 328M.ha.

Average annual rainfall = 1190mm

In million hectare metre = 1190 x 328 = 392 M ha m

Contribution from snowfall = 8 M ha m

Total = 400 m ha m.

The rainfall below 2.5 mm is not considered for water budgeting, since it will immediately evaporate from surface soil without any contribution to surface water or ground water.

When rainfall occurs, a portion of it immediately evaporates from the ground or transpires from vegetation, a portion infiltrates into the soil and the rest flows over surface as run off.

There are on an average 130 rainy days in a year in the country out of which the rain during 75 days considered as effective rain. The remaining 55 days are very light and shallow which evaporates immediately without any contribution to surface or ground water recharge. Considering all these factors it is estimated that out of 400 million

hectare meter of annual rainfall 70 million hectare meter is lost to atmosphere through evaporation and transpiration, about 115 million hectare meter flows as surface run-off and remaining 215 million hectare meter soaks or infiltrates into the soil profile

Surface run-off

Surface run off consists of direct run off from rainfall, melting of snowfall and flow in streams generated from ground water. Total surface run-off has been estimated by Irrigation Commission of India in 1972 as follows.

a) Total surface run off	180 M ha m
b) Rain fall contribution	115 M ha m
c) Contribution from outside the country through steams and rivers	20 M ha m
d) Contribution from regeneration from ground water in Stream and rivers	45 M ha m
Total	180 M ha m

Disposal of surface run off

The surface runoff is disposed in three ways

1. Stored in reservoirs
2. Disappears by means of percolation, seepage and evaporation
3. Goes to sea as waste

The waster stored in reservoirs is lost through evaporation and some amount through seepage. The rest in utilized for various purposes mainly for irrigation and drinking water.

Total surface run off	= 180 M ha m
Stored in reservoir and tanks	= 15 M ha m
Flow in the river	= 165 M ha m
Utilization from the river by diversion tank and direct pumping	= 15 M ha m
Water goes to sea as waste	= 150 M ha m
On full development work expected utilization	= 45 M ha m
Water flows to sea	= 105 M ha m

Land utilization pattern of India

Total geographical area	= 328.00 M ha
Net area reported	= 307.47 M ha
Area under forest	= 65.90 M ha
Area under non agricultural use, barren and uncultivable waste	= 100. 45 M ha
Net Area sown	= 141.12 M ha
Net area irrigated	= 31.20 M ha
Gross area sown	= 164.00 M ha
Gross area irrigated	= 80.50 M ha

Land utilization pattern in Tamil Nadu

Total geographical area	= 13.00 M ha
Area under forest	= 2.00 M ha
Non agricultural area	= 1.40 M ha
Barren and uncultivated	= 0.80 M ha
Pastures	= 0.20 M ha
Tree	= 0.20 M ha
Culturable waste	= 0.50 M ha
Culturable fallow	= 0.90 M ha
Other fallow	= 0.50 M ha
Gross area under cultivation	= 7.30 M ha
Net area sown	= 6.30 M ha
Gross area irrigated	= 3.50 M ha
Net area irrigated	= 2.70 M ha

Tamil Nadu Ground Water Potential

Average rainfall	= 850 mm
Ground water potential	= 36872 Mm^3
G. water utilization	= 19,801 Mm^3

Unutilized = 46.3%

Percentage of area depends upon ground water in various parts of Tami Nadu

Salem = 83%

Dharmapuri = 65.3%

Coimbatore = 51.3%

Madurai = 45.1%

Trichy = 34.9%

Tirunelveli = 35.0%

Water Resources in India and Tamil Nadu

Distribution of irrigated area in '000 hectares

	Canal	Tanks	Wells	Other
India	12,776	4,123	12,034	2,601
Tamil Nadu	931	924	820	35

World Irrigation Statistics

Sl.No.	Countries	Area irrigated in million hectares
1	Australia	1.150
2	Botswana	0.002
3	Brazil	0.141
4	Burma	0.753
5	Canada	0.627
6	Ethiopia	0.030
7	France	2.600
8	India	37.640
9	Indonesia	3.797
10	Iran	4.000
11	Iraq	3.107
12	Israel	0.153
13	Japan	3.390
14	Pakistan	11.970

15	USSR	9.900
16	USA	16.932
17	China	74.000