International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 04, April-2019

WATER RESOURCES OF ARUNACHAL PRADESH AND ITS IMPACT: A CASE STUDY

Toko Rebia[1], Tai Taju [2], Toko Noka [3], Debia Tada[4], Rohit Sahu[5]

[1,2,3,4] *Graduates, Dr. K. N. Modi University, Rajasthan, Pincode - 304021*
[5]*Assistant Professor, Department of Civil Engineering, Dr. K. N. Modi University, Newai, Rajasthan, Pincode - 304021*

Abstract – The water resources in Arunachal Pradesh are in abundance, many rivers coming from china which is located in the upstream, are flowing in the state. The land of rising sun situated in the eastern Himalayan region now days faces severe damages of their water resources due to many reasons. This study is about the various factors which are responsible for the impact of the water resources in the state. The study shows us that, the construction of huge dams by china on the upstream is majorly a factor and is responsible for deplenishen the quality of water in the rivers like Siang. The study also tells us that the long term effects of the construction of dams or diverting the river is very hazardous as the rivers not only dried, but ecological, and geographical problems like Glaciers present in the state are affected by this and land which is very rich in water resources on both ground water and surface water will deplete. The research paper shows the various water resources of the state and its present status, the paper also tries to evaluate the impact of the water bodies on the State and its stake holders.

Keyword –Water Resources, Arunachal Pradesh, Hydro – Power Projects, Rainfall, Mass Curve of Rainfall, Water Quality, Hydropower, Rivers, Indo – China Water Treaty

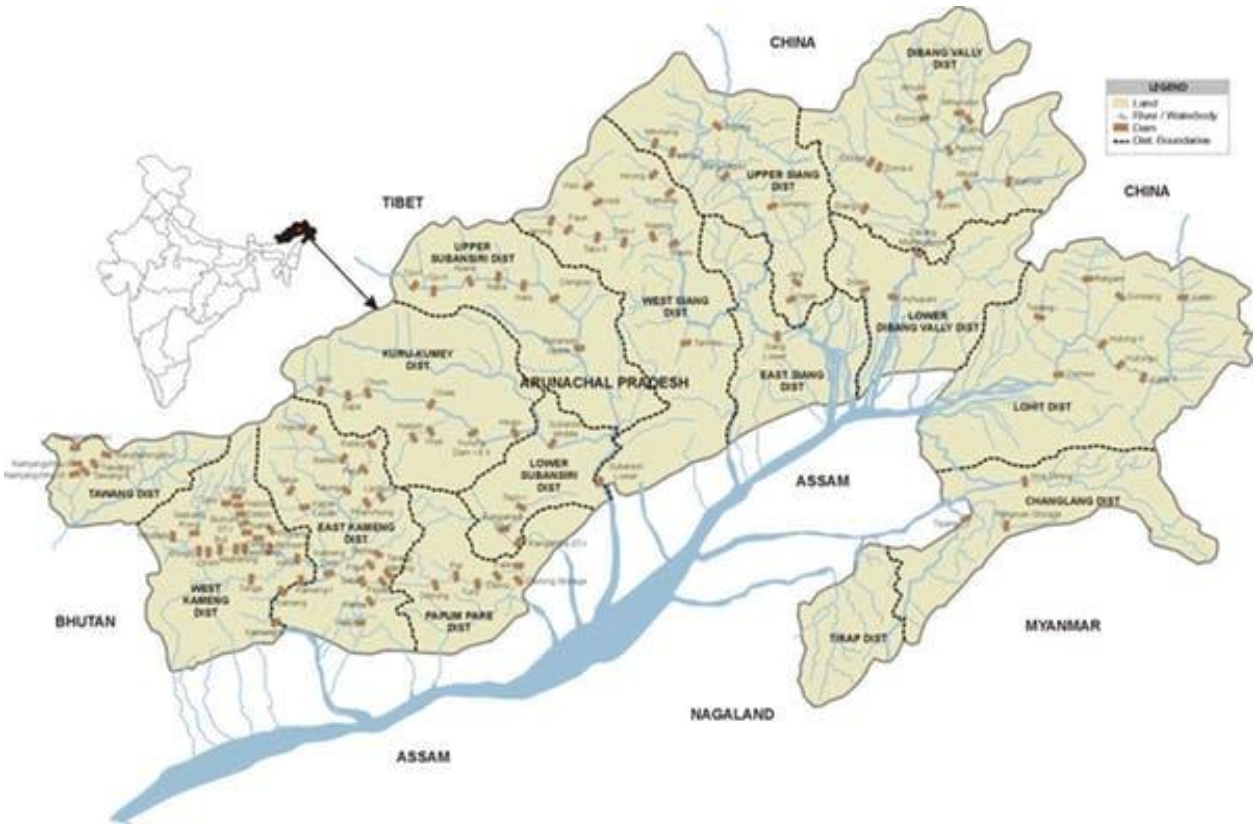
Introduction – Water is an essential resource for all life on planet earth and it is vital component of all living things on earth, and it is demanded for many productions as like agriculture, industrial as well as drinking purpose, and also to maintain the life of ecology cycle.

Water resources are under major stress around the world. Rivers, lakes, and underground aquifers supply fresh water for irrigation, drinking, and sanitation, while the oceans provides habitat for a large share of planets food supply. However, expansion of agriculture, damming, diversion, over-use, and pollution threaten this irreplaceable resource in many parts of global.

Arunachal Pradesh is situated in the eastern Himalaya region which is very rich in water resource on both ground water and surface water and also most of runoff drains into the Brahmaputra river in Assam, total basins area of Brahmaputra is 41.9%. The water resource management of Arunachal Pradesh are like Siang, pare, Panior river, etc from mountain or uphill to flow down and finally debouch or mingle with river Brahmaputra of Assam. There are so many stream and Mini River flowing in Arunachal Pradesh, from that river the govt. of A.P installed a mini hydro project like siang which is also known as Tsangpo River, Panior River etc, for the growth of economic, sagacious and utilization of vast water resources.

In Arunachal Pradesh the rainfall the traditional method of water management consist of harnessing the hill streams during monsoon by constructing temporary check dams on stream bed for diversion and conveying of water through split bamboo pipe, earthen channel, etc. boulder, timber and earthen dams are used to build across a the stream to raise the level of water for diversion. There is a traditional use of such irrigation practices being followed by village /community as whole in carrying water from stream over large distances.

Heavy rainfall combined with some other factors cause soil degradation or deforestation which results low in agricultural activity. The water resources developments influence is great deal for the land resource management. Therefore, it is necessary to develop, conserve and efficiently utilized the available water, it's requires infrastructure and financial support from the centre. While this paper summarized the available water resources of the states like sources of water, rainfall, management of water, hydro power project, lake, indo-china water treaty etc.



2. The study of water resources can be categorized in a broad way which includes not only natural water bodies man made too. As the state received huge amount of rainfall during the monsoon season, the management of the water is a tedious job as most of the terrain is hilly. The state has a channel of almost 5 major rivers and approx. 30 minor rivers. The construction of dams in the state is also very popular and has 3 major dams serves for the power supply, one is on going under construction and 2 major dam in planning.

The research categorises the water resources of the state in the following fields:-

2.1 Rainfall Study

The mean Average annual rainfall data of the 67 rainfall station in and around Arunachal Pradesh for the period between 5 to 70 years which shown that the heavy rainfall zone 3000mm to 5000mm.
The mean average annual rainfall of India is 300mm to 650mm or 11.8 to 25.6 in inches. Arunachal Pradesh average annual rainfall is much higher than the country (India) which means 7.70 to 10 times greater than the India average annual rainfall.
According to Mohile (1999), the tributaries of the Brahmaputra which drain the Himalayan sector of this state, including the Siang, Dibang, Lohit and Subansiri, contribute about 70% of the average annual yield of the Brahmaputra at Pandu near Guwahati.

According to Murthy (1981), the catchment of the Brahmaputra and its tributaries in India receives very heavy rainfall ranging from 1100 to 6400 mm per year. Most of the runoff in the river is contributed by heavy rainfall of about 5100 to 6400mm in the Abore and Mishmi hills in Arunachal Pradesh, and 2500 to 5100mm by the Brahmaputra basin.
Goswami (1998), in his study of the flood hydrology of the Brahmaputra, mentions that the Brahmaputra basin in India receives a mean annual rainfall of 2300mm and its catchment in the north-east (*i.e.* Arunachal Pradesh) receives 4100 mm. He also states that rainfall in the Himalayan sector in north-east India amounts to 5000mm per year, with the lower ranges receiving more than the higher ranges. As an example, he states that Dibrugarh (a station at the head of the Assam valley), in the eastern part, receives annual rainfall of the order of 2850 mm, whereas Pasighat, located in the foothills of the eastern Himalayas in Arunachal Pradesh, receives 5070 mm.
According to Chakraborty and Singh (1999), the mean annual rainfall over the entire Brahmaputra basin in India, excluding Tibet and Bhutan, is 2300 mm. They further state that the mean annual rainfall over the Himalayan catchment is above 3000mm per year.

According to BHAGAWATI *et al.*, The daily rainfall data for the period of 37 years (1979-2015) has been collected from Agro-meteorological Observatory at ICAR Research Farm, Gori, Arunachal Pradesh maintained by India Meteorological Department. The data were quality checked and the time series of monthly and seasonal rainfall were prepared from daily data.

Table: 2.1 Seasonal average rainfalls

Season/month	January-February	March-May	June-September	October-December
monsoon season	-	-	66.5%	-
pre-monsoon	-	20.5%	-	-
post monsoon	-	-	-	7.7%
Winter rainfall	5.5%	-	-	-

The 37 years average rainfall for Southwest monsoon, pre-monsoon, post-monsoon and winter is 21.3, 26.3, 43.2 and 51.8 respectively, indicating wide variability in post-monsoon and winter rainfall. During the period of 1979-2015 the highest rainfall is 3049.7 mm recorded in 2008, while the lowest rainfall is 1530.8 mm in 1981.

Considering the pre-monsoon (March, April and May), in 2011-2015, the average monthly rainfall has increased in March which is 120.88 mm and May i.e., 297.72 mm compared to 37 years normal of 102.9 mm and 223.6 mm respectively for the months. In April the rainfall has been decreased 122.7 mm compared to normal of 155.0 mm. Also during post-monsoon, it has been noticed that the average monthly rainfall during 2011-15 has decreased for all the months compared to 37 years normal for the months with significant decrease in October (59.6 mm) compared to normal (124.4 mm). During winter, the average rainfall of January increased in the last five years (58.22 mm) compared to normal (44.88 mm), while average monthly rainfall in February decreased to 45.12 mm (2011-2015) compared to normal of 78.8 mm (1979-2015). Thus there is no appreciable change in the winter rainfall as a whole in the recent past.

Table: 2.2 The sen's estimator of rainfall in Arunachal Pradesh based on the daily data during 1979-2015. Though there is variability in the distribution of rainfall, but there is no observed significant increasing or decreasing trend, both in season and in month

Rainfall Trends												
Annual -3.73		**Winter** -0.12		**Pre-Monsoon** +2.19			**6W Monsoon** -2.29			**Post monsoon** -0.86	
Monthly rainfall trends in mm per year (37years average)												
Month	**January**	**February**	**march**	**April**	**may**	**June**	**July**	**August**	**Sept**	**Oct**	**Nov**	**December**
	+0.30	-0.08	+0.51	-0.82	+1.29	-0.81	-1.16	+0.39	+0.29	-0.86	-0.10	-0.14

Increasing (+) and Decreasing (-) trends
(Sources;- BHAGAWATI et al., curr. World Environ.,)

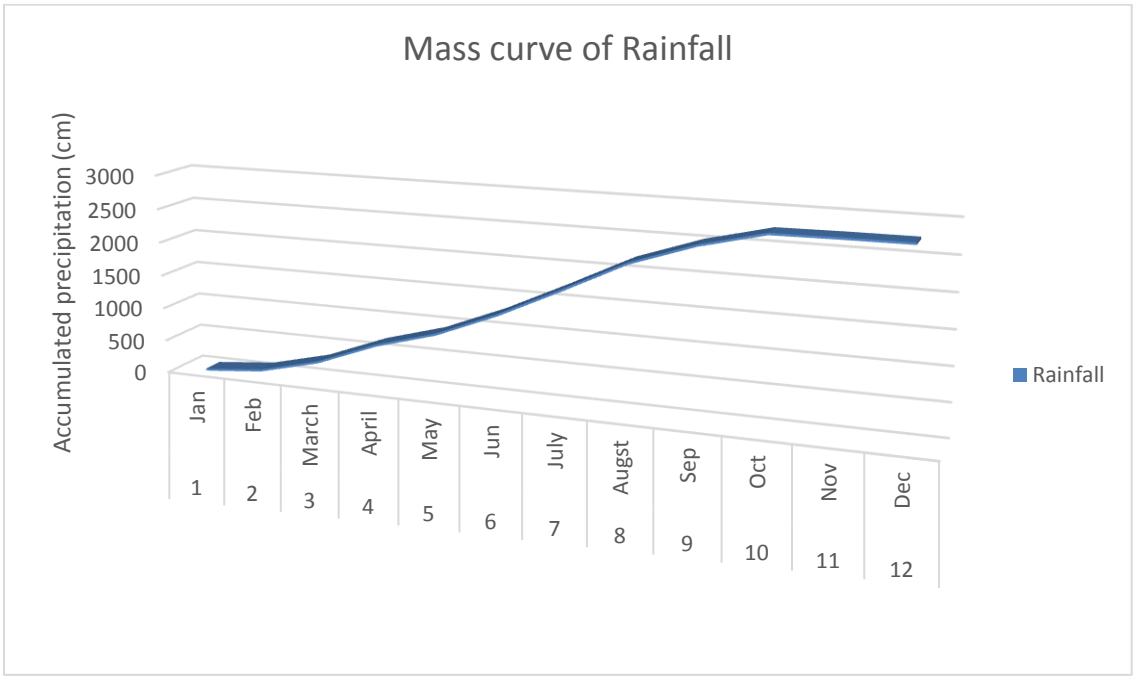
The above rainfall data are estimated by the different researches workers. In the present study an attempt has been made to improve estimates of rainfall received in the easternmost Himalayas, in the Siang basin in Arunachal Pradesh.

2.1.1 Mass curve rainfall and % of departure of Arunachal Pradesh, 2017

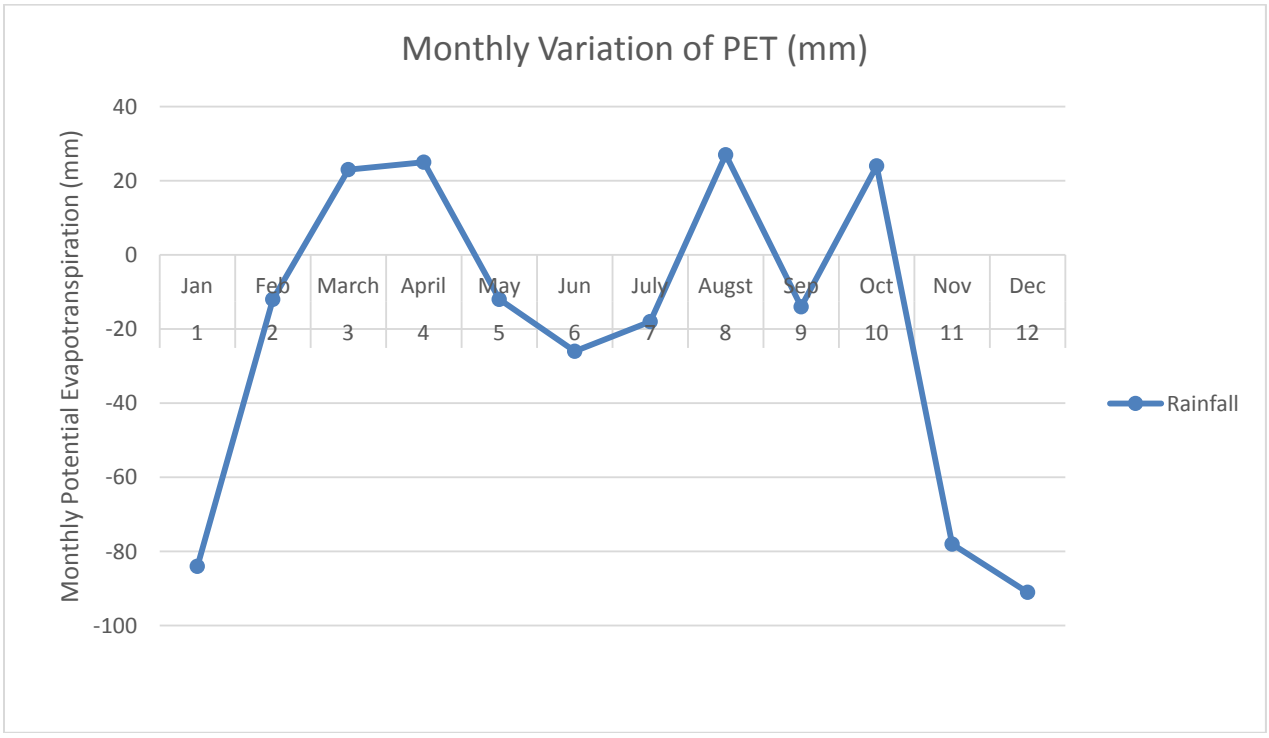
Table: 2.3 Monthly rainfall and % of departure of the Arunachal Pradesh, 2017

Rainfall/month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	8.2	86.2	221.8	348.2	257.1	370.8	437.8	456.4	318.6	227.1	9.9	3.4
% dep.	-84	-12	23	25	-12	-26	-18	27	-14	24	-78	-91

(Sources: Rainfall Statistics of India – 2017 by B. P. Yadav, Dr. Ashok Kr. Das, K. V. Singh and S. K. Manik)



Fig; -2.1.1 (a) Monthly mass curve rainfall of Arunachal Pradesh (2017)



Fig; - 2.1.1 (b) Monthly rainfall departure in % of Arunachal Pradesh (2017)

Water Bodies
Rivers

i) River Siang

The Siang river, drain from the Himalayas, enters in the state of Arunachal Pradesh with an altitude of 3600 m. It flows in between the two hilly ranges of Arunachal Pradesh which is known as Abore on the western side and Mishmi on the eastern side.

Siang river is also known by various name in the region while Brahmaputra in Assam, Yarung Tsangfo in Tibet and Jammu in Bangladesh. It is also called Tsangfo-Brahmaputra (when referring to the whole river including the stretch within Tibet). Siang river is originated from the Mansaraovar lake region, located on the northern side of the Himalayas in Burang County of Tibet as the Yarlung Tsangfo River, it flows across southern Tibet to break through the Himalayas in great gorges and into Arunachal Pradesh. It flows southwest through the Assam Valley and south through Bangladesh as the Jamuna. It is major International river covering 5,80,000km2, 50.50% of which is lying in china, 33.60% in India, 8.10% in Bangladesh and 7.80% in Bhutan. Out of its total basin in India, 41.88% is shared by Arunachal Pradesh alone, 36.33% by Assam, 5.57% by Nagaland, 6.10% by Meghalaya, 3.75% by Sikkim and 6.47% by west Bengal (Goswami, 2008). It enters Arunachal Pradesh at an elevation of 3500 meter and come across greater, middle and sub-Himalaya finally to debouch in Assam plain near Pasighat at 155m altitude and travelling 278km distance (Boni amin laskar, 2014).

About 3,848 km (2,391 mi) long with the brahma is an important river for irrigation and transportation sports etc. The average depth of the river is 38 m (124 ft) and maximum depth is 120 m (380 ft). The river is prone to catastrophic flooding in the spring when Himalaya snow melts. The average discharge of the river is about 19,800 m^3/s (700,000 cu ft/s), and floods can reach over 100,000 m^3/s (3,500,000 cu ft/s). It is a classic example of a braided river and is highly susceptible to channel migration and avulsion. It is also one of the few rivers in the world that exhibit a tidal bore. It is navigable for most of its length.

The entire territories of Arunachal Pradesh forms a complex hill system with varying elevations, traveled throughout by a number of rivers and rivulets. The river provides main water resources for domestic, industrial and agriculture purposes.

During the study of water quality in river Siang was collected from six different portion of the river namely Bodag, Mebo, Ranahat, Ponging, Pasighat, and Rottang. The selection of the location is based on the upstream, mid-stream and downstream of the river Siang, and the samples were collected from six different sites during Monsoon, Post-Monsoon, winter and Pre-Monsoon for the period since July 2012 to June 2013.

(sources ;- https://www.mapsofindia.com/maps/arunachalpradesh/rivers/east-siang.html)

Fig;-3.1 Siang River

Table: 3.1 Habitat characteristics of Siang River

Habitat characteristics						
Stream order	Microhabitat type	Cover type	Substrate type	Riparian Land Use	Signs of Erosion	Valley Segment
First order	Riffle, Cascade	Under cut bedrock, Overhanging, Depth, Turbulence Cover, Small Woody Debris	Boulders Cobbles, Gravels and Fine Sands	Human Habitation, Fishing, Protected Areas as Reserved Forest and Agricultural Use	Visible	Colluvium

Colour of the water, air temperature, pH, water temperature was determined in the field due to their unstable nature. The study of physico-chemical parameters of the River Siang is discussed below:

1. Water color: A Color change is not harmful until and unless it is associated with a toxic chemicals, but it may affect the amount of sunlight penetrating percentage to a given depth inhibit plants and animals metabolism. Color of water was clear in most of the study sites but the color is pale green in the mid-stream of the river.

2. Water temperature: Pasighat bears the highest value of water temperature in summer 30 degree Celsius and minimum in Mebo (winter) of 15 degree Celsius.

3. Air temperature: In summer season the air temperature is highest in the Ranaghat, 35 degree Celsius and minimum in winter season, 21 degree Celsius.

4. PH: During the study the value of pH was found normal in every position of the river, the total range of value lies between 6 to 8. The highest value of pH was recorded as 7.91 in post- monsoon season at Rottang and the minimum recoded as 6.3 in winter season at ponging.

5. Dissolved Oxygen: DO (dissolved oxygen) is an important parameters which indicates level of water quality and organic pollution in water body. The maximum value of DO is recorded as 8.8 mg/L in summer at Rottang and minimum recorded as 4.9 in pre- monsoon at Ranaghat. The maximum value of DO in monsoon is because of bright sunlight as it influences the % of soluble gases.

ii) Kameng river:-

The kameng river is originate from the eastern Himalaya mountains, in Tawang district from glacial lake below snow capped Gori Chen Mountain at an elevation of 6,300 meters' or 20,669 ft on the India-Tibet border in South Tibet. River flow through Bhalukpong circle of west kameng districts in Arunachal Pradesh. Kameng river is about 264 km long and drainage basin is about 11,843 km^2 large.

(source: - https://www.mapsofindia.com/maps/arunachalpradesh/rivers/)

Figure: 3.2 Kameng river

iii) Dikrong river;-

Dikrong river which is originates from Dafla hills near the borders of Lower Subansiri District and East Kameng District of Arunachal Pradesh. Dikrong river basin flow in the capital region, papum pare district Arunachal Pradesh it is also a major river basin of Brahmaputra river. The dikrong river basin is 1250km. sq. flow in Arunachal Pradesh and 275km.sq. in Assam, so total area of dikrong basin is 1525km^2.

Dikrong is a major source of usable water for the local people there is an also the adobe of diverse fish varieties (Bagra et al., 2009).

iv) Subansiri river: -

The subansiri is the one of major river in Arunachal Pradesh and also known as Gold River. It is originating from the Himalayas, in china and flows down through the green tropical rainforest in the state of Arunachal Pradesh. Subansiri rivers is stretched out 170 km in the Tibetan Territory and 250 km in the Eastern Himalayan mountain range, 86 km in the state of Assam to meeting the mighty Brahmaputra at the point of Majuli. Majuli is the highest river island populated area in the world.

The Subansiri River is very famous for the powerful waves and traveling, and this it is quite arduous and difficult. The river has surge, size and an idle spot for river rafting. The river exerts a number of tourists round in the year because of the beautiful spectacular surrounding on the side of Eastern Himalayan mountain ranges and friendliness of the wide variety of hill people coming from different ethnic background. The society and culture of these hill people are diversity, it's the main reasons why most people are visit this area. There are so many tourist attracts places are there in the river bank side of this beautiful rivers. Most important, the Subansiri river is known in all over the world for the its gold dust.

(source: - https://www.mapsofindia.com/maps/arunachalpradesh/rivers/)

Figure: 3.3- Subansiri river

v) Lohit River:

The name Lohit rivers is known as Arunachal Pradesh states of India and also known as Zayu river in China. It is located in Lohit district of Arunacahl Pradesh, and originates from the eastern Tibet, in the Kangri Garpo range, and it passes through this mountainous region and descends through Arunachal Pradesh for the 200km before entering the plain of Assam.

The Mishmis hold sway in the hills, along the lower valleys of the Lohit river flows. In the plains they have towns like Khamptis and the Singphos, enthusiastic Buddhists which is migrants from across the Patkai hills from Burma.

Lohit river is located the Lohit district of eastern Arunachal Pradesh, it is flow through the eastern part of Tibet towards the Arunachal Pradesh, southward and passes through the lohit district in east-west direction and with the Brahmaputra River in Assam.

(source:-upload.wikimedia.org/wikipedia/commons/3/34/Ganges-Brahmaputra-Meghna_basins.jpg)

Figure: 3.4 Lohit river

vi) Tirap river;-

Tirap river is flow in the district Tirap of Arunachal Pradesh in India. The Tirap district situated in the southern part of the Brahmaputra River and in northern part Sibsagar district (Assam) is surrounded. Tirap river known for its abundant supply of a variety of fresh fish, the

Known for its abundant supply of a variety of fresh fish, the Tirap river falls in the Tirap district which gets its name from the river. Standing by the riverside, you can witness majestic sunrises for a great start to the day.

vii) Manas: -

The Manas River is a trans-border river in the Himalayan between southern Bhutan and India. Manas river is also known as Drangme Chhu in Bhutan and Niamjang in china. It is named by the serpent God in Hindu mythology after Manas. Manas river is the largest river system in the Bhutan among the four major river system, Amo chu/torsa river, Wong chu/raidak, Mo chu/sankosh. The total lenght of the river is 376 km, it flows in Bhutan 272 km and through Assam for 104 km before meet the mighty river Brahmaputra.

The Manas river pass through two major forest reserve areas, the royal Manas National park which is 43,854 hectares and establish in 1966 in Bhutan and the contiguous Manas Wildlife Sanctuary which is 391,000 hectares and establish in 1955 and increase up to 95,000 hectares in December 1985 uncompressing Project Tiger reserve, an elephant reserve and a biosphere reserve, which is UNSCO World Heritage Site declared in December 1985.

Dams Constructed

Ranganadi dam: -

Ranganadi dam is located in Lemma village on the Ranganadi river which is 5km upstream of the Yazali town, lower subansiri district Arunachal Pradesh. It is constructed by concrete gravity dam, the propose of project is 12km upstream of Ranganadi dam with power house on the left side of river bank and a 108m high dam. This reservoir will cover up 7.5km of the length of the river. The catchment area of dam is 1315.50km^2 and the tail race channel will be 300m long. The total required area is 390 hectares and out this 42 hectare is river area, 25 hectares is reserved for forest and rest of 323 hectares is private land. The total estimated cost for this project is Rs 820 corers which imply that per megawatt cost is Rs 10.25 corers.

Fig;- 4.1 Ranganadi dam

2 Kameng dam: -

The kameng river dam is situated in the west kameng district of Arunachal Pradesh. It is run-of-the river which will utilize the flows from Bichom and Tenga river, both tributaries of the kameng river. The gross head of 536m available in downstream of the confluence of the Bichom with kameng river. The total catchment area of the dam is 2277km^2 for Bichom and 1019km^2 for Tenga, total land acquired for dam construction is 710 hectares. The project comprises with Bichom and Tenga and water is transport through a Head Race Tunnel (HRT)/penstock into the kimi power house for driving 4 numbers of verticals France Turbine with 150MW each.

3 Pare dam: -

The pare dam or hydro power project is situated in the jampa village of papum pare district in Arunachal Pradesh. NEEPCO has taken up this project to harness the hydro power potential in the river Dikrong. Dikrong river is also a tributary of mighty river Brahmaputra and also utilize the tail race discharge of the 450MW Ranganadi dam project stage. The area catchment of the project is 824km^2 with design head of about 67.36m, and Head Race Tunnel (HRT) is 2.818km long.

4.2 Under- construction Dam

1 Subansiri Lower dam: -

The subansiri dam is officially named Subansiri Lower Hydroelectric Project (SLHEP), which is an under the construction gravity dam on the Subansiri river in Arunachal Pradesh. It is located 2.3km upstream of Gerukamukh village in Demaji district and lower subansiri district on the border of India's two north-eastern states, Arunachal Pradesh and Assam. The project is expected to supply 2000MW of power supply when it is completed. The project has encountered a lot of problems during constructions to include landslides, re-design and opposition.

Sources;-(https://www.power-technology.com/wp-content/uploads/static-progressive/nri/power/projects/LSHEP/lower%20subansiri.jpg)

Fig;- 4.3 Subansiri Lower Dam

4.3 Dam on planning

Dibang Dam

The Dibang Dam will be located in the district lower dibang valley in state Arunachal Pradesh, India. The dibang dam is a planned concrete gravity dam, it will be India's largest dam in the time of it completion and the tallest concrete gravity in the world's, it standing for 288 m (945 ft) tall. The capacity of dibang dam is up to 3,000 MW of hydro-electric power. Foundation stone for the dibang dam was laid on 31 January 2008, but Construction on the project, has yet to begin because the Minister of Environment and Forest rejected the project application in 2013 and NHPC Limited again will resubmit it in 2014. The dibang dam is under intense local and international opposition to its tentative negative environmental impacts and forced relocations. So till now 2019, work was not progressing on the Dibang dam.

Upper Siang Hydroelectric Project

The Upper Siang Hydroelectric Project is a multi-construction project under which there are several hydroelectric power dam construction projects in the Upper Siang district of Arunachal Pradesh. These construction works of the project was began by the National Hydroelectric Power Corporation (NHPC) in April 2009 and the various other dams will be constructed in the phases over a period of 15-20 years.

The chief or main dam is being constructed across Siang River, which is one of the major tributary of the River Brahmaputra. On the completion, the dam reservoir will be able to hold 10 billion cubic meters of water. The hydro power project at Siang will alone generate between 10,000 to 12000 MW, which is the largest hydroelectric dam in the Indian Subcontinent.

4.4 Impact of Dam

Arunachal Pradesh is a harbor for natural resources. The government of India has set a various hydro-electric projects in the states to produce electricity. The governments are also preparation to build the biggest hydro-plant in the country with a capacity to generate 300 MW per day.

The Arunachal Pradesh is going to be entitling as power house of the India, but due to so many large hydro-projects of generating electricity, public are opposing due to devastation of social and environmental impact. So many people and places have been affected due to the constructions of dam and people became homeless and no care has been taken to migrate local people. The main issued raised was due to rehabilitate of migrants and the local people, it all has happened due to lack of proper planning and management of government.

Lack of Transparency:

The local people are unaware of any future situation and public have not been given any information or any knowledge regarding the dam construction and local people even do not why their lands have been acquired by the states government and how the government or companies will help and assist them to migrate another places.

Destruction of resources:

While villages were shown to be losing their land to submergence under water, so many other villages and people were affected as their paddy fields (rice), garden etc, were affected by the dam project. The forest area is cultivatable source like jhum cultivation, cardamom garden etc, for the local people to earn a living but due to the dam construction many other things have also been destroyed.

Ecological impacts:

The river valley and the beauty of river has been affected. These dam projects will destroy very badly the greenery and the flora and fauna which is indigenous to the region and area. The construction of dams have a severe impact on the environment, as the whole cycle of the aquatic life, stream flow, and the villages along the river side are acutely affected by those massive structure.

Destruction of culture and identity:

One of the biggest impacts of dam projects is likely to be on the culture and identity of the local people and the states. In the states the population local are consists of about 26 major tribes and more than 100 sub-tribes in Arunachal Pradesh. The tribes have their different language, identity, customs and locations. The total population of these tribes is small in number, they are excessively vulnerable to the influence of outsiders i.e., likely to take place with the construction of such huge infrastructure projects.

Difficulties of jobs for local people:

The government officials and dam companies are saying to the villagers that the local people will get recruits in the projects works, while the subject to their being found eligible and qualified for the same. Since most of the local people are illiterate and not trained or no any idea about the kind of jobs available, so finally the local people would not really be of benefit to them.

Money Power:

Dam construction projects are estimated to be of millions of money which is used for overall construction of the project and this amount can be misused by corrupted officials for their personal gain. The authorities receives huge amount of payment from the dam builders, so that they get clear cut permission to continue their work without facing any difficulties. After getting permission on prohibited land or some local people's lands they manipulate the land and its resources as they want without concerning the needs of the peoples residing on those particular area or land.

The Environment ministry must be held accounting for the losses of natural resources and due to which millions of people have been affected and forced them to leave their own places. Many political parties and activists have protested and rebelled against the construction of the dams, but no such genuine decision has been taken yet for the beneficial of people.

Problems of Durpai village, near the site of the Subansiri dam.

In the case of the Subansiri project situated in West Siang district of Arunachal Pradesh. It is 2000 MW hydro-project being constructed by NHPC, it is supposed to displace 38 families only from two villages. But it impact is likely to be much bigger as the project which will be unfavorable affect to the natural resource base on which the people in the area depend for agriculture, fishing, and other goods and services, ecology, flora and fauna.

According to headman Dure Bui, the impact of dam project is adversely affected apart from the two villages directly affected by submergence, so many of the paddy field, cultivation plain areas of other villages would also be affected. About 4000 hectares of forest is to be taken for the dam constructions, most of it to be submerged. The damming of the river is already adversely impact on fishing, another important component of the community's sustenance base. While materials for

the housing is brought to this area by the people using rafts on the river, the movement has already been disturbed due to the construction activities on the dam and will be permanently blocked the river flowing water when the dam is complete

Table: 4.5 Hydropower Potential Development

Year	2013	2015	2018
Identified Capacity Total(MW)	50328	50328	50328
Above 25 MW	-	50064	50064
Capacity Developed			
Mega Watts	423.5	405.0	405.0
Percent	0.84	0.81	0.81
Capacity under construction			
Mega Watts	2600.00	2710.00	2854.0
Percent	5.17	5.41	5.70
Capacity Development & Under Construction			
Mega Watts	3023.5	3115.00	3259.0
Percent	6.01	6.22	6.51
Capacity yet to be Developed			
Mega Watts	47304.5	46949.00	46805.00
Percent	93.99	93.78	93.49

Source: Central Electricity Authority, 2008, 2013, 2015. Ministry of Power, Govt. of India

Indo – China Water treaty

The impact of Indo – China water treaty in Arunachal Pradesh

China and India are competing for resources along the Brahmaputra River, which flows through parts of Asia that have been prone to territorial disputes. South Asia is water scarce. Mass dam-building and diversion plans are a source of major tension between India and China. The potential for conflict is low between the two Asian giants; however, a combination of regional competition and water-sharing tension could still threaten regional stability. It is imperative that China, which lies upstream, does not create a situation where India believes its future water security is significantly threatened as a result of damming and other hydro-projects along the Brahmaputra.

- China and India are water-scarce countries that will face significant challenges to food and water security in the future.
- As lower riparian's, India and Bangladesh rely on the Brahmaputra River for water, agriculture and livelihoods. Upstream, China holds an important strategic advantage over the river's flow.
- Chinese dam-building and water division plans along the Yarlung Zangbo (the Brahmaputra in India) is a source of tension between the two neighbours.
- The potential for conflict over water between China and India is increased as long as the two countries do not improve communication and co-operation.

Recently, China is agreed to share the hydrological data of the Brahmaputra River in flood season, months after Beijing stopped the practice, crucial to predict floods.

References

1. Dhar, O. N. and Nandargi, S. (2000a). A study of floods in the Brahmaputra basin in India. Int. J. Climatol., 20, pp. 771–781 —— (2000)
2. An appraisal of precipitation distribution around the Everest and Kanchenjunga peaks in the Himalayas. Weather, 55, pp. 223–234 Dhar, O. N. and Rakhecha, P. R. (1981)
3. The effect of elevation on monsoon rainfall distribution in central Himalayas. In: Lighthill, J. M. and Pearce, R. P. (Eds.)
4. Monsoon dynamics, Cambridge University Press, London Goswami, D. C. (1998)

5. Fluvial regime and flood hydrology of the Brahmaputra river, Assam. In: Kale, V. S. (Ed.) Flood studies in India, Memoir No. 41 of the Geological Society of India, Bangalore, pp. 53–75 Mohile, A. D. (1999)
6. Flood management in Brahmaputra valley – constraints and prospects. In: Bora, M. C. (Ed.) Proceedings of International Conference on Disaster Management, Tezpur University, Guwahati, 23–26 April 1998, pp. 27–41 Murthy, Y. K. (1981)
7. Water resources potential of the Himalayas. In: Lall, J. S. and Moddie, A. D. (Eds.) The Himalayas – aspects of change, India International Centre, New Delhi, pp. 152–171
8. Rao, K. L. (1975) India's water wealth, its assessment, uses and projections. Orient Longman Ltd, New Delhi
9. India Meteorological Department (IMD). 1971. Rainfall Atlas of India. IMD: Pune. India Meteorological Department (IMD). 1986.
10. Agroclimatic Atlas of India. IMD: Pune. Indian Institute of Tropical Meteorology (IITM). 1989.
11. Probable Maximum Precipitation Atlas. IITM: Pune; 1–15. Khosla AN. 1958.
12. Inaugural address to the symposium on 'Meteorological and Hydrological Aspects of Floods and Droughts in India'; 13–14.
13. Proceedings of the Symposium, IMD, New Delhi. Murthy YK. 1981.
14. Water resource potentials of the Himalaya. In The Himalayas—Aspects of Change, Lall JS, Moddi AD (eds).
15. India International Centre: New Delhi; 152–171. Pant PS, Abbi SDS, Gupta DK, Chandra H. 1970.
16. A study of major rainstorms of Assam. Indian Journal of Meteorology and Geophysics 21(2): 189–196. Prasad B. 1974.
17. Diurnal variation of rainfall in Brahmaputra Valley. Indian Journal of Meteorology and Geophysics 25(2): 245–250. Ramaswamy CS, Rao VS. 1979.
18. Very large floods in the Brahmaputra river in August, 1972. Part I, Synoptic aspects. Mausam 30: 9–20. Rao KL. 1975.
19. India's Water Wealth. Orient Longman: New Delhi; 255 pp. Ward R. 1978. Floods—A Geographical Perspective. Macmillan Press: London