Rural Water Supply in Nepal: Hydrology-Water Cycle Course Technical Training Manual No. 1

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HYDROLOGY - WATER CYCLE COURSE

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HYDROLOGY - WATER CYCLE COURSE

1- Definition and hydrologic cycle

Hydrology is the science of distribution and behaviour of water in nature.

Hydrology is a part of climatology. The cycle of water (hydrologic cycle) is without beginning and end and consists of the following:

Precipitation

All water from the atmosphere deposited on the surface of the earth as either rain, snow, hail or mist.

Surface run off

The water which is derived directly from precipitation and passes over ground into water courses. It is the precipitation less the losses from infiltration and evaporation.

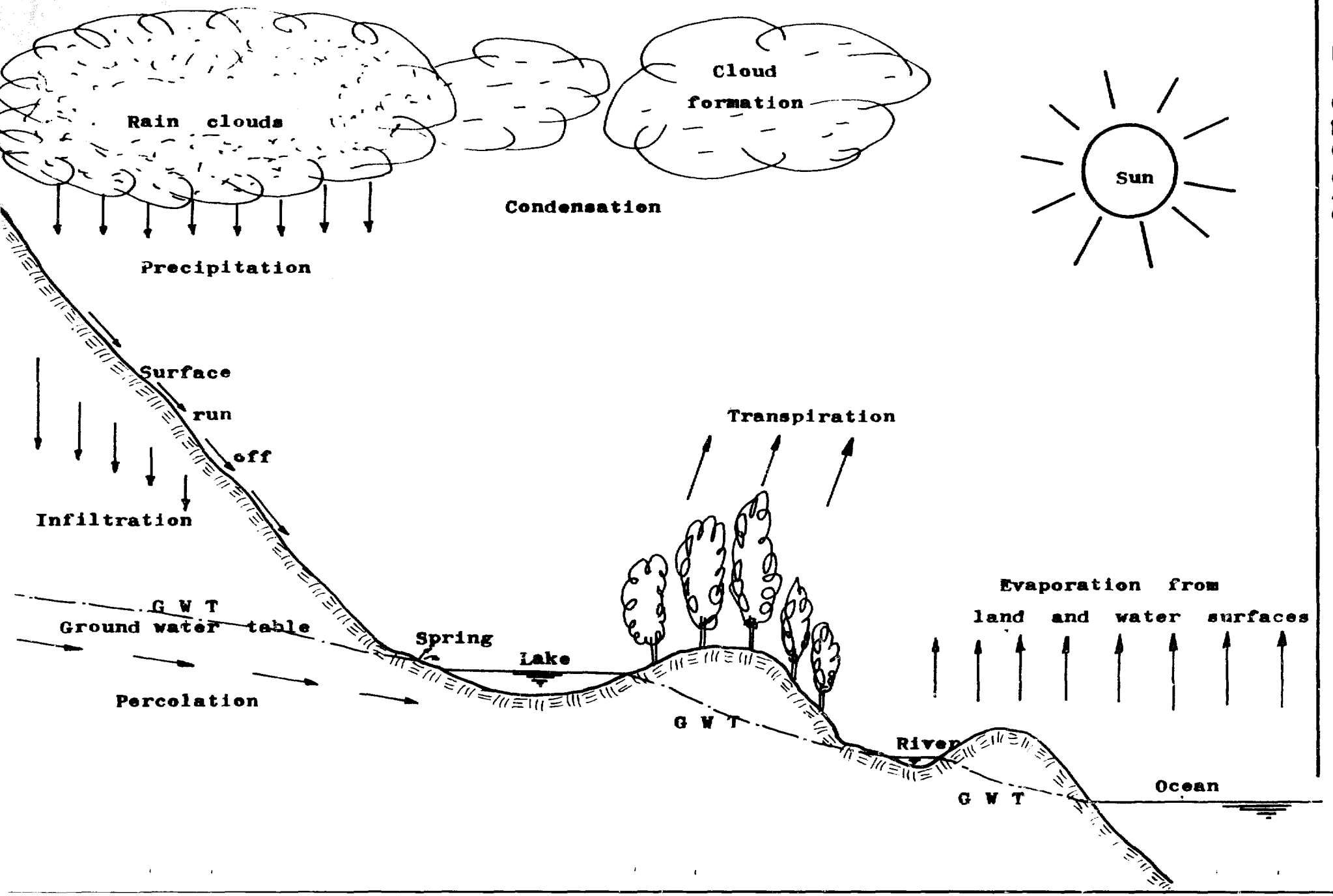
Evaporation, transpiration

Combined loss of water from land and water-surface by evaporation and vegetation transpiration.

Percolation

The term percolation describes the passage of water into, through and out of the ground. Infiltration is the entrance of the water into the ground and its vertical movement down to the ground water table, while percolation (or ground water flow) is applied to the movement of water after it has reached the ground water table.

HYDROLOGIC NATURAL WATER CYCLE



2. Climate

Concerning the year, the main climatic features in Nepal, Gandaki Zone, are as follows:

- The raining season of the year, from April to September (monsoon)
- The dry season of the year, from October to April.

3. Quantity and variation of rainfall in Gandaki Zone, Nepal

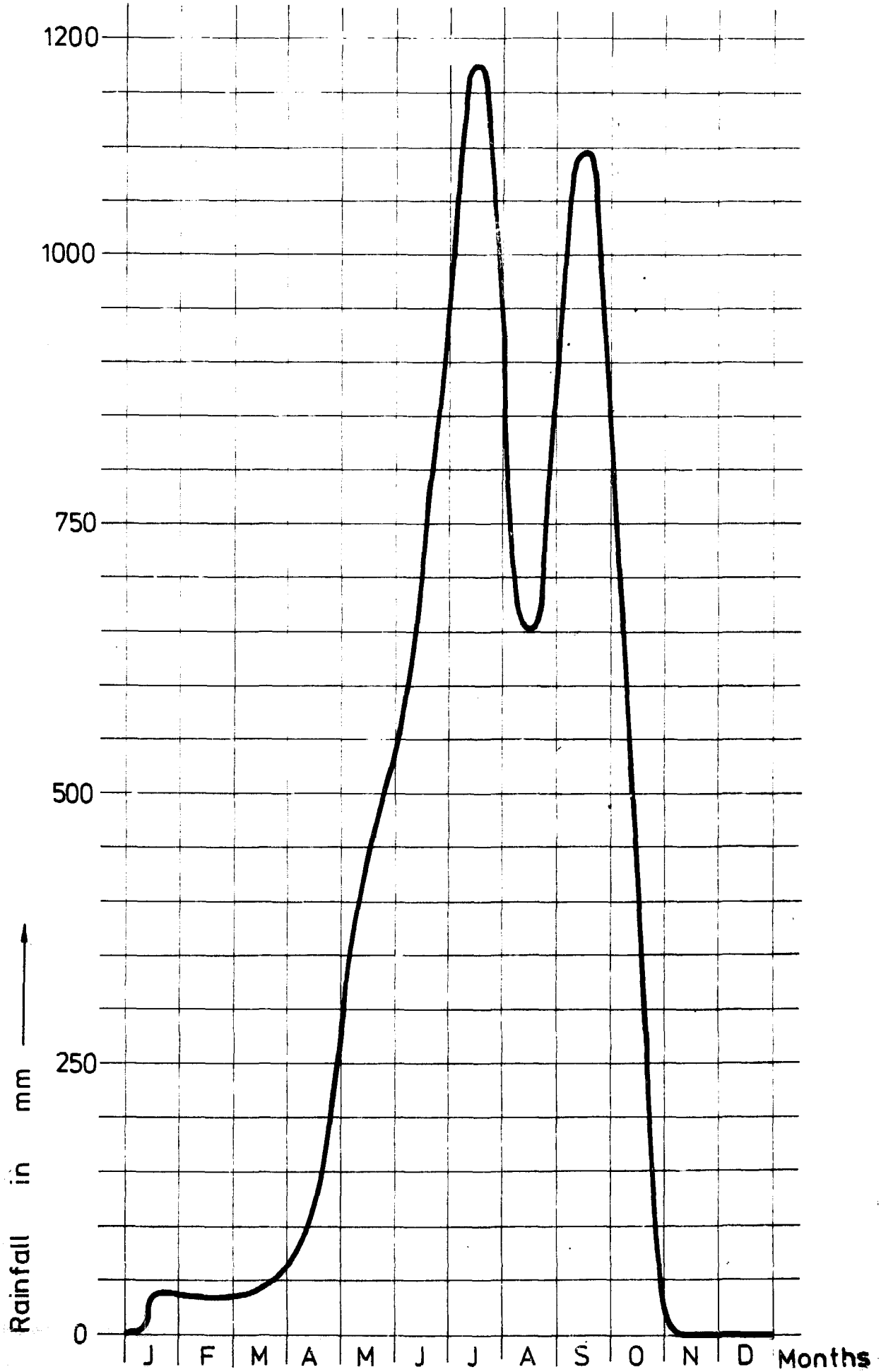
Rainfall quantities can be mapped as for example the following diagram for Pokhara town rainfall in 1975.

The rainfall varies greatly throughout the year and also from one year to the other as well as from one station to another.

Rainfall table for the year 1975

Stations	Rainfall amount in mm													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Annual	Max. in 24 hrs.
Khudibagar	63	55	24	140	235	677	923	555	620	154	00	3	3449	111 25 April
Pokhara	38	37	42	118	446	704	1177	650	1096	259	00	00	4767	171 1 July
Shyangja	29	37	32	123	401	654	1033	562	748	210	00	00	3829	195 3 August
Kunchha	32	71	23	41	272	603	740	452	604	85	00	00	2923	158 25 July
Bandipur	17	24	1	40	340	341	553	329	122	21	00	00	1788	102 27 July
Gorkha	24	30	15	63	176	188	343	250	285	22	00	00	1396	60 21 June
Chaparkot	38	20	33	107	210	674	472	472	609	11	00	00	2646	236 30 June
Lumle	51	59	50	29	285	910	1719	1120	897	232	4	00	5356	188 1 July
Chame	28	46	13	1	2	90	262	128	126	42	18	00	756	61 1 July
Lamachaur	64	41	36	117	271	979	1261	783	1229	368	00	00	5149	175 5 Sept.
Rainfall amount in milimeters														

POKHARA RAINFALL IN 1975



4. Rainfall, run off and infiltration

The quantity of water running from an area into streams and finally into the sea is not the same as the rainfall.

The quantity of rainfall will be shared into:

- direct evaporation
- transpiration through vegetation
- infiltration
- run off

Infiltrated water

It forms the ground water and through its natural filtration it can be used directly as drinking water, only as far as protective, measurements for catchment are adopted.

The characteristics of the yield of a spring depend on the type of soil and sub-soil. From rocky area the quantity of water will directly depend upon the rainfall. Surface springs will also dry up shortly after the monsoon and supply again after the first rains.

Springs from deep porous and water-holding covers, or from far distant catchment areas, are more regular, but their lowest supply quantity does not correspond with the lowest rainfall.

Run off

Similar characteristics can be found in streams. Rocky areas provide flood and low water according to the rains. Porous and water-holding soils supply the streams with underground water and the quantity may still decrease after the first rains. Quantity of water may also varies because of the snow when the melting time arises.

5. Drainage in Gandaki Zone

River	Comes from	Drains	Separates	Runs into or forms
Gandaki River	Tibet	East of Gorkha Distt.	Gorkha & Dhading Distt.	Trisuli river
Trisuli River	Tibet	Central region of Gandaki Zone	Dhading & Nuwakot Distt.	Budhigandaki River
Marsyangdi River	Manang Distt.	Manang & Lamjung Distt.	Gandaki Zone in the middle	Budhigandaki River
Modi River	Annapurna Mountains	Middle part of Gandaki Zone		Budhigandaki River
Seti River	Machhapuchare Mountains	Kaski Distt.		Modi River
Kaligandaki River	Tibet	Western region	Gandaki from Dhaulagiri & Lumbini Zone	Mix with Budhigandaki & forms Narayani River
Modi Stream	Machhapuchare Mountains	West of Gandaki Zone	Kaski & Parabat Distt.	Kaligandaki River
Andhi Stream	South of Pokhara	Syangja Distt.		Kaligandaki River

Important lakes in Gandaki Zone

In Pokhara is the Fewa lake which is partly used for hydro-electric purpose with the help of a dam at the lake outlet.

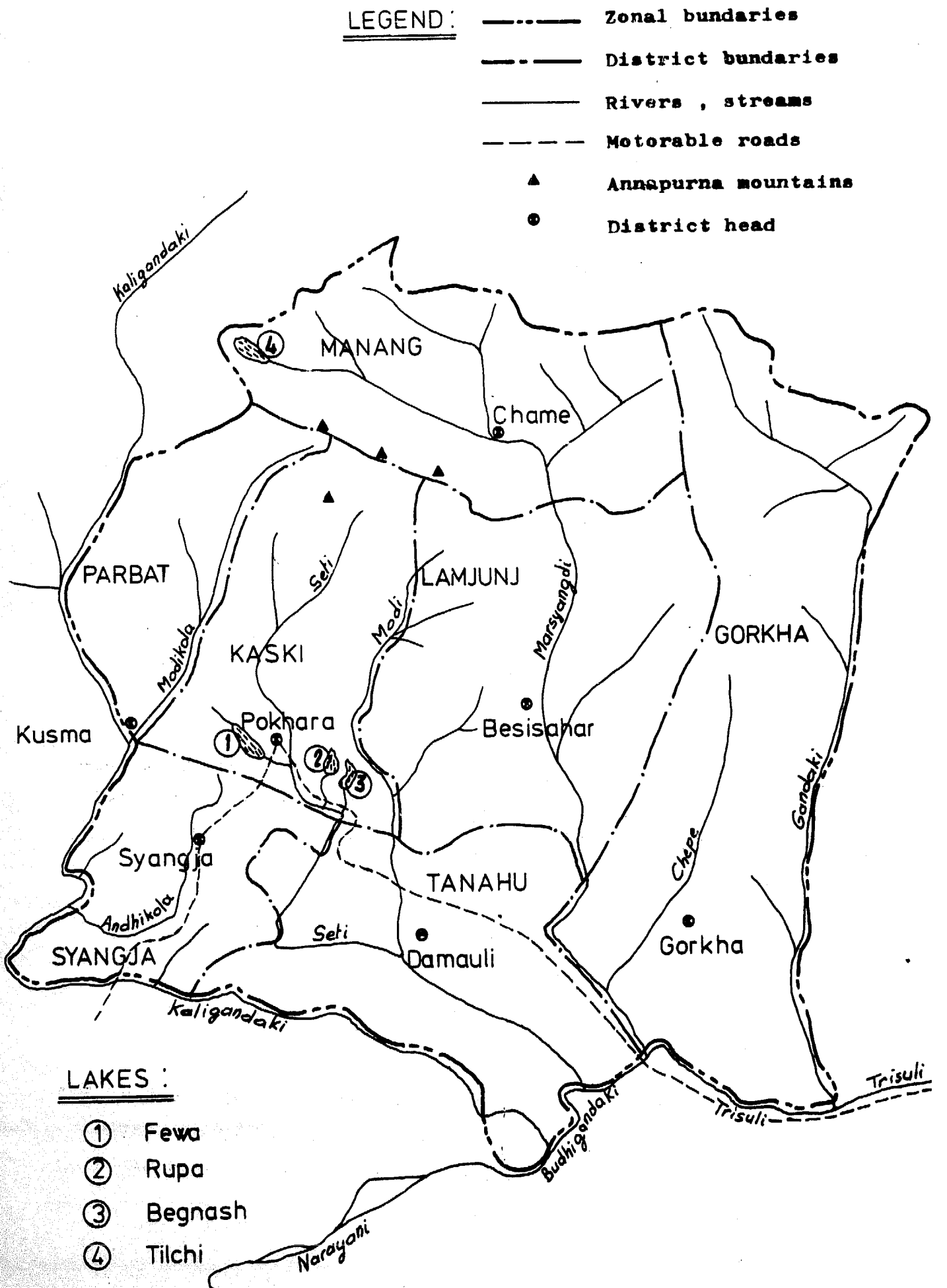
Near Pokhara there are also

two lakes : Begnas lake

Rupa lake

In the north - west of Manang district is located the Tilchi lake

DRAINAGE IN GANDAKI ZONE



6. Water sources

6.1 Importance of water

The water is very essential for :

- life
- health and sanitation
- as raw material for food production
- farming
- cattle

The water conservation and the sanitation are important to everyone.

6.2 Ground-water

The ground-water is the water which by percolating through the ground reaches the ground water table. The quality of the ground-water depends on:

a) The thickness of the stratum which covers the water-bearing soil, this is important because of indirect contaminations like waste water, latrines and fertilizers, etc...

b) The porosity of the sub-soil which influences the natural filtration process.

The quantity of ground - water depends on :

a) The intake areas. It is important to realise that the topographical basin does not necessarily correspond with the geological or hydrological drainage area.

b) Annual rainfall percolation. This depends on the nature of the intake area. (kind of vegetation like forest, farm, bush, grass field, etc..)

c) Perviousness of the ground. This depends on the kind of material, stratification and its homogenety.

d) Storage capacity of the ground. This depends on the same factors as perviousness and the intake area.

6.3 Springs

If ground-water leaves the ground without artificial help, we call it spring-water.

Spring - water is usually the best water quality.

Whenever a water supply is planned, first investigation should be made with possibility to use a spring.

The quality and the quantity of the spring depends on:

a) Intake area

b) Annual rainfall percolation

The continuous flow of a spring depends on the following points :

a) Thickness of the stratum covers

b) Perviousness of the ground

c) Storage capability of the ground

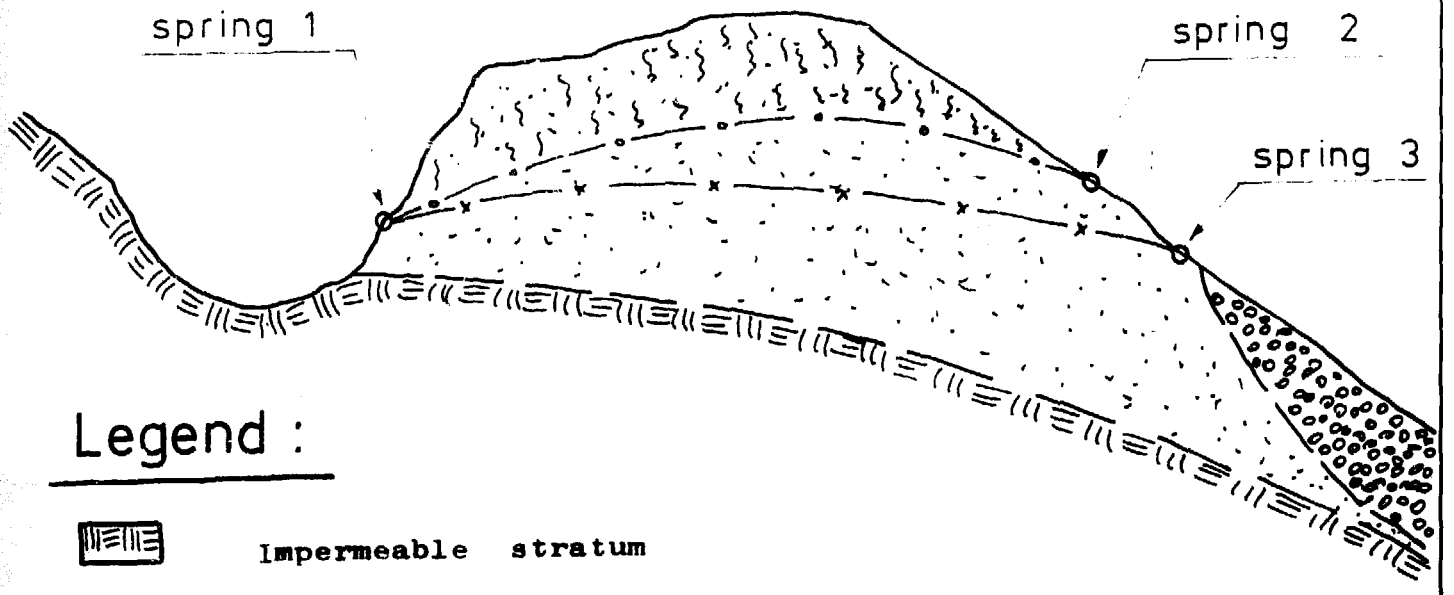
Example of a spring influence by a single rainfall: This spring will not have a constant flow:

- A thin stratum covers the water bearing soil
- The saturated stratum has a great perviousness (cracks and fissures)
- The water - bearing soil has little storage capability (few pores which could be filled with water)

Example of a spring influenced only by annual rainfall. This spring will have a good continuous flow volume :

- A thick stratum covers the water - bearing soil
- The saturated stratum has a small perviousness.
- The water - bearing soil has a big storage capability

Variation of ground water table and position of springs according to season .



Legend :

- Impermeable stratum
- Saturated stratum
- Clays
- —o— Wet season water table
- —x— Dry season water table

Remarks :

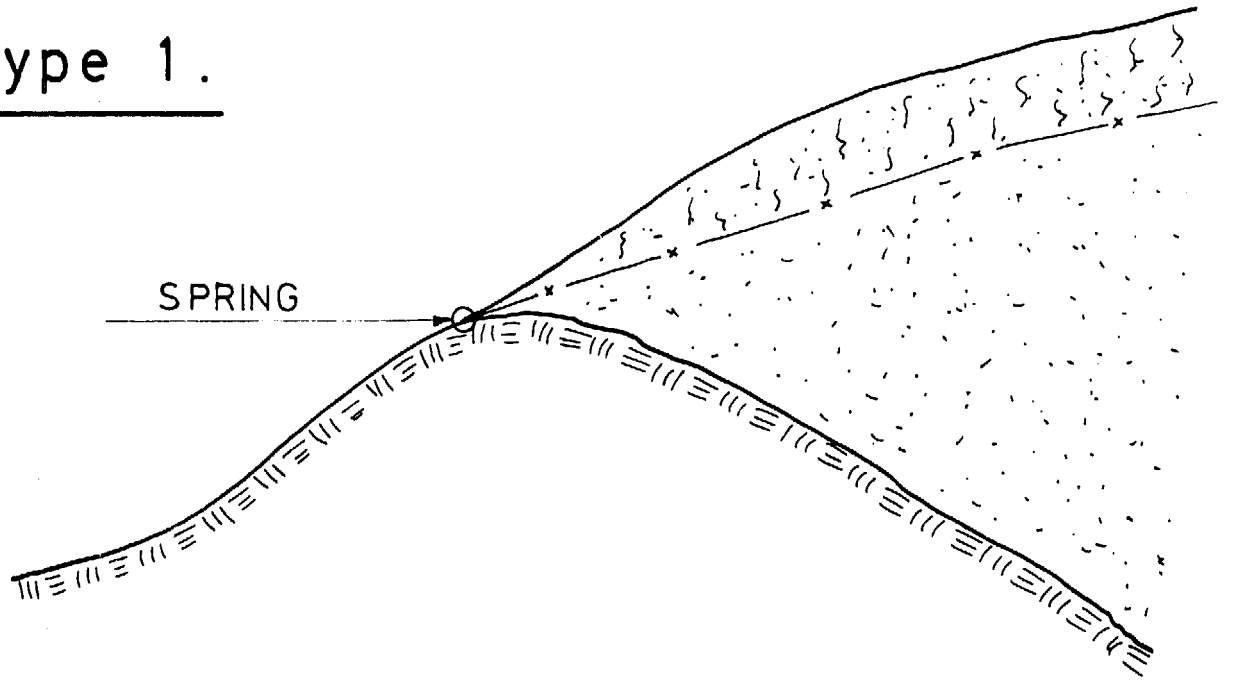
SPRING 1 : Wet season = large flow
Dry season = small flow

SPRING 2 : Wet season = normal flow
Dry season = dry (no water)

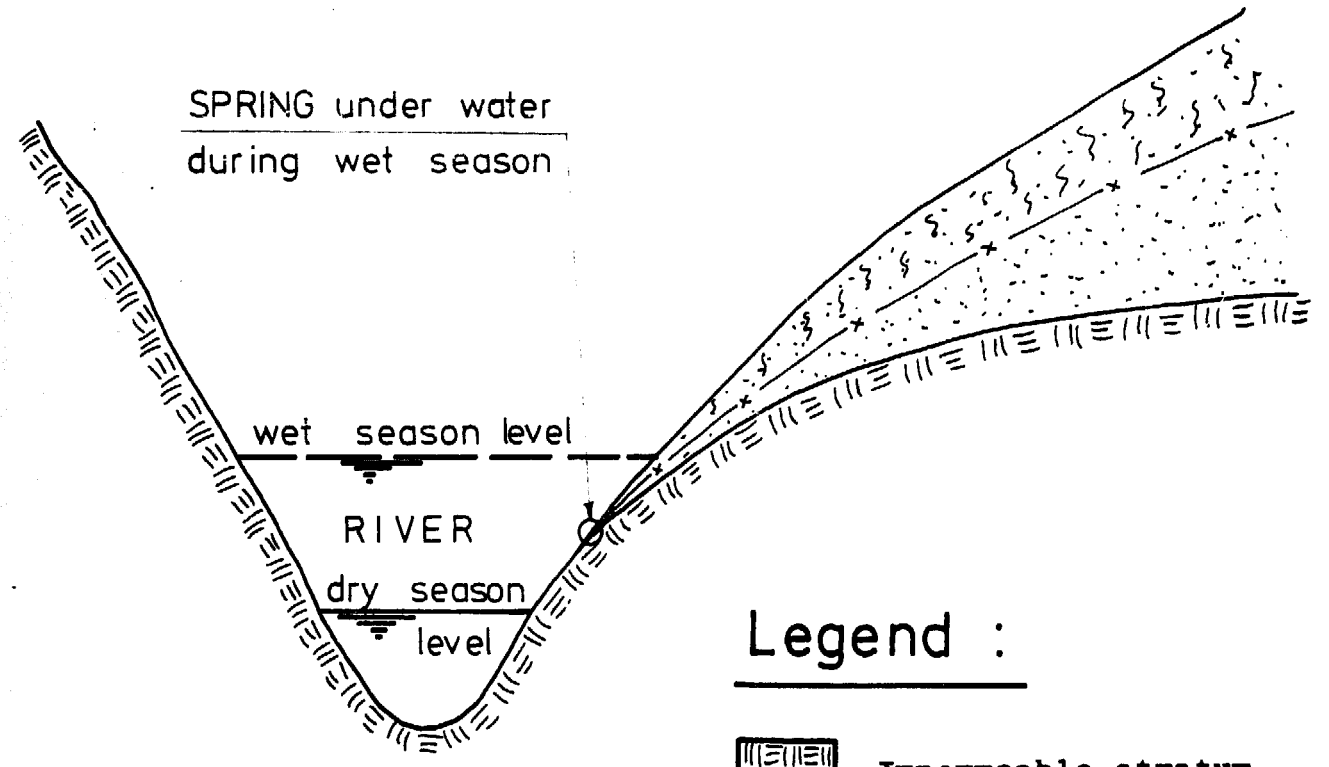
SPRING 3 : Wet season = normal flow
Dry season = normal flow

VARIOUS TYPE OF SPRINGS

Type 1.



Type 2.



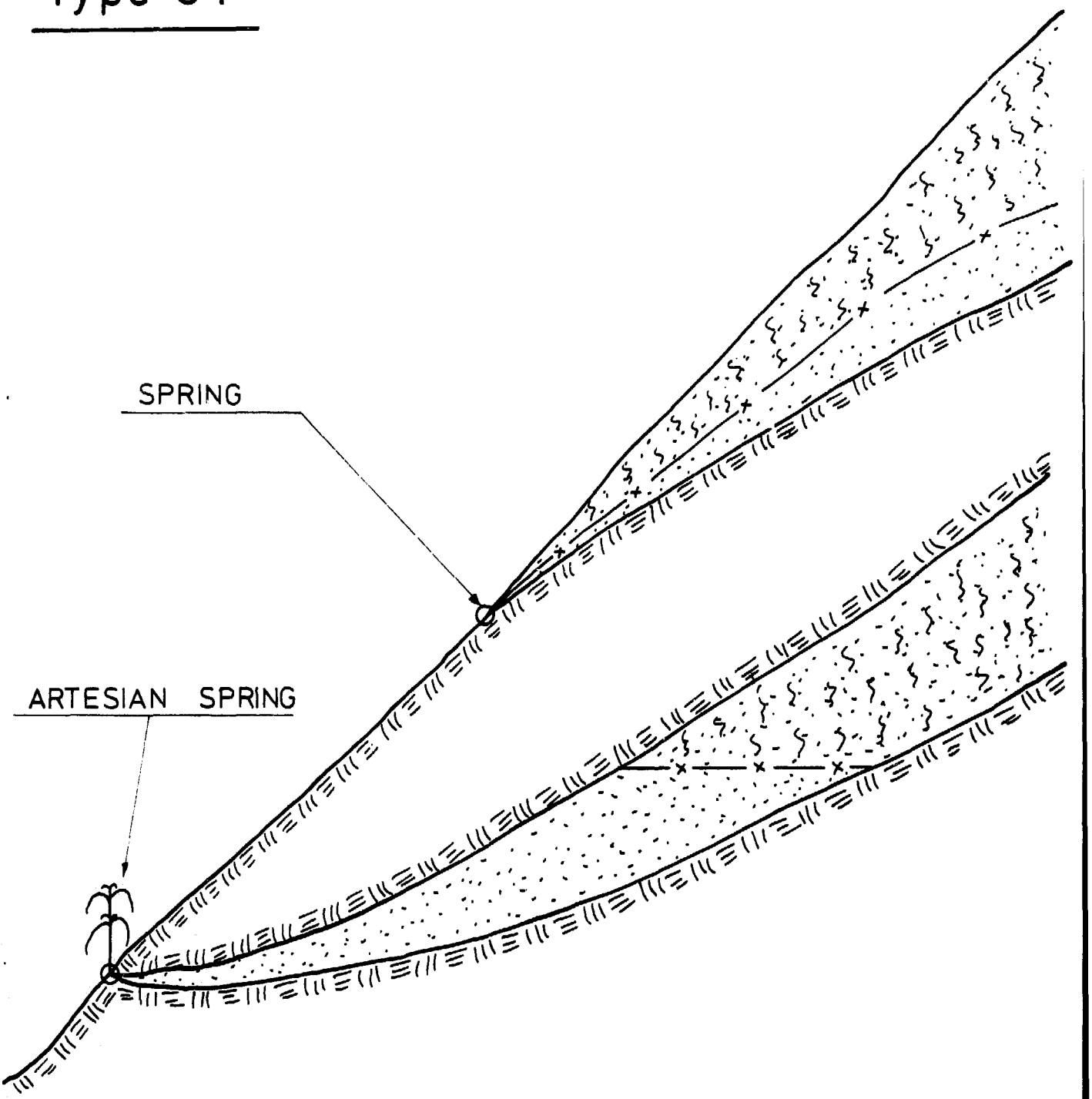
Legend :

Impermeable stratum

Saturated stratum

Ground water table

Type 3.



LEGEND :

Impermeable stratum

Saturated stratum

Pervious stratum

Ground water table

6.4 Wells

A well is a round hole dug in the ground up to a certain distance in the saturated stratum.

Wells make it possible to use the underground water for economic applications as for water supplies or irrigation purposes.

The quality of the water obtained from a well depends on :

a) The thickness of the stratum which covers the water - bearing soil.

b) The porosity of the sub-soil.

The quantity of water obtainable from a well depends on :

a) The intake area

b) The annual rainfall percolation

c) The perviousness of the ground

d) The storage capability of the ground.

The different types of wells are as follows:

a) The shallow well which draws the water from the permeable stratum between surface and the first impermeable stratum.

b) The deep well which draws the water from a deep saturated stratum unaffected by surface impurities.

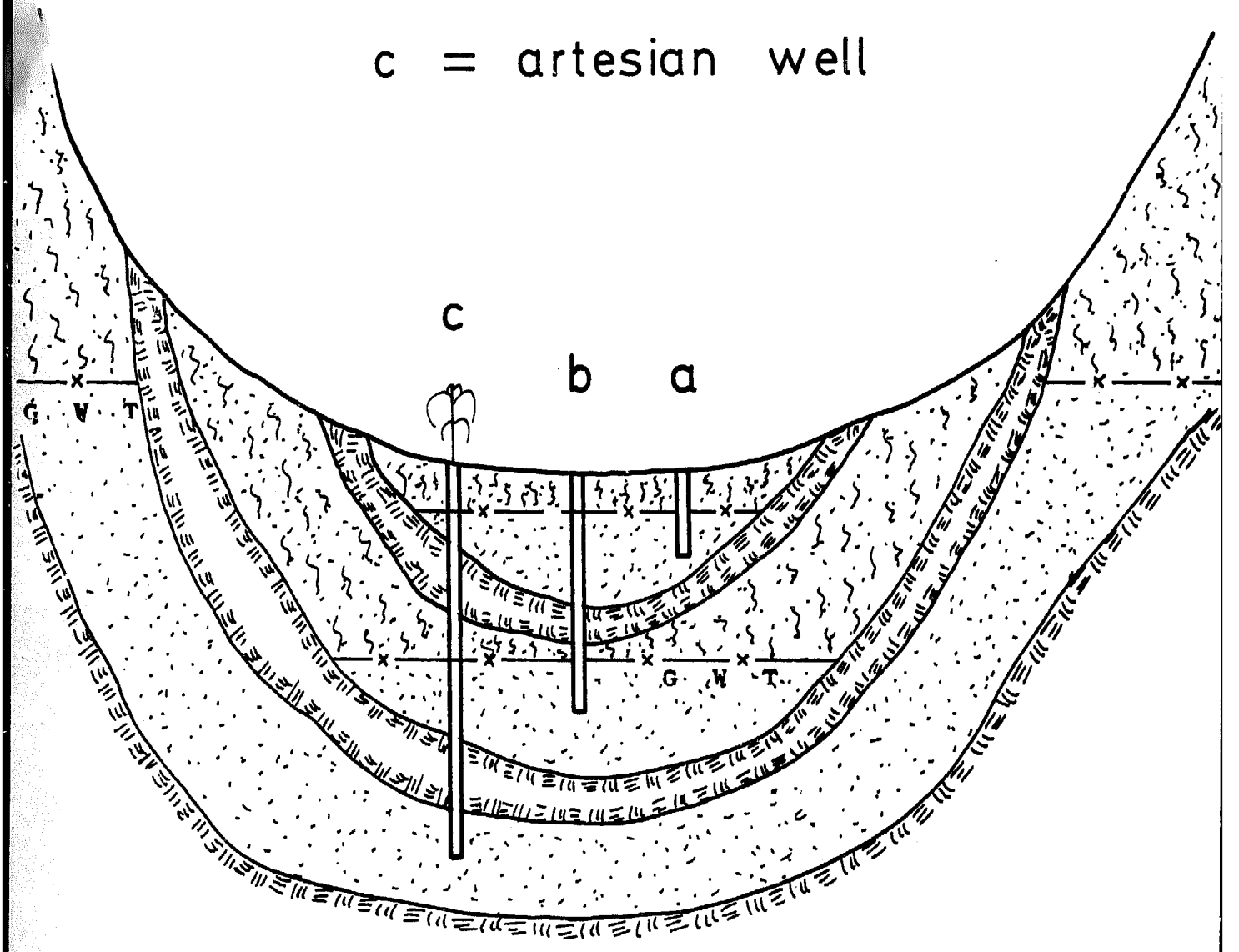
c) The artesian well which has the similar characteristics as the deep well except that it taps water under pressure which will bring the water to the surface under its own head.

TYPE OF WELLS.

a = shallow well

b = deep well

c = artesian well



Legend :

Impermeable stratum

Saturated stratum

Pervious stratum

Ground water table

6.5 Rivers

The run-off water or stream -flow is the water which is gathered into rivulets, brooks, streams or rivers.

The volume and variation of run-off are influenced chiefly by the rainfall and its distribution by the size, shape, cover and general topography of the catchment area, by the nature and condition of the ground.

The melting of the snow also influneces the flow of rivers.

For drinking purpose, the water of rivers should be treated by sedimentation and filtration. Chemical products, (chlorination) can be added for elimination of bacteria. It will be the same for lake water.

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