CHAPTER 1

INTRODUCTION

Irrigation in India refers to the supply of water from Indian rivers, tanks, wells, canals and other artificial projects for the purpose of cultivation and agricultural activities. In country such as India, 64% of cultivated land is dependent on monsoons. The economic significance of irrigation in India is namely, to reduce over dependence on monsoons, advanced agricultural productivity, bringing more land under cultivation, reducing instability in output levels, creation of job opportunities, electricity and transport facilities, control of floods and prevention of droughts.

India has many rivers whose total catchment area is estimated to be 252.8 million ha (mha) Out of about 1 869 km^3 of surface water resources, about 690 km^3 of water is available for different uses. The ultimate irrigation potential of the country has been estimated to be 139.5 mha. India has acquired an irrigation potential of about 84.9 mha against the ultimate irrigation potential. About 360 km^3 of groundwater is also available for irrigation. For soil and water conservation on agricultural lands, both agronomic and mechanical measures are deployed, such as contour farming, management of soil fertility, water nutrient interrelationship, balanced IPNS system and micronutrients. The paper gives details on irrigation water management for major crops in India: rice, wheat, maize, pulses, pigeon pea, gram, mung bean, black gram, field peas, lentil, oil seed crops, sugar cane and cotton. Irrigation is implemented through various methods such as border irrigation, basin irrigation, sprinklers and drip irrigation.

Water is the most critical input for enhancing agricultural productivity, and therefore expansion of irrigation has been a key strategy in the development of agriculture in the country. The ultimate irrigation potential of India has been estimated to be 139.5 mha, comprising 58.5 mha from major and medium schemes,

15 mha from minor irrigation schemes and 66 mha from groundwater exploitation. India's irrigation potential has increased from 22.6 mha in 1951 to about 90 mha at the end of 1995. It is estimated that even after achieving the full irrigation potential, nearly 50 percent of the total cultivated area will remain rain fed.

If we analyze agricultural growth during the past four decades, we find that high-yielding varieties, irrigated area expansion and fertilizer use have been the major factors contributing to the achievement of green revolution in India. The present level of consumption of total nutrients (NPK) is 14.3 million tones/year. On an all-India basis, per-hectare consumption of fertilizer (NPK), which was a meagre 2.0 kg/ha during the early sixties, has risen tremendously during the last 35 years or so, to a level of 76.5 kg/ha.

The share of water use other than for agriculture was only 13 percent in 1985, which is likely to become 27 percent by 2025. Such a fast growth of water need in the face of emerging supply constraints is likely to result in a wide supply gap for irrigation water in the near future.

Irrigation is the controlled application of water for agricultural purposes through manmade systems to supply water requirements not satisfied by rainfall. Crop irrigation is vital throughout the world in order to provide the world's ever-growing populations with enough food. Many different irrigation methods are used worldwide, including:

- **Center-Pivot:** Automated sprinkler irrigation achieved by automatically rotating the sprinkler pipe or boom, supplying water to the sprinkler heads or nozzles, as a radius from the center of the field to be irrigated. Water is delivered to the center or pivot point of the system. The pipe is supported above the crop by towers at fixed spacing's and propelled by pneumatic, mechanical, hydraulic, or electric power on wheels or skids in fixed circular paths at uniform angular speeds. Water is applied at a uniform rate by progressive increase of nozzle size from the pivot to the end of the line. The

depth of water applied is determined by the rate of travel of the system. Single units are ordinarily about 1,250 to 1,300 feet long and irrigate about a 130-acre circular area.

- **Drip:** A planned irrigation system in which water is applied directly to the Root Zone of plants by means of applicators (orifices, emitters, porous tubing, perforated pipe, etc.) operated under low pressure with the applicators being placed either on or below the surface of the ground.
- **Flood:** The application of irrigation water where the entire surface of the soil is covered by pounded water.
- **Furrow:** A partial surface flooding method of irrigation normally used with clean-tilled crops where water is applied in furrows or rows of sufficient capacity to contain the designed irrigation system.
- **Gravity:** Irrigation in which the water is not pumped but flows and is distributed by gravity.
- **Rotation:** A system by which irrigators receive an allotted quantity of water, not a continuous rate, but at stated intervals.
- **Sprinkler:** A planned irrigation system in which water is applied by means of perforated pipes or nozzles operated under pressure so as to form a spray pattern.
- **Sub irrigation:** Applying irrigation water below the ground surface either by raising the water table within or near the root zone or by using a buried perforated or porous pipe system that discharges directly into the root zone.
- **Traveling Gun:** Sprinkler irrigation system consisting of a single large nozzle that rotates and is self-propelled. The name refers to the fact that the base is on wheels and can be moved by the irrigator or affixed to a guide wire.
- **Supplemental:** Irrigation to ensure increased crop production in areas where rainfall normally supplies most of the moisture needed.

- **Surface**: Irrigation where the soil surface is used as a conduit, as in furrow and border irrigation as opposed to sprinkler irrigation or sub irrigation.

Conversion of sunlight to electricity is either directly using photovoltaics (PV) or indirectly using concentrated solar power (CSP). Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaics convert light into electric current using the photovoltaic effect.

Photovoltaics were initially, and still are, used as a source of renewable power for small and medium-sized applications, from the calculator powered by a single solar cell to off-grid homes powered by a photovoltaic array. They are an important and relatively inexpensive source of electrical energy where grid power is inconvenient, unreasonably expensive to connect, or simply unavailable. However, as the cost of solar electricity is falling, solar power is also increasingly being used even in grid-connected situations as a way to feed low-carbon energy into the grid.

The array of a photovoltaic power system, or PV system, produces direct current (DC) power which fluctuates with the sunlight's intensity. For practical use this usually requires conversion to certain desired voltages or alternating current (AC), through the use of inverters. Multiple solar cells are connected inside modules. Modules are wired together to form arrays, then tied to an inverter, which produces power at the desired voltage, and for AC, the desired frequency/phase.

Many residential PV systems are connected to the grid wherever available, especially in developed countries with large markets. In these grid-connected PV systems, use of energy storage is optional. In certain applications such as satellites, lighthouses, or in developing countries, batteries or additional power generators are often added as back-ups. Such stand-alone power systems permit operations at night and at other times of limited sunlight.

Table 4.1 gives world's largest PV power stations situated in different countries.

Table 1.1 World's Largest PV Power Stations

Name	Capacity (MW)	Location	Year Completed Info
Topaz Solar Farm	550	California, USA	2014
Desert Sunlight Solar Farm	550	California, USA	2015
Longyangxia Dam Solar Park	320	Qinghai, China	2013
Solar Star I and II	309	USA	*pending (planned 579 MW)*
California Valley Solar Ranch	292	California, USA	2013
Agua Caliente Solar Project	290	Arizona, USA	2014
Mount Signal Solar	266	California, USA	2014
Antelope Valley Solar Ranch	266	California, USA	*pending*
Charanka Solar Park	224	Gujarat, India	2012
Mesquite Solar project	207	Arizona, USA	*pending (planned 700 MW)*
Huanghe Hydropower Golmud Solar Park	200	Qinghai, China	2011
Gonghe Industrial Park Phase I	200	China	2013
Imperial Valley Solar Project	200	California, USA	2013

Photovoltaic systems use no fuel and modules typically last 25 to 40 years. Capital costs make up the great majority of the cost of solar power. Operations and maintenance costs for new utility-scale solar plants in the US are estimated to be 9 percent of the cost of photovoltaic electricity, and 17 percent of the cost of solar thermal electricity.

As of 2011, the cost per watt of PV has fallen well below that of nuclear power and is set to fall further. The average retail price of solar cells as monitored by the Solar buzz group fell from $3.50/watt to $2.43/watt over the course of 2011, and a decline to prices below $2.00/watt seems inevitable

A microcontroller is a small computer on a single integrated circuits containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferror electric RAM, NOR or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.