THE POLITICAL ECOLOGY OF DIMINISHING WATER RESOURCES IN SIKKIM HIMALAYA

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ABSTRACT *Water scarcity is conceptualized as depleting resource led by the effects of climatevariability by many researchers. However, deviating the cause of water scarcity into rainfall variability alone would not provide a long-term solution to the problem rather it requires a broader critical approach. During recent years, a variety of changes have been emerged in the land use structure in the Himalayan ecosystem in the name of development including Sikkim; such as hydropower projects, concrete man-made structures to attract tourists, tunneling, construction of road networks etc. and these developments have brought enumerable changes on local hydrology. Therefore, this paper focuses on the water scarcity issues beyond meteorological factors on a premise that rainfall variability has been there in the past history as well. It argues that the level of development and human encroachment on the ecosystem has tremendous impact on water resources. This study underscores the decline of spring discharge or becoming seasonal has been led by multiple factors such as the change in climatic condition, anthropogenic factor, and external forces. The interplay of all these factors has remarkable impacts on water resources.*

Keywords: *Political ecology, water scarcity, climate change, land use and land cover change..*

1 Introduction:

Water is a prime natural resource for sustaining all forms of life. It is a basic human need and a precious natural asset. It plays different functions in biotic and abiotic components of the earth. It is indispensable right from quenching of thirst to irrigate agricultural fields and to the highest level of industrial operations. The Earth's water resources can be characterized as; finite- there is a fixed quantity on our planet; sensitive- it can be easily degraded by human activities; and irreplaceable- it has no substitute in all its uses (UNEP, 2009).

The Himalaya, youngest mountain system of the world generally considered to have an abundance of water resource are now facing acute water shortages (Tambe et al, 2012). Sikkim being part of Eastern Himalaya is blessed with plenty of water resources in forms of glaciers, perennial rivers, lakes, streams, and natural springs. The streams and springs play an important role in sustaining lives of hill folks as such more than 80 percent of the population is primarily dependent on these sources for water for household usage and agricultural purposes (Tambe et al, 2012). However, of late, these sources are unable to meet their water requirements due to the marked decline in spring discharge and drying up of hilltops lakes. Various factors are responsible for diminishing discharge such as land use and land cover change, deforestation, developmental works, and other anthropogenic factors. Besides, changes in climatic condition leading to variability in rainfall trend and pattern have a direct impact on natural springs. Other than rainfall variability, the physiographic setting plays an important role in the spatial distribution of rainfall. As such the lower part of South and West district of the state receives comparatively less amount of rainfall due to its location in rain shadow zone of Darjeeling Hills. The less amount of rainfall in these areas means less water is able to percolate down into the surface to recharge the groundwater.

The rainfall variability has been observed in some extent and it has contributed in exaggerating the water problems in the state. However, deviating from the cause of water scarcity into rainfall variability only would not provide a long-term solution to the problem rather it requires a broader approach. During recent years, a variety of changes have emerged in the land use structure in the Himalayan ecosystem including Sikkim. With population growth, there has been increased demand for food, fodder, grazing land, water, and other natural resources and consequently, there is increasing socio-economic and political marginalization (Rawat et al, 2011). The water scarcity is conceptualized as depleting resource led by the effects of climatic change by many researchers. But, there is an urgent need to link water scarcity with wider socio-political, economic and institutional processes. It is also important to distinguish between the biophysical aspects of scarcity that are lived and experienced differently by different people and its constructed aspects (Mehta, 2011).

2 Linking Political Ecology and Water Scarcity:

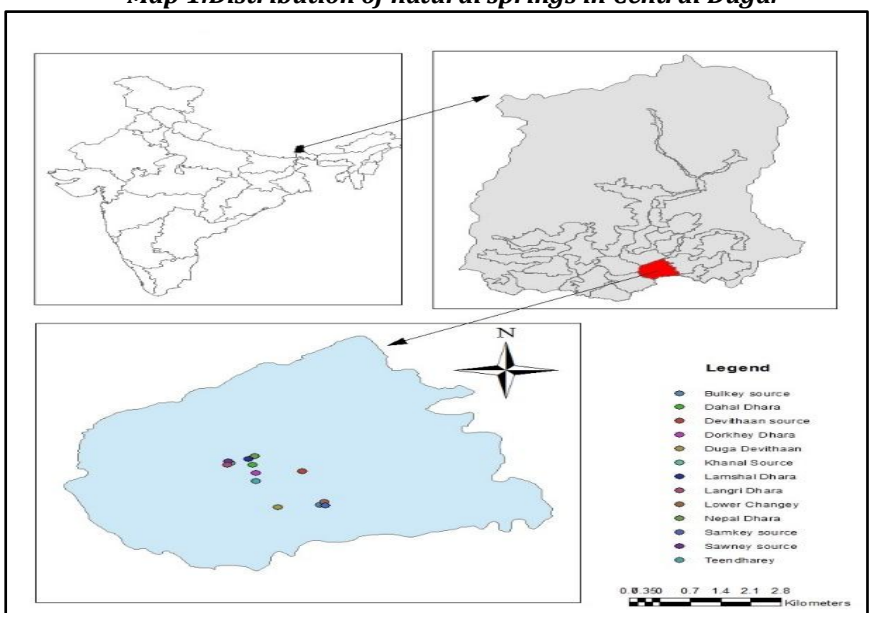
The political ecology not only helps to understand the state-driven developmental policies and its immediate and long-term implications on water resources, it also broadens the approach in understanding water scarcity beyond meteorological perspectives. It focuses on complex social, economicand political relations that how are the land and water resources being utilized, operated and managed.

The research discourses with regard to drying water resources in the hills of Sikkim has been understood through the lens of meteorological discourse only. The special situation in which rains do not arrive in time or inadequate quantity is only one form of drought, the meteorological drought. There are many other processes through which water scarcity gets generated. Deforestation and hydrological destabilization in the mountain catchments of rivers, streams, and springs can make them dry up in the post-monsoon periods (Bandhopadya, 1987). The present water scarcity has a wider and more serious problem to our socio-economic life. Solutions can be sought only on the basis of a comprehensive understanding of the ecological factors at the root of the problem. In fact, our current water scarcity is, firstly due to failure to ensure the stability of the water resources in the course of implementing developmental programmes. Secondly, lack of integrated approach in understanding the issues as such various factors is equally responsible for drying up of these water sources such as changes in resources utilization pattern, land use and land cover change, deforestation, developmental projects, external forces, and other anthropogenic factors. And thirdly, due to spatial unevenness in terms of land and watershed development programmes and policies. The inclusion of socio-economic aspects of people is equally important while understanding the drivers of water problems and may use in identifying the actual water poor's. Therefore, water scarcity debates should be beyond physical and meteorological aspects.

3 Cases, Experiences and Emerging Trends:

The present study addresses the multifaceted nature of water scarcity in Sikkim with the case study of Duga block of East Sikkim. The area represents a rural agrarian economy. The crop production and livestock rearing form the perennial livelihood options of the local community. This block has been included in drought-prone area map of the state. People have observed that springs are becoming seasonal and yields relatively less water than before and have experienced the frequent occurrence of a drought-like situation in the recent past. The household dependency per springs is 33 which means more than 500 households are dependent on 13 natural springs in the area. The local climatic condition and orographic features play an important role in rainfall pattern as such the area receives relatively less rainfall than other parts of the state.

Map 1:Distribution of natural springs in Central Duga.

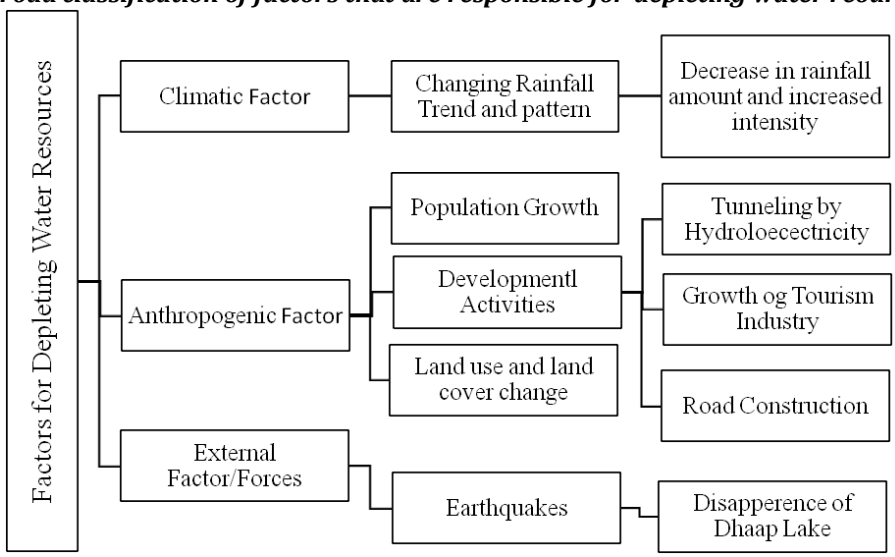


The highest mean rainfall has been observed in the month of July- August (886.57±74.94) and lowest in the month of October- February (16.80±9.88) (Rai, 2014). The earlier studies show that a positive correlation between rainfall and spring discharge in the area indicating these springs are rain-fed in nature and change in rainfall trend may have huge impacts on these water sources.

The local inhabitants have observed a decline in water discharge from springs and streams and some of them have become seasonal. Due to the shortage in water, now these water sources are unable to meet their water requirements and they are compelled to rely on other sources like rainwater. The water shortage has the immense impact on the socio-economic condition of the local community and in the natural environment. However, it is worth mentioning that the area has undergone rapid developmental activities in the recent years. Various new construction came up in the area like roads, concrete buildings, hydropower projects, and village tourism. These developmental activities may have huge impacts on local land and water resources.

Development in the mainstream literature is conceptualized as the solution rather than the cause of backwardness, poverty, and environmental degradation in rural Third World communities. For some political ecologists, however, the post- World War II project of Third World development is an exercise in the domination of the North over the South and the state over local communities (Neumann, 2009). This state-led developments like hydropower projects and tourism industry are the major engine of economic growth, employment generator and an agent of poverty alleviation in the state. However, costs and benefits associated with environmental change are distributed unequally which means the changes in the environment do not affect society in a homogenous way; political, social and economic differences account for the uneven distribution of costs and benefits. Needless to say, these developments neither guarantee equal benefits to all sections of society nor they all will go through proportional crisis led by environmental destruction.

A broad classification of factors that are responsible for depleting water reources.



Source: Constructed from field observation and Focus Group Discussions.

3.1 Climatic Factors

3.1.1 Changing rainfall trend:

The local stakeholders perceive the untimely and unprecedented rainfall with longer winter drought is the important reason for water scarcity. The dry period is becoming longer and the monsoon period has become short and intense. Therefore it has a great impact on rain-fed springs which are the primary source of water in the region.The problem of dying springs is being increasingly felt across the state due to the impacts of climate variability leading to change in precipitation pattern such as the rise in rainfall intensity, reduction in its temporal spread, and a marked decline in winter rain. It has been found a decreasing trend of rainfall amount in the past decades with maximum downpour during the month of June to August leaving other months with scanty or no rainfall.

2 Anthropogenic Factor

3.2.1Growing population:

The increase in the number of the population has put tremendous pressure on local water resources. The water user per springs has grown drastically in past few years. According to the population census data 1991 to 2001, there was a remarkable increase of population in the area from 6.2 to 7.8 thousand. The household number has also been increased from 1164 to 1478. From 2001 to 2011, it shows that there was

a decrease in both household and population with 1149 and 5.4 thousand respectively. However, 2001-11 was the period which witnessed a rapid growth of development. It attracted a huge number of laborers at construction sites. The important construction sites are Tunneling in Deorali, tourist spots and in road construction. These people have added per head dependency on local water sources.

3.2.2 Growth of green economy; the hydroelectric power project and water scenario:

Sikkim has initiated 27 HPP along with an additional smaller one on the river Teesta for revenue generation and development (see Table 1). Ironically, none of the power projects that are constructed in the mountain areas in the North-East India are based on the geo-hydrological assessment (Sharma et al., retrieved in 2013).

The Rongnichu Hydroelectric Power Project is a run-of-river hydro project proposed for development on the Rongnichu stream, a tributary of the Teesta River, in the eastern district of Sikkim. The hosting community or villages are Namli, Sumin, Kumrek, and Duga. According to the project design report (2006), the project will have an installed capacity of 96 MW and generate approximately 384 GWh of electricity (net) per annum. The RHPP is a run-of-river hydroelectric project that will utilize the natural flow of the Rongnichu River to generate electricity. The water will be diverted through an interconnecting channel from the barrage into a desilting basin before being conveyed into a headrace tunnel, penstock tunnel and surge shaft. The powerhouse ventilation located in the lower part of the study area called Bhasmey.

The local community responded that the use of dynamites in underground tunneling by RHEP is the primary causes that develop cracks in aquifers resulting in water loss. They said, the dynamites used in the blasting of rocks creates a vibration which is as strong as tremors of the earthquake. The discharge of springs and streams have gone down after coming up with such projects in their locality. Generally, tunnels do have impacts on groundwater table and aquifers because they are dug in-depth varying from soft clay to hard rock. The earlier studies show that the rivulets, streams, springs, and water seepages near hydropower projects are rapidly disappearing in rural areas causing an acute shortage of drinking and irrigation water.

Table 1: Status of hydropower projects in Sikkim, 2018.

Sl. No.	Project Name	Location	Capacity (MW)	Nature of Ownership	Developer	Status of DPR	Present Status
1	Teesta Stage-III	North Sikkim	1200	BOOT	Teesta Urja Limited	Completed	Under construction
2	Teesta Stage-IV	North Sikkim	520	BOO	N HPC Ltd	Completed	Major construction works still not started
3	Teesta-V	East Sikkim	510	BOO	N HPC Ltd		Project Commissioned
4	Teesta Stage-VI	South/East Sikkim	500	BOOT	Lanco Energy Pvt Ltd	Completed	Works on hold
5	Panan HEP	North Sikkim	300	BOOT	Himagiri Hydro Energy Pvt Ltd	Completed	Pre-construction works started
6	**Rongnichu HEP**	**East Sikkim**	**96**	BOOT	**Madhya Bharati Power Corp**	**Completed**	**Under construction**
7	Chuzachen HEP	East Sikkim	99	BOOT	Gati Infrastructure Ltd	Completed	Under construction
8	Bhasmey HEP	East Sikkim	51	BOOT	Gati Infrastructure Ltd	Completed	Under construction
9	Rangit-II HEP	West Sikkim	66	BOOT	Sikkim Hydro Ventures Ltd	Completed	Under construction
10	Rangit-IV HEP	West Sikkim	120	BOOT	Jal Power Corporation Ltd Sneha Kinetic	Completed	Works on hold
11	Dikchu HEP	North/East Sikkim	96	BOOT	Power Projects Ltd	Completed	Commissioned
12	Jorethang Loop HEP	South Sikkim	96	BOOT	DANS Energy Pvt Ltd	Completed	Commissioned
13	Tashiding HEP	West Sikkim	97	BOOT	Shiga Energy Pvt. Ltd	Completed	Commissioned
14	RahiKyoung HEP	North Sikkim	25	BOOT	Sikkim Engineering Pvt Ltd	DPR completed	Yet to start
15	Rangit-III HEP	West Sikkim	60	BOO	N HPC Limited	Under preparation	Project Commissioned
16	Bakchachu	North Sikkim	40	BOOT	Sanvijay Power and Allied Industries Ltd.	Under preparation	Only LOI Issued

Source: *Compiled by author based on the data acquired from Energy and Power Department, Government of Sikkim.*

Note: The Rongni Chu hydropower project of the study area have been shown in No.6 row in the above table.

Landslides along the mountain slopes and in the spring catchments mostly hydropower project-induced at/near the spring discharge points are the causes of drying up of springs in Rangpo- Dikchu stretch (Sharma et al., retrieved in 2013).

3.2.3 Growing Tourism Industry:

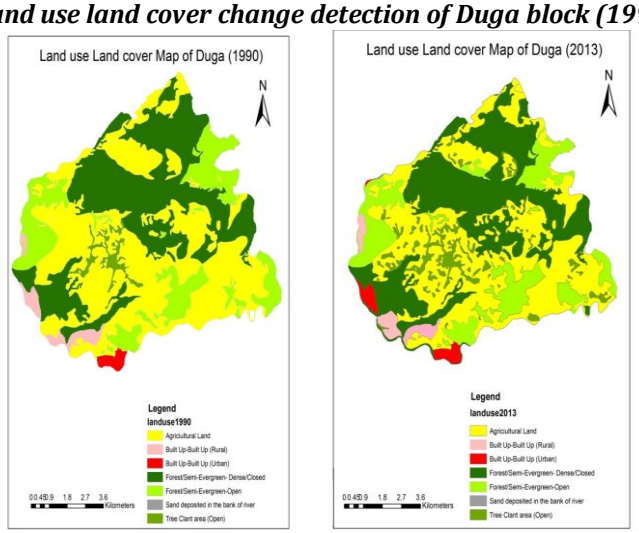
Community-centered natural resource management and biodiversity conservation based on the principles that biodiversity must give itself by generating economic benefits particularly, for local people has become a popular tool in the state. The premise is that eco-tourism depends on maintaining attractive natural landscape and rich flora and fauna; therefore, helping communities earn income as an economic alternative. The state government has commissioned Nishani Devi Kali Bhawani project, which takes in the construction of Goddess Kali statue at the crest of Gadi village. Gadi has a historical significance. In fact, it is a fort built by the monarch of Sikkim, the then King Chador Namgyal in the year 1717 AD to resists the invasion of Bhutanese army. During one of the invasions by Bhutanese army, the princess Pendi took shelter there and so the name of the village Pendam from her name. The fort is 1000 feet long and 100 feet in height and spread over an area of 5 acres. The indigenous communities believe that this sacred mountain is the abode of deities who protect them from natural calamities (Badhuria, retrieved in 2014). Since then, the area has been preserved as a sacred landscape. The area is under Khasmal[1]with dense vegetation or grove type and canopy consists of various tree species. The water catchment area with dense growth bushes and trees, minimal grazing and low human encroachment are ideal for water management and promotes the rainwater retention; augmenting the groundwater recharge-discharge regime (Negi et al., 2004).

The coming up of tourism projects in the area has disturbed the ecological setup. The road has been constructed to reach the crest of Gadi, concrete trekking footpath and other construction activities are taking place. Massive deforestation due to construction activities may leave huge impacts on water resources in the long run. Tourismproject would encourage the removal of trees and vegetation to a large extent as such more surface runoff, erosion and landslides are likely to occur. The construction of road networks changes the water drainage system and disrupts the springs and their catchment area. During monsoon season, gully formation in roads due to high surface runoff is common in the rural village of Sikkim.

3.2.4 Land use and land cover change vis-vis water resources:

The relationship between land use change and hydrology is complex, with linkages existing at a wide variety of spatial and temporal scales and has a strong influence on global water yield. Land cover and use directly impact the amount of evaporation, groundwater infiltration and overland runoff that occurs during and after precipitation events. These factors control the water yields of surface streams and groundwater aquifers and thus the amount of water available for both ecosystem function and human use (Frenierre, retrieved in 2013). Studies indicate that deforestation, grazing, and trampling by livestock, soil erosion, forest fires, and development activities reduce water infiltration capacity of the ground surface. The extensive land use changes in the Himalaya have not only disrupted the fragile ecological balance of the watersheds in the region through deforestation, erosion, landslides, hydrological disruptions, depletion of genetic resources, but have also threatened the livelihood security and community

Map 2: Land use land cover change detection of Duga block (1990-2013)



***Source**: Created by author using GIS technique based on satellite imageries such as Landsat and Liss-III.*

[1]khasmal means forest land settled and set aside by the Government for meeting the bonafide domestic need of timber, firewood and fodder of the adjoining villages.

Table 1: Land use and land cover change between 1990- 2013.

Sl. No.	Land Use/Land Cover	Area (in Km²)		
		1990	2013	Change
1	Agricultural Land	30.20	28.36	1.84
2	Built Up area (Rural)	0.43	1.00	0.56
3	Built Up area (Urban)	0.56	1.09	0.52
4	Dense semi-evergreen forest	22.92	23.18	0.26
5	Open Semi-Evergreen forest	11.50	11.38	0.12
6	Tree clant area (Open)	1.40	3.29	1.89

sustainability in mountains as well as in adjoining plains ecosystem (Rawat et al ., 2011). The high rate of land use change accelerating several environmental problems such as high monsoon runoff, flash flood, soil erosion, and denudation during monsoon season and drought during the non-monsoon period. A massive impact of land use change on the regional hydrological process in the Heihe River Basin has been found (Genxu et al., 2005). The results indicate that with different intensities of land use changes, it has probable impacts on groundwater recharge and discharge regime. It showed an increase of land under irrigation had enhanced the recharge of groundwater.

In 1990- 2013, the remarkable change in LULC has been observed; the decrease of an area under agricultural land and open type forest by 35.10 percent and 2.43 percent respectively.It is found that area under closed type forest, urban built up, rural built up, and tree clant area has been increased by 5.04 percent, 10.09 percent, 10.81 percent, and 36.35 percent respectively. Since 1995, several conservation initiatives have been taken up like the implementation of the ban on open grazing in reserve forests and ban on green felling of trees in forests. This has probably helped to maintain the forest cover in the area. The negative growth of open semi-evergreen forest is probably due to degradation and fragmentation of forests led by heavydependence for firewood and timber, high grazing pressure, poor natural regeneration and naturally slow-growing nature (Tambe et al., 2011).

A remarkable negative growth in agricultural practices has possible linkages with drying springs in the area. A typical example is, people used to cultivate rice before which is a form of terrace farming. In rice cultivation, sufficient water is required and holding the water in the blocked field's means sufficient water will be able to infiltrate in the ground thereby recharging the aquifers. Presently, the area under rice cultivation is very less and it is done only in the lower part area.

3.3 External Forces

3.3.1 Seismic event of 1968 and Dhaap Lake:

The disappearance of Dhaap Lake is considered to be the main reason for water shortage in the area. The lake lies at an altitude of 1,700 meters and surrounded by dense forest cover.The seismic event of 1968 had caused a violent outburst of lake due to the disturbances created by earthquake. It caused heavy loss of lives and property. It used to act as a natural springshedfor recharging underlying aquifers.

4 conclusion:

Sikkim is one of the fastest emerging economies in Indian sub-continent and whatsoever action state has taken so far are tend to justify in the name of economic development like other Global capital does in neo-liberal times. The cost of these developments has started showing its colors in forms of social conflicts, economic inequality, resource depletion, and political uncertainties. The problem of water scarcity in Sikkim is a recent growing issue and it has more deviated towards changes in climatic conditions leading to variability in rainfall trend and pattern. To some extent, this has brought changes in the local hydrological cycle but assessment of other potential factors such as physical feasibility, resource utilization pattern, developmental policies are equally important. It is regardless to say, the state has gained economic prosperity and social upliftment with the initiation of various developments specifically tourism and hydroelectric power projects but the cost of such developments are not par with its benefits. In other words, the state has achieved the success of high growth, but with numerous new challenges. In order to minimize challenges and risk of vulnerability, there should not any comprise on feasibility assessment or environmental impact assessment while initiating any developmental projects. The EIA of such developments needs to incorporate the local water sources like springs, streams, and lakes in their agenda while analyzing the impact assessment of such developments. Nevertheless, the state has come up with

various plans and programs with regard to the conservation and management of land and water resources. Furthermore, the traditional knowledge on water management should be disseminated and comprised in existing water management policies.

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