

Assessment Of Fundamental Characteristics Of Semi-Submerged Soil Based On Water Level In Reservoir At The Area Of Son La Hydroelectricity

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Abstract—The results showed that soil properties at the bottom of the Lake differ significantly according to water level: Sand particles content: from CT1 water level (215m water level: The highest water level) down to water level of CT2 (190 - 195m water level) has increased, from water level CT2 to water level CT3 has decreased, from water level CT3 (175 -190m water level flooded) to water level CT4 (175m dead water level) has increased. Limon particles content: this study shows that the average water level is opposed to grains of sand components, ranged from 31.50 to 58.52%. In which the largest is CT3 (from 175 - 190m flooded water levels) and the lowest water level is CT1. Clay content: The average water levels in this research ranged from 19.48 to 29.37% . In which, the largest at CT1 (215m water level flooded). The water levels of the lowest levels of clay is CT4. Soil property indicates that at water level CT1 (The highest water level) and water level CT2 (190- 195m water level), shows the basic properties of soil is acid, poor nutrition, humus and nitrogen content, tend to accumulate according to depth, alkali cation, in the lower level of the following water level. Al³⁺ concentration increased gradually from 190m to 195m. CT3 (of the submerged from 175 - 190m) and CT4 (175m Dead water level) illustrate the deposition of nutrients pH has increased gradually to the dead water level, humus and nitrogen content tends to accumulate decreases with depth, Alkali cation dropped slightly to the level of dead water, Al³⁺ concentration has decreased steadily.

Keywords—Wetlands half, water level flooded, soil properties, Hydropower reservoir, Son La Hydroelectric.

1. Introduction

Land submerged area is part of the land belong to the hydroelectric reservoir, irrigation but not flooded regularly, flooded time in years depending on the operating procedures of each lake, but not more than six (06) months, the time flooded determined[4]. Son La power plant approximately 200 kilometers from Muong La district, Son La province to Muong Lay district, Dien Bien province, the reservoir flooded about 23,000 ha of natural land in which 10,000 ha of semi-flooded land. At the same time lead to the formation of

new ecological environment, the structure of the system of air and soil, dynamic - plants, water, in which humans are special factors. It is formed and stabilized adapted in a certain time. Also based on the demand for energy, agriculture, hydroelectric plants that adjust to suit the needs, thereby leading to regulated water levels flooded and up and down according to water levels, from dead water level 175m, to the highest water level is 215m. in each of the water levels have different physical characteristics, and the question that is at the different grade levels how flood water level has impact on soil properties in elevation it, the question of sedimentation, erosion at high process is in place.

2. SUBJECTS AND RESEARCH METHODS

2.1. Research subjects

- The subjects of research on the water level
- + The highest water level 215m
- + Water level 190-195m
- + Water level 175-190m
- + Dead water level 175m
- Analyze the subjects

The pH, total Nitrogen, total Humus (% OM), easily digestible K₂O, easily digestible P₂O₅, Ca²⁺, Mg²⁺, Al³⁺ and component level particles

2.2 Research Methods

- Soil sampling methods: Soil samples in the study area were taken at the surface from depths of 0 - 20 cm, on submerged land. After taking soil samples are stored in individual bags, marked with the markings in the package.

- Analytical methods in laboratory:

+ Sample processing method

Soil sample: after taking on removing roots, impurities, drying in air at room temperature then crushed through a sieve to 1 mm.

+ Analytical methods: Define criteria in the ground by the method has high accuracy and commonly used today in the Determine the composition of the soil particles according to TCVN 8567: 2010 (soil quality-method of determining particle-level components)

3. RESULTS AND DISCUSSION

3.1. Environmental division submerged land in Son La hydropower valley

Based on regulatory regimes and seasonal water level in each month of the year, based on the line chart shows the correlation between the high water level and the flood in the months of the year

- From September to December the water level in the lake is 215m The highest water level;
- Since January, the water has been withdrawn. In March, the water level reached 190 - 195m;
- From April to the end of June, the water has gone down rapidly reached the dead water level was 175m
- From July to mid-August the water level maintained at 175m

Table 1: Timeframe of clearance land per month and water level for the submerged lands of Son La hydropower

Month	01	02	03	04	05	06	07	08	09	10	11	12
The highest water level 215	////////////////////								-----			
	Clearance land 8 months								Submerged			
190 - 195	-----		////////////////////						-----			
	Submerged		Clearance land 5 months						Submerged			
175 - 190	-----						////////////////		-----			
	Submerged						2 months		Submerged			
Dead water level 175m	-----											
	Submerged											

- Submerged time between September and December at the highest water level is 215m:

At this water level, time of clearance land was 4 months, the highest land elevation. Semi-submerged land not yet flooded, people using the land for cultivation, planting flowers., but with a small percentage.

Feature land here is soil erosion due to steep ground. In addition, this area is at the highest water level with the highest time of clearance land,so people make use of land for cultivation, in the process of utilizing land with the use of substances, inorganic and organic; Nitrogen, phosphorus, manure, especially pesticides, because the water flooded up it would flood the entire area of arable land and organic substances, chemical, pests were mixed in water and lead to other areas that settle to the bottom of the lake and leads to the landslide when the water withdrew, so in this period usually infertile soil, humus nutrients at a low, soils are acidic.

- Submerged time between January and March the water level reached 190 - 195m:

The land clearance time at this water level is 3 months plus 4 months of 215m, the land here is fundamentally the same time as the flood time at one , but some areas here alluvial sedimentation in low-lying

water level due to withdraw in the water level, some eroded areas are washed away.

The soil features some sloping areas, the soil is infertile, whereas some low-lying areas with high nutrient soil, but soil also contained some chemical components of inorganic, organic, pesticide residue .,

- The time between April and late June the water level quickly down to 175m:

During this time the land is retained an alluvial soil, fertile soil, high humus content, high pH because nutrients are retained in part, the land here has a number of composition of inorganic pollutants, organic mix, due to the process of cultivation, soil basic black.

- The time between July and August dead water level 175m:

The semi-submerged land in this area is alluvial deposition, there are high content of nutrients, pH, humus due to long time of submergence, contains many complex pollutants due to being washed away from top to down, land here is not used by people for cultivation.

3.2 Characteristics of land according to submerged altitude

3.2.1 Results of analysis of grain composition of submerged in submerged altitude in the reservoir area at the Son La hydropower

Table 2: Grain component analysis based on water level

Location of sampling	Water level	Symbol of sample	Grain component % TCVN 8567 :2010		
			Sand 2 - 0.02 mm	Limon 0.02 - 0.002 mm	Clay <0.002 mm
ItOng	CT1	Đ1	39.14	31.51	29.35
	CT2	Đ2	42.72	31.54	25.74
	CT3	Đ3	16.83	58.51	24.66
	CT4	Đ4	28.47	52.06	19.47
MuongTrai	CT1	Đ5	39.11	31.52	29.37
	CT2	Đ6	42.72	31.53	25.75
	CT3	Đ7	16.85	58.50	24.65
	CT4	Đ8	28.46	52.07	19.47
MuongSai	CT1	Đ9	39.13	31.55	29.32
	CT2	Đ10	42.76	31.51	25.73
	CT3	Đ11	16.80	58.56	24.64
	CT4	Đ12	28.45	52.06	19.49
CaNong	CT1	Đ13	39.12	31.51	29.37
	CT2	Đ14	42.77	31.50	25.73
	CT3	Đ15	16.86	58.52	24.64
	CT4	Đ16	28.49	52.02	19.49

Notes:

CT1: Place of sample in water level THE HIGHEST WATER LEVEL 215m. Đ1, Đ5, Đ9, Đ13

CT2: Place of sample in water level 190 - 195m. Đ2, Đ6, Đ10, Đ14

CT3: Place of sample in water level 175 - 190m. Đ3, Đ7, Đ11, Đ14

CT4: Place of sample in water level DEAD WATER LEVEL 175m. Đ4, Đ8, Đ12, Đ14

* *Level content of sand:* Through the table and graph shows the data of sand content from water level CT1 to water level CT2 has increased, from water level CT2 to water level CT3 has decreased, from water level CT3 to water level CT4 has increased, specifically:

- It Ong town, water level CT1 is 39.14% reduced to CT2 is 42.72%, from CT2 down to CT3 by 16.83%, from CT3 down to CT4 increased by 28.47%.

- Muong Trai commune, water level CT1 is 39.11% reduced to CT2 is 42.72%, from CT2 down to CT3 by 16,85%, from CT3 down to CT4 increased by 28,46%.

- Muong Sai Commune, water level CT1 is 39,13% reduced to CT2 is 42.76%, from CT2 down to CT3 by 16,80%, from CT3 down to CT4 increased by 28,45%.

- Ca Na commune, water level CT1 is 39.12% reduced to CT2 is 42.77%, from CT2 down to CT3 by 16.86%, from CT3 down to CT4 increased by 28.49%.

* *Limon content:* The average of water level in the study as opposed to grains of sand components, ranging from 31.50 to 58.52%. Of which the largest is

CT3 (water level from 175 - 190m) and the lowest in water level CT1.

- It Ong town , water level CT1 is 31.51% down to water level CT2 is 31.54%, from CT2 down to CT3 increased by 58.51%, from CT3 down to CT4 by 52.06%.

- Muong Trai commune, water level CT1 is 31.52% down to water level CT2 is 31.53%, from CT2 down to CT3 increased by 58.50%, from CT3 down to CT4 by 52.07%.

- Muong Sai commune, water level CT1 is 31.55% down to water level CT2 is 31.51%, from CT2 down to CT3 increased by 58.56%, from CT3 down to CT4 by 52.06%.

- Ca Nong commune, water level CT1 is 31.51% down to water level CT2 is 31.50%, from CT2 down to CT3 increased by 58.52%, from CT3 down to CT4 by 52.02%.

Grain clay content: The average of water level in the study ranged from 19.48 to 29.37%. Which is the largest location at CT1 (water level 215m). The water level with the lowest clay content is CT4.

- It Ong town , water level CT1 is 29,35% down to water level CT2 is 25,74%, from CT2 down to CT3 by 24,66%, from CT3 down to CT4 by 19,47%.

- Muong Trai commune, water level CT1 is 29,37% down to water level CT2 is 25,75%, from CT2 down to CT3 by 24,65%, from CT3 down to CT4 by 19,49%.

- Muong Sai commune, water level CT1 is 29,32% down to water level CT2 is 25,73%, from CT2 down to CT3 by 24,64%, from CT3 down to CT4 by 19,49%.

- CaNong commune, water level CT1 is 29,37% down to water level CT2 is 25,73%, from CT2 down to CT3 by 24,64%, from CT3 down to CT4 by 19,49%.

3.2.2 Results analyzed of the land properties submerged according to water level in the Lake son La hydropower

Table 2: Analysis of soil properties according to water level

Place of sample	Water level	Symbol	pH	Total Nitrogen (mg/g)	Total Humus (%OM)	K ₂ O (mg/kg)	P ₂ O ₅ (mg/100g)	Ca ²⁺ (meq/100g)	Mg ²⁺ (meq/100g)	Al ³⁺ (cmol/kg)
It Ong	CT1	Đ1	5,55	1,23	0,66	47,52	2,44	3,58	0,91	0,17
	CT2	Đ2	4,14	1,39	1,97	39,16	4,13	2,21	0,36	0,95
	CT3	Đ3	3,95	2,24	2,15	49,14	3,15	2,68	0,93	0,47
	CT4	Đ4	5,19	1,58	1,98	54,16	6,53	5,97	0,79	0,10
MuongTrai	CT1	Đ5	5,25	1,22	0,68	47,43	2,46	3,59	0,89	0,17
	CT2	Đ6	4,24	1,48	2,01	39,15	4,23	2,22	0,45	0,98
	CT3	Đ7	4,17	2,21	2,17	49,21	3,12	2,68	0,53	0,46
	CT4	Đ8	5,39	1,55	1,95	54,17	6,48	5,98	0,87	0,09
MuongSai	CT1	Đ9	5,56	1,18	0,63	47,43	2,39	3,69	0,99	0,18
	CT2	Đ10	4,23	1,46	1,87	39,21	4,23	2,34	0,44	0,93
	CT3	Đ11	4,43	2,11	2,16	49,23	3,12	2,54	0,96	0,48
	CT4	Đ12	5,54	1,51	2,08	54,34	6,49	5,89	0,84	0,09
CaNong	CT1	Đ13	5,38	1,23	0,75	46,42	2,46	3,60	0,93	0,18
	CT2	Đ14	4,12	1,52	1,98	38,06	4,09	2,24	0,40	0,94
	CT3	Đ15	4,18	2,31	2,16	50,04	3,07	2,69	0,91	0,46
	CT4	Đ16	5,36	1,49	1,88	54,34	6,53	5,87	0,81	0,09

Notes:

CT1: Place of sample in water level THE HIGHEST WATER LEVEL 215m. Đ1, Đ5, Đ9, Đ13

CT2: Place of sample in water level 190 - 195m. Đ2, Đ6, Đ10, Đ14

CT3: Place of sample in water level 175 - 190m. Đ3, Đ7, Đ11, Đ14

CT4: Place of sample in water level DEAD WATER LEVEL 175m. Đ4, Đ8, Đ12, Đ14

The pH levels on the table show that water level (CT1) corresponding to the highest water level of 215m, with PH in medium acidity levels, and also higher than the other water level, fluctuating with the lowest water level average to 1,46. At lower water level, the pH was reduced in detail: CT2 (water level 190 - 195m) had an average pH of 4.18 has high acidic, along with the next water level followed by CT3 (water level 175 - 190m) had an average pH of 4.18 at 4 positions sample has high acidic. At the elevation of dead water level, CT4 had a mean pH at four locations of 5.37 has medium acidic.

The soil has a very acidic, slightly acidic reaction, the content of Al³⁺ exchanged in the soil is very low and low in details: content Al³⁺ + low as CT1 (water level 215m), with CT4 (water level dead water level 175m) pH represents the pH average in locations sample is from 5.37 to 5.55 at medium acidic so has a low Al³⁺ content, and lower than the average between the position reached from 2.75 to 5.5, two the water levels

has pH from 4.18, indicating high acidity pH means that the aluminum content at a high level. In CT2 (water level 190 - 195m) average between four positions sample at 0.95 (cmol / kg), CT3 (water level from 175 - 190m) averaged to 0.47 (cmol / kg) at the highest level.

* *Nitrogen content*: The total Nitrogen content at the CT1 level is moderate. The CT2, CT3, CT4 levels has total Nitrogen content ranged from 1.53 to 2.22 (mg/g), indicating the total Nitrogen content was quite good.

- It Ong town, The CT1 level was 1.23 (mg / g); the CT2 was reduced to 1.39 (mg / g), from CT2 down to CT3 increased to 2.24 (mg / g), from CT3 down to CT4 decreased to 1.58 (mg / g).

-Muong Trai commune, The CT1 level was 1.22 (mg / g); the CT2 was reduced to 1.48 (mg / g), from CT2 down to CT3 increased to 2.11 (mg / g), from CT3 down to CT4 decreased to 1.55 (mg / g).

- Muong Sai commune, The CT1 level was 1.18 (mg /g); the CT2 was reduced to 1.46 (mg /g), from CT2 down to CT3 increased to 2.21 (mg / g), from CT3 down to CT4 decreased to 1.51 (mg /g).

- CaNong commune, The CT1 level was 1.23 (mg /g); the CT2 was reduced to 1.52 (mg /g), from CT2 down to CT3 increased to 2.31 (mg / g), from CT3 down to CT4 decreased to 1.49 (mg /g).

* *Humus content:* The total humus content increases with the water level in details:

- It Ong town, water level CT1 was 0.66% down to CT2 increased reached 1.97%, from CT2 down to CT3 increased to 2.15%, From CT3 down to CT4 decreased 1.98%.

- MuongTraicommune, water level CT1 was 0.66% down to CT2 increased reached 2.01%, From CT2 down to CT3 increased to 2.17%, From CT3 down to CT4 decreased 1.95%.

- MuongSai commune, water level CT1 was 0.63% down to CT2 increased reached 1.87%, From CT2 down to CT3 increased to 2.16%, From CT3 down to CT4 decreased 2.08%.

- CaNong commune, water level CT1 was 0.75% down to CT2 increased reached 1.98%, From CT2 down to CT3 increased to 2.16%, From CT3 down to CT4 decreased 1.88%.

It can be said due to the process of flooding up and down. The decomposition process of plants and animals, when submerged, when soak up at the same time occurs the deposition process so the total humus content increases as water take out.

* *The K₂O and P₂O₅ content:*Content of K₂O easily digestible mostly located in very poor levels, in details: At three water levels from the 215m THE HIGHEST WATER LEVEL, content of potassium easily digestible is very poor. At the same time, In CT4 has potassium content is very poor. In details:

- It Ong town, in CT1 down to CT2 down to CT3 respectively 47,52, 39,16, 49,14(mg/kg), potassium content is very poor. In CT4, content of potassium easily digestible reached 54.16(mg/kg).

- MuongTrai commune, in CT1 down to CT2 down to CT3 respectively 47,43, 39,15, 49,21(mg/kg), potassium content is very poor. In CT4, content of potassium easily digestible reached 54.17 (mg/kg).

- MuongSai commune, in CT1 down to CT2 down to CT3 respectively 47,43, 39,21, 49,23(mg/kg), potassium content is very poor. In CT4, content of potassium easily digestible reached 54.34 (mg/kg).

- CaNong commune, in CT1 down to CT2 down to CT3 respectively 46,42, 38,06, 50,04(mg/kg), potassium content is very poor. In CT4, content of potassium easily digestible reached 54.34 (mg/kg).

* *The P₂O₅ content:* It's very poor and poor, as shown below:

- It Ong town, in CT1 down to CT2 down to CT3 respectively 2,44, 4,13, 2,68(mg/100g), potassium content is very poor. In CT4, content of potassium easily digestible reached 6.53(mg/kg).

- MuongTrai commune, in CT1 down to CT2 down to CT3 respectively 2,46, 4,23, 3,12(mg/100g), potassium content is very poor. In CT4, content of potassium easily digestible reached 6.48(mg/kg).

- MuongSai commune, in CT1 down to CT2 down to CT3 respectively 2,39, 4,23, 3,12(mg/100g), potassium content is very poor. In CT4, content of potassium easily digestible reached 6.49(mg/kg).

- CaNong commune, in CT1 down to CT2 down to CT3 respectively 2,46, 4,09, 3,07(mg/100g), potassium content is very poor. In CT4, content of potassium easily digestible reached 6.53(mg/kg).

**Ca²⁺, Mg²⁺ content:*

The Ca²⁺ exchange low and medium, fluctuates in the range of 2.25 - 5.93 (meq/ 100g), in CT1 (THE HIGHEST WATER LEVEL 215m) shows high Ca²⁺ content and according to following water level show reduced from 0.97 to 1.37 times, due to the erosion washed away in two submerged areas from high CT2 to CT3, and when the water drains to dead water level then Ca²⁺ increased from 3.28 - 3.68 times as it is the dead water accumulate so much alkali cations.

Mg²⁺ is in the low level, range of 0.41 - 0.93 (meq/100g), in water level CT2 (190 - 195m water level) has lowest Mg²⁺ content is 0.41 (meq/100g), lower than the average from 2 to 2.3 times. Two water level has same highest Mg²⁺ content is CT1(215m water level) and CT3(190 - 195m water level), on average between the positions reached 0.93 (meq/100g). CT4 has average Mg²⁺ content between the collection position is 0.83 (meq /100g).

4. CONCLUSION

The process of rise and fall of the water level, and slope, soil properties leading to the soil properties at the water level change from top to down, due to sedimentation, erosion from 215m water level down to lower water level, but the nature here basically show pH acidic, nutrient-poor; At water level CT1 (215m) and water level CT2 (190 - 195m), showing the basic nature is acid, poor nutrition, humus content, protein tend to accumulate in degrees deep. Grain levels, alkaline cations at lower of the following water level, Al₃⁺ content gradually increased to water level CT₂ (190 - 195m).

At the end of CT3 (175 - 190m), and CT4 (175m dead water level). Show the deposition of nutrients thereby gradually increasing pH and nutrients gradually increased to dead water level. Humus, nitrogen tends to decrease with depth level. Grain levels, alkaline cations gradually reduced to dead water levels, Al₃⁺ content decreased.

5. REFERENCES

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