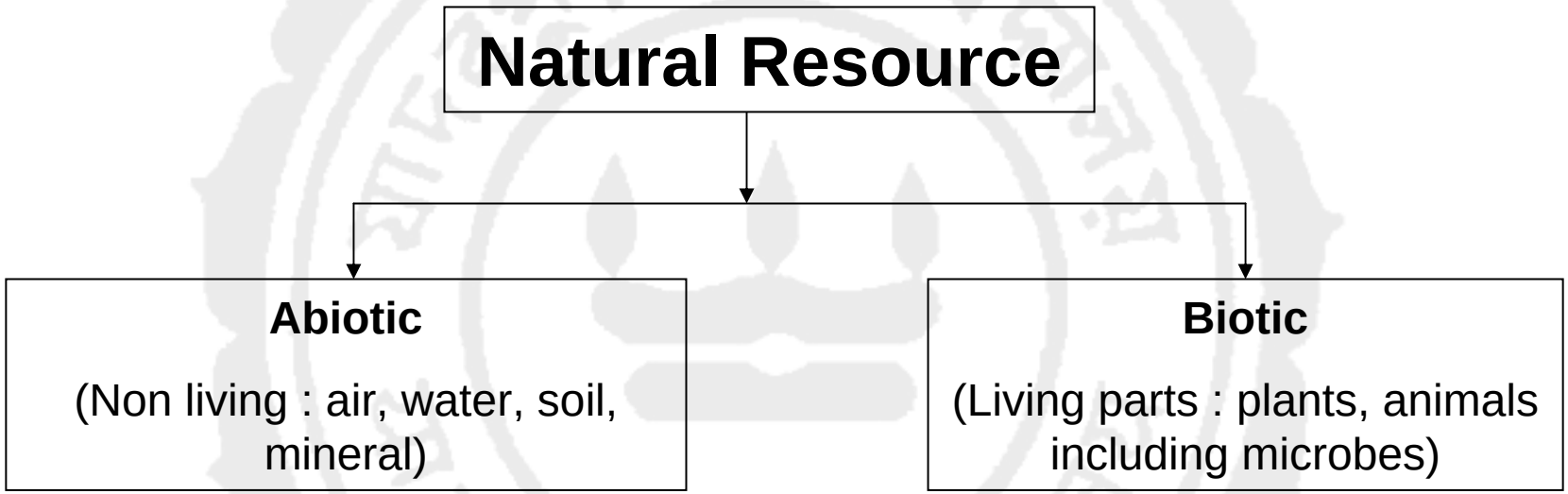
Natural Resource

Renewable and non-Renewable Resources

Natural Resources



Natural Resources

Interaction between the abiotic aspects of nature and specific living organisms together form ecosystems of various types.

Natural Resources

About ten thousand years ago, when mankind changed from a hunter-gatherer, living in wilderness areas such as forests and grasslands, into an agriculturalist and pastoralist, we began to change the environment to suit our own requirements.

Natural Resources

Mankind has been overusing and depleting natural resources. The over-intensive use of land has been found to exhaust the capability of the ecosystem to support the growing demands of more and more people, all requiring more intensive use of resources. Industrial growth, urbanization, population growth and the enormous increase in the use of consumer goods, have all put further stresses on the environment. They create great quantities of soil waste. Pollution of air, water and soil have begun to seriously affect human health.

Changes in land and resource use

During the last 100 years, the normal rise in human numbers has, in the recent past, placed great demands, on the earth's natural resources. Large stretches of land such as forests, grasslands and wetlands have been converted into intensive agriculture. Land has been taken for industry and the urban sectors. These changes have brought about dramatic alterations in land-use patterns and rapid disappearance of valuable natural ecosystems. The need for more water, more food, more energy, more consumer goods, is not only the result of a greater population, but also the result of over-utilization of resources by people from the more affluent societies, and the affluent sections of our own.

Earth's Resources and Man

Atmosphere

- Oxygen for human respiration (metabolic requirements).
- Oxygen for wild fauna in natural ecosystems and domestic animals used by man as food.
- Oxygen as a part of carbon dioxide, used for the growth of plants (in turn are used by man).

The atmosphere forms a protective shell over the earth. The lowest layer, the troposphere the only part warm enough for us to survive in is only 12 kilometers thick. The stratosphere is 50 kilometers thick and contains a layer of sulphates which is important for the formation of rain. It also contains a layer of ozone, which absorbs ultra-violet light known to cause cancer and without which, no life could exist on earth.

Hydrosphere

- Clean water for drinking (a metabolic requirement for living processes)
- Water for washing and cooking
- Water used in agriculture and industry.
- Food resources from the sea, including fish, crustacea, sea weed, etc.
- Food from fresh water sources, including fish, crustacea and aquatic plants.
- Water flowing down from mountain ranges harnessed to generate electricity in hydroelectric projects.

Lithosphere

- Soil, the basis for agriculture to provide us with food.
- Stone, sand and gravel, used for construction.
- Micronutrients in soil, essential for plant growth.
- Microscopic flora, small soil fauna and fungi in soil, important living organisms of the lithosphere, which break down plant litter as well as animal wastes to provide nutrients for plants.
- A large number of minerals on which our industries are based.
- Oil, coal and gas, extracted from under ground sources. It provides power for vehicles, agricultural machinery, industry and for our homes.

Biosphere

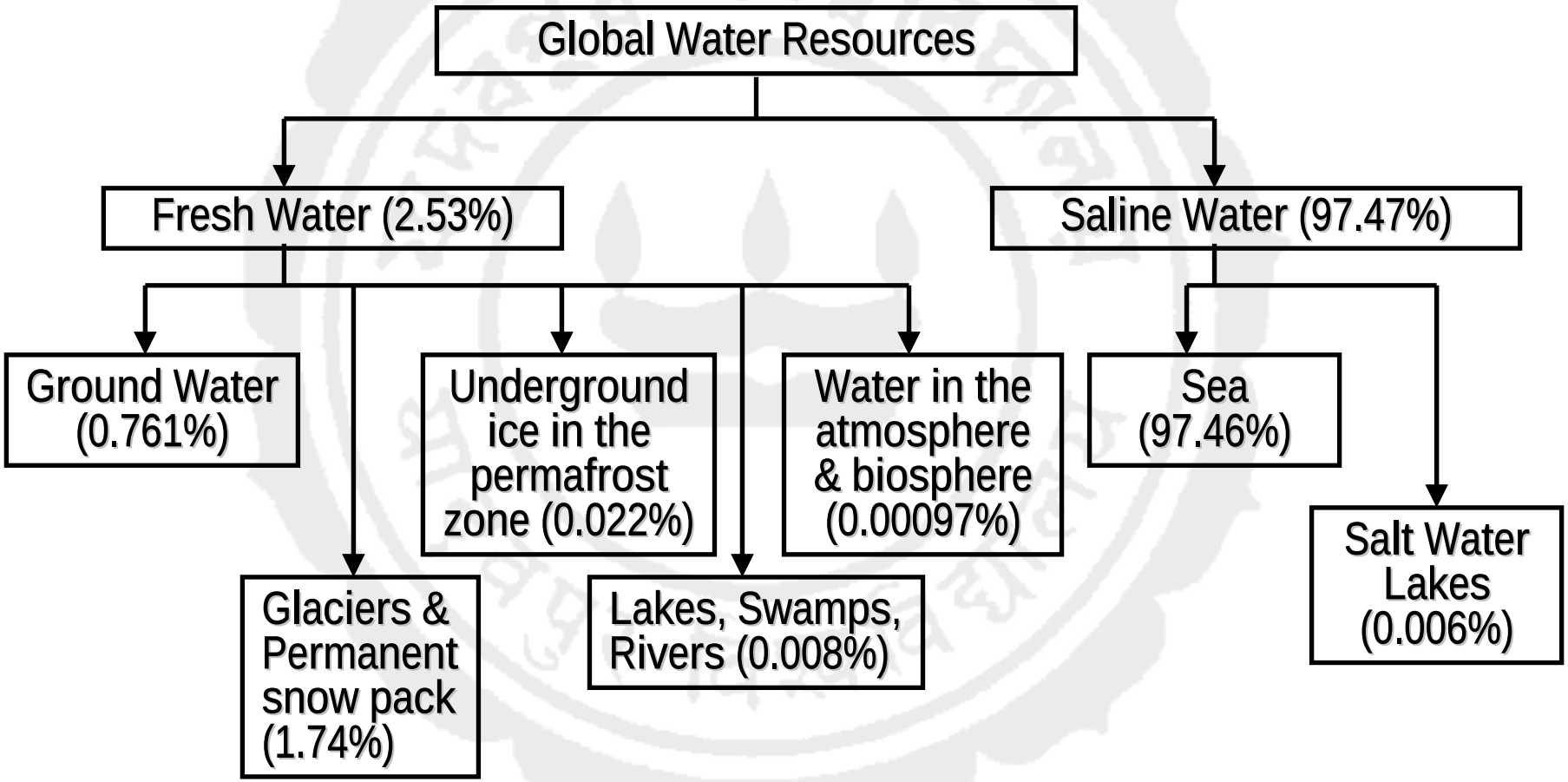
- Food, from crops and domestic animals, providing human metabolic requirements.
- Food, for all forms of life which live as interdependent species in a community and form food chains in natural on which man is dependent.
- Energy needs Biomass fuel wood collected from forests and plantations, along with other forms of organic matter, used as a source of energy.
- Timber and other construction materials.

Water Resource

GLOBAL WATER RESOURCES

The distribution on earth is shown below :

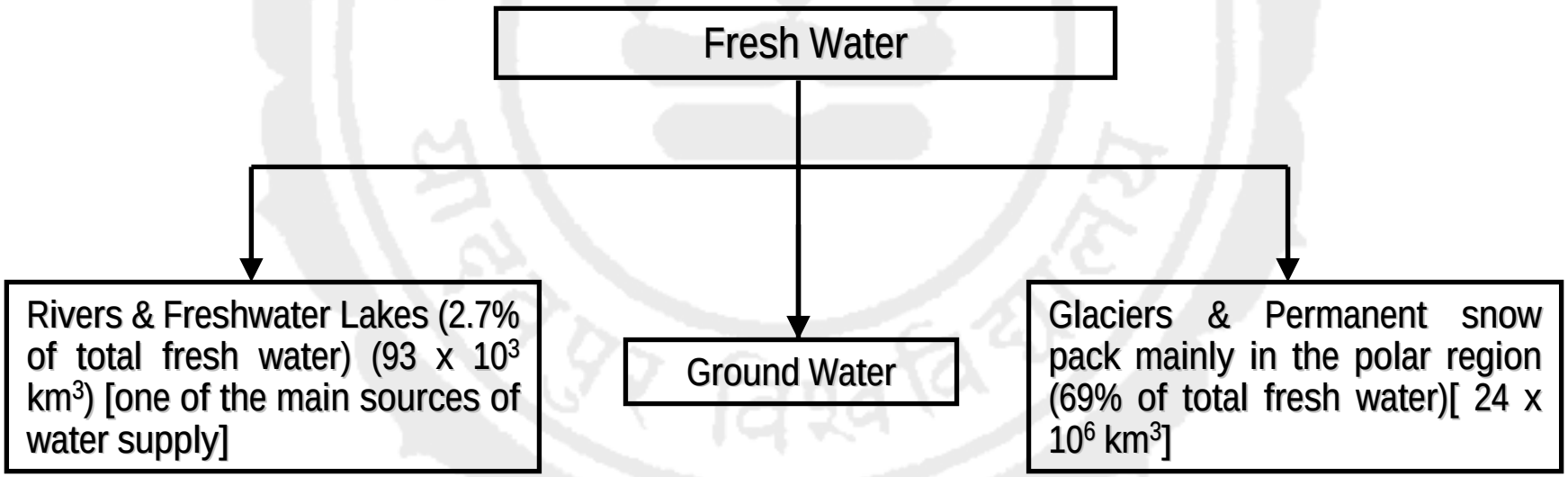
[Global Water Resources estimated 1.386 x 10^9 km^3 = 1.386 x 10^8 M ha m]



Source: "Nature & Resources" Vol.26, No. 3, 1990

WATER RESOURCES STORED IN THREE GIANT RESERVOIR

- Ocean - 97.2%
- Continent - 2.8%
- Atmosphere - 0.00097%
- The total volume of fresh water on earth is about 35 million km^3 (i.e. 35 x 10^6 km^3) which is only 2.5% of the water in the hydrosphere.



Source: "Nature & Resources" Vol.26, No. 3, 1990

SOURCE : WORLD WATER VISION 2025 (STRZEPEK 1999)

SUSTAINABLE YIELD OF WATER RESOURCES IN WORLD

TOTAL AMOUNT OF FRESH WATER AVAILABLE TO HUMANS

40,700 km^3

ACCESSIBLE (80%)
32,900 km^3

TOO INACCESSIBLE
(20%)

¾ FLOODS
24,700 km^3

¼ SUSTAINABLE YIELD
8,200 km^3

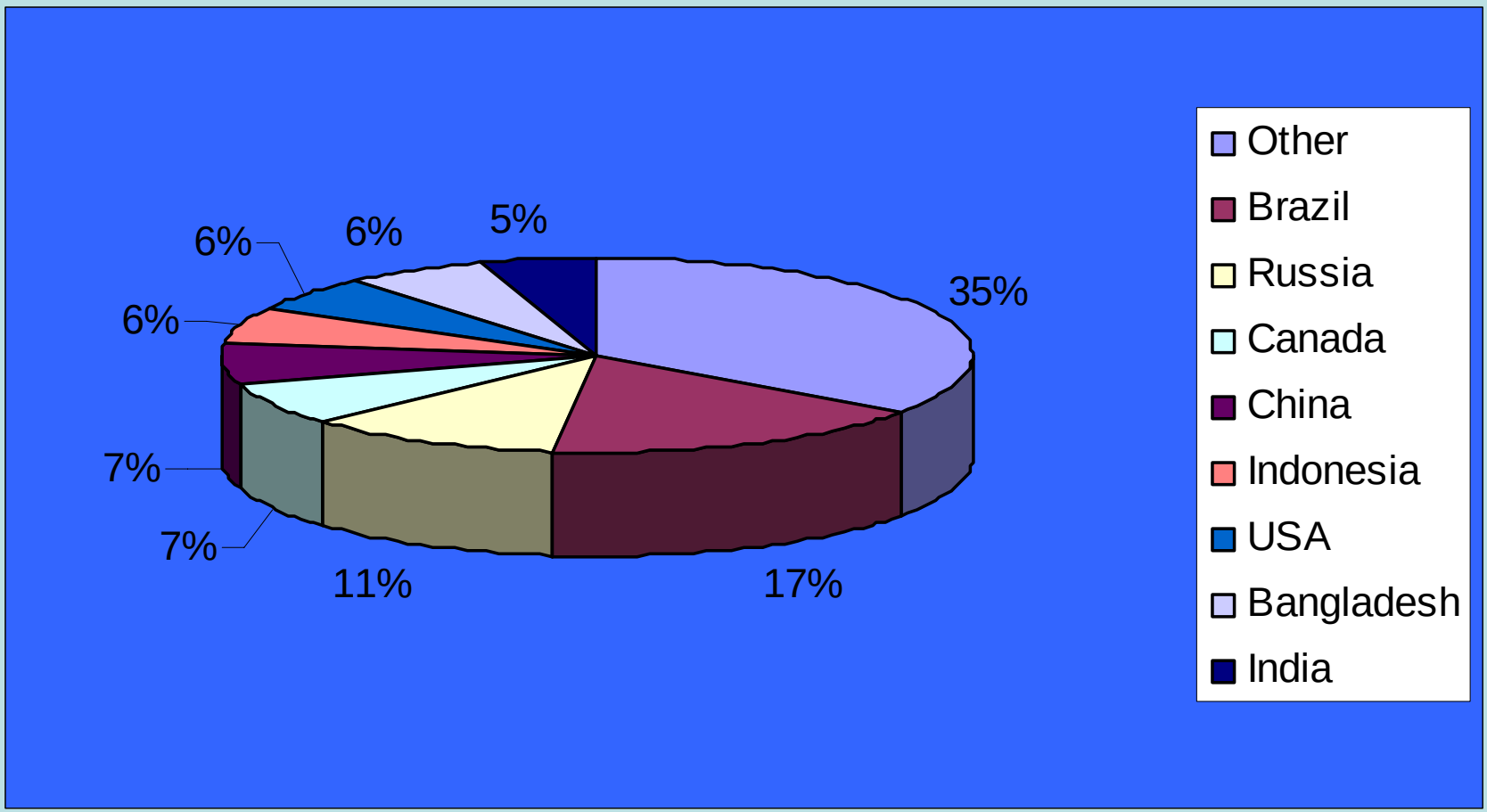
+

DAMS
4,300 km^3

12,500 km^3 (TOTAL SUSTAINABLE YIELD)

CURRENT TOTAL USE = WITHDRAWALS : 4,100 km^3 + INSTREAM USE: 2,150 km^3 = 6,250 km^3

Distribution of the World's Water

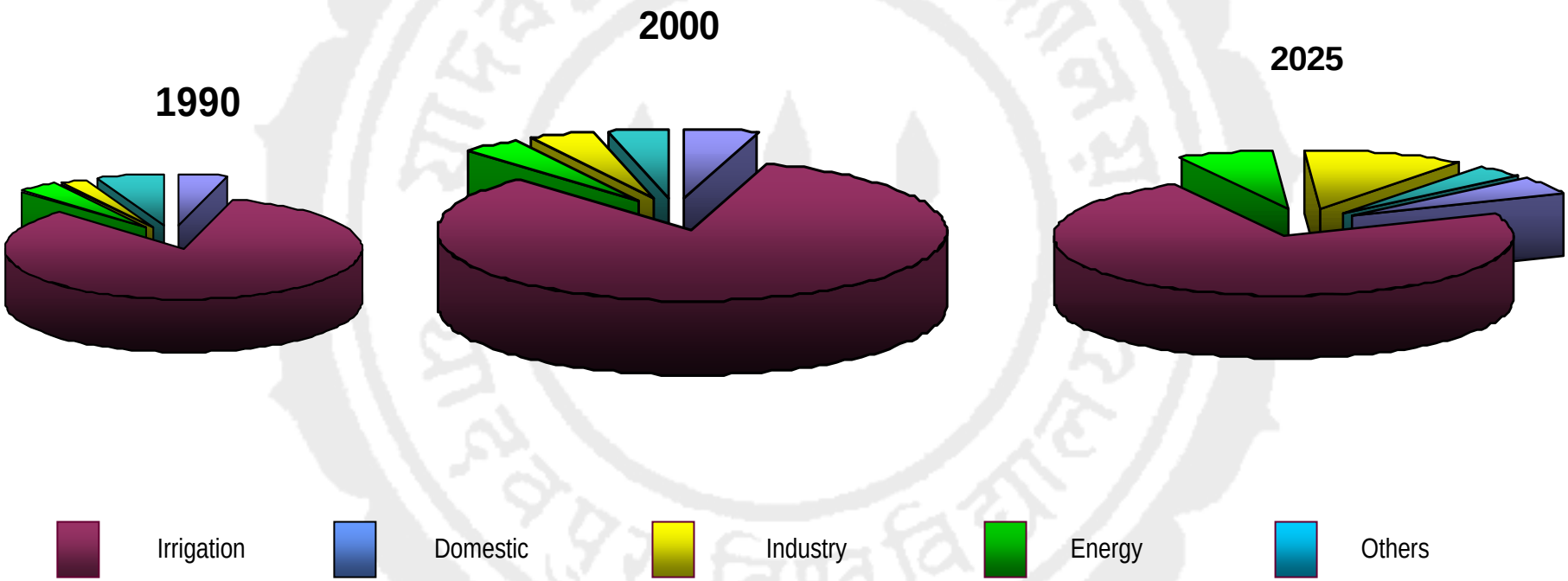


SOURCE : SHIKLOMANOV (1998)

PROJECTED REQUIREMENTS OF WATER IN THE WORLD

YEAR	TOTAL GLOBAL WATER ($km^3\ yr^{-1}$)	TOTAL ACTUAL CONSUMPTION ($km^3\ yr^{-1}$)	CONSUMPTION OF WITHDRAWAL (%)
1995	3750 ($km^3\ yr^{-1}$)	2270 ($km^3\ yr^{-1}$)	61 %
2025	5100 ($km^3\ yr^{-1}$)	2860 ($km^3\ yr^{-1}$)	56 %

Sectorial projection of relative water demand



Source: Rao 1997

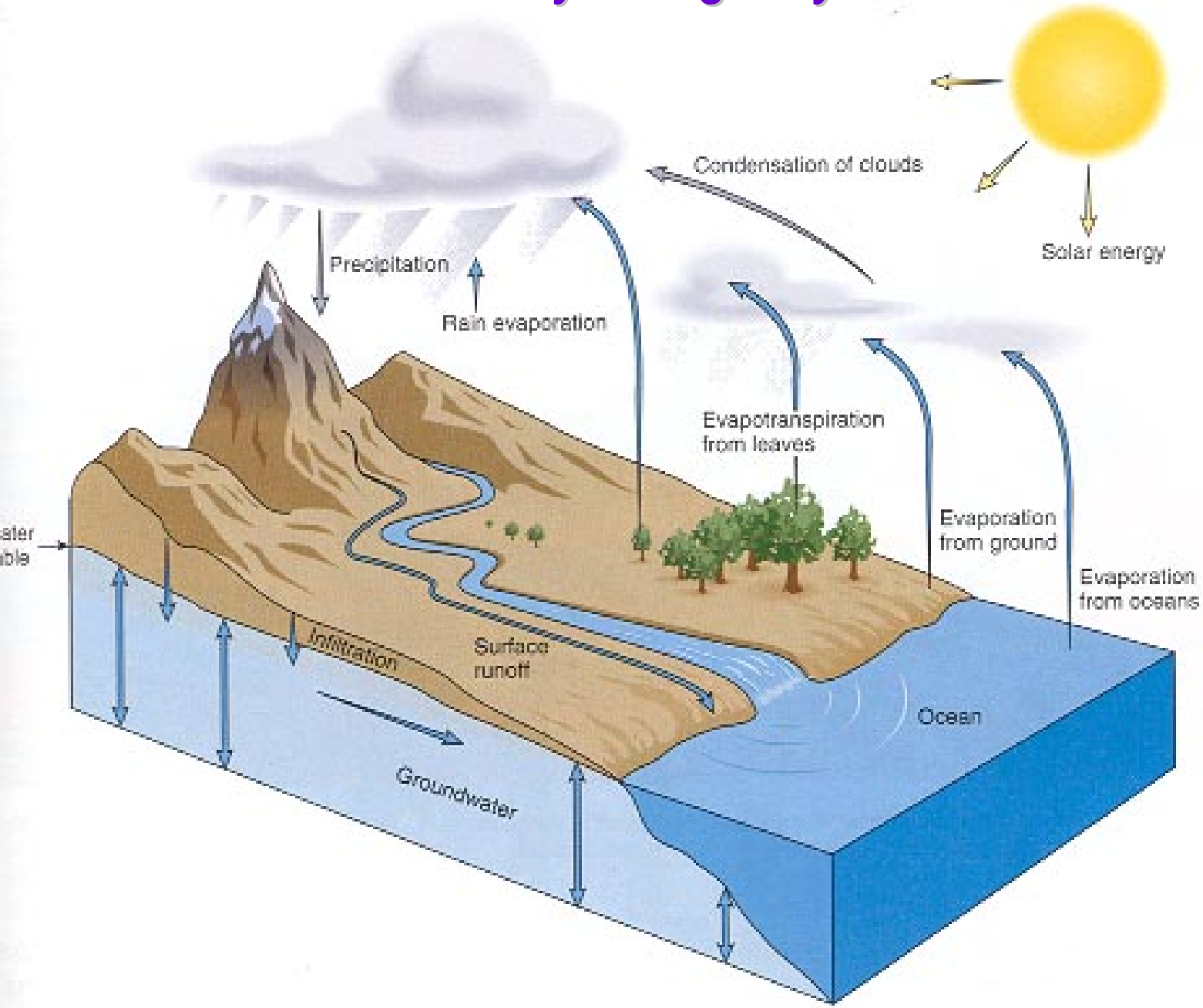
Water Cycle

Water is different from other natural resources in being mobile. Most of the water on earth is involved in a continuous movement called the Water Cycle. Water evaporates from the surface of the oceans, seas, lakes rivers, etc., forms clouds and moves inland. When the water vapor in the clouds condenses, it precipitates as rain or snow depending upon the ambient temperature. Part of the precipitation on land forms surface runoff, and part percolates downward forming groundwater.

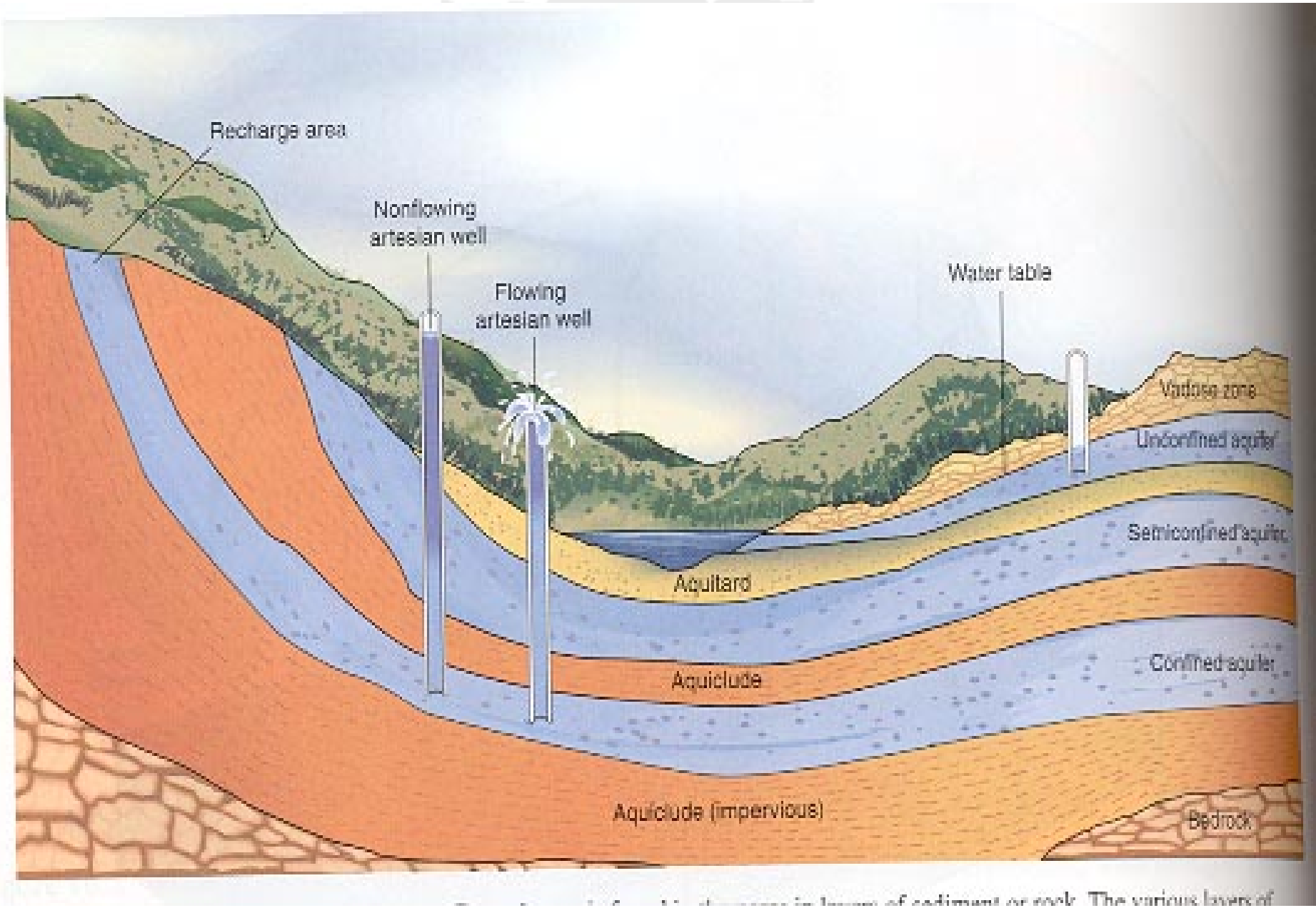
Water Cycle

The force of gravity moves surface water and groundwater into depression (river valleys) and forms rivers which feed the oceans. Part of the rainfall is retained in the soil as soil moisture, which undergoes evaporation (including transpiration). The vapors of the atmosphere are carried by air currents, condense and form precipitation, and a new cycle starts.

Hydrologic Cycle



Aquifers & Ground Water



There is little doubt that in the twenty-first Century, water issues are going to emerge as the most serious problem facing humankind.

Dublin Principles:

Principle No. 1 – Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment,

Principle No. 2 – Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels,

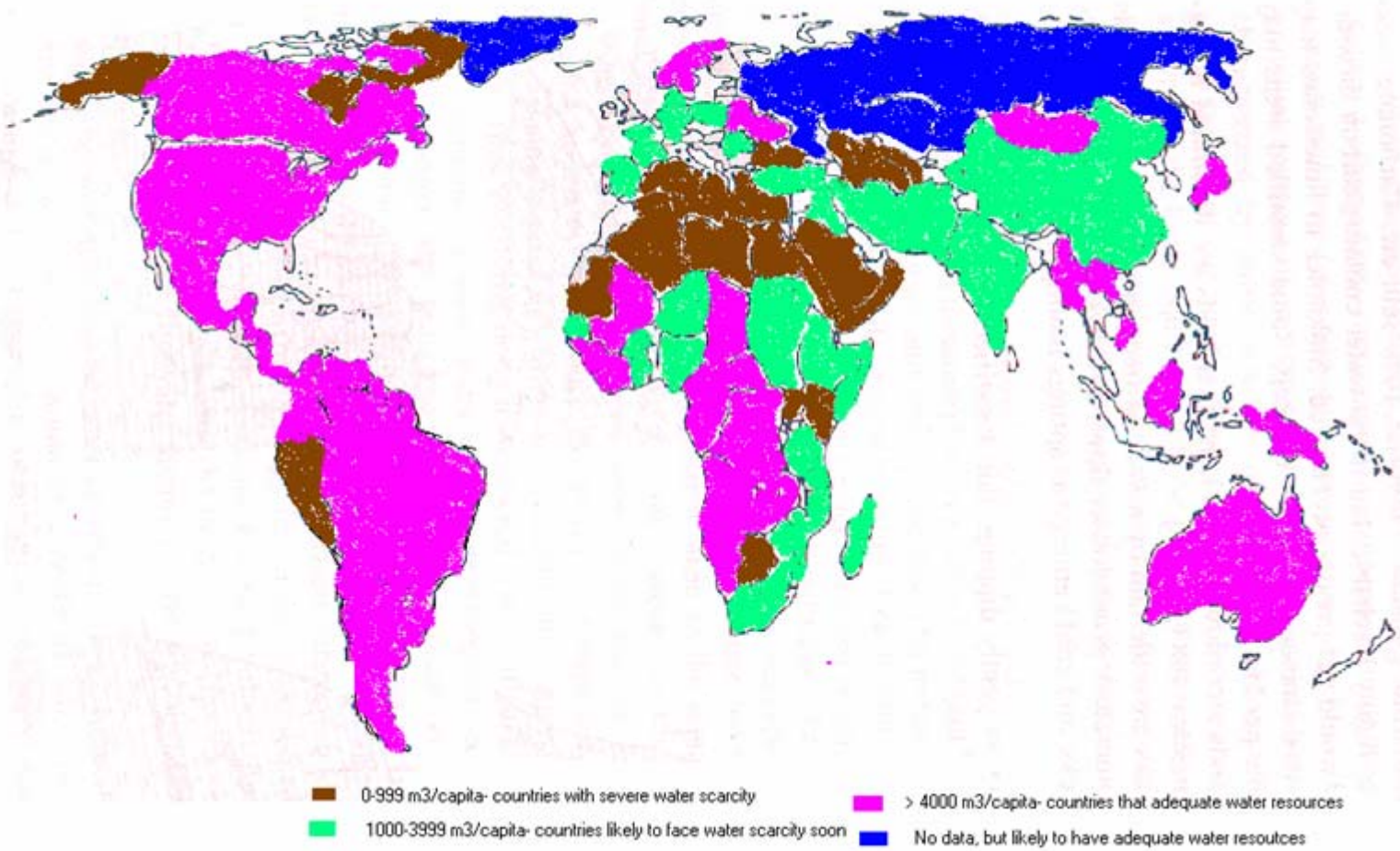
Principle No. 3 – Women play a central part in the provision, management and safeguarding of water,

Principle No. 4 – Water has an economic value in all its competing uses and should be recognized as an economic good.

Over all these years, therefore the message has remained the same: water is a precious resource that must be assessed and managed with care for the benefit of mankind and the natural environment

Annual Renewal Water Resources of the various Countries in the World

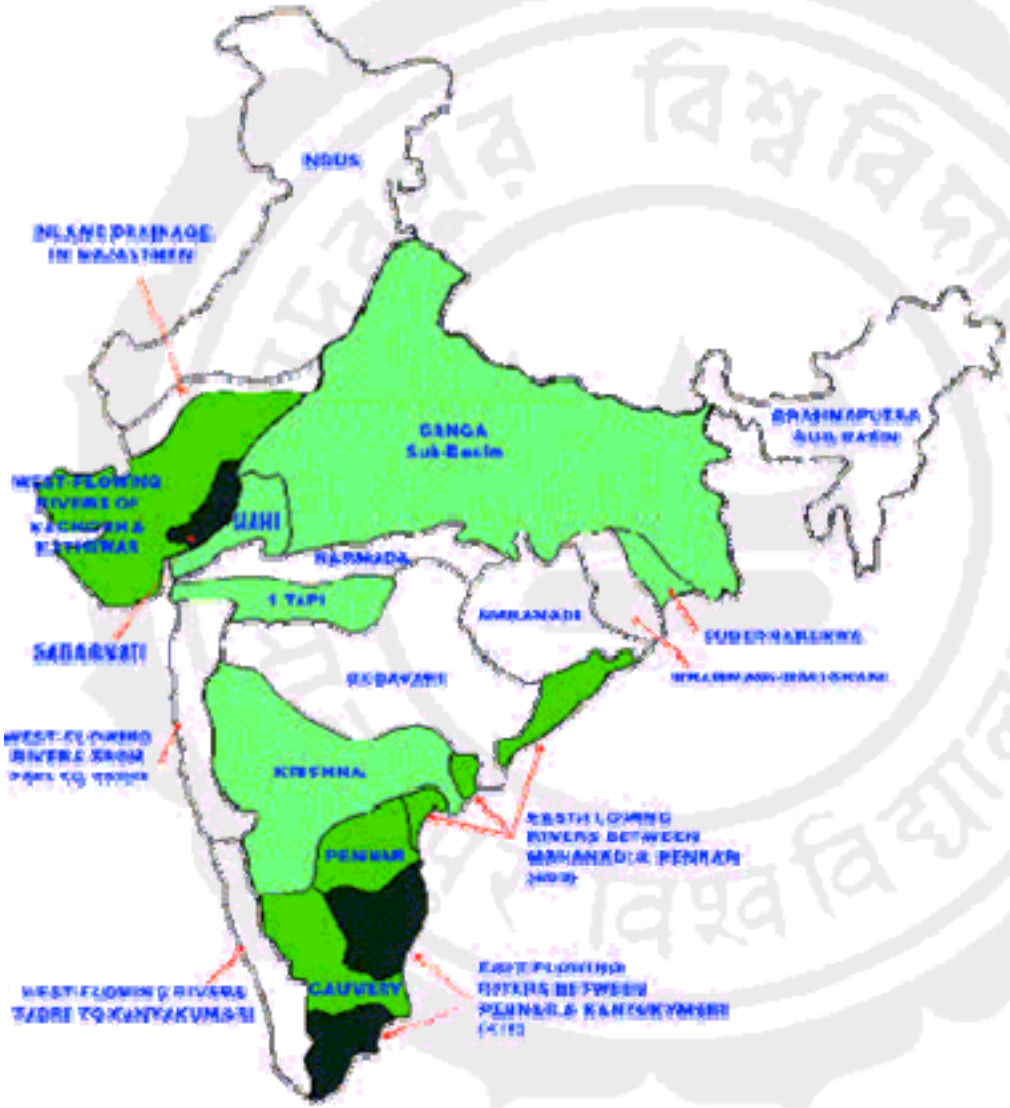
Figure Annual Renewal Water Resources of the various countries in the World (source: World Bank 1992)



WATER SCARCITY INDICATORES (Falkenmark Indicator)

> 1700 m3/Capita/Yr.	Water Scarcity Rare
< 1700 m3/Capita/Yr.	Country faces seasonal or regular water-stressed conditions
< 1000 m3/Capita/Yr.	Water shortage hamper the health and well being of the human beings- Econo activities are affected
< 500 m3/Capita/Yr.	Shortages are severe constraints to human life

Water Scarcity in India



Absolute scarcity :

Sabarmati Basin & East flowing river basins between Pennar & Kanyakumari

- Occasional Water Problem
- Water Stress
- Water scarcity
- Absolute scarcity

- **Scarcity amongst plenty :**

- Cherrapunji (11000 mm of rainfall) suffers from serious drinking water shortages mainly due to seasonal nature of the rainfall, quick runoff and excessive preference of local community towards spring water supply over any other source

- **Management with scarce resource** :

- Barmer (one India's driest place) has less rainfall (100 mm) but few people and a lot of land available per person whereas 24 parganas in West Bengal has much more rain but more people hence less land available per person.

DIMENSIONS OF WATER RESORUCES MANAGEMENT

- The United Nations Report entitled, “Comprehensive Assessment of the Fresh water Resources of the World” (1997), draws a sombre picture of how water shortages in the 21st century could constrain economic and social development, and become sources of conflict between countries. Water use has been increasing twice as fast as population during this century. Population has made the matters worse. Total water use in the world rose from 1000 km^3 yr^{-1} in 1940 to 4130 km^3 yr^{-1} in 1990. It is expected to rise to 5000 km^3 yr^{-1} in 2000. At least one-fifth of the world’s people lack access to safe drinking water. About 80 countries in the world, making up 40% of the world's population, are already suffering from serious water shortage, which had become a limiting factor in their economic and social development. The Report forecasts that by 2025, as much as two-thirds of the world's population will be affected by moderate to severe water scarcity, unless appropriate mitigation measures are take.

DIMENSIONS OF WATER RESORUCES MANAGEMENT

- Presently, agricultural irrigation accounts for 70-80% of all water use. Increasing population would need more food and hence more water would be needed for irrigation. The report argues that water must be perceived as a marketable commodity, with its use being subject to the market laws of supply and demand. It has been estimated that in USA, one acre-foot of water would yield an income of US$ 400 when used in agriculture, and US$ 400,000 when used in manufacturing. So in the American context, when water is scare, it would be used for drinking and manufacturing purposes. Food is to be grown in areas where water is plentiful.

DIMENSIONS OF WATER RESORUCES MANAGEMENT

- A complication factor is the global trend towards urbanization – urban population as a percentage of total population, varies from 100% in city-states like Singapore, 80-90% in several countries of Western Europe (e.g. UK: 89%) and South America (e.g. Argentina: 86%), 20-30% in most African countries (e.g. Mozambique: 30%), with Bhutan having the lowest percentage (5%). Globally, urban populations are increasing at a faster rate than the general population growth, and this is particularly evident in the developing countries where this differential can be as high as three to four. This has serious implication for water resources planning. Cities cannot be shifted to places where resources like water and fertile soil are available. On the other hand, services like drinking water, habitation, sanitation, roads, etc. have to be organized keeping in mind the existing location of towns.

NEED OF THE HOUR

- India which has 16 % of the world's population, 2.45 % of the world's land area and 4 % of the world's water resources already has a grave drinking water crisis.
- Per capita availability of water, which was in the order of 5000 m^3 per year at the time of independence, has drastically come down to approx. 1900 m^3 per year at present.
- Estimates of the Central Ground Water Board are that the reservoir of underground water will dry up almost entirely upto the present extractable and lifting capacity by 2025 in as many as fifteen states in India if the present level of exploitation and misuse of underground water continues.
- By 2050 when more than 50 % on the Indian population is expected to shift to the cities, fresh drinking water is expected to get very scare. A new category of refugees is expected to emerge around that time: the water migrants.

Distribution of large Dams in India

Year of Completion	No. of Dams
Upto 1900	42
1901 – 1950	251
1951 – 1960	234
1961 – 1970	461
1971 – 1980	1190
1981 – 1989	1066
1990 And above	116
Year of Construction not available	236
Under Construction	695
Total	4291

Regional Distribution of Major Dams in India

No. of Dams	No. of State	States where located
Upto 50	09	Bihar, H.P. J&K, Kerala, Meghalaya, Orissa, Punjab, West Bengal, Goa, Daman and Due
50 – 100	04	AP, Karnataka, Tamilnadu, U.P.
50 – 150	01	M.P.
50 and above	02	Gujarat, Maharashtra.

BIG DAM CONTROVERSY IN INDIA

- It is now universally agreed that economic growth initiates a disequilibria to break the low-level equilibrium trap of the low income economies. This is urgent for economic development the primary aim of which is to uplift the living standard of the huge mass of the weaker sections of the population in those countries. To achieve the target, development economics in the decade of fifties relied mainly on rapid income generation through capital formation in the form of machineries (in large scale capital-intensive industries), irrigation infrastructures (like big dams and multipurpose river valley projects), power (hydro, thermal and nuclear) and transport (highways) believing in the theory of trickle-down of benefits.

BIG DAM CONTROVERSY IN INDIA

- Among the developing low income countries of the world, India is known to be an economy with wide and comprehensive statistical data base for a long time. But astonishingly it has no detailed date on the ex-post benefits and costs of bid dams and the divergence between the targets an achievements in this sector during the last 50 years. The Central Water Commission has estimated that India is now the word's third largest dam builder and in 2001 she has 4,291 dams which can be called big dams out of which only 300 were built before independence. A large number of such dams (695) are still under construction. In any cost-benefit analysis, it is required to provide reliable estimates of costs and benefits in money terms. But the projected actual costs of such dams will widely vary as the track record of Indian dams show that they usually take much longer period than planned for completion leading to cost escalation.

REMARKS

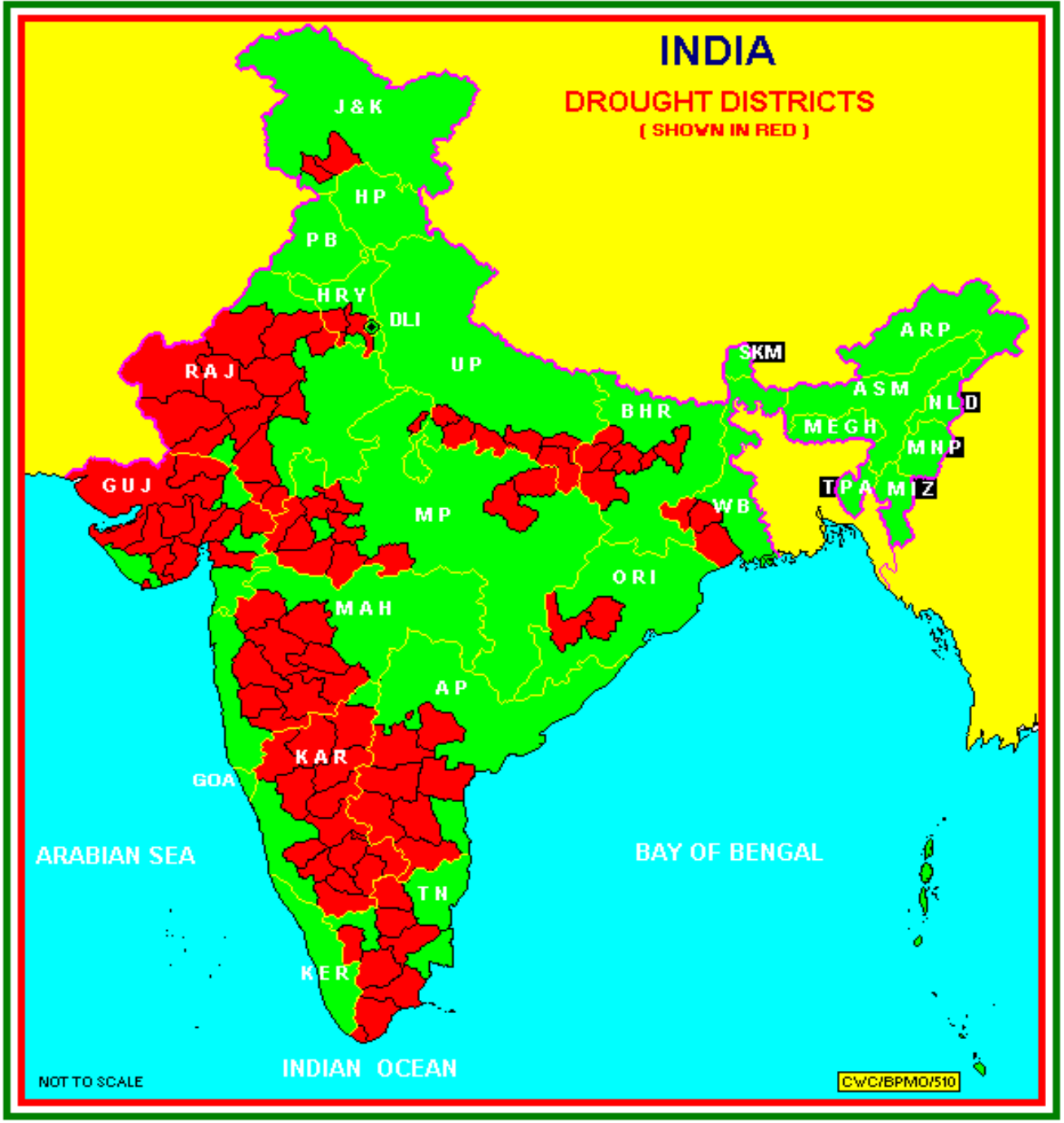
- Inspite of all the achievements made so far in water resources development sectors since independence, there cannot be complacency, as yet, in the matter of further development in as much as only 37% of cultivable land stand irrigated and 15% of the hydropower potential is harnessed. It is true that there are several arguments in favour of and in against of the dams. Some of the established facts are rare myths and can be avoided by taking precautions. It is difficult for an economy like India to have sustainable development without acknowledging the social and economy implication of major dams. However, the smaller dams may be promoted because of their advantages, bigger may be planned with grate care to avoid delay in completion and cost escalation. Social issues and demerits can be avoided if proper planning for displacement, rehabilitation and employment opportunities are managed.

INDIA

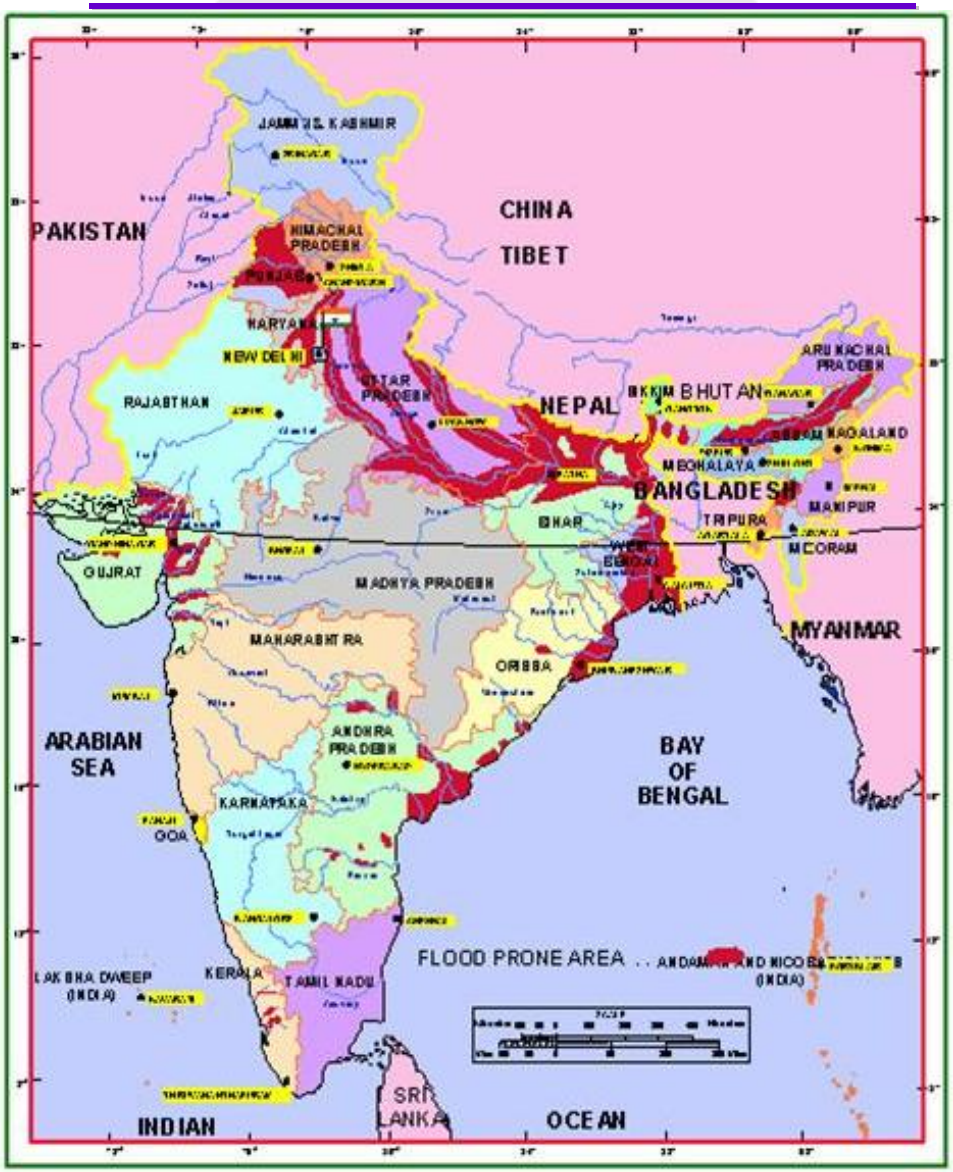
GEOGRAPHICAL AREA	329 M ha (2.45% OF WORLD LAND AREA)
POPULATION	1.027 BILLION (16% OF WORLD POPULATION)
CULTIVABLE AREA	184 M ha
CULTIVATED AREA	142 M ha
GROSS CROPPED AREA	190.7 M ha
CROPPING INTENSITY	134.3%

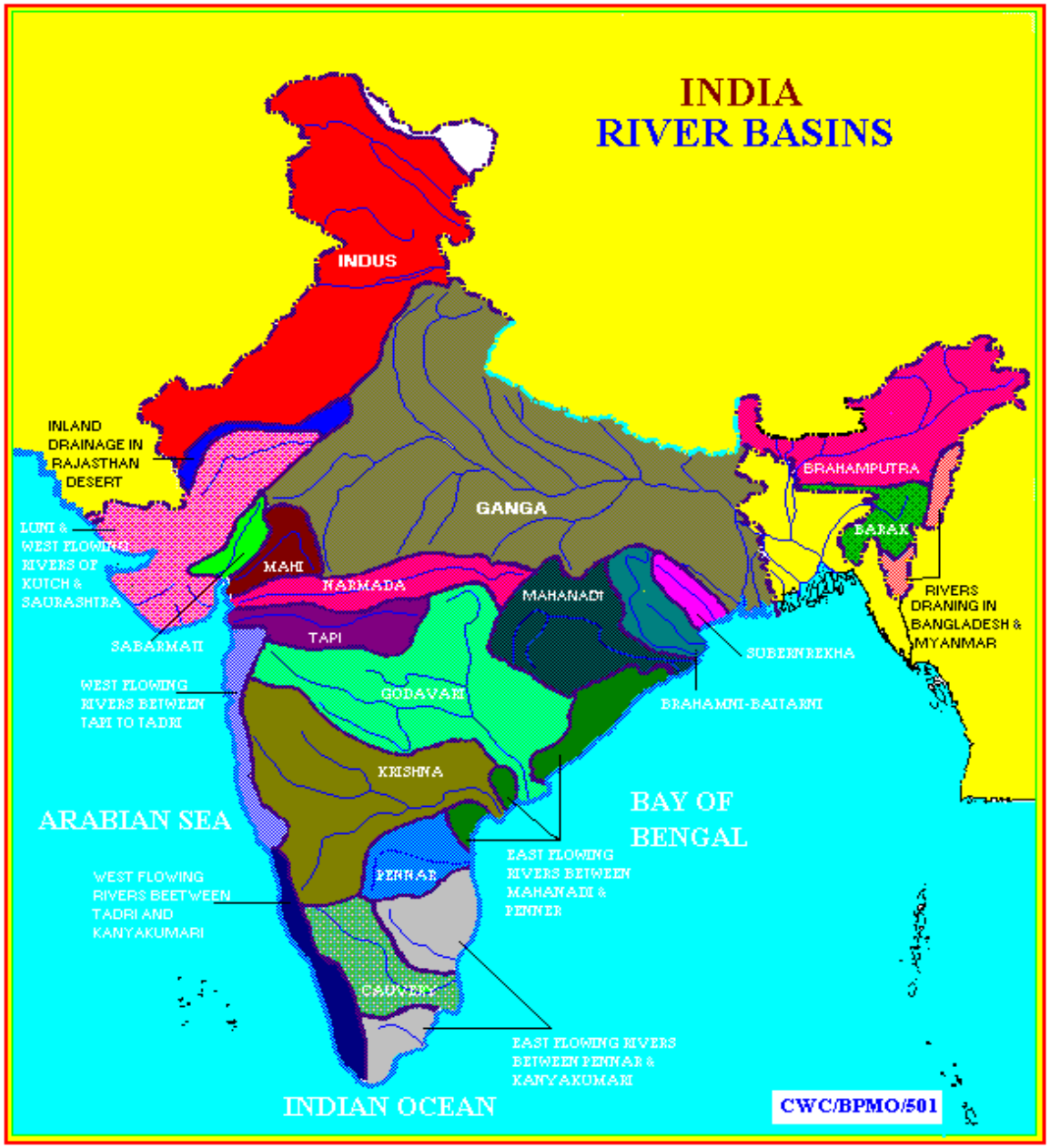
INDIA

- Annual average precipitation - 4000 BCM
  - Highly variable in space and time
    - Minimum 100 mm in Western Desert
    - Maximum 11000 mm in North Eastern Region
- Rainfall during June to September 3000 BCM
- As a result the Country Faces Droughts & Floods
- Drought Prone Area 108 M ha
- Flood Prone Area 40 M ha


INDIA
DROUGHT DISTRICTS
(SHOWN IN RED)
J & K
HP
PB
HRY
DLI
RAJ
UP
BHR
SKM
ARP
ASM
NLD
MEGH
MNP
TPA
MIZ
GUJ
MP
WB
ORI
MAH
AP
KAR
GOA
TN
KER
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
NOT TO SCALE
CWC/BPMO/510

INDIA: Area Liable to Floods




INDIA
RIVER BASINS
INDUS
INLAND
DRAINAGE IN
RAJASTHAN
DESERT
LUNI &
WEST FLOWING
RIVERS OF
KUTCH &
SAURASHTRA
SABARMATI
WEST FLOWING
RIVERS BETWEEN
TAPI TO TADRI
MAHI
NARMADA
TAPI
GANGA
MAHANADI
GODAVARI
KRISHNA
PENNAR
CAUVERY
BRAHAMPUTRA
BARAK
RIVERS
DRANING IN
BANGLADESH &
MYANMAR
SUBERNREKHA
BRAHAMNI-BAITARNI
ARABIAN SEA
BAY OF
BENGAL
WEST FLOWING
RIVERS BEETWEEN
TADRI AND
KANYAKUMARI
EAST FLOWING
RIVERS BETWEEN
MAHANADI &
PENNER
EAST FLOWING RIVERS
BETWEEN PENNAR &
KANYAKUMARI
INDIAN OCEAN
CWC/BPMO/501

INDIA

WATER AVAILABILTY

- Average annual water resource potential — 1869 BCM
- Utilizable Surface water resources — 690 BCM
- Replenishable Ground water resource — 432 BCM
- Total utilizable water resource — 1122 BCM

INDIA

- Per capita availability is progressively reducing owing to increasing population

Year	Population (in million)	per capita water availability (in cubic metre)
1951	361	5177
1991	846	2209
2001	1027	1820
2025	1394 (projected)	1340
2050	1640 (projected)	1140

WATER REQUIREMENT

	2002	2025
❑ DOMESTIC WATER SUPPLY	42 BCM (6.6%)	73 BCM (6.7%)
❑ WATER FOR IRRIGATION	541 BCM(85.3%)	910 BCM (83.2%)
❑ WATER FOR INDUSTRY	8 BCM (1.3%)	23 BCM (2.1%)
❑ WATER FOR ENERGY	2 BCM (0.3%)	15 BCM (1.4%)
❑ OTHER USES	41 BCM (6.5%)	72 BCM (6.6%)
TOTAL	634 BCM	1093 BCM

WATER VISION
IDENTIFIED OBJECTIVES

- To Help Meet the Food and Fibre Requirement of a Projected Population of 1390 Million by 2025
- To Make Available Safe Drinking Water for All
- To Safeguard Existing Water Sources From Pollution and Over Exploitation
- To Ensure Safety and Serviceability of Existing Infrastructure and Improve Efficiency of Irrigation Water Systems and Its Application

...Contd

WATER VISION
IDENTIFIED OBJECTIVES

- Enhance Ecology by Maintaining Minimum Water Flows in Rivers.
- Minimize the Adverse Environmental and Social Impact of Water Resources Projects
- To Maximize the Hydropower Development
- To Mitigate Miseries Caused by Water Related Natural Disaster Through Flood and Drought Management

WATER VISION
STRATEGY

- Integrated Development and Management of Water Resources
- Development of New Resources
- Optimal Utilization of Developed Water Resources
- Preserving the Resources
- Augmenting the Available Water Resources
- Stakeholders Participation in Water Resources Management.
- Demand Side Management Through Mass Awareness
- Dissemination and Application of Technology & Research

NATIONAL WATER POLICY

For Achieving it's Water Vision the Country has adopted the updated Nation Water Policy (2002)

NATIONAL WATER POLICY-2002
WATER ALLOCATION PRIORITIES

In the planning and operation of systems, water allocation priorities should be broadly as follows:

- Drinking water
- Irrigation
- Hydropower
- Ecology
- Agro-industries and non-agricultural industries
- Navigation and other uses

However, the priorities could be modified or added if warranted by the area/region specific considerations.

Forest Resource

Forest Resources (Contd.)

The estimates provided in the FRA Forest Resources Assessment 2000 report for the area covered by forests in the world was around 3.9 billion ha, which corresponds to approximately 30% of the world's land area. About 95% of the forest cover was in natural forest and 5% in forest plantations. Natural forests, in this context, refers to forest stands predominantly composed of self-sown native trees (trees which have germinated and grown from spontaneous seedfall, either wholly naturally or influenced by various silvicultural activities).

Forest Resources (Contd.)

Of the total forest area, 47% is concentrated in the tropics, 33% in the boreal zone, 11% in the temperate areas, and 9% in the subtropics. The distribution of the forest area by region is presented in Table 1.

Table 1 Forest area by region (FAO Global Forest Resource Assessment, 2000)

Region	Land area (ha x 10^6)	Total forest (natural forest and forest plantations)				Natural forests (ha x 10^6)	Forest plantations (ha x 10^6)
		Area (ha x 10^6)	% of land area	% of all forests	Net change		
Africa	2978	650	22	17	-5.3	642	8
Asia	3085	548	18	14	-0.4	432	116
Europe	2260	1039	46	27	0.9	1007	32
North and Central America	2137	549	26	14	-0.6	532	18
Oceania	849	198	23	5	-0.4	194	3
South America	1755	886	51	23	-3.7	875	10
World Total	13064	3869	30	100	-9.4	3682	187

Forest Resources (Contd.)

Traditionally, in tropical countries forest management strategies have been based on the premise that sustainable forest management being the responsibility of a profession al forest service, and by focusing forest production measures predominantly on commercial timber production. In the mid 1970s it became recognized that this strategy was too top-down –oriented and that it focused predominantly on national interests rather than on the needs of local communities. Therefore it did not contribute much towards improving the welfare and well being of large segments of the population living in or near forests.

Forest Resources (Contd.)

Consequently, a new strategy for forest management was proposed, in which explicit attention was given to the forest-related needs of rural communities and to community participation in the sustainable management of forest resources. This new strategy was termed social forestry or community forestry. This strategy has become widely accepted, and in the last decades of the twentieth century much experience has been gained about how to involve local communities actively in forest management.

Forest Resources (Contd.)

India should ideally have 33% of its land under forests. Ministry of Environment & Forests, Govt. of India has set this optimistic target of 33% forest cover by 2012.

Forest Resources (Contd.)

CFM in India is known as Joint Forest Management (JFM) (Table 5), under a model whereby the forest is people in the management and protection of forests, signifying the birth of JFM, later interpreted at state level where each state forest department has control over forest policy (Table 5).

Forest Resources (Contd.)

JFM in India was, until recently, reserved for degraded forest lands, Guidelines passed in 2000 allow JFM to be implemented in forests with over 40% crown cover. The 1988 National Forest Policy is federal law, but is adapted by each state, so that the exact arrangements of JFM Resolutions differ between states. Twenty-two of India's 26 states have implemented JFM resolutions, and both the Resolution and the motivational levels of each state forest department influence its success.

Table 5 Definition of Joint Forest Management

Definition	Structure	Products	Purpose
Joint Forest Management (JFM) is a forest management strategy under which the Forest Department and the village community enter into an agreement to jointly protect and manage forest land adjoining villages and to share responsibilities and benefits.	The village community is represented through an institution specifically formed for he purpose. This institution is known by different names in different states (e.g., Vana Samaraksha Samitis in Andhra Pradesh and Hill Resource Management Societies in Haryana) but most commonly referred to as Forest Protection Committee or FPC. In some states, panchayats can also enter into JFM agreement with the Forest Department .	Under JFM, the village community gets a greater access to a number of non Timber Forest Products (NTFPs) and a share in timber revenue in return for increased responsibility for its protection from fire, gazing and illicit harvesting. The details vary from state to state as each state has issued its own JFM resolution / rules.	The essential difference between 'social forestry' and JFM is that while the former sought to keep people out of forests, the latter seeks to involve them in the management of forest lands. JFM also emphasizes joint management by the Forest Department and the local community.

Forest Resources (Contd.)

According to state forest report 2005 the forest cover of the country has been estimated to 677088 sq km. which is 20.60% of the total geographical area. Madhya Pradesh has the largest area of 76.013sq km. under forest cover constituting 11.22% of the total forest area followed by Arunachal Pradesh (10.01%), Chattisgarh (8.25%), Orissa (7.15%), Maharastra (7.01%). The seven north east states together account for 25.11% of the total forest area of the country whereas the tribal districts (188) comprises 60.11% of the total forest area of the country.

According to state forest report (2005) recorded forest and tree cover of some of the major states and West Bengal. The total forest area is 769.126 sq. km. which is 23.41% of the total geographical area.

State	Total Forest Area(Sq. km.)	% of Geographical area
Andaman & Nicobar Islands	7171	86.93
Sikkim	5841	82.31
Manipur	17418	78.01
Mizoram	16717	79.30
West Bengal	11879	13.99