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Address:-Ashok Yakkaldevi 258/34, Raviwar Peth, Solapur - 413 005 Maharashtra, India
Cell : 9595 359 435, Ph No: 02172372010 Email: ayisrj@yahoo.in Website: www.isrj.net

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ORIGINAL ARTICLE

WATER SCARCITY IN THE NORTH EASTERN STATES OF INDIA: MECHANISMS AND MITIGATIONS

AZNARUL ISLAM

Department of Geography, University of Burdwan, West Bengal

Abstract:

Water Scarcity is one of the most important environmental hazards world-over associated with atmosphere, hydrosphere, lithosphere, and biosphere. In spite of receiving intensive orographic rainfall, North-Eastern States face increasing water scarcity day by day. The present paper tries to focus on the mechanisms of water scarcity from the perspectives of physical processes and anthropogenic processes. Today's water scarcity in the North-Eastern States of India is mostly triggered by anthropogenic activities decreasing water supply both in relative term and absolute term. This paper finally presents some measures that can be taken to reduce the hazardous effects of water scarcity for sustainable development of the ecologically fragile ecosystems of the North-Eastern States of India.

KEYWORDS:

Water Scarcity; NE States of India; Mechanisms; Mitigations

INTRODUCTION

According to the 'World Business Council for sustainable Development' water scarcity applies to 'situations where there is not enough water for all uses, whether agricultural, industrial, or domestic'. Though the 'seven sister states of India'(Stirn and Ham, 2000) or North-Eastern states of India(Arunachal Pradesh, Assam, Nagaland, Manipur, Mizoram, Tripura and Meghalaya) are not drought prone like the Marusthali, the inhabitants face water stress at an increasing rate day by day that hampers the socio-economic fabric of the region.

OBJECTIVES

The major objectives behind this paper are as follows:

1)To find out the physical causes of water scarcity in the North-Eastern regions of India
2)To find out the anthropogenic causes of water scarcity in the North-Eastern regions of India
3)To seek out the possible measures to reduce the water scarcity in this region

DATA SOURCES

This paper is based upon the secondary data from various sources which are follows:

1)Provisional Census data, Census of India, 2001.
2)Migration Tables, Census of India. 2001.

3)Forest Survey of India (FSI), 1987-1997
4) India Meteorological Observatory at Cherrapunjee,1973-2011
5) Economic Survey of Delhi, 2007-2008
6)Directorate of Economics & Statistics of State Governments of NE India, and Central Statistical Organisation

METHODOLOGY

In the first phase, for the preparation of this paper, extensive literature survey and collection of relevant data have been accomplished on the concerned topic.

In the second phase, the collected data have been processed using Microsoft Excel 2007 and conventional diagrams like simple bar diagrams, multiple bar diagrams and line diagrams have been prepared for the present analysis and drawing valid deductions.

RESULTS AND DISCUSSIONS

North-Eastern states of India face water scarcity despite receiving intensive orographic rainfall, because of both the physical and anthropogenic reasons.

A) Physical causes of water scarcity: The major causes of water scarcity include the following.

i)The faulted steep slope

There are a number of thrust faults in this region like Main Boundary Fault, Naga thrusts etc. that have intensified the steepness of the slope which is consequent upon ready overland flow of rainwater and negligible infiltration of water.

ii) Impervious rocky surface

Some of the region like Meghalaya-Mikir region is the eastward extension of the massive block of the Indian Peninsular Shield from which it has been separated by the Malda Gap as a result of denudational and tectonic forces (Singh, 1971). So the plateau is mainly constituted by the rocks of Precambrian age consisting of a group of hard crystalline granites, gneisses, and granulites (Singh, 1971). Another region i.e. Arunachal Pradesh in eastern Himalaya consists of sediments of tertiary or Mesozoic period (Singh, 1971). So it is seen that expect some portions of Assam valley most of the regions consists of impervious rocky surface that do not permit infiltration of rainwater for groundwater storage.

iii) Great altitude of the region

The region contains physiographic diversity ranging from plains in Assam Valley, plateau in Meghalaya to mountain system in Arunachal Pradesh. But most of the region is undulating and rugged having the altitude up to 7750m at Namcha Barwa in Arunachal Pradesh (Singh, 1971). Because of the great altitude and sloping nature of the region the rainwater falls downward rapidly due to gravitational force.

iv) Inaccessible ground water

Here access to ground to ground water is not a reality because of physiographic reasons. First impervious rocky surface neither allow infiltration for ground water storage nor for excavation of well. Second, even if the surface were pervious the infiltrating water would have fallen down under gravity. Here water supply totally depends on the surface water and rain and import from plain land.

B) Anthropogenic causes of water scarcity

Initially water was adequate for inhabitants, but today situation is quite different i.e.in the earlier days scarcity of water was not at all severe because there prevailed a more or less balanced condition between the supply of water and the demand for it. But what have intensified the problem of water scarcity are anthropogenic reasons. In today's context, the main causes of acute water scarcity are twofold which are related to human activities.

1) Relative decrease of water supply

a) Rapid growth of population

The absolute population growth over the decades is increasing (Fig. 1). Not only that the decadal growth rate is also higher than the Indian average (Fig. 2).

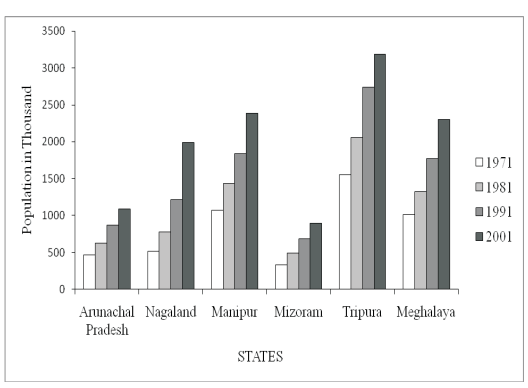


Fig. 1 : Population Growth in the North -Eastern States of India (*Source:* Provisional Census data, Census of India, 2001.)

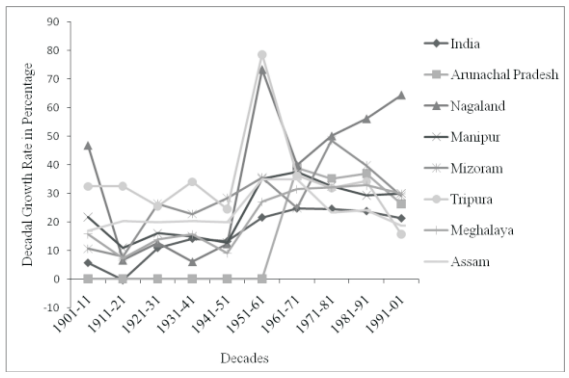


Fig. 2: Decadal Growth Rate in the North -Eastern States of (*Source*: Provisional Census data, Census of India, 2001.)

The population is growing at an accelerating rate in the NE states of India because not only there is highly positive natural growth (birth rate-death rate) but also the problem of huge immigration is present there intensifying the population growth. The history of the NE part of India has been the history of migration (Goswami, 2007).Both in the colonial and post colonial period streams of migrants were brought from the bordering states were welcome into the NE states as a part of state policy. In the colonial period tea-tribes, adivasis (tribes) were brought for the British economic policy, while in post colonial period population influx from neighbouring countries continued. As a deliberate state policy the Nepalese were brought into Assam by the post colonial state in the wake of 1962 Indo-China War to build border roads and railways in Arunachal Pradesh (then NEFA) to bring the frontiers areas closers to administrative areas (Hussain, 1993; Goswami, 2007). It is also to be noted that Streams of illegal migration is coming at an increasing rate from the bordering states of Nepal, Bhutan, Bangladesh, Tibet (Goswami, 2007). There is also the problem of forced migration. Among the major aspects of forced migration in India's east and north-east that deserve attention are border and boundary conflict, security, and refugees, the large presence of internally displaced persons in the region due to various conflicts and development projects, and mass-scale displacement due to natural disasters and environmental degradation leading to resource conflicts in recent times (Dasgupta and Dey, 2010). Rapid population and economic growth in NE India in the last 50 years have placed significant pressure on the region's fragile environment and water resources. There is a close relation between population dynamics and water scarcity (Fig.3)

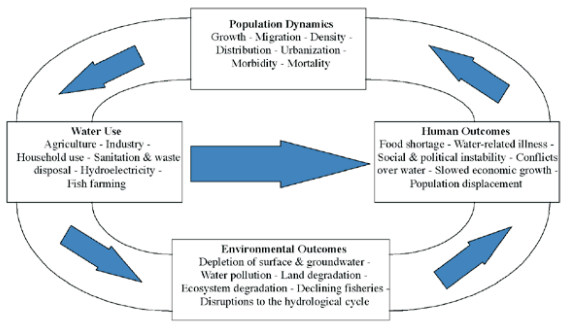


Fig. 3: Links between Population and Fresh Water

(*Source:* IUCN et.al. 1996)

b) Increased affluence of the population

With the passage of time, in tune with economic growth led by the expansion of tourism industry and other handicraft industries and development of service sector, affluence of the population has increased. Per capita Net State Domestic Product has increased substantially in the NE states of India (Table 1).Percentage of population below poverty line has also substantially decreased (Table 2). Consequently increased economic attainment has increased private car or bike ownership, creation of recreation sites like swimming pools and parks and their maintenance require huge amount of water.

Table 1: Per Capita Net State Domestic Product at Current Prices 1999 -2000 to 2005 -06 (Position as on 25.11.2007)

Year	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-2005**	**2005-2006**
Arunachal Pradesh	14054	15452	17893	17434	19707	22542	23788
Assam	12269	12797	13153	14600	15687	16825	18598
Manipur	13260	12369	12801	13250	14728	18386	20326
Meghalaya	14611	16100	17936	18756	20729	21915	23420
Mizoram	16443	17826	19430	20896	21963	22417	NA
Nagaland	13819	16903	18961	20407	20821	20998	NA
Tripura	14119	15983	18368	19059	21138	22836	24706
India	15839	16648	17800	18899	20936	22946	25716

Source: Economic Survey of Delhi, 2007 -2008 p.343

Table 2: State wise Percentage of Population below Poverty Line in NE India

Year	**1973-74**	**1977-78**	**1983**	**1987-88**	**1993-94**	**1999-2000**
Arunachal Pradesh	51.93	58.32	40.88	36.22	39.35	33.47
Assam	51.21	57.15	40.77	36.21	40.86	36.09
Manipur	49.96	53.72	37.02	31.35	33.78	28.54
Meghalaya	50.2	55.19	38.81	33.92	37.92	33.87
Mizoram	50.32	54.38	36	27.52	25.66	19.47
Nagaland	50.81	56.04	39.25	34.43	37.92	32.67
Tripura	51	56.88	40.03	35.23	39.01	34.44
India	54.88	51.32	44.48	38.86	35.97	26.1

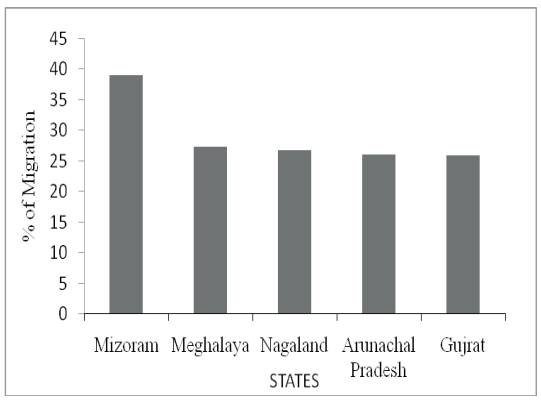
Source: For the NE States - Directorate of Economics & Statistics of respective State Governments, and for All - India -Central Statistical Organization,

c)Expansion of the business activities mainly tourism industry

The expansion of tourism industry, based on natural beauty (e.g. lakes, waterfalls) and cultural attractions, has encouraged business of hotel, lodge, and guest house where huge water is consumed by the tourists for various purposes. This increasing consumption of water in such a fragile ecosystem has put the place in critical situation.

d)Overall rapid urbanization

In the NE states of India, rural depopulation and concentration of population in some urban centres are increasing, thereby triggering rapid urbanization. It is seen that out of top five states of India in respect of rural-urban migration based on last residence with duration 0-9, the top four states i.e. Mizoram, Meghalaya, Nagaland, and Arunachal Pradesh are located In the NE Region of India (Fig.4). It is directly correlated that the higher the urban population, the higher is the water consumption because urban life is luxurious and affluent. Increasing urban and industrial demands for water now compete with the already high water requirements of the agricultural sector, while deteriorating quality constrains stretched water supplies. There is fierce competition for water at many levels in NE India—between and within regions, between and among sectors of the economy, and permutations of the two (Asia Society, 2009)



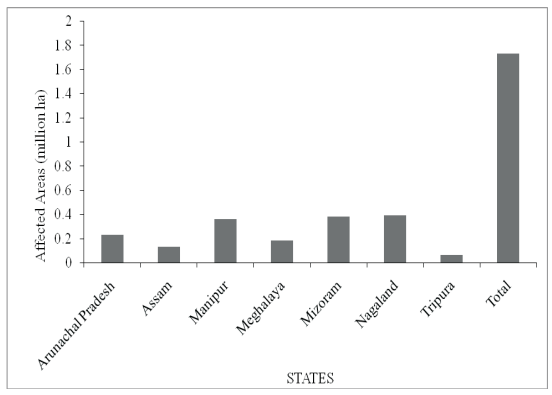


Fig. 4: Rural to Urban Migration in the top five States of India (Source: Migration Tables, Census of India. 2001.)

Fig. 5: Areas affected by Shifting Cultivation in the NE Region during 1987-1997 (Source: Forest Survey of India, 1987-1997)

2)Absolute decrease of water supply

Deforestations and melting of Himalayan glaciers are responsible for absolute decrease of water supply.

a)Deforestations

The seven states of the northeast account for 25.7% of the total forest cover in India which is experiencing net forest loss. Deforestations are generally triggered by the anthropogenic activities such as timber and fuel extraction in illegal and unscientific manner, traditional Jhum cultivation i.e. the slash and burn technique, and spread of step cultivation. The area affected by shifting cultivation or Jhum cultivation is 1.73 million hectare in NE India the statewise distribution of which is diagrammatized (Fig. 5).

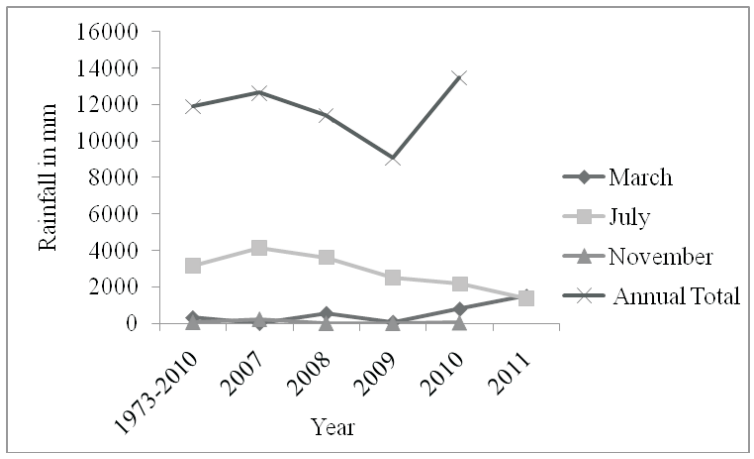


Fig. 6: Cheranpunjee's Rainfall Pattern
(Source: India Meteorological Observatory at Cherrapunjee, 1973-2011)

Deforestation is consequent not only upon reduction in rainfall but also upon the increasing variability of rainfall (Soja and Starkel,2006) e.g. Cherapunjee (Fig. 6). The deforestation affects water supply and invites various socio-economic hazards (Fig. 7). These trends, combined with increasing industrial and motor vehicle pollution output, have led to atmospheric temperature increases, shifting precipitation patterns, and declining intervals of drought recurrence in many areas. (Wikipedia, 2011)

b) Melting of Himalayan glaciers

The global warming, caused by deforestation and urban economic growth, result in the melting of Himalayan glaciers and reduction of water flow in the glacier-fed rivers of NE Region especially Brahmaputra in the lean period, thus reducing surface water supply. Brahmaputra will lose about 7% to 14% of the annual flow due to depletion of glaciers.

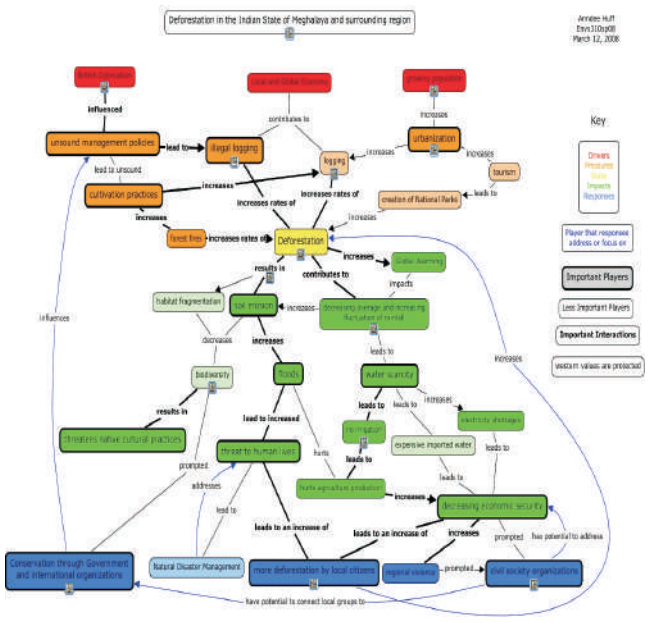


Fig. 7: Deforestation, Water Scarcity and related phenomena in Meghalaya and surroundings (Source: Anndee Huff, Envs 310, March 12, 2008)

MEASURES TO ARREST WATER SCARCITY

Water supply cannot be increased by altering the existing water supply system. What are needed are as follows:

1)Population check by preventing infiltration from neighouring states and introduction of family planning strategy (anti-natal policy).
2)Rain water harvesting to arrest relative scarcity.
3)Refortation in degraded forest and afforestation in new area.
4)Covering bare soil either by mulching or by growing successive cover crops, so that rainfall may increase, to arrest absolute water scarcity.
5)Growing mass awareness about the need of water conservation
6)Integrated drainage basin management including the local people especially women folk, government organization, and non- government organization should be adopted.
7)Mass tourism is to be replaced by sustainable tourism.
8)To stop rural depopulation and urban sprawling, some growth points are to be developed in the rural areas which act as counter magnets against unplanned urban growth.

CONCLUSION

It should be concluded that minimum disturbance in the ecosystems is needed while pursuiting the natural resources for the development of the civilization and sustainable development policies are to be adopted as the region's ecosystems are fragile and vulnerable. If the proper care is not taken immediately for water scarcity, it will invite future disaster, disrupting civilization.

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