THE ASSESSMENT OF CARBON DIOXIDE (CO2) ADSORPTION AND SPATIAL BIOMASS DISTRIBUTION MAPPING IN THE RESERVOIR OF HINBOUN HYDROPOWER PROJECT

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Abstract

Geographical Information System (GIS) is an excellent tool to be employed with computer control system and play very significant role for database management, storing, capture, mapping and data analysis which includes vector and raster data. This study is mainly to focus on: (i) to study on the tree volumes, carbon storages and analyze the adsorption of carbon dioxide (CO_2), (ii) to estimate the existing biomass within the reservoir and (iii) to create the spatial biomass distribution maps. Consequently, the distribution maps are described and indicated in low to high biomass density within the study area. Hence, this study has found that: there are 10,365.3 m^3 of the total volume, 421.423 kg of total Carbone storage, 1,542.41kg of total CO_2 absorption and 36,346.48 tons of total Biomass within the study area.

Keywords: *GIS, Biomass, Carbon Dioxide, Adsorption, Dam.*

1. INTRODUCTION

Lao government has set forest strategy and targeted to restore and increase the forest cover to be 70% by 2020 [1].It means that 8.2 million hectares of land need to be planted, Carbon dioxide emission has been increased gradually since 2000 and 2013 there was 3,199 Kilotons at highest concentration in Lao PDR [2,3,4]. It is caused of global warming and climate change as encountering [5]. Carbon absorption of the trees are natural way to reduce global warming issue and save the global from high temperature around the global, it also increases the oxygen for the people and living and nonliving thing [6].

2. LITERATURE REVIEW

Currently, GIS is developed and employed commonly in multi-tasks for instance: science, engineering and relevant works [7]. Spatial biomass distribution is integrated between data collection from field work and ArcGIS software application [8]. In particular, Arc toolbox is a wise tool that applies to interpolate with Kriging method [9], in order to deal with biomass spatial distribution of each sampling point within the reservoir area of Hinboun Hydroelectric Plant [10], the Kriging methods were calculated and generated the raster files of the biomass distribution based on data analysis [11] and were stored in the database as attribute data, entire

data was employed the statistical function to analyze and then be transferred from Microsoft Excel to Arc GIS by Geospatial method [12].

3. METHODOLOGY

The study is conducted and followed the research methodology as indicated in Fig 1.

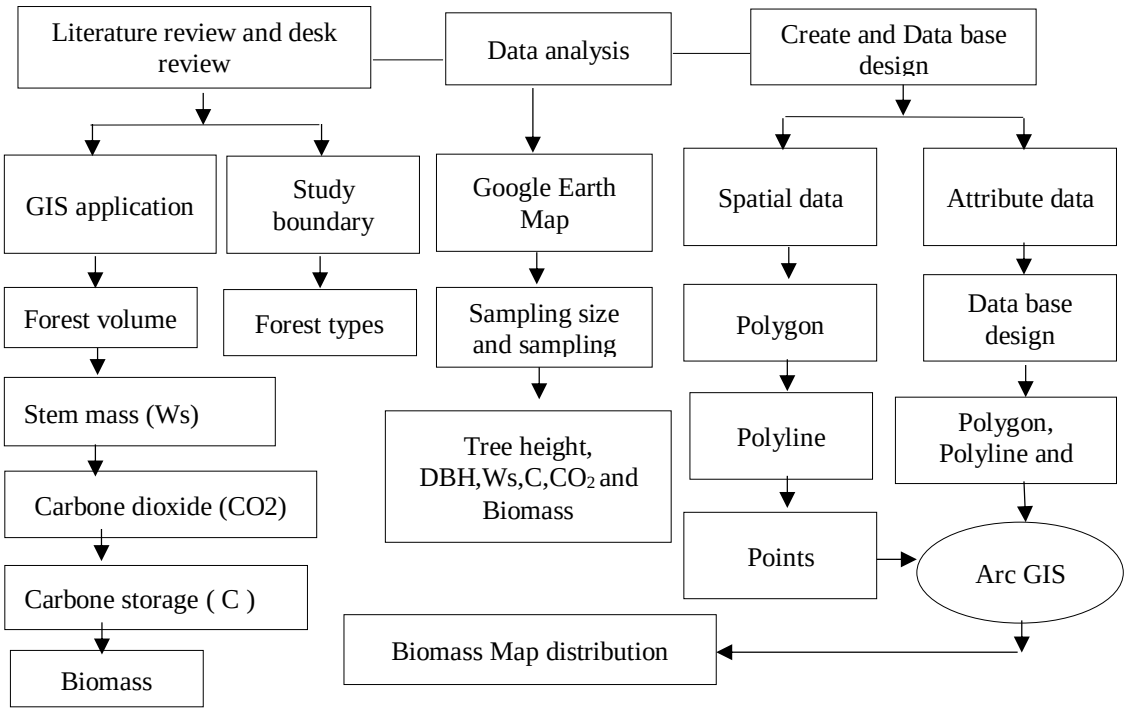

Fig1. Research methodology

A. Site study and sampling data collection

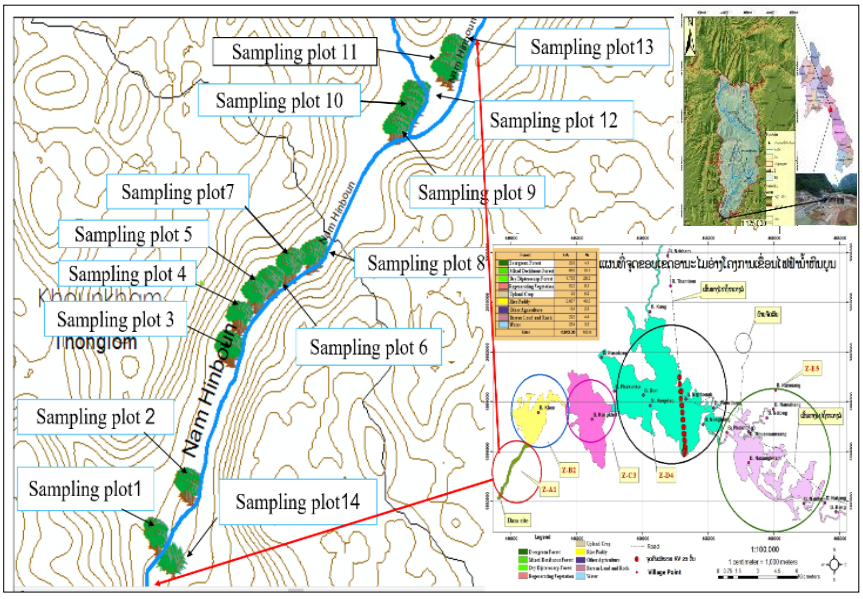

Fig2. Study area and sampling plots

Hinboun Hydro Power is a project that belongs to the Electricite Du Laos (EDL) to generate the electricity and support to Local need, it is located approximately 3 km above Thonglom Village to the East, Hinboun district, Khammouane Province and also approximately 30 kilometers downstream of the existing Theun Hinboun Dam and 60 km away and North of the confluence area of Nam Hinboun River and Mekong River. The type of dam is a run-off river concrete diversion dam which the main purpose is to generate the electricity for local use, low and high point is 167 masl and 468 masl [13], respectively, the study will cover only Z-A1 which is 60.78 ha, there are 14 sampling locations where were collected data as shown in Fig 2.

B. Formulas and Equations

$$W_s = 0.0509 \times D \times H \quad [1]$$

$$C = W_s \times 0.5 \quad [2]$$

$$Abs(CO_2) = C \times (\frac{44}{12}) \quad [3]$$

$$V = D^2 \times (\frac{\pi}{4}) \times h \times f \quad [4]$$

$$Biomass = (\frac{W_s \times V \times 800}{1000}) \quad [5]$$

Where:

W_s: Stem mass [kg]

C: Carbone Storage [kg]

$Abs(CO_2)$: Carbon dioxide absorption [Kg]

V: Volume [m^3]

f :Factor = 0.65

C. Data analysis and Biomass calculation

Based on data collection at sampling sites. Therefore, data was manipulated and analyzed to obtain the biomass volume [14, 15] as indicated in Fig 3.

Sampling points	Ws (kg)	V (m^3)	C(Kg)	Co2(Kg)	Biomass (Tons)	Biomass (Tons) /year
1	75.622	931.679	37.811	138.388	3303.858	9.05
2	64.573	797.5	32.287	118.169	2978.174	8.16
3	64.222	791.263	32.111	117.526	2519.148	6.90
4	60.785	743.388	30.393	111.237	2909.89	7.97
5	66.833	822.758	33.417	122.304	3068.079	8.41
6	39.124	477.814	19.562	71.597	978.442	2.68
7	59.068	729.297	29.534	108.095	2454.142	6.72
8	47.505	583.38	23.752	86.934	1657.757	4.54
9	46.148	566.088	23.074	84.451	1253.235	3.43
10	44.219	542.3	22.109	80.921	1275.022	3.49
11	61.251	750.304	30.626	112.09	2270.052	6.22
12	59.891	737.384	29.945	109.6	2430.282	6.66
13	72.363	892.649	36.182	132.424	4587.172	12.57
14	81.241	999.472	40.62	148.671	4661.232	12.77
Total	**842.845**	**10,365.28**	**421.423**	**1542.407**	**36346.485**	**99.57941**

Fig3. Sampling points and Biomass calculation

4. RESULT AND DISCUSSION

Figure 4 shows relationship between biomass and carbon absorption and also biomass and carbon storage within the study area, according to the finding, root mean square is 0.838 and 0.839, respectively. It means that the more biomass, the more absorption within the trees as well as the carbon storage.The distribution maps. Figure 5, 6, 7, 8 and 9 are described and indicated in low to high biomass density within the study area.**T**he low biomass density is meant that, those areas are not much richness of biodiversity and adsorption carbon dioxide is not rather good, the high biomass density is relevant to the abundance of the forest cover due to most of the standing trees are enriched and sustained; they are adsorptive carbon dioxide very well. Therefore, the forest cover will support and mitigate global warming and also climate change issue Among of 14 sampling points, the biomass distributions

Are mostly covered at plot 14 and 13 and 1 which are 4661.232 kg, 4587.172 kg and 3303.858 kg, respectively. The biomass distribution is covered very less at Plot 6, 9 and 10 which are 978.442 kg, 1253.235 kg and1275.022 kg, respectively.

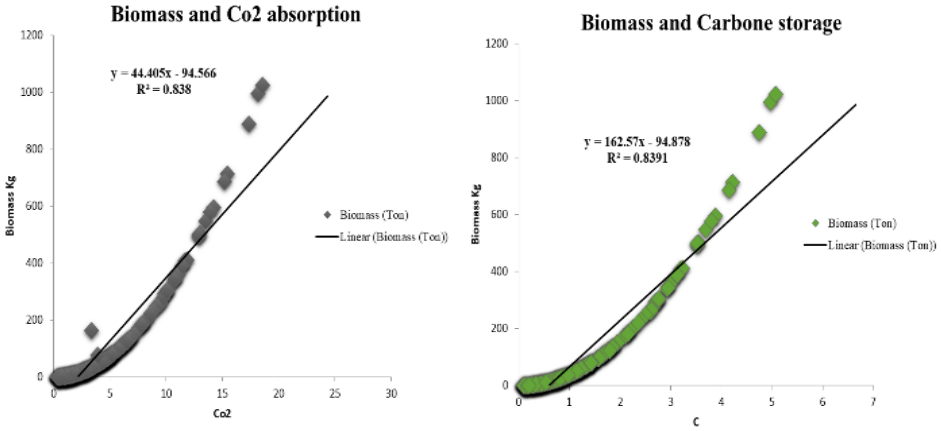

Fig4. Biomass, Carbon Storage and CO2 absorption model

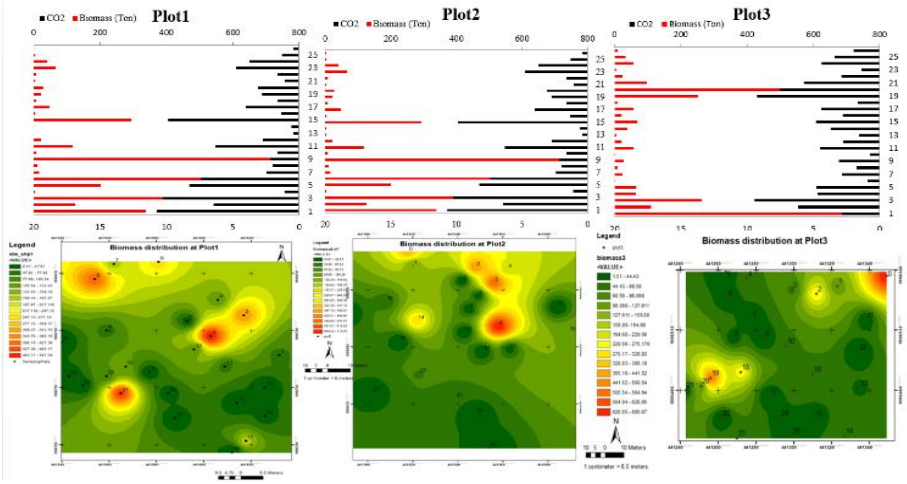

Fig5. Biomass Distribution at Plot 1, 2 and 3

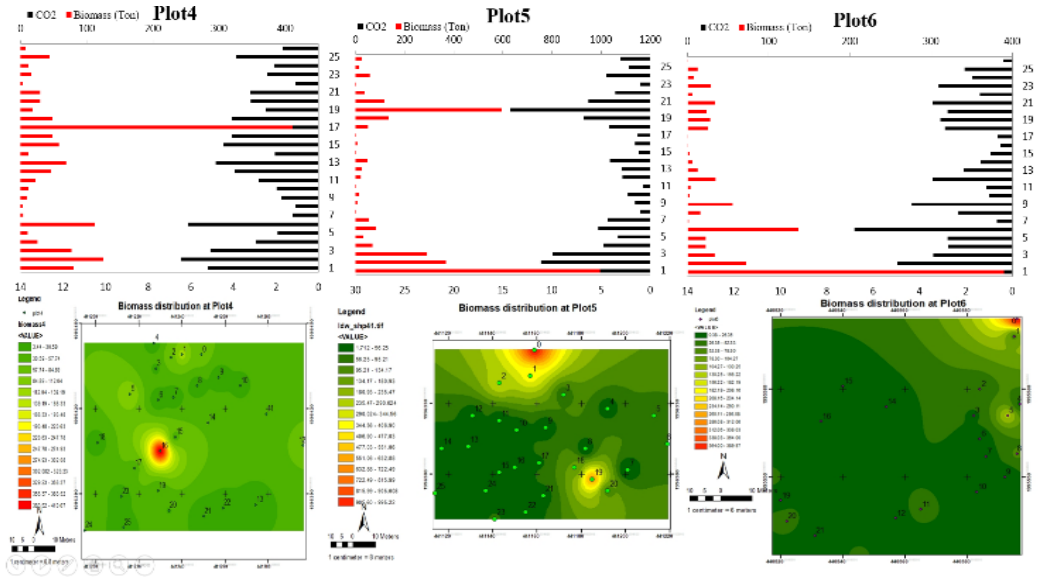

Fig6. Biomass Distribution at Plot 4, 5 and 6.

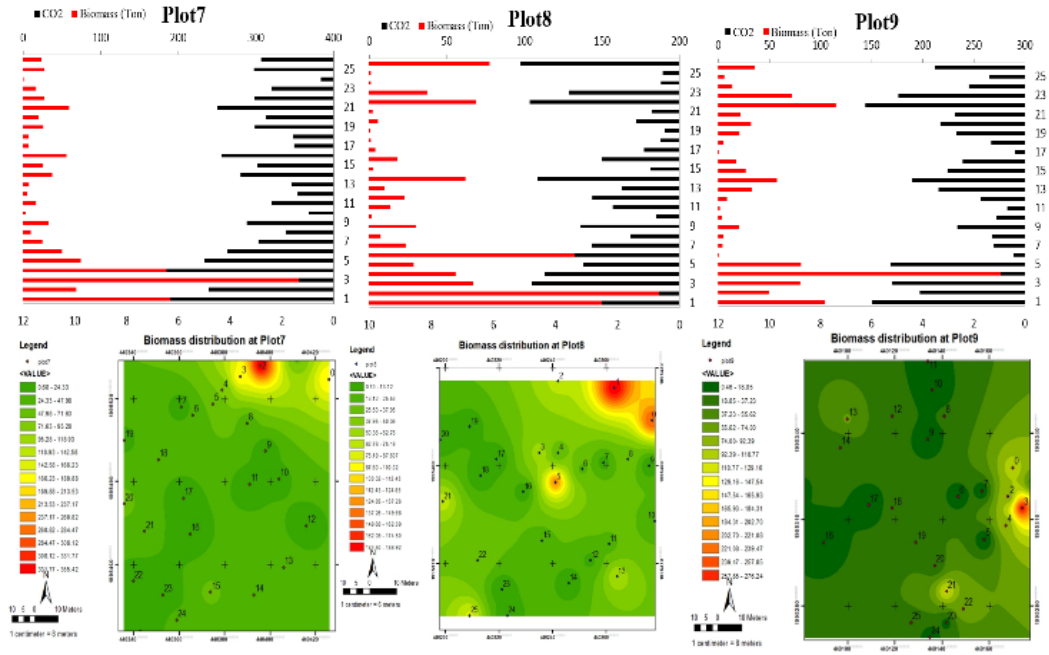

Fig7. Biomass Distribution at Plot 7,8 and 9

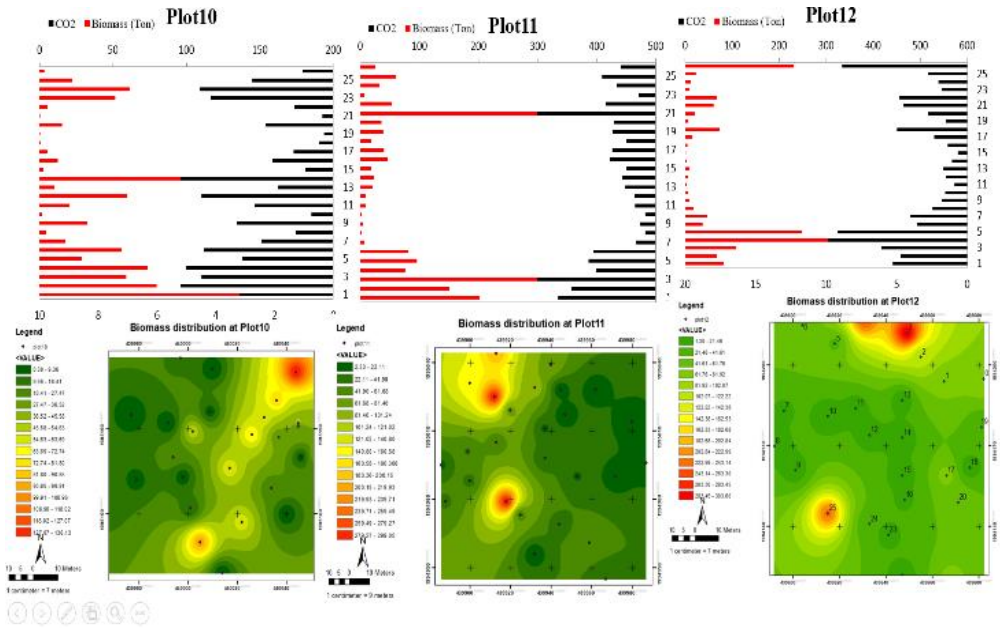

Fig8. Biomass Distribution at Plot 10, 11 and 12

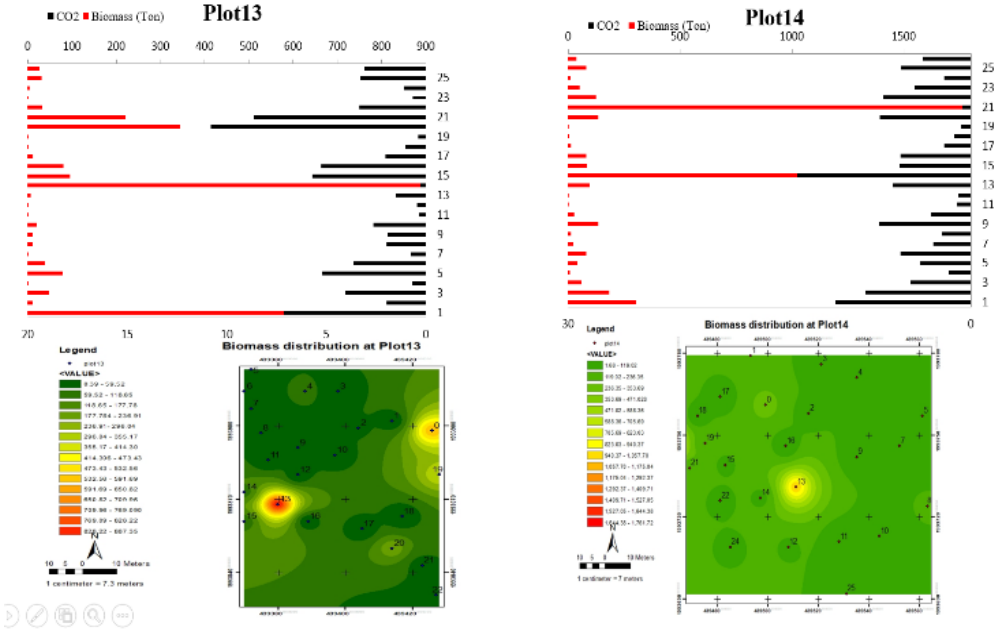

Fig9. Biomass Distribution at Plot 13 and 14

5. CONCLUSION

This paper is presented the integrated ArcGIS and excel sheet working together from the site to deskwork by employing the Biomass formula to manipulate and map. Therefore, the study results within the Z-A1are as followings:

The biomass distribution coverage at plot 1,13 and 14 are significantly to environment and biodiversity conservation, due to they are considered as good carbon dioxide absorption, at Plot 6,9 and 10 are considered as low carbon dioxide absorption and the other plots are classified

as medium. Therefore, increasing of the sustainable Biomass will be vital factor that will support and mitigate global warming and also climate change issue in both down and up scaling.

In addition, Biodiversity Offset should be compensated when forest is cut and burned in order to sustain the forest and wildlife and also climate change issue.

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REFERENCES

[1] Ministry of Natural Resources and the Environment (MoNRE),” National Biodiversity Strategy and Action Plan for Lao PDR 2016-2025. Vientiane Lao PDR”,2016.
[2]World Bank, “Lao PDR carbon (Co2) emission 1996-2019”, [Online], Available:https://www.macrotrends.net/countries/LAO/lao-pdr/carbon-co2-emissions, 2019.
[3]Sorphasith Xaisongkham, Syvanh Phonasa, Khaysy Srithilat and Honglin Yuan “Carbon dioxide emissions and the prospects for Lao PDR's economic self-development”, June 2019.
[4] Muntean, M., Guizzardi,D.,Schaaf,E., Crippa,M.,Solazzo,E., Oliver,J,G,J.,Vignati,E. Fossil “CO2 emssions of all world countries-2018
[5]report”,2018, [Online], Available: https://countryeconomy.com/energy-and-environment/co2-emissions
[6] Biswjit Mukhopadhyay ,”Global Warming – A Threat to the Planet”,2013.
[7] Graciela Tejada , Eric Bastos Görgens , Fernando Del Bon Espírito-Santo , Roberta Zecchini Cantinho and Jean Pierre Ometto ”Evaluating spatial coverage of data on the aboveground biomass in undisturbed forests in the Brazilian Amazon”,2019.
[8] Geoffery J. Meaden , José Aguilar-Manjarrez ,”Advances in geographic Paper information systems and remote sensing for fisheries and aquaculture”,2013.
[9] Na Li, Gaodi Xie,Changshun Zhang, Yu Xiao, Biao Zhang, Wenhui Chen ,Yanzhi Sun and Shuo Wang, “Biomass Resources Distribution in the Terrestrial Ecosystem of China”, 2015.
[10]Aba SC , Ndukwe OO , CJ Amuand KP Baiyeri ,”The role of trees and Plantation agriculture in mitigating global climate change”, 2017.
[11] Nam Hinboun Hydro Power, “Environmental Social Management Monitoring Plan report”, 2012.
[12] Tomislav Hengl, “A Practical Guide to Geostatistical Mapping”, 2009.
[13] S.Phoummixay,” Introduction to Geographical Information System”, 2018, ch.1.
[14] Electricite Du Laos ,”Project design document form for CDM project activities, version 8.0”,2017.
[15] P.Khamphet, “Forest survey and inventory manual”, 2015.
[16] Asian Development Bank (ADB),”Project performance audit report on the Theun-Hinboun Hydropower project (Loan 1329-LAO[SF]) in the Lao People’s Democratic Republic”,2002.