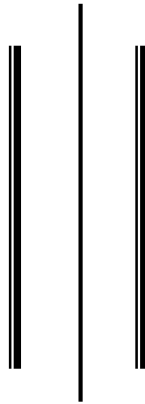
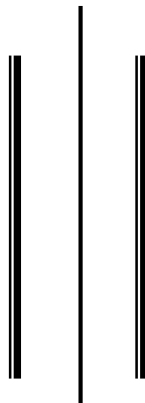


STATUS OF HYDROPOWER IN NEPAL'S ECONOMY



A Thesis

**Submitted to the Central Department of Economics,
Tribhuvan University, Kirtipur, Kathmandu, Nepal
In Partial Fulfillment of the Requirement for
the Degree of
Master of Arts
in
Economics**



By

MADHAB KANDEL

Roll No.: 86 (060/062)

Central Department of Economics

Tribhuvan University

Kirtipur, Kathmandu, Nepal

October, 2006

Date: 2063/07/12

LETTER OF RECOMMENDATION

This is to certify that Mr. Madhab Kandel has prepared this thesis entitled "**Status of Hydropower in Nepal's Economy**" for partial fulfillment of the requirement for the Master's Degree in Economics under my supervision and guidance. This thesis bears the candidate's own work and is in the form as required by Central Department of Economics, Tribhuvan University.

I therefore recommend the thesis for approval and acceptance.

Prof. Dr. Sri Ram Poudyal
Thesis Supervisor
CEDECON

Date: October 29, 2006

Date: 2063/07/22

LETTER OF APPROVAL

This is to certify that the thesis entitled "**Status of Hydropower in Nepal's Economy**" submitted by Mr. Madhab Kandel to the Central Department of Economics, Faculty of Humanities and Social Sciences, Tribhuvan University, in partial fulfillment of the requirements for the Degree of Masters of Arts in Economics has been found satisfactory in scope and quality. Therefore, the thesis is approved by our committee.

Thesis Committee

Chairman

Prof. Dr. Madhavi Singh Shah
Head
CEDECON

External Examiner

Prof. Dr. Sharad Kumar Sharma
CEDECON

Thesis Supervisor

Prof. Dr. Sri Ram Poudyal
CEDECON

Date: November 8, 2006

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude and appreciation to my respected supervisor Prof. Dr. Sri Ram Poudyal for providing scholarly guidance, continuous support and inspiration to carry out my research.

I would like to record my heartfelt thanks to Prof. Dr. Madhavi Singh Shah, Head of the Department, Central Department of Economics, T.U. and External examiner Prof. Dr. Sharad Kumar Sharma for rendering me genuine and essential suggestions in this connection.

Similarly, I am very much grateful to all cooperative employees of central library, T.U. for their untiring support and welcoming gesture. I am indebted to Dr. Bamdev Sigdel of Nepal Rastra Bank (NRB), Thapali, Prof. Amrit Nakarmi of Centre for Energy studies (CES) Pulchowk Engineering College, Lila Nath Bhattarai, Project Manager of Chilime Hydropower project, Bikash Thapa of ICIMOD Resource Centre, Nurendra Bahadur Basnet of Nepal oil corporation (NOC), Account section for their sincere cooperation to shape my research in this concrete form. Likewise, I am thankful to Astha Laxmi Shakya, Dundapani Basyal of Nepal Electricity Authority (NEA) for their cooperation in course of my thesis. My thanks goes to Jeeten Maharjan and Bibek Maharjan of Jee Computer Center who assist me in accurate desktop works. In this regard, my friend Bhumi Raj Chapagain also deserves immense thanks for providing me his personal computer.

Indeed, there are no words to reflect my gratitude and indebtedness to my beloved parents, Hari Prasad Kandel and Tulasi Devi Kandel for always keeping my spirit. The unflagging emotional and moral support that I have been receiving from my brothers Krishna Prasad Kandel and Tilak Prasad Kandel, and Sisters Parbati and Bishnu including sister-in-law Shova, Kids Kushal, Namu and Aayush they provide me emotional spirit, moral support and kept intact my zeal.

Last but not least, I would like to record my passionate thanks to all executives of my own organization NSDO, Gaidakot for their moral boost. Friend Krishna also deserves thanks for his company and emotional support throughout my research. I would not forget the cooperation extended by brother Jeevan Sapkota and by my colleagues and well-wishers in this regard.

Madhab Kandel

CONTENTS

	<i>Page</i>
LETTER OF RECOMMENDATION	i
LETTER OF APPROVAL	ii
ACKNOWLEDGEMENTS	iii
CONTENTS	iv
LIST OF TABLES	vii
LIST OF FIGURES	ix
ABBREVIATIONS	x
CHAPTER–I: INTRODUCTION	1-7
1.1 Background	1
1.2 Statement of the Problem	4
1.3 Objectives of the Study	6
1.4 Research Methodology	6
1.4.1 Research Design	6
1.4.2 Data Collection	7
1.5 Limitations of the Study	7
1.6 Organization of the Study	7
CHAPTER–II: LITERATURE REVIEW	8-17
CHAPTER–III: CONSUMPTION PATTERN OF ENERGY IN NEPAL	18-33
3.1 Importance of Energy	18
3.2 Consumption of Energy in Nepal	18
3.2.1 Biomass	18
3.2.2 Petroleum Products and Coal	21
3.2.3 Alternative Sources of Energy	22
3.3 Energy Consumption by Source and Sector	25
3.4 Government Policy on Energy and Hydropower Sector	29
3.5 Major Issues of Renewable Energy Technologies	32

CHAPTER–IV: HYDROPOWER DEVELOPMENT AND	
SOME ECONOMIC ASPECTS	34-91
4.1 Development of Hydroelectricity	34
4.1.1 Introduction	34
4.1.2 Characteristics of Hydropower	35
4.1.3 Advantages of Hydropower Projects	36
4.1.4 Hydropower Potential of Nepal	37
4.1.5 Classification of Hydroelectric Schemes	38
4.1.6 Nepal's Status in Hydropower among SAARC Countries	39
4.1.7 Development of Hydroelectricity in Nepal	40
4.1.8 Projects currently under construction	59
4.1.9 Power Summit 2006	60
4.1.10 Decade-wise Development of Hydropower	63
4.1.11 National Water Plan (2002-2027)	66
4.1.12 Problems of Hydropower Development in Nepal	70
4.2 Contribution of Hydropower to National Economy	72
4.2.1 Contribution to GDP	72
4.2.2 Contribution of Electricity to Commercial Energy	73
4.2.2 Revenue generation from electricity	74
4.3 Cost of different Hydropower Projects	76
4.3.1 Cost of Hydropower Projects	76
4.3.2 Cost Comparison of different Projects at 2005 price	76
4.3.3 Investment Requirement	78
4.3.4 Projects Under Operation	82
4.3.5 Chilime Hydropower Project as an example of successful project	84
4.4 Foreign Exchange Saving from Hydropower Development	86
4.4.1 Import of Petroleum Products	87
4.4.2 Import of Petroleum Products Against Commodity Export	88
4.4.3 Import of POL Products by Type	90

CHAPTER-V: SUMMARY, CONCLUSION AND RECOMMENDATIONS	92-99
5.1 Summary	92
5.2 Conclusion	94
5.3 Recommendations	96
References	100-103
Annex	104-142

LIST OF TABLES

	<i>Page</i>
Table 3.1 Consumption of fuel wood	20
Table 3.2: Consumption of Dung Cake	21
Table 3.3 Consumption of Petroleum Products and Coal	22
Table 3.4: Energy Consumption Pattern by Source	26
Table 3.5: Energy Consumption by Sector	26
Table 3.6 Share of Energy Consumption by Sector	27
Table 3.7: Share of Different Types of Energy in Total Energy Consumption	27
Table 4.1: Hydropower potential in Nepal	38
Table 4.2 Nepal's Position in Hydroelectric Power in the World and SAARC	39
Table 4.3: Electrical Installations before 1956	40
Table 4.4: The power plants installed and commissioned during First Plan	41
Table 4.5: Targeted projects of the second plan	42
Table 4.6: Target of Third Plan	43
Table 4.7: Target of Fourth Plan	44
Table 4.8: The Achievement of Fourth Plan	45
Table 4.9: Target of Fifth plan	46
Table 4.10: Transmission lines in Fifth Plan	46
Table 4.11: Achievements of Fifth plan	47
Table 4.12: Achievement of Sixth Plan	48
Table 4.13: Power Projects Planned in the Seventh Plan	49

Table 4.14: Progress during Seventh Plan and Interim Period	50
Table 4.15: Achievement in the Eighth Plan	52
Table 4.16: Power Generation in Ninth Plan	54
Table 4.17: Ninth plan Targets	55
Table 4.18: Targets and Achievement of the Ninth Plan	55
Table 4.19: Hydroelectricity Projects to be commenced	59
Table 4.20: Decade wise Development of Hydropower	64
Table 4.21: Installed Capacity of Hydro Power in Different DR	65
Table 4.22: Number of Households Having Connection to Electricity	66
Table 4.23: Contribution of Electricity in Gross Domestic Product by ISIC Division	72
Table 4.24: Contribution of Electricity to Commercial Energy	73
Table 4.25: Revenue from electricity	74
Table 4.26: Consumer sales and revenue	75
Table 4.27: Cost of Hydropower Projects by size	76
Table 4.28: Comparison of different projects cost	77
Table 4.29: Fund Requirements and Sources	79
Table 4.30: Estimated programme cost of Hydropower development	80
Table 4.31: Foreign Aid Disbursements	81
Table 4.32: Summary table of the projects under operation	83
Table 4.33: Share of the Petroleum Products in Total Import	87
Table 4.34: Import of Petroleum Product against Commodity Export	89
Table 4.35: Import of POL Products by Type	90

LIST OF FIGURES

	<i>Pages</i>
Figure 3.1: Trend of Energy Consumption	28
Figure 4.1: Decade wise development of hydropower generation (MW)	65
Figure 4.2: Revenue in 2006	75
Figure 4.3: Percentage Share of Grant and Loan in Power Sector	82
Figure 4.4: Trend of Import of petroleum products	88
Figure 4.5: Import of Petroleum Product against Commodity Export	89
Figure 4.6: Import of petroleum products in different years	91

ABBREVIATIONS

ADB	= Asian Development Bank
BCM	= Billion cubic meter
BOOT	= Built-own-operate and Transfer system
CGGC	= The China Gezhouba Construction Group Corporation for Water Resources and Hydropower
DR	= Development Region
DWRC	= District Water Resources Committee
EDCF	= Economic Development Corporation Fund
EDD	= Electricity Development Department
GJ	= Gigajoules
Gwh	= Gigawatt hour
Gwh/y	= Gigawatt hour per year
HH	= Household
HMG/N	= His Majesty Government of Nepal
ICIMOD	= International Centre for Integrated Mountain Development
ICS	= Improved Cooking Stoves
INPS	= Integrated Nepal Power System
IPPS	= Independent Power Producers
ISIC	= International Industrial Classifications of All Economic Activities
ITDG	= Intermediate technology Development Group
IWRM	= Integrated Water Resource Management
KFW	= German Development Fund
KV	= Kilovolt
KW	=Kilo watt
KWH	= Kilowatt hour
MHP	= Micro hydro power
MOF	= Ministry of Finance
MOPE	= Ministry of Population and environment
MOWR	= Ministry of Water Resources
MVA	= Mega Volt Ampere

MW	= Megawatt
NEA	= Nepal electricity Authority
NOC	=Nepal Oil Corporation
NPC	= National Planning Commission
NWP	= National Water Plan
OECF	= Overseas Economic Co-operation Fund
PPA	= Power Purchase Agreement
PV	= Photovoltaic
RECAST	= Research Centre for Applied Science and Technology
RETS	= Renewable Energy Technologies
SAARC	= South Asian Association for Regional Co-operation
SFD	= The Saudi Fund for Development
SPV	= Solar Photo Voltaic
TOE	= Tonne of oil Equavalent
TWH	= Terra Watt hours = 10^{12} units.
UNDP	= United Nations Development Programme
WB	= World Bank
WECS	= Water and Energy Commission Secretariat
WRS	= Water Resource Strategy