

F.No. L-11013/30/2015-IA-I
Government of India
Ministry of Environment, Forest & Climate Change
(IA-I Division)

Indira Paryavaran Bhawan
Jor Bagh Road, New Delhi-3

Dated: 13th April, 2018

To,
The Secretary,
Ministry of Power
Government of India

The Secretary,
Ministry of Water Resources, River Development & Ganga Rejuvenation
Government of India

The Secretary,
Ministry of New & Renewable Energy,
Government of India

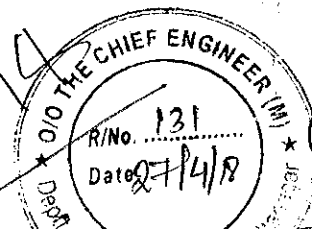
✓ The Chief Secretary
Government of Arunachal Pradesh
Itanagar, Arunachal Pradesh

Subject: Additional Study for Cumulative Impact Assessment & Carrying Capacity Study of Subansiri River Basin in Arunachal Pradesh for Development of Hydroelectric Power Projects (HEPs)- approved recommendations-Reg.

Sir,

The recommendations of the Additional Study for Cumulative Impact Assessment & Carrying Capacity Study report of Subansiri River Basin in Arunachal Pradesh has been approved by Ministry of Environment, Forest & Climate Change (MoEF&CC). The recommendations as accepted are required to be considered as road map for development of HEPs in Subansiri River Basin in Arunachal Pradesh in continuation to the earlier approved Subansiri River Basin Study (Main) report. The report outlines recommended capacity, size and location of HEPs commensurate with the basin environmental carrying capacity conforming to the accepted cumulative impacts. However, EIA/EMP shall have to be carried out for individual projects as per provision of EIA Notification 2006 and its subsequent relevant amendments. Modifications in design in HEPs or re-arrangements wherever recommended need to be incorporated.

Contd....



Commr. (Power)

Office of the Chief Secretary
Dy. No. 3455
Date 24/04/2018

P.C.F.

CE(M)

H. Dixit

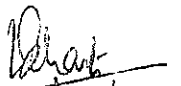
27/4/18

The major approved recommendations of the Additional Study report are as below:

- (i) A total of 27 HEPs with total installed capacity of 1116.5 MW have been considered in the Additional study of Subansiri River Basin (26 HEPs proposed with IC 711.5 MW and 01 HEP – Ranganadi HEP with IC 405 MW already commissioned). The executive summary of the Additional study of Subansiri River Basin is annexed at **Annexure-I**.
- (ii) List of the recommended 26 HEPs with total installed capacity of 711.5 MW is annexed at **Annexure-II**.
- (iii) All these HEPs shall not be reallocated by altering their design features, location, names etc. Recommended Environment flow releases of these 26 HEPs is annexed at **Annexure-III**.
- (iv) On the other free stretches of main river as well as tributaries, no further HEPs should be planned/allotted in the entire Subansiri basin in Arunachal Pradesh even if they are of smaller capacity (less than 25 MW) and do not fall under the purview of EIA Notification, 2006.

Encl: As above

Yours faithfully


13/04/18
(Gyanesh Bharti)
Joint Secretary

Copy to:

1. DG (Forest), 4th Floor, Jal Block, Indira Paryavaran Bhawan, New Delhi for information and necessary action with regard to issue of FC in respect of HEPs pending for Subansiri Basin Study report.
2. Inspector General (FC), 5th Floor, Jal Block, Indira Paryavaran Bhawan, New Delhi for information and necessary action with regard to issue of FC in respect of HEPs pending for Subansiri Basin Study report.
3. Chairman, Central Electricity Authority, Ministry of Power, Sewa Bhawan, Sector-I, R.K.Puram, New Delhi-110066
4. Chairman, Central Water Commission, MOWR, RD & GR, Room No. 313 S, Sewa Bhawan, Sector 1, RK Puram, New Delhi, Delhi 110066

Additional Study for Cumulative Impact Assessment & Carrying Capacity Study (CIA & CCS) of Subansiri Basin in Arunachal Pradesh

Executive Summary

In 2015, Central Water Commission (CWC), Government of India, Ministry of Water Resources, River Development and Ganga Rejuvenation had initiated "Cumulative Impact and Carrying Capacity Study of Subansiri sub basin including Downstream Impacts (CIA & CCS)" with an objective to assess the cumulative impacts of hydropower development in the basin. Expert Appraisal Committee (EAC) for River Valley and Hydroelectric Projects of Ministry of Environment, Forest and Climate Change (MoEF&CC) had provided the Terms of Reference (TOR) for this study. The above said study was initiated by Central Water Commission, Ministry of Water Resources and Ganga Rejuvenation with an objective of assessment of the cumulative impacts of hydropower development and to provide optimum support for various natural processes and allowing sustainable activities. The study was assigned to IRG Systems South Asia Private Ltd (IRGSSA), New Delhi. The objectives of study are:

- Inventorisation and analysis of the existing resource base.
- Determination of regional ecological fragility / sensitivity.
- Review of hydropower development plans.
- Evaluation of cumulative impacts on various facets of environment due to hydropower development.
- Broad framework of environmental action plan to mitigate the adverse impacts on environment, in the form of: preclusion of an activity; modification in the planned activity and implementation of set of measures for amelioration of adverse impacts.

The Final Report of the project prepared by IRG Systems South Asia Private Limited (IRGSSA) was approved by EAC in August 2016 vide Minutes of the 86th Meeting of the Expert Appraisal Committee for River Valley and Hydroelectric Projects held on 24th -25th August, 2015. Subsequently, 27 HEPs were identified to be included in additional Subansiri Basin study by Department of Hydropower Development, Government of Arunachal Pradesh. This includes one commissioned project namely Ranganadi HEP on Ranganadi adjoining Dikrong with IC of 405 MW (3x135) in 2002. These additional projects were then considered by MOEFCC for Additional Study for cumulative Impact Assessment and Carrying Capacity Study (CIA & CCS) of Subansiri basin in Arunachal Pradesh in September 2016 and assigned to IRG Systems South Asia Private Ltd, New Delhi. The study area to be covered as a part of the River Basin Study (RBS) includes HEPs which were not included in Main Subansiri RBS.

As per Central Electricity Authority (CEA) estimates, the basin has 6092 MW at 60% load factor, hydroelectric schemes with potential of 114.6 MW at 60% L.F. (1.66% of the assessed potential) have already been developed. The total installed capacity of these schemes has been projected to be 13,767 MW. 28 HEPs (more than 25 MW) capacity 11,282.7 MW had been considered in previous Subansiri basin study¹. These include 18 HEPs with IC 11274 MW. 10 small HEPs (with installed capacity of less than 25 MW) totaling IC 8.7 MW.

In the additional study, 27 HEPs have been considered with total IC of 1,116.5 MW of which 26 HEPs have IC total 711.5 MW and Ranganadi HEP 405 MW is already commissioned. Base map of the Additional Subansiri study is given in Figure 1.

¹ CIA & CCS of Subansiri Basin study 2015 (Main Basin Study)

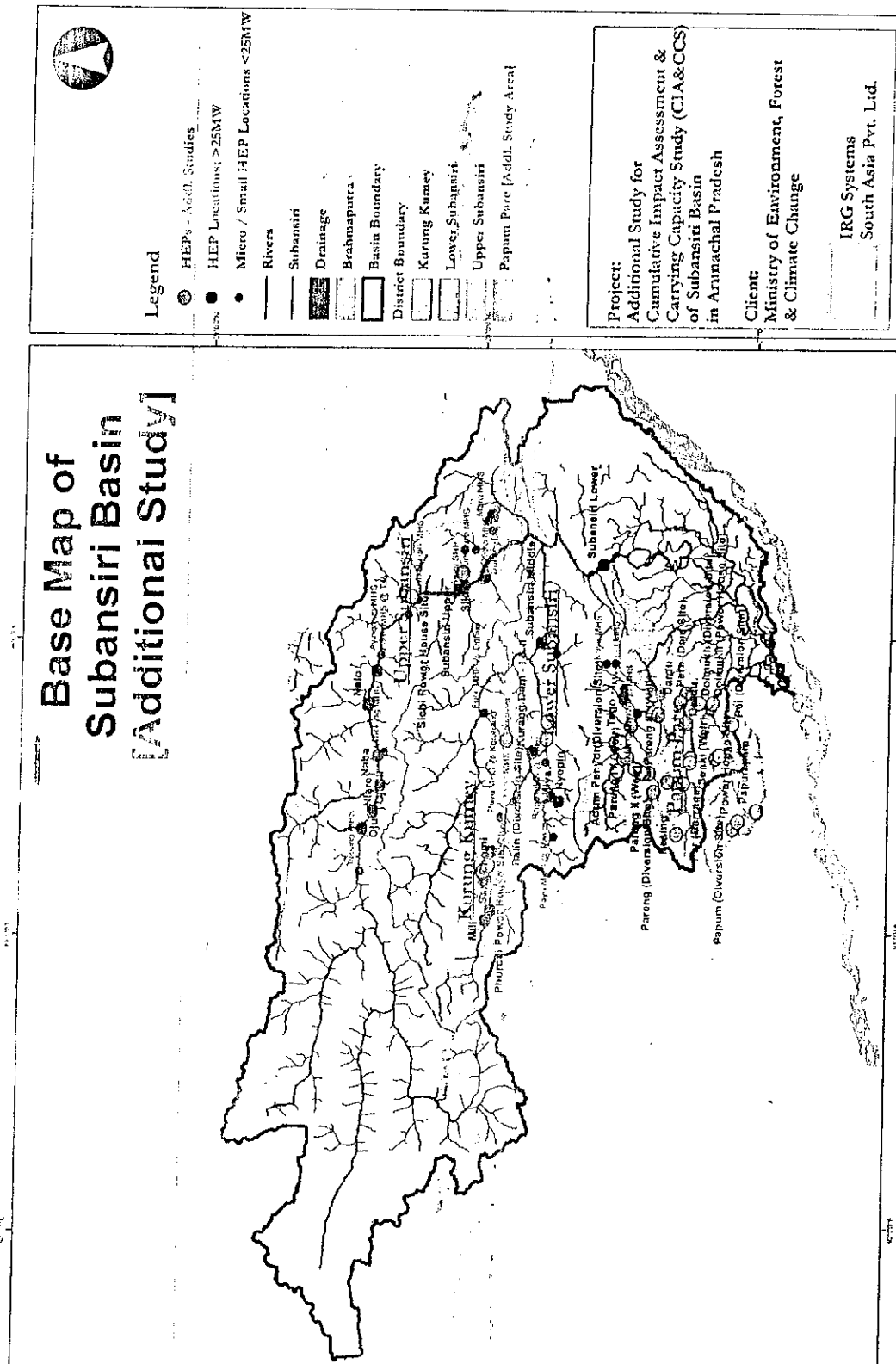


Figure 1: Base map of Subansiri Basin (Additional Subansiri study)

Eight of the schemes are proposed on Kurung River, an important tributary of Subansiri River with total installed capacity 99 MW. Nine schemes are proposed on Panyor River with total installed capacity of 245.5 MW and one Ranganadi HEP project (405 MW) has been commissioned since 2002, totalling 650.5 MW. Nine of the schemes are proposed on Dikrong River with installed capacity of 367 MW. Table 1.1 (a, b, c) describes the current status of 27 projects in the Additional basin study.

Table 1.1 (a): Proposed HEPs on Subansiri River

S.No.	Name of the project	Catchment Area (Sq.km)	Present IC (MW)	Altitude (meters)	FRL m	Tail Water Level (m)	Present Status	Developer/ Propone
1.	Pein HEP	320.69	8	473	-	-	DPR Prepared.	M/S Nido Energy Systems Pvt. Ltd.
2.	Siken HEP	74.16	8	685	506.75	257	PFR Prepared.	M/s Geopong Enterprises.
3.	Palin HEP	155.62	15	615	786.65	570	DPR Prepared	M/S Built Infrastructure
4.	Panyi HEP	215	24	1087	915	-	PFR Prepared.	M/S Sowbhagya Energy Pvt. Ltd.
5.	Sichi HEP	62	24	1060	750	-	PFR Prepared.	M/S SLS Power Ltd.
6.	Pei HEP	20	5	401	-	655	PFR Prepared.	M/S Apik Construction Pvt. Ltd.
7.	Phurchi HEP	40.6	5	1100	1123	948	PFR Prepared.	DLBB Projects Private Limited
8.	Vaphi	117	10	-	-	-	PFR Prepared.	DLBB Projects Private Limited

A total of 8 HEPs are located on Subansiri River (less than 25 MW) with a total IC of 99 MW.

Table 1.1 (b): Proposed HEPs on Panyor River

S.No.	Name of the project	Catchment Area (Sq.km)	Present IC (MW)	Altitude (meters)	FRL m	Tail Water Level (m)	Present Status	Developer/ Proponent
1.	Adum Panyor HEP	366.5	25	1052	1072	968	PFR Prepared.	SALCON-BSS Joint Venture
2.	Panyor Lepa Middle HEP	494	21	936	948	851	Under S&I.	M/S JMD Power Solutions Private Limited
3.	Pareng HEP	119	14.5	1418	1421.3	1306	DPR Prepared.	Virtuaal Pareng Hydro Pvt. Ltd.
4.	Pareng II HEP	226	24	1246	1251	1116.15	PFR Prepared.	Virtuaal Pareng Hydro Pvt. Ltd.
5.	Pareng III HEP	228	21	1108	1115	1001.1	PFR Prepared.	Virtuaal Pareng Hydro Pvt. Ltd.
6.	Pareng IV HEP	315	24	938	946	857.88	PFR Prepared.	Virtuaal Pareng Hydro Pvt. Ltd.
7.	Keyi HEP	259.6	23	897	902.60	722.2	DPR Prepared.	DD Hydro Power & Developers Pvt. Ltd.

S.No.	Name of the project	Catchment Area (Sq.km)	Present IC (MW)	Altitude (meters)	FRL m	Tail Water Level (m)	Present Status	Developer/ Proponent
8.	Panyor HEP	494	80	783	-	-	Under S&I.	M/S Raajratna Energy Holding Pvt. Ltd.
9.	Pith HEP	67.22	13	1042	-	-	DPR Prepared.	M/S I Built Infrastructure
10	Ranganadi HEP#	1730	405	-	567	247.76	Commissioned in 2002	NEEPCO

Total IC on Panyor River: 245.5 MW + 405 MW (Ranganadi HEP, commissioned, 2002) = 650.5 MW

#Note: Ranganadi Hydroelectric Project (HEP) is a commissioned HEP of NEEPCO with IC of 405 MW (3x135) since 2002 on Panyor river (also known as Ranganadi in the Plains) and has been considered in the Additional Subansiri Study.

Table 1.1 (c): Proposed HEPs on Dikrong River

S.No	Name of the project	Catchment Area (Sq.km)	Present IC(MW)	Altitude (meters)	FRL m	Tail Water Level (m)	Present Status	Developer/ Proponent
1.	Pare HEP	824	110	238	245.15	169.82	EC accorded by MoEF 13 Sep 2006, (under construction)	NEEPCO
2.	Turu HEP	560	60	601	612	419.1	DPR Prepared.	Turu Hydro Energy Private Ltd
3.	Dardu HEP	710	49	386	400	261	DPR Prepared.	KVK-ECI Hydro Energy Private Ltd
4.	Par HEP*	420	52	809	848	630	Recommended for proposal afresh by EAC	KVK-ECI Hydro Energy Private Ltd
5.	Papumpa m HEP	460	21	242	160	117.6	DPR Prepared	M/S Meena Entrade & Engineering Pvt. Ltd.
6.	Senki HEP	64.131	2	442	390	-	PFR Prepared.	M/S T.K. Engineering Consortium Pvt. Ltd.
7.	Papum HEP	184.2	15	334	-	-	PFR Prepared.	M/S Sonam Hydro Power Pvt Ltd.
8.	Doimukh HEP	863.38	52	154	163.2	115.6	PFR Prepared.	SJVN
9.	Resing HEP	87.647	6	1298	1350	-	PFR Prepared.	M/S Geopong Enterprises

Total IC on Dikrong River: 367 MW

A total of 27 HEPs are located in Additional Subansiri Basin study area with IC of 711.5 MW and one commissioned Ranganadi HEP with IC of 405 MW which totals 1,116.5 MW

*As per 7th meeting of EAC for river valley and hydroelectric project held on 24-25.08.2017 committee recommended PP to apply the proposal afresh as per the EIA notification 2006, and amended thereof.

Cumulative Impact Assessment describes the cumulative impacts of 27 hydel projects in Subansiri Basin predicated on the baseline primary (one season) and secondary data. The baseline data and cumulative impact assessment forms the basis of conclusions and recommendations for sustainable utilization of resources for development of hydropower in Subansiri basin.

Socio-cultural and Religious Values

In Arunachal Pradesh, Gumpa Forests, known as Sacred Groves are attached to Buddhist monasteries. There are 101 sacred groves recorded from AP². No monuments/protected monuments in Subansiri Basin have been listed in the list of Ancient Monuments and Archaeological Sites and Remains of National Importance by Archaeological Survey of India³. However, Ruins of Copper temple in Papumpare district is a State Protected Monument in the study area⁴.

Land use

The total geographical area of the state is about 83,743 sq km (approx), out of which 70% constitutes broad and narrow valleys, 10% foothills and flat area and 20% constitutes wooded peak area. The total land area of four districts of Subansiri basin was 20060.75 sq.km.

Forest Cover

The recorded forest area in the State is 51,407 sq.kms. which is 61.39 % of State's geographical area. Reserved forests is spread in an area of 10,589 sq.km (20.59 % of recorded forest area), protected forests in 9,779 sq.km. area (19.02 %) and unclassified forests in 31,039 sq.km. area (60.37%) in Arunachal Pradesh⁵. Recorded forest area is 61.39% of state geographical area.

Forest Loss

On the basis of interpretation of the satellite data of October to December 2015, the forest cover in the state is 66,964 sq.km which works out as 79.96 % of the State's geographical area (83,743 sq.kms.). In terms of forest canopy density classes in the state has 20,721 sq. km. under very dense forest, 30,955 sq.km under moderately dense forest and 15,288 sq.km. under open forest⁶.

Cumulative Impact Assessment of proposed HEPs in Subansiri Basin indicates loss of forests on account of development of proposed HEPs. Total cumulative loss of forest cover including HEPs in Main Basin Study and Additional Basin Study is as under:

Main Basin Study: Lower Subansiri and Kurung Kumey districts have total forest cover of 8382 sq.km. Cumulative forest area loss is 61.62 sq. km which is 0.73% of total forest cover of Lower Subansiri and Kurung Kumey districts. Upper Subansiri district has total forest cover of

² <http://www.ecoheritage.cpreec.org>

³ http://asi.nic.in/asi_monu_alphalist_arunachal.asp

⁴ http://asi.nic.in/asi_protected_monu_arunachal.asp

⁵ Arunachal Pradesh: India State of Forest Report, 2015.

⁶ Arunachal Pradesh: India State of Forest Report, 2017

5571 sq.km. Cumulative forest area loss is 43.92 sq. km which is 0.78% of forest cover of Upper Subansiri district. This totals to 105.54 sq.km

Additional Basin Study: Cumulative forest loss on account of development of proposed HEPs in Papumpare district (total forest cover 3191 sq.km of the district) in Additional Subansiri Study is 1.1763 sq. km which is 0.037% of the total forest cover of the Papumpare District.

Cumulative forest loss is therefore 105.54 sq. km (Main Basin Study) and 1.1763 sq.km (Additional Basin Study) totaling 106.71. sq.km.

The total forest cover of the Main basin Study and Additional Subansiri Basin study area is 17,144 sq.kms. which is 25.29% of the total forest cover of the State. The total cumulative loss due to development of HEPs in both the studies is 106.71 sq.km which is 0.62% of the total forest cover of the Subansiri Basin. However, forest cover loss due to proposed HEPs in Additional Subansiri study area only is 0.006 percentage.

Terrestrial Biodiversity

Floral Diversity in Subansiri Basin

An estimated number of 5000 flowering plants, 600 orchids, 400 ferns, 48 gymnosperms and an equally high number of unexplored algae, fungi, lichens and bryophytes inhabit the diverse habitats that occur in at least six broad forest types of Arunachal Pradesh

220 endemic species have been listed from Arunachal Pradesh, out of which Subansiri Basin has 62 endemic species which accounts for 28% of the State's endemic flora. This is indicative of high endemism in the Subansiri Basin. 7 endemic species of Ericaceae, 3 endemic species of Begoniaceae and 1 species each of Orchidaceae and Arecaceae are threatened as well.

36 threatened species (including 12 endemic species) have been reported from Subansiri basin. Out of 36 threatened species, 6 Endangered, 15 Vulnerable, 13 Rare and 2 Indeterminate) reported to occur in Subansiri Basin. Of 36 threatened species, 2 threatened species are recorded in the study area:

1. *Livistona jenkinsiana* is reported in Lower Subansiri Districts (Arunachal Pradesh). This palm is among the commonly found palms in the forests of Arunachal Pradesh. However, the species has been assessed as Endangered. It is also an Endemic species to North East India and is assessed as Endangered due to extensive deforestation and degradation.
2. *Lagerstroemia minuticarpa* has been reported in Pare HEP of Papumpare District which has been assessed as Endangered as per IUCN Redlist Version 2017-1

Faunal Diversity in Subansiri Basin

A total of seven hundred and fifty seven species belonging to 8 faunal groups is reported to occur in Subansiri basin. Insecta group is the most diverse faunal group with 207 species, followed by aves (175), mammals (106), Pisces (213), Protozoa (27), Reptilia (19), Amphibia (6) and Trematodes of amphibia (4)

100 species belonging to Mammals (out of 106 reported species), 57 species belonging to Aves (out of 175 reported species), 1 Reptilian (out of 19 reported species), 2 Amphibians (out of 6 reported species), 28 fishes (out of 94 reported species), 25 species belonging to Odonata of Insecta fauna group (out of 28 reported species) are reported to be assessed as per IUCN's threatened categories.

66 species belonging to Mammals (out of 106 reported species), 50 Aves (out of 175 reported species) and 2 amphibians (out of 6 reported species) in Subansiri Basin are listed in Schedules of Wildlife Protection Act, 1972 (as amended till date). 60 lepidopteron (butterflies) species are listed in various schedules of WPA.

Aquatic Biodiversity

The distribution of fishes in Arunachal Pradesh can be mainly attributed to altitude and topology. The higher elevations generally support cold water fishes and the foot hills region and mid elevations comprises of fishes which are economically important. Arunachal Pradesh is rich in high altitude fish species like *Tor putitora*, *Tor* sp., *Schizothorax richardsonii*, *Barilius barna*, *Gara gotyla gotyla*, *Psilorhynchus balitora*, *Nemacheilus botia botia*, *Xenentodon cancila*, *Channa punctatus*, *Mastacembelus armatus*, *Badiis badiis*, etc., though there are no regular fish landing centres, fishes are caught with the help of long line, cast nets and traps from different streams and nallas (drains) in the area by local tribals for their local consumption.

The proposed diversion structures may obstruct the migration route of the Mahaseer species, which can be termed as one of the major impacts. The Mahaseer species undertake upstream migration in river Subansiri during summer and monsoon months in search of new feeding and breeding grounds. As the winter sets in the upper reaches, the species takes a downstream journey as far as up to its confluence with river Brahmaputra. In addition certain species of *Schizothorax* (Snow trout) also undertake migration from upper reaches during winter months basically for feeding and breeding as this fish species breeds in the lower reaches.

Environment Flow

As per the objectives, scope of work and Terms of reference, the study described basin characteristics, proposed hydropower development in Subansiri basin, hydrometeorology, terrestrial ecology, aquatic ecology, etc. Based on the results of the model, the study computed environment flows, assessed downstream impact due to hydropower development and cumulative impact Assessment. The study recommended following:

- i. Environmental flow has been estimated by using HEC-RAS model to assess flow scenarios and recommended environmental flow for proposed HEPs. The flow scenario of 90% dependable year series of the each hydro electric project has been used and the average discharge of leanest four months, monsoon four months and non lean non monsoon four months have been computed. The flow parameters i.e. water depth, velocity of flow and top width of river has been assessed for 10%, 15%, 20%, 30%, 40%, 50% and 100% release of respective average of the three season's flow of each hydroelectric project to estimate the environment flow release during the lean, monsoon and non lean non monsoon periods.
- ii. Norm of free flowing stretch between FRL of the downstream HEP and TWL of upstream HEP has been considered keeping in mind terrain and slope in Subansiri basin.

Environment flow release and recommendations for proposed HEPs on Subansiri River, Panyor and Dikrong river is given in Table 1.2 (a, b & c).

Table 1.2 (a): Environmental flow release and recommendations for proposed HEPs on Subansiri River

Sr. No.	Name	IC	Lean Environmental Flow Release (EFR)						Monsoon Environmental Flow Release (EFR)						Pre-monsoon and Post-monsoon Environmental Flow Release (EFR)						Threatened, endemic and migratory aquatic fauna	Recommendation/remarks
			EFR in %	EFR in Cumec	Top width (m)	50% of Pre-project flow width (m)	Flow depth (cm)	50% of Pre-project flow depth (cm)	EFR in %	EFR in Cumec	Top width (m)	50% of Pre-project flow width (m)	Flow depth (cm)	50% of Pre-project flow depth (cm)	EFR in %	EFR in Cumec	Top width (m)	50% of Pre-project flow width (m)	Flow depth (cm)	50% of Pre-project flow depth (cm)		
1	Vapthi	10	20%	0.69					20%	3.26					20%	1.50					Tor tor, Tor putitora, Garra kempfi, Schizothorax sp., Amblyceps apangi, Amblyceps arunachalensis	Project is recommended. It's the first project (less than 25 MW) in Vapthi river, a tributary of Kurung river, which drains into Subansiri River.
2	Phurchi	5	20%	0.31					20%	1.37					20%	0.85					Tor tor, Tor putitora, Garra kempfi, Schizothorax sp., Amblyceps apangi, Amblyceps arunachalensis	Project is recommended as it meets environment flow requirement
2	Palin HEP	15	20%	1	3.95	6.76	28	25.1	20%	1.58	9.78	7.7	31.2	29.4	20%	1.17	9.34	7.09	29.6	26.7	Tor tor, Tor putitora, Garra kempfi, Schizothorax sp., Amblyceps apangi, Amblyceps arunachalensis	Project is recommended as it meets environment flow requirement
3	Siken HEP	8	20%	0.31					20%	1.37					20%	0.85					Tor tor, Tor putitora, Garra kempfi, Schizothorax sp., Amblyceps apangi, Amblyceps arunachalensis	Project is recommended as it meets environment flow requirement

4	Per HEP	5	Project is recommended based on E- Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.
5	Panyi HEP	24	Project is recommended based on E- Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.
6	Sichi HEP	24	Project is recommended based on E- Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.
7	Pain HEP	8	Project is recommended based on E- Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.

Table 1.2 (b): Environmental flow release and recommendations for proposed HEPs on Panyor River

Sr. No	Name	IC	Lean Environmental Flow Release (EFR)						Monsoon Environmental Flow Release (EFR)						Pre-monsoon and Post-monsoon Environmental Flow Release (EFR)						Threatened endemic and migratory aquatic fauna	Recommendation/remarks
			EFR in %	EFR in Cumec	Top width	50% of Pre-project flow	Flow depth	50% of Pre-project flow	EFR in %	EFR in Cumec	Top width	50% of Pre-project flow	Flow depth	50% of Pre-project flow	EFR in %	EFR in Cumec	Top width	50% of Pre-project flow	Flow depth	50% of Pre-project flow		
1	Adum Panyor	25	20%	1.95	9.92	9.08	54.4	49.8	20%	5.7	14.84	13.61	81.4	74.7	20%	3.68	12.59	11.54	69.4	63.4	Tortor, Tor putitora, Garra kempfi	Project is recommended as it meets environment flow requirement
2	Panyor Lepa middle	21	20%	1.84					20%	8.38					20%	4.22					Tortor, Tor putitora, Schizothora x sp., Garra kempfi	Project is recommended as it meets environment flow requirement
3	Keyi	23	20%	1.2					20%	3.52					20%	2.27					Tortor, Tor putitora, Schizothora x sp., Garra kempfi, Amblyceps apang, A	Project is recommended as it meets environment flow requirement

Sr. No.	Name	Lean Environmental Flow Release (EFR)						Monsoon Environmental Flow Release (EFR)						Pre-monsoon and Post-monsoon Environmental Flow Release (EFR)						Threatened, endemic and migratory aquatic fauna	Recommendation/remarks
		EFR in %	EFR in Cumec	Top width	50% of Pre-project flow width	Flow depth	50% of Pre-project flow depth	EFR in %	EFR in Cumec	Top width	50% of Pre-project flow width	Flow depth	50% of Pre-project flow depth	EFR in %	EFR in Cumec	Top width	50% of Pre-project flow width	Flow depth	50% of Pre-project flow depth		
4	Panyor	20%	6.79	19.41	18.2	56	52	25%	24.81	31.91	30.32	92.25	79	25%	12.82	71.75	66.5	24.79	22.98	anunachalen sis	Project is recommended as it meets environment flow requirement
5	Parang-II	20%	1.58	9.65	9.07	35.71	33.5	20%	8.66	18.76	17.93	69.14	64.71	20%	4.12	14.05	13.3	51.71	48.5	Tor lor, Tor pulitora, Garra kempi	Project is recommended as it meets environment flow requirement
6	Parang-III	20%	1.6	5.67	5.4	40.43	38.5	20%	8.73	11.22	11.86	79.86	76.13	20%	4.16	8.32	8.12	59.14	56.71	Tor lor, Tor pulitora, Schizothora x sp., Garra kempi, Amblyceps apangi, A. anunachalen sis	Project is recommended as it meets environment flow requirement
7	Parang-IV	20%	2.21	7.85	7.15	61.43	55.92	20%	12.07	14.78	13.42	1	104.93	20%	5.74	11.2	10.21	87.57	79.71	Tor lor, Tor pulitora, Schizothora x sp., Garra kempi, Amblyceps apangi, A. anunachalen sis	Project is recommended as it meets environment flow requirement

Sr. No.	Name	IC	Lean Environmental Flow Parameters (EFR)						Monsoon Environmental Flow Release (EFR)						Pre-monsoon and Post-monsoon Environmental Flow Release (EFR)						Threatened aquatic fauna	Recommendation/Remarks
			EFR in %	EFR in Cumec	Top width	50% of Pre-project flow width	Flow depth	50% of Pre-project flow depth	EFR in %	EFR in Cumec	Top width	50% of Pre-project flow width	Flow depth	50% of Pre-project flow depth	EFR in %	EFR in Cumec	Top width	50% of Pre-project flow width	Flow depth	50% of Pre-project flow depth		
8	Pith	13	20%	0.48	10.89	7.06	12.83	12.92	25%	1.17	12.54	7.96	18.83	17.75	25%	0.77	11.7	7.39	15.33	14.58	Tor tor, T. putitora, Schizothorax x sp. Garra kempfi, Amblyceps apangi, A. arunachalensis	Project is recommended as it meets environment flow requirement
9	Pareng	14.5																				Project is recommended based on E-Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.

Table 1.2 (c): Environmental flow release and recommendations for proposed HEPs on Dikrong River

Sr. No.	Name	IC	Lean Environmental Flow Release (EFR)						Monsoon Environmental Flow Release (EFR)						Pre-monsoon and Post-monsoon Environmental Flow Release (EFR)						Threatened, endemic and migratory aquatic fauna	Recommendation/remarks
			EFR in %	EFR in Cumec	Top width (m)	50% of Pre-project flow width (m)	Flow depth (cm)	50% of Pre-project flow depth (cm)	EFR in %	EFR in Cumec	Top width (m)	50% of Pre-project flow width (m)	Flow depth (cm)	50% of Pre-project flow depth (cm)	EFR in %	EFR in Cumec	Top width (m)	50% of Pre-project flow width (m)	Flow depth (cm)	50% of Pre-project flow depth (cm)		
1	Par	52	20%	1.89	8.36	8.17	58.2	51.6	25%	6.61	92.4	71.3	92.4	71.3	25%	3.04	9.65	9.03	68.8	55.8	Tor tor, Tor putitora, Garra kempfi,	Project is recommended as it meets environment flow requirement (as per TOR letter on 12th Feb, 2014 E flow release Lean Flow 2 cumec, Monsoon release 7 cumec, Pre monsoon 2.5 cumec)
2	Tunu	60	20%	2.46	8.11	7.51	60.8	52.6	25%	8.59	13.75	12.42	93.6	75.9	25%	3.95	10.1	8.05	71.2	57.2	Tor tor, Tor putitora, Garra kempfi, Amblyceps apangi, A. arunachalensis	Project is recommended as it meets environment flow requirement (as per TOR letter on 12th Feb, 2015 E flow release Lean Flow 2.5 cumec, Monsoon release 9 cumec, Pre monsoon 4 cumec)
3	Dardu	49	20%	3.19	19.5	14.43	57.6	52.4	25%	11.17	26.85	18.09	92	77.9	25%	5.13	5.13	15.2	69.6	57.5	Tor tor, Tor putitora, Garra kempfi,	Project is recommended as it meets environment flow requirement
4	Dolmuk h	52	20%	12.4					25%	40.71					25%	22.13					Tor tor, Tor putitora, Schizothorax sp., Garra kempfi, Amblyceps apangi, A. arunachalensis	Project is recommended as it meets environment flow requirement (as per TOR letter on 2th Feb, 2017 E change in Capacity from 80 MW to 52 MW)

Sr. No.	Name	IC	Lean Environmental Flow Release (EFR)						Monsoon Environmental Flow Release (EFR)						Pre-monsoon and Post-monsoon Environmental Flow Release (EFR)						Threatened, endemic and migratory aquatic fauna	Recommendation/remarks
			EFR in %	EFR In Cumec	Top width (m)	50% of Pre-project flow width (m)	Flow depth (cm)	50% of Pre-project flow depth (cm)	EFR in %	EFR In Cumec	Top width (m)	50% of Pre-project flow width (m)	Flow depth (cm)	50% of Pre-project flow depth (cm)	EFR in %	EFR In Cumec	Top width (m)	50% of Pre-project flow width (m)	Flow depth (cm)	50% of Pre-project flow depth (cm)		
5	Papum HEP	15	20%	0.76	9.85	9.19	23	21	20%	5.27	20.89	16.86	48	44.63	20%	2.05	13.58	13.01	32.5	31	Tor tor, T. putitora, Schizothorax sp, Garra kempfi, Amblyceps apangi, A. arunachalensis	Project is recommended as it meets environment flow requirement

6	Resing	6	Tor tor, T. putitora, Schizothorax sp., Garra kempfi, Amblyceps apangi, A arunachalensis	Project is recommended based on E- Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.
7	Pare	110	Tor tor, T. putitora, Garra kempfi	
8	Papumpa m HEP	21	Tor tor, T. putitora, Garra kempfi	
9	Senki HEP	2	Tor tor, T. putitora, Garra kempfi	
Notes on Fish and recommendation				
Project is recommended based on E- Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.				
Project is recommended based on E- Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.				
Project is recommended based on E- Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.				

Notes on Fish and recommendation

Tor putitora (Endangered) and *Tor tor* (Near Threatened) are migratory
Schizothorax sp. is vulnerable and migratory
Garra kempfi is Endemic, Least Concern
Amblyceps apangi is Endemic, Least Concern
Amblyceps arunachalensis is Endemic and Endangered
50 cms depth for fish (including mahseer and trout) is recommended to be maintained in lean season

Overall Biodiversity Impact

Based on the data availability on biodiversity on the proposed HEPs, it can be inferred that Papumpare is the most important district from the point of view of having highest number of (16) HEPs with total highest installed capacity (576.5 MW), the estimated loss of forest area 0.037% and reported presence of endemic and threatened species.

Papum pare district has reserved forest and unclassified state forest. Itanagar wildlife sanctuary is located in Papum pare district. Senki HEP at Dikrong river is located at 2.7 km of Itanagar Wildlife Sanctuary, Power house site of Par HEP is 7.35 km from the IWS, barrage location of Turu HEP is 5.5 km and power house location is about 6 km from the IWS. However, Zero meter eco-sensitive zone around Itanagar Wildlife Sanctuary has been declared vide MoEF&CC F.No.10-151/2113 WL, letter dated 22, October, 2014. Wildlife management plan has been recommended as referred in the said letter.

Summary of E flow recommendations

In additional Subansiri basin study, 26 HEPs out of 27 HEPs with a total IC of 711.5 MW have been recommended. One HEP, namely Ranganadi HEP (405 MW) is already commissioned in 2002 totalling 1,116.5 MW (IC). Eight out of 26 HEPs with a total installed capacity of 99 MW are proposed on tributaries of Kurung river which is an important tributary of Subansiri River. Nine HEP are proposed on Panyor River with installed capacity (245.5 MW) and one commissioned Ranganadi HEP (405 MW). Nine HEPs are proposed on Dikrong River with installed capacity (367 MW). These projects are diversion by trench weir (broad crested) schemes.

- The environmental flow criteria for the projects having the capacity 25 MW & more than 50 MW has been estimated for Par HEP (52 MW), Turu (60 MW) and Dardu (49 MW) on the basis of hydro dynamic simulation results. On the basis of results of Par, Turu and Dardu projects the environmental flow for Doimukh (52 MW) has also been recommended, which need to be confirmed at project specific EIA study.
- The projects having the proposed capacity of 25 MW and below the hydrodynamic simulations could be performed for Pareng II (24 MW), Pareng III (21 MW), Pareng IV (24 MW), Adum Panyor (25 MW), Pith (13 MW) and Papum (15 MW) HE Projects.
- Projects where hydraulic modelling has not been carried out due to non-availability of data, are recommended based on E- Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Expert Appraisal Committee, River Valley and Hydroelectric projects. These projects are namely:
 - Subansiri River HEPs: Pein (8 MW), Panyi (24 MW), Sichi (24 MW) and Pei (5 MW),
 - Panyor River: Pareng HEP (14.5)
- Dikrong River: Senki (2 MW), Resing (6 MW) Papumpam 21 (MW). Besides, for Pare HEP (110 MW) during lean season 10.52 cumecs (10% water is released) has been recommended as per EC letter dated 13th September 2006.
- For Panyor HEP with proposed capacity of 80 MW the environment flow may be adopted as 20% of average lean months flow, 25% of average monsoon months flow and 25% of average non monsoon non lean months flow of 90% dependable year.

Kurung River (Tributary of Subansiri) length is 340 Kms, Panyor River length is 174 Kms and Dikrong River length is 144 Kms totalling 658 kms. Cumulatively, total river length affected due to proposed HEPs is 16.03 % (105.5 kms of total 658 kms) including Main River Stem and Tributaries. Distance between FRL and TWL of proposed HEPs in cascade development is more than 1 kms which is in accordance with MOEFCC's guidelines and hence 26 HEPs are recommended.

Downstream Impact

The peaking will have minor impact in the river reach of Dikrong river downstream of Doimukh HEP during the non-monsoon period. The non-monsoon peaking release from the projects on Panyor and Dikrong rivers will cause nominal fluctuations in discharge and water level in Dikrong river up to its confluence with Subansiri/Brahmaputra river. In this reach of river the daily fluctuation in water level may be about 20 cm to 40 cm. No change or fluctuations in Brahmaputra water level will occur due to very peaking releases from projects in Panyor and Dikrong rivers as these peaking releases are of very small quantity in comparison to normal lean period discharge of Brahmaputra.

Table-2 – List of HEPs recommended in the Additional Study of Subansiri River Basin

S.No.	Name of the project	Present IC (MW)	Tributary
1.	Pein HEP	8.00	Subansiri River
2.	Siken HEP	8.00	-do-
3.	Palin HEP	15.00	-do-
4.	Panyi HEP	24.00	-do-
5.	Sichi HEP	24.00	-do-
6.	Pei HEP	5.00	-do-
7.	Phurchi HEP	5.00	-do-
8.	Vaphi HEP	10.00	-do-
9.	Adum Panyor HEP	25.00	Panyor River
10.	Panyor Lepa Middle HEP	21.00	-do-
11.	Pareng HEP	14.50	-do-
12.	Pareng II HEP	24.00	-do-
13.	Pareng III HEP	21.00	-do-
14.	Pareng IV HEP	24.00	-do-
15.	Keyi HEP	23.00	-do-
16.	Panyor HEP	80.00	-do-
17.	Pith HEP	13.00	-do-
18.	Pare HEP	110.00	Dikrong River
19.	Turu HEP	60.00	-do-
20.	Dardu HEP	49.00	-do-
21.	Par HEP	52.00	-do-
22.	Papumpam HEP	21.00	-do-
23.	Senki HEP	2.00	-do-
24.	Papum HEP	15.00	-do-
25.	Doimukh HEP	52.00	-do-
26.	Resing HEP	6.00	-do-
Proposed Installed Capacity		711.50 MW	

Annexure-III

1. Recommended Environmental Flow Release (EFR) for proposed HEPs on Subansiri River

Sr. No	Name of HEP	IC MW	Lean Season (EFR)		Monsoon season (EFR)		Non Lean Non Monsoon (EFR)	
			% age	in Cumec	% age	in Cumec	% age	in Cumec
1	Vaphi	10	20	0.69	20	3.26	20	1.50
2	Phurchi	5	20	0.31	20	1.37	20	0.85
3	Palin	15	20	1.0	20	1.58	20	1.17
4	Siken	8	20	0.31	20	1.37	20	0.85

5	Pei	5	Project is recommended based on E- Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.					
6	Panyi	24	-do-					
7	Sichi	24	-do-					
8	Pein	8	-do-					

2. Recommended Environmental Flow Release (EFR) for proposed HEPs on Panyor River

Sr. No.	Name of HEP	IC (MW)	Lean Season (EFR)		Monsoon season (EFR)		Non Lean Non Monsoon (EFR)	
			% age	in Cumec	% age	in Cumec	% age	in Cumec
1	Adum Panyor	25	20	1.95	20	5.7	20	3.68
2	Panyor Lepa Middle	21	20	1.84	20	8.38	20	4.22
3	Keyi	23	20	1.2	20	3.52	20	2.27
4	Panyor	80	20%	6.79	25%	24.81	25%	12.82
5	Pareng-II	24	20%	1.58	20%	8.66	20%	4.12
6	Pareng-III	21	20%	1.6	20%	8.73	20%	4.16
7	Pareng-IV	24	20%	2.21	20%	12.07	20%	5.74
8	Pith	13	20%	0.48	25%	1.17	25%	0.77

9	Pareng	14.5	Project is recommended based on E- Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.					
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3. Recommended Environmental Flow Release (EFR) for proposed HEPs on on Dikrong River

S. No.	Name of HEP	IC (MW)	Lean Season (EFR)		Monsoon Season (EFR)		Non Lean Non Monsoon (EFR)	
			% age	in Cumec	% age	in Cumec	% age	in Cumec
1	Par	52	20	1.89	25	6.61	25	3.04
2	Turu	60	20	2.46	25	8.59	25	3.95
3	Dardu	49	20	3.1	25	11.1	25	5.13
4	Doimukh	52	20	12.4	25	40.7	25	22.13
5	Papum	15	20	0.76	20	5.27	20	2.05

6	Resing	6	Project is recommended based on E- Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.					
7	Pare	110	During lean season 10.52 cumecs (10% water is released) as per EC letter on 13 Sep 2006.					
8	Papumpam	21	Project is recommended based on E- Flows prescribed in standard ToR for River Valley and Hydroelectric projects i.e. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.					
9	Senki	2	-do-					