APPENDIX – I
CONCEPT AND DEFINITION

1. DEFINITIONS

Culturable Command Area (CCA):
The area which can be irrigated from a scheme and is fit for cultivation.

Gross Irrigated Area:
The area irrigated under various crops during a year, counting the area irrigated under more than one crop during the same year as many times as the number of crops grown and irrigated.

Irrigation Potential Created:
The total gross area proposed to be irrigated under different crops during a year by a scheme. The area proposed to be irrigated under more than one crop during the same year is counted as many times as the number of crops grown and irrigated.

Irrigation Potential Utilised:
The gross area actually irrigated during reference year out of the gross proposed area to be irrigated by the scheme during the year.

Minor Irrigation (M.I.) Scheme:
A scheme having CCA up to 2,000 hectares individually is classified as minor irrigation scheme.

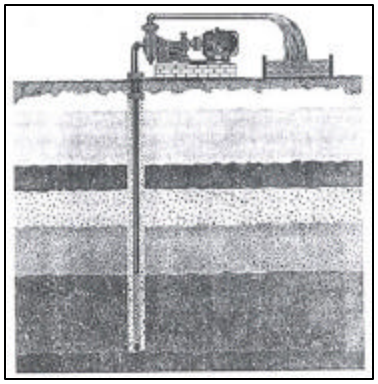
Medium Irrigation Scheme:
A scheme having CCA more than 2,000 hectares and up to 10,000 hectares individually is a medium irrigation scheme.

Major Irrigation Scheme:
A scheme having CCA more than 10,000 hectares is major irrigation scheme.

2. TYPES OF M. I. SCHEMES

Dug-well:
It covers ordinary open wells of varying dimension dug or sunk from the ground surface into water bearing stratum to extract water for irrigation purposes. These are broadly masonry wells, kuchcha wells and dug-cum-bore wells. All such schemes are of private nature belonging to individual cultivator.

Shallow tube-well:



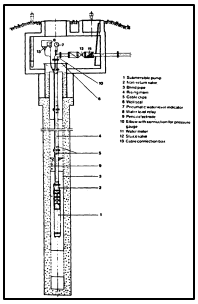
It consists of a bore hole built into ground with the purpose of tapping ground water from porous zones. In sedimentary formations depth of a shallow tube well does not exceed 60-70 metres. These tube wells are either cavity tube-wells or strainer tube-wells. These are usually drilled by percussion

method using hand boring sets and sometimes percussion rigs. Success and popularity of the scheme depends on how cheap they are. Coir structures formed by binding coir strings over an iron frame are being used as strainer. In shallow water table areas, bamboo frames are also used. Sometimes steel pipe casing are replaced by pipes constructed by rapping bituminised gunny bags over the bamboo frame. These are called bore wells, in which bore-hole is stable without a lining in the bottom portion and a tube is inserted only in the upper zone. The tube wells are generally operated for 6 to 8 hours during irrigation season and give yield of 100-300 cubic metre per day, which is roughly 2 to 3 times that of a dug well.


BOREWELL

Deep tube wells:

It usually extends to the depth of 100 metre and more and is designed to give a discharge of 100 to 200 cubic meter per hour. The deep tubewell are drilled by rotary percussion or rotary cum percussion rigs. These tube wells operate round the clock during the irrigation season, depending upon the availability of power. Their annual out put is roughly 15 times that of an average shallow tube well and are usually constructed as public scheme which are owned and operated by government departments or corporations.



Surface flow irrigation scheme:

These schemes use rainwater for irrigation purposes either by storing it or by diverting it from a stream, nala or river. Some times, permanent diversions are constructed for utilising the flowing water of a stream or river. Temporary diversions are also constructed in many areas which are usually washed away during the rainy season. The small storage tanks are called ponds or bundhis which are mostly community owned. The command areas of such schemes are 20 hectares or less. The large storage tanks whose command varies from 20 to 2000 hectares are generally constructed by government departments or local bodies. These are the biggest items of surface minor irrigation works.

Storage schemes

Storage schemes include tanks and reservoirs which impound water of streams and rivers for irrigation purposes. After wells, tanks occupy a very important place under the minor irrigation programme. They provide nearly two-third of the total irrigation from minor sources in the states of Andhra Pradesh, Karnataka, Kerala, Maharashtra, Orissa and Tamilnadu. Tracts with undulating topography and rocky sub-strata are eminently suitable for tank irrigation. Besides, there exists scope for further construction of tanks in many areas. A large number of existing tanks in southern States have gone into disuse due to long neglect of repairs.

Renovation of these tanks so as to restore the lost irrigation potential is being accorded priority under the minor irrigation programme.

The essential features of these schemes are (i) a bund or a dam which is generally of earth, but is also sometimes partly or fully masonry, (ii) anicut and feeder channels to divert water from adjoining catchments, (iii) a waste weir to

dispose of surplus flood water, (iv) sluice or sluices to let out water for irrigation, and (v) conveyance and distribution system. The size of the storage is determined by the run-off expected on the basis of dependable monsoon rainfall in the catchment and by the fact whether the rainfall and cropping pattern would permit more than one filling of the tank. The best and direct method to calculate the runoff would be to gauge the stream flow at the proposed site for a number of years. However, as the observed data over a long number of years is normally not available, the run-off is computed on the basis of empirical formula found applicable from past experience for the region. When tanks are constructed in a series by bunding up the same valley at several points, some spill-over yield from the bunded catchment is also accounted for. In the gross storage provided some percentage provision is allowed for dead storage to be consumed by silting in course of time.

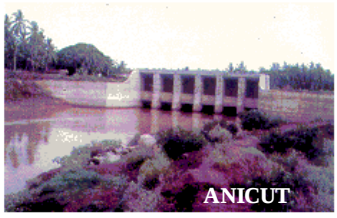
The irrigable command of the scheme is fixed on the basis of certain standard duties in terms of crop area irrigated per unit of water. The proposed cropping pattern is decided on the basis of past experience in the region. The flood discharge to be escaped over a waste weir is computed by empirical formula which from experience is found to generally hold good for the region. The design of the various component parts of the tank usually requires specialised engineering knowledge.

The tanks fail mainly due to two reasons: (i) silting of bed, and (ii) breach due to inadequate surplussing arrangement or bad maintenance of the bund. Renovation of derelict tanks so as to restore the lost irrigation potential is being accorded priority under the minor irrigation programme. The work of restoration generally consists of (i) strengthening or raising of bund, (ii) improving the surplussing capacity and (iii) occasional de-silting of bed. De-silting is costly but in some cases this is being rendered economical by utililsing the excavated earth for reclaiming part of the previously submerged land. The work of restoration is usually carried out by the State Public Works Department. After renovation, irrigation works below a specified acreage are handed over to the panchayats for maintenance. Works having higher irrigation capacity are maintained by the Public Works Department. The new works are usually taken up as State works by the State Public Works Department.

Diversion schemes

These schemes aim at providing gravity flow irrigation by mere diversion of stream water supply without creating any storage. As compared to storage schemes they are economical but their feasibility is dependent on the presence of flow in the stream at the time of actual irrigation requirements. Essentially such schemes consist of (i) an

obstruction (weir) or bund constructed across the stream for raising and diverting water; the weir being called anicut in the South,



ANICUT

BHANADARAS

These are check dams or diversion weirs built across rivers. A traditional system found in Maharashtra, their presence raises the water level of the rivers so that it begins to flow into channels. They are also used to impound water and form a large reservoir

bandhara in Maharashtra and Gujarat, and thingal in the Assam region, and (ii) an artificial channel, known as kul in the hilly areas, pyne in Chhota Nagpur and Bihar and dong and ilhowkong in the Assam region. In case of small schemes which have prominent scope in the hilly tracts and foot hill plains, the water is usually diverted by constructing temporary bunds across the streams, made up of earth, stones or even bamboos. The discharge handled being of small order, the bund on the head of the channel is not provided with any gated structure for controlling and regulating the flow. Construction of work, is, therefore, simple and cheap and can be handled to a large extent by the people themselves. However, these constructions being temporary, require frequent renovation. The bunds are liable to be washed away by every major flood. The channels also get silted up and scoured frequently. It is essential that whenever such schemes aim at diverting higher discharges, say more than 5 to 10 cusecs, or tackle streams having high intensity of flood discharge, proper regulation structures equipped with suitable types of gates are provided. Weir has to be provided with scouring sluices in order to regulate the flow of silt in the off-taking channels. The construction of masonry weir is comparatively simpler and cheaper where rocky foundation is available beneath the streambed. The design of the weir on permeable and erodable foundation is more complicated and requires specialised engineering knowledge.

The irrigation capacity of the diversion schemes is dependent on the actual flow in the stream at the time the irrigation is required. The cold weather and the hot weather flow, therefore, need to be ascertained carefully before deciding the feasibility and economics of these schemes. This is particularly important in the case of non-snow fed flashy streams that spurt to lift suddenly in the rainy season after which the discharge in them dwindles down to appreciable quantity. Some diversion schemes are also constructed as kharif or monsoon channels supplying water only during the monsoon season. Such schemes are useful for providing supplemental irrigation for paddy and preliminary watering for sowing of rabi.

Kul

Kuls are water channels found in precipitous mountain areas. These channels carry water from glaciers to villages in the Spiti valley of Himachal Pradesh. Where the terrain is muddy, the kul is lined with rocks to keep it from becoming clogged. In the Jammu region too, similar irrigation systems called kuhls are found

In most of the hilly tracts, small irrigation channels called 'kuls' are the only means of irrigation. These channels carry water diverted from streams by constructing temporary or pucca bunds across the streams. These channels are often constructed in hazardous hilly terrain under very difficult conditions.

To avoid seepage of water and for the sake of stability, these channels are lined in most of the reaches.

Water conservation-cum-ground-water recharging Schemes:

Under this head are included schemes which serve primarily one or more of the following purposes: (i) submerging agricultural land during monsoon for sowing post-monsoon crops, (ii) improving moisture regime of the adjoining fields down stream for raising of post-monsoon crops without irrigation and replenishing the ground water. An additional advantage of these schemes is that they help to conserve the soil. When constructed in the head water region serving catchment area of tanks down below, they serve the important purpose of retarding the silting rate of these tanks.

The system of water conservation through field embankments is peculiar to central Indian tracts and is commonly in vogue in the northern Madhya Pradesh, Bundhelkhand region of Uttar Pradesh and eastern Rajasthan. In the Bundhelkhand region, these works are popularly known as 'bundhies', which consist of earthen embankments thrown across gently sloping ground. During the rainy season, water is stored upstream and the land gets submerged. If the land slope is gradual, often large areas get submerged even by low embankments. Ordinarily, no direct irrigation is carried out and benefit is mostly due to submergence. In nearly all these areas, the soil is generally black which is retentive of moisture. After remaining submerged under water during the rainy season, the soil retains sufficient moisture to grow good rabi crops. The remaining water is let out and the submerged land released for cultivation. The other advantage of submerging land in this manner is that the first flood brings a lot of silt which acts as rich manure. By preventing free flow of water across steep gradient, the soil of the land is also conserved.

Ahars in Bihar, which store water for irrigation of paddy fields also function somewhat in a similar manner. Water is let out in October for irrigating the rice fields and the drained out fields in the bed of the ahars are cultivated with rabi crops. The head water tanks popularly in vogue in Orissa have a similar role to perform. These consist of bunds put up across slope at the head of gullies with the objective of impounding and diverting the cumulative run-off into the wider valley area down stream of the bunds by percolation, seepage and surface flow. Surface channels are provided in the flanks to carry floodwater received in excess of the storage capacity of the bunds during the monsoon season.

AHARS

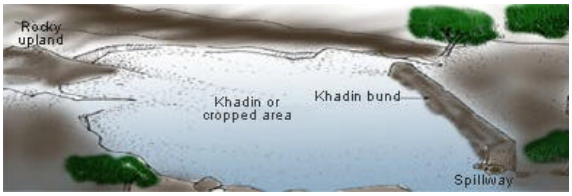
An ahar is a catchment basin embanked on three sides, the 'fourth' side being the natural gradient of the land itself. Ahar beds were also used to grow a rabi (winter) crop after draining out the excess water that remained after kharif (summer) cultivation.

Percolation tanks primarily constructed for the purpose of recharging ground water are in vogue in Maharashtra, Tamilnadu, Kerala and Rajasthan.

Check-dams or rapats are in vogue in Rajasthan. They consist of bunds constructed

RAPAT

A rapat is a percolation tank, with a bund to impound rainwater flowing through a watershed and a waste weir to dispose of the surplus flow. If the height of the structure is small, the bund may be built of masonary, otherwise earth is used. Rajasthan rapats, being small, are all masonry structures. Rapats and percolation tanks do not directly irrigate land, but recharges well within a distance of 3-5 km downstream.



*A **khadin**, also called a **dhora**, is an ingenious construction designed to harvest surface runoff water for agriculture. Its main feature is a very long (100-300 m) earthen embankment built across the lower hill slopes lying below gravelly uplands. Sluices and spillways allow excess water to drain off*

across the streams for the purpose of retarding the surface flow and also the sub-surface flow to some extent by making the bed slope of the stream flattened. This results in increased percolation of water in the sub-soil with consequent increase of the ground water supply.

In the case of big embankments impounding large catchments, it is essential that adequate arrangements are made at one or both the flanks or at some other suitable location for passing the floodwater. If no such provision is made, the embankments are liable to be breached.

Surface Lift Irrigation Scheme:

In regions where the topography does not permit direct flow irrigation from rivers and streams, water has to be lifted into the irrigation channels. These works are similar to diversion schemes, but in addition pumps are installed and pump houses constructed. These schemes, being costly in operation, are feasible only in areas where (i) gravity flow irrigation is not possible (ii) there is keen demand for irrigation and cultivators are enthusiastic, (iii) water is available in the streams for at least about 200 days in a year, and (iv) cheap electric power is available. Installation of diesel operated pump sets for lifting water makes the operation and maintenance cost of these schemes exorbitantly high. However, for lifting small order of discharge by individual cultivators, portable diesel engine pump sets are feasible as they provide greater flexibility and mobility for installation at different points of the water source or sources. In some areas Solar Pumps are also used for lifting water.

SOLAR PUMP

The solar pump unit consists essentially of a solar array, a direct-current electric motor and a pumping unit. The other components are the electrical control and some mechanism for tracking the array against the sun. Among the solar technologies useful in agriculture are water lifting and pumping with solar photovoltaic systems

3. TYPE OF WATER DISTRIBUTION DEVICE

Sprinkler Irrigation System:

Sprinkler Irrigation is a method of applying irrigation water which is similar to rainfall. Water is distributed through a system of pipes usually by pumping. It is then sprayed into the air entire soil surface through spray heads so that it breaks up into small water drops which fall to the ground.

Drip irrigation system:

Drip irrigation system delivers water to the crop using a network of mainlines, sub-mains and lateral lines with emission points spaced along their lengths. Each dripper/emitter, orifice supplies a measured, precisely controlled uniform application of water, nutrients, and other required growth substances directly into the root zone of the plant.