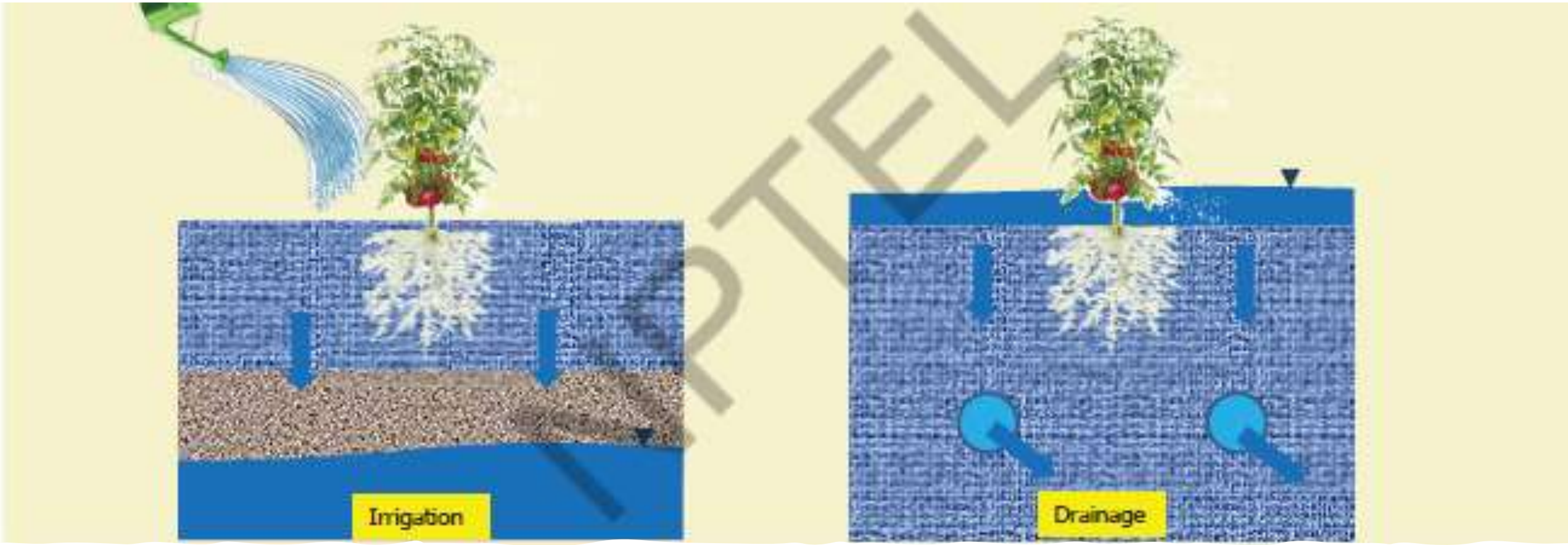
ON AND DRAINAG E

By:

CATHERINE DR. PUEYO


Irrigation
Drainage

EARNING OUTCOME

- ✓ To understand irrigation and drainage principles
- ✓ To design gravity and pressurized irrigation systems
- ✓ To understand groundwater hydraulics
- ✓ To design surface and subsurface drainage systems
- ✓ To familiar with some irrigation and drainage models
- ✓ To know about water lifting devices and pumps

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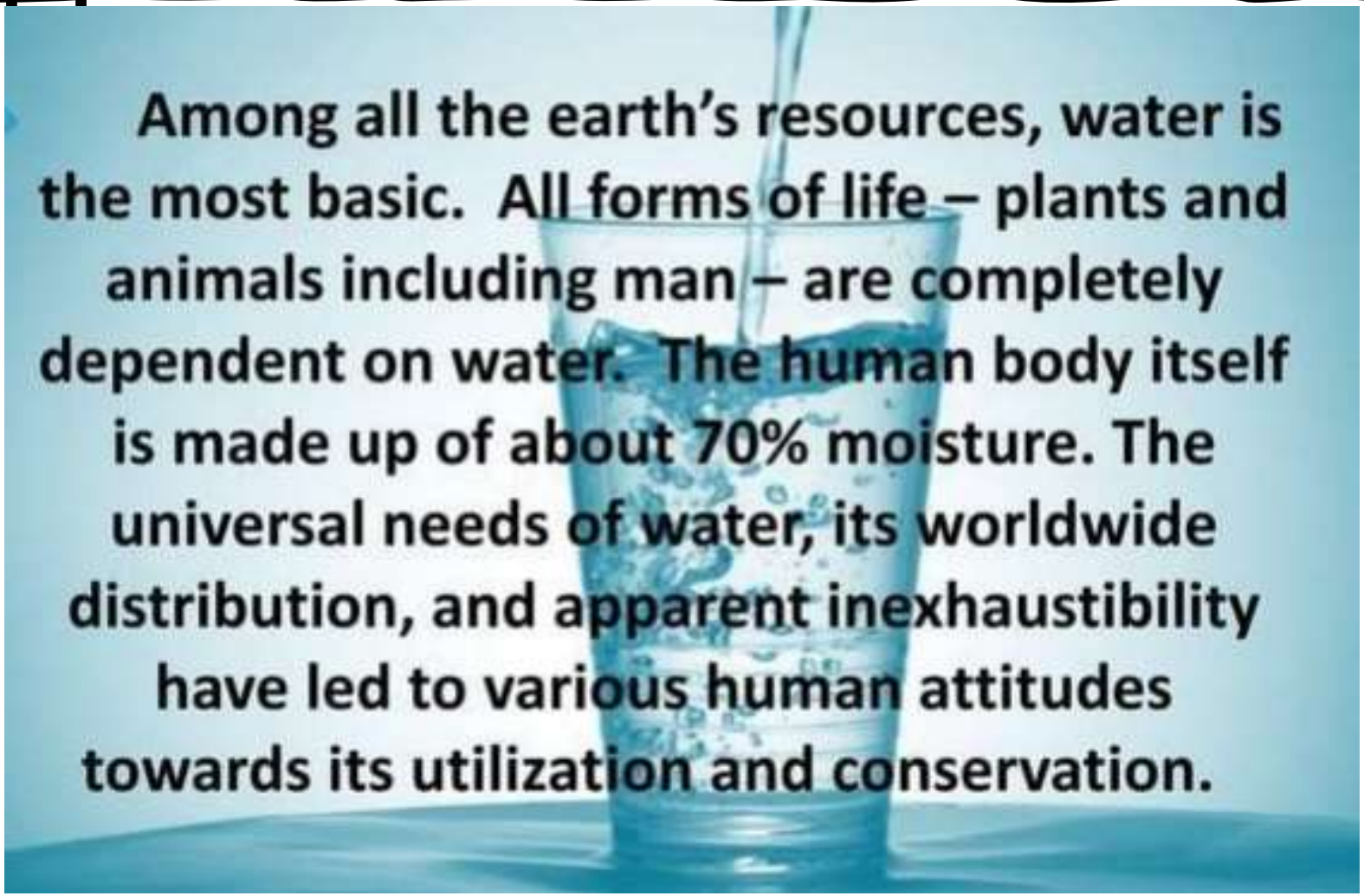
INTRODUCTION

- Sustainable development and efficient management of water is challenging in India
  - Declining groundwater table due to over-exploitation
  - Incomplete (many) major and medium irrigation projects
  - Very slow increase in gross irrigated area
  - Unsatisfactory quality of our rivers and lakes

Water resources in the Philippines



Sources of Water Supply

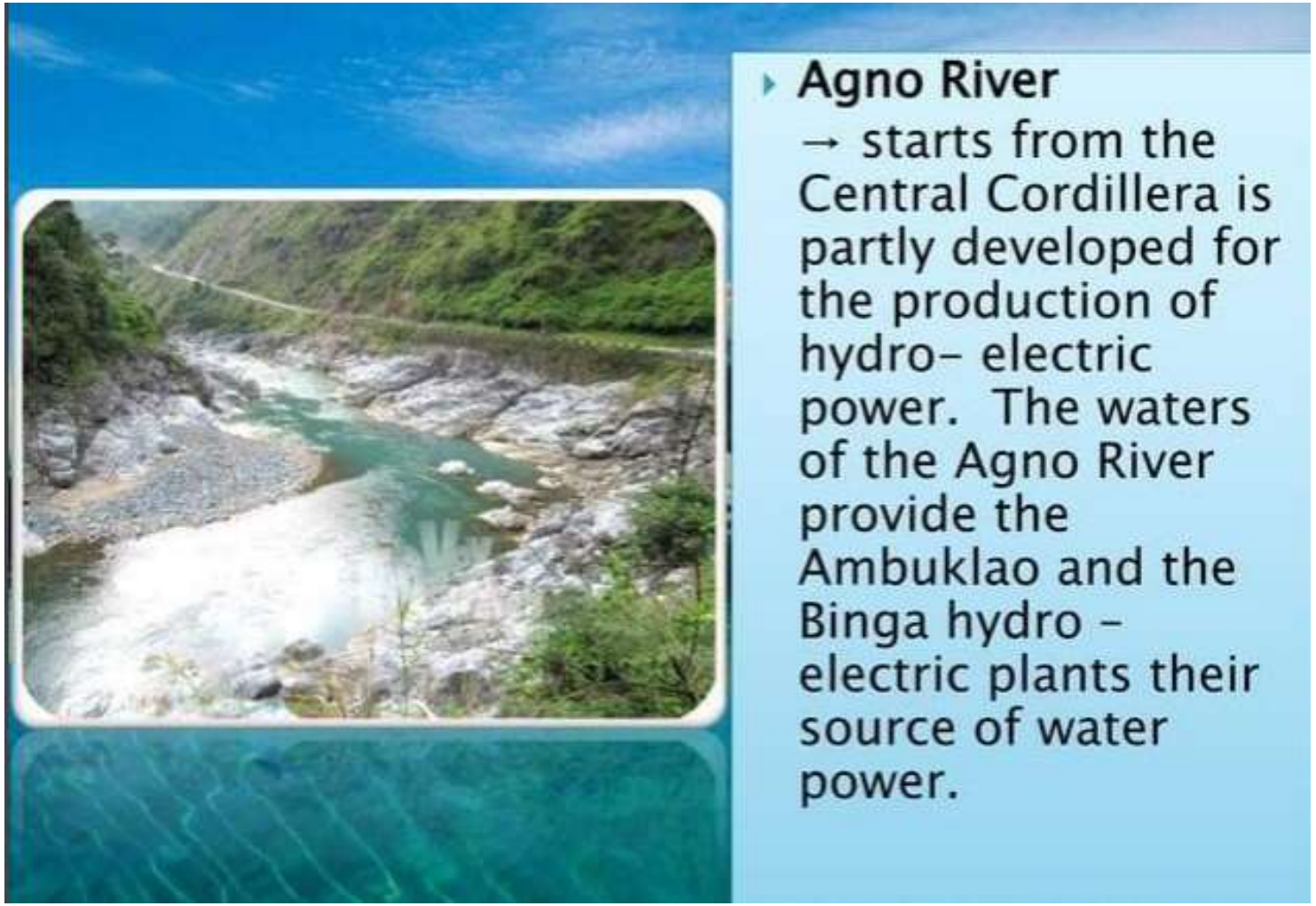
Courses of water:

- Evaporated
- Run – off (rivers, lakes, rapids, waterfalls)
- Penetrate the surface (underground or ground water)

RIVERS

Most Outstanding Rivers in Northern Luzon:

- **Cagayan River** → the longest river in the Philippines, rises in the Caraballo mountains, then runs northward through the entire length of the Cagayan Valley. Overflowing its banks yearly, it has made the Cagayan Valley very fertile and richest tobacco – growing region of the country.



- **Agno River**
  → starts from the Central Cordillera is partly developed for the production of hydro- electric power. The waters of the Agno River provide the Ambuklao and the Binga hydro – electric plants their source of water power.


Central Luzon:
Pampanga River
→ The Upper Pampanga River Project located at Pantabangan, Nueva Ecija has been developed for multi – purposes: irrigation, water power, water supply and flood control.
Angat River→ which flows through the provinces of Bulacan and Rizal has likewise been developed for such purposes.


BICOL RIVER
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Mindanao:

Visayas:

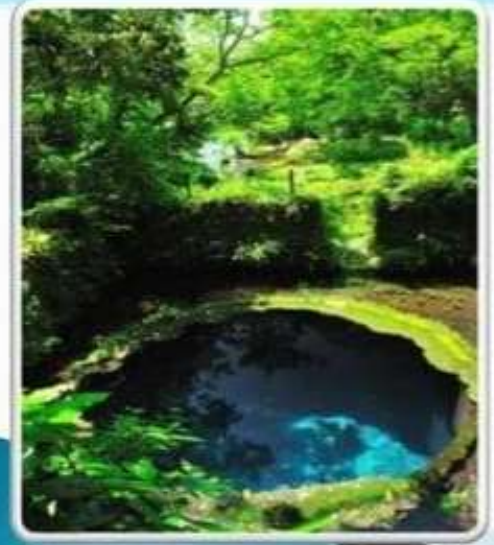
Owing to the nature of the islands, the rivers are generally short with high gradients. They rise from the mountainous interiors and descent to the coastal regions.

It has been mentioned previously that part of the rainfall, prevented from flowing immediately to the streams and the seas, penetrates the surface of the earth forming ground water. The amount of ground water as well as the depth of the water table is dependent on the amount of rainfall, the topography of the land, the vegetation cover and the porosity of the soil.

Springs and Wells:

- derive their water supply from the groundwater. The location of springs depends upon the terrain and rock structures in relation to the water table. Most of the springs in the Philippines are found on the slopes of mountains and near volcanic regions .Those formed on the slopes of mountains are generally cold water springs while those found adjacent to volcanoes are warm and mineralized.

- **Pansol Spring** in Pansol, Laguna, which is warm and medicinal for it, has some curative properties for the treatment of diseases like rheumatism.



Tiwi Spring in Albay is likewise medicinal for its water is used to treat skin diseases .The springs of the country , be they cold, thermal, mineral or medicinal in character, should be developed and conserved for they could become sources of revenue and satisfy a vital need as regards the health and water requirements of a community.

- **Well** is formed when a supply of water is obtained by digging or drilling from the surface of the ground to the water table.

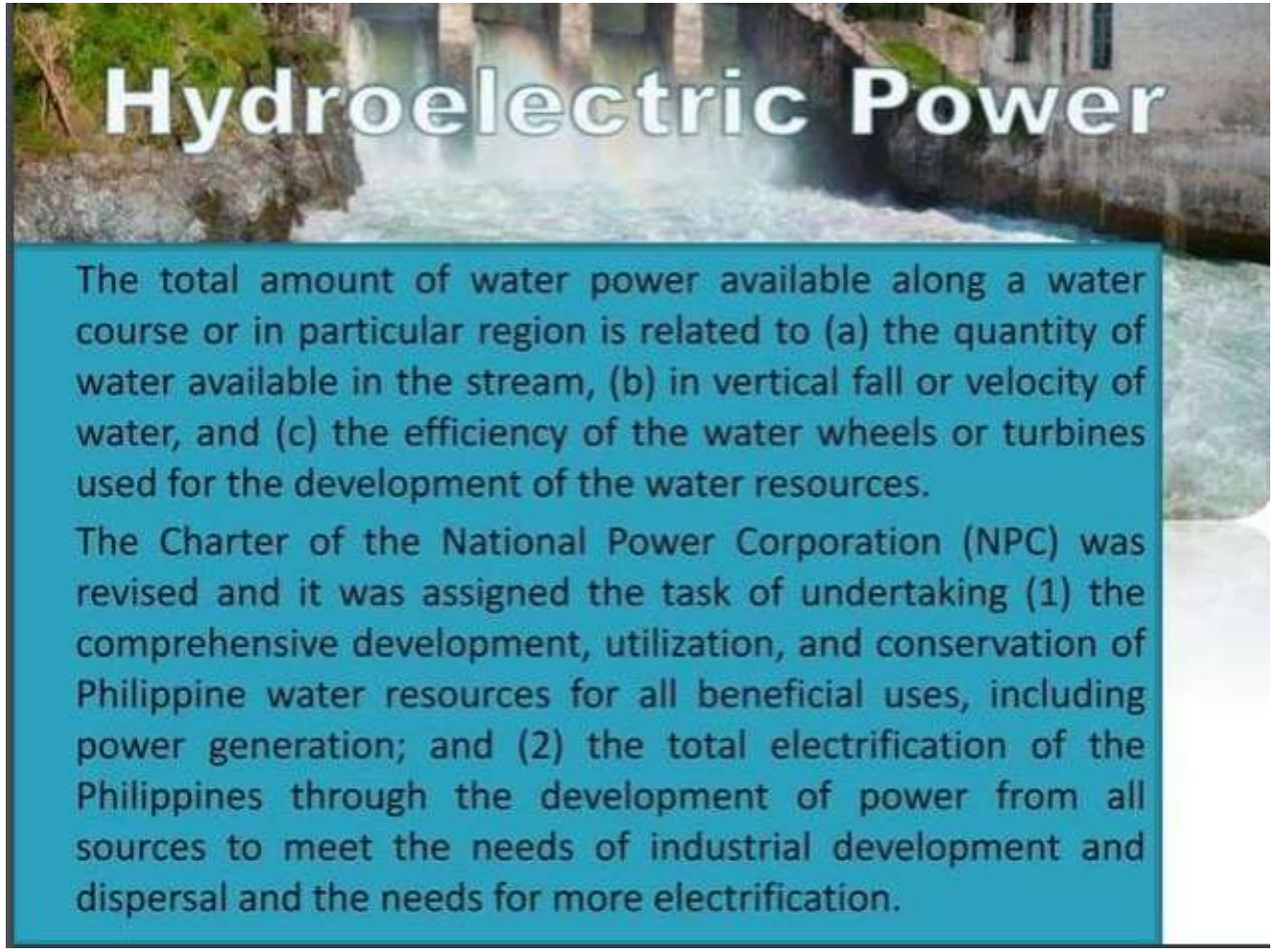
The term **artesian** well was derived from **Artois** , a province in France , where the water from many well rises above the surface of the earth like a fountain. Today, however the term artesian well is commonly applied to any deep well from which ground water is brought to the surface, even though water does not flow naturally.


Domestic and Industrial Uses of Water
The industrial uses of water fall under three categories:
(1) as an important ingredient of the finished product ;
(2) as an agent for cooling, removing impurities and preparing solution ; and
(3) as an agent for diluting and removing of industrial waste.

Water for Irrigation

- The history of irrigation in the country may be traced to pre-Spanish times when the Ifugao constructed the famous rice terraces of the Mountain Province which showed a skillful use of irrigation water. During the more than 300 years of Spanish rule, the government did not build any irrigation system. However, the Church responsible for the construction of irrigation systems in the so called Friar Lands that were found in the provinces around manila and in the Central Plain of Luzon.

PRINCIPAL IRRIGATION SYSTEMS


Hydroelectric Power
The total amount of water power available along a water course or in particular region is related to (a) the quantity of water available in the stream, (b) in vertical fall or velocity of water, and (c) the efficiency of the water wheels or turbines used for the development of the water resources.
The Charter of the National Power Corporation (NPC) was revised and it was assigned the task of undertaking (1) the comprehensive development, utilization, and conservation of Philippine water resources for all beneficial uses, including power generation; and (2) the total electrification of the Philippines through the development of power from all sources to meet the needs of industrial development and dispersal and the needs for more electrification.

WATER RESOURCES AND ECONOMIC DEVELOPMENT

- When the water resource is used for irrigation or for generation of hydroelectric power, proper conservation measures should be taken to prevent silting of the dam and the water reservoir. The life of the irrigation system as well as the reservoir for water power will depend greatly upon the volume and height of the water in the dam or reservoir.

Water Resources Situationer

- Land area 300,000 km2
- Rivers and lakes occupy 1,830 km2
- Bays and Coastal Waters cover an area of 266,000 km2
- Annual Average rainfall 2,400 mm
- 12 Water Resources Regions based on hydrological boundaries

Per capita availability in the Philippines

Water Resources Situationer

- Surface water dependable supply
- - 125,790 MCM (80 dependability)

- Groundwater potential - 20,200 MCM (safe yield)

- Total dependable water supply -
- 145,990 MCM

- 421 principal river basins
- - 18 are major river basins (DA ? 1,400 Km2)

Major river basins of the country 1. Abra-

Ilocos (5,125 sq. km.) 2. Cagayan- Cagayan Valley
(25,649 sq. km.) 3. Abulug- Cagayan Valley (3,372
sq. km.) 4. Agno- Central Luzon (5,972 sq. km.) 5. Pampanga- Central Luzon (9.759 sq. km.) 6. Pasig-Laguna Bay- Southern Luzon (4,678
sq. km) 7. Bicol- Bicol (3,771 sq. km) 8. Panay-
Western Visayas (1,843 sq. km.) 9. Jalaur-
Western Visayas (1,503 sq. km.) 10. Ilog Hilabangan- Western Visayas (1,945 sq. km.) 11. Agusan- Northern Mindanao (10,921 sq. km.) 12.
Tagoloan- Northern Mindanao (1,704 sq. km.) 13.
Cagayan de Oro- Northern Mindanao (1,521 sq.
km.) 14. Tagum-Libuganon- Southeastern Mindanao
(3,064) 15. Davao- Southeastern Mindanao (1,623
sq. km.) 16. Buayan-Malungon- Southeastern
Mindanao (1.434) 17. Agus- Southern Mindanao
(1,890 sq. km.) 18. Mindanao- Southern Mindanao
(23,169 sq, km.)

HARD FACTS (Philippines)

- 9 major cities are at risk /vulnerable to experiencing significant water constraints (Master Plan 1998).
- 18 river systems are below water quality standards (Philippine Environment Monitor 2003).
- 50 rivers (12) of the 421 rivers in the country are considered biologically dead (Phil. Environment Monitor 2003).

IRRIGATION

- Irrigation is the artificial application of water to soil for meeting crop water requirement
- Irrigation water is applied to supplement water available from precipitation and ground water
- Main concerns of irrigation
  - How to apply?
  - How much to apply?
  - When to apply?

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BENEFITS OF IRRIGATION

- ✓ Irrigation development has played a key role in
  - ✓ strenghtening economy
  - ✓ increasing employment opportunities
  - ✓ self sufficeincy in food production

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BENEFITS OF IRRIGATION

- ✓ Raise a crop where nothing would grow otherwise
- ✓ Grow a more profitable crop
- ✓ Increase the yield and/or quality of a given crop
- ✓ Increase the aesthetic value of a landscape

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OTHER BENEFITS OF IRRIGATION

- ✓ Leaching of salts
- ✓ Wind erosion control
- ✓ Multiple cropping during an year
- ✓ Provides jobs
- ✓ Reduces risk of crop failures
- ✓ Improves socioeconomic conditions

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DISADVANTAGES OF IRRIGATION

- Excessive irrigation
  - decrease in crop yield
  - leaching/transport of chemicals
- Yield reduction-deficit irrigation
- Water logging and salinity

Waterlogging at Lohgad village of Sarsa district in Haryana (Source: Narrain, 2005)

GW withdrawal as % of recharge

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Types of irrigation systems in the philippines

TYPES OF SYSTEMS

There are three categories of irrigation systems: national, communal, and private. ***National irrigation systems*** (NIS) are large and medium schemes. These are basically operated and maintained by NIA where beneficiaries are charged irrigation service fee for the services rendered in the delivery of water. In the 1980s, joint management of portions of national systems with irrigators associations (IA) was effected.

Types of irrigation systems in the philippines

Communal irrigation systems (CIS) are small-scale schemes and constructed with the participation of farmer-beneficiaries thru their IAs. The operation and maintenance (O&M) of CIS is turned over to IAs upon project completion subject to a cost recovery arrangement. Farmers amortize the chargeable cost for a period not exceeding 50 years at 0 percent interest. The repayment scheme is pre-arranged and acceptable to both NIA and the IA.

Types of irrigation systems in the philippines

Private irrigation systems are those constructed, operated and maintained by private individuals or groups with or without technical assistance by NIA or other government agencies.

COMPARISON BETWEEN THE NATIONAL AND COMMUNAL IRRIGATION SYSTEMS

For Comparison	National Irrigation System	Communal Irrigation System
Area (ha)	> 1,000	< 1,000
Implementation/construction	NIA	NIA with farmers' participation
Operation and maintenance	NIA and Irrigators Associations	Irrigators Associations
Water charges	Farmers pay irrigation service fee per hectare/season/crop	Farmers pay amortization
Purpose of water charges	Purpose of water charges	Capital cost recovery

TYPES OF SCHEME OF DEVELOPMENT

The three schemes of development of irrigation systems are run-of-the river diversion, storage or reservoir, and pump irrigation. Diversion projects entail the drawing of water under controlled conditions directly from the flow of rivers or streams. Storage or reservoir projects involve the construction of storage dams to impound water and released as needed to be drawn from a diversion dam downstream. Reservoir projects are usually multi-purpose to include other functions like power generation, flood control, fishery and recreation. In pump projects, water is lifted from underground or from rivers and streams. Pump systems are also common in some storage or diversion schemes to lift water to irrigate areas on higher elevation or pump groundwater to supplement available supply from the river. Environmental protection and conservation is a key consideration in the design of various schemes.

STATUS OF IRRIGATION DEVELOPMENT

The Philippines has about 10.3 million ha agricultural lands. Out of this, around 3.1 million ha are considered irrigable, with up to 3 percent slope, and primarily devoted to rice and corn. A study by the World Bank, however, identified more than 6.1 M ha as irrigable, including areas that are relatively more difficult to irrigate and up to 8 percent slope.

As of December 2015, about 1.731 million ha or 57.33 percent of the 3.1 million ha have been developed for irrigation. Of the total area under irrigation, about 754,665 ha are under NIS; 615,797 ha under CIS that are farmer-managed; and 187,766 ha under privately owned systems that are constructed through private initiatives.

REASONS FOR LOW IRRIGATION EFFICIENCY

- ✓ Unlined canal systems with excessive seepage
- ✓ Lack of field channels
- ✓ Lack of canal communication network
- ✓ Lack of field drainage
- ✓ Improper field levelling
- ✓ No or low price for water

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Irrigation Terminologies

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