My Ly - Nam Mo Hydropower JSC

Environmental and Social Impact Assessment

NAM MO 1 HYDROPOWER PROJECT

Volume II

Agreements, Approvals and Specialist Reports

29 September 2017

ENVIRO-DEV
With Input from
PECC1

Volume II

Environmental and Social Impact Assessment
Nam Mo 1 Hydropower Project

Date 2017	Revision History	Document No. and Name	Issued by Name and Signature
30 June	First Issue	ENVIRO-DEV Doc03-2017: ESIA Volume II Agreements, Approvals and Specialists reports	Previously signed
29 September	Final Issue	ENVIRO-DEV Doc03-2017: ESIA Volume II Agreements, Approvals and Specialists reports	 Shivcharn Dhillion

International Consultant:	Input from National Consultant:
ENVIRO-DEV	**Power Engineering Consulting Joint Stock Company I (PECC1)**
Contact: Olsbergsveien, N-2510 Tylldalen Norway env-dev@online.no; +47 90267958	Contact: Km 9+200 Nguyen Trai Street, Thanh Xuan Nam Ward, Thanh Xuan District, Ha Noi, Vietnam caothuyen@yahoo.com +84 3 8542270; +84 904230082

TABLE OF CONTENTS

ANNEX 1: AGREEMENTS AND APPROVALS

1.1 Record of Discussion – The 1st Negotiation Round Agreement between the Government of the Lao People's Democratic Republic and the Government of the Socialist Republic of Vietnam

RECORD OF DISCUSSION

THE 1ST NEGOTIATION ROUND

AGREEMENT

BETWEEN

THE GOVERNMENT OF THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

AND

THE GOVERNMENT OF THE SOCIALIST REPUBLIC OF VIETNAM

Today,March 11, 2016, at the headquarter of the Ministry of Industry and Trade of Vietnam, 54 Hai Ba Trung, Hanoi, the Delegation of the Socialist Republic of Vietnam and the Delegation of the Lao People's Democratic Republic held the first negotiation on Agreement between the two countries on cooperation for the project development for investment, construction and operation management of My Ly an Nam Mo hydropower plants.

H.E. Mr Hoang Quoc Vuong, Deputy Minister of the Ministry of Industry and Trade of Vietnam, led the Delegation of the Socialist Republic of Vietnam. Members of the Delegation are representatives of the Government Office and Ministries: Industry and Trade; Foreign Affairs; Justice; Finance; Public Security; National Defense; Natural Resources and Environment; Agriculture and Rural Development; and

H.E. Mr. Viraphonh Viravong, Deputy Minister of the Ministry of Energy and Mines of Laos, led the Delegation of the Lao People's Democratic Republic Members of the Delegation are representative of the Ministries: Energy and Mines; Foreign Affairs;Natural Resources and Environment; Agriculture and Rural Development.

*) The list of participants is in the attachment annex.

The negotiation proceeded as follows:

I. The general regulation

1. The two Parties confirmed that the two countries' traditional and friendly relationship will be enhanced by the signing of this Agreement.
2. The two Parties reaffirmed the significance and importance of the Agreement signing thatshall be the legal framework for the Investor (My Ly – Nam Mo hydropower joist stock company) to implement the Project.
3. The Project will relate to several crucial issues of the two countries such as society – economy, national security, mutual border, environment, immigration and resettlement. Thus, the signing of this Agreement is very necessary.

II. The specific contents

1. The two Parties agreed that the subjects of Agreement signing are the Governments of the two countries. However, the Governments may assign to suitable Ministries for signing. The two Parties proposed to report to the two Governments about the representative agencies of signing. For the Vietnamese side, the Ministry of Industry and Trade will be the representative and for the Laotian side, the Ministry of Energy and Mines will be the representative of Lao side for negotiation and signing of the Agreement(s).

1

2. Two Parties in principle agreed on the draft Agreement proposed by Vietnam Party. However, the Laotian Party proposed several issues to be carried out in the near future such as: i). Environmental and Social Impact Assessment including other mitigation plans as required by Lao PDR laws and procedure; ii). border issue is required to be elaborated in detail on the issues to be taking care and mitigation measure to avoid any illegal activities. Such border issues might be deal with in the draft Agreement and/or separated agreement between the two countries.The specific regulations will be stated in relevant Agreements (if needed) between the relevant Ministries of the two Parties. The two Parties assign the Investor to implement as soon as possible Environmental and Environmental and Social Impact Assessment (ESIA) in Lao territory in accordance with the current laws and regulation of Laos.

3. The Lao Party agreed that the Lao Government shall not issue permission for other new projects within the reservoirs of My Ly project with the full supply water level up to 300masl and Nam Mo 1 project with the full supply water level up to 235masl since the signing date of this Agreement.

4. The Lao Party agreed that the Ministry of Industry and Trade of Vietnam shall be responsible for the approval of design and technical specification of the Project because the whole site of the Project's construction locate in the territory of Vietnam.

5. The Vietnamese Party shall assign the Investor to implement the process of compensation and resettlement, design, construction in accordance with the current laws and regulations of Vietnam in Vietnamese territory.

6. The Vietnamese side shall update and amend the contents of the draft Agreement based on the contributing ideas of the Lao Party during the negotiation and submit the draft to relevant agencies of Vietnam for confirmation before sending to the Lao Party for consideration.

7. The Lao side will review and comment the draft provide by Vietnamese side as necessary to make sure that such agreement and following agreement will be in line with Lao laws and procedure.

8. The second round of negotiation will tentatively held in Nghe An Province, Viet Nam as soon as possible. The two Parties agreed to speed up the process of finalization and getting approval of the relevant agreements from both governments within the 2nd Quarter, 2016.

This Record of Discussion was signed in English in two versions in Hanoi, Vietnam on March 11, 2016.

For the Delegation of the Socialist Republic of Vietnam	For the Delegation of the Lao People's Democratic Republic
Hoang Quoc Vuong Deputy Minister Ministry of Industry and Trade	Viraphonh Viravong Deputy Minister Ministry of Energy and Mines

1.2 Document 209ML-TD Assigning two Consultants to Conduct Consultations during the Preparation of the ESIAs for My Ly and Nam Mo 1 HPPs

CÔNG TY CP THỦY ĐIỆN
MỸ LÝ – NẬM MÔ

Số: 209 /ML-NM-TĐ
V/v: Tham vấn trong quá trình lập Báo cáo ĐTM của dự án: Thủy điện Mỹ Lý và Nậm Mô 1

CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM
Độc lập - Tự do - Hạnh phúc

Hà Nội, ngày 14 tháng 08 năm 2015

Kính gửi: UBND các xã Mỹ Lý, Keng Đu, Tà Cạ và Mường Típ.
BCH các Đồn biên phòng: Keng Đu, Mỹ Lý và Mường Típ

Căn cứ vào Thông báo kết luận số: 193/TB-UBND ngày 09/04/2015 của UBND tỉnh Nghệ An về việc kết luận của Chủ tịch UBND tỉnh Nguyễn Xuân Đường tại cuộc họp về Dự án thủy điện Mỹ Lý - Nậm Mô 1.

Căn cứ vào thông báo kết luận số: 14/TB-UBND huyện Kỳ Sơn ngày 17/4/2015 của đồng chí Bùi Trầm - Chủ tịch huyện tại cuộc họp về triển khai Dự án thủy điện Mỹ Lý -Nậm Mô 1.

Công ty CP thủy điện Mỹ Lý Nậm Mô cử hai chuyên viên là: Nguyễn Đức Thắng và Đoàn Ngọc Tân vào thực hiện công tác tham vấn trong quá trình lập báo cáo Đánh giá tác động môi trường ĐTM của dự án thủy điện Mỹ Lý và Nậm Mô 1.

Vậy, Công ty CP thủy điện Mỹ Lý Nậm Mô kính đề nghị các phòng ban chức năng, UBND các xã và BCH các đồn Biên phòng liên quan phối hợp, tạo điều kiện thuận lợi để Công ty CP thủy điện Mỹ Lý-Nậm Mô thực hiện nhiệm vụ đảm bảo chất lượng và tiến độ thời gian.

Trân trọng cảm ơn!

Nơi nhận:
- Như trên;
- Lưu VT, TĐ.

KT.TỔNG GIÁM ĐỐC
PHÓ TỔNG GIÁM ĐỐC

CÔNG TY CP THỦY ĐIỆN MỸ LÝ-NẬM MÔ

NGUYỄN TIẾN PHONG

ANNEX 2: SPECIALIST REPORTS ON BIOLOGY AND WATER RESOURCES

2.1 Appendices to Chapter 7

Appendix 7.1 Forest vegetation in reservoir and construction area

No	Project area	Villages	Sampling plots[1]	Area (ha)	Land-use
1	**Reservoir area**				
		Keng Du	01, 02, 03	1,247.3	Secondary tropical grassland on uncultivated land; Secondary scrub vegetation on uncultivated land for 7-10 years; *Melia azedarach L. plantation* have regenerated.
		Hat Ta Ven	04		Predominant bamboo forest
		Huoi Xui	05		Secondary mixed evergreen rain forest after exploitation
		Cha Nga	06, 07, 08, 09		Secondary tropical grassland; Semi-deciduous forest after exploitation; Secondary scrub vegetation on uncultivated land for 7-10 years.
		Xop Duong	10, 11, 12		Semi-deciduous forest after exploitation; Mixed broadleaf and bamboo forest; Broadleaf forest after exploitation
2	**Construction areas**				
	Headworks	Xang Tren	13		Secondary mixed evergreen rain forest after exploitation
	Powerhouse		14, 15		Secondary forest on uncultivated land for 7-15 years
	Auxiliary area 2		16		Secondary forest on uncultivated land for 10-15 years
	Auxiliary area 3		17 - 19		Secondary forest on uncultivated land for 10-15 years
	Disposal area 1		20		Secondary forest on uncultivated land for 10-15 years

[1] Forest vegetation survey plots were established along the riverbanks which will be submerged and/or part of construction area.

Appendix 7.2 Vegetation in forest sample sites

Project area/ Village	Plot No.	Forest Type	Stage of forest growth	Regeneration	Species
Reservoir Area					
Xop Tip	1	Semi-deciduous Forest after exploitation	Pole – large saw timber	Dimocarpus fumatus, Streblus ilicifolius	**Tree Species**: Burretiodendron hsienmu, Celtis philippense, Dimocarpus fumatus, Ormosia pinnata, Phyllanthus annamensis, Streblus ilicifolius, Sterculia foetida (875 trees/ha) **Shrub:** Albizia corniculata, Bauhinia viridescens, Capparis micrantha (450 shrubs/ha) **Non-woody:** Eupatorium odoratum, Tinospora crispa, Fern species grass species
Xop Phee	2	Semi-deciduous Forest after exploitation	Large saw timber	Burretiodendron hsienmu	**Trees:** Burretiodendron hsienmu, Burretiodendron hsienmu, Ormosia pinnata, Sterculia foetida (300/ha) **Shrub:** none **Non-woody:** Eupatorium odoratum, Fern species grass species
Ha Lat	3	Semi-deciduous Forest after exploitation	Large saw timber	Burretiodendron hsienmu, Lagerstroemia tomentosa, Streblus ilicifolius	**Trees:** Burretiodendron hsienmu, Milletia sp, Ormosia pinnata (350 trees/ha) **Shrub:** none **Non-woody:** Eupatorium odoratum, Fern species grass species
	4	Semi-deciduous Forest after exploitation	Pole to small saw timber	Celtis philippense, Dimocarpus fumatus, Phyllanthus annamensis	**Trees:** Aglaia sp.. Canthium sp., Celtis philippense Dimocarpus fumatus, Lagerstroemia tomentosa, Ormosia pinnata, Phyllanthus annamensis, Syzygium sp., Sterculia foetida, Vitex tripinnata (374 trees/ha) **Shrub:** Bauhinia viridescens, Fissistigma villossium **Non-woody:** Tinospora crispa, ferns, grass

Project area/ Village	Plot No.	Forest Type	Stage of forest growth	Regeneration	Species
	5	Semi-deciduous Forest after exploitation	Small to large saw timber	Celtis philippense, Canthium horridum, Canthium sp, Dimocarpus fumatus	**Trees:** Celtis philippense, Dimocarpus fumatus, Phyllanthus annamensis, Streblus asper, Sterculia foetida, Vitex tripinnata (825 trees/ha) Shrub: none Non-woody: Ferns and grass species
Vang Ngo	6	Tropical Grassland on uncultivated land	None	Callicarpa arborea, Clerodendrum cyrtophyllum, Streblus ilicifolius	**Trees:** none **Shrub:** Acacia sp., Licuala spinosa **Non-woody:** Eupatorium odoratum, Paederia scandens, Passiflora foetida
	7	Tropical Grassland on uncultivated land	None	Streblus asper, Streblus ilicifolius	**Trees:** none **Shrub:** Derris sp., Harrisonia perforate **Non-woody:** Eupatorium odoratum
Ta Do	8	Tropical Grassland on uncultivated land	None	Streblus asper, Streblus ilicifolius	**Trees:** none **Shrub:** none **Non-woody:** Eupatorium odoratum
Se Vang	9	Grassland on uncultivated land	None	Streblus ilicifolius	**Trees:** Archidendron lucidum, Milletia sp. (75 trees/ha) **Shrub:** Derris sp., Harrisonia perforata **Non-woody:** Eupatorium odoratum
Nha Nhu	10	Tropical Grassland on uncultivated land after 4-5 years	Pole size	Lagerstroemia tomentosa	**Trees:** Ormosia pinnata (50 trees/ha) **Shrub:** none **Non-woody:** Cassia occidentalis, Eupatorium odoratum
	11	Tropical Grassland on uncultivated land after 4-5 years	None	Cratoxylum cochinchinensis, Litsea cubeba	**Trees:** none **Shrub:** Capparis micrantha, Desmos chinensis **Non-woody:** Eupatorium odoratum, Imperata cylindrica

Project area/ Village	Plot No.	Forest Type	Stage of forest growth	Regeneration	Species
	12	Tropical Grassland on uncultivated land after 4-5 years	Pole size	Streblus asper, Streblus ilicifolius	**Trees:** Albizia lucidior, Archidendron lucidum **Shrubs:** Derris sp., Harrisonia perforate (200 trees/ha) **Non-woody:** Eupatorium odoratum,
Headworks	13	Grassland on uncultivated land	None	Albizia lucidior, Milletia sp., Ormosia pinnata, Streblus asper, Streblus ilicifolius	**Trees:** none **Shrub: none** **Non-woody:** Eupatorium odoratum, ferns, grass
HW	14	Semi-decidupous forest after exploitation	Small to large saw timber	Canthium horridum, Milletia sp., Streblus ilicifoliu	**Trees:** Burretiodendron hsienmu, Lagerstroemia tomentosa , Milletia sp., (450 trees/ha) **Shrubs:** Bauhinia viridescens, Capparis micrantha **Non-woody:** Eupatorium odoratum, Jasminum triplinerve, Tinospora crispa**,** ferns and grasses
Auxiliary area	15	Tropical Grassland on uncultivated land after 4-5 years		Streblus ilicifolius, Streblus asper	**Trees:** Albizia lucidior, Archidendron lucidum, Milletia sp. (200 trees/ha) **Shrubs:** Derris sp., Harrisonia perforata **Non-woody:** Eupatorium odoratum

Stage of growth: Large saw timber = more than 50 cm dbh; Saw timber = > 25 -50 cm dbh; Pole = 12.5-25 cm dbh; Saplings = 10-12.5 cm dbh

Appendix 7.3: Ethno-botanical Characteristics of plants grown in project area

No.	Plant Species	Plant parts used for						
		Fuelwood & timber species	Ess. Oil, Fat & Resin plant	Medicinal plants /Poisonous plants	Edible plants	Ornamental plants	Rattan & bamboo	Others
1	Acampe ochracea (Lindl.) Hochr.					x		
2	Acorus gramineus Ait. ex Soland.			x				
3	Acronychia pedunculata (L.) Miq.		x	x				
4	Adiantum caudatum L.			x				
5	Ageratum conyzoides L.			x				
6	Aglaia edulis (Roxb.) Gray	x						
7	Aglaia tomentosa T. & B.	x						
8	Alocasia macrorrhizos (L.) G. Don			x				x
9	Alseodaphne velutina Cher.	x						
10	Alstonia scholaris (L.) R. Br.	x		x				
11	Ampelopsis cantoniensis (H. et A.) Planch.			x				
12	Antidesma bunius (L.) Spreng				x			
13	Aphanamixis polystachya (Wlall.) R. N. Parker	x						
14	Aralia armata (Wall. ex G. Don) Seem.			x				
15	Argyreia acuta Lour.			x				
16	Artocarpus rigidus Blume	x			x			
17	Arundina graminifolia (D. Don) Hodr.					x		

No.	Plant Species	Plant parts used for						
		Fuelwood & timber species	Ess. Oil, Fat & Resin plant	Medicinal plants /Poisonous plants	Edible plants	Ornamental plants	Rattan & bamboo	Others
18	Asparagus cochinchinensis (Lour.) Merr.					x		
19	Asplenium nidus L.					x		
20	Baccaurea racemosa Lour.	x						
21	Bambusa blumeana J. A. et J. H. Schult.						x	
22	Belamcanda chinensis (L.) DC.					x		
23	Bischofia javanica Blume				x			
24	Blumea balsamifera (L.) DC.		x	x				
25	Boehmeria nivea (L.) Gaudich.							x
26	Breynia fruticosa Hook. f.			x				
27	Bulbophyllum affine Lindl.					x		
28	Burretiodendron hsienmu W.Y.Chun & F.C.How	x						
29	Calamus faberi Becc.						x	
30	Calamus rudentum Lour.						x	
31	Calamus salicifolius Becc.						x	
32	Calanthe clavata Lindl.					x		
33	Callipteris esculenta (Retz.) J. J. Sm.				x			
34	Camellia sinensis (L.) Kuntze							x
35	Canarium album Raeusch	x		x				
36	Castanopsis fissa (Champ.) Rehd. & Wild.	x						

No.	Plant Species	Plant parts used for						
		Fuelwood & timber species	Ess. Oil, Fat & Resin plant	Medicinal plants /Poisonous plants	Edible plants	Ornamental plants	Rattan & bamboo	Others
37	Castanopsis indica (Roxb.) A. DC.	x						
38	Castanopsis tonkinensis Seem.	x						
39	Celtis philippense Blanco	x						
40	Celtis sinensis Person	x						
41	Chisocheton chinensis Merr.	x						
42	Cinnamomum iners Reinw. ex Blume	x						
43	Coelogyne pallens Ridl.					x		
44	Colocasia esculenta (L.) Schott							x
45	Commelina communis L.							x
46	Costus speciosus (Koenig) Smith			x		x		
47	Crateva magna (Lour.) DC. (C. nurvala Buch.-Ham.)				x			
48	Cratoxylum cochinchinensis (Lour.) Blume	x						
49	Cratoxylum formosum (Jack.) Benth. et Hook. f. ex Dyer	x						
50	Croton tiglium L.			x				
51	Curculigo gracilis Wall.			x				
52	Curculigo latifolia Dryand. ex Ait.			x				
53	Curcuma longa L.			x	x			
54	Cymbidium aloifolium (L.) Sw.					x		
55	Cyperus rotundus L.			x				

No.	Plant Species	Plant parts used for						
		Fuelwood & timber species	Ess. Oil, Fat & Resin plant	Medicinal plants /Poisonous plants	Edible plants	Ornamental plants	Rattan & bamboo	Others
56	Dendrobium dentatum Seidenf.					x		
57	Dendrobium faulhaberianum Schltr.					x		
58	Derris elliptica (Roxb.) Benth.			x				
59	Dimocarpus fumatus (Blume) Leenh.	x						
60	Dioscorea cirrhosa Lour.							x
61	Dioscorea persimilis Prain & Burk.			x	x			
62	Dracaena cochinchinensis (Lour.) Merr.					x		x
63	Drynaria fortunei (Kuntze ex Mett.) J. Sm.			x				
64	Duabanga grandiflora (DC.) Walp.	x						
65	Elephantopus scaber L.			x				
66	Endospermum chinense Benth.	x						
67	Engelhardtia roxburghiana Wall.	x		x				
68	Euodia lepta (Spreng) Merr.		x	x				
69	Garcinia cochinchinensis (Lour.) Chóiy	x			x			
70	Garcinia merguensis Wight	x			x			
71	Gelsemium elegans (Gardn. et Champ.) Benth.			x				
72	Gironniera subaequalis Planch.	x						
73	Gomphostemma leptodon Dunn.			x				
74	Hedyotis capitellata Wall. ex G. Don			x				

No.	Plant Species	Plant parts used for						
		Fuelwood & timber species	Ess. Oil, Fat & Resin plant	Medicinal plants /Poisonous plants	Edible plants	Ornamental plants	Rattan & bamboo	Others
75	Hedyotis diffusa Willd.			x				
76	Helicia cochinchinensis Lour.	x						
77	Heliciopsis lobata (Merr.) Sleum.	x						
78	Hodgsonia macrocarpa (Blume) Cogn.				x			
79	Homalomena occulta (Lour.) Schott			x				
80	Hopea mollissima C. Y. Hu	**x**	VU A1c,d					
81	Horsfieldia thorelii Lecomte	x						
82	Houttuynia cordata Thunb.				x			
83	Hydnocarpus ilicifolia King	x		x				
84	Ixora coccinea L.					x		
85	Kadsura coccinea (Lem.) A. C. Smith			x				
86	Knema conferta Warb.	x						
87	Kydia calycina Roxb.	x						
88	Lagerstroemia calyculata Kurz	x						
89	Lagerstroemia tomentosa Presl	x						
90	Leea indica (Burm. f.) Merr.			x				
91	Leucas aspera (De Wilde) Link			x				
92	Lithocarpus annamensis (Hick. & A. Camus) Barn.	x						
93	Lithocarpus pseudosundaicus (Hick. & A. Camus) A. Camus	x						

No.	Plant Species	Plant parts used for						
		Fuelwood & timber species	Ess. Oil, Fat & Resin plant	Medicinal plants /Poisonous plants	Edible plants	Ornamental plants	Rattan & bamboo	Others
94	Litsea cubeba (Lour.) Pers		x	x				
95	Litsea glutinosa (Lour.) C. B. Robins		x	x				
96	Lycopodiella cernua (L.) Franco & Vasc.					x		
97	Macaranga denticulata (Blume) Muell.-Arg.	x						x
98	Manglietia conifera Dandy	x						
99	Melia azedarach L.	x						
100	Michelia foveolata Merr. ex Dandy (M. fulgens Dandy)	x						
101	Millettia pachyloba Drake			x				
102	Millettia reticulata Benth.			x				
103	Morinda umbellata L.			x				
104	Mosla dianthera (Benth. et Hook.) Maxim.			x	x			
105	Musa coccinea Andr.			x				
106	Neolamarkia cadamba (Roxb.) Bosser	x						
107	Ophiopogon japonicus (L. f.) Ker.-Gawl.			x				
108	Ophiopogon latifolius Rodr.			x				
109	Ophiopogon longifolius Dcne.			x				
110	Ormosia pinnata (Lour.) Merr.	x						
111	Oroxylum indicum (L.) Kurz			x	x			
112	Pandanus tectorius Parkinson			x				

No.	Plant Species	Plant parts used for						
		Fuelwood & timber species	Ess. Oil, Fat & Resin plant	Medicinal plants /Poisonous plants	Edible plants	Ornamental plants	Rattan & bamboo	Others
113	Passiflora foetida L.			x				
114	Paviesia annamensis Pierre	x						
115	Pentaphragma sinense Hemsl. & Wils.				x			
116	Phyllanthus embrica L.				x			
117	Pinanga dupperreana Pierre ex Gagnep.						x	
118	Piper lolot C. DC.			x,	x			
119	Plantago asiatica L.			x				
120	Plantago major L.			x				
121	Polygonum multiflorum Thunb. ex Murray			x				
122	Pometia pinnata Forst. & Forst. f.	x						
123	Pouteria sapota (Jacq.) H. Moore & Stearn.				x			
124	Prunus arborea (Blume) Kalkm.	x						
125	Pterocarya stenoptera C. DC. var. tonkinensis Frach.	x,		x				
126	Rhapis gracilis Burret						x	
127	Rubus alcaefolius Poir.			x				
128	Schefflera heptaphylla (L.) Harms			x				
129	Scoparia dulcis L.			x				
130	Shorea chinensis (Wang Hsie) H.Zhu	x						
131	Spondias lakoensis Pierre	x			x			

No.	Plant Species	Plant parts used for						
		Fuelwood & timber species	Ess. Oil, Fat & Resin plant	Medicinal plants /Poisonous plants	Edible plants	Ornamental plants	Rattan & bamboo	Others
132	Sterculia foetida L.	x						
133	Sterculia lanceolata Cav.	x						
134	Streblus asper Lour.	x						
135	Streblus ilicifolius (Vidal) Corner	x						
136	Streptocaulon juventas (Lour.) Merr.			x				
137	Strychnos axillaris Colebr.			x				
138	Symplocos cochinchinensis (Lour.) Moore. [S. laurina Wall. ex G. Don]	x		x				
139	Syzygium cumini (L.) Druce	x						
140	Syzygium formosum (Wall.) Masam	x						
141	Syzygium zeylanicum (L.) DC.	x						
142	Tabernaemontana bovina Lour.			x				
143	Tacca chantrieri Andre			x				
144	Trevesia palmata (Roxb. & Lindl.) Vis.			x				
145	Vatica odorata (Griff.) Symington	x						
146	Vernicia montana Lour.		x					
147	Vitex tripinnata (Lour.) Merr.					x		
148	Wrightia annamensis Eberh. & Dub.	x						
149	Zanthoxylum nitidum (Roxb.) DC.		x	x				

Appendix 7.4 List of wildlife species recorded in My Ly HPP influence area

SN	Species	
	Family / Species	**Vietnamese Name**
Reptiles		
	1. Agamidae	
1	*Calotes versicolor*	Nhông xanh
2	*Physignathus cocincinus*	Rồng đất
	2. Gekkonidae	
3	*Gekko gecko*	Tắc kè
	3. Lacertidae	
4	*Takydromus kuhnei*	Liu điu kúc-ni
5	*Takydromus sexlineatus*	Liu điu chỉ
	4. Scincidae	
6	*Mabuya multifasciata*	Thằnlằnbónghoa
	5. Varanidae	
7	*Varanus nebulosus*	Kỳ đà vân
8	*Varanus salvator*	Kỳ đà hoa
	6.Typhlopidae	
9	*Ramphotyphlops braminus*	Rắngiun thường
	7. Xenopeltidae	
10	*Xenopeltis unicolor*	Rắn mống
	8. Colubridae	
11	*Ahaetulla prasina*	Rắn roi thường
12	*Ptyas korros*	Rắnráo thường
13	*Ptyas mucosus*	Rắn ráo trâu
14	*Enhydris plumbea*	Rắn bồng chì
15	*Amphiesma stolata*	Rắn sãi thường
16	*Xenochrophis piscator*	Rắn nước
	9. Elapidae	
17	*Bungarus fasciatus*	Rắn cạp nong
18	*Bungarus multicinctus*	Rắncạp nia bắc
19	*Naja* cf. *atra*	Rắn hổ mang trung quốc
	10. Viperidae	**10. Họ Rắn lục**
20	*Trimeresurus albolabris*	Rắn lục mép trắng
21	*Trimeresurus stejnegeri*	Rắn lục xanh
	11. Testudines/Geoemydidae	
22	*Cuora mouhotii*	Rùa sa nhân
Amphibians		
	1. Anura/Bufonidae	
1	*Duttaphrynus melanostictus*	Cóc nhà
2	*Ingerophrynus galeatus*	Cóc rừng
	2. Megophryidae	

3	*Leptolalax pelodytoides*	Cóc mày bùn
4	*Xenophrys major*	Cóc mắt bên
	3. Microhylidae	
5	*Kaloula pulchra*	Ễnh ương thường
6	*Microhyla fissipes*	Nhái bầu hoa
7	*Microhyla heymonsi*	Nhái bầu hây-môn
8	*Microhyla pulchra*	Nhái bầu vân
	4. Dicroglossidae	
9	*Fejervarya limnocharis*	Ngoé
10	*Hoplobatrachus chinensis*	Ếch đồng
11	*Limnonectes kuhlii*	Ếch nhẽo
12	*Occidozyga lima*	Cóc nước sần
	5. Ranidae	
13	*Huia andersonii*	Chàng an-đéc-sơn
14	*Huia chloronota*	Ếch xanh
15	*Hylarana taipehensis*	Chàng đài bắc
16	*Rana johnsi*	Hiu hiu
17	*Sylvirana guentheri*	Chẫu
17	*Sylvirana nigrovittata*	Ếch suối
	6. Rhacophoridae	
18	*Phylautus* sp.	Nhái cây
Mammals		
	1. Insectivora / Soricidae	
1	*Suncus murinus*	Chuột chù
	2. Scandenta / Tupaiidae	Họ Đồi
2	*Tupaia belangeri*	Đồi
	3. Chiroptera / Pteropodidae	
3	*Cynopterus sphinx*	Dơi chó ấn
4	*Macroglossus minimus*	Dơi ăn mật hoa
	4. Hipposideridae	
5	*Hipposideros armiger*	Dơi mũi quạ
6	*Hipposideros larvatus*	Dơi mũi xám
	5. Rhinolophidae	
7	*Rhinolophus affinis*	Dơi lá đuôi
8	*Rhinolophus pusillus*	Dơi lá mũi
	6. Primates / Loricidae	
9	*Nycticebus bengalensis*	Cu li lớn
	7. Cercopithecidae	
10	*Macaca mulatta*	Khỉ vàng
	8. Carnivora/ Mustelidae	
11	*Martes flavigula*	Chồn vàng
	9. Viverridae	
12	*Paguma larvata*	Cầy vòi mốc

13	*Paradoxurus hermaphroditus*	Cầy vòi đốm
	10. Herpestidae	
14	*Herpestes javanicus*	Cầy lỏn
15	*Herpestes urva*	Cầy móc cua
	11. Felidae	
16	*Prionailurus bengalensis*	Mèo rừng
	12. Artiodactyla / Suidae	
17	*Sus scrofa*	Lợn rừng
	13. Cervidae	
18	*Muntiacus muntjak*	Hoẵng
	14. Rodentia / Sciuridae	
19	*Callosciurus erythraeus*	Sóc bụng đỏ
20	*Dremomys rufigenis*	Sóc mõm hung
	15. Rhizomyidae	
21	*Rhizomys pruinosus*	Dúi mốc lớn
22	*Rhizomys sumatrensis*	Dúi má vàng
	16. Muridae	
23	*Bandicota indica*	Chuột đất lớn
24	*Bandicota savilei*	Chuột đất bé
25	*Rattus bowersi*	Chuột mốc lớn
26	*Rattus edwardsi*	Chuột hươu lớn
27	*Rattus flavipectus*	Chuột nhà
28	*Rattus fulvescens*	Chuột hươu bé
28	*Rattus koratensis*	Chuột rừng
30	*Rattus nitidus*	Chuột bóng
31	*Rattus sabanus*	Chuột núi
Bird Species		
	1. Ardeidae	
1	*Egretta garzetta*	Cò trắng
2	*Bubulcus ibis*	Cò ruồi
	2. Accipitridae	
3	*Spilornis cheela*	Diều hoa Miến Điện
	3. Falconidae	
4	*Falco severus*	Cắt bụng hung
	4. Phasianidae	
5	*Gallus gallus*	Gà rừng
	5. Turnicidae	
6	*Turnix tanki*	Cun cút lưng hung
	6. Rallidae	
7	*Rallus striatus*	Gà nước vằn
8	*Gallinula chloropus*	Kịch
	7. Charadriidae	
9	*Charadrius dubius*	Choi choi nhỏ

	8. Scolopacidae	
10	*Tringa ochropus*	Choắt bụng trắng
11	*Actitis hypoleucos*	Choắt nhỏ
	9. Columbidae	
12	*Streptopelia tranquebarica*	Cu ngói
13	*Streptopelia chinensis*	Cu gáy
	10. Psittacidae	
14	*Psittacula alexandri*	Vẹt ngực đỏ
	11. Cuculidae	
15	*Centropus sinensis*	Bìm bịp lớn
16	*Centropus bengalensis*	Bìm bịp nhỏ
	12. Strigidae	
17	*Glaucidium cuculoides*	Cú vọ
	13. Caprimulgidae	
18	*Caprimulgus indicus*	Cú muỗi ấn Độ
	14. Trogonidae	
19	*Harpactes erythrocephalus*	Nuốc bụng đỏ
	15. Alcedinidae	
20	*Ceryle rudis*	Bói cá nhỏ
21	*Alcedo atthis*	Bồng chanh
	16. Coraciidae	
22	*Coracias benghalensis*	Sả rừng
	17. Capitonidae	
23	*Megalaima franklinii*	Cu rốc đầu vàng
	18. Eurylaimidae	
24	*Serilophus lunatus*	Mỏ rộng hung
	19. Pittidae	
25	*Pitta nipalensis*	Đuôicụt gáy xanh
26	*Pitta soror*	Đuôi cụt đầu xám
	20. Hirundinidae	
27	*Hirundo concolor*	Nhạn nâu hung
28	*Hirundo rustica*	Nhạn bụng trắng
	21. Motacillidae	
29	*Motacilla flava*	Chìa vôi vàng
30	*Motacilla cinerea*	Chìa vôi núi
31	*Motacilla alba*	Chìa vôi trắng
	22. Campephagidae	
32	*Coracina melaschistos*	Phường chèo xám
33	*Hemipus picatus*	Phường chèo đen
34	*Tephrodornis gularis*	Phường chèo nâu
	23. Pycnonotidae	
35	*Pycnonotus jocosus*	Chào mào
36	*Pycnonotus aurigaster*	Bông lau tai trắng

37	*Pycnonotus finlaysoni*	Bông lau họng vạch
38	*Criniger pallidus*	Cành cạch lớn
39	*Hypsipetes propinquus*	Cành cạch nhỏ
	24. Irenidae	
40	*Aegithina tiphia*	Chim nghệ ngực vàng
41	*Chloropsis aurifrons*	Chim xanh trán vàng
42	*Chloropsis hardwickei*	Chim xanh hông vàng
43	*Irena puella*	Chim lam
	25. Laniidae	
44	*Lanius cristatus*	Bách thanh mày trắng
45	*Lanius collurioides*	Bách thanh nhỏ
46	*Lanius schach*	Bách thanh đầu đen
	26. Turdidae	
47	*Erithacus sibilans*	Oanh cổ trắng
48	*Erithacus cyane*	Oanh lưng xanh
49	*Copsychus saularis*	Chích chòe
50	*Copsychus malabaricus*	Chích chòe lửa
51	*Monticola solitarius*	Hoét đá
52	*Zoothera dauma*	Sáo đất
53	*Zoothera marginata*	Sáo đất nâu
	27. Timaliidae	
54	*Pellorneum ruficeps*	Chuối tiêu ngực đốm
55	*Spelaeornis chocolatinus*	Khướu đất đuôi dài
56	*Stachyris rufifrons*	Khướu bụi trán hung
57	*Chrysomma sinense*	Họa mi mỏ ngắn
58	*Yuhina diademata*	Khướu mào cổ trắng
59	*Yuhina nigrimenta*	Khướu mào đầu đen
	28. Sylviidae	
60	*Tesia olivea*	Chích đuôi cụt
61	*Megalurus palustris*	Chiền chiện lớn
62	*Locustella lanceolata*	Chích đầm lầy nhỏ
63	*Acrocephalus aedon*	Chích mỏ rộng
64	*Phylloscopus tenellipes*	Chích chân xám
65	*Phylloscopus coronatus*	Chích mày vàng
66	*Phylloscopus davisoni*	Chích đuôi trắng
	29. Muscicapidae	
67	*Muscicapa dauurica*	Đớp ruồi nâu
68	*Muscicapa thalassina*	Đớpruồi xanh xám
69	*Niltava unicolor*	Đớpruồi xanh nhạt
70	*Niltavas banyumas*	Đớp ruồi họng hung
	30. Monarchidae	
71	*Terpsiphone paradisi*	Thiên đường đuôi phướn
72	*Rhipidura albicollis*	Rẻquạt họng trắng

	31. Paridae	
73	*Parus major*	Bạc má
74	*Parus spilonotus*	Bạc má mào
	32. Sittidae	
75	*Sitta castanea*	Trèocâybụng hung
76	*Sitta frontalis*	Trèo cây trán đen
	33. Dicaeidae	
77	*Dicaeum chrysorrheum*	Chim sâu bụng vạch
78	*Dicaeum ignipectus*	Chim sâu ngực đỏ
	34. Nectariniidae	
79	*Nectarinia sperata*	Hút mật họng hồng
80	*Aethopiga saturata*	Hút mật ngực đỏ
	35. Zosteropidae	
81	*Zosterops palpebrosa*	Vành khuyên họng vàng
	36. Emberizidae	
82	*Emberiza rutila*	Sẻ đồng hung
83	*Emberiza spodocephala*	Sẻ đồng mặt đen
	37. Estrildidae	
84	*Lonchura striata*	Di cam
85	*Lonchura punctulata*	Di đá
	38. Ploceidae	
86	*Passer montanus*	Sẻ nhà
	39. turnidae	
87	*Sturnus nigricollis*	Sáo sậu
88	*Sturnus sinensis*	Sáo đá Trung Quốc
89	*Acridotheres grandis*	Sáo mỏ vàng
	40. Oriolidae	
90	*Oriolus traillii*	Tử anh
	41. Dicruridae	
91	*Dicrurus macrocercus*	Chèo bẻo
92	*Dicrurus leucophaeus*	Chèo bẻo xám
93	*Dicrurus aeneus*	Chèo bẻo rừng
	42. Artamidae	
94	*Artamus fuscus*	Nhạn rừng
	43. Corvidae	
95	*Urocissa erythrorhyncha*	Giẻ cùi
96	*Corvus macrorhynchos*	Quạ đen

Appendix 7.5 List of fish species in Nam Mo River and stream

No.	Scientific name	Nam Mo River	Stream	IUCN
1	*Anguilla marmorata*	+		VU
2	*Cossoma brachypomum*	++		
3	*Prochilodus argenteus*	+		
4	*Oryzias latipes*	+		
5	*Danio laoensis*	+		
6	*Yaoshanicus kyphus*		+	
7	*Spinibarbus denticulatus*	+		
8	*Puntius partipentazona*		+	
9	*Acheilognathus lamensis*	++	+	
10	*Acrossocheilus lamus*	+		
11	*Acrossocheilus annamensis*	+		VU
12	*Garra poilanei*	++	+	
13	*Cyprinus rubrofuscua*	+		
14	*Carassius auratus*	+		
15	*Carassioides acuminatus*	+		
16	*Onychostoma leptura*	++		
17	*Osteochilus salsburyi*		+	
18	*Cirrhinus molitorella*	+		
19	*Paraspinibarbus macracanthus*	+		
20	*Puntius semifasciolatus*	+	+	
21	*Puntius ocellatus*	++		
22	*Opsarichthys bidens*		+	
23	*Metzialineata* Pellegrin	+		
24	*Culter erythropterus*	++		
25	*Culter flavipinnis*	+		
26	*Ancherythroculter daovantieni*	+		
27	*Hemiculter leucisculus*	++		
28	*Megalobrama terminalis*	+		
29	*Bagana lemassoni*	+		VU
30	*Squaliobarbus curriculus*	+		
31	*Hypophthalmichthys molitrix*	+		
32	*Mylopharyngodon piceus*	+		
33	*Acheilognathus tonkinensis*	+		
34	*Saurogobio immaculatus* Koller	+		
35	*Hemibarbus medius*	+		

No.	Scientific name	Nam Mo River	Stream	IUCN
36	*Aristichthys nobilis*	+		
37	*Ctenopharyngodon idella*	+		
38	*Labeo rohita*	+		
39	*Cirrhinus mrigala*	+		
40	*Misgurnus tonkinensis*		+	
41	*Misgurnus anguillicaudatus*	+	+	
42	*Schistura orthocauda*		++	
43	*Schistura incerta* Nichols		+	
44	*Schistura fasciolata*		+	
45	*Beaufortia leveretti*	+		
46	*Balitora lancangjiangensis*	+		
47	*Pteorocypris conchinchinensis*		+	
48	*Silurus asotus*	++		
49	*Pelteobagrus fulvidraco*	+		
50	*Hemibagrus guttatus*	+		VU
51	*Pseudobagrus virgatus*	+	+	
52	*Pseudobagrus vachellii*	+		
53	*Cranoglanis henrici*	++		
54	*Clarius fuscus* Lacepede	+		
55	*Clarias gariepinus*	+		
56	*Bagarius rutilus*	+		VU
57	*Glyptothorax lampris*		+	
58	*Glyptothorax quadriocellatus*		+	
59	*Glyptothorax hainanensis*		+	
60	*Pareuchiloglanis nebulifer*	+	+	
61	*Monopterus albus*	+	+	
62	*Mastacembelus armatus*	++		
63	*Sinobdella sinensis*		+	
64	*Anabas testudineus*	+	+	
65	*Siniperca chuatsi*		+	
66	*Siniperca vietnamensis*		+	
67	*Macropodus opercularis*		+	
68	*Trichogaster trichopterus*		+	
69	*Glossogobius giuris* Hamilton	+		
70	*Rhinogobius duospilus* Herre		+	
71	*Rhinogobius giurinus* Rutter		+	

No.	Scientific name	Nam Mo River	Stream	IUCN
72	*Eleotris fusca*	+		
73	*Eleotris oxycephala*		+	
74	*Eleotris melanosoma*		+	
75	*Oreochromis mosambicus*	++	+	
76	*Oreochromis niloticus*	+	+	
77	*Channa striata* Bloch	+		
78	*Channa maculata*	+		
79	*Channa asiatica*		+	
80	*Channa gachua*		+	
		57	**33**	**5**

Notes:

(+): less common; (++): common; (+++) met a lot

2.2 Specialist Report on Biology

EVN PECC1

POWER ENGINEERING CONSULTING

JOINT-STOCK COMPANY 1

Project:

NAM MO 1 HYDROPOWER PROJECT

FEASIBILITY STUDY

REPORT ON BIOLOGICAL BASELINE

FOR PREPARING ESIA REPORT OF MY LY - NAM MO 1 HPPs IN VIETNAM AND LAOS

VIETNAM ELECTRICITY
POWER ENGINEERING CONSULTING
JS COMPANY 1
FOR AND ON BEHALF OF GENERAL DIRECTOR
DEPUTY GENERAL DIRECTOR

M.S.D.N: 0100100953 - C.T.C.P
CÔNG TY CỔ PHẦN TƯ VẤN XÂY DỰNG ĐIỆN 1
Q. THANH XUÂN - T.P HÀ NỘI

Pham Nguyen Hung

INSTITUTE OF ECOLOGY
BIOLOGY RESOURCES
HEAD OF BIOLOGICAL TEAM

Le Hung Anh

Hanoi, May 2017

POWER ENGINEERING CONSULTING JOINT STOCK COMPANY 1

INSTITUTE OF ECOLOGY BIOLOGY RESOURCES

REPORT
ON
BIOLOGY SYSTEM

Nam Mo 1 Hydropower Project
Ky Son district, Nghe An province, Vietnam

Hà Nội, 5-2017

TABLE OF CONTENT

LIST OF TABLE

CHAPTER 1. ECOLOGY OVERVIEW

1.1. Project description

1.1.1. Project location

Nam Mo 1 hydropower project (HPP) is located on main course of Nam Mo river, the tributary grade I of Ca river, in both territories of Socialist Republic of Viet Nam and Lao People Democratic Republic.

Main civil works of Nam Mo 1HPP is located inTa Ca commune, Ky Son district Nghe An province, some of 5km NW of Muong Xen town. Reservoir area spreads on a narrow river section where its two banks are sloping, river bed is also sloping with lots of water steps making navigation difficult to local resident. The reservoir is in territory of Ta Ca, Muong Tip, Nam Can and Muong Ai communes of Ky Son district Nghe An province (Vietnam); and villages of Noonghed district, XiangKhoang province, Lao People Democratic Republic. (Figure 1: Location of Nam Mo 1 HPP on Vietnamese and Laos Map).

By co-ordinates system VN2000, the dam axis has point Đ1 (X= 2,147,545.443m; Y= 429,569.684) and point Đ2 (X= 2,147,206.578; Y= 429,117.113).

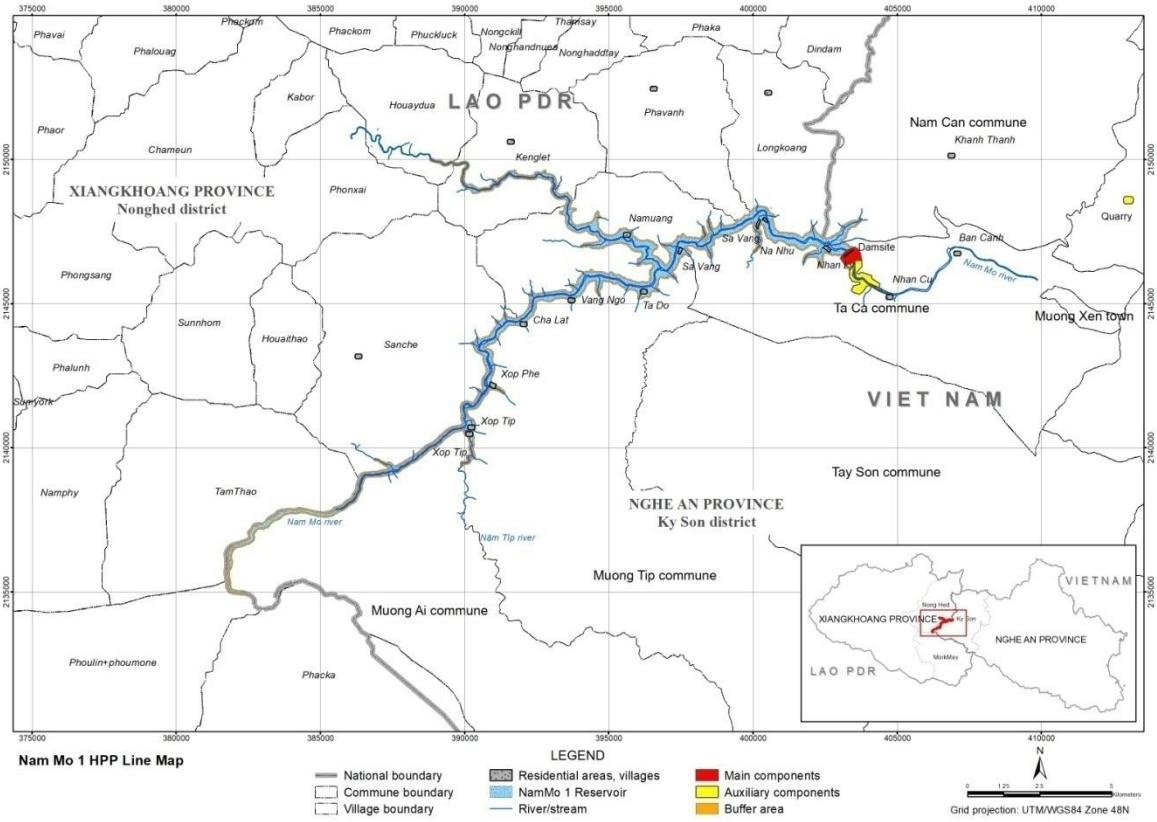


Figure 1: Location of Nam Mo 1 HPP

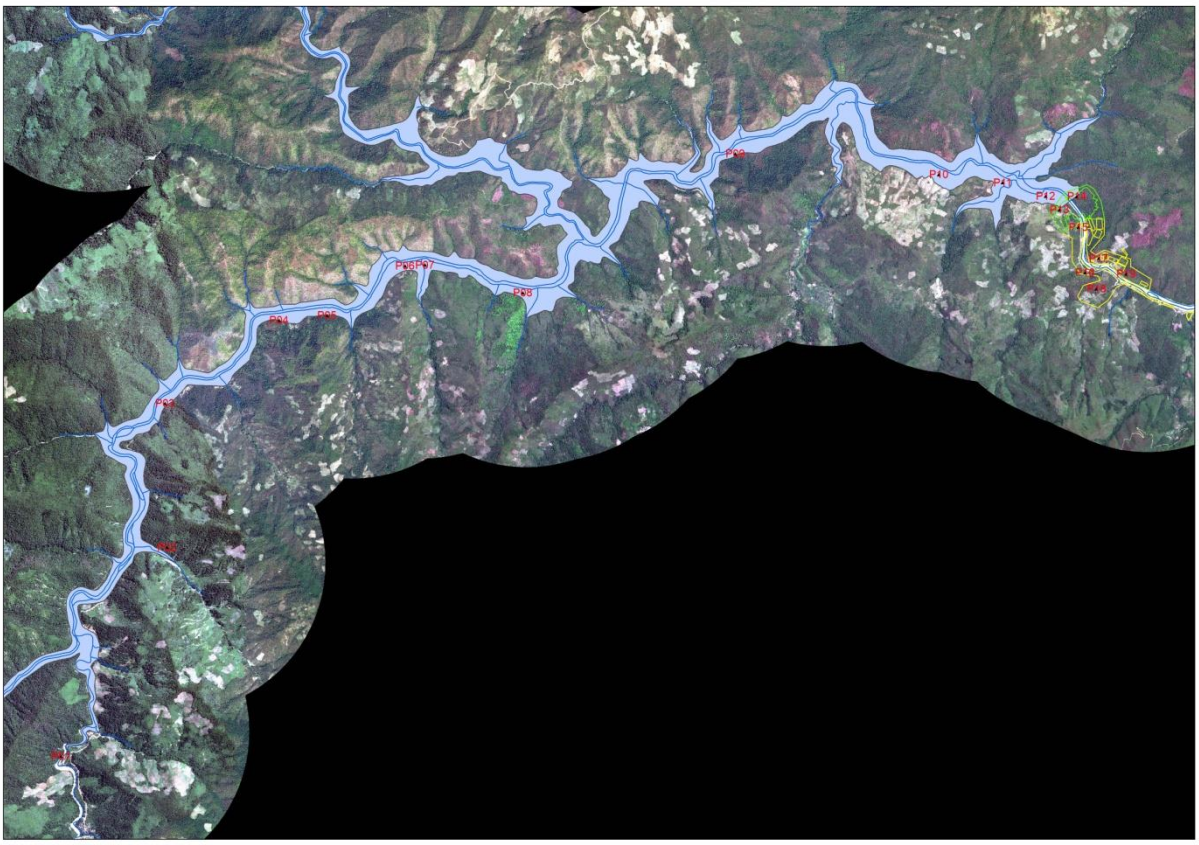


Figure 2. Plant, plot of plant and aquatic samples at Nam Mo river

1.1.2. Characteristics of project area

Project affected communes are remote and mountainous communes of two countries where technical infrastructure (transportation, power supply, water supply, communication) and social infrastructure (education, health care, environmental sanitation) are characterized with difficulty and limited. There is no industrial zone. Trading and services activities are negligible. Local resident in project area (both Ta Ca and Muong Tip communes) are mainly ethnic people of Thai, Kho Mu who live in small villages along Nam Mo River. Economic life of local resident is difficult, main income source is from upland cultivation and forest exploitation.

1.2. Purposes of study

Evaluates present status of ecology in the catchment area, in submergence area and areas affected by Nam Mo 1 HPP construction.

Forecasts possible and potential impacts to ecology by construction of Nam Mo 1 HPP and recommends mitigation measures.

1.3. Methodologies

1.3.1. Flora and vegetation – methods in this study (June 2016 and March 2017)

To research plant community structure, we did standard plots research wich has a size 20x20 m. Beside, in oder to study on species and plants community structure concerned, we did the points and routes research.

The species has determine by morphology method, base on morphology characteristics of reproductive and vegetative organs.

The List of species was based on the Checklist of plant species of Vietnam

Threatened species were based on Vietnam Red Data Book (2007) and The IUCN Red List of Threatened Species.

In each plot, all the data was measured and collected as: species, the number of individuals, the diameter and canopy of each individual.

The field measurements were used to calculate relative values such as relative frequency (RF), relative density (RD), relative of basal area (RBA), and Importance Value Index (IVI).

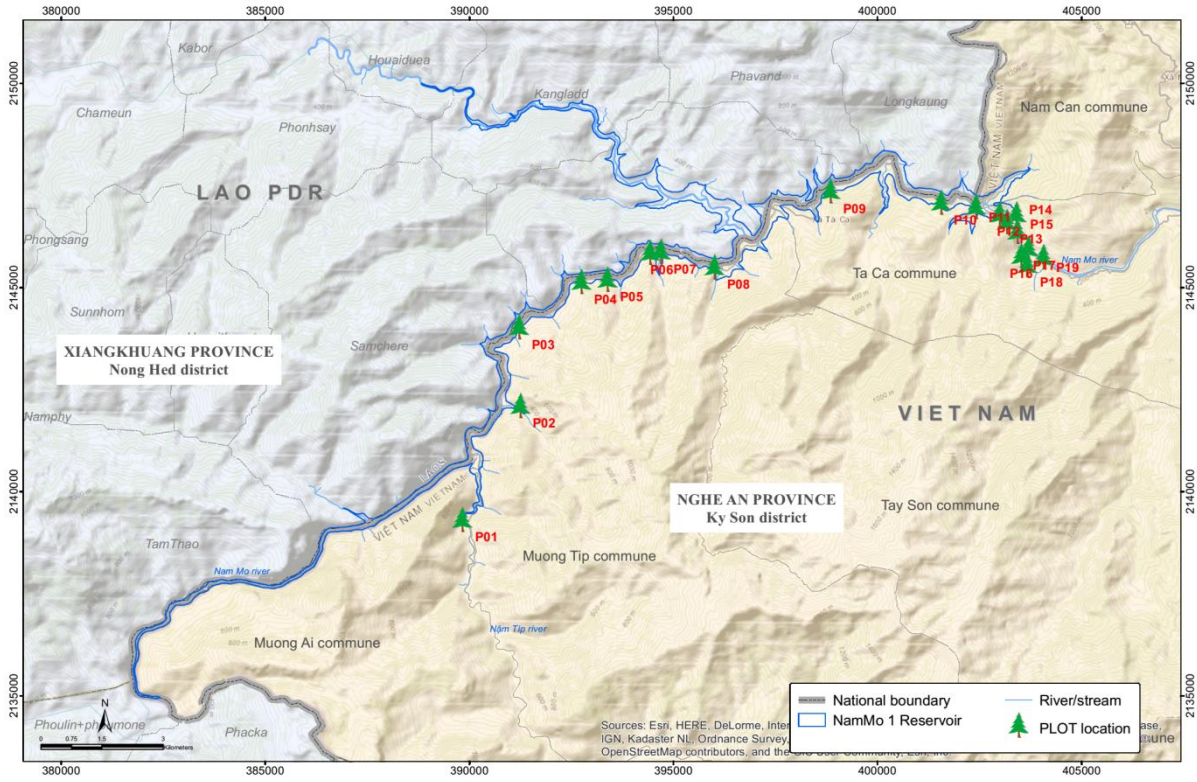


Figure 3: Location of vegetation plots of Nam Mo1 HPP

1.3.2. Fauna and wildlife

Used in the EIA report for approval MONRE, 2015 (PECI)

Birds: During the field surveys, community interviews were conducted, focusing on key bird species found in the Project area.

Mammals, Reptiles and Amphibians: During our field surveys, the occurrence of mammals, reptiles and amphibian species in the Project area was documented based on interview data collected from 20 local people in Muong Ai and Muong Tip communes.

We used the following photographic guides and books with colour photos to support species identification:

- The mammals of the Indomalayan Region[1]
- Environment and Bio resources of Vietnam Present Situation and Solutions[2]
- Checklist of Mammals in Vietnam[3]
- An identification guide to the rodents of Vietnam[4]

[1]Corbet G.B. & Hill J.E. 1992. The Mammals of the Indomalayan Region: A Systematic Review. Oxford: Oxford University Press. 488p.
[2]Cao, S.V. (ed.). 1998. Environment and Bioresources of Vietnam Present Situation and Solutions. Hanoi: The Gioi Publishers. 235p.
[3]Dang, H.H., Dao, T.V., Cao, S.V., Pham, A.T., and Hoang, K.M. 1994. Checklist of Mammals in Vietnam. Hanoi: Publishing House Science & Technics. 168p. [in Vietnamese].
[4]Lunde, D. and Nguyen, S.T. 2001. An identification Guide to the Rodents of Vietnam. Centre for Biodiversity and Conservation and the American Museum of National History, New York. 80p.

Site investigation, interviews at surveyed location. Summarizes data from previous studies [1[5], 10[6], 9[7], 16[8],18[9], 20[10], 27[11]]

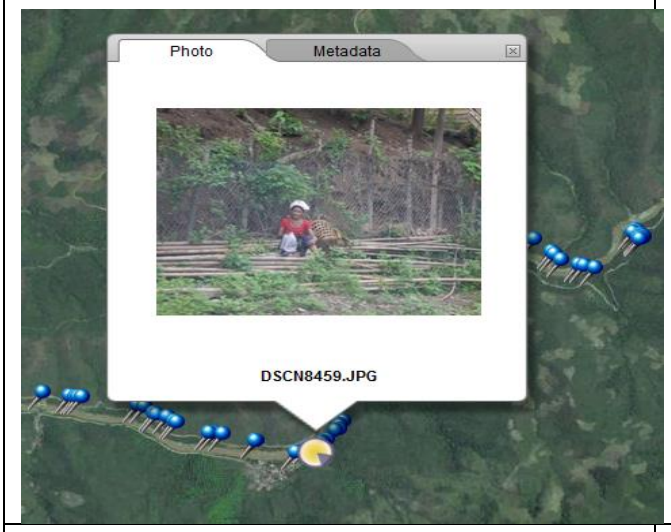
1.3.3. Aquatic life

a. Collects aquatic life samples

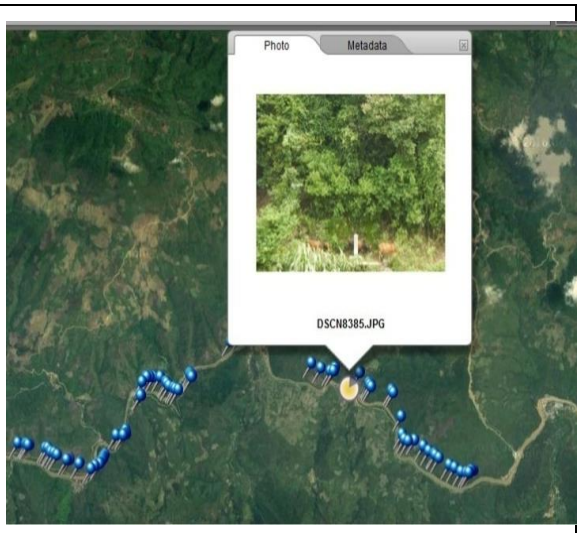
Collects samples of phytoplankton, zooplankton using cone net (Juday type), diameter of the net mouth is 25cm, length 90cm. Bar-pitch of the net for phytoplankton size 75 (75 fibre/cm), cloth making net for zooplankton is of size 49. Phytoplankton sample collected from surface layer and deep layer beween 5-0m. Net to take zoobenthos is manual net which horizontal edge of net mouth is 30cm, bar-pitch size 0.5mm. Besides, zoobenthos sample are also taken by hand from caves, hollow holes. Phytoplankton samples are fized in formaline solution 5%, benthos is fized in formaline solution 6-7%.

Net to take zoobenthos is manual handle net and net in triangle shape with bottom edge of net mouth of 25cm long, net bar-pitch is 0.5mm in size. Besides, zoobenthos samples are also taken by manual [11[12], 12[13]].

Fish samples are taken by various types of net and from buying from fishermen and from market (more information on nets and also show pictures of the net etc used by the villagers/fishermen). Visuals the net after fishing, using photo, and coulor picture of fish to interview fishermen and local resident. Samplesof unknown name fish at site are kept in formalin solution 10% [24[14]].

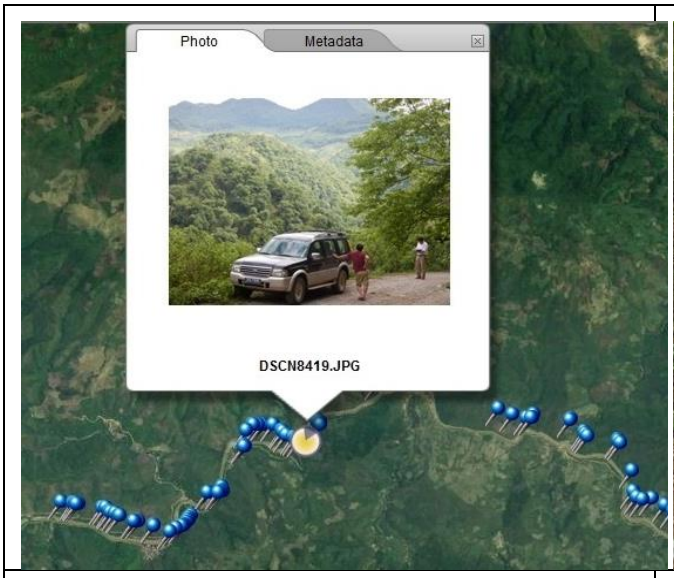


Interviews local resident

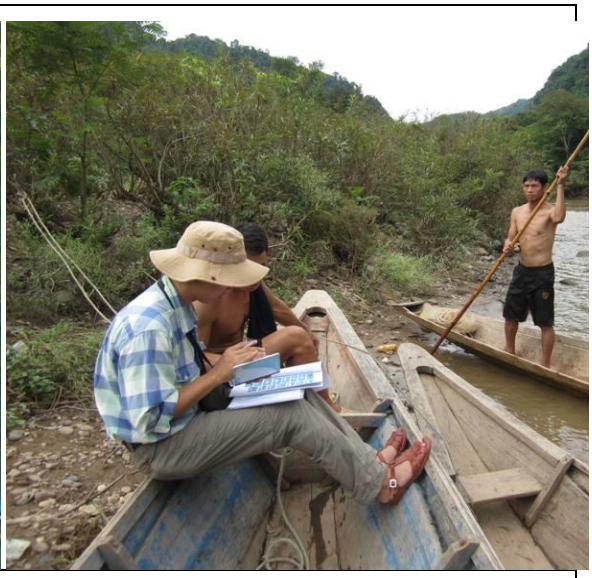


Habitat along river in Laos

[5]Nguyễn Cử, Lê Trọng Trải, Karen Phillipps, 2000: Chim Việt Nam. Nxb Lao Động-Xã Hội, Hà Nội, 250tr.
[6]Đặng Huy Huỳnh (chủ biên), Đào Văn Tiến, Cao Văn Sung, Phạm Trọng ảnh, Hoàng Minh Khiên, 1994.Danh lục *các loài thú (Mammalia) Việt Nam. Nxb KH và KT, Hà Nội, 167 trang*
[7]Red Data Book of Vietnam, 2007. Section 1: Plant; Section 2: Wildlife.
[8]Dự án lâm nghiệp xã hội và bảo tồn thiên nhiên tỉnh Nghệ An (SFNC): ALA/VIE/94/24, 2001: Pù Mát: Điều tra đa dạng sinh học của một số khu bảo vệ ở Việt Nam. Nxb Lao động- Xã hội, 174 tr.
[9]Bryan Stuart (2000) in SFNC Project: Pù Mát - A biodiversity survey of a Vietnamese protected area, Chapter Five. Amphibians and Reptiles: 62-72
[10]Nguyễn Thanh Nhàn, 2001. Đa dạng sinh học ở khu BTTN Pù Mát – Nghệ An. Hội thảo quốc tế sinh học. International workshop on Biology.Hanoi - Vietnam 2-5 July 2001: 150 - 155.
[11]Vi Luu Binh, 2015.Biodiversity of western Nghe An and the sustainable development model of the Biosphere Reserve. Department of Agriculture and Rural Development.
[12]Đặng Ngọc Thanh, Hồ Thanh Hải, 2001.*Crustacean in fresh water.Animals in Vietnam, volume 5.*Science and Technique Publishing House, Ha Noi.
[13]Đặng Ngọc Thanh, Thái Trần Bái, Phạm Văn Miên, 1980.*Classification of invertebrate fauna in fresh water environment in North Vietnam.*Science and Technique Publishing House, Ha Noi.
[14]Nguyễn Thái Tự, 1994. Fish on Lam river (Msc Thesis on biology)

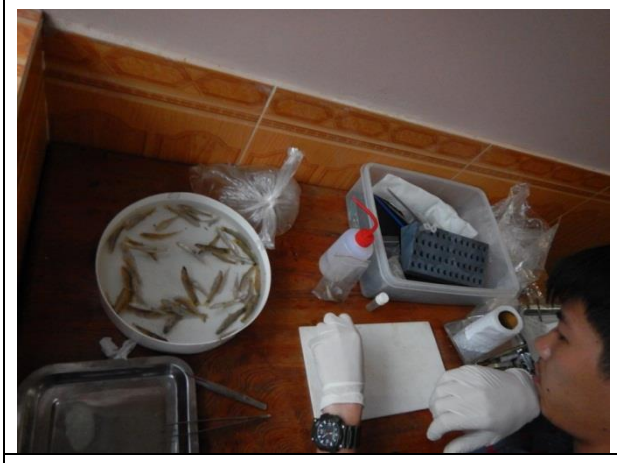


Vegetation investigation in Vietnam and Laos



Interviews ower of fishing boat in Nam Mo river

Survey, collect sample in Nam Mo river



Fish samples kept in formaline solution 10%

Interviews local people at Nhan Ly village, Ta Ca commune

Interviews local people at Muong Tip commune

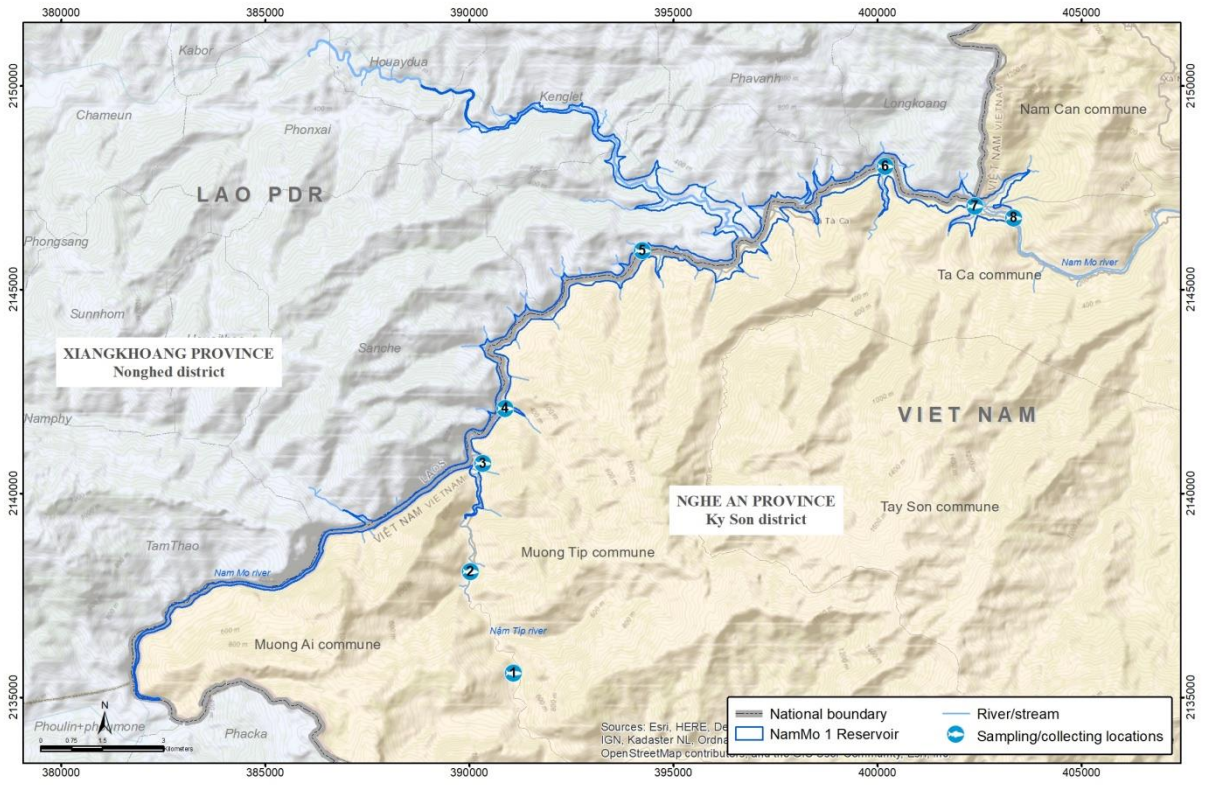


Figure 4: Location of fish samples

b. Sample analysis

Qualitative analysis to samples of phytoplankton, zooplankton is done mainly according to classification manual by Vietnamese authors.

Quantitative analysis to **phytoplankton** is done using Goriaev counter, storage 0.0009 ml.

Quantitative analysis to **zooplankton** is done using Bogorov counter, storage 10 ml.

Quantitative analysis to **zoobenthos** is done by counting quantity of individual collected per are of the surface where the net going through.

c . Reliability

Treats collected data, selects necessary data (empirical, experience, knowledge of experts in such sector). Estimates investigation and collected indexes using Excel software.

d. Route of survey

Performs survey in typical ecological area, approaches investigated location by navigation.

Co-ordinates of investigated location are listed below:

Table 1: Co-ordinates of investigated locations

No.	Location (village, commune)	Coordinates	
		Longitude (E)	Latitude (N)
1	Muong Ai commune	103.9633	19.31125
2	Vang Phao -Nam Tip bridge	103.9531	19.33366
3	Xop Tip village	103.9559	19.3577
4	Xop Phe PC	103.9609	19.36994
5	Vang Ngo village	103.9928	19.40505
6	Na Nhu village	104.0494	19.42404
7	The confluence of river, Vietnam-Laos border	104.0704	19.41535
8	Dam site	104.0794	19.41278

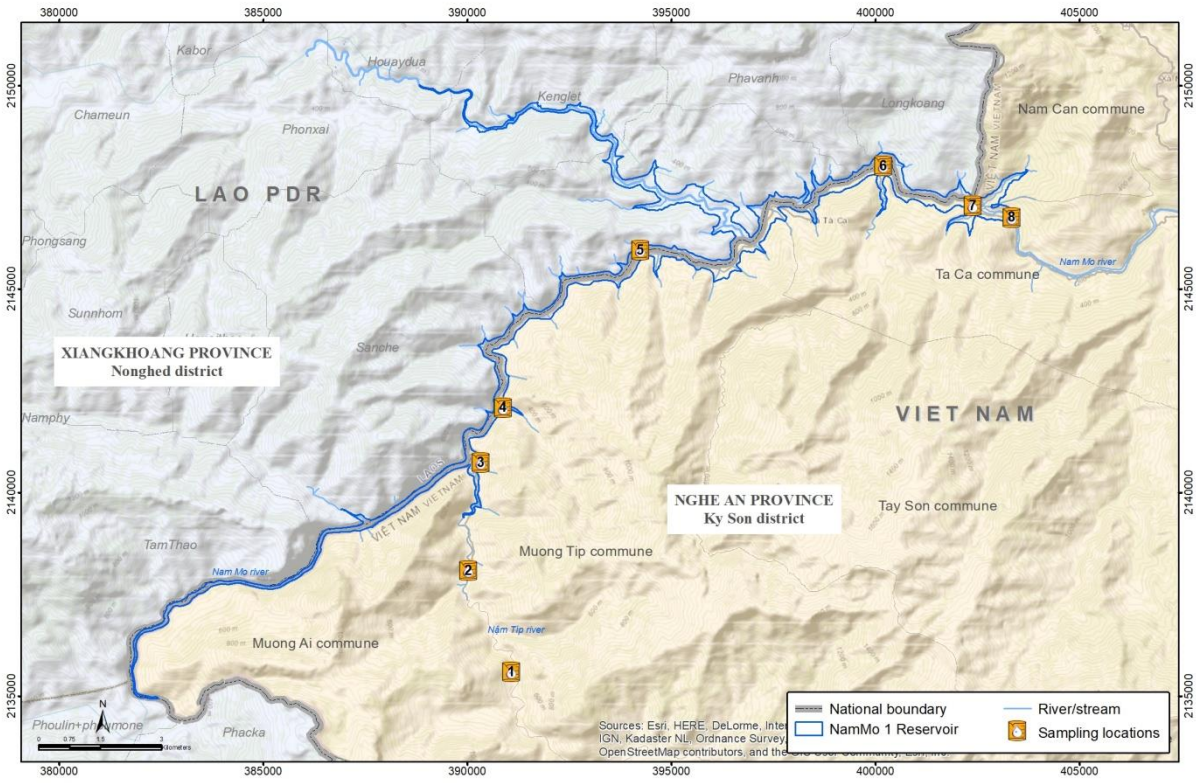


Figure 5: Location of aquaculture investigation

Coordinates and record of the plots in the reservoir, damsite and auxiliary areas is shown in the following table:

Table 2: Coordinates and record of plots in the Resorvoir

Plots	Coordinates (VN 2000)		Record	Corresponding to vegetation map (*)
	X	Y		
P01	415863.735	2139930.997	The semi-deciduous forest after exploitation	III
P02	417277.403	2142725.727	The semi-deciduous forest after exploitation	III
P03	417251.147	2144650.72	The semi-deciduous forest after exploitation	III
P04	418770.515	2145763.117	The semi-deciduous forest after exploitation	III
P05	419412.701	2145827.903	The semi-deciduous forest after exploitation	III
P06	420456.464	2146491.531	Grassland on uncultivated land	V
P07	420722.786	2146504.756	Grassland on uncultivated land	V
P08	422028.282	2146136.27	Grassland on uncultivated land	V
P09	424870.521	2147997.127	Grassland on uncultivated land	V
P10	427589.105	2147723.358	Grassland on uncultivated land after 4-5 years	V
P11	428441.203	2147616.527	Grassland on uncultivated land	V
P12	429018.145	2147438.997	Grassland on uncultivated land after 4-5 years	V

Table 3: Coordinates and record of plots at Damsite

Plots	Coordinates (VN 2000)		Record	Corresponding to vegetation map (*)
	X	Y		
P13	429204.988	2147255.338	Grassland on uncultivated land	V
P14	429435.312	2147434.296	The semi-deciduous forest after exploitation	III

Table 4: Coordinates and record of plots at Auxiliary area

Plots	Coordinates (VN 2000)		Record	Corresponding to vegetation map (*)
	X	Y		
P15	429457.828	2147023.311	Grassland on uncultivated land after 4-5 years	V
P16	429546.749	2146416.274	Grassland on uncultivated land after 4-5 years	V
P17	429726.126	2146607.644	Grassland on uncultivated land	V
P18	430094.010	2146398.849	The secondary forest	I
P19	429701.410	2146199.583	Secondary forest on uncultivated land for 10-15 years	I

Table 5: Coordinates and record at Auxiliary area

No.	Name of items	Coordinates (VN2000)		Record	Corresponding to vegetation map (*)
		X	Y		
1	Crushing facility for RCC and aggregate stockpile area	2149057.026	438705.242	The secondary forest after exploitation	I
2	Crushing facility	2149059.739	438907.281	The secondary forest after exploitation	I
3	RCC facility	2147068.123	429736.396	The secondary forest after exploitation	I
4	RCC conveyor system	2147497.971	429521.577	The secondary forest after exploitation (near left shouder of dam)	I
5	Concrete facility at dam, powerhouse areas				
	5_1	2147050.313	429457.320	The secondary forest after exploitation	I
	5_2	2146932.116	429719.038	The mixed of Grassland on uncultivated land and scrub	V
6	Steel reinforcement facility at headworks, waterway areas	2146631.688	429820.107	The secondary scrub on uncultivated land	IV
7	Steel formwork facility at headworks, waterway areas	2146607.679	429730.281	The cultivated land (village) and Grassland on uncultivated land	V
8	Pre-casted concrete yard	2146607.354	429766.798	The cultivated land (village) and Grassland on uncultivated land	V
9	Maintenance facility and parking area for construction equipment	2146504.588	429978.377	The Mixed of scrub and small trees	IV
10	Workshop for hydro-mechanic erection	2146587.039	429916.673	The secondary scrub on uncultivated land	IV
11	Workshop for electrical-mechanic erection of the powerhouse	2146564.552	430051.756	The secondary forest after exploitation	I
12	Laboratory of the headworks, waterway	2146399.484	430070.957	The secondary forest after exploitation	I
13	Explosive dynamite warehouse for headworks, waterway areas	2145974.14	430655.840	The Grassland on uncultivated land	V
14	Petroleum warehouse for dam, waterway areas	2146484.606	430011.575	The Mixed of scrub and small trees	IV
15	Technical material warehouse (Project management Board's warehouse)	2146457.333	430040.631	The Mixed of scrub and small trees	IV
16	Water, power facilities for dam areas	2146382.509	430109.246	The secondary forest after exploitation	I
17	Provision power			The Grassland on uncultivated land	V
	17_1	2146982.452	429762.474	The Grassland on uncultivated land	V
	17_2	2146647.154	429751.138	The Grassland on uncultivated land	V

	17_3	2146534.936	430102.354	The Grassland on uncultivated land	V
	17_4	2146233.554	430376.363	The Grassland on uncultivated land	V
	17_5	2145832.753	430956.069	The Grassland on uncultivated land	V
18	Sand stockpile area at headworks, waterway areas	2147059.955	429633.572	The secondary forest after exploitation	I
19	Rubble stockpile area	2146902.576	429600.299	The secondary forest and banana garden	I, V
20	Disposal area No.1	2146533.735	429890.792	The Mixed of scrub and small trees	IV
21	Disposal area No.2	2146120.631	429687.734	The Mixed of scrub and small trees	IV
22	Substations	2146601.142	429697.269	The Grassland on uncultivated land	V
23	Technical water treatment station at dam, powerhouse areas	2147050.569	429579.051	The secondary forest after exploitation	I
24	Technical water treatment station at auxiliary area	2146572.528	429636.180	The cultivated land (village) and Grassland on uncultivated land	V
25	Pump & treatment station of household waste water	2146568.814	429657.252	The cultivated land (village) and Grassland on uncultivated land	V
26	Office of Contractor at the dam, wateray areas			The secondary forest after exploitation	I
	26_1	2146351.227	430168.112	The secondary forest after exploitation	I
	26_2	2145866.753	430943.954	The Grassland on uncultivated land	V
27	Housing and office of PMB, specialists, Engineer			The Grassland on uncultivated land	V
	27_1	2146289.885	430292.891	The secondary forest after exploitation	I
	27_2	2145817.716	430932.754	The Grassland on uncultivated land	V
29	Clinics at dam, waterway areas	2146477.906	430094.252	The secondary forest after exploitation	I
30	Post Office	2146470.910	430089.874	The secondary forest after exploitation	I
31	Police station	2146458.317	430083.395	The secondary forest after exploitation	I
32	Fire station	2146446.948	430077.441	The secondary forest after exploitation	I

(*) Vegetation map consisting of the following main objects:

I. Secondary mixed evergreen rain forest
II. Mixed broadleaf and bamboo forest
III. Semi-deciduous forest after exploitation
IV. Secondary scrub on uncultivated land
V. Grassland/shrub/bamboo/cultivated/uncultivated land
VI. Other lands;

VII. River/stream

Table 6: Coordinates and record at Interviews locations for fauna wildlife

STT	Location (village, commune)	Coordinates		Record
		Longitude (E)	Latitude (N)	
1	Muong Ai commnune	103.57477	19.18405	Interviews: Frequent encounters and hunts
2	Nam Tip Village, Muong Tip commune	103.5711	19.20119	Interviews: Frequent encounters and hunts
3	Nhan Ly Village, Muong Tip Commune	104.25788	19.252655	Interviews: Frequent encounters and hunts

Table 7: Coordinates and record at locations for aquatic

No.	Location (village, commune)	Coordinates		Record
		Longitude (E)	Latitude (N)	
1	Muong Ai commune	103.9633	19.31125	Survey and collected samples (plankton, zoobenthos)
2	Vang Phao -Nam Tip bridge	103.9531	19.33366	Survey and collected samples (plankton, zoobenthos)
3	Xop Tip village	103.9559	19.3577	Survey and collected samples (plankton, zoobenthos)
4	Xop Phe Village	103.9609	19.36994	Survey and collected samples (plankton, zoobenthos)
5	Vang Ngo village	103.9928	19.40505	Survey and collected samples (plankton, zoobenthos)
6	Na Nhu village	104.0494	19.42404	Survey and collected samples (plankton, zoobenthos)
7	The confluence of river, Vietnam-Laos border	104.0704	19.41535	Survey and collected samples (plankton, zoobenthos)
8	Dam site	104.0794	19.41278	Survey and collected samples (plankton, zoobenthos)

Table 8: Coordinates and record at locations for fish

No.	Location	Coordinates		Record
		Longitude (E)	Latitude (N)	
1	Muong Ai commune	103.9633	19.31125	Interviewed local people; Survey and collected samples
2	Vang Phao -Nam Tip bridge	103.9531	19.33366	Survey and collected samples
3	Xop Tip village	103.9559	19.3577	Survey and collected samples
4	Xop Phe village	103.9609	19.36994	Interviewed local people; Survey and collected samples
5	Vang Ngo village	103.9928	19.40505	Interviewed local people; Survey and collected samples

6	Na Nhu village	104.0494	19.42404	Survey and collected samples
7	The confluence of river, Vietnam-Laos border	104.0704	19.41535	Survey and collected samples
8	Dam site	104.0794	19.41278	Survey and collected samples

CHAPTER 2. ECOLOGICAL STATUS

2.1. Biodiversity and its characteristics in Nam Mo 1 reservoir area

In Nam Mo 1 HPP project area, 19 plots were established to investigate the vegetation (the reservoir area: plots 1-12; both sides of the dam: plots 13-14; the auxiliary items area: plot 15-19. see the attached Annex). The vegetation in the plots represents most of vegetation types in the project area. Besides, the transect along the river, the vegetation had been investigated.

Table 9: Coordinates and record of plots in the Resorvoir

Plots	Coordinates (VN 2000)		Record	Ressonding to vegetation map
	X	Y		
P01	415863.735	2139930.997	The semi-deciduous forest after exploitation	III
P02	417277.403	2142725.727	The semi-deciduous forest after exploitation	III
P03	417251.147	2144650.72	The semi-deciduous forest after exploitation	III
P04	418770.515	2145763.117	The semi-deciduous forest after exploitation	III
P05	419412.701	2145827.903	The semi-deciduous forest after exploitation	III
P06	420456.464	2146491.531	Grassland on uncultivated land	V
P07	420722.786	2146504.756	Grassland on uncultivated land	V
P08	422028.282	2146136.27	Grassland on uncultivated land	V
P09	424870.521	2147997.127	Grassland on uncultivated land	V
P10	427589.105	2147723.358	Grassland on uncultivated land after 4-5 years	V
P11	428441.203	2147616.527	Grassland on uncultivated land	V
P12	429018.145	2147438.997	Grassland on uncultivated land after 4-5 years	V

Table 10: Coordinates and record of plots at Damsite

Plots	Coordinates (VN 2000)		Record	Ressonding to vegetation map
	X	Y		
P13	429204.988	2147255.338	Grassland on uncultivated land	V
P14	429435.312	2147434.296	The semi-deciduous forest after exploitation	III

Table 11: Coordinates and record of plots at Auxiliary area

Plots	Coordinates (VN 2000)		Record	Ressonding to vegetation map
	X	Y		
P15	429457.828	2147023.311	Grassland on uncultivated land after 4-5 years	V
P16	429546.749	2146416.274	Grassland on uncultivated land after 4-5 years	V
P17	429726.126	2146607.644	Grassland on uncultivated land	V
P18	430094.010	2146398.849	The secondary forest	I
P19	429701.410	2146199.583	Secondary forest on uncultivated land for 10-15 years	I

And the vegetation in auxilary items of Nam Mo 1 HPP project area was investigated.

Table 12: Vegetation in auxiliary items of Nam Mo 1 HPP

No.	Name of items	Coordinates (VN2000)		Record	Vegetation map
		X	Y		
1	Crushing facility for RCC and aggregate stockpile area	2149057.026	438705.242	The secondary forest after exploitation	I
2	Crushing facility	2149059.739	438907.281	The secondary forest after exploitation	I
3	RCC facility	2147068.123	429736.396	The secondary forest after exploitation	I
4	RCC conveyor system	2147497.971	429521.577	The secondary forest after exploitation (near left shouder of dam)	I
5	Concrete facility at dam, powerhouse areas				
	5_1	2147050.313	429457.320	The secondary forest after exploitation	I
	5_2	2146932.116	429719.038	The mixed of Grassland on uncultivated land and scrub	V
6	Steel reinforcement facility at headworks, waterway areas	2146631.688	429820.107	The secondary scrub on uncultivated land	IV
7	Steel formwork facility at headworks, waterway areas	2146607.679	429730.281	The cultivated land (village) and Grassland on uncultivated land	V
8	Pre-casted concrete yard	2146607.354	429766.798	The cultivated land (village) and Grassland on uncultivated land	V
9	Maintenance facility and parking area for construction equipment	2146504.588	429978.377	The Mixed of scrub and small trees	IV
10	Workshop for hydro-mechanic erection	2146587.039	429916.673	The secondary scrub on uncultivated land	IV
11	Workshop for electrical-mechanic erection of the powerhouse	2146564.552	430051.756	The secondary forest after exploitation	I
12	Laboratory of the headworks, waterway	2146399.484	430070.957	The secondary forest after exploitation	I
13	Explosive dynamite warehouse for headworks, waterway areas	2145974.14	430655.840	The Grassland on uncultivated land	V
14	Petroleum warehouse for dam, waterway areas	2146484.606	430011.575	The Mixed of scrub and small trees	IV
15	Technical material warehouse (Project management Board's warehouse)	2146457.333	430040.631	The Mixed of scrub and small trees	IV
16	Water, power facilities for dam areas	2146382.509	430109.246	The secondary forest after exploitation	I
17	Provision power			The Grassland on uncultivated land (gần 26,27)	V
	17_1	2146982.452	429762.474	The Grassland on uncultivated land	V
	17_2	2146647.154	429751.138	The Grassland on uncultivated land	V
	17_3	2146534.936	430102.354	The Grassland on uncultivated land	V
	17_4	2146233.554	430376.363	The Grassland on uncultivated land	V
	17_5	2145832.753	430956.069	The Grassland on uncultivated land	V
18	Sand stockpile area at headworks, waterway areas	2147059.955	429633.572	The secondary forest after exploitation	I
19	Rubble stockpile area	2146902.576	429600.299	The secondary forest and banana garden	I, V
20	Disposal area No.1	2146533.735	429890.792	The Mixed of scrub and small trees	IV
21	Disposal area No.2	2146120.631	429687.734	The Mixed of scrub and small trees	IV
22	Substations	2146601.142	429697.269	The Grassland on uncultivated land	V

23	Technical water treatment station at dam, powerhouse areas	2147050.569	429579.051	The secondary forest after exploitation	I
24	Technical water treatment station at auxiliary area	2146572.528	429636.180	The cultivated land (village) and Grassland on uncultivated land	V
25	Pump & treatment station of household waste water	2146568.814	429657.252	The cultivated land (village) and Grassland on uncultivated land	V
26	Office of Contractor at the dam, wateray areas			The secondary forest after exploitation	I
	26_1	2146351.227	430168.112	The secondary forest after exploitation	I
	26_2	2145866.753	430943.954	The Grassland on uncultivated land	V
27	Housing and office of PMB, specialists, Engineer			The Grassland on uncultivated land	V
	27_1	2146289.885	430292.891	The secondary forest after exploitation	I
	27_2	2145817.716	430932.754	The Grassland on uncultivated land	V
29	Clinics at dam, waterway areas	2146477.906	430094.252	The secondary forest after exploitation	I
30	Post Office	2146470.910	430089.874	The secondary forest after exploitation	I
31	Police station	2146458.317	430083.395	The secondary forest after exploitation	I
32	Fire station	2146446.948	430077.441	The secondary forest after exploitation	I

2.1.1. Biodiversity of various forest vegetation in the catchment area

In proposed area of Nam Mo 1 reservoir, there are some typical vegetations, as herein description.

2.1.1.1. The mixed evergreen rain forest after exploitation

The vegetation is resulted from human impact on the natural forest causing exploitive succession and then progressive succession. The composition of timber tree species is of high diversity. However, these forests are not much within the area

The dominant layer includes broad-leaved trees. These are species left after selected exploitation which are less value or premature timber trees, 15-25 m tall includes: Ngát – *Gironiera subaequalis*, Gội – *Aglaia* sp., Gội nước - *Aphanamixis polystachya*, Chẹo – *Engelhardtia roxburghiana*, Vạng Trứng – *Endospermum chinense*, species of Giổi – *Manglietia* spp., species of Trâm *Syzygium* spp., species of Dẻ - *Lithocarpus* spp., species of Dẻ gai – *Castanopsis* spp., Máu cho – *Knema conferta* Warb, *Horsfieldia* spp., Sến – *Madhuca* sp, *Vatica odorata*(Griff.) Symington, Sao – *Shorea chinensis* (Wang Hsie) H.Zhu, Nhãn rừng – *Dimocarpus fumatus* (Blume) Leenh...

The subdominant layer includes small trees, scattering, less than 15 m tall which includes: Dâu gia đất – *Baccaurea racemosa*, species of Súm – *Eurya* spp., species of Trâm – *Syzygium* spp., species of Bứa – *Garcinia* spp., species of Bời lời – *Litsea* spp., Quế rừng – *Cinnamomum* spp., Sảng – *Sterculia* sp., Trám – *Canarium album*...

Scrub layer includes species of Chòi mòi *Antidesmabunius*, Ớt rừng – *Tabernaemontana bovina* Lour., Mua – *Melastoma septemnervium*, species of Khôi – *Ardisia* spp., Bổ béo – *Gomphandra mollis* Merr. , Kích nhũ - *Polygala tonkinensis* Chodat, Móc – *Pinnaga* spp. Lá nón – *Licuala* spp. and regenerated premature trees.

Shrub layer is mainly species of fern, species in family of Gừng – *Zingiberaceae*, family Hòa Thảo – *Poaceae*, Family Cói *Cyperaceae*.....

Plate 1.i: The mixed evergreen rain forest after exploitation in Ta Ca commune

Limb layer is mainly species of fern, species of creeper in family Đậu - *Fabaceae*, family Khoai lang - *Convolvulaceae*, Song mây – *Calamus* spp....

b.The semi-deciduous forest after exploitation

The dominant layer includes semi-deciduous trees. These are timber trees, 8-12 m tall includes: Nghiến - *Burretiodendron hsienmu* W.Y.Chun & F.C.How; Săng lẻ - *Lagerstroemia tomentosa* Presl, Thàn mát - *Ormosia pinnata* (Lour.) Merr., Trôm thối - *Sterculia foetida* L., Săng lẻ - *Lagerstroemia tomentosa* Presl, Diệp hạ châu - *Phyllanthus annamensis* Beille., Nhãn rừng - *Dimocarpus fumatus* (Blume) Leenh., Má tra - *Celtis philippense* Blanco, Ruối - *Streblus asper* Lour….

Table 13: 10 common woody species in some plots

No	Scientific name	Local name	RD	RF	RBA	IVI
1	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiến	29.730	15.385	38.647	83.762
2	Ormosia pinnata (Lour.) Merr.	Thàn mát	12.162	15.385	13.004	40.551
3	Sterculia foetida L.	Trôm thối	8.108	7.692	22.733	38.533
4	Lagerstroemia tomentosa Presl	Săng lẻ	2.703	7.692	10.800	21.195
5	Phyllanthus annamensis Beille.	Diệp hạ châu	9.459	7.692	2.774	19.926
6	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	8.108	7.692	3.541	19.342
7	Milletia sp.		6.757	7.692	4.213	18.662
8	Celtis philippense Blanco	Má tra	4.054	11.538		15.593

9	Streblus asper Lour.	Ruối	9.459	3.846	1.465	14.770
10	Vitex tripinnata (Lour.) Merr.	Bình linh	2.703	3.846	1.240	7.789

Scrub layer includes species of Ruối ô rô - *Streblus ilicifolius* (Vidal) Corner, Găng - *Randia spinosa* Blume, Bình linh - *Vitex tripinnata* (Lour.) Merr., Nhãn rừng - *Dimocarpus fumatus* (Blume) Leenh….

Shrub layer is mainly species of Fern, species in family of Gừng – Zingiberaceae, family Hòa Thảo – Poaceae, Family Cói - Cyperaceae... Limb layer are mainly species of Fern, species of creeper: Dây đau xương - *Tinospora crispa* (L.) Miers, Cáp - *Capparis micrantha* DC., Cách lông - *Fissistigma villossium* (Ast.) Merr., family Đậu – *Fabaceae*, family Khoai lang – *Convolvulaceae*....

Plate 1.ii: The semi-deciduous forest after exploitation in Muong Tip commune

2.1.1.2. The vegetation after burn-over lands

This type of vegetation occupies all most of area and is the product of cultivated activities. In the studied area, this type of vegetation is roughly divided into 3 types of vegetation after burn-over lands as follows:

Plate 1.iii: The secondary scrub on uncultivated land for 5-10 years in Ta Ca commune

The secondary scrub on uncultivated land for 5-10 years:

The communities are progressive succession on uncultivated land for 5-10 years, presently in recovery proess. Vegetative structure is relatively simple. Priority timber trees includes Thừng mức – *Wightia pubescens*, Mã rạng – *Macaranga denticulata*, Ràng ràng – *Ormosia pinnata,* Hu lá hẹp – *Trema angustifolia*, Muối – *Rhus chinensis*, Thàu tau – *Apurosa dioca*, Me rừng – *Phyllanthus embrica* ...

Predominant by scrub layer mixed with species of herbaceous species, main species are those of Bồ cu vẽ - *Breynia fruticosa,* Cơm rượu – *Glycomis pentaphylla,* Găng gai – *Randia spinosa,* Trang – *Ixora coccinea,* Lấu – *Psychotria* spp*.,* Mắt trâu – *Micromelum hirsutum*, Đơn nem – *Maesa* spp.

Shrub layer are species in family Đậu – Fabaceae, family Cúc – *Asteraceae*, family Hòa thảo – *Poaceae*, family Cói – *Cyperaceae*... and fern species.

Secondary forest on uncultivated land for 10-15 years:

The vegetation pattern includes vegetation communities of 2-3 timber trees layers. The dominant layer are trees as high as 5-6 m: Thừng mức – *Wightia pubescens*, Mã rạng – *Macaranga denticulata*, Ràng ràng – *Ormosia pinnata,* Hu đay – *Tremna orrientalis*, Muối – *Rhus chinensis*, Thàu tau – *Apurosa dioca*, Me rừng – *Phyllanthus embrica,* Dẻ gai – *Castanopsisannamensis*, Lòng mang – *Pterospermumheterophyllum*, Sảng – *Sterculia hymenocalys*, Bời lời – *Litsea* spp., Sung – *Ficus* spp., Hoắc quang – *Wendlandia paniculata*, Ngát - *Gironiera subaequalis*, Lọng bàng - *Dillenia* spp...

The scrub layer mainly includes species in family Thầu dầu – *Euphorbiaceae*, Cà phê – *Rubiaceae*, Đơn nem – *Myrsinaceae*, Trúc đào – *Apocynaceae*, Mua – *Melastomataceae*... Shrub layer is species of ferm, species in family Gừng – *Zingiberaceae*, Hòa Thảo – *Poaceae*,

Cói *Cyperaceae*, Đậu - *Fabaceae*... In this vegetation type, limb layer is creeper species in family of Khoai lang - *Convolvulaceae*which is strongly developed.

Young forest recovered on scrub land area:

The vegetation is characterized as tropical forest with evergreen rain forest in low hills, broadleaf trees. The upper layer is timber of 15-20 m tall, including species as: Lim vang - *Peltrophorum dasyrrhachis*, Xoan nhừ- *Choerospondias axillaris*, Táu- *Vatica* spp....

Dominant layer includes the evergreen broadleaf trees, 10-15 m tall as: Dẻ - *Lithocarpus* spp., De núi - *Cinnamomum* spp., Bời lời - *Litsea* spp., Cà đuối -*Cryptocarya* spp., Gội- *Aglaia* spp…

Foliage layer is species of broadleaf timber trees as high as 10-15 m, including species of Dẻ - *Lithocarpus* spp., De núi – *Cinnamomum* spp., Bời lời – *Litsea* spp., Cà đuối – *Cryptocarya* spp., Gội – *Aglaia* spp....

The scrub layer is secondary tree and species of scrub such as Ba chạc – *Euodia lepta*, Lấu – *Psychotria* spp., Ớt rừng – *Tabernaemontana* spp., Gang – *Randia* spp., Trang – *Ixora* spp., Thần linh – *Kibatalia* sp., Thừng mức – *Wightia* sp... These are low scrub bushes, growable in shadow but slowly growing.

The shrub layer is species of family Hòa thảo – Poaceae, family of Cói – Cyperaceae, Gừng gió – *Ammomum* spp., Riềng gió – *Alpinia* spp., Ráy dại – *Alocasia* sp., Thiên niên kiện – *Homalomena oculta* and species of Fern.

The sub layer includes species developing on other such as ferns, species of Tiêu dại – *Piper spp*. , Má đào – *Aschynanthus* spp.... species of creepers in family Khoai lang – *Convolvulaceae*, family Đậu – *Fabaceae*, family Tiết dê – *Menispermaceae*... and creeping timber species or running species of family Na – *Annonaceae* (Bù dẻ - *Desmos* spp., *Uvaria* spp., *Fissistigma* spp., Tứ thư – *Tetrastigma* spp...

Plate 1.iv: Young forest recovered on scrub land area in Ta Ca commune

2.1.1.3. The mixed broadleaf and bamboo forest

This type of forest is not many within the area. This is also what resulted of secondary forest after being impacted and now is under recovery. Some broadleaf timber species, as high as 10-15 m as Re núi – *Cinnamomum* spp., Gội - *Aglaia* spp., Dẻ - *Lithocarpus* spp., Bứa – *Garcinia* spp., Trám – *Canarium* sp., Táu – *Vatica* spp., Bụp – *Mallotus* spp., Hu đay – *Tremna* spp.... grow intercalated with Nứa – *Neohouzeaua dulloa*.

2.1.1.4. The predominant bamboo forest

Bamboo forest in the studied area is mainly formed after timber forest has been overexploited, destroyed under burning or left uncultivated after slash and burn activities. Pattern of bamboo forest is close forest with only one predominant species to be bamboo Nứa **-** *Chizostachyum dullooa,* locally appear with some other species but of negligible quantity. Shrub layer is quite simple, comprising some few species of fern, some species in family Hòa thảo - *Poaceae* or family Cói - *Cyperaceae*.

2.1.1.5. The vegetation on rock along streams

The flows in upstream area are normally characterized as rapid flows. However, right at the flow and two banks are normally exposed rock terrains running long together with small sand lanes. This creates conditions for some vegetation to grow, creating different vegetation. Along rivers, the vegetation includes some plants as: Thạch xương bồ - *Acorus gramineus*, Côm hải nam - *Elaeocarpus hainanensis*, Rù rì - *Momonia riparia*, Rù rì bãi - *Ficus subpyriformis*, Gáo nước - *Aidia pilulifera*, Trâm lá hẹp - *Syzygium linneatum*... Along river banks, the vegetation includes some typical species as Cơi - *Pterocarya tonkinensis*, Sung - *Ficus* spp. Trâm - *Syzygium* spp... Along small streams are habitats of species as Thiên niên kiện - *Homalonema oculta*, Râu hùm - *Tacca chantrieri*, Cao cẳng - *Ophiopogon* spp., some species in family Cói - *Cyperaceae*...

2.1.1.6. The secondary tropical grass land

The secondary tropical grass lands are results of uncultivated land for 3-5 years. They occupy most of area in the region. On lands where degradation has not happened much usually are high or medium grass species as: Cỏ Lào - *Eupatorium odoratum* L., Cỏ tranh - *Imperata cylindrical*, Sậy - *Phragmites karka*, Lách - *Saccharum spontaneum*, Chít - *Thysanolaena maxima*, Chè vè - *Miscanthus sinensis*...

On land areas where soil has been much degraded, normally exist with low grass, poor recovery with main species such as Dị thảo- *Heteropogon conturtus*, Cỏ công viên - *Paspalum conjugatum*, Sả hôi-*Cymbopogon caesius*, Trúc thảo - *Arundinella nepalense*, Cỏ phao - *Themeda triandra*...

On lands subject to regular stepping on, exists low grass with predominant species such as Cỏ may - *Chrysopogon aciculatus*, Cỏ gà - *Cynodon dactylon*, Cỏ cát vĩ - *Eulalia monostachya*, Cỏ đuôi voi - *Paspalum conjugatum*...

On land area where soil is quite good or bordering with forest ecology, is normally grass land with predominant species such as Cỏ cứt lợn - *Ageratum conyzoides*, Cỏ lào -*Eupatorium odoratum*. Growing together with herbaceous species are some timber species, bushes, creeper, jumper which are recently regenerated with species component almost similar to scrub, shrub, bush vegetation in surrounding.

2.1.2. Forest ecology with economic-ecology-environment values and preservation characteristics in reservoir area of Nam Mo 1

In our study, in reservoir area of Nam Mo 1 HPP, forest ecologies have economic-ecology-environment meaning (on viewpoint of flora and botany). This is watershed forest in upstream

most of Ca river, therefore forest ecology here plays important role in protecting upstream area. Forest ecologies in this region are sources of timber for construction demand of all ethnic minority communities, besides it is where supplying sub-product from forest, an important income sources of local resident. This is evergreen mixed rain forest after exploitation, evergreen mixed rain forest after slash and burn activities, mixed forest of broadleaf and bamboo forest and bamboo predominant forest.

Ecology of the evergreen mixed rain forest after exploitation is of medium biodiversity while other forest ecologies including evergreen mixed rain forest after slash and burn activities, mixed forest of broadleaf and bamboo forest and bamboo predominant forest are of low biodiversity. Among the said ecologies, growing 2 species listed in Red Data Book of Vietnam (2007).

2.1.3. Ethno Botanical Description

Local communities have always used forest resources for fuel-wood, timber, fodder and forage, medicines, food and rituals. There are several medicinal plants of high value at the same time there are poisonous plants naturally growing in the forest like Crotontiglium spp. (Ba đậu), Millettia pachyloba (Dây mật), Engelhardtia roxburghiana (Chẹo) and other species. Plant species with their uses are described below.

Medicinal & Poisonous plants: 61 species; Fuel-wood & Timber trees: 58 species; Eatable plants: 18 species; Ornamental plants: 16 species; Rattan & bamboo: 8 species; Forages (tannin plant): 8 species.

Table 14: Ethno-botanical Characterists of plants grown in project area

No.	Local name	Scientific name	Fuel-wood & Timber trees	Ess. Oil, Fat & Resin plant	Medicinal & poisonous plants	Eatable plants	Ornamental plants	Rattan & bamboo	Others

No.	Local name	Scientific name	Fuel-wood & Timber trees	Ess. Oil, Fat & Resin plant	Medicinal & poisonous plants	Eatable plants	Ornamental plants	Rattan & bamboo	Others
1	Xuệ lan vàng đỏ	Acampe ochracea (Lindl.) Hochr.					x		
2	Thạch xương bồ	Acorus gramineus Ait. ex Soland.			x				
3	Bai bái, Bởi bung	Acronychia pedunculata (L.) Miq.		x	x				
4	Tóc thần vệ nữ đuôi	Adiantum caudatum L.			x				
5	Cứt lợn	Ageratum conyzoides L.			x				
6	Gội dịu	Aglaia edulis (Roxb.) Gray	x						
7	Gội lông	Aglaia tomentosa T. & B.	x						
8	Khoai ráp	Alocasia macrorrhizos (L.) G. Don			x				x
9	Vàng trắng lông	Alseodaphne velutina Cher.	x						
10	Sữa	Alstonia scholaris (L.) R. Br.	x		x				
11	Chè dây	Ampelopsis cantoniensis (H. et A.) Planch.			x				
12	Chòi mòi bun	Antidesma bunius (L.) Spreng				x			
13	Gội nước	Aphanamixis polystachya (Wlall.) R. N. Parker	x						
14	Đơn châu chấu	Aralia armata (Wall. ex G. Don) Seem.			x				
15	Bạc thau	Argyreia acuta Lour.			x				
16	Mít nài	Artocarpus rigidus Blume	x			x			
17	Lan lá lúa	Arundina graminifolia (D. Don) Hodr.					x		
18	Thiên môn đông	Asparagus cochinchinensis (Lour.) Merr.					x		
19	Tổ điểu	Asplenium nidus L.					x		
20	Dâu gia đất	Baccaurea racemosa Lour.	x						
21	Tre gai	Bambusa blumeana J. A. et J. H. Schult.						x	
22	Rẻ quạt	Belamcanda chinensis (L.) DC.					x		
23	Nhội	Bischofia javanica Blume				x			
24	Đại bi	Blumea balsamifera (L.) DC.		x	x				
25	Gai	Boehmeria nivea (L.) Gaudich.							x
26	Bồ cu vẽ	Breynia fruticosa Hook. f.			x				
27	Lan cầu gần	Bulbophyllum affine Lindl.					x		

No.	Local name	Scientific name	Fuel-wood & Timber trees	Ess. Oil, Fat & Resin plant	Medicinal & poisonous plants	Eatable plants	Ornamental plants	Rattan & bamboo	Others
28	Nghiến trắng	Burretiodendron hsienmu W.Y.Chun & F.C.How	x						
29	Mây thủ công	Calamus faberi Becc.						x	
30	Song đá	Calamus rudentum Lour.						x	
31	Mây lá liễu	Calamus salicifolius Becc.						x	
32	Kiều lan đỉnh	Calanthe clavata Lindl.					x		
33	Rau dớn	Callipteris esculenta (Retz.) J. J. Sm.				x			
34	Chè	Camellia sinensis (L.) Kuntze							x
35	Trám trắng	Canarium album Raeusch	x		x				
36	Dẻ gai phảng	Castanopsis fissa (Champ.) Rehd. & Wild.	x						
37	Dẻ gai ấn độ	Castanopsis indica (Roxb.) A. DC.	x						
38	Dẻ gai bắc bộ	Castanopsis tonkinensis Seem.	x						
39	Ma trá oai	Celtis philippense Blanco	x						
40	Sếu	Celtis sinensis Person	x						
41	Quếch trung hoa	Chisocheton chinensis Merr.	x						
42	Quế lợn	Cinnamomum iners Reinw. ex Blume	x						
43	Thanh đạm tái	Coelogyne pallens Ridl.					x		
44	Khoai sọ, Khoai n-ớc	Colocasia esculenta (L.) Schott							x
45	Thài lài	Commelina communis L.							x
46	Mía dò	Costus speciosus (Koenig) Smith			x		x		
47	Cây bún	Crateva magna (Lour.) DC. (C. nurvala Buch.-Ham.)				x			
48	Thành ngạnh	Cratoxylum cochinchinensis (Lour.) Blume	x						
49	Đỏ ngọn	Cratoxylum formosum (Jack.) Benth. et Hook. f. ex Dyer	x						
50	Ba đậu, Mần để	Croton tiglium L.			x				
51	Cồ nốc mảnh	Curculigo gracilis Wall.			x				
52	Sâm cau lá rộng	Curculigo latifolia Dryand. ex Ait.			x				
53	Nghệ, Nghệ trồng	Curcuma longa L.			x	x			
54	Lan lô hội, Đoản kiếm lô hội	Cymbidium aloifolium (L.) Sw.					x		

No.	Local name	Scientific name	Fuel-wood & Timber trees	Ess. Oil, Fat & Resin plant	Medicinal & poisonous plants	Eatable plants	Ornamental plants	Rattan & bamboo	Others
55	Cỏ gấu	Cyperus rotundus L.			x				
56	Thạch hộc răng	Dendrobium dentatum Seidenf.					x		
57	Bạch trúc	Dendrobium faulhaberianum Schltr.					x		
58	Dây mật	Derris elliptica (Roxb.) Benth.			x				
59	Nhãn rừng	Dimocarpus fumatus (Blume) Leenh.	x						
60	Củ nâu	Dioscorea cirrhosa Lour.							x
61	Củ mài, Hoài sơn	Dioscorea persimilis Prain & Burk.			x	x			
62	Huyết giác nam bộ	Dracaena cochinchinensis (Lour.) Merr.					x		x
63	Cốt toái bổ	Drynaria fortunei (Kuntze ex Mett.) J. Sm.			x				
64	Phay	Duabanga grandiflora (DC.) Walp.	x						
65	Cúc chỉ thiên	Elephantopus scaber L.			x				
66	Vạng trứng	Endospermum chinense Benth.	x						
67	Chẹo	Engelhardtia roxburghiana Wall.	x		x				
68	Chè cỏ, Ba chạc	Euodia lepta (Spreng) Merr.		x	x				
69	Bứa nam bộ	Garcinia cochinchinensis (Lour.) Chóiy	x			x			
70	Sơn vé	Garcinia merguensis Wight	x			x			
71	Lá ngón, Ngón	Gelsemium elegans (Gardn. et Champ.) Benth.			x				
72	Ngát vàng	Gironniera subaequalis Planch.	x						
73	Đinh hùng mảnh	Gomphostemma leptodon Dunn.			x				
74	Dạ cẩm	Hedyotis capitellata Wall. ex G. Don			x				
75	Lõi rắn trắng	Hedyotis diffusa Willd.			x				
76	Cơm vàng	Helicia cochinchinensis Lour.	x						
77	Túng, Đáng	Heliciopsis lobata (Merr.) Sleum.	x						
78	Đại hái	Hodgsonia macrocarpa (Blume) Cogn.				x			
79	Sơn thục	Homalomena occulta (Lour.) Schott			x				
80	Táu mặt quỷ	Hopea mollissima C. Y.	**x**	VU					

No.	Local name	Scientific name	Fuel-wood & Timber trees	Ess. Oil, Fat & Resin plant	Medicinal & poisonous plants	Eatable plants	Ornamental plants	Rattan & bamboo	Others
		Hu		A1c,d					
81	Săng máu tô-ren	Horsfieldia thorelii Lecomte	x						
82	Diếp cá	Houttuynia cordata Thunb.				x			
83	Nang trứng lá ô rô	Hydnocarpus ilicifolia King	x		x				
84	Đơn đỏ	Ixora coccinea L.					x		
85	Chua cùm đỏ	Kadsura coccinea (Lem.) A. C. Smith			x				
86	Máu chó lá nhỏ	Knema conferta Warb.	x						
87	Bò ké, Ong bù	Kydia calycina Roxb.	x						
88	Bằng lăng	Lagerstroemia calyculata Kurz	x						
89	Săng lẻ	Lagerstroemia tomentosa Presl	x						
90	Gối hạc đen	Leea indica (Burm. f.) Merr.			x				
91	Bạch thiệt	Leucas aspera (De Wilde) Link			x				
92	Dẻ trung bộ	Lithocarpus annamensis (Hick. & A. Camus) Barn.	x						

No.	Local name	Scientific name	Fuel-wood & Timber trees	Ess. Oil, Fat & Resin plant	Medicinal & poisonous plants	Eatable plants	Ornamental plants	Rattan & bamboo	Others
93	Dẻ xanh	Lithocarpus pseudosundaicus (Hick. & A. Camus) A. Camus	x						
94	Màng tang	Litsea cubeba (Lour.) Pers		x	x				
95	Bời lời nhớt	Litsea glutinosa (Lour.) C. B. Robins		x	x				
96	Thông đất	Lycopodiella cernua (L.) Franco & Vasc.					x		
97	Lá nến, Ba soi	Macaranga denticulata (Blume) Muell.-Arg.	x						x
98	Mỡ	Manglietia conifera Dandy	x						
99	Xoan	Melia azedarach L.	x						
100	Giổi nhung	Michelia foveolata Merr. ex Dandy (M. fulgens Dandy)	x						
101	Dây mật	Millettia pachyloba Drake			x				
102	Kè huyết đằng	Millettia reticulata Benth.			x				
103	Mặt quỉ	Morinda umbellata L.			x				
104	Lá men	Mosla dianthera (Benth. et Hook.) Maxim.			x	x			
105	Chuối rừng, Chuối sen	Musa coccinea Andr.			x				
106	Gáo, Săng tàn	Neolamarkia cadamba (Roxb.) Bosser	x						
107	Mạch môn đông	Ophiopogon japonicus (L. f.) Ker.-Gawl.			x				
108	Cao cẳng lá rộng	Ophiopogon latifolius Rodr.			x				
109	Cao cẳng lá dài	Ophiopogon longifolius Dcne.			x				
110	Ràng ràng	Ormosia pinnata (Lour.) Merr.	x						
111	Núc nác	Oroxylum indicum (L.) Kurz			x	x			
112	Dứa gỗ	Pandanus tectorius Parkinson			x				
113	Lạc tiên, Nhãn lồng	Passiflora foetida L.			x				
114	Trờng mật trung bộ	Paviesia annamensis Pierre	x						
115	Rau tai voi	Pentaphragma sinense Hemsl. & Wils.				x			
116	Me rừng	Phyllanthus embrica L.				x			
117	Cau rừng	Pinanga dupperreana Pierre ex Gagnep.						x	
118	Lá lốt	Piper lolot C. DC.			x,	x			

No.	Local name	Scientific name	Fuel-wood & Timber trees	Ess. Oil, Fat & Resin plant	Medicinal & poisonous plants	Eatable plants	Ornamental plants	Rattan & bamboo	Others
119	Mã đề châu á	Plantago asiatica L.			x				
120	Mã đề	Plantago major L.			x				
121	Hà thủ ô	Polygonum multiflorum Thunb. ex Murray			x				
122	Sâng	Pometia pinnata Forst. & Forst. f.	x						
123	Trứng gà	Pouteria sapota (Jacq.) H. Moore & Stearn.				x			
124	Xoan đào	Prunus arborea (Blume) Kalkm.	x						
125	Cơi bắc bộ	Pterocarya stenoptera C. DC. var. tonkinensis Frach.	x,		x				
126	Lụi mảnh	Rhapis gracilis Burret						x	
127	Mâm xôi	Rubus alcaefolius Poir.			x				
128	Chân chim tám lá	Schefflera heptaphylla (L.) Harms			x				
129	Cam thảo đất	Scoparia dulcis L.			x				
130	Chò chỉ	Shorea chinensis (Wang Hsie) H.Zhu	x						
131	Dâu da xoan	Spondias lakoensis Pierre	x			x			
132	Trôm thối	Sterculia foetida L.	x						
133	Sảng	Sterculia lanceolata Cav.	x						
134	Ruối	Streblus asper Lour.	x						
135	Ruối ô rô	Streblus ilicifolius (Vidal) Corner	x						
136	Hà thủ ô nam	Streptocaulon juventas (Lour.) Merr.			x				
137	Mã tiền	Strychnos axillaris Colebr.			x				
138	Dung nam bộ	Symplocos cochinchinensis (Lour.) Moore. [S. laurina Wall. ex G. Don]	x		x				
139	Trâm mốc	Syzygium cumini (L.) Druce	x						
140	Trâm đẹp	Syzygium formosum (Wall.) Masam	x						
141	Trâm vỏ đỏ	Syzygium zeylanicum (L.) DC.	x						
142	Lài trâu	Tabernaemontana bovina Lour.			x				
143	Râu hùm	Tacca chantrieri Andre			x				
144	Thầu dầu núi	Trevesia palmata (Roxb. & Lindl.) Vis.			x				
145	Táu	Vatica odorata (Griff.)	x						

No.	Local name	Scientific name	Fuel-wood & Timber trees	Ess. Oil, Fat & Resin plant	Medicinal & poisonous plants	Eatable plants	Ornamental plants	Rattan & bamboo	Others
		Symington							
146	Trẩu	Vernicia montana Lour.		x					
147	Bình linh cọng mảnh	Vitex tripinnata (Lour.) Merr.					x		
148	Lòng mức trung bộ	Wrightia annamensis Eberh. & Dub.	x						
149	Xuyên tiêu	Zanthoxylum nitidum (Roxb.) DC.		x	x				
150	Măng nứa	Schizostachyum dullooa (Gamble) R. B. Majumdar				x			
151	Chít	Thysanolaena maxima							x

2.1.4. Ecosystem Services

Terrestrial ecosystems, mainly forests and grasslands, in the project area provide tangible products such as food, construction materials, medicinal plants and less tangible items like tourism and recreation. As per the Millennium Ecosystem Assessment[15] *Ecosystem services* are benefits people obtain from ecosystems.

Provisional ecosystem services include i) food, crops, wild foods, and spices, ii) raw materials such as fuel wood, organic matter, fodder, iii) water, iv) medicinal resources, v) ornamental resources like handicraft materials, furs, feathers, etc. Whereas cultural services include are spiritual and religious value.

Table 15: Forest and grassland ecosystem services in project area

Ecosystem services	Species	Availability	Duration
Food, crops, wild foods (leaves, stem, seeds/fruits/ root crops, and spices	Houttuynia cordata Thunb. – Rau diếp cá Pentaphragma sinense Hemsl. & Wils. – Rau tai voi Colocasia esculenta (L.) Schott – Khoai sọ Canarium album Raeusch - Trám Piper lolot C. DC. – Lá lốt Dioscorea persimilis Prain & Burk. – Củ Mài Curcuma longa L. – Nghệ Artocarpus rigidus Blume – Mít nài Garcinia cochinchinensis (Lour.) Chosiy – Bứa nam bộ Bischofia javanica Blume – Nhội	x	Rainy season: From July to October (lunar calender)

[15] Millennium Ecosystem Assessment (MA). 2005. Ecosystems and Human Well-Being: Synthesis [1]. Island Press, Washington. 155pp.

	Callipteris esculenta (Retz.) J. J. Sm. – Rau dớn Schizostachyum dullooa (Gamble) R. B. Majumdar – Măng nứa		
Wood	Aglaia edulis (Roxb.) Gray - Gội Aglaia tomentosa T. & B. - Gội Alseodaphne velutina Cher. - Bộp Aphanamixis polystachya (Wlall.) R. N. Parker - Gội nước Castanopsis fissa (Champ.) Rehd. & Wild. - Dẻ gai Celtis philippense Blanco - Má tra Endospermum chinense Benth. - Vạng trứng Lithocarpus pseudosundaicus (Hick. & A. Camus) A. Camus - Dẻ xanh Lithocarpus annamensis (Hick. & A. Camus) Barn. - Dẻ Melia azedarach L. Paviesia annamensis Pierre - Trường mật	x	Year around
Construction materials	Burretiodendron hsienmu W.Y.Chun & F.C.How - Nghiến trằng Cinnamomum iners Reinw. ex Blume - De Duabanga grandiflora (DC.) Walp. - Phay Hopea mollissima C. Y. Hu - Táu Lagerstroemia calyculata Kurz - Bằng lăng Lagerstroemia tomentosa Presl - Săng lẻ Manglietia conifera Dandy – Mỡ Michelia foveolata Merr. ex Dandy (M. fulgens Dandy) – Giổi Pometia pinnata Forst. & Forst. f. - Sâng Shorea chinensis (Wang Hsie) H.Zhu – Chò chỉ Vatica odorata (Griff.) Symington – Táu Pterocarpus indicus – Giáng hương	x	Year around
Fodder/Forage	Alocasia macrorrhizos (L.) G. Don – Khoa ráp Colocasia esculenta (L.) Schott – Khoai nước Commelina communis L. – Thài lài		
Medicine	Acorus gramineus Ait. ex Soland.	x	Year around

	Ampelopsis cantoniensis (H. et A.) Planch. – Chè dây Costus speciosus (Koenig) Smith – Mía dò Curculigo latifolia Dryand. ex Ait. – Cồ nốc Curcuma longa L. – Nghệ Drynaria fortunei (Kuntze ex Mett.) J. Sm. – Cốt toái bổ Homalomena occulta (Lour.) Schott – Thiên niên kiện Kadsura coccinea (Lem.) A. C. Smith – Na rừng Morinda umbellata L. – Dây ruột gà Musa coccinea Andr. – Chuối hột Ophiopogon japonicus (L. f.) Ker.-Gawl. – Mạch môn Ophiopogon latifolius Rodr. – Cao cẳng Ophiopogon longifolius Dcne. – Cao cẳng Pandanus tectorius Parkinson – Dứa dại Passiflora foetida L. Lạc tiên Plantago major L. – Mã đề Polygonum multiflorum Thunb. ex Murray – Hà Thủ ô Streptocaulon juventas (Lour.) Merr. – Hà thủ ô Tacca chantrieri Andre – Râu hùm		
Fibrers and handicraft materials	Bambusa blumeana J. A. et J. H. Schult. – Tre Calamus faberi Becc. - Mây Calamus rudentum Lour. -Mây Calamus salicifolius Becc. - Mây Thysanolaena maxima (Roxb.) Kuntze - Đót Licuala spinosa Wurm. – Lá nón		Year around

Religious and spiritual sites:

2.2. Main features of flora and vegetation in Nam Mo 1 HPP basin area

2.2.1. Biodiversity of flora and vegetation in the basin area

What resulted from our study shows that, flora and vegetation in the basin of Nam Mo 1 HPP comprises of at least x0 tracheophyta species, 328 genus, 117 families in 4 botanical phylum namely: *Licopodiophyta*, *Polypodiophyta*, *Pinophyta* and *Magnoliophyta* (see the attached Annex, the botanical list). Biodiversity in taxon component of the said 4 botanical phylum available in the basin controlled by Nam Mo 1 HPP is as in table below:

Table 16: Taxon components of flora and vegetation in Nam Mo 1 HPP project area

Phylum	No. of family	No. of genus	No. of species
Lycopodiophyta Phylum	2	2	2
Polypodiophyta Phylum	7	9	9
Pinophyta Phylum	1	1	1
Magnoliophyta Phylum	107	316	408
- Magnoliopsida Class	87	235	314
- Liliopsida Class	20	69	94
Biodiversity in Nam Mo 1 HPP basin	**117**	**328**	**420**

2.2.2. Rare species in the area

List of rare species in the basin area controlled by Nam Mo 1 HPP and it situation is described and summarized in table 3.3.

Table 17: List of rare species in Nam Mo 1 HPP basin

No.	Scientific name	Vietnamese name	Botanical family	Red Data Book of Vietnam 2007
1	*Drynaria fortunei* (Kuntze ex Mett.) J. Sm.	Cốt toái bổ	Polypodiaceae	EN A1,c,d
2	*Hopea mollissima* C. Y. Hu	Táu mặt quỷ	Dipterocarpaceae	VU A1c,d

As according to Red Data Book of Vietnam – Botanical Section (2007), rare botanical species existing in forest ecologies in basin of Nam Mo 1 HPP comprise of 2 species:

- EN species: Cốt toái bổ - *Drynaria fortunei* (O. Kuntze ex Mett.) J. Smith
- VU species: Táu mặt quỷ - *Hopea mollissima* C. Y. Hu

2.3. Preliminary data on situation and characteristics of flora biodiversity in Nam Mo 1 reservoir area

Presently, the flora biodiversity characteristic in reservoir area is identified basing on what gained from site survey combining with Map classifying forest vegetation types (supplied by Management Board of Protection Forest of Ky Son district), Map covering land area occupied by the project, satellite photos.

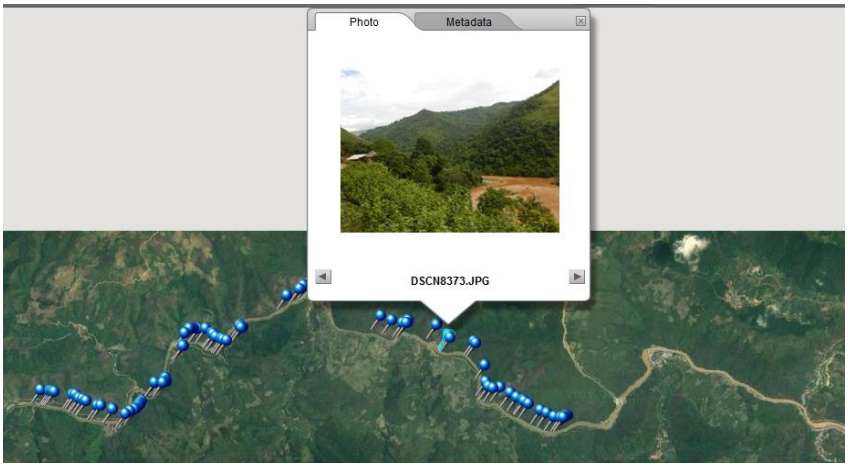


Figure 6: Proposed damsite location of Nam Mo 1 HPP

Results gained from the study show that, vegetation in reservoir area of Nam Mo 1 HPP comprises of almost all vegetation types existed in this catchment area, such as:

2.3.1 The vegetation on rock along the streams

Botanical component in this vegetation type develops along river banks and exposed rock, and is simple in structure. Species in this plant community comprise of species such as Thạch xương bồ - *Acorus gramineus*, Côm hải nam – *Elaeocarpus hainanensis*, Rù rì – *Momonia riparia*, Rù rì bãi – *Ficus subpyriformis*, Gáo nước – *Aidia pilulifera*, Trâm lá hẹp – *Syzygium linneatum*... Growing along river bank are some typical species such as Cơi – *Pterocarya tonkinensis*, Sung – *Ficus* spp. Trâm – *Syzygium* spp... Along smaller streams where humidity is existed are habitats of species of as: Thiên niên kiện – *Homalonema oculta*, Râu hùm – *Tacca chantrieri*, Cao cẳng – *Ophiopogon* spp., Thu hải đường – *Begonia* spp., some species of family Cói - *Cyperaceae*...

2.3.2. Grass land, slash, and burn land area

This is grass land with high or medium grass species as: Cỏ tranh – *Imperata cylindrical*, Sậy – *Phragmites karka*, Lách – *Saccharum spontaneum*, Chít – *Thysanolaena maxima*, Chè vè – *Miscanthus sinensis*... On land areas where soil has been much degraded, normally exist with low grass, poor recovery with main species such as Dị thảo – *Heteropogon conturtus*, Cỏ công viên – *Paspalum conjugatum*, Sả hôi – *Cymbopogon caesius*, Trúc thảo – *Arundinella nepalense*, Cỏ phao – *Themeda triandra*... On lands subject to regular stepping on, exists low grass with predominant species such as Cỏ may – *Chrysopogon aciculatus*, Cỏ gà – *Cynodon dactylon*, Cỏ cát vĩ – *Eulalia monostachya*, Cỏ đuôi voi – *Paspalum conjugatum*... On land area where soil is quite good or bordering with forest ecology is normally grass land with predominant species such as Cỏ cứt lợn – *Ageratum conyzoides*, Cỏ lào – *Eupatorium odoratum*. Growing together with grass species are some timber species, bushes, creeper, jumper which are recently regenerated with species component almost similar to bush vegetation in surrounding.

Slash and burn land area is where local resident cultivates food crops such as rain-fed rice, corn, cassava, etc, some vegetable species and some other economic crops and trees.

Plate 1.v: Grass land after cultivated in Ta Ca commune

2.3.3. Secondary scrub land

The vegetation has quite simple structure. Species of priority tree such as Thừng mức – *Wightia pubescens*, Mã rạng – *Macaranga denticulata*, Ràng ràng – *Ormosia pinnata,* Hu lá hẹp – *Trema angustifolia*, Muối – *Rhus chinensis*, Thàu tau – *Apurosa dioca*, Me rừng – *Phyllanthus embrica* .... Predominant by the scrub layer mixing with herbaceous species, mainly are species of Bồ cu vẽ - *Breynia fruticosa,* Cơm rượu – *Glycomis pentaphylla,* Găng gai – *Randia spinosa,*

Trang – *Ixora coccinea,* Lấu – *Psychotria* spp.*,* Mắt trâu – *Micromelum hirsutum*, Đơn nem – *Maesa* spp.

The shrub layer is species of family Đậu – *Fabaceae*, family Cúc – *Asteraceae*, family Hòa thảo – *Poaceae*, family Cói – *Cyperaceae*... and species of Fern.

Plate 1.vi: Secondary scrub land in Ta Ca commune

2.3.4. Secondary forest on abandoned cultivated land

This vegetation comprises of plant communities with 2-3 timber tree layers. Predominant layer comprises of some timber tree species such as Thừng mức – *Wightia pubescens*, Mã rạng – *Macaranga denticulata*, Ràng ràng – *Ormosia pinnata,* Hu đay – *Tremna orrientalis*, Muối – *Rhus chinensis*, Thàu tau – *Apurosa dioca*, Me rừng – *Phyllanthus embrica,* Dẻ gai – *Castanopsisannamensis*, Lòng mang – *Pterospermumheterophyllum*, Sảng – *Sterculia hymenocalys*, Bời lời – *Litsea* spp., Sung – *Ficus* spp., Hoắc quang – *Wendlandia paniculata*, Ngát - *Gironiera subaequalis*, Lọng bàng - *Dillenia* spp... Scrub layer is mainly species in family Thầu dầu – *Euphorbiaceae*, Cà phê – *Rubiaceae*, Đơn nem – *Myrsinaceae*, Trúc đào – *Apocynaceae*, Mua – *Melastomataceae*... The shrub layer is species of fern, family Gừng – *Zingiberaceae*, Hòa Thảo – *Poaceae*, Cói *Cyperaceae*, Đậu - *Fabaceae*... In this type of vegetation, limb layer with species of creeper in family Khoai lang – *Convolvulaceae* is strongly developed...

2.3.5. Young forest recovered on scrub land:

The upper foliage layer comprises of some species such as Lim vang – *Peltrophorum dasyrrhachis*, Xoan nhừ - *Choerospondias axillaris*, Táu – *Vatica* spp....Foliage layer is species of broadleaf evergreen timber trees, comprising of species such as Dẻ - *Lithocarpus* spp., De núi – *Cinnamomum* spp., Bời lời – *Litsea* spp., Cà đuối – *Cryptocarya* spp., Gội – *Aglaia* spp.... The scrub layer is regenerated trees and scrub species such as Ba chạc – *Euodia lepta*, Lấu – *Psychotria* spp., Ớt rừng – *Tabernaemontana* spp., Gang – *Randia* spp., Trang – *Ixora* spp.,

Thần linh – *Kibatalia* sp., Thừng mức – *Wightia* sp... These are low scrub bushes, growable in shadow but growing slowly. The shrub layer is species in family Hòa thảo – *Poaceae*, family Cói – *Cyperaceae*, Gừng gió – *Ammomum* spp., Riềng gió – *Alpinia* spp., Ráy dại – *Alocasia* sp., Thiên niên kiện – *Homalomena oculta* and species of fern. Especially is appearance of sub-layer plants including species developing on other such as fern, species of Tiêu dại – *Piper* spp. , Má đào – *Aschynanthus* spp.... Species of creeper in family Khoai lang – *Convolvulaceae*, family Đậu – *Fabaceae*, family Tiết dê – *Menispermaceae*... and species of creeping timber or jumper such as those in family Na – *Annonaceae* (Bù dẻ - *Desmos* spp., *Uvaria* spp., *Fissistigma* spp., Tứ thư – *Tetrastigma* spp...

2.3.6. The secondary mixed evergreen rainy forest after exploitation

The dominant layer includes broadleaf trees species. These are species left after selected exploitation. They are timber tree species such as Ngát – *Gironiera subaequalis*, Chẹo – *Engelhardtia roxburghiana*, Vạng Trứng – *Endospermum chinense*, species of Trâm *Syzygium* spp., species of Dẻ - *Lithocarpus* spp., species of Dẻ gai – *Castanopsis* spp., Máu cho – *Knema conferta* Warb, *Horsfieldia* spp., Nhãn rừng – *Dimocarpus fumatus* (Blume) Leenh. The below foliage layer is species of timber trees growing scattering such as Dâu gia đất – *Baccaurea racemosa*, species of Súm – *Eurya* spp., species of Trâm – *Syzygium* spp., species of Bứa – *Garcinia* spp., species of Bời lời – *Litsea* spp., Quế rừng – *Cinnamomum* spp., Sảng – *Sterculia* sp....The scrub layer is species of Chòi mòi *Antidesmabunius*, Ớt rừng – *Tabernaemontana bovina* Lour. , Mua – *Melastoma septemnervium*, species of Khôi – *Ardisia* spp., Bổ béo – *Gomphandra mollis* Merr., Kích nhũ - *Polygala tonkinensis* Chodat, Móc – *Pinnaga* spp. Lá nón – *Licuala* spp. and regenerated young trees. The shrub layer mainly is species of fern, species in family of Gừng – *Zingiberaceae*, family Hòa Thảo – *Poaceae*, family Cói *Cyperaceae*... Limb layer is mainly species of fern, species of creeper in family Đậu – *Fabaceae*, family Khoai lang – *Convolvulaceae*, Song mây – *Calamus* spp....

2.3.7. Dominant bamboo forest

Bamboo forest is a close forest with only one dominant species to be Nứa **-** *Chizostachyum dullooa,* sometimes appearing with some other species but of negligible quantity. The shrub layer is also simple, comprising some species of fern, some species in family Hòa thảo – *Poaceae* or family Cói – *Cyperaceae*.

Comparison on biodiversity of various vegetation types in the studied region with surrounding, see table below:

Table 18: Comparison on biodiversity of various vegetation types in studied area with surrounding area

Studied region / Vegetation	Nam Mo 1 reservoir	Basin area controlled by Nam Mo 1 HPP	Pu Mat National Park
Close evergreen rain forest which is suffered negligible impact at high elevation	NA (*)	NA	Comprises of sub-classification: Close evergreen rain broadleaf forest on low land Close evergreen rain broadleaf-coniferous forest Close evergreen rain coniferous forest Low forest
Evergreen rain forest which is suffered impact at high elevation	NA	NA	Comprises of sub-classification: Secondary evergreen rain broadleaf mixed forest
Evergreen rain forest which is suffered negligible impact at low elevation	NA	NA	Comprises of sub-classification: Evergreen rain forest on upland Evergreen rain forest on limestone
Evergreen rain forest which is suffered strong impact at low elevation	Comprises of sub-classification Mixed evergreen rain broadleaf forest on low land after exploitation Broadleaf – bamboo mixed forest Single predominant bamboo forest Rock sticking vegetation along river and stream	Comprises of sub-classification Mixed evergreen rain broadleaf forest on low land after exploitation Broadleaf – bamboo mixed forest Single predominant bamboo forest Rock sticking vegetation along river and stream	Comprises of sub-classification: Mixed evergreen rain broadleaf forest on low land after exploitation Broadleaf – bamboo mixed forest Single predominant bamboo forest Single predominant Bục bạc forest Vegetation on wet land (swamp and rock sticking along stream)
Evergreen tropical vegetation at low elevation	Comprises of sub-classification:	Comprises of sub-classification:	Comprises of sub-classification:

	Secondary scrub land on uncultivated land for 5-10 years. Secondary forest land on uncultivated land for 10-15 years. Young forest recovered on scrub land.	Secondary scrub land on uncultivated land for 5-10 years. Secondary forest land on uncultivated land for 10-15 years. Young forest recovered on scrub land.	Secondary scrub land on uncultivated land for 5-10 years. Secondary forest land on uncultivated land for 10-15 years. Young forest recovered on scrub land.
Secondary tropical vegetation	Yes	Yes	Yes

(*) NA: Not available

Generally, biodiversity of vegetation in the project area is limited, coinciding with that in Pu Mat National Park in 3 types: evergreen rain forest on low land which suffers strong impact; tropical evergreen vegetation on low land and secondary tropical grass land.

2.3.8. Density of Forest Vegetation

Describe density of forest vegetation in the project area are shown in following table:

Table 19: Density of forest vegetation in reservoir, headwork and auxiliary and area

No.	Vegetation types	Number of species/tree in the area					
		Reservoir		Headwork		Auxiliary	
		species	trees	species	trees	species	trees
		(1)	(2)	(3)	(4)	(5)	(6)
A	**Vegetation layer**	**30**	**577,163**	**7**	**12,439**	**18**	**30,062**
1	Tree (woody)	17	182,692	3	3,359	13	10,139
2	Generation of trees	(*) 02 new /12 total	188,998	(*) 0 new /6 total	4,114	(*) 0 new /4 total	9,591
3	Shrub	8	180,446	2	4,284	4	9,362
4	Herb (non-woody)	3	25,028	2	682	1	970
B	**Density**						
1	No. of tree/ha	184		137		183	

<u>Explaination:</u> example in colume (1): (*) 02 new/12 total: this mean that out of 12 species of generation of tree, there are 02 identified as new species and 10 remaining species identified coincide with the species of tree.

Example: in column 1 total number of species is the reservoir is 17+02+08+03 = 30 species.

Similar for column 3 and 5 the total number of species in Headwork is 3+0+2+2 = 7 species, and 13+0+4+1 = 18 species.

2.4. Summary on Forest Management and Protection

Protection forest

Protection forest management and Protection are specified in Protection Forest Regulation issued together with Decision No. 17/2015/QĐ-TTg dated 09/06/2015 of Prime Minister..

Content: Protection and Management of Forest protection (FP)

The Province sets up a Forest Protection Board including Forest Protection Unit (700ha/1people)

Protecting Protection forest: Protecting forest ecosystem and vegetation; preventing and fighting forest fire; preventing hamful organisms to the protection forest.

Arranging Protection Forest: Protection Forest Management Board (PFMB), people who hired/contracted Protection Forest; Local Forest Protection Division; Commune People Committe support for the forest owner, protect the forest area that not allocated/contracted in the locality.

Protection forest contracting, co-management and benefit-sharing: Protection Forest Management Boards are responsible for organization of forest contracting, implementation of forest co-management with households, individuals, and village communities.

The rate for protecting of protection forest is 200,000VND/ha.

Using protection forest and benefit sharing mechanism: Exploiting forest products; utilizing wood in Protection forest for natural forest; Exploiting wood in planted forest (<20% & <3 ha..); Exproiting forest bamboo and forest products (<30% of reserves); Eco-tourism, scientific research, education; intergrated agro-fishery (for area without forest, planted forest has not yet closed capyno, water surface);

Productive forest

Protective forest protection and management is provided in Productive forest regulation issued together with Decision No. 49/2016/QĐ-TTg dated 01/11/2016 the Pirme Minister.

Content: Protecting and deleloping Productive forest

Productive forest owner has to develop the forest protection plans and organize forest protection by themselves, prevent and fight forest fire; and organize and conduct to contract/hire and protect for households, individuals, local communities or forest cooperatives.

Local Forest Protection Offices and Commune people's Committees coordinate and support for forest development, prevent and fight forest fire according to the National Law. Inspect and supervise the forest owners in implementing the responsibility of forest protection, prevent and fight forest.

Forest owner have to develop sustainable forest management plans under the guidance of the Ministry of Agriculture and Rural Development and submit Department of Agriculture and Rural Development for appraisal and approval and organize in managing, protecting, developing, using forest, inspect and monitoring under plans of sustainable forest management.

Details:

Improvement of productive forest categorized as natural forests in accordance with the approved plan;

Timber exploitation in natural productive forest; timber exploitation in natural productive forests to serve the essential demands on the spot of households, individuals, and village communities

(district-level approval & <10m^3/time); Utilization of timber in natural production forest areas when changing the forest use purpose (with the list of forest products to track/monitor their origins when they are circulated and consumed); utilization of timber when implementing silvicultural measures and scientific research; recovery of timber in natural production forests; exploitation of non-timber forest products in production forests; utilization and recovery of timber in concentrated planted forests; other activities in production forests (forest environmental services, development of non-timber forest products, agricultural and fishery production combined with less than 30% of the area, scientific research and technological application activities, management of other forest categories and land categories in productive forests (protection forests, agricultural land…);

2.5. Vegetation map of My Ly HPP

Remote sensing and GIS methods was used to establish vegetation map of My Ly HPP. The data used for the study included:

VNRedSAT satellite image 2014 with 2.5m resolution.

Topo map 1/10.000, VN2000 coordinates system.

GPS photos (taken during field surveys at My Ly HPP area).

Other reference data.

Satellite imagery needs to be pre-processed and geometric correction based on topo map and cut off boundaries of the study area. The information on the image is extracted using supervised classification method (Maximum likelihood), combined with visual interpretation to correct and add information layers. This is the process of separating the qualitative and quantitative information from the image by direct signals (image signals) and indirect signals (non-image signals and indicators) such as size; shape; shadow; lightness; color; structure; relevance ... create layers of thematic information from satellite imagery. To assist in the sorting and verification of results, we used field survey data and other reference materials for comparison.

Finally, the images are classified and vectorized to construct thematic maps on GIS software. From this result we can actually print or build derivative products, extract data for computing, statistics area for each object.

Vegetation map is shown following figure:

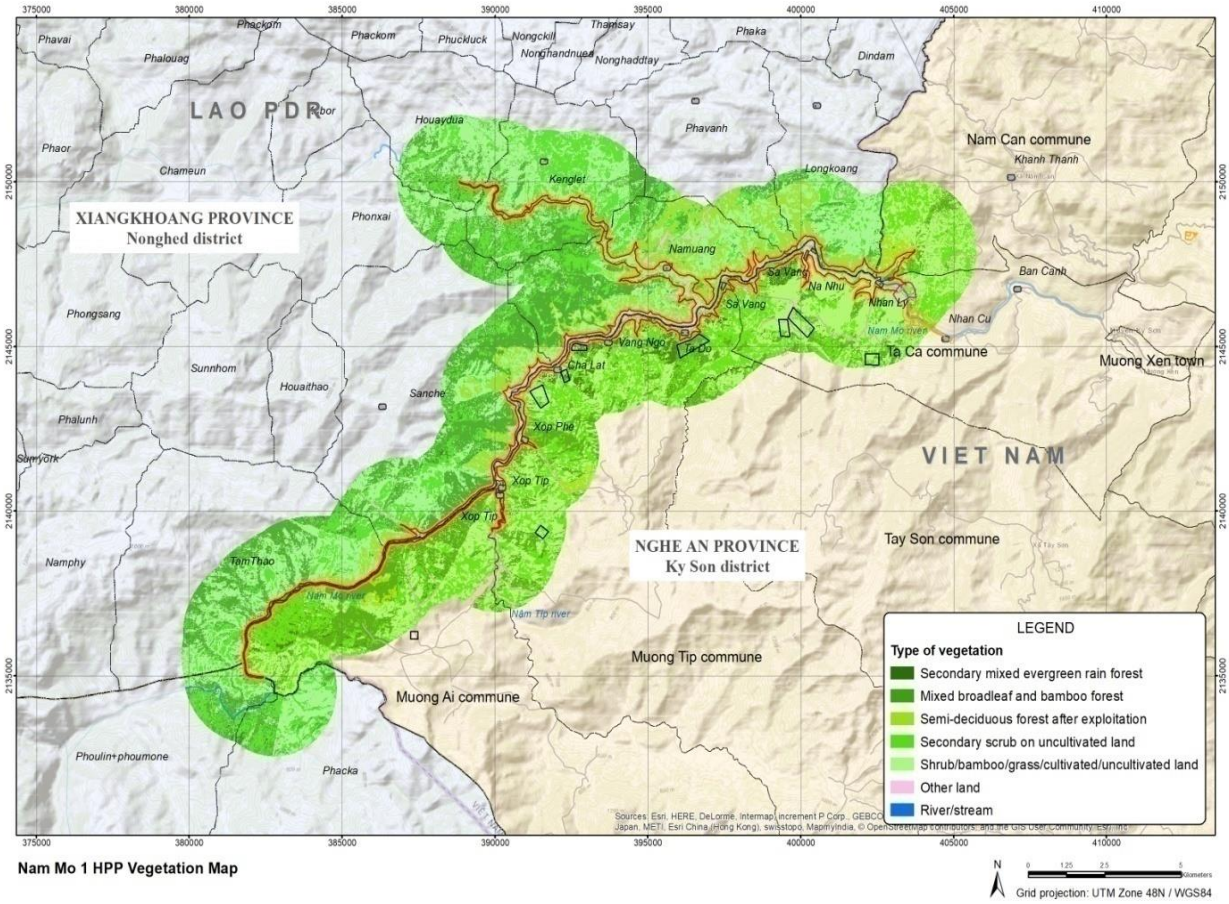


Figure 7: Vegetation map of Nam Mo 1HPP

Figure 7 is vegetation map consisting of the following main objects:

I. Secondary mixed evergreen rain forest
II. Mixed broadleaf and bamboo forest
III. Semi-deciduous forest after exploitation
IV. Secondary scrub on uncultivated land
V. Grass/shrub/bamboo/cultivated/uncultivated land
VI. Other lands
VII. River/stream

2.6. Estimation of submerged biomass due to construction of Nam Mo 1 HPP

The area of 5 vegetation types was calculated based on the vegetation map.

Biomass calculation was based on Do Huu Thu (2015), Pham Tuan Anh (2007), Tran Binh Da (2012), Vu Tan Phuong et al. (2012), and *Nguyen Thanh Tien (2012)*

The results of vegetation area and biomass are shown in the table follows:

Table 20: Area of vegetation type (ha)/Total dry biomass of both ground and underground (roots) of vegetation type (Ton)

No	Occupied area	Total area (ha)	Occupied area of each vegetation type (ha)/ total dry biomass (08 vegetation types according to Vegetation map)						
			I	II	III	IV	V	VI	VII
A	**Permannent area**								
1	**Submerged area**	**962.07**	98.2/5,892	128.5/3,849	152.0/7,600	159.5/1,910.5	226.4/1,131.5	110.2	87.2
2	**Buffer area**	**559.15**	68.2/4,092	126.7/3,801	100.5/5,025	108.4/1,300,8	140.3/701.5	13.3	1.7
3	**Head work**	**24.20**	0.0	4.8/144	2.7/135	1.1/13,2	12.7/63.5	0.7	2.2
B	**Temtorary area**	**55.27**							
1	Auxiliary area No.1	16.67	0.0	2.1/63	0	8.67/104.04	2.6/13	1.4	1.9
2	Auxiliary area No.2	8.08	0.4/24	4.4/132	0	1.2/14.4	1.6/8	0	0.5
3	Disposal No.2, construction road	*29.97*	0	4.1/123	0	8.05/96.6	16.04/80.2	1.78	0
4	Other auxiliary area	0.55							
C	**Quarry**	**6.50**							
	Items No.1 and No.2	1.75	0	0	0	1.75/21	0	0	0

Notes:

- ***I. Secondary mixed evergreen rain forest after exploitation:*** *Total dry biomass of both ground and underground (root) was60 tons/1ha*
- ***II. Mixed broadleaf and bamboo forest:*** *Total dry biomass of both ground and underground (root) was 30 tons/1ha*
- ***III. Semi-deciduous forest after exploitation:*** *Total dry biomass of both ground and underground (root) was 50 tons/1ha*
- ***IV. Secondary scrub on uncultivated land:*** *Total dry biomass of both ground and underground (root) was 12 tons/1ha*
- ***V. Grass/shrub/bamboo/cultivated/uncultivated land):*** *Total dry biomass of both ground and underground (root) was 5 tons/1ha.*
- ***VI. Other lands***
- ***VII. River/stream***

On the numerator is area (ha), the denominator is total biomass of both the ground and underground (roots) of whole vegetion types (tons)

2.6. Fauna

In addition, the project area has recorded total x9fauna species of 11 families, 22 orders, 6 classes in area of Ta Ca, Muong Ai, Muong Tip and Nam Can communes, Ky Son district, Nghe An province, including 31 mammal species, 96 bird species, 22 reptile species, 19 amphibian species and 171 insect species, 80 fish species.

Table 21: Composition of mammals, bird, reptile, amphibian and insect in Nam Mo 1 HPP basin

No.	Wildlife	No. of order	No. of family	No. of species	
				2012	2017
1	Mammal	7	16	29	30
2	Bird	14	43	96	96
3	Reptile	2	11	22	22
4	Amphibian	1	6	19	19
5	Insect	2	14	171	171
6	Fish	7	21	74	74
	Total	**33**	**111**	**411**	**412**

Source for 2012: Environmental Impact Assessment report, Nam Mo1 HPP, 2012, PECI.

2.6.1. Mammal

Biodiversity of wildlife in the region is low. There have been listed with 31 species (9.6% total number of known species in Vietnam), belonging to 16 families, 7 orders. Results in 2012 recorded 29 species and in 2016 was 30 species. Small size animal species is dominant and is mainly distributed in forest, slash and burn area and population area.

According to statistical data, *Rodentia* has the most species with 13 species, 3 families; then to the *Carnivora* and *Chiroptera* with 6 species, orders having 1 species and 1 family are *Insectivora* and *Scandenta*.

Table 22: Mammal species in Nam Mo 1 HPP basin

No.	Vietnamese name	Scientific name	No. of family	No. of species
1	Bộ ăn sâu bọ	Insectivora	1	1
2	Bộ nhiều rang	Scandenta	1	1
3	Bộ dơi	Chiroptera	3	6
4	Bộ linh trưởng	Primates	2	2
5	Bộ ăn thịt	Carnivora	4	6
6	Bộ móng guốc ngón chẵn	Artiodactyla	2	2
7	Bộ gặm nhấm	Rodentia	3	13
	Total		**16**	**31**

Table for all the catergories showing the 10-15 most commonly seen species.

Table 23: Catergories showing the 10-15 most commonly seen species

No.	Vietnamese name/ Local language names	Scientific name
1	Chuột chù cộc	Anourosorex squamipes
2	Chuột chù	Suncus murinus
3	Dơi mũi quạ	Hipposideros armiger
4	Dơi mũi xinh	Hipposideros pomona
5	Dơi mũi xám	Hipposideros larvatus
6	Dơi lá mũi	Rhinolophus pusillus
7	Dơi ống tai tròn	Murina cyclotis
8	Dơi muỗi nâu	Pipistrellus coromandra
9	Chuột đất lớn	Bandicota indica
10	Chuột đất bé	Bandicota savilei
11	Chuột nhà	Rattus flavipectus
12	Chuột cống	Rattus norvegicus

Site surveys and studies show in the proposed project damsite area mostly are small animal, widely distributed species such as mice, bat... It shall be noted that the number of individuals of most mammals species have been seriously impaired due to overexploitation and habitat destruction.

2.6.2. Bird

A total of 96 bird species recorded in the area belonging to 43 families, 14 orders. There are about 57 species identified through visual or listening to singing. The remaining species were identified based on body parts such as skin, hair, mine kept in the locals and by interviewing.

Generally, bird in this area is poor in biodiversity, taking 9.22% of total number of bird species in Vietnam.

Orders having predominant species are: *Passeriformes* has 26 families 73 species; *Coraciiformes*, *Gruiformes*, *Charadriiformes* have 2 families 3 species.

Table 24: Bird species in Nam Mo 1 HPP basin

No.	Vietnamese name	Scientific name	No. of family	No. of species	
				2012	2017
1	Bộ hạc	Ciconiiformes	1	2	2
2	Bộ Cắt	Falconiformes	2	2	2
3	Bộ Gà	Galliformes	1	1	1
4	Bộ Sếu	Gruiformes	2	3	2

5	Bộ Rẽ	Charadriiformes	2	3	3
6	Bộ Bồ câu	Columbiformes	1	2	2
7	Bộ vẹt	Psittaciformes	1	1	1
8	Bộ Cu cu	Cuculiformes	1	2	2
9	Bộ Cú	Strigiformes	1	1	1
10	Bộ Cú muỗi	Caprimulgiform	1	1	1
11	Bộ Nuốc	Trogoniformes	1	1	1
12	Bộ Sả	Coraciiformes	2	3	3
13	Bộ Gõ kiến	Piciformes	1	1	1
14	Bộ Sẻ	Passeriformes	26	71	73
	Total		**43**	**94**	**95**

Source for 2012: Environmental Impact Assessment report, Nam Mo1 HPP, 2012, PECI.

2.6.3. Reptile

Biodiversity of reptile species is moderate. It has been determined 22 reptile species belong to 11 families, 2 orders. The *Lacertilia* has 10 families with 21 species and *Testudines* has 1 family, 1 species. Reptile species distribute mainly in area of evergreen forest along rivers and streams.

Table 25: Reptile species in Nam Mo 1 HPP basin

No.	Vietnamese name	Scientific name	No. of family	No. of species	
				2012	2017
1.	Bộ có vảy	Lacertilia	10	20	21
2.	Bộ rùa	Testudinata	1	1	1
	Total		**11**	**21**	**22**

Source for 2012: Environmental Impact Assessment report, Nam Mo1 HPP, 2012, PECI.

2.6.4. Amphibian

The number of amphibian species is of low level. The site survey in 2012 identified 17 amphibian species and survey in 2016 identified 18 species. Generally, it has identified 19 amphibian species of 6 families belonging to *Anura* order. Families such as *Ranidae* have 6 species, *Microhylidae* and *Dicroglossidae* have 4 species, *Bufonidae* and *Megophryidae* have 2 species, and *Rhacophoridae* has 1 species. Amphibian species distributes in forest area along streams which are flowing to Nam Mo river and in population areas.

Table 26: Amphibian species in Nam Mo 1 HPP basin

No.	Vietnamese name	Scientific name	No. of species	No. of species	
				2012	2017
1	Bộ không đuôi	Anura			
2	Họ Cóc	Bufonidae	2	2	2
3	Họ Cóc bùn	Megophryidae	2	2	2
4	Họ Nhái bầu	Microhylidae	4	4	3

5	Họ Ếch nhái chính thức	Dicroglossidae	4	4	4
6	Họ Ếch nhái	Ranidae	6	4	6
7	Họ Ếch cây	Rhacophoridae	1	1	1
	Total		**19**	**17**	**18**

Source for 2012: Environmental Impact Assessment report, Nam Mo1 HPP, 2012, PECI.

2.6.5. Insect

It has preliminarily determined 171 insect species belonging to 14 families, 2 orders. They are: *Coleoptera* and *Lepidoptera*.

Table 27: Insect species in Nam Mo 1 HPP basin

No.	Vietnamese name	Scientific name	No. of family	No. of species	
				2012	2016
1	Bộ Cánh cứng	Coleoptera	1	1	1
2	Bộ Cánh vảy	Lepidoptera	13	170	166
	Total		**14**	**171**	**167**

Source for 2012: Environmental Impact Assessment report, Nam Mo1 HPP, 2012, PECI.

2.6.6. Fish

Diversity. The number of fish in water bodies in the region are quite diversity, distinctly distribution in the two types of water bodies as rivers and streams. Through the survey and interview process at Nam Mo1 River, 80 species of fish have been recorded: In 2012 by means of site survey and interview identified 71 species, in 2016 it was 74 fish species belonging to 21 families, 7 orders. And in March 2017, identify 68 fish species. This is common species composition of both two site surveys. In which, the Cypriniformes order has 2 families xspecies, Perciformes has 7 families 17 species, and Siluriformes has 5 families 14 species. Compares to fish species component in My Ly hydropower project, the fish pattern in Nam Mo 1 HPP is better in biodiversity. Rivers, streams and watershed in Nam Mo 1 are larger in size. Fish in this region is characterized as that in middle area which is close to delta area so stream fish species is less while those adopting with wide watershed and rapid flow environment are strongly developed. There is a great difference between fish species component between main river course basin and that of smaller streams. In main river basin, there are 52 fish species recorded, while in smaller streams in surround, there are only 31 species. There are 9 fish species distributing in both main river basin and smaller tributaries.

Fisheries. Interviewing fishermen in project area shows that the species exploited mainly are carp *Cyprinus rubrofuscua*, crucian *Carassius auratus*, hemicultur *Hemiculter leucisculus*, zebra tilapia *Oreochromis niloticus*, black tilapia *Oreochromis mosambicus*rô phi đen, eel *Monopterus albus*, snake-head mullet, goby *Spinibarbus denticulatus*, huss*Glyptothorax quadriocellatus* and some other small fish species with not high economic value. Caught fish uses for personal and family only. Fishing productivity is low, varying between some of 0.5-2 kg/capita/day. Villagers take day off to go fishing in small streams for their own demand on daily meal. Means and tools are simple and manual. Mostly are handy net or hand. Sometime local resident stop the flow on stream, dewatering and fishing. Some villagers use poison leave in a stream section for fishing.

Some pitures of fish types

On main river course, some fishermen also perform fishing and other aquatic species such as crab, shrimp, etc. Tools are mainly fishing net, and other simple tools. Fishing yield on river is higher than on streams and component of fishes caught is more diversify. Sometime fishermen still catch some big size fish of high value such as *Anguilla mamorata*, *Bagarius rutilus*, *Hemibagrus guttatus*, etc…Generally, fishing yield in this region is low and there is no more residents living regularly on fishing.

Aquaculturally, in area of Nam Mo 1 HPP, fishing farm area is not many, mainly are small ponds or pens lying areas to keep water, not high yield. Generally speaking, fishery in this area is un-developed and for self demand only. Local resident in villages along river, stream has not yet in custom and fish farming. It could be because present water level is low, unstable; water surface area is limited causing un-development to aquaculture activities.

Table 28: Fish orders and number of familes and species in studies of the in the Ca river stretch of the planned Nam Mo1 HPP

No.	Vietnamese name	Scientific name	No. of family	No. of species		
				2012	2016	2017
1	Bộ cá Chép Mỡ	Characiformes	2	2	2	2
2	Bộ Cá Chép	Cypriniformes	3	x	38	40
3	Bộ Cá Sóc	Beloniformes	1	1	1	1

4	Bộ Cá Nheo	Siluriformes	5	12	13	12
5	Bộ Cá Vược	Perciformes	7	17	17	11
6	Bộ cá Chình	Anguilliformes	1	1	1	0
7	Bộ Mang liền	Synbranchiformes	2	2	2	3
	Total		**21**	**71**	**74**	**68**

Source for 2012: Environmental Impact Assessment report, Nam Mo1 HPP, 2012, PECI.
Source for 2016: Scoping report, Nam Mo1 HPP, 2016, PECC1.

Table 29: The most fish common species caught in Nam Mo river and stream

No.	Vietnamese name / local name also	Scientific name	Nam Mo river	stream
1	Cá thè be sông lam	*Acheilognathus lamensis* (Nguyen, 1983)	++	+
2	Cá mát	*Onychostoma lepturus*	++	
3	Cá đong chấm	*Puntius ocellatus* (Mai,1978)	++	+
4	Cá Đòng đong cân cấn	*Puntius semifasciolatus* Gunther, 1868	++	+
5	Cá Thiểu	*Culter erythropterus* Basilewsky, 1855	++	
6	Cá Rô phi thường	*Oreochromis mosambicus* Peters, 1852	+++	+
7	Cá Rô phi vằn	*Oreochromis niloticus* Linnaeus, 1758	++	+
8	Cá Mương nổi	*Hemiculter leucisculus* Basilewsky, 1855	++	
9	Cá mại khe lào	*Danio laoensis* (Pellegrin & Fang, 1940)	+	+
10	Lươn	*Monopterus albus* Zuiew, 1793	+	+

Notes:

(+): less common; (++): common; (+++) met a lot
Source for 2012: Environmental Impact Assessment report, Nam Mo1 HPP, 2012, PECI.

Source for 2016: Scoping report, Nam Mo1 HPP, 2016, PECC1.

Rare fish species of high economic value are shown in following table:

Table 30: The most fish species of high economicvalue in Nam Mo river

No.	Vietnamese name/local name	Scientific name
1	Cá lệch, cá chình hoa	*Anguilla marmorata* Quoy & Gaimard, 1824
2	Cá bỗng	*Spinibarbus denticulatus* (Oshima, 1926)
3	Cá Chép	*Cyprinus rubrofuscua* Lacepede, 1803
4	Cá mát	*Onychostoma lepturus*
5	Cá Lăng	*Hemibagrus guttatus* Lacepede, 1803
6	Cá Ngạnh	*Cranoglanis henrici* Vaillant, 1893
7	Cá Chiên, cá ghé	*Bagarius rutilus* Ng.& Kottelat, 2000
8	Cá Quả	*Channa striata* Bloch, 1793

According to the survey results, it has found that, in the studied basin there are 5 rare fish species listed in Vietnam Red Data Book (2007) as Vulnerable VU, including: *Anguilla mamorata*,

Bagana lemassoni, *Acrossocheilus annamensis*, *Hemibagrus guttatus*, *Bagarius rutilus*. These fishes are large in size, of high economic value.They are over-hunted, fishing, and increasingly decreased in numbers, under great threat. Compares to My Ly HPP basin, this region is distributed with *Bagana lemassoni* fish which prefers clean, rich in nutrient watershed and is under overexploited and more and more reduced in quantity.

Fish species distribute in river, stream in the catchment

Site survey shows 57 species of fish living in main river course, 34 species living in tributaries, of which 9 species distribute both in river and stream such as zebra tilapia, black tilapia, *Misgurnus anguillicaudatus* Cantor, anabas, eel, etc... Species living in streams are normally small fish species, preferring rapid water and high oxygen content. Typical stream fish species are those such as *Schistura*, *Rhinogobius, Oparichthys biden, Channa assiatica*particularly zebra tilapia *Oreochromis niloticus*. They distribute, grow and adapt strongly in such small streams. At the time of site survey, there was lots of young tilapia, in group, seen finding food in static water in streams. Parent tilapia is big, strong, hardly to catch even with net and electric shock. The benefit source from zebra tilapia *Oreochromis niloticus* has raised and improved the meal of local resident. In our opinion, those zebra tilapia has developed, predominant over other local fish species and caused reduction to biodiversity but it somehow plays an important role in supplying aquatic benefit to local resident.

In short, after formation of Nam Mo 1 reservoir, aquatic species structure and composition will change both in quantity and in quality, reflecting typical characteristics of aquatic communities in reservoir. Distribution in composition and density of phytoplankton shows differences between upstream and downstream areas of reservoir, between surface and bed layers. In first years after impoundment, density of aquatic biomass in general and phytoplankton in particular will develop strongly. It can forecast that after the reservoir in upstream is formed, there will be great possibility that reservoir in downstream will be richer in nutrient with higher density, biomass of aquatic comparing to upstream cascade. The formation of reservoir will be great and favorable conditions for fishery to develop on reservoir.

Table 31: List of fish species in Nam Mo river, stream (Vietnam, Lao and IUCN) of Nam Mo1 HPP area

No.	Vietnamese name	Scientific name	Nam Mo river	stream	IUCN
	I. BỘ CÁ CHÌNH	**ANGUILLIFORMES**			
	1.Họ cá Chình	**Anguillidae**			
1	Cá lệch, cá Chình hoa	*Anguilla marmorata* Quoy & Gaimard, 1824	+		VU
	II. BỘ CÁ CHÉP MỠ	**CHARACIFORMES**			
	2. Họ cá Chép mỡ	***Characidae***			
2	Cá Chim trắng	*Cossoma brachypomum* (Cuvier, 1818)	++		
	3. Họ cá Vũn	**Prochilodontidae**			
3	Cá Vền nam mỹ	*Prochilodus argenteus* Spix & Agassiz, 1829	+		
	III. BỘ CÁ SÓC	**BELONIFORMES**			
	4. Họ cá Sóc	**Adrianichthyidae**			

4	Cá Sóc	*Oryzias latipes*(Tem. & Schl. 1846)	+		
	IV. BỘ CÁ CHÉP	**CYPRINIFORMES**			
	5. Họ cá Chép	**Cyprinidae**			
5	Cá mại khe lào	*Danio laoensis* (Pellegrin & Fang, 1940)	**+**		
6	Cá giao sơn	*Yaoshanicus kyphus* (Mai, 1978)		+	
7	Cá bỗng	*Spinibarbus denticulatus* (Oshima, 1926)	+		
8	Cá ngũ vân	*Puntius partipentazona (*Fowler, 1934)		+	
9	Cá thè be sông lam	*Acheilognathus lamensis* (Nguyen, 1983)	++	+	
10	Cá chát sông lam	*Acrossocheilus lamus* (Mai, 1978)	+		
11	Cá trốc	*Acrossocheilus annamensis* (Pellegrin & Chevey, 1936)	+		VU
12	Cá bậu, cá sứt môi	*Garra poilanei*	++	+	
13	Cá Chép	*Cyprinus rubrofuscua* Lacepede, 1803	+		
14	Cá Diếc	*Carassius auratus* Linnaeus, 1758	+		
15	Cá Rưng	*Carassioides acuminatus* Richardson, 1846	+		
16	Cá mát	*Onychostoma leptura*	++		
17	Cá Dầm đất	*Osteochilus salsburyi* Nichol & Pope, 1927		+	
18	Cá Trôi	*Cirrhinus molitorella* Valenciennes,1844	+		
19	Cá Cầy	*Paraspinibarbus macracanthus* Pellegrin & Chevey, 1936	+		
20	Cá Đòng đong cân cấn	*Puntius semifasciolatus* Gunther, 1868	+	+	
21	Cá đong chấm	*Puntius ocellatus* (Mai,1978)	++		
22	Cá Cháo	*Opsarichthys bidens* Gunther, 1873		+	
23	Cá Mại	*Metzialineata* Pellegrin, 1907	+		
24	Cá Thiểu	*Culter erythropterus* Basilewsky, 1855	++		
25	Cá Ngão gù	*Culter flavipinnis* Tirant, 1883	+		
26	Cá Thiểu mắt to	*Ancherythroculter daovantieni* Banarescu, 1967,	+		
27	Cá Mương nổi	*Hemiculter leucisculus* Basilewsky, 1855	++		
28	Cá Vền	*Megalobrama terminalis* Richardson, 1946	+		
29	Cá Dầm xanh	*Bagana lemassoni*Pellegrin & Chevey	+		VU
30	Cá Chày mắt đỏ	*Squaliobarbus curriculus* Richardson, 1846	+		

31	Cá Mè trắng trung quốc	*Hypophthalmichthys molitrix* Valenciennes, 1844	+		
32	Cá Trắm đen	*Mylopharyngodon piceus* Richardson, 1846	+		
33	Cá Thè be	*Acheilognathus tonkinensis* Vaillant, 1892	+		
34	Cá Đục đanh	*Saurogobio immaculatus* Koller, 1927	+		
35	Cá Đục ngộ	*Hemibarbus medius* Yue	+		
36	Cá Mè hoa	*Aristichthys nobilis* Richardson, 1844	+		
37	Cá Trắm cỏ	*Ctenopharyngodon idella* Valenciennes, 1842	+		
38	Cá Rô hu	*Labeo rohita* Hamilton, 1822	+		
39	Cá Mrigan	*Cirrhinus mrigala* Hamilton, 1822	+		
	6. Họ cá Chạch	**Cobitidae**			
40	Cá chạch bùn núi	*Misgurnus tonkinensis* Rendahl,1937		+	
41	Cá Chạch bùn	*Misgurnus anguillicaudatus* Cantor, 1842	+	+	
	7.Họ cá Chạch suối	**Namacheilidae**			
42	Cá chạch đá đuôi bằng	*Schistura orthocauda* (Mai, 1978)		++	
43	Cá chạch đá nâu	*Schistura incerta* Nichols, 1931		+	
44	Cá chạch đá sọc	*Schistura fasciolata (*Nichols & Pope, 1927)		+	
	8. Họ cá bám đá	**Balitoridae**			
45	Cá Bám đá khuyết	*Beaufortia leveretti* Nichol & Pope, 1927	+		
46	Cá vây bằng vảy lan can	*Balitora lancangjiangensis* (Zheng, 1980)	+		
	V. BỘ CÁ NHEO	**SILURIFORMES**			
	9. Họ cá nheo	**Siluridae**			
47	Cá Thèo	*Pteorocypris conchinchinensis* (Valenciennes, 18x)		+	
48	Cá Nheo	*Silurus asotus* Linnaeus, 1758	++		
	10. Họ cá lăng	**Bagridae**			
49	Cá Bò	*Pelteobagrus fulvidraco* Richardson, 1846	+		
50	Cá Lăng	*Hemibagrus guttatus* Lacepede, 1803	+		VU
51	Cá Mịt	*Pseudobagrus virgatus* Oshima, 1926	+	+	
52	Cá Mầm	*Pseudobagrus vachellii* Richardson, 1846	+		

	11. Họ cá ngạnh	**Cranogranidae**			
53	Cá Ngạnh	*Cranoglanis henrici* Vaillant, 1893	++		
	12. Họ cá trê	**Claridae**			
54	Cá Trê	*Clarius fuscus* Lacepede, 1803	+		
55	Cá Trê phi	*Clarias gariepinus* Burchell, 188	+		
	13. Họ cá chiên	**Sisoridae**			
56	Cá Chiên, cá ghé	*Bagarius rutilus* Ng.& Kottelat, 2000	+		VU
57	Cá chiên suối	*Glyptothorax lampris* Fowler, 1934		+	
58	Cá chiên suối	*Glyptothorax quadriocellatus* (Mai, 1978)		+	
59	Cá chiên suối	*Glyptothorax hainanensis* Nichols & Pope, 1927		+	
60	Cá chiên bẹt	*Pareuchiloglanis nebulifer*	**+**	+	
	VI. Bộ MANG LIỀN	**SYNBRANCHIFORMES**			
	14. Họ lươn	**Monopteridae**			
61	Lươn	*Monopterus albus* Zuiew, 1793	+	+	
	15. Họ cá chạch sông	**Mastacembelidae**			
62	Cá Chạch sông	*Mastacembelus armatus* Lacepede, 1800	++		
63	Cá Chạch	*Sinobdella sinensis*		**+**	
	VII. BỘ CÁ VƯỢC	**PERCIFORMES**			
	16. Họ cá rô	**Anabantidae**			
64	Cá Rô	*Anabas testudineus* Bloch, 1792	+	+	
	17. Họ cá rô mo				
65	Cá rô mo	*Siniperca chuatsi*(Basilewki, 1855)		+	
66	Cá rô mo việt nam	*Siniperca vietnamensis*(Mai, 1978)		+	
	18. Họ cá tai tượng	**Osphronemidae**			
67	Cá Đuôi cờ	*Macropodus opercularis* Linneaus, 1758		+	
68	Cá Sặc bướm	*Trichogaster trichopterus* Pallas, 1770		+	
	19.Họ cá bống trắng	**Gobiidae**			
69	Cá Bống trắng	*Glossogobius giuris* Hamilton, 1822	+		

70	Cá Bống suối	*Rhinogobius duospilus* Herre, 1935		+	
71	Cá Bống đá	*Rhinogobius giurinus* Rutter, 1897		+	
	20. Họ cá bống đen	**Eleotridae**			
72	Cá bống đen tối	*Eleotris fusca (*Forster, 1801)	+		
73	Cá bống đen nhỏ	*Eleotris oxycephala*(Tem. & Schl., 1845)		+	
74	Cá bống đen lớn	*Eleotris melanosoma*Bleeker, 1853		+	
	21. Họ cá rô phi	**Cichlidae**			
75	Cá Rô phi thường	*Oreochromis mosambicus* Peters, 1852	++	+	
76	Cá Rô phi vằn	*Oreochromis niloticus* Linnaeus, 1758	+	+	
	22. Họ cá quả	**Channidae**			
77	Cá Quả	*Channa striata* Bloch, 1793	+		
78	Cá chuối	*Channa maculata* Lacepede, 1801	+		
79	Cá trèo đồi	*Channa asiatica* (Linnaeus, 1758)		+	
80	Cá chuối suối	*Channa gachua* (Hamilton, 1822)		+	
	Total		**57**	**34**	**5**

Notes:

(+): less common; (++): common; (+++) met a lot

2.6.7. *Phytoplankton*

Results gained from analyzing phytoplankton samples taken during site survey have identified x species belonging to 4 algae phylum.They are silica algae*Bacillariophyta*; blue algae *Cyanophyta*; green algae *Chlorophyta* and eye algae*Euglenophyta*. Species composition as said is lower than the river waters forms. This could possibly due to number of samples taken which is not many and therefore not yet reflecting all number of actual species existing in this area. However, the results from investigation have assessed somehow biodiversity of phytoplankton in the region. Among its composition, the silica algae *Bacillariophyta* is dominated with 22 species accounted for 50.0 % and 14 species of green algae *Chlorophyta* 31.8%; 5 species of blue algae *Cyanophyta* (11.4%) and eye algae *Euglenophyta* 3 species, accounting for 6.8%. Appearance of many species in genus of *Navicula*, *Nitzschia*, *Diatoma* (silica algae *Bacillariophyta*), *Oscillatoria* (blue algae *Cyanophyta*) and *Spirogyra* (green algae *Chlorophyta*) has shown predominant in species composition belongs to algae groups preferring rapid water in mountainous watershed where organic contamination is still less. These are species preferring clean water, normally occur in natural rivers, streams, lakes in mountainous area. There are differences in quantity of species at various investigated locations but not much. Results gained from the study in 2012 identified x species with 14-23 species/location and that from study in 2016 identified 43 species with 15-22 species/location.

Results gained from quantitative analysis of phytoplankton from two site surveys are listed in table 3.13. It shows a low density of phytoplankton, in 2012 it was between 2.68×10^{6} and

8.45×10^6cell/m^3 at surveyed location on Nam Mo river and in 2016 it was between 2.97×10^6 and 8.34×10^6cell/m^3. Within the composition, species predominant in density are silica algae *Bacillariophyta*, while group of green algae *Chlorophyta*and blue algae *Cyanophyta*has low density, the eye algae *Euglenophyta* group is normally of low density and does not appear in quantitative sample. The results prove that, during investigation time which was in rainy season, the water flows rapidly, has somehow limited the development in quantity of phytoplankton group.

Table 32: Density of phytoplankton at investigated location on Nam Mo1 river

In 09/2012

Investigation location	No. of species	Density of phytoplankton (10^6cell/m^3)				
		Total	Bacillariophyta	Cyanophyta	Chlorophyta	Euglenophyta
NM1	21	6.15	4.32	0.24	1.54	0.1
NM2	23	8.45	4.17	1.90	2.38	0.0
NM3	17	6.14	3.15	1.14	1.85	0.0
NM4	18	3.36	1.82	0.00	1.54	0.0
NM5	15	5.27	2.54	1.92	0.81	0.0
NM6	17	2.68	1.10	0.95	0.63	0.0
NM7	14	2.72	1.18	1.02	0.52	0.0
NM8	15	2.75	1.16	0.98	0.61	0.0
Average	17	4.69	2.43	1.02	1.24	0.01

In 07/2016

Investigation location	No. of species	Density of phytoplankton (10^6cell/m^3)				
		Total	Bacillariophyta	Cyanophyta	Chlorophyta	Euglenophyta
NM1	20	5.93	4.25	0.22	1.46	0
NM2	22	8.34	4.21	1.85	2.28	0
NM3	18	6.88	3.78	1.17	1.93	0
NM4	18	4.21	2.05	0.47	1.59	0.1
NM5	16	5.57	2.69	1.84	1.04	0
NM6	15	2.97	1.26	1.13	0.58	0
NM7	17	3.1	1.34	1.21	0.55	0
NM8	16	3.6	1.29	1.19	1.12	0
Average	18	5.07	2.61	1.14	1.32	0.01

In 03/2017

Investigation location	No. of species	Density of phytoplankton (10^6cell /m^3)				
		Total	Bacillariophyta	Cyanophyta	Chlorophyta	Euglenophyta
NM1	21	7.35	4.62	1.34	1.39	0
NM2	20	8.46	4.81	1.67	1.98	0
NM3	19	7.98	4.05	1.82	2.11	0

NM4	20	6.29	3.16	1.38	1.65	0.1
NM5	18	6.51	3.35	1.91	1.16	0
NM6	17	5.23	2.65	1.43	1.05	0.1
NM7	19	6.41	3.08	1.62	1.71	0
NM8	18	5.74	2.92	1.57	1.25	0
Average	19	6.75	3.58	1.59	1.54	0.03

Source for 2012: Environmental Impact Assessment report, Nam Mo1 HPP, 2012, PECI.
Source for 2016: Scoping report, Nam Mo1 HPP, 2016, PECC1.

2.6.8. Zooplankton

Results gained from analyzing samples taken from site survey 2012 have helped identifying 44 species, quantity of species indentified at locations varied between 10-15 species/location while results gained from analyzing samples taken from site survey 2016 have helped identifying x species and quantity of species indentified at locations varied between 11-15 species/location. The surveyed area has been identified with x zooplankton species of *Copepoda* (11 species, taking 31.4%), *Cladocera* (17 species; 48.6%), *Rotatoria* (6 species; 17.1%), *Ostracoda* (1 species, 2.8%) (table 2-Appendixes). Identified species are common species, widely distributed and typically for flowing water environment where nutrient content is low. Popular species in such type of water bodies include *Diplois daviesiae* (Rotatoria), *Macrothrix* spp.(Cladocera), *Biapertura, Paracyclops, Paracyclops fimbriatus, Ectocyclops phaleratus* (Copepoda)...

Table 33: Lists of species of Phylum

No.	Phylum	No. of species		Rate (%)
		2012	**2016**	
1	Copepoda	11	11	31.4
2	Cladocera	16	17	48.6
3	Rotatoria	5	6	17.1
4	Ostracoda	1	1	2.8
	Total	***33***	***35***	***100***

Source for 2012: Environmental Impact Assessment report, Nam Mo1 HPP, 2012, PECI.
Source for 2016: Scoping report, Nam Mo1 HPP, 2016, PECC1.

Density of zooplankton in investigated locations on Nam Mo river is low, varying between 178-523 individual/m^3 (resulted gained in 2012 site survey) and between 224 – 530 individual/m^3 (resulted gained in 2016 site survey). Composition of predominant species, density of dominant species in communities is not clearly shown. Some species adapting to flowing water environment appear mainly in quantitative sample but of small quantity. Within component it is mainly small crustaceans (Cladocera, Copepoda), groups of species eat filter (Rotatoria) usually have very low density. Density of zooplankton tends to increase following the flow direction, but difference between locations is not much. Features on number and variation in zooplankton reflect characteristics of flowing water environment in the mountain river waters which are generally lower in nutrient and high in flow velocity.

Table 34: Density of zooplankton at investigated locations on Nam Mo river

In 09/2012

Sampling location	Density (individual/m^3)								
	NM1	NM2	NM3	NM4	NM5	NM6	NM7	NM8	Average
No. of species	13	15	13	14	12	11	10	11	11
Copepoda	280	170	290	80	110	235	70	134	171
Cladocera	115	135	150	72	84	185	110	112	120
Rotatoria	23	30	48	0	21	0	0	12	17
Others	38	40	35	26	20	35	26	27	31
Total	**456**	**375**	**523**	**178**	**235**	**455**	**206**	**285**	**339**

In 07/2016

Sampling location	Density (individual/m^3)								
	NM1	NM2	NM3	NM4	NM5	NM6	NM7	NM8	Average
No. of species	14	13	14	15	11	12	12	11	11
Copepoda	270	185	286	95	125	240	95	150	181
Cladocera	115	125	165	86	90	180	135	115	126
Rotatoria	24	25	37	15	0	20	10	14	18
Others	25	35	35	28	15	30	22	23	27
Total	**434**	**370**	**530**	**224**	**230**	**470**	**262**	**302**	**353**

In 03/2017

Sampling location	Density (individual/m^3)								
	NM1	NM2	NM3	NM4	NM5	NM6	NM7	NM8	Average
No. of species	15	14	15	15	13	14	14	12	12
Copepoda	320	247	308	206	227	238	215	223	248
Cladocera	161	135	174	109	135	169	126	128	142
Rotatoria	0	10	26	11	5	13	12	11	11
Others	19	35	38	31	21	27	25	23	27
Total	**500**	**433**	**546**	**357**	**386**	**447**	**378**	**385**	**429**

Source for 2012: Environmental Impact Assessment report, Nam Mo1 HPP, 2012, PECI.
Source for 2016: Scoping report, Nam Mo1 HPP, 2016, PECC1.

2.6.9. Zoobenthos

Results gained from site survey at 7 locations on rivers, streams, ponds within Nam Mo 1 HPP area in Ky Son district, Nghe An province have helped identifying 26 species of benthos in groups *Bivalvia* (6 species, taking 23.1%), *Gastropoda* (14 species; 53.8%), *Crustacea* (4 species; 15.4%) and Insecta larva (2 species; 7.7%). These identified species must be less than the actual

species available in the region. In species composition we found families of Pachychilidae, Thiaridae (*Brotia siamensis, Tarebia granifera, Thiara scabra*, etc.) which often distribute predominately in mountainous areas and appear in most of investigated locations. The species in families of *Corbiculidae*, *Unionidae* are often seen in river while species in family *Ampullariidae* distribute widely all over the basin. The identified species are widely distributed, some of them typically characterized for mountainous regions, in rapid flowing water bodies (see table – Appendixes).

Density of zoobenthos varies between 40-65 individual/m^2 (resulted gained in 2012 site survey) and between x-62 individual/m^2 (resulted gained in 2016 site survey). Among composition, predominating is snail (*Gastropoda*) and group of insect larva (*Insecta*). Insect larva in families Chironomidae and Baetidae is normally of the highest density in most of investigated locations, then to snail groups popular in mountainous water bodies, which lives sticking on rock or aquatic vegetation, in families Pachychilidae, Bithyniidae, Thiaridae. However, most of zoo benthos species are identified belong in to small size species therefore biomass will not high. Benefits from zoo benthos generally unremarkable, some species can be used as food for local resident but not many in quantity and very few exploited.

Table 35: Density of benthos at investigated locations on Nam Mo river

In 09/2012

Name	Density of zoobenthos (individual /m3)								
	NM1	NM2	NM3	NM4	NM5	NM6	NM7	NM8	Average
Bivalvia	3	5	2	11	8	3	0	3	4
Gastropoda	20	22	14	12	14	21	9	13	16
Crustacea	2	1	8	5	2	8	11	6	5
Insect	32	19	41	12	36	13	25	23	25
Total	**57**	**47**	**65**	**40**	**60**	**45**	**45**	**45**	**50**

In 07/2016

Name	Density of zoobenthos (individual /m^3)								
	NM1	NM2	NM3	NM4	NM5	NM6	NM7	NM8	Average
Bivalvia	4	3	4	10	8	5	2	4	5
Gastropoda	16	20	17	13	15	19	11	13	15
Crustacea	2	2	6	4	3	6	8	5	4
Insect	26	22	35	21	30	15	20	21	24
Total	**48**	**47**	**62**	**48**	**56**	**45**	**41**	**44**	**49**

In 03/2017

Name	Density of zoobenthos (individual /m^3)								
	NM1	NM2	NM3	NM4	NM5	NM6	NM7	NM8	Average
Bivalvia	0	6	0	8	6	4	0	2	3
Gastropoda	18	14	20	18	12	20	16	14	17
Crustacea	7	4	9	10	8	7	6	7	7
Insect	29	16	27	19	24	17	23	20	22
Total	**54**	**40**	**56**	**55**	**50**	**48**	**45**	**43**	**49**

2.6.10. Rare wildlife

a. Mammal

Among 31 mammal species recorded in the region, there are 3 rare species (taking 9.6% total number of mammal species in the surveyed area). Of which, there is one species recorded in Red List of IUCN (2011) as VU; 2 species listed in Red Data Book of Vietnam (2007) including 1 VU species and 1 LR species and 3 species listed in Decree 32/2006/NĐ-CP including 2 species in category IB and 1 species in category IIB.

Table 36: List of rare mammal in Nam Mo 1 HPP basin

No.	Vietnamese name	Scientific name	Data sources	Red Data Book Of Vietnam 2007	IUCN 2011	Decree 32/2006 NĐ-CP
1	Cu li lớn	*Nycticebus bengalensis*	i	VU	VU	IB
2	Khỉ vàng	*Macaca mulatta*	i	LR		IIB
3	Mèo rừng	*Felis bengalensis*	**i**			IB

Notes:
i: interviewed
IUCN (2016) (The IUCN Red List of Threatened Species (2016): (VU) = Vulnerable;
VNRB (2007) (Vietnam Red Data Book, 2007): (VU) = Vulnerable;(LR) = Lower Risk;
Decree 32/2006/ND-CP (The Governmental Decree No. 32/2006/ND-CP (2006): (IB) = Prohibit of collection and use for commercial purposes; (IIB) = Restricting exploitation and use for commercial purposes.

b. Bird

There are 3 rare bird species (taking 2.7% total number of species) identified in surveyed area, including species listed in Decree 32/2006/NĐ-CP (2006) category IIB.

Table 37: List of rare bird in Nam Mo 1 HPP basin

No.	Vietnamese name	Scientific name	Data sources	Red Data Book Of Vietnam 2007	IUCN 2016	Decree 32/2006 NĐ-CP
1	Cắt bụng hung	*Falco severus*	i			IIB
2	Vẹt ngực đỏ	*Psittacula alexandri*	i			IIB
3	Chích chòe lửa	*Copsychus malabaricus*	i			IIB

Notes:

(i)-interviewed

IUCN (2016) (The IUCN Red List of Threatened Species (2016): (VU) = Vulnerable;

VNRB (2007) (Vietnam Red Data Book, 2007): (VU) = Vulnerable; (LR) = Lower Risk;

Decree 32/2006/ND-CP (The Governmental Decree No. 32/2006/ND-CP (2006): (IB) = Prohibit of collection and use for commercial purposes; (IIB) = Restricting exploitation and use for commercial purposes.

c. Reptile

Among 22 identified reptile species, there are 8 rare species taking 33.33% total number of reptile species in the investigated region. There are 8 species listed in Red Data Book of Vietnam (2007), including 6 EN species and 2 VU species; and 6 species listed in Decree 328/2006/NĐ-CP (2006) including 1 species of category IB, 5 species of category IIB.

Table 38: List of rare reptile in Nam Mo 1 HPP basin

No.	Vietnamese name	Scientific name	Data sources	Red Data Book Of Vietnam 2007	IUCN 2015	Decree 32/2006 NĐ-CP
1	Tắc kè	*Gekko gecko*	I, o	VU		
2	Rồng đất	*Physignatus coccincinus*	I	VU		
3	Kỳ đà vân	*Varanus nebulosus*	I	EN		IIB
4	Kỳ đà hoa	*Varanus sanvator*	I	EN		IIB
5	Rắn ráo thường	*Ptyas korros*	I, o	EN		IIB
6	Rắn ráo trâu	*Ptyas mucosus*	I	EN		IB
7	Rắn cạp nong	*Bungarus fasciatus*	I	EN		IIB
8	Rắn hổ mang	*Naja naja*	I	EN		IIB

Notes:

(o) = obseved; (i)-interviewed

IUCN (2016) (The IUCN Red List of Threatened Species (2016): (VU) = Vulnerable;

VNRB (2007) (Vietnam Red Data Book, 2007): (VU) = Vulnerable;(EN) = Endengrable;

Decree 32/2006/ND-CP (The Governmental Decree No. 32/2006/ND-CP (2006): (IB) = Prohibit of collection and use for commercial purposes;(IIB) = Restricting exploitation and use for commercial purposes.

d. Amphibian

This is no species listed in Red Data Book of Vietnam 2007 and Red List of IUCN 2011 or Decree 32/2006 of the Government.

e. Insect

Though species quantity is quite lot but in the region there are no species recorded in Vietnam Red Book 2007, Red list IUCN 2011 and Decree 32/2006 by the Government.

f. Fish

Table 39: List of rare fish species in My Ly HPP basin (2012-2017)

No.	Vietnamese name	Scientific name	Data sources	Red Data Book of Vietnam 2007	IUCN 2016
1	Cá Chiên	*Bagarius rutilus*	O, p	VU	**DD**
2	Cá trốc	*Acrossocheilus annamensis*	i	VU	
3	Cá Rầm xanh	*Bangana lemassoni*	O, p	VU	**DD**
4	Cá Lăng	*Hemibagrus guttatus*	O, p	VU	**DD**

Notes:

(O) = obseved; (i)-interviewed; (p) = Photo specimens in the field

VU: Vulnerable; DD: Data deficient

2.6.11. Distribution of wildlife according to main habitats

a. Mixed evergreen rain forest after exploitation

Mammals: Main species in broadleaf forest habitat are: yellow monkey *Macaca mulatta*, wild cat *Felis bengalensis*, wild pig *Sus scrofa*, muntjac *Muntiacus muntjak*, big bamboo rat *Bandicota indica*.

Bird: this is habitat for species of families of drongo, crow, fly eating bird *Muscicapa dauurica*, honey eating bird *Nectarinia sperata*, Chinese laughing-thrush, cock, turtle bird etc…

Reptile, amphibian: Typical species of this habitat are: ground dragon*Physignathus cocincinus*, *Varanus nebulosus*, cobra *Naja naja*, green snake *Trimeresurus albalabris*, species of family tortoise *Emydidae*, gecko *Gekko gecko* live in this habitat.

b. Secondary forest on abandoned cultivated land

Mammal: this habitat is where concentrating lots of small animal of orders of rodent *Rodentia*, bat *Chiroptera*....

Bird: this type of habitat concentrates quite lots species and is living space and food finding space of lots wild birds....

Reptile, amphibian: mainly are species of ground dragon *Physignathus cocincinus*, snake *Ptyas mucosus*, snake *Bungarus fasciatus*, snake *Bungarus candidus*, (*Naja naja*), etc...

c. Habitat along river, stream, swidden plot and population area

These habitats locate along river, stream in communes, slash and burn land areas, population area all along road alignment.

Animal: Species typically for this habitat are: black tail rat *Crocidura attennata*, mosquito eating bat *Java Pipistrellus javanicus*, mice *Rattus flavipectus*, rat *R. norvegicus*, etc...

Bird: representatives of this habitat are species such as milky stork *Egretta garzetta*, fly stork *Bubulcus ibis*, Milky necked stork *Amaurornis phoenicurus*, big kingfisher *Megaceryle lugubris*, small kingfisher *Ceryle rudis*, woolly necked stork *Halcyon chloris*, *Alcedo atthis*, etc...

Reptile, amphibian: typically for this habitat are species of: gecko, water snake and most of species belongs to family of amphibian (*Ranidae*), family of tree frog (*Rhacophoridae*), family of small frog (*Microhylidae*), etc...

Insect: Most species of butterfly are distributed in this habitat.

2.6.12. Wildlife exploitation situation

Local resident normally exploits wildlife for various purposes. Values in using of wildlife mainly are[16,17]:

Statistical data shows that 38 species are used as food including 10 animal species (mainly is civet, squirrel, wild pig); 12 bird species (mainly is doves family *Columbidae*, red-whiskered bulbul *Pycnonotus jocosus*, sparrow order *passeriformes*); 10 species of reptile (ground dragon *Physignathus cocincinus*, spotted gecko *Varanus salvator*, species of snake) and 6 species amphibian (field frog *Hoplobatrachus chinensis*, big frog *Sylvirana guentheri*, *Limnonectes kuhlii*, stream frog *Sylvirana nigrovittata*, tree frog *Rhacophoridae*).

There are 25 species used as drug including 10 mammals species (mainly are loris *Loricidae*, monkey *Cercopithecidae*, species of cat family *Felidae*..), 4 bird species (group of boucal *Centropus sinensis*, bird of dove family *Columbidae*,..), 10 reptile species (gecko *Gekko gecko*, species of varan *Varanidae*, species of snake *Serpentes*, species of tortoise *Testudines*,...) and 1 amphibian species (home toad *Duttaphrynus melanostictus*).

There are 45 species of animal exploited for commercial purposes including 20 animal species (species of loris *Loricidae*, species of monkey *Cercopithecidae*, species of civet *Viverridae*, species of squirrel *Sciuridae*); 13 species of birds (blue dove, spotted dove, parrot*Psittacidae*, dollarbird, mynah*Timaliidae*, Chinese laughing-thrush*Sturnidae*); 12 species of reptile (gecko*Gekko gecko*, ground dragon *Physignathus cocincinus*, species of varan*Varanidae*, species of snake*Serpentes*, species of tortoise*Testudines*). Those species are exploited, trading between regions all over the country, even to abroad. Some species with food value are sold to restaurant to be special dishes.

Besides, there are some species exploited as fur in household or their remains are decoration.

2.6.13. Characteristics of fauna in reservoir area

Site survey shows that: the reservoir area comprises mainly poor forest, bamboo forest, scrub land and grass land... Therefore wildlife is not so abundant as in areas where forest is still in good condition. Species in reservoir area is missing with large size and rare species and instead seen with small size animal of family civet *Viverridae*, weasel *Mustelidae*, some species of tree squirrel *Sciuridae*, rat family *Muridae*, bamboo rat *Rhizomyidae*; bird comprises of wild chicken *Gallus gallus*, some species of woodpecker family *Piciformes*, *Coraciidae*, kingfisher family *Alcedinidae*, boucal, some species of cock, drongo, *Muscicapidae*etc; reptile and amphibian have some species of agama*Agamidae*, ground dragon *Physignathus cocincinus*, gecko *Gekko gecko*, varan *Varanidae*, snake*Coelognathus radiatus*, cobra*Elapidae*, species of frog, etc...

2.7. Natural reserves, national forest, protective forest

In project area and distance 5km from the project area, there is no special forest such as National Park, Natural reserve. Pu Mat, Pu Hoat and Pu Huong Natural Reserves are all located quite far from the project area.

[16]*Policy brief: on controlling wildlife trade and consumption in Vietnam. The Asian Program actions against trafficking in endangered species. Biodiversity conservation Agency.*

[17]*Đặng Huy Huỳnh, Cao Văn Sung, Lê Xuân Cảnh, Phạm Trọng Ảnh, Nguyễn Xuân Đặng, Hoàng Minh Khiên, Nguyễn Minh Tâm, 2008. Fauna of Vietnam, volume 25. Science and Technique Publishing House, Ha Noi.*

Biosphere Reserve of Western Nghe An (http://sinhquyennghean.vn/?n=11/da-dang-sinh-hoc); Environmental Impact Assessment for Ban Ve hydropower project on Ca river, Nghe An province, 2006.

Table 40: Comparison on biodiversity between the project basin and others and with natural reserves, national park

Ecology	Nam Mo 1 HPP	Ban Ve HPP	Pu Huong Natural Reserves	Pu Hoat Natural Reserves	Pu Mat National Park
No. of species					
Flora	420	686	1200	763	2.494
In Red Data Book	2	37	43	30	70
Fauna	413				
Mammal	31	63	291	45	93
	3		45	7	
Bird	96	176	265	142	361
	3		11		15
Reptile	22	35	35		53
	8		10		20
Amphibian	19	16	25		33
					3
Insect	171				1,084
Fish	74	105			83
	4	15			5

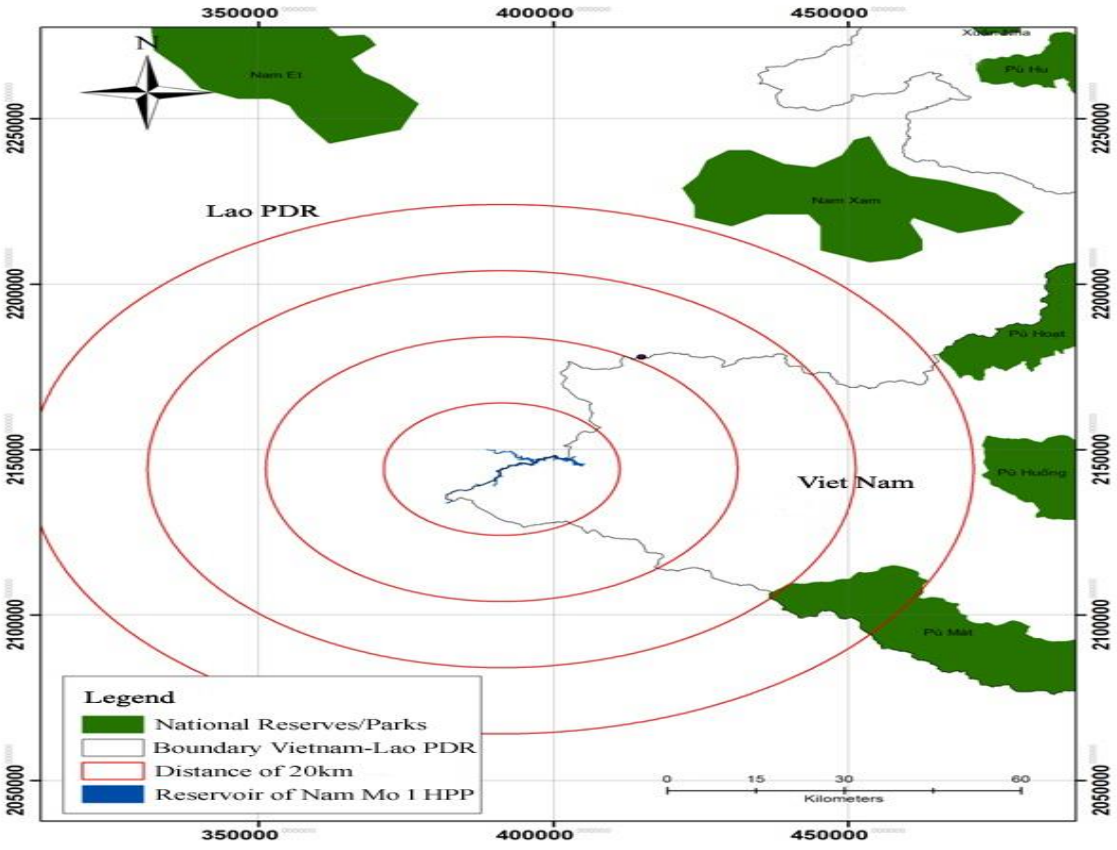


Figure 8: Project location and distance to special forest, natural reserve, national park

CHAPTER 3. IMPACTS BY HYDROPOWER PROJECT TO ECOLOGY

To assess possible and potential impacts caused by construction and development of Nam Mo 1 hydropower project to natural environment, the report divides potential impacted area in to two sub-regions, as below:

The upper including area to construct main dam, where reservoir will be formed, along reservoir area and the basin upstream of the reservoir down to Nam Mo 1 damsite, borrow areas, appurtenant work area, access road system for project construction, etc.

The lower from the damsite to downstream of damsite, including area of penstock, powerhouse, switchyard, tailrace channel and transmission line alignment, etc, together with other project components such as appurtenant work, worker camp, access road for construction, access road to powerhouse and downstream of the dam.

3.1. Sources of impacts

Nam Mo 1 HPP is proposed to be constructed in 5 years including 1 year for preparation. The project construction will happen on an area of some 1607.19 ha in Ta Ca, Muong Tip, Muong Ai and Nam Cancommunes of Ky Son district, Nghe An province, including reservoir area, headwork component, appurtenant work, access road, etc.

Detail sees in the table following:

Table 41: Total occupied area of Nam Mo 1 HPP

No.	Affected area	Total occupied area (ha)
	Total	**1607.19**
A	**Permanent area**	**1545.42**
1	Submerged reservoir area	962.07
2	Bufer area	559.15
3	Headwork area	24.2
B	**Temporary area**	**55.27**
C	**Quarry area**	**6.50**
	In which: Crushing facilitys (items No.1 and 2)	1.75

3.1.1. Wastes relative impacts

a. During preparation period

Cutting, leveling ground to prepare layout in project construction site, appurtenant work, worker camp, stockpile, disposal site.

Constructs works such as access road, power supply system, water supply system, worker camp, office for project management board, worker camp for contractor, appurtenant work serving construction.

b. During construction period

Operation of vehicles serving hauling and transportation and construction of the project.

- ✓ Constructs project components such as dam, powerhouse, waterway.
- ✓ Operation of production bases, mechanical workshop where repairing, maintaining vehicles.
- ✓ Operation of workers on site.

Wastes resulted and generated during construction period, including:

- ✓ Solid wastes: mainly are rock, soil, wastes from construction activities such as cement bag, abundant material, wood boxes containing equipment and domestic wastes.
- ✓ Liquid wastes: oil, lubrication, wasted water from construction activities, from domestic activities.
- ✓ Exhausted gas: mainly are dust and some poison gas resulted from exploitation and hauling of construction material, equipment to the project.

c. During operation period

Operation of powerhouse will almost cause no wastes, except a certain volume of petroleum which could possibly leakage to soil and water environment and thus causing pollution during operation. Living activities by Project Management Board and workers at powerhouse will generate a volume of wastes and wasted water from domestic activities. However, this volume of waste is forecasted not so much.

3.1.2. Non-waste relative impacts

a. During construction period

Compensation, land acquisition for access road and project construction site.

Constructs access road, appurtenant works.

Constructs dam and powerhouse.

Fills reservoir.

Concentrates workers, labor force and population.

b. During operation period

Forms a reservoir covering an area of some 962.07 ha.

Operation regime of reservoir.

Living activities of staff, workers at the power plant.

3.1.3. Object of impacts

Impacts to geology, geomorphology and foundation.

Impacts to ambient air environment

Impacts to water quality

Impacts to hydrological regime

Impacts to land using pattern

Impacts to ecology (fauna, flora, aquatic).

3.2. Impacts to ecology during construction period

3.2.1. Impact to flora and vegetation during construction period

Negative impacts to flora, botanical resources during construction period of Nam Mo 1 HPP can happen, as following describes:

Loosing a vegetation area in reservoir area: when reservoir is filling, it will cause submergence to some of 962.07 ha poor forestry land area in Ta Ca, Muong Tip, Muong Ai and Nam Can communes of Ky Son district, Nghe An province and a limited area of agricultural and residential land.

Submergence to a limited cultivated land and forestry land as mentioned above is negative impacts to productive activities of local resident as well as to ecology in the region. However, this impact is unremarkable, thanks to following reasons:

There is some of 5% in total of submerged cultivated land is slash and burn land area and one crop paddy rice area where productivity is not so high. Moreover, this land area will be reasonably compensated in resettlement site so as to ensure livelihood and living standard of Project Affected People (PAP) will be better than before.

There are up to 90% of submerged forestry land is poor forest of small storage. Submergence to such forestry land area will cause not much impact to biodiversity in the region.

Some individual rare plant species to be submerged are all those of widely distributed characteristics, existed in many un-submerged areas. In future these plants will still have conditions to grow, no gene source will be lost.

Within submergence area, there is no natural ecology of preservative value or protective value (as special forest or natural reserve area, etc).

Losing some vegetation area for construction of access road and appurtenant works: to serve the construction, appurtenant work, access road shall be constructed first. By estimation, this appurtenant work will occupy an area less than 10 ha. However, because the project site is quite close to existing access road, natural land area required for access road connecting the project site will be unremarkable. This area is mainly covered by secondary forest, agriculture and scrub land, therefore this impact is assessed as unremarkable.

Effects forestry resources: particularly during construction of the dam and other components, there will be a large number (some of 1000-1500) of workers concentrating at the site. It will be a great challenge to meet demands on accommodation, food and other activities for this number of people in the local. Only firewood has been a tough issue already. By estimation, in average each individual will consume some of 0.5m^3 to 0.7m^3 firewood in a year. That means every year the construction site must explore at least 10,000m^3 firewood for every day demand. This will be a great threat to forest and other natural vegetation in the region. Extent of impact will depend largely on awareness of worker as well as immigrants. Biodiversity in the region will therefore not be affected largely.

Besides, fire can happen too if happening petroleum fire, explosion or careless in domestic activities by workers.

In shorts, during land acquisition process, construction of project component, there will be negative impacts to environment in general and to biodiversity in particular as mentioned above. Buts they are instantaneous impacts, in small extent and unavoidable in any hydropower project development. Extent of impacts will be within the construction site and some of surrounding forest. After construction period of 4-5 years a new ecology will go in stable. Negative impacts will be mitigated if mitigation measures proposed in next sections are properly applied and implemented.

3.2.2. Impact to fauna and wildlife during construction period

a. Impacts to habitats, distribution of wildlife

Even if the hydropower is not constructed, fauna and wildlife in the region still subject to human impact which are, losing habitat due to cultivation activities which approaches to forest land, construction of rural access road, forest fire, exploitation of forest resource (firewood, timber, non-timber products) and particularly wildlife hunting. All of these make a great contribution to reduced number of wildlife in the region.

When hydropower project is construction, landscape will be altered not only on the reservoir basin but also in downstream of powerhouse in many aspects: climate, hydrology, fauna, flora as well as socio-economic activities in the region, including the fauna (mammal, bird, reptile, amphibian) in project construction site both in the basin and downstream of powerhouse.

However the dam is construct at what elevation, the reservoir will anyway causes submergence to a certain land area where forest is existed and therefore narrowing habitat of wildlife. Interrupted habitat, some forest land on mountain, in reservoir area will be isolated or fully submerged. Due to the reservoir formation, population in reservoir area must move higher to resettle. New population area will cause demands on cultivate land, land for housing, timber for construction and every day duel. Besides, it shall take in to consideration a number of workers, construction vehicles and machine which will cause noise pollution. All of such will impact to wildlife in the region. Many species will displace far from the project site but in different directions.

Large size animal whose living area is large, moving fast, sensitive to disturbance (noises, population), distributed nearby the project such as bear, panther, bull, monkey, etc… will displace to further calm forest in high mountain to live. In the region there are Pu Mat National Park, etc… and some protective watershed forests which are in good conditions and good preserved and will be new habitats of those species. As said, in reservoir area, large size animal is not many left therefore this impact is assessed as negligible.

Species live near population area such as deer, muntjac, wild boar, etc will move far from project site, normally to forest in valley or low mountain, but then back to forest, slash and burn area close to project site looking for food. Small size wildlife, bird, reptile will only moves out of submergence area or spreading far from project site for new habitat. If they can not make it when the reservoir is filling, some individual of rat and species living in cave, holes in project site could be death. Species living on water such as otter, water bird (heron families, kingfisher family, and duck family), species of varan, water snake and amphibian will only move to coastal area to live on. Because wildlife will not move so far from project site, it will be cause illegal hunting by local resident living nearby. But when the powerhouse is under operation, when noises caused by construction activities are reduced, wildlife will gradually get back to live in the region.

Though Nam Mo 1 HPP is not located in any national park or natural preserve but pressure from using of natural reserves during construction period, if not well and properly managed, it will cause impacts to wildlife in surrounding area. During construction period, thousand of worker will focus at this location, demand on food, drug will remarkably increase. Local resident will have market for wildlife and their products (restaurants, rare drug from wildlife such as bear gall, monkey bone glue, gecko and fur). To satisfy this market, there will appear hunter going to forest to hunt, catch illegally wildlife, bird and other wildlife if possible. Hunting and trapping wildlife may be popular in the region, particularly where bordering with protective watershed forest of Ky Son (in Muong Ai, Muong Tip, Ta Ca communes of Ky Son district). When the source in surrounding area is limited, they will enter and approach to natural reserves, national park where rare species of high gene preservation value are living.

b. Impact to food finding and resting

Noises will cause changes and reaction of wildlife, especially bird and animal. Intensive acting habit of animal is finding food, which normally happens at night, between 19:00 in the evening to the next 6:00. From 10:00 to 16:00, animal normally rests and less activities. The busiest times for bird species to find food are in two intervals: early morning (5:00 to 9:00) and evening (16:00 to 18:00). Resting time of bird, besides night time is also mid day time (11:00 to 15:00).

Along rivers and streams there are sand lanes or gravel areas where some small size wildlife goes to find food, hunting in night time. Therefore, during food finding time as biological habit, it means in night time, noises caused by construction activities near their places of food finding will cause panic, scare them away. In contrary, in day time, animal usually finds deep forest, far from

areas where human normally passing such as access road and population areas for resting. At construction site, activities will be done mainly in day time, except when schedule requires high intensity then will be done also in night time. Therefore construction activities will affect to food finding and resting activities of wildlife in the region but in unremarkable extent.

3.3. Impact to aquatic and fishery during construction period

During construction period, aquatic and fishery will be affected as below:

Due to a retaining dam stopping water, drainage system serving construction of technical infrastructures, habitat of fish species as well as other aquatic life will be changed and altered. Interruption of the flow will create barrier to fish migration. Altered habitat will make it hard to small size fishes to reproduce and therefore resulting in quantity reduction. Some species of stream fish, when water is drained up, will focus living in plashes and caves. Some species can not get up with changes and will die.

Besides, during preparation and construction periods of Nam Mo 1 HPP, and these periods may as long as 5-6 years, there will be continuously a certain volume of oil, lubrication from means of transport, fuel from machine, cement, etc…discharged in to water environment. All of these will cause impacts to aquatic system in the future reservoir area and downstream area.

Turbidity in river will be increased thus reducing light in various water layers and therefore affecting to development of plants (of photosynthetic ability) such as phytoplankton, periphyton. This will result in possibility of reducing primary productivity of the watershed. In the watershed, plant is the first and important in the natural food chain of material and energy alternation in the ecology. When primary productivity of watershed is reduces, secondary productivity including eating creatures such as phytoplankton, zooplankton, zoobenthos and fish eating vegetation will be reduced since food source is lost. Species of meat eating fish will be reduced since lower graded animal is reduced already. Species of fish preferring clean water habitat and oxygen rich habitat will be reduced too and could disappear. Instead will be fish species of high bearing ability, widely adaption, livable in pollution habitat such as zebra tilapia*Oreochromis niloticus*, black tilapia *Oreochromis mosambicus*, anabas *Cyprinus rubrofuscua*, catfish, etc to grow and develop strongly. Fish species of large size will predominant…

Increases of soil, rock volume from construction could lead to increasing of nutrient in soil adding to the watershed. This nutrient source is mineralized and could be adding to water in downstream of the project.

Volume of oil, lubrication and other wastes from project will poison sources to water environment, affecting to aquatic communities: resulting in reduction of species component and also number of individual. Generally, during this phase the aquatic system in the watershed will be altered both in reducing of species component and number of individual. Biodiversity will be less, fish species of migration habit along river and oxygen loving fish species, clean habitat loving fish species will be gradually replaced by small size fish species which can bear and deal with alternative and polluted environment. During construction period, fish will be subject to impact and strong alternation. Number of species and individual in the species will be reduced. Fish species will move far from construction site to upstream or following the river to downstream.

3.4. Impact to ecology during operation period

3.4.1. Impact to flora and vegetation during operation period

It can be said straight away that, when the project is constructed and under operation, Nam Mo 1 will cause negligible negative impacts to ecology in the region and its impacts to biodiversity will be mainly positive impacts.

One positive impact which is distinguishly seen after formation of reservoir is local climate which is improved, underground water table will be raised up, air humidity, and soil humidity will be also

improved. These will be positive impacts to biodiversity. Resettlement of plant will be much easier, their growing and development will be more favorable and if it is properly utilized, these will be good conditions for covering bare hill, enhancing coverage of forest vegetation along reservoir and in the catchment.

In downstream of Nam Mo 1 dam, besides some forest areas along river, the remaining is cultivate land, mainly is corn, potato, cassava, paddy rice. When the project is under operation, there will be an additional water sources satisfying irrigation, domestic water demands in downstream. This is a positive impact to ecology in the region.

3.4.2. Impact to wildlife and fauna

When the project is completed, the reservoir is impounded, climate in the region will be gentler, and to ensure water resources inflowing to the reservoir, forest and watershed forest will be paid with more attention. This will be helpful to fauna here to maintain and growing. Such as:

Due to existence of hydropower plant, population distribution in the region will be changed. Exchanges between regions will be more and more increasing. Thanks to regulation of water in reservoir area as well as in downstream, agriculture will be more developed than before, this will of course result in appearance of some species as well as number of individual, alternation on distribution of species preferring to live closely to human, seed eating species such as mouse*Rattus flavipectus*, rat*Chiromyscus chiropus*, sparrow*Passer montanus*, home toad*Duttaphrynus melanostictus*, etc…

Formation of reservoir will create swamp areas along Nam No river, and tributaries to this river will be great conditions for species to appear and for increasing number of individual of species living with water environment such as otter, bird species in family *Ardeidae*, dug family *Anatidae*, *Charadrlidae*, kingfisher family *Alcedinidae*, species of ravan *Varanus salvator*, water snake, species of *Ranidae* family,….

There is possibility to attract migration bird species: the reservoir in a large area will be a great factor to attract migration bird during winter time flying from the North looking for shelter in cold period.

Formation of reservoir will attract wildlife species in the basin. Some animal species will go on living in this new habitat. Wild pig, civet, wild dog and monkey species will consider this is their new habitat and food sources from water will be used more properly. Species of otter will feel comfortable in new habitat.

Upstream forest will be protected, reforestation will be performed, and forest will be more and more developed. Under calm environment, it will be positive factor to attract species, both small and medium size wildlife, and bird to live here.

In short, construction of Nam Mo 1 HPP will cause impacts to fauna in the region by affecting to habitat, and cause direct impacts to some species. However, during operation, the reservoir formation will cause positive impacts to some species living near water. Living standard of local resident will be surely enhanced and improved. This will be a permanent condition helping protection and development of fauna and wildlife in the region.

3.5. Impact to aquatic and fishery after project completion

The reservoir created by Nam Mo 1 HPP is a small component covering an area of some 962 ha only. After impoundment, the reservoir will change basically terrestrial ecology as well as various watersheds in submergence area. New reservoir ecology together with aquatic system typically for this watershed will be formed.

In first years after filling, aquatic system in Nam Mo 1 reservoir is basically reservoir aquatic system. Plants, vegetation after submergence will be disintegrated in organic and nutrient making

rich to food sources of aquatic life living in the reservoir, increasing primary reproduction, increasing development of zooplankton and therefore making rich food source to fish. Phytoplankton will develop fast, zoobenthos species will be less developed due to deep water and deposition causing damages to previous bed, creation of new bed. Species of fish preferring egg laying in rapid water environment, gravel bed shall have to displace to upstream of tributaries or be reduced in quantity.

Plant communities represent reservoir environment in Vietnam such as blue algae *Microcystis*, silica algae *Melosira,* in upstream is yellow algae *Dinobryon* spp. (phytoplankton), *Bosmina, Diaphanasoma* (Crustacean), *Mongolodiaptomus birulai, Vietodiaptomus hatinhensis, Allodiaptomus* spp*., Dentodiaptomus javanicus, Mesocyclops leukartii, Thermocyclops* spp. (Gastropoda) will appear in predominant density within phytoplankton biology in the reservoir. Density and biomass of phytoplankton, in first duration will be high (density of zooplankton) will reach to tens of thousand individual per /m^3, density of phytoplankton reaches to hundred of thousand to million tb/l), even happening phytoplankton blossom. Within the composition, yellow algae *Dinobryon* will develop. Characteristics, distribution, composition as well as quantity of phytoplankton in reservoir in general and in My Ly reservoir in particular relate to distribution characteristics of nutrient salt and some other environmental factors. Generally, quantitative and qualitative distribution of phytoplankton tends to vary distinguishly by hydrological season. In case of a reservoir, density of phytoplankton in general will be much higher than that in stream, river bodies as at present. There will be forming a density gradient of phytoplankton along the reservoir. In dry season, density of phytoplankton is the least in upstream, the highest focuses in middle part near upstream, and getting lower in downstream. In flood season, density of phytoplankton is the least in upstream, getting higher to downstream and the highest is near damsite location. Besides the difference in distribution which is in surface area, phytoplankton has characteristics of distributing in quantity in vertical direction, the heighest on surface layer, getting lower in deeper water layers.

Also during first time after impoundment, soft body species will reduce in number of species as well as in quantity due to unstable reservoir bed. However, shrimp of family *Atyidae* will develop in quite high quantity in areas along banks.

Hypophthalmichthys

Vegetation eating fish species and organic mud eating fish species adapt with stand still water environment will develop, fish species adopts with flowing water environment will reduce both in number of species and quantity. Fishery on reservoir will be formed, during first period productivities of natural fish will be high, with lots of individual of larger size than present such as carp, hypophthalmichthys, major carp. In first years after impoundment, quantity of phytoplankton and organic matters in water is abundant, to be important food source to fish species. Fish species in stand still water environment will grow and strongly develop. Small fish community will be gradually replaced by large fish communities and less movement. Stable water level and higher water level as well as large water surface, the bed is getting to deposit mud and sediment from upstream, making it favorable for catfish and meat eating fish species to strongly develop. Large water surface area will also make it more difficult to fishing, this is great conditions for catfish species such as *Silurus asotus*, *Clarius fuscus,Hemibagrus guttatus*, *Bagarius rutilus*, *Cranoglanis henricia*nd *Mylopharyngodon piceus* to develop and get to their larger size.

In watershed of Nam Mo 1 HPP, it has recorded one fish species *Anguilla mamorata* to be the one migrating between river and the sea for breeding. So, *Anguilla mamorata* individual in upstream of the dam will be stopped to get to the sea for reproduction while young babies *Anguilla mamorata* individual are stopped in downstream of the dam, unable to get to the upstream to live and grow.

Water impoundment upstream of Nam Mo 1 HPP will be chance and conditions to develop aquaculture and fishery. In our opinions, after the reservoir is filling, the water surface in reservoir shall be assigned to some enterprises to perform aquaculture farming and tourism services. Fish species grown in reservoir shall include of *Ctenopharyngodon idella*, *Mylopharyngodon piceus*, *Cirrhinus molitorella*, Indian major carp, *Aristichthys nobilis*, *Cyprinus rubrofuscua*, *Hemibagrus guttatus,* mudfish. Those are fish species well adopting to stand still water environment and rich in nutrient. They are also fish species grow fast, easy to catch. Besides, the hydropower plant shall allow some households or enterprise to do fish cage farming on reservoir. The hydropower plant shall also expand tourism service and fishing for entertainment.

Impact to aquatic life in downstream of the dam

Flood control in seasons will cause negative impacts to some aquatic species and wildlife living nearby the water environment. Flood intervals are considered as festival of aquatic communities and various wildlife communities, focusing on flooding delta along Nam Mo river. Nam Mo 1 HPP will help reducing peak flood in downstream, it means it narrower the said flooding delta and therefore resulting in reduction of some species as well as number of individual, particularly species with habit of laying egg in flood season. In the same time wildlife living nearby water bodies will be subject to impacts due to a reduced food volume.

Forecast on reservoir ecology pattern and behavior

During using, most of reservoirs will pass 4 periods, including:

1. Disturbance period: this period happens right after reservoir formation, and might lasts in 10 years. This period has 2 succeed phases which are high nutrient phase and reduced nutrient phase.

2. Stable period: this is period follows the disturbance period.

3. Eutrophication: follows the stable period.

4. And swampy period: this is the final period of any reservoir, starting when sediment mud reaches to Minimum Operating Level.

Each period has typical characteristics in pattern, structure, composition and quantity of creatures, under direct impacts of water environment.

In the view of watershed nutrient, the nutrient volume supplies regularly to reservoir will be from two main sources, which are:

External nutrient source, this source comes from main inflow and from catchment area through erosion process.

Nutrient source created inside reservoir itself (internal source), due to disintegration process from bed sediment layer (grain nutrient in to dissolved nutrient) and from cage fish farming (if any).

So the external nutrient adding to reservoir will depends partially on erosion process, and on the other hand depends on soil type, mode of land using, extent of cultivation and type of vegetation covering the basin. Besides, it shall consider also possibility of industrialization and new population area in basin which is factors increasing nutrient to the reservoir too. Such things show that impacts by human in the basin will be the most important factor affecting to quality of reservoir ecology.

In short, after formation of Nam Mo 1 reservoir, aquatic species structure and composition will change both in quantity and in quality, reflecting typical characteristics of aquatic communities in reservoir. Distribution in composition and density of phytoplankton shows differences between upstream and downstream areas of reservoir, between surface and bed layers. In first years after impoundment, density of aquatic biomass in general and phytoplankton in particular will develop

strongly. It can forecast that after the reservoir in upstream is formed, there will be great possibility that reservoir in downstream will be richer in nutrient with higher density, biomass of aquatic comparing to upstream cascade. The formation of reservoir will be great and favorable conditions for fishery to develop on reservoir.

MITIGATION MEASURES

Outline mitigation measures for forestry, wildlife and fish and fisheris:

I. Preventive measures

II. Compensatory measures

III. Corrective measures

Limit grading and filling activities to what is necessary;

Ensure to monitor all activities to prevent malfunction in the Dam area by workforce employed during construction phase;

Adequate sanitation facilities will be provided to prevent pollution due to sewage and garbage;

The Project owner shall conduct the necessary training and provide instruction for works in Dam area to prevent such issue of contamination.

CONCLUSIONS

In regards to impacts caused by the project to environment, by means of assessment, following conclusions can be drawn:

Positive impacts

The project has high socio-economic benefit, to be additional power supply source to regional power system, in both countries and will help changing the situation in mountainous rural area of Ky Son district, Nghe An province. The project is supported by various authorities and local resident.

The project will help controlling flood, increasing water supply in dry season to cultivate area, supplying domestic water to population areas in downstream of Ca river.

Forms up a quite comprehensive infrastructure system to local area living in project area.

By means of resettlement and compensation program during project implementation, local resident will have chance to contact with labor force, favorable trading with other developed regions in the provinces, improving spirit and cultural living life. Project affected people in particular and Ky Son district in general will be benefited from better social benefit, changing economic conditions, reducing number of poor households in the local.

The hydropower project after completion will create a good climate area, better landscape making it good for tourism to develop.

Formation of Nam Mo 1 reservoir will help developing fishery, improving nutrient condition to local resident and raising up economic benefit in the local.

Negative impacts

The reservoir will cause submergence to some of 962.07 ha including various types of land such as forestry land, slash and burn land, paddy rice land, residential land, home garden land, water bodies and unused land area.

This 962.07 ha of land comprises mainly secondary poor forest, bamboo forest, scrub land area where timber resources is not high, impact to vegetation is unavoidable.

Causes pollution to ambient air, noise will be temporarily impact during construction period and can be mitigated. This impact is negligible.

Water pollution: after treating sources of wastes and performing methods of reservoir clearance, this impact will only effect during first period.

To the natural environment, during preparation period and construction period, the ecology will be hurt. But such impacts will be in short term (3- 5 years of construction).

If mitigation measures are properly applied, negative impacts caused by the project development will be minimized. Long-term positive impacts by the project still be predominant.

RECOMMENDATIONS

Construction of Nam Mo 1 HPP will cause unremarkable impacts to natural environment in the project area, however, there are some unavoidable impacts to ecology. To overcome and mitigate impacts listed above, the Project Owner must commit to apply fully and properly solutions on prevention, control, mitigation as mentioned in the above sections.

It is recommending local authority of Ky Son district, Nghe An province and environmental management agencies of various levels (Ministry of Natural Resources and Environment, Department of Natural Resources and Environment, Department of Forestry Guard, Department of Agriculture and Rural Development) shall co-operate to perform mitigation measures and environmental monitoring program in the project area.

REFERENCES

1. **Nguyễn Cử, Lê Trọng Trải, Karen Phillipps,** 2000: Chim Việt Nam. Nxb Lao Động-Xã Hội, Hà Nội, 250tr.

2. **Phạm Hoàng Hộ**, 1999-2000. An Illustrated Flora of Vietnam. Books 1-3. Youth Publishing House.

3. **Forest Planning and Survey Institute**, 1978-1988. Timber Tree of Vietnam. Volume 2 (1978); Volume 3 (1981); Volume 4 (1981); Volume 5 (1982); Volume 6 (1986); Volume 7 (1988). Agriculture Publishing House, Ha Noi.

4. **Many authors**, 2001-2003. List of botanical species in Vietnam. Volume I. 1182tr (2001); Volume 2, 1202tr (2003). Agriculture Publishing House, Ha Noi.

5. **A. Aubréville, J. Leroy & Ph. Morat** (Rédacteurs), 1960-2000. **F**lore du **C**ambodge, du **L**aos et du **V**ietnam. 1 (1960); 2 (1962); 3 (1963); 4 (1965); 5 (1967); 6 (1968); 7 (1968); 8 (1968); 9 (1969); 10 (1969); 11 (1970); 12 (1970); 13 (1972); 14 (1973); 15 (1975); 16 (1977); 17 (1979); 18 (1980); 19 (1981); 20 (1983); 21 (1985); 22 (1985); 23 (1987); 24 (1989); 25 (1990); 26 (1992); 27 (1994); 28 (1996); 29 (1999); 30 (2001)... Paris.

6. **H.Lecomte,** (Rédacteur) 1907-1937. **F**lore **G**énérale de L' **I**ndo-chine, tome 1, 1070 pp. (1907-1912); tome 2, 1213 pp. (1908-1923); tome 3, 1279 pp. (1922-19x); tome 4, 1040 pp. (1912-19x); tome 5, 1106 pp. (1910-1931); tome 6, 12x pp. (1908-1937); tome 7, 650 pp. (1912-1923). Paris.

7. **Tardieu Blot & C. Christensen**, 19x. **F**lore **G**énérale de l' **I**ndo-Chine, tome 7, 2 partie: Fougères, 5x pp. Paris.

8. **Nguyễn Tiến Bân** (chairman of editorship) et al. 1996. Red Data Book of Vietnam, Plants). Science and Technique Publishing House, Ha Noi.

9. **Red Data Book of Vietnam, 2007. Section 1: Plant; Section 2: Wildlife.**

10. Đặng Huy Huỳnh (chủ biên), Đào Văn Tiến, Cao Văn Sung, Phạm Trọng ảnh, Hoàng Minh Khiên, 1994. Danh lục *các loài thú (Mammalia) Việt Nam. Nxb KH và KT, Hà Nội, 167 trang*

11. **Đặng Ngọc Thanh, Hồ Thanh Hải, 2001.***Crustacean in fresh water. Animals in Vietnam, volume 5.*Science and Technique Publishing House, Ha Noi.

12. **Đặng Ngọc Thanh, Thái Trần Bái, Phạm Văn Miên, 1980.** *Classification of invertebrate fauna in fresh water environment in North Vietnam.*Science and Technique Publishing House, Ha Noi.

13. **H.Humbert,** (Redacteur). 1938-1950. **S**uplément à la **F**lore **G**énérale de l' **I**ndo-Chine, tome 1, 1028 pp. Paris.

14. **Nguyễn Tiến Hiệp, Phan Kế Lộc and L. V. Averyanov.** 1999. Collection of workshop on biodiversity in North Truong Son (the second): 105. National University Ha Noi Publishing House.

15. **Vu Van Dung** (Editor) et al., 1996. **V**ietnam **F**orest **T**rees (Timber tree in Vietnamese forest), 788 pp. Agr. Publ. House, Hanoi.

16. **Dự án lâm nghiệp xã hội và bảo tồn thiên nhiên tỉnh Nghệ An (SFNC): ALA/VIE/94/24,** 2001: Pù Mát: Điều tra đa dạng sinh học của một số khu bảo vệ ở Việt Nam. Nxb Lao động- Xã hội, 174tr.

17. **IUCN, 1998.** The World List of Threatened Trees, 650 pp. World Concerv. Press.

18. **Bryan Stuart (2000) in SFNC Project:** Pù Mát - A biodiversity survey of a Vietnamese protected area, Chapter Five. Amphibians and Reptiles: 62-72

19. Environmental Impact Assessment for Ban Ve hydropower project on Ca river, Nghe An province, 2006. Power Engineering Consulting Company 1.

20. **Nguyễn Thanh Nhàn, 2001. Đa dạng sinh học ở khu BTTN Pù Mát – Nghệ An**. Hội thảo quốc tế sinh học. International workshop on Biology.Hanoi - Vietnam 2-5 July 2001: 150 - 155.

21. **Lê Nguyên Ngật, Hoàng Xuân Quang (2001):** Kết quả điều tra bước đầu về thành phần loài ếch nhái, bò sát ở KBTTN Pù Mát, tỉnh Nghệ An. Tạp chí Sinh học, Hà Nội, 23(3b): 59-65.

22. **Lê Nguyên Ngật, Nguyễn Quảng Trường (2002):** Kết quả điều tra bước đầu về các loài rùa ở KBTTN Pù Mát, tỉnh Nghệ An. Tạp chí Sinh học, Hà Nội, 24(2A): 58-64.

23. **Nguyễn Văn Sáng, Hồ Thu Cúc, Nguyễn Quảng Trường (2005):** Danh lụcếch nhái và bò sát ViệtNam. Nxb Nông nghiệp: 180 trang.

24. **Nguyễn Thái Tự, 1994**. Fish on Lam river (Msc Thesis on biology)

25. Planning on New Rural Construction in My Ly commune, Ky Son district, Nghe An province 2011 – 2020.

26. **Ngo Xuan Tuong, 2012**. Bird in Pu Ma National Park (Doctor thesis on biology).

27. **Vi Luu Binh, 2015.** Biodiversity of western Nghe An and the sustainable development model of the Biosphere Reserve. Department of Agriculture and Rural Development.

28. Proceeding of the 3rd National Scientific Conference on Amphibians and Reptiles in Viet Nam. Ha Noi Nov. 2016. Publishing house for Science and technology, 186 pp.

APPENDIXES

Table1. Phytoplankton species on Nam Mo river

No	Scientific name	2012	2016	2017
	SILICA ALGAE : BACILLARIOPHYTA			
	Class Centridae			
	Order Discinales			
	Family Coscinodiscaceae			
1	*Melosira granulata* Ralfs	X	X	X
2	*M. granulata var angutissima*	X	X	X
	Class Pennatae			
	Order Araphinales			
	Family Fragilariaceae			
3	*Synedra ulna* (Nitzsch) Ehr.	X	X	X
4	*S. ulna* (Nitzsch) Ehr var *biceps* (kg) Schonf.	X	X	X
5	*Fragillaria virescens Ralfs.*	X	X	X
	Family Naviculaceae			
6	*Navicula placentula* Grun	X	X	X
7	*N. gracillis*	X	X	X
8	*N. cuspidata*	X	X	X
9	*Navicula gastrum Husted*	X	X	X
10	*Gyrosigma attenuatum*	X	X	X
11	*Cymbella turgida* Clever	X	X	X
12	*C. ventricosa* Kutz	X	X	X
13	*C. cistula*	X	X	X
14	*Gomphonema sphaerophorum* Ehr		X	X
15	*G. olivaceum* Ehr	X	X	X
	Family Nitzschiaceae			
16	*Nitzschia recta* Hantsch	X	X	X
17	*Nitzschia philippinarum Ehr*	X	X	X
18	*Nitzschia nyanensis*	X	X	X
	Family Surirellaceae			
19	*Surirella robusta* Ehr	X	X	X
20	*S. robusta var. splendida*	X	X	X

	Family Tabelariaceae			
21	*Diatoma elongatum Ehr*	X	X	X
22	*Tabeleria fenestrata Kutz*	X	X	X
	GREEN ALGAE: CHLOROPHYTA			
	Class Chlorophyceae			
	Order Chlorococcales			
	Family Oocystaceae			
23	*Ankistrodesmus falcatus* Ralfs (Corda)	X	X	X
	Family Scenedesmaceae			
24	*Scenedesmus quadricauda var spinosus* Dedus		X	X
25	*Scenedesmus ellipsoideus Chodat*	X	X	X
26	*Crucigenia rectanguilaris (Nag.) Gay*	X	X	X
	Order: Zygnematales			
	Family Zygnemataceae			
27	*Spirogyra ionia*	X	X	X
28	*S. prolifica*	X	X	X
29	*Zygnemopsis americana*Transeau	X	X	X
	Family Desmidisceae			
30	*Neitrium digitus* (Ehr.) Roy & Bis	X	X	X
31	*Closterium moniliferum ((Bory) Ehr.*	X	X	X
32	*Cosmarium binum West*	X	X	X
33	*Desmidium aptogomun De Breb.*	X	X	X
34	*Micrasterias foliacea Bail*	X	X	X
35	*Pleurotaenium verrucosum Ehr*	X	X	X
36	*Euastrum spinosum Lenorm.*	X	X	X
	GREEN ALGAE : CYANOPHYTA			
	Class Chroococcaceae			
	Order Chroococcales			
	Family Oscillatoriaceae			
37	*Oscilllatoria limosa* Ag	X	X	X
38	*O. princeps*	X	X	X

39	*Lyngbya birgei*	X	X	X
	Family Anabaennaceae			
40	*Anabaena vigueri*	X	X	X
	Family Nostocaceae			
41	*Nostochopsis lobatus Wood*	X	X	X
	EYE ALGAE: EUGLENOPHYTA			
	Class Euglenophyceae			
	Order Euglenales			
	Family Euglenaceae			
42	*Euglena acus* Ehr	X	X	X
43	*Euglena granulata*	X	X	X
44	*Phacus acuminatus var. acuminatus*		X	X
	Total	**41**	**43**	**43**

Table 2. Zooplankton species on Nam Mo river

No.	Taxon name	2012	2016	2017
	ROTATORIA			
	1. Asplanchnidae family			
1	*Asplanchna sieboldi* Laydig	X	X	X
	2. Mytilinidae family			
2	*Mytilina ventralis* Ehrenberg	X	X	X
	3. Euchlanidae family			
3	*Diplois daviesiae* Gosse	X	X	X
	4. Brachionidae family			
4	*Brachionus caudatus* Apstein	X	X	X
5	*B. calyciflorus* Pallas	X	X	X
6	*Platyias quadricornis* Ehrenberg		X	X
	CLADOCERA			
	5. Bosminidae family			
7	*Bosmina longirostris* Muller	X	X	X
8	*Bosminopsis deitersi* Richard	X	X	X
	6. Sididae family			
9	*Diaphanosoma sarsi* Richard	X	X	X
10	*D. leuchtenbergianum* Fischer	X	X	X
11	*Macrothrix triserialis* Brady	X	X	X
12	*Macrothrix spinosa* King	X	X	X
13	*Ilyocryptus halyi* Brady	X	X	X
	7. Daphniidae family			
14	*Moina dubia* de Guerne et Richard	X	X	X
15	*Moinodaphnia macleayi*(King)	X	X	X
16	*Ceriodaphnia rigaudi* Richard	X	X	X
	8. Chydoridae family			
17	*Chydorus elexandrovi* Poggempol	X	X	X
18	*C. sphaesicus sphaesicus*(Muller)	X	X	X
19	*Disparalona rostrata* Koch	X	X	X
20	*Alona eximia* Kiser	X	X	X
21	*A. rectangula Sars*	X	X	X

22	*Biapertura intermedia* Sars	X	X	X
23	*B. affinis vietnamica* Dang	X	X	X
	COPEPODA			
	CALANOIDA sub-order			
	9. Diaptomidae family			
24	*Mongolodiaptomus birulai* (Rylov)	X	X	X
25	*Neodiaptomus handeli* Brehm	X	X	X
	CYCLOPOIDA sub-order			
	10. Cyclopidae family			
26	*Eucyclop serrulatus* (Fischer)	X	X	X
27	*Eucyclop speratus* (Lilljeborg)	X	X	X
28	*Paracyclops fimbriatus* (Fischer)		X	
29	*Ectocyclops phaleratus* Koch	X	X	X
30	*Microcyclops varicans* (Sars)	X	X	X
31	*Mesocyclops leuckarti* (Claus)	X	X	X
32	*Thermocyclops hyalinus* (Rehberg)	X	X	X
33	*T. taihokuensis* Harada	X	X	X
	HARPACTICOIDA sub-order			
	11. Canthocamptidae family			
34	*Elaphoidella coronata* (Sars)	X	X	X
	OSTRACODA			
	12. Cypridae family			
35	*Strandesia uenoi* Klie	X	X	X
	Total	**33**	**35**	**34**

Table 3: List of fish species on rivers, treams in Nam Mo1 HPP basin

No.	Vietnamese name	Scientific name	Red Data Book Of Vietnam 2007	2012	2016	2017
	I. BỘ CÁ CHÌNH	**ANGUILLIFORMES**				
	Họ cá Chình	**Anguillidae**				
1	Cá lệch, cá Chình hoa	*Anguilla marmorata* Quoy & Gaimard, 1824	VU	X	X	
	II. BỘ CÁ CHÉP MỠ	**CHARACIFORMES**				
	2. Họ cá Chép mỡ	*Characidae*				
2	Cá Chim trắng	*Cossoma brachypomum* (Cuvier, 1818)		X	X	X
	3. Họ cá Vũn	**Prochilodontidae**				
3	Cá Vền nam mỹ	*Prochilodus argenteus* Spix & Agassiz, 1829		X	X	X
	III. BỘ CÁ SÓC	**BELONIFORMES**				
	4. Họ cá Sóc	**Adrianichthyidae**				
4	Cá Sóc	*Oryzias latipes* (Tem. & Schl. 1846)		X	X	
	IV. BỘ CÁ CHÉP	**CYPRINIFORMES**				
	5. Họ cá Chép	**Cyprinidae**				
5	Cá giao sơn	*Yaoshanicus kyphus* (Mai, 1978)		X	X	X
6	Cá mại khe lào	*Danio laoensis* (Pellegrin & Fang, 1940)				X
7	Cá bỗng	*Spinibarbus denticulatus* (Oshima, 1926)			X	X
8	Cá ngũ vân	*Puntius partipentazona (*Fowler, 1934)		X	X	X
9	Cá thè be sông lam	*Acheilognathus lamensis* (Nguyen, 1983)		X	X	
10	Cá chát sông lam	*Acrossocheilus lamus* (Mai, 1978)		X	X	
11	Cá trốc	*Acrossocheilus annamensis* (Pellegrin & Chevey, 19x)	VU	X	X	
12	Cá bậu, cá sứt môi	*Garra orientalis* Nichols, 1925		X	X	X
13	Cá Chép	*Cyprinus rubrofuscua* Lacepede, 1803		X	X	
14	Cá Diếc	*Carassius auratus* Linnaeus, 1758		X	X	X

15	Cá Rưng	*Carassioides acuminatus* Richardson, 1846		X	X	X
16	Cá mát	*Onychostoma leptura*				X
17	Cá Dầm đất	*Osteochilus salsburyi* Nichol & Pope, 1927			X	X
18	Cá Trôi	*Cirrhinus molitorella* Valenciennes,18x		X	X	X
19	Cá Cầy	*Paraspinibarbus macracanthus* Pellegrin & Chevey, 19x		X	X	X
20	Cá đong chấm	*Puntius ocellatus* (Mai,1978)				X
21	Cá Đòng đong cân cấn	*Puntius semifasciolatus* Gunther, 1868		X	X	X
22	Cá Cháo	*Opsarichthys bidens* Gunther, 1873		X	X	X
23	Cá Mại	*Metzialineata* Pellegrin, 1907		X	X	X
24	Cá Thiểu	*Culter erythropterus* Basilewsky, 1855		X	X	X
25	Cá Ngão gù	*Culter flavipinnis* Tirant, 1883		X	X	X
26	Cá Thiểu mắt to	*Ancherythroculter daovantieni* Banarescu, 1967,		X	X	X
27	Cá Mương nổi	*Hemiculter leucisculus* Basilewsky, 1855		X	X	X
28	Cá Vền	*Megalobrama terminalis* Richardson, 1946		X	X	
29	Cá Dầm xanh	*Bagana lemassoni* Pellegrin & Chevey	VU	X	X	
30	Cá Chày mắt đỏ	*Squaliobarbus curriculus* Richardson, 1846		X	X	X
31	Cá Mè trắng trung quốc	*Hypophthalmichthys molitrix* Valenciennes, 18x		X	X	X
32	Cá Trắm đen	*Mylopharyngodon piceus* Richardson, 1846		X	X	X
33	Cá Thè be	*Acheilognathus tonkinensis* Vaillant, 1892		X	X	X
34	Cá Đục đanh	*Saurogobio immaculatus* Koller, 1927		X	X	X
35	Cá Đục ngộ	*Hemibarbus medius* Yue		X	X	X
36	Cá Mè hoa	*Aristichthys nobilis* Richardson, 18x		X	X	X
37	Cá Trắm cỏ	*Ctenopharyngodon idella* Valenciennes, 18x		X	X	X
38	Cá Rô hu	*Labeo rohita* Hamilton, 1822		X	X	X
39	Cá Mrigan	*Cirrhinus mrigala* Hamilton, 1822		X	X	X

	6. Họ cá Chạch	**Cobitidae**				
40	Cá chạch bùn núi	*Misgurnus tonkinensis* Rendahl,1937		X	X	X
41	Cá Chạch bùn	*Misgurnus anguillicaudatus* Cantor, 18x		X	X	X
	7.Họ cá Chạch suối	**Namacheilidae**				
42	Cá chạch đá đuôi bằng	*Schistura orthocauda* (Mai, 1978)		X	X	X
43	Cá chạch đá nâu	*Schistura incerta* Nichols, 1931		X	X	X
44	Cá chạch đá sọc	*Schistura fasciolata (*Nichols & Pope, 1927)		X	X	X
45	Cá chạch suối	*Micronemacheilus taeniatus*				X
	Họ cá bám đá	**Balitoridae**				
46	Cá Bám đá khuyết	*Beaufortia leveretti* Nichol & Pope, 1927		X	X	X
47	Cá vây bằng vảy lan can	*Balitora lancangjiangensis* (Zheng, 1980)				X
	V. BỘ CÁ NHEO	**SILURIFORMES**				
	8. Họ cá nheo	**Siluridae**				
48	Cá Thèo	*Pteorocypris conchinchinensis* (Valenciennes, 18x)		X	X	X
49	Cá Nheo	*Silurus asotus* Linnaeus, 1758		X	X	X
	9. Họ cá lăng	**Bagridae**				
50	Cá Bò	*Pelteobagrus fulvidraco* Richardson, 1846		X	X	X
51	Cá Lăng	*Hemibagrus guttatus* Lacepede, 1803	VU	X	X	X
52	Cá Mịt	*Pseudobagrus virgatus* Oshima, 1926			X	X
53	Cá Mầm	*Pseudobagrus vachellii* Richardson, 1846		X	X	
	10. Họ cá ngạnh	**Cranogranidae**				
54	Cá Ngạnh	*Cranoglanis henrici* Vaillant, 1893		X	X	X
	11. Họ cá trê	**Claridae**				
55	Cá Trê	*Clarius fuscus* Lacepede, 1803		X	X	X
56	Cá Trê phi	*Clarias gariepinus* Burchell, 188		X	X	X
	12. Họ cá chiên	**Sisoridae**				
57	Cá Chiên, cá ghé	*Bagarius rutilus* Ng.& Kottelat, 2000	VU	X	X	X

58	Cá chiên suối	*Glyptothorax lampris* Fowler, 1934		X	X	X
59	Cá chiên suối	*Glyptothorax quadriocellatus* (Mai, 1978)		X	X	X
60	Cá chiên suối	*Glyptothorax hainanensis* Nichols & Pope, 1927		X	X	
61	Cá chiên bẹt	*Pareuchiloglanis nebulifer*				
	VI. Bộ MANG LIỀN	**SYNBRANCHIFORMES**				
	13. Họ lươn	**Monopteridae**				
62	Lươn	*Monopterus albus* Zuiew, 1793		X	X	X
	14. Họ cá chạch sông	**Mastacembelidae**				
63	Cá Chạch sông	*Mastacembelus armatus* Lacepede, 1800		X	X	X
	Cá Chạch	*Sinobdella sinensis*				X
	VII. BỘ CÁ VƯỢC	**PERCIFORMES**				
	15. Họ cá rô	**Anabantidae**				
64	Cá Rô	*Anabas testudineus* Bloch, 1792		X	X	X
	16. Họ cá rô mo					
65	Cá rô mo	*Siniperca chuatsi* (Basilewki, 1855)		X	X	
66	Cá rô mo việt nam	*Siniperca vietnamensis* (Mai, 1978)		X	X	
	17. Họ cá tai tượng	**Osphronemidae**				
67	Cá Đuôi cờ	*Macropodus opercularis* Linneaus, 1758		X	X	X
68	Cá Sặc bướm	*Trichogaster trichopterus* Pallas, 1770		X	X	X
	18. Họ cá bống trắng	**Gobiidae**				
69	Cá Bống trắng	*Glossogobius giuris* Hamilton, 1822		X	X	X
70	Cá Bống suối	*Rhinogobius duospilus* Herre, 19x		X	X	X
71	Cá Bống đá	*Rhinogobius giurinus* Rutter, 1897		X	X	X
	19. Họ cá bống đen	**Eleotridae**				
72	Cá bống đen tối	*Eleotris fusca (*Forster, 1801)		X	X	
73	Cá bống đen nhỏ	*Eleotris oxycephala* (Tem. & Schl., 1845)		X	X	

74	Cá bống đen lớn	*Eleotris melanosoma* Bleeker, 1853		X	X	
	20. Họ cá rô phi	**Cichlidae**				
75	Cá Rô phi thường	*Oreochromis mosambicus* Peters, 1852		X	X	X
76	Cá Rô phi vằn	*Oreochromis niloticus* Linnaeus, 1758		X	X	X
	21. Họ cá quả	**Channidae**				
77	Cá Quả	*Channa striata* Bloch, 1793		X	X	X
78	Cá chuối	*Channa maculata* Lacepede, 1801		X	X	
79	Cá trèo đồi	*Channa asiatica* (Linnaeus, 1758)		X	X	X
80	Cá chuối suối	*Channa gachua* (Hamilton, 1822)		X	X	X
	Total		**5**	**71**	**74**	**68**

Table 4: List of wildlife in Nam Mo 1 HPP area, Ky Son district, Nghe An province

No.	Vietnamese name	Scientific name	Data
	I. Bộ Ăn sâu bọ	**Insectivora**	
	1. Họ Chuột chù	**Soricidae**	
1	Chuột chù	*Suncus murinus*	M
	II. Bộ Nhiều răng	**Scandenta**	
	2. Họ Đồi	**Tupaiidae**	
2	Đồi	*Tupaia belangeri*	M
	III. Bộ Dơi	**Chiroptera**	
	3. Họ Dơi quả	**Pteropodidae**	
3	**Dơi chó ấn**	*Cynopterus sphinx*	M
4	**Dơi ăn mật hoa**	*Macroglossus minimus*	M
	4. Họ Dơi nếp mũi	**Hipposideridae**	
5	Dơi mũi quạ	*Hipposideros armiger*	M
6	Dơi mũi xám	*Hipposideros larvatus*	M
	5. Họ Dơi lá mũi	Rhinolophidae	
7	Dơi lá đuôi	*Rhinolophus affinis*	M
8	Dơi lá mũi	*Rhinolophus pusillus*	M
	IV. Bộ Linh trưởng	**Primates**	
	6. Họ Cu li	**Loricidae**	
9	Cu li lớn	*Nycticebus bengalensis*	QS
	7. Họ Khỉ	**Cercopithecidae**	
10	Khỉ vàng	*Macaca mulatta*	QS
	V. Bộ Ăn thịt	**Carnivora**	
	8. Họ Chồn	**Mustelidae**	
11	Chồn vàng	*Martes flavigula*	TL
	9. Họ Cầy	**Viverridae**	
12	Cầy vòi mốc	*Paguma larvata*	QS
13	Cầy vòi đốm	*Paradoxurus hermaphroditus*	QS
	10 Họ Cầy lỏn	**Herpestidae**	
14	Cầy lỏn	*Herpestes javanicus*	TL

No.	Vietnamese name	Scientific name	Data
15	Cầy móc cua	*Herpestes urva*	TL
	11 Họ Mèo	**Felidae**	
16	Mèo rừng	*Prionailurus bengalensis*	QS
	VI. Bộ guốc - chẵn	**Artiodactyla**	
	12. Họ Lợn	**Suidae**	
17	Lợn rừng	*Sus scrofa*	PV
	13. Họ Hươu Nai	**Cervidae**	
18	Hoẵng	*Muntiacus muntjak*	PV
	VII. Bộ Gặm nhấm	**Rodentia**	
	14. Họ Sóc cây	**Sciuridae**	
19	Sóc bụng đỏ	*Callosciurus erythraeus*	QS
20	Sóc mõm hung	*Dremomys rufigenis*	QS
	15. Họ Dúi	**Rhizomyidae**	
21	Dúi mốc lớn	*Rhizomys pruinosus*	M
22	Dúi má vàng	*Rhizomys sumatrensis*	M
	16. Họ Chuột	*Muridae*	
23	Chuột đất lớn	*Bandicota indica*	M
24	Chuột đất bé	*Bandicota savilei*	M
25	Chuột mốc lớn	*Rattus bowersi*	M
26	Chuột hươu lớn	*Rattus edwardsi*	M
27	Chuột nhà	*Rattus flavipectus*	M
28	Chuột hươu bé	*Rattus fulvescens*	M
29	Chuột rừng	*Rattus koratensis*	M
30	Chuột bóng	*Rattus nitidus*	M
31	Chuột núi	*Rattus sabanus*	M

Table 5: List of bird in Nam Mo 1 HPP area, Ky Son district, Nghe An province

No.	Vietnamese name	Scientific name	Data
	I. Bộ Hạc	**CICONIIFORMES**	
	1. Họ Diệc	**Ardeidae**	
1	Cò trắng	*Egretta garzetta*	QS
2	Cò ruồi	*Bubulcus ibis*	QS
	II. Bộ Cắt	**FALCONIFORMES**	
	2. Họ Ưng	**Accipitridae**	
3	Diều hoa Miến Điện	*Spilornis cheela*	QS
	3. Họ Cắt	**Falconidae**	
4	Cắt bụng hung	*Falco severus*	QS
	III. Bộ Gà	**GALLIFORMES**	
	4. Họ Trĩ	**Phasianidae**	
5	Gà rừng	*Gallus gallus*	QS
	IV. Bộ Sếu	**GRUIFORMES**	
	5. Họ Cun cút	**Turnicidae**	
6	Cun cút lưng hung	*Turnix tanki*	QS
	6. Họ Gà nước	**Rallidae**	
7	Gà nước vằn	*Rallus striatus*	QS
8	Kịch	*Gallinula chloropus*	QS
	V. Bộ Rẽ	**CHARADRIIFORMES**	
	7. Họ Choi choi	**Charadriidae**	
9	Choi choi nhỏ	*Charadrius dubius*	QS
	8. Họ Rẽ	**Scolopacidae**	
10	Choắt bụng trắng	*Tringa ochropus*	QS
11	Choắt nhỏ	*Actitis hypoleucos*	QS
	VI. Bộ Bồ câu	**COLUMBIFORMES**	
	9. Họ Bồ câu	**Columbidae**	
12	Cu ngói	*Streptopelia tranquebarica*	QS
13	Cu gáy	*Streptopelia chinensis*	QS

No.	Vietnamese name	Scientific name	Data
	VII. bộ vẹt	**psittaciformes**	
	10. Họ Vẹt	**Psittacidae**	
14	Vẹt ngực đỏ	*Psittacula alexandri*	QS
	VIII. Bộ Cu cu	**CUCULIFORMES**	
	11. Họ Cu cu	**Cuculidae**	
15	Bìm bịp lớn	*Centropus sinensis*	QS
16	Bìm bịp nhỏ	*Centropus bengalensis*	QS
	IX. Bộ Cú	**STRIGIFORMES**	
	12. Họ Cú mèo	**Strigidae**	
17	Cú vọ	*Glaucidium cuculoides*	QS
	X. Bộ Cú muỗi	**CAPRIMULGIFORMES**	
	13. Họ Cú muỗi	**Caprimulgidae**	
18	Cú muỗi ấn Độ	*Caprimulgus indicus*	QS
	XI. Bộ Nuốc	**TROGONIFORMES**	
	14. Họ Nuốc	**Trogonidae**	
19	Nuốc bụng đỏ	*Harpactes erythrocephalus*	QS
	XII. Bộ Sả	**CORACIIFORMES**	
	15. Họ Bói cá	**Alcedinidae**	
20	Bói cá nhỏ	*Ceryle rudis*	QS
21	Bồng chanh	*Alcedo atthis*	TL
	16. Họ Sả rừng	**Coraciidae**	
22	Sả rừng	*Coracias benghalensis*	TL
	XIII. Bộ Gõ kiến	**PICIFORMES**	
	17. Họ Cu rốc	**Capitonidae**	
23	Cu rốc đầu vàng	*Megalaima franklinii*	TL
	XIV. Bộ Sẻ	**PASSERIFORMES**	
	18. Họ Mỏ rộng	**Eurylaimidae**	
24	Mỏ rộng hung	*Serilophus lunatus*	TL

No.	Vietnamese name	Scientific name	Data
	19. Họ Đuôi cụt	**Pittidae**	
25	Đuôi cụt gáy xanh	*Pitta nipalensis*	QS
26	Đuôi cụt đầu xám	*Pitta soror*	QS
	20. Họ Nhạn	**Hirundinidae**	
27	Nhạn nâu hung	*Hirundo concolor*	QS
28	Nhạn bụng trắng	*Hirundo rustica*	QS
	21. Họ Chìa vôi	**Motacillidae**	
29	Chìa vôi vàng	*Motacilla flava*	QS
30	Chìa vôi núi	*Motacilla cinerea*	TL
31	Chìa vôi trắng	*Motacilla alba*	TL
	22. Họ Phường chèo	**Campephagidae**	
32	Phường chèo xám	*Coracina melaschistos*	TL
33	Phường chèo đen	*Hemipus picatus*	TL
34	Phường chèo nâu	*Tephrodornis gularis*	QS
	23. Họ Chào mào	**Pycnonotidae**	
35	Chào mào	*Pycnonotus jocosus*	QS
36	Bông lau tai trắng	*Pycnonotus aurigaster*	TL
37	Bông lau họng vạch	*Pycnonotus finlaysoni*	TL
38	Cành cạch lớn	*Criniger pallidus*	QS
39	Cành cạch nhỏ	*Hypsipetes propinquus*	QS
	24. Họ Chim xanh	**Irenidae**	
40	Chim nghệ ngực vàng	*Aegithina tiphia*	QS
41	Chim xanh trán vàng	*Chloropsis aurifrons*	TL
42	Chim xanh hông vàng	*Chloropsis hardwickei*	TL
43	Chim lam	*Irena puella*	TL
	25. Họ Bách thanh	**Laniidae**	
44	Bách thanh mày trắng	*Lanius cristatus*	QS
45	Bách thanh nhỏ	*Lanius collurioides*	QS
46	Bách thanh đầu đen	*Lanius schach*	TL
	26. Họ Chích chòe	**Turdidae**	
47	Oanh cổ trắng	*Erithacus sibilans*	QS
48	Oanh lưng xanh	*Erithacus cyane*	QS
49	Chích chòe	*Copsychus saularis*	QS

No.	Vietnamese name	Scientific name	Data
50	Chích chòe lửa	*Copsychus malabaricus*	QS
51	Hoét đá	*Monticola solitarius*	QS
52	Sáo đất	*Zoothera dauma*	TL
53	Sáo đất nâu	*Zoothera marginata*	QS
	27. Họ Khướu	**Timaliidae**	
54	Chuối tiêu ngực đốm	*Pellorneum ruficeps*	TL
55	Khướu đất đuôi dài	*Spelaeornis chocolatinus*	TL
56	Khướu bụi trán hung	*Stachyris rufifrons*	TL
57	Họa mi mỏ ngắn	*Chrysomma sinense*	TL
58	Khướu mào cổ trắng	*Yuhina diademata*	QS
59	Khướu mào đầu đen	*Yuhina nigrimenta*	TL
	28. Họ Chim Chích	**Sylviidae**	
60	Chích đuôi cụt	*Tesia olivea*	QS
61	Chiền chiện lớn	*Megalurus palustris*	QS
62	Chích đầm lầy nhỏ	*Locustella lanceolata*	QS
63	Chích mỏ rộng	*Acrocephalus aedon*	QS
64	Chích chân xám	*Phylloscopus tenellipes*	TL
65	Chích mày vàng	*Phylloscopus coronatus*	TL
66	Chích đuôi trắng	*Phylloscopus davisoni*	QS
	29. Họ Đớp ruồi	**Muscicapidae**	
67	Đớp ruồi nâu	*Muscicapa dauurica*	QS
68	Đớp ruồi xanh xám	*Muscicapa thalassina*	QS
69	Đớp ruồi xanh nhạt	*Niltava unicolor*	TL
70	Đớp ruồi họng hung	*Niltavas banyumas*	QS
	30. Họ Rẻ quạt	**Monarchidae**	
71	Thiên đường đuôi phướn	*Terpsiphone paradisi*	QS
72	Rẻ quạt họng trắng	*Rhipidura albicollis*	QS
	31. Họ Bạc má	**Paridae**	
73	Bạc má	*Parus major*	QS
74	Bạc má mào	*Parus spilonotus*	QS
	32. Họ Trèo cây	**Sittidae**	
75	Trèo cây bụng hung	*Sitta castanea*	TL
76	Trèo cây trán đen	*Sitta frontalis*	TL

No.	Vietnamese name	Scientific name	Data
	33. Họ Chim sâu	**Dicaeidae**	
77	Chim sâu bụng vạch	*Dicaeum chrysorrheum*	QS
78	Chim sâu ngực đỏ	*Dicaeum ignipectus*	QS
	34. Họ Hút mật	**Nectariniidae**	
79	Hút mật họng hồng	*Nectarinia sperata*	QS
80	Hút mật ngực đỏ	*Aethopiga saturata*	TL
	35. Họ Vành khuyên	**Zosteropidae**	
81	Vành khuyên họng vàng	*Zosterops palpebrosa*	TL
	36. Họ Sẻ đồng	**Emberizidae**	
82	Sẻ đồng hung	*Emberiza rutila*	QS
83	Sẻ đồng mặt đen	*Emberiza spodocephala*	QS
	37. Họ Chim di	**Estrildidae**	
84	Di cam	*Lonchura striata*	QS
85	Di đá	*Lonchura punctulata*	QS
	38. Họ Sẻ	**Ploceidae**	
86	Sẻ nhà	*Passer montanus*	QS
	39. Họ Sáo	**Sturnidae**	
87	Sáo sậu	*Sturnus nigricollis*	QS
88	Sáo đá Trung Quốc	*Sturnus sinensis*	TL
89	Sáo mỏ vàng	*Acridotheres grandis*	QS
	40. Họ Vàng anh	**Oriolidae**	
90	Tử anh	*Oriolus traillii*	QS
	41. Họ Chèo bẻo	**Dicruridae**	
91	Chèo bẻo	*Dicrurus macrocercus*	QS
92	Chèo bẻo xám	*Dicrurus leucophaeus*	QS
93	Chèo bẻo rừng	*Dicrurus aeneus*	QS
	42. Họ Nhạn rừng	**Artamidae**	
94	Nhạn rừng	*Artamus fuscus*	TL
	43. Họ Quạ	**Corvidae**	
95	Giẻ cùi	*Urocissa erythrorhyncha*	QS
96	Quạ đen	*Corvus macrorhynchos*	QS

Table 6: List of reptile, amphibian in Nam Mo 1 HPP area Ky Son district, Nghe An province

No.	Vietnamese name	Scientific name	Data
	Lớp Bò sát	**Reptilia**	
	I. Bộ Có vảy	**Squamata**	
1	Thằn lằn	Sauria	
	1. Họ Nhông	**Agamidae**	
1	Nhông xanh	*Calotes versicolor*	M
2	Rồng đất	*Physignathus cocincinus*	M
	2. Họ Tắc kè	**Gekkonidae**	
3	Tắc kè	*Gekko gecko*	M
	3. Họ Thằn lằn chính thức	**Lacertidae**	
4	Liu điu kúc-ni	*Takydromus kuhnei*	TL
5	Liu điu chỉ	*Takydromus sexlineatus*	TL
	4. Họ Thằn lằn bóng	**Scincidae**	
6	Thằn lằn bóng hoa	*Mabuya multifasciata*	M
	5. Họ Kỳ đà	**Varanidae**	
7	Kỳ đà vân	*Varanus nebulosus*	QS
8	Kỳ đà hoa	*Varanus salvator*	QS
	Rắn	**Serpentes**	
	6. Họ Rắn giun	**Typhlopidae**	
9	Rắn giun thường	*Ramphotyphlops braminus*	M
	7. Họ Rắn mống	**Xenopeltidae**	
10	Rắn mống	*Xenopeltis unicolor*	M
	8. Họ Rắn nước	**Colubridae**	
11	Rắn roi thường	*Ahaetulla prasina*	M
12	Rắn ráo thường	*Ptyas korros*	M
13	Rắn ráo trâu	*Ptyas mucosus*	QS
14	Rắn bồng chì	*Enhydris plumbea*	M
15	Rắn sãi thường	*Amphiesma stolata*	M
16	Rắn nước	*Xenochrophis piscator*	M
	9. Họ Rắn hổ	**Elapidae**	
17	Rắn cạp nong	*Bungarus fasciatus*	QS
18	Rắn cạp nia bắc	*Bungarus multicinctus*	QS
19	Rắn hổ mang trung quốc	*Naja* cf. *atra*	TL
	10. Họ Rắn lục	**Viperidae**	
20	Rắn lục mép trắng	*Trimeresurus albolabris*	M
21	Rắn lục xanh	*Trimeresurus stejnegeri*	M

No.	Vietnamese name	Scientific name	Data
	II. Bộ Rùa	**Testudines**	
	11. Họ Rùa đầm	**Geoemydidae**	
22	Rùa sa nhân	*Cuora mouhotii*	TL
	Lớp Ếch nhái	**Amphibia**	
	I. Bộ Không đuôi	**Anura**	
	1. Họ Cóc	**Bufonidae**	
23	Cóc nhà	*Duttaphrynus melanostictus*	M
24	Cóc rừng	*Ingerophrynus galeatus*	M
	2. Họ Cóc bùn	**Megophryidae**	
25	Cóc mày bùn	*Leptolalax pelodytoides*	M
26	Cóc mắt bên	*Xenophrys major*	M
	3. Họ Nhái bầu	**Microhylidae**	
27	Ễnh ương thường	*Kaloula pulchra*	M
28	Nhái bầu hoa	*Microhyla fissipes*	M
29	Nhái bầu hây-môn	*Microhyla heymonsi*	M
30	Nhái bầu vân	*Microhyla pulchra*	M
	4. Họ Ếch nhái chính thức	**Dicroglossidae**	
31	Ngoé	*Fejervarya limnocharis*	M
32	Ếch đồng	*Hoplobatrachus chinensis*	M
33	Ếch nhẽo	*Limnonectes kuhlii*	M
34	Cóc nước sần	*Occidozyga lima*	M
	5. Họ Ếch nhái	**Ranidae**	
35	Chàng an-đéc-sơn	*Huia andersonii*	M
36	Ếch xanh	*Huia chloronota*	M
37	Chàng đài bắc	*Hylarana taipehensis*	M
38	Hiu hiu	*Rana johnsi*	M
39	Chẫu	*Sylvirana guentheri*	M
40	Ếch suối	*Sylvirana nigrovittata*	M
	6. Họ Ếch cây	**Rhacophoridae**	
41	Nhái cây	*Phylautus* sp.	M

Table 7: List of insect species in Nam Mo 1 HPP area, Ky Son district, Nghe An province

No.	Vietnamese name	Scientific name	Data
	I. Bộ Cánh cứng	**COLEOPTERA**	
	1. Họ Bọ hung	**Scarabaeidae**	
1		*Peltonotus morio* Burm.	M
	II. Bộ Cánh vảy	**LEPIDOPTERA**	
	2. Họ Bướm phượng	**Papilionidae**	
1		*Chilasa paradosa* (Hewitson)	M
2		*Chilasa slateri* (Hewitson)	M
3		*Graphium agamemnon* (Linn.)	M
4		*Lamproptera meges* (Butler)	M
5		*Meandrusa payeni* (Fruhstorfer)	M
6		*Pachliopa aristolochiae* (Fabricius)	M
7		*Papilio atcnenor* Westwood	M
8		*Papilio bianor* Fruhstofer	M
9		*Papilio memnon* Linn.	M
10		*Papilio nephelus* Westwood	
11		*Papilio noblei noblei* de Niceville	M
12		*Papilio paris* Linn.	M
	3. Họ Bướm phấn	**Pieridae**	
13		*Eurema andersoni* Shisozu et Yata	M
14		*Eurema blanda* (Wallace)	M
15		*Eurema hecabe* (Linn.)	M
16		*Gandaca harina burmana* Moore	M
17		*Hebomoia glaucippe* (Linn.)	M
18		*Ixias pyrene* (Linn.)	M
19		*Leptosia nina nina* (Fabricius)	M
20		*Prioneris philomome* (Boidusval)	M
21		*Prioneris thestylis* (Doubleday)	M
	4. Họ Bướm giáp	**Nymphalidae**	
22		*Argyreus hyperbius* (Linn.)	M
23		*Ariadne ariadne* (Linn.)	M
24		*Ariadne merione* Cramer	M
25		*Ariadne isaeus* Wallace	M
26		*Athyma asura*Moore	M
27		*Athyma kanwa*Moore	M
28		*Charaxes kahruba* Moore	M

No.	Vietnamese name	Scientific name	Data
29		*Charaxes marmax* Westwood	M
30		*Chersonesia risa* Doubleday	M
31		*Cirrochoroa aoris* de Niceville	M
32		*Cirrochoroa tyche* (C. et R. Felder)	M
33		*Hypolymnas bolina* (Linn.)	M
34		*Junonia almana* (Linn.)	M
35		*Junonia hierta* Fabricius	M
36		*Junonia lemonias* (Linn.)	M
37		*Moduza procris* (Cramer)	M
38		*Neptis miah*Moore	M
39		*Neptis nata* (Moore)	M
40		*Neptis sankara* Kollar	M
41		*Neptis soma*Moore	M
42		*Pantoporia aurelia* Stau.	M
43		*Pantoporia hordontia* (Stoll)	M
44		*Stibochiona nicea* (Gray)	M
45		*Symbrenthia hypselis* (Godart)	M
46		*Symbrenthia lilaea* Hewitson	M
47		*Tanaecia cocytus* (Fabricius)	M
48		*Vagrans egista* (Cramer)	M
49		*Vindula erota* (Fabricius)	M
	5. Họ Bướm đốm	**Danaidae**	
50		*Danaus genutia* (Cramer)	M
51		*Euploea aglea* Godart	M
52		*Euploea camaralzeman* Butler	M
53		*Euploea coregodarti* Lucas	M
54		*Parantica aglea* (Moore)	M
55		*Parantica melaneus* (Cramer)	M
56		*Parantica sita* (Kollar)	M
57		*Tirumala limniasce* (Cramer)	M
58		*Tirumala septentrionis* (Butler)	M
	6. Họ Bướm mắt rắn	**Satyridae**	
59		*Coelites nothis* Fruhstorfer	M
60		*Elymnias casiphone* Distant	M
61		*Erites medura* Horsfield	M
62		*Lethe chandica* (Moore)	M
63		*Lethe confusa* (Auriv.)	M

No.	Vietnamese name	Scientific name	Data
64		*Lethe europa* (Fabricius)	M
65		*Lethe naga* Doherty	M
66		*Mycalesis mnasides* Hewitson	M
67		*Mycalesis perseoides* (Moore)	M
68		*Ypthima baldus* (Fabricius)	M
69		*Ypthima huebneri* Kirby	M
70		*Ypthima imitans* Elwes et Edwards	M
71		*Ypthima savana* Smith	M
72		*Zipaetis unipupilata* Lee	M
	7. Họ Bướm tro	**Lycaenidae**	
73		*Acytolepis puspa* (Horsfield)	M
74		*Ancema ctesia* Hewitson	M
75		*Anthene emolus emolus* (Godart)	M
76		*Anthene lycaenina* (Hewitson)	M
77		*Arhopala perimuta* Moore	M
78		*Caleta elna* Hewitson	M
79		*Caleta roxus* Godart	M
80		*Catochrysops strabo* (Fabricius)	M
81		*Jamides alecto alocina* Swinhoe	M
82		*Jamides bochus* Stoll	M
83		*Jamides celeno* Cramer	M
84		*Jamides pura pura* Moore	M
85		*Jamides virulatus* Druke	M
86		*Loxura atymnus* Fruhstorfer	M
87		*Megisba malaya sikkima* Moore	M
88		*Spindasis lohita* Horsfield	M
89		*Spindasis syana* (Horsfield)	M
90		*Yasoda tripunctata* (Hewitson)	M
91		*Zeltus amasa amasa* (Hewitson)	M
	8. Họ Bướm tro vạch	**Riodinidae**	
92		*Abisara burnii* (Fruhstorfer)	M
93		*Abisara echerius* (Stoll)	M
94		*Abisara fylla* (Fruhstorfer)	M
95		*Abisara neophron* (Fruhstorfer)	M
96		*Dodona deodata* Hewitson	M
97		*Laxita thuisto* Hewitson	M
98		*Paralaxita dora* Fruhstorfer	M

No.	Vietnamese name	Scientific name	Data
99		*Stiboges nymphidia*Butler	M
100		*Taxila dora* (Fruhstorfer)	M
101		*Zemeros flegyas* (Cramer)	M
	9. Họ Bướm rừng	**Amathusiidae**	
102		*Amathuxidia amythaon* Talbot	M
103		*Discophora deo* de Niceville	M
104		*Discophora sondaica* Boisduval	M
105		*Enispe eurymius* Doubleday	M
106		*Faunis caneus* Stichel	M
107		*Faunis eumeus* (Staudinger)	M
108		*Stichophthalma fruhstorferi* Rober	M
109		*Stichopthalma louisa* Janet	M
110		*Thaumantis diores* Doubleday	M
111		*Thauria aliris lathyi* Fruhstorfer	M
112		*Zeuxidia anethysa* Butler	M
	10. Họ Bướm nhảy	**Hesperidae**	
113		*Astictopterus jama* Moore	M
113		*Badamia exclamationis* (Fabricius)	M
114		*Baoris farri* (Moore)	M
115		*Bibasis amara* (Moore)	M
116		*Bibasis oedipodea belesis* (Mabille)	M
117		*Bibasis sena sena* (Moore)	M
118		*Celaenorrhinus asmara*Butler	M
119		*Cephrenas acalle* Hopffer	M
120		*Cupitha purea* (Moore)	M
121		*Halpe zola zola* Evans	M
122		*Hasora badra badra* (Moore)	M
123		*Tagiades gana sangarava* Fruhstorfer	M
124		*Tagiades menaka* (Moore)	M
125		*Thoressa cerata* Hewitson	M
126		*Thoressa mansoni* Moore	M
127		*Thoressa submaculata* (Leech)	M
	11. Họ Bướm mỏ chim	**Libytheidae**	
128		*Libythea myrrha* Godart	M
129		*Libythea celtis* Laich.	M
130		*Libythea geoffroyi* Godart	M
131	**12. Họ Bướm ngọc**	**Acraeidae**	

No.	Vietnamese name	Scientific name	Data
132		*Acraea viola* Godart	M
	13. Họ Ngài chim	**Sphingidae**	
133		*Agrius convulvuli* (Linn.)	M
134		*Megacorma obliqua obliqua* (Walker)	M
135		*Acherontia lachensis* (Fabricius)	M
136		*Meganoton analis* (Felder)	M
137		*Meganoton yunanfuana* Clark	M
138		*Psilogramma inrecta* (Walker)	M
139		*Psilogramma menephron* (Cramer)	M
140		*Dolbina inexacta* (Walker)	M
141		*Amplypterus masoni mansoni* (Clark)	M
142		*Barbourion lemaii* (Moult)	M
143		*Ampelophaga dolichoides* (Felder)	M
144		*Elibia dolichus* (Westwood)	M
145		*Acosmeryx shervillii* Boisduval	M
146		*Acosmeryx anceus* Roth. et Jordan	M
147		*Acosmeryx naga* (Moore)	M
148		*Eupanacra variolosa* (Walker)	M
149		*Eupanacra busiris* (Walker)	M
150		*Eupanacra mydon* (Walker)	M
151		*Eupinanga assamensis* (Walker)	M
152		*Angonix testacea* (Walker)	M
153		*Eupteryx bhaga* (Moore)	M
154		*Macroglosum belis* (Linn.)	M
155		*Macroglosum fritzei* Roth. et Jordan	M
156		*Macroglosum corythus* Walker	M
157		*Macroglosum hemichroma* Butler	M
158		*Macroglosum faro* (Cramer)	M
159		*Rhagastis abdomarginatus* (Roth.)	M
160		*Cechenena aegrota* (Butler)	M
161		*Cechenena helops* (Walker)	M
162		*Cechenena minor* (Butler)	M
163		*Cechenena lineosa* (Walker)	M
164		*Cechenena subangustata* Roth.	M
	14. Họ Ngài tằm trời	**Saturnidae**	
165		*Archaeoattacus edwardsii* White	M
166		*Samia cynthia* Drury	M

No.	Vietnamese name	Scientific name	Data
167		*Actias selene* Hubner	M
168		*Antheraea assamensis* Helfer	M
169		*Loepa katina* Westwood	M
170		*Salassa thepis* Leech	M

Table 8: List of flora species in Nam Mo 1 HPP basin

No.	Local name	Scientific name	Use	SĐVN (2007)

	Ngành Thông đất	**Lycopodiophyta**		
	Họ Thông đất	**Lycopodiaceae**		
1.	Thông đất	Lycopodiella cernua (L.) Franco & Vasc.	x	
	Họ Quyển bá	**Selaginellaceae**		
2.	Quyển bá oa-lích	Selaginella wallichii (Wall. ex Hook. & Grev.) Spring		
	Ngành Dương xỉ	**Polypodiophyta**		
	Họ Tóc thần vệ nữ	**Adiantaceae**		
3.	Tóc thần vệ nữ đuôi	Adiantum caudatum L.	x	
	Họ Rau dớn	**Athyriaceae**		
4.	Rau dớn	Callipteris esculenta (Retz.) J. J. Sm.	x	
	Họ Tổ chim	**Aspleniaceae**		
5.	Tổ điểu	Asplenium nidus L.	x	
	Họ Ráng lá dừa	**Blechnaceae**		
6.	Ráng lá dừa	Blechnum orientale L.		
7.	Quyết	Tectaria stenosemioides C. Chr. & Tard.		
	Họ Ráng nhiều chân	**Polypodiaceae**		
8.	Cốt toái bổ	Drynaria fortunei (Kuntze ex Mett.) J. Sm.	**x**	**EN** A1,c,d
9.	Ráng	Microsorum brachylepis (Bak.) Nak.		
	Họ Bòng bong	**Schizeaceae**		
10.	Bòng bong to	Lygodium conforme C. Chr.		
	Họ Ráng lỡi beo	**Vittariaceae**		
11.	Ráng tô tần dàu	Vittaria elongata Sw.		
	Ngành thông	**Pinophyta**		
	Họ Gắm	**Gnetaceae**		
12.	Gắm núi	Gnetum montanum Markgraf		
	Ngành Mộc lan	**Magnoliophyta**		
	Lớp Mộc lan	**Magnoliopsida**		
	Họ Ô rô	**Acanthaceae**		
13.	Cát đằng thơm	Thunbergia eberhardtii R. Ben.		
	Alangiaceae	**Họ Thôi ba**		
14.	Quăng lâm	Alangium barbatum (R. Br.) Baill.		
	Họ Xoài	**Anacardiaceae**		

15.	Dâu da xoan	Spondias lakoensis Pierre	x, x	
16.	Muối	Rhus chinensis Muell.		
	Họ Na	**Annonaceae**		
17.	Dây công chúa	Desmos chinensis Lour.		
18.	Cách có lông	Fissistigma villossium (Ast.) Merr.		
	Họ Trúc đào	**Apocynaceae**		
19.	Sữa	Alstonia scholaris (L.) R. Br.	x, x	
20.	Lài trâu	Tabernaemontana bovina Lour.	x	
21.	Lòng mức trung bộ	Wrightia annamensis Eberh. & Dub.	x	
	Họ Bùi	**Aquifoliaceae**		
22.	Bùi tròn	Ilex rotunda Thunb.		
	Họ Nhân sâm	**Araliaceae**		
23.	Đơn châu chấu	Aralia armata (Wall. ex G. Don) Seem.	x	
24.	Chân chim tám lá	Schefflera heptaphylla (L.) Harms	x	
25.	Thầu dầu núi	Trevesia palmata (Roxb. & Lindl.) Vis.	x	
	Họ Thiên lý	**Asclepiadaceae**		
26.	Hà thủ ô nam	Streptocaulon juventas (Lour.) Merr.	x	
	Họ Cúc	**Asteraceae**		
27.	Cứt lợn	Ageratum conyzoides L.	x	
28.	Đại bi	Blumea balsamifera (L.) DC.	x,x	
29.	Cúc chỉ thiên	Elephantopus scaber L.	x	
30.	Cỏ lào	Eupatorium odoratum L.		
31.	Rau tàu bay	Gynura crepidioides Benth.		
	Họ Núc nác	**Bignoniaceae**		
32.	Núc nác	Oroxylum indicum (L.) Kurz	x,x	
33.	Quao	Radermachera stellata Steen.		
	Họ Gạo	**Bombacaceae**		
34.	Gạo	Bombax malabaricum DC.		
	Họ Bọ chó	**Buddlejaceae**		
35.	Bọ chó, Cây chìa vôi	Buddleja asiatica Lour.		
	Họ Trám	**Burseraceae**		
36.	Trám trắng	Canarium album Raeusch	x,x	
	Họ Vang	**Caesalpiniaceae**		

37.	Móng bò	Bauhinia viridescens Desv.		
38.	Móc mèo núi	Caesalpinia bonduc (L.) Roxb.		
39.	Muồng lá khế	Cassia occidentalis L.		
40.	Thảo quyết minh	Cassia tora L.		
	Họ Màn màn	**Capparaceae**		
41.	Cáp	Capparis micrantha DC.		
42.	Cây bún	Crateva magna (Lour.) DC. (C. nurvala Buch.-Ham.)	x	
43.	Trứng cuốc	Stixis scandens Lour.		
	Họ Kim ngân	**Caprifoliaceae**		
44.	Cơm cháy	Sambucus hookeri Rehd.		
45.	Vót vàng	Viburnum lutescens Blume		
	Họ Rum	**Cecropiaceae**		
46.	Rum thơm	Poikilospermum suaveolens (Blume) Merr.		
	Họ Bứa	**Clusiaceae**		
47.	Sơn vé	Garcinia merguensis Wight	x,38,x	
48.	Bứa nam bộ	Garcinia cochinchinensis (Lour.) Chóiy	x, x	
	Họ Dây khế	**Connaraceae**		
49.	Lốp bốp	Connarus paniculatus Roxb.		
	Convolvulaceae	**Họ Khoai lang**		
50.	Bạc thau	Argyreia acuta Lour.	x	
51.	Bìm bìm lam	Ipomoea nil (L.) Roth.		
52.	Bìm bìm vàng	Merremia boisiana (Gagnep.) Van Ooststn.		
	Họ Bầu bí	**Cucurbitaceae**		
53.	Đại hái	Hodgsonia macrocarpa (Blume) Cogn.	x	
	Họ Tơ hồng	**Cuscutaceae**		
54.	Tơ hồng	Cuscuta chinensis Lam		
	Họ Dầu	**Dipterocarpaceae**		
55.	Táu mặt quỷ	Hopea mollissima C. Y. Hu	x	VU A1c,d
56.	Chò chỉ	Shorea chinensis (Wang Hsie) H.Zhu	x	
57.	Táu	Vatica odorata (Griff.) Symington	x	
	Họ Sổ	**Dilleniaceae**		
58.	Lọng bàng	Dillenia turbipinnata Fin. & Ggnep.		

59.	Chạc chìu	Tetracera scandens (L.) Merr.		
	Họ Nhót	**Elaeagnaceae**		
60.	Nhót lá rộng	Elaeagnus latifolia L.		
	Họ Côm	**Elaeocarpus**		
61.	Côm hải nam	Elaeocarpus hainamensis		
	Họ Thầu dầu	**Euphorbiaceae**		
62.	Chòi mòi bun	Antidesma bunius (L.) Spreng	x	
63.	Ngăm	Aporusa dioica (Roxb.) Muell.-Arg.		
64.	Dâu gia đất	Baccaurea racemosa Lour.	x	
65.	Nhội	Bischofia javanica Blume	x	
66.	Bồ cu vẽ	Breynia fruticosa Hook. f.	x	
67.	Ba đậu, Mần để	Croton tiglium L.	x	
68.	Vạng trứng	Endospermum chinense Benth.	x	
69.	Bòn bọt	Glochidion eriocarpum Champ.		
70.	Rù rì	Homonoia riparia Lour.		
71.	Lá nến, Ba soi	Macaranga denticulata (Blume) Muell.-Arg.	x,34	
72.	Bục bục	Mallotus barbatus (Wall.) Muell.-Arg.		
73.	Bục bạc	Mallotus paniculatus (Lam.) Muell-Arg. (M. cochinchinensis Lour.)		
74.	Me rừng	Phyllanthus embrica L.	x	
75.	Diệp hạ châu	Phyllanthus annamensis Beille.		
76.	Trẩu	Vernicia montana Lour.	34,x	
	Họ Đậu	**Fabaceae**		
77.	Đậu săng	Cajanus indicus Spreng		
78.	Lục lạc trắng xanh	Crotalaria pallida Aiton		
79.	Dây mật	Derris elliptica (Roxb.) Benth.	x	
80.	Hàn the dị phiến	Desmodium heterophyllum (Willd) DC.		
81.	Dây mật	Millettia pachyloba Drake	x	
82.	Kè huyết đằng	Millettia reticulata Benth.	x	
83.	Ràng ràng	Ormosia pinnata (Lour.) Merr.	x	
	Fagaceae	**Họ Dẻ**		
84.	Dẻ gai phảng	Castanopsis fissa (Champ.) Rehd. & Wild.	x	
85.	Dẻ gai ấn độ	Castanopsis indica (Roxb.) A. DC.	x	

86.	Dẻ gai bắc bộ	Castanopsis tonkinensis Seem.	x	
87.	Dẻ trung bộ	Lithocarpus annamensis (Hick. & A. Camus) Barn.	x	
88.	Sồi ghẻ	Lithocarpus corneus (Lour.) Rehd.		
89.	Dẻ xanh	Lithocarpus pseudosundaicus (Hick. & A. Camus) A. Camus	x	
	Họ Bồ	**Flacourtiaceae quân**		
90.	Nang trứng lá ô rô	Hydnocarpus ilicifolia King	x,x	
	Họ Thợng tiền	**Gesneriaceae**		
91.	Hai hùng nhám	Didissandra aspera Drake		
	Họ Liên đằng	**Hernandiaceae**		
92.	Liên đằng	Illigera celebica Miq.		
	Họ Thường sơn	**Hydrangeaceae**		
93.	Thường sơn	Dichroa febrifuga Lour.		
	Họ Ban	**Hypericacaceae**		
94.	Thành ngạnh	Cratoxylum cochinchinensis (Lour.) Blume	x	
95.	Đỏ ngọn	Cratoxylum formosum (Jack.) Benth. et Hook. f. ex Dyer	x	
	Họ Thụ đào	**Icacinaceae**		
96.	Mao hùm mềm	Gomphandra mollis Merr.		
97.	Mộc thông, Tử quả	Iodes cirrhoza Turz		
	Họ Hồ đào	**Juglandaceae**		
98.	Chẹo	Engelhardtia roxburghiana Wall.	x, x	
99.	Cơi bắc bộ	Pterocarya stenoptera C. DC. var. tonkinensis Frach.	x,x	
	Họ Hoa môi	**Lamiaceae**		
100.	Đinh hùng mảnh	Gomphostemma leptodon Dunn.	x	
101.	Bạch thiệt	Leucas aspera (De Wilde) Link	x	
102.	Lá men	Mosla dianthera (Benth. et Hook.) Maxim.	x,x	
	Họ Long não	**Lauraceae**		
103.	Vàng trắng lông	Alseodaphne velutina Cher.	x	
104.	Tơ xanh	Cassytha filiformis L.		
105.	Quế lợn	Cinnamomum iners Reinw. ex Blume	x	
106.	Re chay	Cinnamomum tamala (Buch.-Ham.) Nees et Eberm		
107.	Mò trung hoa	Cryptocarya chinensis (Hance) Hemsl.		

108.	Mò lá tù, ẩn hạch, Cà đuối nhuộm	Cryptocarya infectoria (Blume) Miq. (C. obtusifolia Merr.)		
109.	Liên đàng thờng	Lindera communis Hemsl.		
110.	Màng tang	Litsea cubeba (Lour.) Pers	x,x	
111.	Bời lời nhớt	Litsea glutinosa (Lour.) C. B. Robins	x,x	
112.	Kháo thơm	Machilus odoratissimus Nees		
113.	Bài nhài tích-lan	Neolitsea zeylanica (C. & T. Nees) Merr.		
114.	Sụ lá to	Phoebe tavoyana (Meissn.) Hook. f.		
	Họ Gối hạc	**Leeaceae**		
115.	Gối hạc đen	Leea indica (Burm. f.) Merr.	x	
	Họ Mã tiền	**Loganiaceae**		
116.	Trai tích lan	Fagraea ceilanica Thunb.		
117.	Lá ngón, Ngón	Gelsemium elegans (Gardn. et Champ.) Benth.	x	
118.	Mã tiền	Strychnos axillaris Colebr.	x	
	Họ Tầm gửi	**Loranthaceae**		
119.	Đại cán lá bắc hai	Macrosolen bibracteolatus (Hance) Dans.		
120.	Tầm gửi sét	Scurrula ferruginea (Jack) Danser		
121.	Mộc vệ ký sinh	Scurrula parasitica L.		
	Họ Bằng lăng	**Lythraceae**		
122.	Bằng lăng	Lagerstroemia calyculata Kurz	x	
123.	Săng lẻ	Lagerstroemia tomentosa Presl	x	
	Họ Bần	**Soneratiaceae**		
124.	Phay	Duabanga grandiflora (DC.) Walp.	x	
	Họ Mộc lan	**Magnoliaceae**		
125.	Mộc lan lông	Magnolia albosericea C. H. Tsoong		
126.	Mỡ	Manglietia conifera Dandy	x	
127.	Giổi nhung	Michelia foveolata Merr. ex Dandy (M. fulgens Dandy)	x	
	Họ Bông	**Malvaceae**		
128.	Bò ké, Ong bù	Kydia calycina Roxb.	x	
129.	Ké hoa vàng	Sida acuta Burm.		
130.	Bái bò	Sida cordata (Burm. f.) Boiss		
131.	Ké hoa vàng	Sida rhombifolia L.		
132.	Ké hoa đào	Urena lobata L.		

	Họ Mua	**Melastomataceae**		
133.	Mua rừng	Blastus cochinchinensis Lour.		
134.	Mua không tuyến	Blastus eglandulosus Staf. ex Spare		
135.	Mua thờng	Melastoma normale D. Don		
136.	Mua máu	Melastoma sanguinea Sims.		
137.	Sầm bù	Memecylon edule Roxb.		
138.	Mua đỏ chùm	Oxyspora paniculata (D. Don) DC.		
139.	Cẩm hơng bò cạp	Phyllagathis scorpiothyrsioides C. Hans		
140.	Cẩm hơng nằm ngang	Phyllagathis prostrata C. Hans		
	Sơn linh fi-nê	Sonerila finetii Guillaumin		
	Họ Xoan	**Meliaceae**		
141.	Gội dịu	Aglaia edulis (Roxb.) Gray	x	
142.	Gội lông	Aglaia tomentosa T. & B.	x	
143.	Gội nước	Aphanamixis polystachya (Wlall.) R. N. Parker	x	
144.	Quếch trung hoa	Chisocheton chinensis Merr.	x	
145.	Cà muối quả mọng	Cipadessa baccifera (Roxb.) Miq.		
146.	Xoan	Melia azedarach L.	x	
	Họ Tiết dê	**Menispermaceae**		
147.	Tiết dê	Cissampelos pareira L.		
148.	Dây xanh	Cocculus trilobus (Thunb.) DC.		
149.	Lõi tiềm lam	Pericampilus glaucus (Lam.) Merr.		
150.	Phải đằng	Pycnarrhena poilanei (Gagnep.) Forman		
151.	Dây cóc	Tinospora crispa (L.) Miers		
	Họ Trinh nữ	**Mimosaceae**		
152.	Sống rắn dày	Acacia pennata (L.) Willd.		
153.	Sống rắn sừng nhỏ	Albizia corniculata (Lour.) Druce		
154.	Dái bò, Bản xe	Albizia lucidior (Steud.) I. Niels.		
155.	Lim bình hành, mán đỉa	Archidendron clypearia (Jack.) I. Niels.		
156.	Mán đỉa trâu	Archidendron lucidum (Benth.) I. Niels.		
157.	Trinh nữ	Mimosa diplotricha C. Wright ex Sauvalle		
158.	Trinh nữ gỗ, Ma Dơng	Mimosa pigra L.		
159.	Trinh nữ thẹn	Mimosa pudica L.		

	Họ Dâu tằm	**Moraceae**		
160.	Mít nài	Artocarpus rigidus Blume	x,x	
161.	Mỏ quạ ba mũi	Cudrania tricuspidata (Carr.) Bur. ex Lav.		
162.	Ngoã lông vàng	Ficus fulva Reinw. ex Blume		
163.	Ngái lông	Ficus hirta Vahl		
164.	Ngái	Ficus hispida L. f.		
165.	Sung táo	Ficus oligodon Miq.		
166.	Sung bán tâm	Ficus semicordata Griff.		
167.	Rù rì quả lê	Ficus subpyriformis Hook. & Arg.		
168.	Sung biến diệp	Ficus variolosa Lindl. ex Benth.		
169.	Ruối	Streblus asper Lour.	x	
170.	Ruối ô rô	Streblus ilicifolius (Vidal) Corner	x	
	Họ Máu chó	**Myristicaceae**		
171.	Săng máu quả đào	Horsfieldia amygdalina (Wall.) Warb.		
172.	Săng máu tô-ren	Horsfieldia thorelii Lecomte	x	
173.	Máu chó lá nhỏ	Knema conferta Warb.	x	
	Họ Đơn nem	**Myrsinaceae**		
174.	Trọng đũa sóng giả	Ardisia pseudocrispa Pit.		
175.	Trọng đũa xỉn	Ardisia quinquegona Blume		
176.	Thùn mũn, Vón vén	Embelia ribes Burm. f.		
177.	Đơn nem núi	Maesa balansae Mez		
178.	Đơn nem màng	Maesa membranacea A. DC.		
	Họ Sim	**Myrtaceae**		
179.	Trâm lục hoa nhỏ	Decaspermum parviflorum (Lam.) Scott.		
180.	Sim	Rhodomyrtus tomentosa (Aiton) Hassk.		
181.	Trâm mốc	Syzygium cumini (L.) Druce	x	
182.	Trâm đẹp	Syzygium formosum (Wall.) Masam	x	
183.	Trâm lá hẹp	Syzygium linneatum		
184.	Trâm oai	Syzygium wightianum Wall et Arn.		
185.	Trâm vỏ đỏ	Syzygium zeylanicum (L.) DC.	x	
	Họ Nhài	**Oleaceae**		
186.	Lài ba gân	Jasminum triplinerve Vahl		

187.	Nhài dạng sóng	Jasminum undulatum Ker.-Gawl.		
188.	Lí lãm đầu nhụy nhỏ	Linociera insignis C. B. Clarker		
	Họ Rau mương	**Onagraceae**		
189.	Rau mơng đứng	Ludwigia octovalvis (Jack.) Raven		
190.	Rau mơng đất	Ludwigia prostrata Roxb.		
	Họ Chua me	**Oxalidaceae**		
191.	Chua me đất	Biophytum sensitivum (Lour.) DC.		
192.	Chua me đất vàng	Oxalis corniculata L.		
	Họ Lạc tiên	**Passifloraceae**		
193.	Vòng kỷ	Adenia heterophylla (Blume) Koord		
194.	Lạc tiên, Nhãn lồng	Passiflora foetida L.	x	
	Họ Rau tai voi	**Pentaphragmataceae**		
195.	Rau tai voi	Pentaphragma sinense Hemsl. & Wils.	x	
	Họ Hồ tiêu	**Piperaceae**		
196.	Rau càng cua	Peperomia pellucida (L.) H. B. K		
197.	Tiêu lông	Piper bonii C. DC.		
198.	Tiêu dày	Piper densum Blume		
199.	Lá lốt	Piper lolot C. DC.	x,x	
200.	Tiêu dài	Piper longum L.		
201.	Thảo hồ tiêu	Zippelia begoniifolia Blume ex Schult. & Schult.		
	Họ Hải đồng	**Pittosporaceae**		
202.	Hải đồng lá mác	Pittosporum aff. baileyanum Gowda		
	Họ Mã đề	**Plantaginaceae**		
203.	Mã đề châu á	Plantago asiatica L.	x	
204.	Mã đề	Plantago major L.	x	
	Họ Viễn chí	**Polygalaceae**		
205.	Viễn chí bắc bộ	Polygala tonkinensis Chodat		
	Họ Rau răm	**Polygonaceae**		
206.	Nghể râu	Polygonum barbatum L.		
207.	Thồm lồm	Polygonum chinense L.		
208.	Hà thủ ô	Polygonum multiflorum Thunb. ex Murray	x	
209.	Thồm lồm gai	Polygonum perfoliatum L.		

	Họ Quắn hoa	**Proteaceae**		
210.	Cơm vàng	Helicia cochinchinensis Lour.	x	
211.	Túng, Đáng	Heliciopsis lobata (Merr.) Sleum.	x	
	Ranunculaceae	**Họ Mao lương**		
212.	Vằng kim cang	Clematis smilacifolia Wall.		
213.	Bạch tụ tích lan	Naravelia zeylanica (L.) DC.		
	Họ Táo ta	**Rhamnaceae**		
214.	Dây đòn gánh	Gouania leptostachya DC.		
215.	Táo hoang	Ziziphus oenoplia (L.) Mill.		
	Họ Đước	**Rhizophoraceae**		
216.	Trúc tiết cành doãng	Carallia brachiata (Lour.) Merr.		
	Họ Hoa hồng	**Rosaceae**		
217.	Xoan đào	Prunus arborea (Blume) Kalkm.	x	
218.	Mâm xôi	Rubus alcaefolius Poir.	x	
219.	Ngấy hơng	Rubus cochinchinensis Tratt.		
	Họ Cà phê	**Rubiaceae**		
220.	Gáo nước	Adina pilulifera (Wall. ex Don) Benth.		
221.	Gáo hoa dày	Aidia pycnantha (Drake) Tirv.		
222.	Đoản ngạc xỉ oa-lích	Brachytome wallichii Hook. f.		
223.	Găng gai	Canthium horridum Blume		
224.	Dạ cẩm	Hedyotis capitellata Wall. ex G. Don	x	
225.	Lỡi rắn trắng	Hedyotis diffusa Willd.	x	
226.	Đơn đỏ	Ixora coccinea L.	x	
227.	Mẫu đơn lá đại sa	Ixora pavettaefolia Craib		
228.	Xú hơng trung bộ	Lasianthus annamicus Pit.		
229.	Xú hơng phiến mác	Lasianthus lancilimbus Merr.		
230.	Mặt quỉ	Morinda umbellata L.	x	
231.	Bớm cam-pu-chia	Mussaenda cambodiana Pierre		
232.	Bớm bạc lông mềm	Mussaenda pubescens Ait.		
233.	Tuyến ngạc ba-lăng-xa	Mycetia balansae Drake		
234.	Vạn kính tàn	Myrioneuron effusum (Drake) Merr.		
235.	Gáo, Săng tàn	Neolamarkia cadamba (Roxb.) Bosser	x	
236.	Xà căn lá to	Ophiorrhiza amplifolia Drake		

237.	Mơ leo	Paederia scandens (Lour.) Merr.		
238.	Dọt sành hoa	Pavetta graciliflora Wall.		
239.	Lấu núi	Psychotria montana Blume		
240.	Lấu gân ít	Psychotria oligoneura Pierre ex Pit.		
241.	Lấu bò	Psychotria repens L.		
242.	Lấu đỏ, Lấu	Psychotria rubra (Lour.) Poit.		
243.	Găng trâu, Găng mài	Randia spinosa Blume		
244.	Trèn lá to	Tarenna latifolia Pit.		
245.	Câu đằng lá to	Uncaria macrophylla DC.		
246.	Câu đằng lá nhọn	Uncaria rhynchophylla (Miq.) Hail		
247.	Chà hươu lào	Wendlandia laotica Pit.		
248.	Chà hươu chuỳ	Wendlandia paniculata (Roxb.) DC.		

249.	Chà hươu nhuộm	Wendlandia tinctoria (Roxb.) DC.		
	Họ Cam	**Rutaceae**		
250.	Bai bái, Bởi bung	Acronychia pedunculata (L.) Miq.	x, x	
251.	Hồng bì lõm	Clausena excavata Burm. f.		
252.	Chè cỏ, Ba chạc	Euodia lepta (Spreng) Merr.	x, x	
253.	Cơm rượu	Glycomis pentaphylla Retz.		
254.	Tiêu vân lông, Mắt trâu	Micromelum hirsutum Oliv.		
255.	Tiểu vân nhỏ, Kim s-ơng lá nhỏ	Micromelum minutum (Forst. f.) Wight & Arn. (M. falcatum Tanaka)		
256.	Sơn tiêu, Truống	Zanthoxylum avicenniae (Lam.) DC.		
257.	Trng, Sng	Zanthoxylum nitidum (Roxb.) DC.	x, x	
	Họ Bồ hòn	**Sapindaceae**		
258.	Ngoại mộc lục	Allophylus viridis Radlk		
259.	Dây tầm phong	Cardiospermum halicacabum L.		
260.	Nhãn rừng	Dimocarpus fumatus (Blume) Leenh.	x	
261.	Trờng mật trung bộ	Paviesia annamensis Pierre	x	
262.	Sâng	Pometia pinnata Forst. & Forst. f.	x	
263.	Bồ hòn	Sapindus saponaria L.		
	Họ Hồng xiêm	**Sapotaceae**		
264.	Cồng sữa vàng	Eberhardtia aurata (Dub.) Lecomte		
265.	Trứng gà	Pouteria sapota (Jacq.) H. Moore & Stearn.	x	
266.	Nhục tử hẹp	Sacrosperma angustifolium Gagnep.		
267.	Hồng đạt	Sarcosperma kachinense (King & Prain) Excell		
268.	Sến đất trung hoa	Sinosideroxylon aff. wightianum Hook. & Arn.		
	Họ Diếp cá	**Saururaceae**		
269.	Diếp cá	Houttuynia cordata Thunb.	x	
	Họ Ngũ vị	**Schisandraceae**		
270.	Chua cùm đỏ	Kadsura coccinea (Lem.) A. C. Smith	x	
	Họ Hoa mõm chó	**Scrophulariaceae**		
271.	Tuyến hơng lam	Adenosma caerulea R. Br.		
272.	Cam thảo đất	Scoparia dulcis L.	x	
	Họ Thanh thất	**Simaroubaceae**		
273.	Sầu đâu cứt chuột,	Brucea javanica (L.) Merr. (B. sumatrana		

	Nha đảm tử	Roxb.)		

274.	Hải sơn	Harrisonia perforata (Blumea) Merr.		
	Họ Cà	**Solanaceae**		
275.	Cà hoa lông, Cà hôi	Solanum erianthum D. Don		
	Họ Trôm	**Sterculiaceae**		
276.	Tai mèo bông vàng, Nga khoai	Abroma angusta (L.) L. f.		
277.	Trôm leo	Byttneria aspera Colebr.		
278.	Thung	Commersonia bartramia (L.) Merr.		
279.	Con chuột	Helicteres hirsuta Lour.		
280.	Lòng mang	Pterospermum heterophyllum Hance		
281.	Mang lá cụt	Pterospermum truncatolobatum Gagnep.		
282.	Trôm thối	Sterculia foetida L.	x	
283.	Sảng	Sterculia lanceolata Cav.	x	
	Họ Dung	**Symplocaceae**		
284.	Dung nam bộ	Symplocos cochinchinensis (Lour.) Moore. [S. laurina Wall. ex G. Don]	x,x	
285.	Dung lá súm	Symplocos euryoides Hand.-Mazz.		
286.	Dung lông	Symplocos glomerata subsp. adenopus (Hance) Nooteb.		
	Họ Chè	**Theaceae**		
287.	Chè	Camellia sinensis (L.) Kuntze	38	
288.	Súm trơn	Eurya nitida Korth.		
289.	Súm có lông	Eurya trichocarpa Korth.		
290.	Trín	Schima wallichii (DC.) Korth.		
	Họ Trầm	**Thymelaeaceae**		
291.	Niệt gió	Wikstroemia indica (L.) C. A. Mey		
	Họ Đay	**Tiliaceae**		
292.	Nghiến trắng	Burretiodendron hsienmu W.Y.Chun & F.C.How	x	
293.	Bồ an dạng tai	Colona auriculata (Desf.) Craib		
294.	Cò ke châu á	Grewia asiatica L.		
295.	Cò ke lá sếu	Grewia ericocarpa Juss. (G. celtidifolia Juss.)		
296.	Cò ke	Grewia paniculata Roxb.		
297.	Ké đay vàng	Triumfetta rhomboidea Jack.		
	Họ Du	**Ulmaceae**		

298.	Ma trá oai	Celtis philippense Blanco	x	
299.	Sếu	Celtis sinensis Person	x	
300.	Ngát vàng	Gironniera subaequalis Planch.	x	
301.	Hu lá hẹp	Trema angustifolia (Planch.) Blume		
	Họ Gai	**Urticaceae**		
302.	Gai	Boehmeria nivea (L.) Gaudich.	38	
303.	Lâu khê	Elatostema balansae Gagnep.		
304.	Cao hùng da	Elatostema rupestre Wedd.		
305.	Han đài hai	Laportea disepala (Gagnep.) Chew.		
306.	Han lá dài	Laportea thorelii Gagnep.		
307.	Han lá nguyên	Oreocnide integrifolia (Gaud.) C. J. Chen		
308.	Sam đá	Pellionia repens (Lour.) Merr.		
309.	Pí lè ba vì, Nan ông ba vì	Pilea boniana Gagnep. (P. baviensis Gagnep.)		
310.	Bọ mắm lông	Pouzolzia hirta Hassk.		
311.	Bọ mắm	Pouzolzia zeylanica (L.) Benn.		
	Họ Cỏ roi ngựa	**Verbenaceae**		
312.	Tu hú thân gỗ	Callicarpa arborea Roxb.		
313.	Tu hú hồng	Callicarpa rubella Lindl.		
314.	Bọ mẩy, Đắng cẩy	Clerodendrum cyrtophyllum Turcz.		
315.	Lõi thọ châu á	Gmelina asiatica L.		
316.	Bông ổi	Lantana camara L.		
317.	Cách ba-lăng-xa	Premna balansae Dop.		
318.	Cỏ roi ngựa	Verbena officinalis L.		
319.	Đẻn ba lá	Vitex trifolia L.		
320.	Bình linh cọng mảnh	Vitex tripinnata (Lour.) Merr.	x	
	Họ Hoa tím	**Violaceae**		
321.	Tam giác xa	Rinorea virgata (Thw.) Kuntze		
322.	Cải gừng tía	Viola inconspicua Blume		
	Họ Nho	**Vitaceae**		
323.	Chè dây	Ampelopsis cantoniensis (H. et A.) Planch.	x	
324.	Ô liễm ba lá	Cayratia trifolia (L.) Domino		
325.	Bạch phấn bốn cạnh	Cissus subtetragona Planch.		

326.	Tứ th thân dẹt	Tetrastigma planicaule (Hook. f.) Gagnep.		
	Lớp Loa kèn	**Liliopsida**		
	Họ Thạch Xơng bồ	**Acoraceae**		
327.	Thạch xương bồ	Acorus gramineus Ait. ex Soland.	x	
	Họ Ráy	**Araceae**		
328.	Khoai ráp	Alocasia macrorrhizos (L.) G. Don	x,43	
329.	Khoai sọ, Khoai nớc	Colocasia esculenta (L.) Schott	43	
330.	Ráy	Colocasia macrorhiza (L.) G. Don		
331.	Sơn thục	Homalomena occulta (Lour.) Schott	x	
332.	Cơm lênh bò	Pothos repens (Lour.) Druce		
333.	Ráy leo chân rết	Pothos scandens L.		
334.	Đuôi phợng men xuống	Raphidophora decursiva (Roxb.) Schott		
	Họ Cau	**Arecaceae**		
335.	Mây thủ công	Calamus faberi Becc.	x	
336.	Song đá	Calamus rudentum Lour.	x	
337.	Mây lá liễu	Calamus salicifolius Becc.	x	
338.	Đùng đình	Caryota mitis Lour.		
339.	Đùng đình bông đơn	Caryota monostachya Becc.		
340.	Lá nón	Licuala spinosa Wurm.		
341.	Cau rừng	Pinanga dupperreana Pierre ex Gagnep.	x	
342.	Lụi mảnh	Rhapis gracilis Burret	x	
	Họ Măng tây	**Asparagaceae**		
343.	Thiên môn đông	Asparagus cochinchinensis (Lour.) Merr.	x	
	Họ Thài lài	**Commelinaceae**		
344.	Thài lài	Commelina communis L.	43	
345.	Pôn nhật	Pollia japonica Thunb.		
346.	Thài lài tía	Tradescantia zebrina Hort. ex Loudon		
347.	Đầu rìu	Floscopa scandens Lour.		
348.	Loã trai ngọt	Murdannia edulis (Stokes) Faden.		
349.	Rau lài	Pollia secundiflora (Blume) Bakh. f.		
350.	Bôn dãy	Pollia thyrsiflora (Blume) Endl. & Hassk.		
	Họ Tỏi đá	**Convallariaceae**		

351.	Mạch môn đông	Ophiopogon japonicus (L. f.) Ker.-Gawl.	x	
352.	Cao cẳng lá rộng	Ophiopogon latifolius Rodr.	x	
353.	Cao cẳng lá dài	Ophiopogon longifolius Dcne.	x	
	Họ Mía dò	**Costaceae**		
354.	Mía dò	Costus speciosus (Koenig) Smith	x,x	
	Họ Cói	**Cyperaceae**		
355.	Cói hoa xoè	Cyperus diffusus Vahl		
356.	Cói bông cách	Cyperus distans L. f.		
357.	Cói cao	Cyperus exaltatus Retz.		
358.	Cỏ gấu	Cyperus rotundus L.	x	
359.	Năn dẹt	Fimbristylis complanata (Retz.) Link.		
360.	Năn hai ngả	Fimbristylis dichotoma (L.) Vahl		
361.	Cỏ bạc đầu	Kyllinga monocephala Rottb.		
362.	Bạc đầu	Kyllinga nemoralis (J. R. & G. Forst) Dandy ex Hutch. & Dalz.		
363.	Cơng tản phòng	Scleria corymbifera Hook. & Thoms.		
	Họ Củ nâu	**Dioscoreaceae**		
364.	Củ nâu	Dioscorea cirrhosa Lour.	38	
365.	Khoai mài	Dioscorea depauperata Prain et Burk.		
366.	Củ mài, Hoài sơn	Dioscorea persimilis Prain & Burk.	x,x	
367.	Từ lá lê	Dioscorea pyrifolia Kunth		
368.	Từ hoa nhỏ	Dioscorea scortechini Prain & Burk.		
369.	Từ ba lá	Dioscorea triphylla L.		
	Họ Bồng bồng	**Dracaenaceae**		
370.	Huyết giác nam bộ	Dracaena cochinchinensis (Lour.) Merr.	38,x	
	Họ Sâm cau	**Hypoxidaceae**		
371.	Cồ nốc mảnh	Curculigo gracilis Wall.	x	
372.	Sâm cau lá rộng	Curculigo latifolia Dryand. ex Ait.	x	
	Họ La dơn	**Iridaceae**		
373.	Rẻ quạt	Belamcanda chinensis (L.) DC.	x	
	Họ Dong ta	**Marantaceae**		
374.	Dong dạng đầu	Phrynium capitatum Willd		
	Họ Chuối	**Musaceae**		

375.	Chuối rừng, Chuối sen	Musa coccinea Andr.	x	
	Họ Phong lan	**Orchidaceae**		
376.	Xuệ lan vàng đỏ	Acampe ochracea (Lindl.) Hochr.	x	
377.	Lan lá lúa	Arundina graminifolia (D. Don) Hodr.	x	
378.	Lan cầu gần	Bulbophyllum affine Lindl.	x	
379.	Kiều lan đỉnh	Calanthe clavata Lindl.	x	
380.	Thanh đạm tái	Coelogyne pallens Ridl.	x	
381.	Lan lô hội, Đoản kiếm lô hội	Cymbidium aloifolium (L.) Sw.	x	
382.	Thạch hộc răng	Dendrobium dentatum Seidenf.	x	
383.	Bạch trúc	Dendrobium faulhaberianum Schltr.	x	
384.	Lan phích lá hợp	Flickengeria angustifolia (Blume) Hawekes		
385.	Phiên thân lan	Hetaeria rubens (Lindl.) Benth. ex Hook. f.		
386.	Lan nhẫn diệp ba-lăng-xa	Liparis balansae Gagnep.		
387.	Móng rùa quảng Tây	Oberonia kwangsiensis Seidenf.		
	Họ Dứa dại	**Pandanaceae**		
388.	Dứa gỗ	Pandanus tectorius Parkinson	x	
	Họ Lúa	**Poaceae**		
389.	Cỏ lá tre	Acroceras munroanum (Balansa) Henr.		
390.	Trúc thảo	Arundinella nepalense		
391.	Tre gai	Bambusa blumeana J. A. et J. H. Schult.	x	
392.	Cỏ may	Chrysopogon aciculatus (Retz.) Trin.		
393.	Sả hôi	Cymbopogon caesius		
394.	Cỏ gà	Cynodon dactylon (L.) Pers		
395.	Cỏ lá tre	Cyrtococcum patens (L.) A. Camus		
396.	Cỏ mần trầu	Eleusine indica (L.) Gaertn.		
397.	Cỏ chỉ	Eriachne pallescens R. Br.		
398.	Cỏ tranh	Imperata cylindrica L.		
399.	Chè vè	Miscanthus sinensis Anderson		
400.	Dị thảo	Heteropogon conturtus		
401.	Sậy khô	Neyraudia reynaudina (Kunth) Keng		
402.	Cỏ kê	Panicum miliaceum L.		
403.	Cỏ giác	Panicum sarmentosum Roxb.		

404.	Cỏ công viên	Paspalum conjugatum		
405.	Sậy núi	Phragmites karka (Retz.) Trin. ex Steud.		
406.	Lau	Saccharum arundinaceum Retz.		
407.	Lách	Saccharum spontaneum L.		
408.	Nứa	Schizostachyum dullooa (Gamble) R. B. Majumdar		
409.	Cỏ phao	Themeda triandra		
410.	Chít	Thysanolaena maxima (Roxb.) Kuntze		
	Họ Kim cang	**Smilacaceae**		
411.	Kim cang	Heterosmilax chinensis Wang		
412.	Khúc khắc trung hoa	Smilax china L.		
413.	Kim cang bạc	Smilax corbularia Kunth		
414.	Khu đóng	Smilax perfoliata Lour.		
	Họ Râu hùm	**Tacaceae**		
415.	Râu hùm	Tacca chantrieri Andre	x	
	Họ Gừng	**Zingiberaceae**		
416.	Riềng đài tua	Alpinia blepharocalyx K. Schum.		
417.	Sa nhân lỡi dài	Amomum longiligulare T. L. Wu		
418.	Nghệ, Nghệ trồng	Curcuma longa L.	x,x	
419.	Gừng	Zingiber officinale Roscoe		
420.	Riềng dại, Gừng gió	Zingiber zerumbet Sm.		

Notes:

Use, numbered as follows: x. Fuel-wood & Timber trees; x&x. Essential oil plant & Fat. 37. Resin plant; 38. Tannin plant; x. Medicinal & poisonous plants; x. Ornamental plants; x. Eatable plants; 43. Forages; x. Rattan & bamboo.

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March, 2017

Location:

Site name: Village: District: Ky Son

Plot No.: 01 Size: 20 x 20 m

GPS points (N/E): 19.344861/103.951055999999 Altitude (m): 228 m

Ecosystem type (coding): The semi-deciduous forest after exploitation

Overall conditions of forest (encircle the suitable option):

No	Species		Height (m)	DBH (cm)	Counts (total number)	Canopy diameter (m)
	Scientific name	Local name				
1	Ormosia pinnata (Lour.) Merr.	Ràng ràng	15.0	131.0	01	8.0
2	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	8.0	49.0	03	4.5
3	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	4.5	15.5	23	2.0
4	Phyllanthus annamensis Beille.	Diệp hạ châu	3.5	50.0	01	2.0
5	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	5.0	17.0	03	2.5
6	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiến	18.0	152.0	01	10.0
7	Sterculia foetida L.	Trôm thối	18.0	233.0	01	12.0
8	Celtis philippense Blanco	Má tra	7.0	50.0	02	3.0

Shrubs

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Bauhinia viridescens Desv.	Móng bò		5	
2	Capparis micrantha DC.	Cáp		7	
3	Albizia corniculata (Lour.) Druce	Sống rắn		6	

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Tinospora crispa (L.) Miers	Dây cóc		3	
2	Eupatorium odoratum L.	Cỏ lào			1-2 individuals/m^2
3	Ferns				2-3 individuals/m^2
4	Grass				2-3 individuals/m^2

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	**Local name**			
1.	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	< 2	8	
2.	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	<2	13	

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March, 2017

Location:

Site name: Village: District: Ky Son

Plot No.: 02 Size: 20 x 20 m

GPS points (N/E): 19.3701669999999/103.964389 Altitude (m): 203 m

Ecosystem type (coding): The semi-deciduous forest after exploitation

Overall conditions of forest (encircle the suitable option):

No	Species	Height	DBH	Counts (total	Canopy diameter

	Scientific name	Local name				
1.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiến	11.0	79.0	01	6.0
2.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiên	8.5	63.0	01	5.0
3.	Ormosia pinnata (Lour.) Merr.	Thàn mát	15.0	70.0	01	7.0
4.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiên	5.5	55.0	01	3.5
5.	Ormosia pinnata (Lour.) Merr.	Thàn mát	11.5	65.0	01	6.0
6.	Ormosia pinnata (Lour.) Merr.	Thàn mát	16.0	82.0	01	8.0
7.	Sterculia foetida	Trôm thối	12.0	65.0	01	6.0
8.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiến	13.0	79.0	01	6.0
9.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiến	8.5	59.5	01	5.0
10.	Ormosia pinnata (Lour.) Merr.	Thàn mát	12.0	70.0	01	7.5
11.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiến	9.0	72.0	01	8.0
12.	Sterculia foetida	Trôm thối	17.0	95.0	01	8.0

Shrubs: None

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1.	Eupatorium odoratum L.	Cỏ lào			3-4 individuals/m^2
2.	Ferns				
3.	Grass				

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Burretiodendron hsienmu W.Y.Chun & F.C.How	Nghiến	<2	03	

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March, 2017

Location:

Site name: Village: Ta Ca District: Ky Son

Plot No.: 03 Size: 20 x 20 m

GPS points (N/E): 103.964056/103.964056 Altitude (m): 195 m

Ecosystem type (coding): The semi-deciduous forest after exploitation

Overall conditions of forest (encircle the suitable option):

No	Species		Height (m)	DBH (cm)	Counts (total number)	Canopy diameter (m)
	Scientific name	Local name				
1.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiến	12,0	84.0	01	6.0
2.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiên	12.5	98.0	01	7.5
3.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiên	5.5	55.0	01	3.5
4.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiên	10.0	68.0	01	5.5
5.	Ormosia pinnata (Lour.) Merr.	Thàn mát	9.5	58.0	01	6.0
6.	Ormosia pinnata (Lour.) Merr.	Thàn mát	15.0	74.0	01	8.0
7.	Ormosia pinnata (Lour.) Merr.	Thàn mát	16.0	82.0	01	8.0
8.	Milletia sp.		12.0	67.5.0	01	5.0
9.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiến	13.0	79.0	01	6.0
10.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiến	8.5	59.5	01	5.0
11.	Milletia sp.		13.0	81.0	01	7.5
12.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiến	12.0	86.0	01	7.0
13.	Burretiodendron hsienmu W.Y. Chun & F.C.How	Nghiến	12.0	84.0	02	8.0

Shrubs: None

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1.	Eupatorium odoratum L.	Cỏ lào			3-4 individuals/m^2
2.	Ferns				2-3 individuals/m^2
3.	Grass				2-3 individuals/m^2

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	< 2	01	
2	Lagerstroemia tomentosa Presl	Săng lẻ	<2	04	
3	Burretiodendron hsienmu W.Y.Chun & F.C.How	Nghiến	<2	01	

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location:

Site name: Village: Muong Tip District: Ky Son

Plot No.: 04 Size: 20 x 20 m

GPS points (N/E): 19.3976669999999/103.978472 Altitude (m): 208 m

Ecosystem type (coding): The semi-deciduous forest after exploitation

Overall conditions of forest (encircle the suitable option):

No	Species		Height (m)	DBH (cm)	Counts (total number)	Canopy diameter (m)
	Scientific name	Local name				
1.	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	3.5	33.5	02	2.0 (broken)
2.	Phyllanthus annamensis Beille.	Diệp hạ châu	4.5	28.0	02	2.0 (broken)
3.	Canthium sp.	Găng	7.0	44.5	01	7.5
4.	Lagerstroemia tomentosa Presl	Săng lẻ	25.0	210	01	12.0
5.	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	7.5	55.0	03	4.0
6.	Celtis philippense Blanco	Má tra	9.0	32.5	01	3.0
7.	Sterculia foetida L.	Trôm thối	6.0	36.0	01	3.0
8.	Phyllanthus annamensis Beille.	Diệp hạ châu	7.0	51	01	6.0
9.	Vitex tripinnata (Lour.) Merr.	Bình linh	6.5	38.0	01	3.8
10.	Ormosia pinnata (Lour.) Merr.	Ràng ràng	3.5	26.0	01	2.5
11.	Syzygium sp.	Trâm	3.5	26.0	01	2.5
12.	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	8.5	37.0	01	4.8
13.	Aglaia sp.	Gội	8.5	36.0	01	5.5

Shrubs:

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Bauhinia viridescens Desv.	Móng bò		3	
2	Fissistigma villossium (Ast.) Merr.	Cách lông		3	

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1.	Tinospora crispa (L.) Miers	Dây cóc		5	
2.	Ferns				2-3 individuals/m^2
3.	Grass				2-3 individuals/m^2

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Celtis philippense Blanco	Má tra	< 2	13	
2	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	<2	26	
3	Phyllanthus annamensis Beille.	Diệp hạ châu	<2	7	

(4) Vegetations in Laos side:

The mixed broadleaf and bamboo forest

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location:

Site name: Village: District: Ky Son

Plot No.: 05 Size: 20 x 20 m

GPS points (N/E): 19.398278/103.984583 Altitude (m): 201 m

Ecosystem type (coding): The semi-deciduous forest after exploitation

Overall conditions of forest (encircle the suitable option):

No	Species		Height (m)	DBH (cm)	Counts (total number)	Canopy diameter (m)
	Scientific name	Local name				
1.	Streblus asper Lour.	Ruối	2.5	21.5	01	1.0 (broken)
2.	Celtis philippense Blanco	Má tra	18.5	61.0	01	7.5
3.	Streblus asper Lour.	Ruối	10.0	44.7	01	3.5
4.	Phyllanthus annamensis Beille.	Diệp hạ châu	6.0	18.0	01	3.0
5.	Phyllanthus annamensis Beille.	Diệp hạ châu	18.0	67.5	01	6.0
6.	Streblus asper Lour.	Ruối	4.5	20.5	02	3.0
7.	Streblus asper Lour.	Ruối	8.0	30.5	02	6.0
8.	Sterculia foetida L.	Trôm thối	22.0	125.0	01	8.0
9.	Streblus asper Lour.	Ruối	3.5	19.0	03	2.5
10.	Phyllanthus annamensis Beille.	Diệp hạ châu	4.0	18.0	02	3.5
11.	Streblus asper Lour.	Ruối	8.0	37.7	01	3.5
12.	Streblus asper Lour.	Ruối	6.0	22.5	06	3.5
13.	Vitex tripinnata (Lour.) Merr.	Bình linh	6.5	61.0	02	5.5
14.	Sterculia foetida L.	Trôm thối	20.0	101.0	01	8.0
15.	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	5.0	26.5	01	4.5
16.	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	7.0	31.0	06	2.5
17.	Phyllanthus annamensis Beille.	Diệp hạ châu	5.0	21.5	01	3.0

Shrubs: None

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1.	Ferns				2-3 individuals/m^2
2.	Grass				2-3 individuals/m^2

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Celtis philippense Blanco	Má tra	< 2	4	
2	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	<2	13	
3	Canthium horridum Blume	Găng	<2	12	
4	Canthium sp.		<2	6	

(4) Vegetations in Laos side:

The mixed broadleaf and bamboo forest

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location:

Site name: Village: District:

Plot No.: 06 Size: 20 x 20 m

GPS points (N/E): 19.404313999999/103.994493 Altitude (m): 162

Ecosystem type (coding): Grassland on uncultivated land

Overall conditions of forest (encircle the suitable option): None

No	Species		Height (m)	Diameter (cm)	Counts (total number)	Remark
	Scientific name	Local name				

Shrubs

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Licuala spinosa Wurm.	Lụi	< 1	6 clusters	5-6 stems/cluster
2	Acacia sp.	Sống rắn		13	

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1.	Eupatorium odoratum L.	Cỏ lào	1.5-2 m		3-5 stems/m^2
2.	Passiflora foetida L.	Lạc tiên		06	
3.	Paederia scandens (Lour.) Merr.	Mơ leo	< 1	7	

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			

1	Callicarpa arborea Roxb.	Tu hú gỗ	<2 m	6	
2	Clerodendrum cyrtophyllum Turcz.	Đắng cảy	<2 m	4	
3	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	<1.5m	13	

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location:

Site name: Village: District:

Plot No.: 07 Size: 20 x 20 m

GPS points (N/E): 19.404444/103.997028 Altitude (m): 164

Ecosystem type (coding): Grassland on uncultivated land

Overall conditions of forest (encircle the suitable option): None

No	Species		Height (m)	Diameter (cm)	Counts (total number)	Remark
	Scientific name	Local name				

Shrubs

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Derris sp.			12	
2	Harrisonia perforata (Blumea) Merr.	Hải sơn		03	

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Eupatorium odoratum L.	Cỏ lào	1.5-2	1-2 cluster/m^2	3-4 stems/cluster

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			

1	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	<1	1	
2	Streblus asper Lour.	Ruối	<1	1	

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location:

Site name: Village: District:

Plot No.: 08 Size: 20 x 20 m

GPS points (N/E): 19.401167/104.009472 Altitude (m): 164

Ecosystem type (coding): Grassland on uncultivated land

Overall conditions of forest (encircle the suitable option): None

No	Species		Height (m)	Diameter (cm)	Counts (total number)	Remark
	Scientific name	Local name				

Shrubs: None

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Eupatorium odoratum L.	Cỏ lào	1.5-2	1-2 cluster/m^2	3-4 stems/cluster

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	<1	1	
2	Streblus asper Lour.	Ruối	<1	1	

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location:

Site name: Village: District:

Plot No.: 09 Size: 20 x 20 m

GPS points (N/E): 19.4180859999999/104.036458999999 Altitude (m): 175

Ecosystem type (coding): Grassland on uncultivated land

Overall conditions of forest (encircle the suitable option):

No	Species		Height (m)	Diameter (cm)	Counts (total number)	Remark
	Scientific name	Local name				
1	Archidendron lucidum (Benth.) I. Niels.	Mán đỉa trâu	3		01	
2	Milletia sp.		4-4.5		12	

Shrubs:

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Derris sp.			04	
2	Harrisonia perforata (Blumea) Merr.	Hải sơn		07	

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Eupatorium odoratum L.	Cỏ lào			3-4 stems/m^2

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	<1		02-0.3 plant/m^2

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location:

Site name: Village: District:

Plot No.: 10 Size: 20 x 20 m

GPS points (N/E): 19.4157119999999/104.062355 Altitude (m):

Ecosystem type (coding): Grassland on uncultivated land after 4-5 years

Overall conditions of forest (encircle the suitable option):

No	Species		Height (m)	Diameter (cm)	Counts (total number)	Remark
	Scientific name	Local name				
1	Ormosia pinnata (Lour.) Merr.	Thàn mát	4		04	

Shrubs: None

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Eupatorium odoratum L.	Cỏ lào	1-1.5		10-12 stems/m^2
2	Cassia occidentalis L.	Muồng lá khế	1-1.5	03	4-5 stems/m^2

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Lagerstroemia tomentosa Presl	Săng lẻ	1.5-2	4	

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location:

Site name: Village: District:

Plot No.: 11 Size: 20 x 20 m

GPS points (N/E): 19.4147779999999/104.07047 Altitude (m): 168

Ecosystem type (coding): Grassland on uncultivated land

Overall conditions of forest (encircle the suitable option): None

No	Species		Height (m)	Diameter (cm)	Counts (total number)	Remark
	Scientific name	Local name				

Shrubs:

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Capparis micrantha DC.	Cáp		05	
2	Desmos chinensis	Bù dẻ		08	

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Eupatorium odoratum L.	Cỏ lào			2-3 stems/m^2
2	Imperata cylindrica L.	Cỏ tranh			3-4 stems/m^2

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Litsea cubeba (Lour.) Pers	Màng tang rô	<1.5	03	
2	Cratoxylum cochinchinensis (Lour.) Blume	Thành ngạnh	<2	06	

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location:

Site name: Village: District:

Plot No.:12 Side: 20 x 20 m

GPS points (N/E): 19.413194/104.075971999999 Altitude (m): 154

Ecosystem type (coding): Grassland on uncultivated land after 4-5 years

Overall conditions of forest (encircle the suitable option):

No	Species		Height (m)	Diameter (cm)	Counts (total number)	Remark
	Scientific name	Local name				
1	Archidendron lucidum (Benth.) I. Niels.	Mán đỉa trâu	3.5-4		03	
2	Albizia lucidior (Steud.) I. Niels.	Bản xe	3-4		05	

Shrubs

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Derris sp.			02	
2	Harrisonia perforata (Blumea) Merr.	Hải sơn		05	

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Eupatorium odoratum L.	Cỏ lào	1.5-2		2-3 stems/m^2

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	<1	1	
2	Streblus asper Lour.	Ruối	<1	1	

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location of Dam contruction

Site name: Village: District:

Plot No.:13 Size: 20 x 20 m

GPS points (N/E): 19.411542/104.077758 Altitude (m):

Ecosystem type (coding): Grassland on uncultivated land

Overall conditions of forest (encircle the suitable option): None

No	Species		Height (m)	Diameter (cm)	Counts (total number)	Remark
	Scientific name	Local name				

Shrubs: None

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Eupatorium odoratum L.	Cỏ lào	2-2.5		4-5 stems/m^2
2	Ferns		<1		1-2 stems/m^2
3	Grass		<1		2-3 stems/m^2

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	<1		01-0.2 plant/m^2
2	Streblus asper Lour.	Ruối	<1		0.2-0.3 plant/m^2
3	Ormosia pinnata (Lour.) Merr.	Thàn mát	<3	03	
4	Milletia sp.	Thàn mát	<3	05	
5	Albizia lucidior (Steud.) I. Niels.	Bản xe	<3	04	

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location:

Site name: Village: Ta Ca District: Ky Son

Plot No.: 14 Size: 20 x 20 m

GPS points (N/E): 19.413167/104.079944 Altitude (m): 176 m

Ecosystem type (coding): The semi-deciduous forest after exploitation

Overall conditions of forest (encircle the suitable option):

No	Species		Height (m)	DBH (cm)	Counts (total number)	Canopy diameter (m)
	Scientific name	Local name				
1	Burretiodendron hsienmu W.Y.Chun & F.C.How	Nghiến	10.0	92.0	01	6.5
2	Burretiodendron hsienmu W.Y.Chun & F.C.How	Nghiên	8.0	47.5	01	5.0
3	Milletia sp.		5.0	36	03	4.0
4	Lagerstroemia tomentosa Presl	Săng lẻ	5.5	29.5	01	3.0
5	Milletia sp.		7.0	42.0	02	6.0
6	Burretiodendron hsienmu W.Y.Chun & F.C.How	Nghiến	7.5	44.5	01	5.5
7	Burretiodendron hsienmu W.Y.Chun & F.C.How	Nghiến	13.0	175.0	01	12.0
8	Milletia sp.		5.5	58.0	03	5.5
9	Burretiodendron hsienmu W.Y.Chun & F.C.How	Nghiến	12.0	86.0	01	7.0
10	Burretiodendron hsienmu W.Y.Chun & F.C.How	Nghiến	12.0	84.0	02	8.0
11	Burretiodendron hsienmu W.Y.Chun & F.C.How	Nghiến	8.0	57.5	02	6.0

Shrubs

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Bauhinia viridescens Desv.	Móng bò		3	
2	Capparis micrantha DC.	Cáp		3	

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1.	Tinospora crispa (L.) Miers	Dây cóc		5	
2.	Jasminum triplinerve Vahl	Nhài		3	
3.	Eupatorium odoratum L.	Cỏ lào			3-4 individuals/m^2
4.	Ferns				2-3 individuals/m^2
5.	Grass				2-3 individuals/m^2

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Milletia sp.	Nàng nàng	< 2	21	
2	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	< 2	7	
3	Canthium horridum Blume	Bình linh	<2	7	

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location:

Site name: Village: District:

Plot No.: 15 Side: 20 x 20 m

GPS points (N/E): 19.409455/104.080174 Altitude (m): 154

Ecosystem type (coding): Grassland on uncultivated land after 4-5 years

Overall conditions of forest (encircle the suitable option):

No	Species		Height (m)	Diameter (cm)	Counts (total number)	Remark
	Scientific name	Local name				
1	Archidendron lucidum (Benth.) I. Niels.	Mán đỉa trâu	4		01	
2	Milletia sp.		4-4.5		03	
3	Albizia lucidior (Steud.) I. Niels.	Bản xe	2.5-3		04	

Shrubs

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Derris sp.			03	
2	Harrisonia perforata (Blumea) Merr.	Hải sơn		04	

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Eupatorium odoratum L.	Cỏ lào	1.5-2		2-3 stems/m^2

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			

1	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	<1	1	01-0.2 plant/m^2
2	Streblus asper Lour.	Ruối	<1	1	0.2-0.3 plant/m^2

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location:

Site name: Village: District:

Plot No.: 16 Size: 20 x 20 m

GPS points (N/E): 19.403974/104.081042999999 Altitude (m): 173

Ecosystem type (coding): Grassland on uncultivated land after 4-5 years

Overall conditions of forest (encircle the suitable option): None

No	Species		Height (m)	Diameter (cm)	Counts (total number)	Remark
	Scientific name	Local name				

Shrubs: None

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Eupatorium odoratum L.	Cỏ lào	1-1.5		8-10 stems/m^2
2	Blumea balsamifera (L.) DC.	Đại bi	1-1.5	1	0.4-0.5 stem/m^2

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	<1	1	01-0.2 plant/m^2

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location:

Site name: Village: District:

Plot No.:17 Size: 20 x 20 m

GPS points (N/E): 19.405709/ 104.082744 Altitude (m):

Ecosystem type (coding): Grassland on uncultivated land

Overall conditions of forest (encircle the suitable option): None

No	Species		Height (m)	Diameter (cm)	Counts (total number)	Remark
	Scientific name	Local name				

Shrubs: None

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Eupatorium odoratum L.	Cỏ lào	2-2.5		4-5 stems/m^2
2	Grass		<1		2-3 stems/m^2

(3) Regeneration trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Streblus spp.	Ruối	<1	1	0.3-0.4 plant/m^2
2	Milletia sp.	Thàn mát	<3	12	

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location: near by site 16

Site name: Village: District: Ky Son

Plot No.: 18 Size: 20 x 20 m

GPS points (N/E): 19.403835/ 104.086254 Altitude (m):

Ecosystem type (coding): The secondary forest

Overall conditions of forest (encircle the suitable option):

No	Species		Height (m)	DBH (cm)	Counts (total number)	Canopy diameter (m)
	Scientific name	Local name				
1	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	7	55	1	3.5
2	Phyllanthus annamensis Beille.	Diệp hạ châu	5	47	1	3
3	Ormosia pinnata (Lour.) Merr.	Ràng ràng	12	122	1	6
4	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	7.5	42	1	4.5
5	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	5.5	33	1	4
6	Celtis philippense Blanco	Má tra	7.0	52	1	3.5
7	Ormosia pinnata (Lour.) Merr.	Ràng ràng	8	92	1	6
8	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	6.5	35	1	3.5
9	Sterculia foetida L.	Trôm thối	15	156	01	7
10	Celtis philippense Blanco	Má tra	12	76	1	5
11	Phyllanthus annamensis Beille.	Diệp hạ châu	6	33	1	2.5
12	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	7	35	1	3

Shrubs

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1.	Capparis micrantha DC.	Cáp		3	
2.	Albizia corniculata (Lour.) Druce	Sống rắn		5	

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Eupatorium odoratum L.	Cỏ lào			1-2 individuals/m^2
2	Ferns				2-3 individuals/m^2
3	Grass				2-3 individuals/m^2

(3) Regeneration of trees

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1.	Streblus ilicifolius (Vidal) Corner	Ruối ô rô	< 2	5	
2.	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	<2	7	

PLANT SURVEY FIELD FORM

(1) Woody vegetation (forest/shrub):

Lead surveyor: NGUYEN THE CUONG

Other surveyor: TRINH XUAN THANH

Date: March. 2017

Location: near by site 21

Site name: Village: Nam Mo District: Ky Son

Plot No.: 19 Size: 20 x 20 m

GPS points (N/E): 19.4020219999999/ 104.082524 Altitude (m):

Ecosystem type (coding): Secondary forest on uncultivated land for 10-15 years

Overall conditions of forest (encircle the suitable option):

No	Species		Height (m)	DBH (cm)	Counts (total number)	Canopy diameter
	Scientific name	Local name				
1.	Engelhardtia roxburghiana Wall.	Chẹo	8	112	01	6
2.	Celtis philippense Blanco	Má tra	18.5	61.0	01	7.5
3.	Streblus asper Lour.	Ruối	10.0	44.7	01	3.5
4.	Phyllanthus annamensis Beille.	Diệp hạ châu	6.0	18.0	01	3.0
5.	Grewia asiatica L.	Cò ke	7	42	01	4.5
6.	Vitex tripinnata (Lour.) Merr.	Bình linh	6.5	61.0	02	5.5
7.	Sterculia foetida L.	Trôm thối	20.0	101.0	01	8.0
8.	Dimocarpus fumatus (Blume) Leenh.	Nhãn rừng	5.0	26.5	01	4.5
9.	Canthium sp.	Găng	2-3		3	
10.	Streblus asper Lour.	Ruối	< 2.5		11	
11.	Desmos chinensis Lour.		<2.0		7	
12.	Micromelum minutum (Forst. f.) Wight & Arn.		<1.5		6	

Shrubs

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1.	Acacia sp.			5	

2.	Harrisonia perforata (Blumea) Merr.	Hải sơn		2	

(2) Non-woody vegetation

No	Species		Height (m)	Counts (total number)	Remark
	Scientific name	Local name			
1	Ferns				3-4 stems/m^2
2	Grass				5-6 stems/m^2

2.3 Specialist Report on Water Quality

EVN PECC1

POWER ENGINEERING CONSULTING

JOINT-STOCK COMPANY 1

Project:

NAM MO 1 HYDROPOWER PROJECT

FEASIBILITY STUDY

RESULTS OF SURFACE WATER SAMPLING

FOR PREPARING ESIA REPORT OF MY LY - NAM MO 1 HPPs IN VIETNAM AND LAOS

VIETNAM ELECTRICITY
POWER ENGINEERING CONSULTING
JS COMPANY 1
FOR AND ON BEHALF OF GENERAL DIRECTOR
DEPUTY GENERAL DIRECTOR

Pham Nguyen Hung

VIETNAM INSTITUTE OF
INDUSTRIAL CHEMISTRY
DIRECTOR OF ANALYSING CENTER

Nguyen Doan Huy

Hanoi, March 2017

TABLE OF CONTENT

List of table

LIST OF PARTICIPANT

Person in charge: MBA. Nguyen Doan Huy, Director of laboratory - Vietnam Institute of Industrial Chemistry

List of out-door team:

1. Nguyen Doan Huy Vietnam Institute of Industrial Chemistry
2. Cao Van Nam Vietnam Institute of Industrial Chemistry
3. Pham Thanh Hien Vietnam Institute of Industrial Chemistry

List of in-door team:

4. Nguyen Thu Hien Vietnam Institute of Industrial Chemistry
5. Nguyen Thanh Binh Vietnam Institute of Industrial Chemistry
6. Nguyen Thi Cuc Vietnam Institute of Industrial Chemistry
7. Pham Thi Thu Hoai Vietnam Institute of Industrial Chemistry
8. Nguyen Thi ThuyVietnam Institute of Industrial Chemistry
9. Tran Thi Hong Hien Vietnam Institute of Industrial Chemistry
10. Nguyen Thi Thu Van Vietnam Institute of Industrial Chemistry
11. Ngo Thi Tuyen Yen Vietnam Institute of Industrial Chemistry
12. Trinh Thi Nhu Vietnam Institute of Industrial Chemistry
13. Dam Thuy Hang Vietnam Institute of Industrial Chemistry

CHAPTER I. FOREWORD

I.1. Legal background

Environmental monitoring is done on the basis of law on environment, including:

Environmental protection law dated 23/6/2014;

Decree No. 18/2015/ND-CP dated 14/02/2015 regulating in detail how to implement some provision of Environmental protection law.

Contract No. 371/VHH-PT signed on 29/12/2016 between Power Engineering Consulting Joint Stock Company 1 (Party A) and Vietnam Institute of Industrial Chemistry (party B);

Decision No. 1271/QĐ-BTNMT dated 28/5/2015 by Ministry of Natural Resources and Environment certifying conditions for performing environmental monitoring services to Vietnam Institute of Industrial Chemistry, Chemistry of Vietnam.

I.2. Summary on client

1. **Company**: Power Engineering Consulting Joint Stock Company 1 (PECC1)

2. **Address**: Km 9+200, Nguyen Trai Road, Thanh Xuan Nam ward, Thanh Xuan district, Ha Noi city, Vietnam.

I.3. Summary on contractor

Agency: Vietnam Institute of Industrial Chemistry

Address: No.2 Pham Ngu Lao street, Phan Chu Trinh ward, Hoan Kiem district, Ha Noi city of Vietnam.

Decision of establishment: No. 232/QĐ-CNNg-TCNS dated 10/7/1990 by Heavy industry ministry (now is Ministry of Industry and Trade)

Register Number: A-695 dated 07/01/2008 (renew)

Account number: 115000001386 at Joint Stock Bank of Industry and Commercial of Vietnam, Ha Noi branch.

Enterprise code/tax code: 0100101121

BỘ TÀI NGUYÊN VÀ MÔI TRƯỜNG

CHỨNG NHẬN

ĐỦ ĐIỀU KIỆN HOẠT ĐỘNG DỊCH VỤ QUAN TRẮC MÔI TRƯỜNG

Số hiệu: VIMCERTS 087

Tên tổ chức:

Viện Hóa học Công nghiệp Việt Nam,
Tập đoàn Hóa chất Việt Nam

Trụ sở chính:

Số 2 Phạm Ngũ Lão, quận Hoàn Kiếm, Thành phố Hà Nội

Quyết định số: 1271 /QĐ-BTNMT ngày 28 tháng 5 năm 2015 của Bộ trưởng Bộ Tài nguyên và Môi trường về việc chứng nhận đủ điều kiện hoạt động dịch vụ quan trắc môi trường.

Người đứng đầu tổ chức:

Họ và tên: Hoàng Văn Hoan Chức vụ: Viện trưởng

CMND số: 010566192 do Công an Thành phố Hà Nội

Cấp ngày 28 tháng 3 năm 2007

Thời hạn của Giấy chứng nhận: 03 năm

Từ ngày 28 tháng 5 năm 2015

Đến ngày 27 tháng 5 năm 2018

LĨNH VỰC VÀ PHẠM VI ĐƯỢC CẤP GIẤY CHỨNG NHẬN

I. QUAN TRẮC HIỆN TRƯỜNG

1. Nước:		
- Nước mặt	☒	Số thông số: 06
- Nước thải	☒	Số thông số: 04
- Nước dưới đất	☒	Số thông số: 06
- Nước biển	☒	Số thông số: 07
- Nước mưa	☒	Số thông số: 04
2. Khí:		
- Không khí xung quanh và môi trường lao động	☒	Số thông số: 14
3. Đất:	☒	Số thông số: 01
4. Trầm tích:	☒	Số thông số: 01
5. Chất thải:	☒	Số thông số: 01

II. PHÂN TÍCH MÔI TRƯỜNG

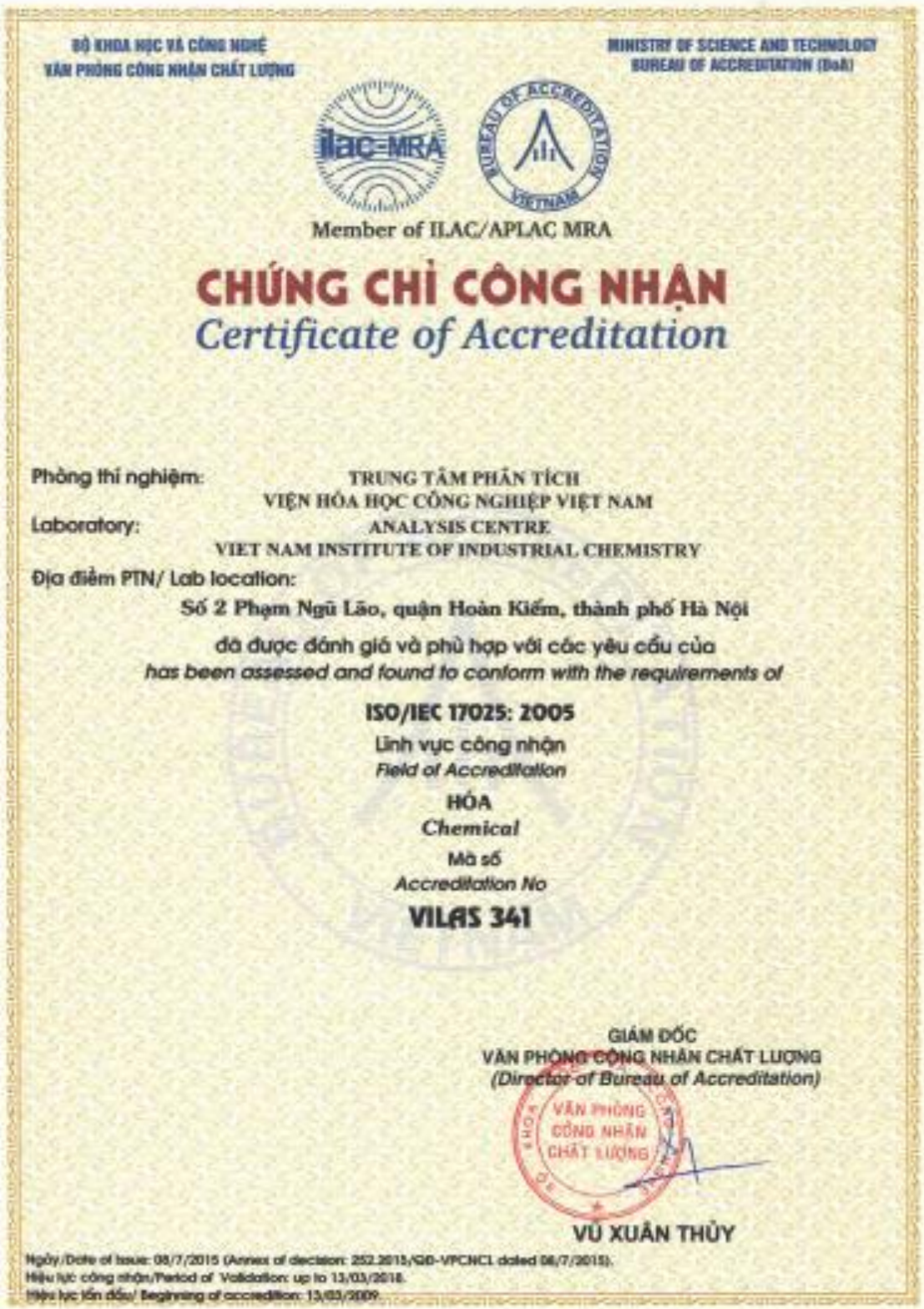
1. Nước:		
- Nước mặt	☒	Số thông số: 32
- Nước thải	☒	Số thông số: 28
- Nước dưới đất	☒	Số thông số: 31
- Nước biển	☒	Số thông số: 22
- Nước mưa	☒	Số thông số: 11
2. Khí:		
- Không khí xung quanh và môi trường lao động	☒	Số thông số: 08
3. Đất:	☒	Số thông số: 16
4. Trầm tích:	☒	Số thông số: 07
5. Chất thải:	☒	Số thông số: 10

(Chi tiết phương pháp thử, giới hạn phát hiện của các Thông số được chứng nhận kèm theo Quyết định số: 1271 /QĐ-BTNMT của Bộ trưởng Bộ Tài nguyên và Môi trường).

Hà Nội, ngày 28 tháng 5 năm 2015

KT. BỘ TRƯỞNG
THỨ TRƯỞNG

Bùi Cách Tuyến



BỘ KHOA HỌC VÀ CÔNG NGHỆ
VĂN PHÒNG CÔNG NHẬN CHẤT LƯỢNG

MINISTRY OF SCIENCE AND TECHNOLOGY
BUREAU OF ACCREDITATION (BoA)

Member of ILAC/APLAC MRA

CHỨNG CHỈ CÔNG NHẬN
Certificate of Accreditation

Phòng thí nghiệm: TRUNG TÂM PHÂN TÍCH
VIỆN HÓA HỌC CÔNG NGHIỆP VIỆT NAM

Laboratory: ANALYSIS CENTRE
VIET NAM INSTITUTE OF INDUSTRIAL CHEMISTRY

Địa điểm PTN/ Lab location:
Số 2 Phạm Ngũ Lão, quận Hoàn Kiếm, thành phố Hà Nội

đã được đánh giá và phù hợp với các yêu cầu của
has been assessed and found to conform with the requirements of

ISO/IEC 17025: 2005

Lĩnh vực công nhận
Field of Accreditation
HÓA
Chemical

Mã số
Accreditation No
VILAS 341

GIÁM ĐỐC
VĂN PHÒNG CÔNG NHẬN CHẤT LƯỢNG
(Director of Bureau of Accreditation)

VĂN PHÒNG CÔNG NHẬN CHẤT LƯỢNG

VŨ XUÂN THỦY

Ngày/Date of issue: 08/7/2015 (Annex of decision: 252.2015/QĐ-VPCNCL dated 08/7/2015).
Hiệu lực công nhận/Period of Validation: up to 13/03/2018.
Hiệu lực lần đầu/ Beginning of accreditation: 13/03/2009.

CHAPTER II: SUMMARY ON MONITORING PROGRAM

II.1. General on monitoring locations

II.1.1. Scope of work

The monitoring, sampling water surface sample for preparation of ESIA report of My Ly – Nam Mo 1 HPP under WB/IFC standard was done under contract No. 371/VHH-PT dated 29/12/2016 signed between PECC1 and Vietnam Institute of Industrial Chemistry.

II.1.2. Type of monitoring

This is monitoring, sampling program for surface water environment to be done at 4 locations downstream of population areas along Nam Mo river starting from upstream from Xop Tip, Vang Ngo, Namuang, Sa Vang villages in Ky Son district Nghe An province of Vietnam.

II.1.3. Project location

Nam Mo 1 Hydropower Project (Nam Mo 1 HPP) is located on main course of Nam Mo river, a grade 1 tributary ò Ca river, in territories of SR Vietnam and Lao PDR.

Main civil works of Nam Mo 1 HPP is located in Ta Ca commune, Ky Son district, Nghe An province of Vietnam, some of 5km North West of Muong Xen town. Reservoir component will be formed on a narrow river section where two banks are steep. The river bed sloping is high and existing with many waterfall, water step which cause trouble and difficulties to navigation, in territories of Ta Ca, Muong Tip, Muong Ai and Nam Cam communes of Ky Son district, Nghe An province (Vietnam), and communes in NoongHed district, Xiangkhoang province, Lao PDR.

Co-ordinates of the designed damsite is 19^{o}39’10,2” North latitude, 104^{o}19’27,3” East longitude, by co-ordinates system VN2000, the dam axis Đ1 (X= 2 147 545.443; Y= 429 569,684) and Đ2 (X= 2 147 206.578; Y= 429 117.113).

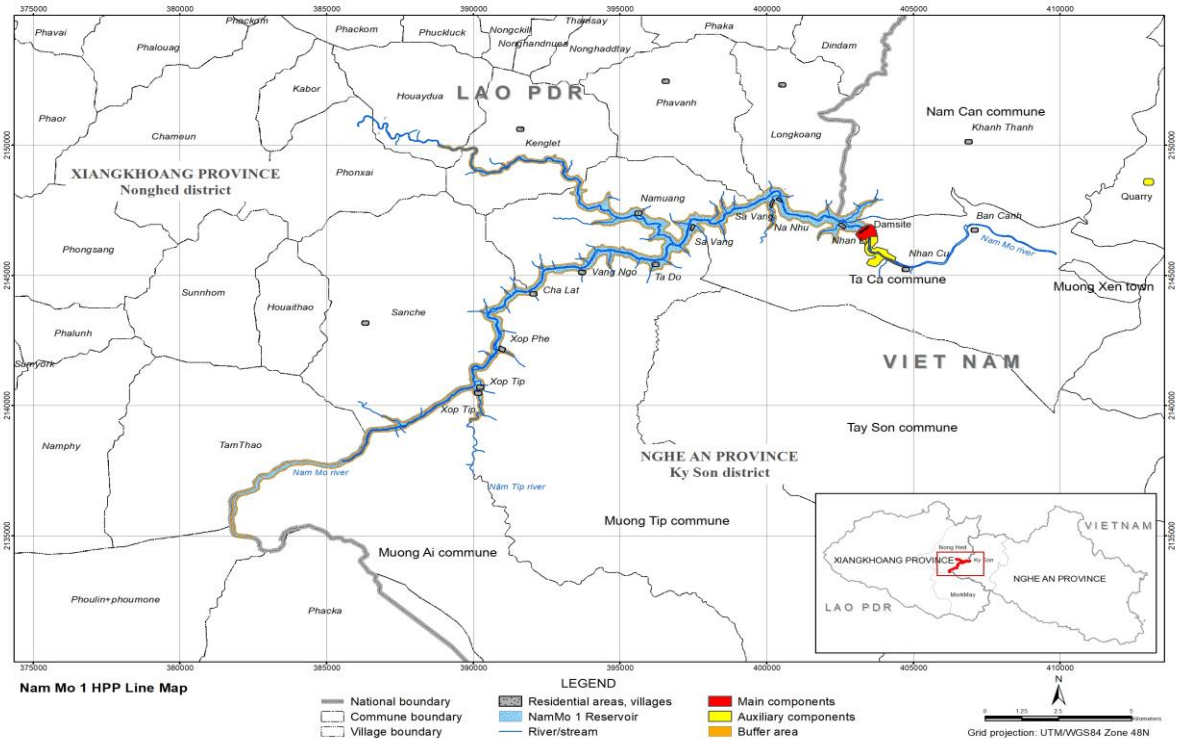
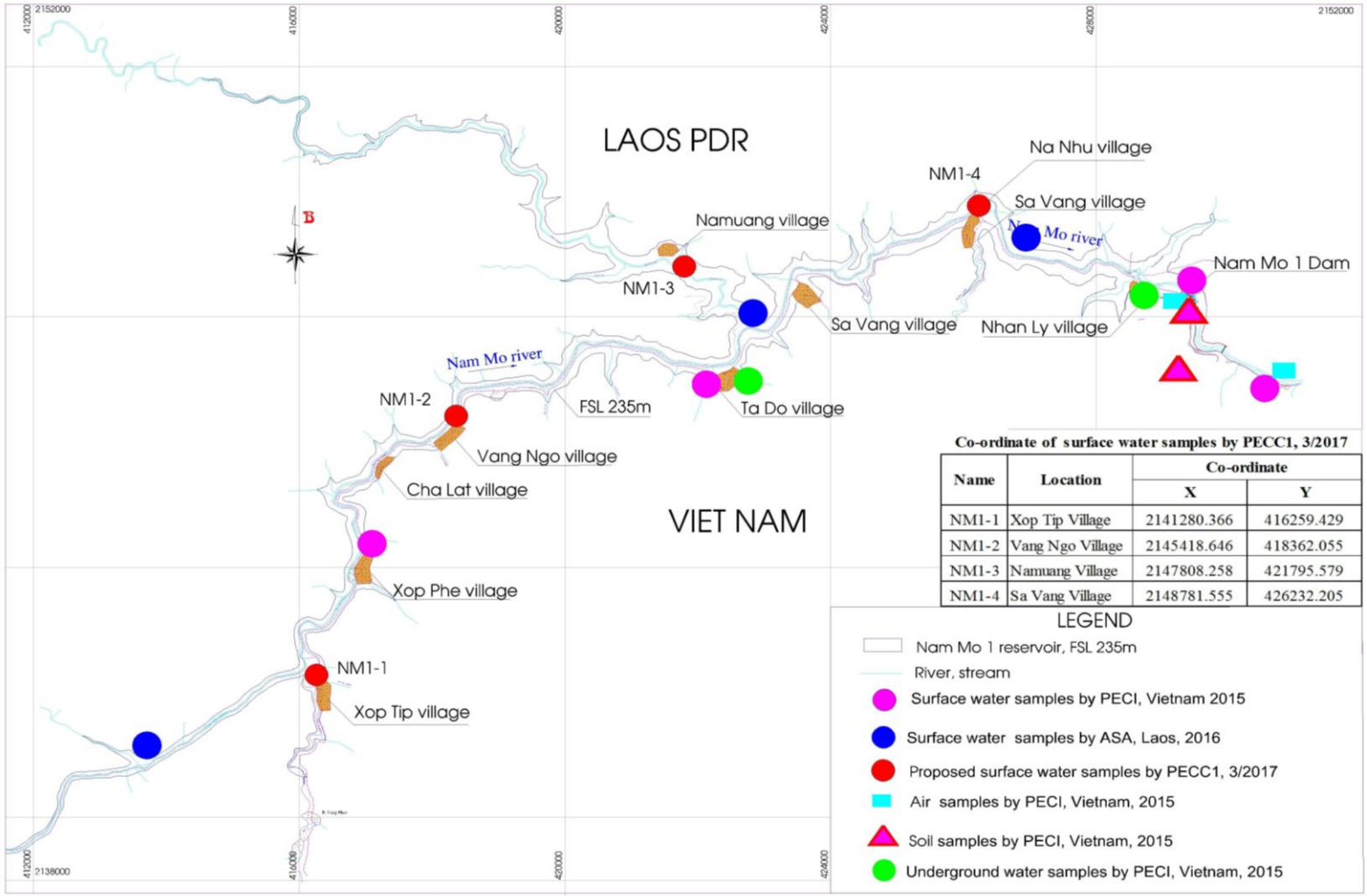


Figure 1: Location map of Nam Mo 1 HPP

Location of investigation, sampling is shown in the below figure:

Figure 2: Water sampling location map in Nam Mo 1 HPP



II.2. List of monitoring parameters

Table 1. List of monitoring component and indicators

No.	Monitoring location	Monitored parameter
I	04 locations: - Water surface sample at Xop Tip village, Muong Tip commune, Ky Son district, Nghe An province, Vietnam. - Water surface sample at Vang Ngo village, Muong Tip commune, Ky Son district, Nghe An province, Vietnam. - Water surface sample at Namuang village, Noonghed district, Xiangkhuang province, Lao PDR. - Water surface sample at Sa Vang village, Ta Ca commune, Ky Son district, Nghe An province, Vietnam.	20 indicators: pH, BOD_5, COD, dissolved oxygen, total suspended solid, Ammonite, Chloride, Fluoride, Nitrite, Nitrate, Phosphate, Xyanua, Arsenic, zinc, Mangan, mercury, iron, total oil, grease, Coliform, E.coli.

II.3. List of monitoring apparatus and Lab equipment

Table 2. Monitoring apparatus and lab equipment

No.	List of equipment	Code	Made in	Inspection	Calibration	Calibration by
1	Taking water sample by incline method		Vietnam			
2	Measure multi-properties of water	P/N 5465000	HACH		Before using	The Lab
3	Rod to take water sample	-	Vietnam			
4	Wire to take water sample	-	Vietnam			
5	Sample keeping box	-	Vietnam			
6	Analysis weight 5 numbers	OHUAS	USA		once a year	TTQT
7	Analysis weight 4 numbers	Satorius-TE214S	Germany		once a year	TTQT
8	Technical weight	JY	China	When using		
9	Nuclear absorber at heater regime, graphite burner, FIAS unit, radiation	Perkin elmer AA 800	USA	When using	once a year	Perkinelmer

No.	List of equipment	Code	Made in	Inspection	Calibration	Calibration by
10	Molecule spectrum absorber	Agilent 8453	USA		once a year	TTQT
11		LaMotte	USA		once a year	
12	Heater	Ecocell	Germany		once a year	TTQT
13	pH measuring apparatus	Hanna	EUROPE	When using	once a year	The Lab
14	Temperature keeping cubicle	FOC-VELP	Italia	Before using	once a year	TTQT
15	Sample keeping cubicle	Towashi	Japan			
16	COD distill tools		USSR			
17	DO measuring apparatus	51302954	HACH	Before using		The Lab
18	Vacuum rotational apparatus	SN 10702315	Japan			
19	Double water distilling apparatus	Hamilton	England			
20	Moisture absorber					
21	Glass distil set		Germany			
22	Sample extracting apparatus		Vietnam			

II.4. Methodology of sampling, storing and transporting sample

The monitoring sample is taken under national technical standards which have been issued.

Table 3. Method of taking sample at the site

No.	Parameters	Method of sample taking
I	Sampling	- TCVN 6663-1:2011, Water quality – taking sample – Part 1: Guidance on sample taking technique. - TCVN 666-3:2008, Water quality – Taking sample – Part 3: Guidance on sample storing and treatment. - TCVN 6663-6:2008, Water quality – Taking sample – Part 6: Guidance on sample taking from river and stream.

II.5. List of measurement methods for out-door and in-door works

Table 4. Measurement method in out-door work

No.	Parameters	Method of sample taking
1	pH	TCVN 6492-2011
2	Dissolved oxygen (DO)	TCVN 7325:2004

Table 5. Analysis method in laboratory

No.	Parameters	Standard
1	BOD_5 (20°C)	TCVN 6001-1:2008
2	COD	SMEWW 5220B:2012
3	Total Suspended Solid (TSS)	TCVN 6625:2000
4	Ammonite (NH4+ estimated according to N)	TCVN 6179-1:1996
5	Chloride (Cl^-)	TCVN 6194:1996
6	Fluoride (F^-)	SMEWW 4500B&D:2012
7	Nitrite (NO^{2-} estimated according to N)	TCVN 6178:1996
8	Nitrate (NO^{3-} estimated according to N)	TCVN 6180:1996
9	Phosphate (PO_4^{3-} estimated according to P)	TCVN 6202:2008
10	Xyanua (CN^-)	TCVN 6181:1996
11	Arsenic (As)	ISO 15586:2003
12	Zinc (Zn)	TCVN 6193:1996
13	Mangan (Mn)	TCVN 6002:1995
14	Mercury (Hg)	TCVN 7877:2008
15	Iron (Fe)	TCVN 6177:1996
16	Total oils & grease	SMEWW 5520B:2012
17	Coliform	TCVN 6182-2:1996
18	E.coli	TCVN 6182-2:1996

II.6. Monitoring location

Table 6. List of monitoring locations

No.	Location	Symbol	Co-ordinates of taking sample
1	Water surface sample at Xop Tip village, Muong Tip commune, Ky Son district, Nghe An province, Vietnam.	NM1-1	X 2141280.366; Y 416259.429
2	Water surface sample at Vang Ngo village, Muong Tip commune, Ky Son district, Nghe An province, Vietnam.	NM1-2	X 2145418.646; Y 418362.055
3	Water surface sample at Namuang village, Noonghed district, Xiangkhuang province, Lao PDR.	NM1-3	X 2147808.258; Y 421795.579
4	Water surface sample at Sa Vang village, Ta Ca commune, Ky Son district, Nghe An province, Vietnam.	NM1-4	X 2148781.555; Y 426232.205

II.7. Weather condition when taking sample

Samples were taken under good weather condition, cloudy, no rain.

CHAPTER III. COMMENTS ON MONITORING RESULTS

Table 7. Results gained from monitoring water surface samples

No.	Indicators	Unit	Results and analysis				Max. allowable limit (*)
			NM1-1	NM1-2	NM1-3	NM1-4	
1	pH		6.44	6.64	6.56	6.50	6 to 8.5
2	BOD_5 (20°C)	*mg/l*	0.64	0.72	1.2	0.68	6
3	COD	*mg/l*	0.94	1.14	1.51	0.96	15
4	Dissolved oxygen (DO)	*mg/l*	6.5	6.6	6.2	6.4	≥ 5
5	Total suspended solid (TSS)	*mg/l*	16	12	15	8	30
6	Ammonite (NH4+ estimated according to N)	*mg/l*	0.14	0.05	0.12	0.02	0.3
7	Chloride (Cl^-)	*mg/l*	1.62	1.62	1.62	1.45	350
8	Fluoride (F^-)	*mg/l*	<0.05	<0.05	<0.05	<0.05	1.5
9	Nitrite (NO^2- estimated according to N)	*mg/l*	<0.01	<0.01	<0.01	<0.01	0.05
10	Nitrate (NO^{3-} estimated according to N)	*mg/l*	0.03	0.02	<0.01	0.03	5
11	Phosphate (PO_4^{3-} estimated according to P)	*mg/l*	<0.01	<0.01	<0.01	<0.01	0.2
12	Xyanua (CN^-)	*mg/l*	<0.01	<0.01	<0.01	<0.01	0.05
13	Arsenic (As)	*mg/l*	<0.0001	<0.0001	<0.0001	<0.0001	0.02
14	Zinc (Zn)	*mg/l*	0.012	0.010	0.005	0.005	1.0
15	Mangan (Mn)	*mg/l*	<0.01	<0.01	<0.01	<0.01	0.2
16	Mercury (Hg)	*mg/l*	<0.0001	<0.0001	<0.0001	<0.0001	0.001

No.	Indicators	Unit	Results and analysis				Max. allowable limit (*)
			NM1-1	NM1-2	NM1-3	NM1-4	
17	Iron (Fe)	*mg/l*	<0.01	<0.01	<0.01	<0.01	1
18	Total oils & grease	*mg/l*	0.2	0.1	<0.1	<0.1	0.5
19	Coliform	*MPN/100ml*	680	310	250	210	5000
20	E.coli	*MPN/100ml*	16	11	6	2	50

Notes:

- (*) Maximum allowable limit regulated by National Technical Standard on quality of surface water (QCVN 08-MT:2015/BTNMT)- column A2: applying to surface water resources used for domestic water supply purpose but it shall be applied with suitable treatment method, for irrigation, navigation and other similar purposes.
- NM1-1: Water surface sample at Sop Tip village, Muong Tip commune, Ky Son district, Nghe An province, Vietnam.
- NM1-2: Water surface sample at Vang Ngo village, Muong Tip commune, Ky Son district, Nghe An province, Vietnam.
- NM1-3: Water surface sample at Namuang village, Noonghed district, Xiangkhuang province, Lao PDR.
- NM1-4: Water surface sample at Sa Vang village, Ta Ca commune, Ky Son district, Nghe An province, Vietnam.

Comments:

Generally, quality of surface water at all monitored locations reflects no sign of pollution beyond corresponding regulation and standard in column A2 in National Standard on water surface QCVN 08-MT:2015/BTNMT, corresponding with quality of surface water used for domestic water supply purpose but it shall be applied with suitable treatment method, for irrigation, navigation and other similar purposes. This shows that activities by population along the river section cause unremarkable pollution to surface water quality in corresponding investigated locations.

VIII. CONCLUSIONS

Monitoring results show that quality of surface water environment in investigated locations and in location where samples were took in Nam Mo 1 HPP territory is good, no sign of pollution.

ANNEX
(Sheets of analyzed results)

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

SHEET OF ANALYZED RESULTS OF WATER SAMPLE

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

VILAS 341

Client	:	Power Engineering Consulting Joint Stock Company 1 (PECC1)
Project	:	ESIA for My Ly – Nam Mo 1 HPP
Sample name	:	Surface water sample at Xop Tip village, Muong Tip commune, Ky Son district, Nghe An province, SR Viet Nam
Sample code	:	NM1-1
Sample co-ordinates	:	X 2141280.366- Y 416259.429
Date of sampling	:	07/03/2017

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

VILAS 341

No.	Indicator	Unit	Method	Results	Max allowable limit(*)
1	pH		TCVN 6492:2011	6.44	6 to 8.5
2	BOD_5 (20°C)	mg/l	TCVN 6001-1:2008	0.64	6
3	COD	mg/l	SMEWW 5220B:2012	0.94	15
4	Dissolved Oxygen (DO)	mg/l	TCVN 7325:2004	6.5	≥ 5
5	Total Suspended Solid (TSS)	mg/l	TCVN 6625:2000	16	30
6	Ammonite (NH4+ estimated according to N)	mg/l	TCVN 6179-1:1996	0.14	0.3
7	Chloride (Cl^-)	mg/l	TCVN 6194:1996	1.62	350
8	Floride (F^-)	mg/l	SMEWW 4500B&D:2012	<0.05	1.5
9	Nitrite (NO^{2-} estimated according to N)	mg/l	TCVN 6178:1996	<0.01	0.05
10	Nitrate (NO^{3-} estimated according to N)	mg/l	TCVN 6180:1996	0.03	5
11	Phosphate (PO_4^{3-} estimated according to P)	mg/l	TCVN 6202:2008	<0.01	0.2
12	Xyanua (CN^-)	mg/l	TCVN 6181:1996	<0.01	0.05
13	Arsenic (As)	mg/l	ISO 15586:2003	<0.0001	0.02
14	Zinc (Zn)	mg/l	TCVN 6193:1996	0.012	1.0
15	Mangan (Mn)	mg/l	TCVN 6002:1995	<0.01	0.2
16	Mercury (Hg)	mg/l	TCVN 7877:2008	<0.0001	0.001
17	Iron (Fe)	mg/l	TCVN 6177:1996	<0.01	1
18	Total oils & grease	mg/l	SMEWW 5520B:2012	0.2	0.5
19	Coliform	MPN/100ml	TCVN 6182-2:1996	680	5000
20	E.coli	MPN/100ml	TCVN 6182-2:1996	16	50

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

Notes: Maximum allowable limit regulated by National Technical Standard on quality of surface water (QCVN 08-MT:2015/BTNMT)- column A2: applying to surface water resources used for domestic water supply purpose but it shall be applied with suitable treatment method, for irrigation, navigation and other similar purposes..

Ha Noi, March 20th 2017.

Analyzed by	**Checked by**	For and on behalf of Director of Institute **DIRECTOR OF LABORATORY**
Nguyen Thi Cuc	**MBA. Nguyen Thu Hien**	**MBA. Nguyen Doan Huy**

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

SHEET OF ANALYZED RESULTS OF WATER SAMPLE

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

VILAS 341

Client	:	Power Engineering Consulting Joint Stock Company 1 (PECC1)
Project	:	ESIA for My Ly – Nam Mo 1 HPP
Sample name	:	Surface water sample at Vang Ngo village, Muong Tip commune, Ky Son district, Nghe An province, SR Viet Nam
Sample code	:	NM1-2
Sample co-ordinates	:	X = 2145418.646; Y = 418362.055
Date of sampling	:	07/03/2017

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

No.	Indicator	Unit	Method	Results	Max allowable limit(*)
1	pH		TCVN 6492:2011	6.64	6 to 8.5
2	BOD_5 (20°C)	mg/l	TCVN 6001-1:2008	0.72	6
3	COD	mg/l	SMEWW 5220B:2012	1.14	15
4	Dissolved Oxygen (DO)	mg/l	TCVN 7325:2004	6.6	≥ 5
5	Total Suspended Solid (TSS)	mg/l	TCVN 6625:2000	12	30
6	Ammonite (NH4+ estimated according to N)	mg/l	TCVN 6179-1:1996	0.05	0.3
7	Chloride (Cl^-)	mg/l	TCVN 6194:1996	1.62	350
8	Floride (F^-)	mg/l	SMEWW 4500B&D:2012	<0.05	1.5
9	Nitrite (NO^{2}- estimated according to N)	mg/l	TCVN 6178:1996	<0.01	0.05
10	Nitrate (NO^{3-} estimated according to N)	mg/l	TCVN 6180:1996	0.02	5
11	Phosphate (PO_4^{3-} estimated according to P)	mg/l	TCVN 6202:2008	<0.01	0.2
12	Xyanua (CN^-)	mg/l	TCVN 6181:1996	<0.01	0.05
13	Arsenic (As)	mg/l	ISO 15586:2003	<0.0001	0.02
14	Zinc (Zn)	mg/l	TCVN 6193:1996	0.010	1.0
15	Mangan (Mn)	mg/l	TCVN 6002:1995	<0.01	0.2
16	Mercury (Hg)	mg/l	TCVN 7877:2008	<0.0001	0.001
17	Iron (Fe)	mg/l	TCVN 6177:1996	<0.01	1
18	Total oils & grease	mg/l	SMEWW 5520B:2012	0.1	0.5
19	Coliform	MPN/100ml	TCVN 6182-2:1996	310	5000
20	E.coli	MPN/100ml	TCVN 6182-2:1996	11	50

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

Notes: Maximum allowable limit regulated by National Technical Standard on quality of surface water (QCVN 08-MT:2015/BTNMT)- column A2: applying to surface water resources used for domestic water supply purpose but it shall be applied with suitable treatment method, for irrigation, navigation and other similar purposes..

Ha Noi, March 20th 2017

Analyzed by	**Checked by**	For and on behalf of Director of Institute **DIRECTOR OF LABORATORY**
Nguyen Thi Cuc	**MBA. Nguyen Thu Hien**	**MBA. Nguyen Doan Huy**

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

SHEET OF ANALYZED RESULTS OF WATER SAMPLE

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

Client	:	Power Engineering Consulting Joint Stock Company 1 (PECC1)
Project	:	ESIA for My Ly – Nam Mo 1 HPP
Sample name	:	Surface water sample at Namuang village, Noonghed district, Xiangkhuang province, Lao PDR
Sample code	:	NM1-3
Sample co-ordinates	:	X = 2147808.258; Y = 421795.579
Date of sampling	:	08/03/2017

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

VILAS 341

No.	Indicator	Unit	Method	Results	Max allowable limit(*)
1	pH		TCVN 6492:2011	6.56	6 to 8.5
2	BOD_5 (20°C)	mg/l	TCVN 6001-1:2008	1.2	6
3	COD	mg/l	SMEWW 5220B:2012	1.51	15
4	Dissolved Oxygen (DO)	mg/l	TCVN 7325:2004	6.2	≥ 5
5	Total Suspended Solid (TSS)	mg/l	TCVN 6625:2000	15	30
6	Ammonite (NH4+ estimated according to N)	mg/l	TCVN 6179-1:1996	0.12	0.3
7	Chloride (Cl^-)	mg/l	TCVN 6194:1996	1.62	350
8	Floride (F^-)	mg/l	SMEWW 4500B&D:2012	<0.05	1.5
9	Nitrite (NO^{2-} estimated according to N)	mg/l	TCVN 6178:1996	<0.01	0.05
10	Nitrate (NO^{3-} estimated according to N)	mg/l	TCVN 6180:1996	<0.01	5
11	Phosphate (PO_4^{3-} estimated according to P)	mg/l	TCVN 6202:2008	<0.01	0.2
12	Xyanua (CN^-)	mg/l	TCVN 6181:1996	<0.01	0.05
13	Arsenic (As)	mg/l	ISO 15586:2003	<0.0001	0.02
14	Zinc (Zn)	mg/l	TCVN 6193:1996	0.005	1.0
15	Mangan (Mn)	mg/l	TCVN 6002:1995	<0.01	0.2
16	Mercury (Hg)	mg/l	TCVN 7877:2008	<0.0001	0.001
17	Iron (Fe)	mg/l	TCVN 6177:1996	<0.01	1
18	Total oils & grease	mg/l	SMEWW 5520B:2012	<0.1	0.5
19	Coliform	MPN/100ml	TCVN 6182-2:1996	250	5000
20	E.coli	MPN/100ml	TCVN 6182-2:1996	6	50

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

Notes: Maximum allowable limit regulated by National Technical Standard on quality of surface water (QCVN 08-MT:2015/BTNMT)- column A2: applying to surface water resources used for domestic water supply purpose but it shall be applied with suitable treatment method, for irrigation, navigation and other similar purposes..

Ha Noi, March 20th 2017

Analyzed by	**Checked by**	For and on behalf of Director of Institute **DIRECTOR OF LABORATORY**
Nguyen Thi Cuc	**MBA. Nguyen Thu Hien**	**MBA. Nguyen Doan Huy**

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

SHEET OF ANALYZED RESULTS OF WATER SAMPLE

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

VILAS 341

Client	:	Power Engineering Consulting Joint Stock Company 1 (PECC1)
Project	:	ESIA for My Ly – Nam Mo 1 HPP
Sample name	:	Surface water sample at Sa Vang village, Ta Ca commune, Ky Son district, Nghe An province, SR Viet Nam
Sample code	:	NM1-4
Sample co-ordinates	:	X = 2148781.555; Y = 426232.205
Date of sampling	:	08/03/2017

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

No.	Indicator	Unit	Method	Results	Max allowable limit(*)
1	pH		TCVN 6492:2011	6.50	6 to 8.5
2	BOD_5 (20°C)	mg/l	TCVN 6001-1:2008	0.68	6
3	COD	mg/l	SMEWW 5220B:2012	0.96	15
4	Dissolved Oxygen (DO)	mg/l	TCVN 7325:2004	6.4	≥ 5
5	Total Suspended Solid (TSS)	mg/l	TCVN 6625:2000	8	30
6	Ammonite (NH4+ estimated according to N)	mg/l	TCVN 6179-1:1996	0.02	0.3
7	Chloride (Cl^-)	mg/l	TCVN 6194:1996	1.45	350
8	Floride (F^-)	mg/l	SMEWW 4500B&D:2012	<0.05	1.5
9	Nitrite (NO^{2-} estimated according to N)	mg/l	TCVN 6178:1996	<0.01	0.05
10	Nitrate (NO^{3-} estimated according to N)	mg/l	TCVN 6180:1996	0.03	5
11	Phosphate (PO_4^{3-} estimated according to P)	mg/l	TCVN 6202:2008	<0.01	0.2
12	Xyanua (CN^-)	mg/l	TCVN 6181:1996	<0.01	0.05
13	Arsenic (As)	mg/l	ISO 15586:2003	<0.0001	0.02
14	Zinc (Zn)	mg/l	TCVN 6193:1996	0.005	1.0
15	Mangan (Mn)	mg/l	TCVN 6002:1995	<0.01	0.2
16	Mercury (Hg)	mg/l	TCVN 7877:2008	<0.0001	0.001
17	Iron (Fe)	mg/l	TCVN 6177:1996	<0.01	1
18	Total oils & grease	mg/l	SMEWW 5520B:2012	<0.1	0.5
19	Coliform	MPN/100ml	TCVN 6182-2:1996	210	5000
20	E.coli	MPN/100ml	TCVN 6182-2:1996	2	50

VIETNAM INSTITUTE OF INDISTRIAL CHEMISTRY
ANALYSIS LABORATORY CENTER
No. 2 Pham Ngu Lao- Hoan Kiem- Ha Noi. Tel: 04. 38242107. Fax: 04.39335421

Notes: Maximum allowable limit regulated by National Technical Standard on quality of surface water (QCVN 08-MT:2015/BTNMT)- column A2: applying to surface water resources used for domestic water supply purpose but it shall be applied with suitable treatment method, for irrigation, navigation and other similar purposes..

Ha Noi, March 20th 2017.

Analyzed by	**Checked by**	For and on behalf of Director of Institute **DIRECTOR OF LABORATORY**
Nguyen Thi Cuc	**MBA. Nguyen Thu Hien**	**MBA. Nguyen Doan Huy**