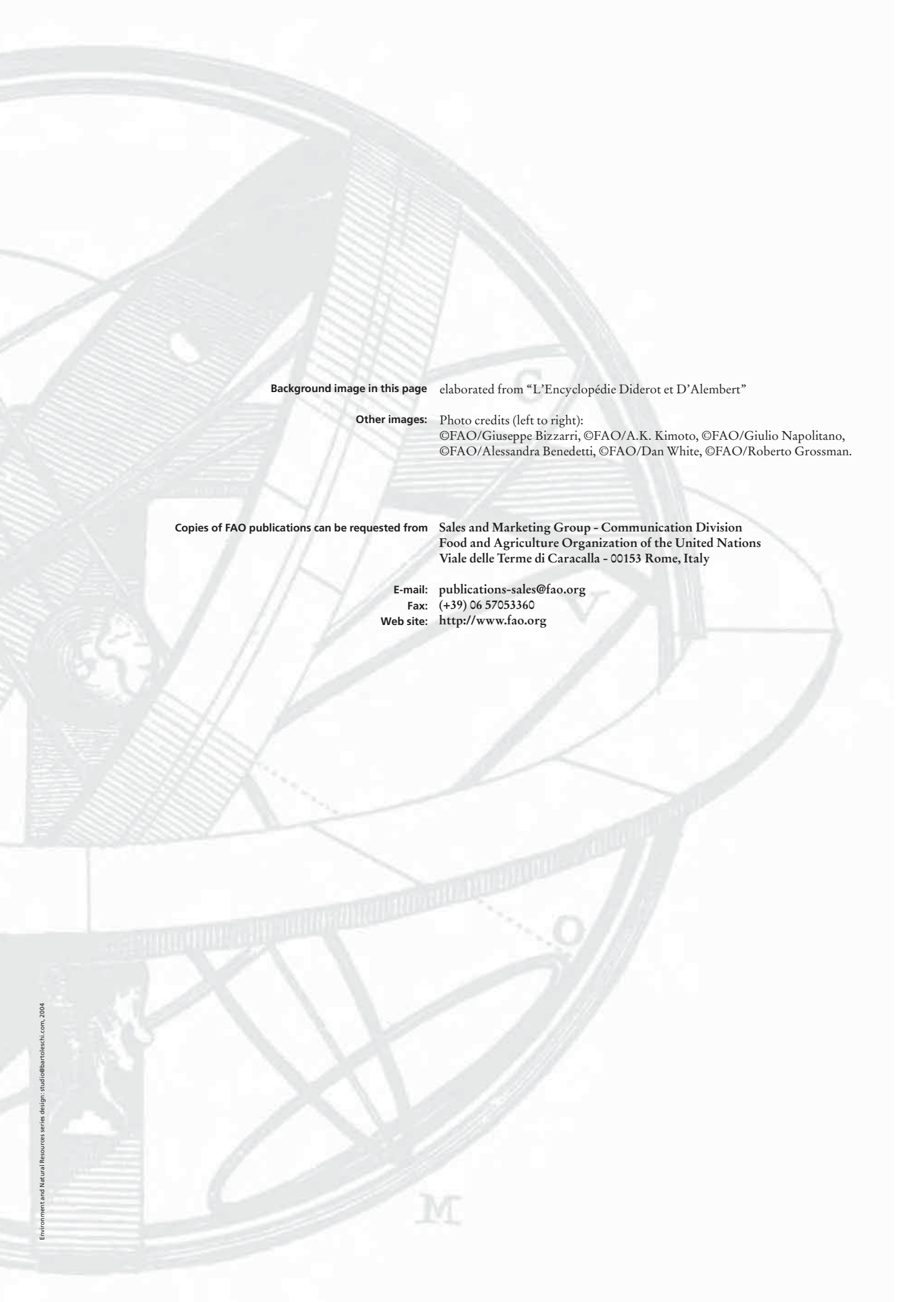


BEFS Thailand

Key results and policy recommendations for future bioenergy development

ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT WORKING PAPER
ENVIRONMENT CLIMATE CHANGE [BIOENERGY] MONITORING AND ASSESSMENT





Background image in this page elaborated from “L’Encyclopédie Diderot et D’Alembert”

Other images: Photo credits (left to right):
©FAO/Giuseppe Bizzarri, ©FAO/A.K. Kimoto, ©FAO/Giulio Napolitano,
©FAO/Alessandra Benedetti, ©FAO/Dan White, ©FAO/Roberto Grossman.

Copies of FAO publications can be requested from Sales and Marketing Group - Communication Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla - 00153 Rome, Italy

E-mail: publications-sales@fao.org
Fax: (+39) 06 57053360
Web site: <http://www.fao.org>



BEFS Thailand

Key results and policy recommendations
for future bioenergy development

Beau Damen



The views expressed in this information product are those of the author(s) and do not necessarily reflect the views of FAO.

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

ISBN 978-92-5-106647-8

FAO declines all responsibility for errors or deficiencies in the database or software or in the documentation accompanying it, for program maintenance and upgrading as well as for any damage that may arise from them. FAO also declines any responsibility for updating the data and assumes no responsibility for errors and omissions in the data provided. Users are, however, kindly asked to report any errors or deficiencies in this product to FAO.

All rights reserved. FAO encourages the reproduction and dissemination of material in this information product. Non-commercial uses will be authorized free of charge, upon request. Reproduction for resale or other commercial purposes, including educational purposes, may incur fees. Applications for permission to reproduce or disseminate FAO copyright materials, and all queries concerning rights and licences, should be addressed by e-mail to:

copyright@fao.org

or to the

Chief
Publishing Policy and Support Branch
Office of Knowledge Exchange
Research and Extension
FAO
Viale delle Terme di Caracalla, 00153 Rome, Italy

© FAO 2010

FOREWORD

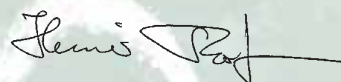
In an effort to improve energy access, energy security and to lower global green house gas emissions, many countries have placed bioenergy developments high on their agenda. Over time, however, serious concerns about the effect of bioenergy on food security, its social feasibility and level of sustainability have arisen, especially with first generation biofuels. In this context FAO, with generous funding from the German Federal Ministry of Food, Agriculture and Consumer Protection (BMELV), set up the Bioenergy and Food Security (BEFS) project to assess how bioenergy developments could be implemented without threatening food security.

During its term, the BEFS project has supported Peru, Tanzania and Thailand assess the feasibility of the bioenergy sector and its, potential impacts on food security, growth and poverty. In this effort, BEFS has constructed an analytical framework that aims to assist countries with the development of bioenergy policy and/or clarification of the potential impacts of bioenergy developments.

The analysis presented in this document includes the main findings and recommendations for policy-makers on how to achieve Thailand's envisaged biofuel targets in a sustainable way without impacting food security. A draft of this document was the centrepiece of policy discussions with the Thai Government conducted during the *BEFS Thailand Policy Consultation* in June 2010.

Full details of the methodologies and data employed to produce the material in this document are being published in a separate volume entitled "*Bioenergy and Food Security – The BEFS analysis for Thailand*".

As part of its activities, BEFS has also run training programmes in the participating countries to ensure full ownership, replicability and potential extensions to the analysis presented.



Heiner Thofern

Senior Natural Resources Management Officer
BEFS Project Coordinator

ABSTRACT

The Government of Thailand, through its Alternative Energy Development Plan, has set a target to increase biofuel production to five billion litres by 2022. The Thai Government sees this expansion as a way to strengthen the country's energy security, foster rural development and reduce greenhouse gas emissions.

The FAO Bioenergy and Food Security (BEFS) project aims to strengthen the capacity of developing countries to balance the trade-offs associated with bioenergy development and mitigate the impact of bioenergy on food security. The analysis presented in this document includes the main findings and recommendations for policy-makers on how to achieve Thailand's envisaged biofuel targets in a sustainable way without threatening food security.

The targets are found to impact on Thailand's future agricultural outlook and lead to additional utilization of Thailand's natural resources. Growth of the sector in line with the targets has the potential to affect the national economy and households through various channels such as the price of food made from biofuel feedstock crops. How the Thai Government manages the potential pressures that the bioenergy sector will exert on its natural resources and agricultural markets and the general populace will determine the future sustainability of biofuels and bioenergy as alternative energy sources in Thailand.

Full details of the methodologies and data employed to produce the material in this document are being published in a separate volume entitled "*Bioenergy and Food Security – The BEFS analysis for Thailand*".

BEFS Thailand – Key results and policy recommendations for future bioenergy development

by Beau Damen

59 pages, 33 figures and 13 tables.

Environment and Natural Resources Working Paper No. 43 - FAO, Rome, 2010.

Keywords:

Bioenergy, food security, policy recommendations, Thailand, BEFS.

This series replaces the following:

Environment and Energy Series

Remote Sensing Centre Series

Agrometeorology Working Paper

A list of documents published in the above series and other information can be found at the Web site:

www.fao.org/climatechange/49363@138259/en/

ACKNOWLEDGEMENTS

A large number of experts have assisted produce the work reported in this publication. The author would like to thank the BEFS Thailand Technical Partners for their technical contributions in the following specific chapters of this document:

- Chapter 3: Dr Jirapa Inthisang, Ms Tapee Vatcharangkool and Ms Orapim Sundaraketu, Office of Agricultural Economics (OAE), Ministry of Agriculture and Cooperatives, with the technical training, support and supervision of Holger Matthey, Trade and Markets Division of FAO;
- Chapter 4: Mr Yuttachai Anuluxtipun, Land Development Department (LDD), Ministry of Agriculture and Cooperatives;
- Chapter 5: Mr Upali Amarasinghe, International Water Management Institute (IWMI);
- Chapter 6 and 7: Mr Werner Siemers, Dr Boonrod Sujjakulnukij and Mr Nattapong Chayawatto, Joint Graduate School of Energy and Environment (JGSEE), King Mongkut's University of Technology Thonburi;
- Chapter 8: Dr Somchai Jitsuchon, Thailand Development Research Institute (TDRI); Dr Apichai Puntasen, Rural and Social Management Institute (RASMI); Mr Thanapon Sreshtaputra, ChangeFusion Institute; and Prof Sombat Chinawong, Krabi Campus Establishment Project, Kasetsart University.

The author would also like to thank the following experts for useful insights and comments on previous versions of this document:

- Mr Montree Boonpanit and Dr Suppatra Cherdchuchai, National Economic and Social Development Board (NESDB);
- Dr Twarath Sutabutr, Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy;
- Dr Shabbir Gheewala, JGSSE.

The BEFS Thailand project benefited from the overall support of Mr Hiroyuki Konuma and from collaboration with experts at the Regional Office for Asia and the Pacific. In particular the author would like to thank Mr Sverre Tvinnereim, Ms Suntaree Rangkusone, Ms Delgermaa Chuluunbaatar, Mr Ruben van der Laan, Mr Patrick Durst, Mr Simmathiri Appanah, Mr Sumiter Broca, Mr Thierry Facon and Mr Yuji Niino.

In FAO Headquarters the author would like to thank Heiner Thofern and Andreas von Brandt, for their managerial support.

Finally, the author would like to give special thanks to Ms Mirella Salvatore for her support and guidance in implementing the BEFS project in Thailand and in producing this report.

Claudia Tonini provided valuable assistance with graphic design.

This study was undertaken in the framework of the Bioenergy and Food Security project (GCP/INT/020/GER) with funding from the German Federal Ministry of Food, Agriculture and Consumer Protection (BMELV).

CONTENTS

iii	Foreword
v	Abstract
vi	Acknowledgements
x	Acronyms
1	1. INTRODUCTION
2	1.1 BEFS Analytical Framework
2	1.2 The BEFS tool box
2	1.3 BEFS in Thailand
5	2. THAILAND'S POLICY CONTEXT
5	2.1 Thailand's bioenergy policy framework
6	2.1.1 Thailand biofuel sector
6	2.1.2 AEDP measures for biofuels
9	2.1.3 Biofuel pricing policies
9	2.2 Thailand's agricultural policy framework
9	2.2.1 Biofuel feedstock policies
11	3. AGRICULTURE MARKET PROJECTIONS
11	3.1 Overview of analysis
11	3.2 Assumptions for development of biofuel
12	3.3 Market projections of key agricultural crops
12	3.3.1 Sugar and molasses
13	3.3.2 Cassava
14	3.3.3 Palm Oil
15	3.3.4 Rice
17	4. NATURAL RESOURCE ANALYSIS: LAND
17	4.1 Overview of analysis
18	4.2 Sugar cane
19	4.3 Cassava
21	4.4 Oil palm
23	5. NATURAL RESOURCE ANALYSIS: WATER
23	5.1 Overview of analysis
23	5.2 Water footprint of sugar-based ethanol
25	5.3 Water footprint of cassava-based ethanol
56	5.4 Outlook for biofuel water footprint
27	5.5 Water quality impacts
29	6. ECONOMIC COMPETITIVENESS
29	6.1 Overview of analysis
29	6.2 Competitiveness of sugar-based ethanol
30	6.3 Competitiveness of cassava-based ethanol
32	6.4 Competitiveness of biodiesel

35	7. CLIMATE CHANGE MITIGATION
35	7.1 Overview of analysis
35	7.2 GHG emissions of sugar-based ethanol
37	7.3 GHG emissions of cassava-based ethanol
39	7.4 GHG emissions of biodiesel
41	8. SOCIO-ECONOMIC ASPECTS
41	8.1 Overview of analysis
41	8.2 Poverty situation in Thailand
43	8.3 Impact of biofuels on households
44	8.4 Impact of biofuels on Thai economy
45	8.5 Small-scale bioenergy and rural development
49	9. RECOMMENDATIONS
49	9.1 Natural resources
51	9.2 Bioenergy sector's economic competitiveness
51	9.3 National economy and consumer prices
52	9.4 GHG, energy balance and climate change
52	9.5 Management policies
55	10. REFERENCES

LIST OF FIGURES AND TABLES

FIGURES

- 1 Figure 1.1 The BEFS analytical framework and BEFS tool box
- 3 Figure 1.2 BEFS Analytical Framework in Thailand
- 5 Figure 2.1 Actual and planned biofuel production under AEDP
- 7 Figure 2.2 AEDP roadmap for ethanol
- 8 Figure 2.3 AEDP roadmap for biodiesel
- 13 Figure 3.1 Projected production, consumption and net trade of sugar and molasses
- 13 Figure 3.2 Projected production, consumption and net trade of cassava
- 15 Figure 3.3 Projected production, consumption and net trade of palm oil
- 15 Figure 3.4 Projected production, consumption and net trade of Rice
- 16 Figure 3.5 Projected changes in area for key agricultural crops
- 18 Figure 4.1 Actual versus potential area for sugar cane by suitability class
- 20 Figure 4.2 Actual versus potential area for cassava by suitability class
- 21 Figure 4.3 Actual versus potential area for oil palm by suitability class
- 24 Figure 5.1 Process of sugar-based ethanol production
- 25 Figure 5.2 Sugar-based ethanol WF by districts
- 26 Figure 5.3 Cassava-based ethanol WF by districts
- 27 Figure 5.4 Total WF of sugar and cassava-based ethanol
- 30 Figure 6.1 Comparison of sugar-based ethanol production costs
- 31 Figure 6.2 Comparison of cassava-based ethanol production costs
- 31 Figure 6.3 Cost and benefit summary for each cassava-based ethanol scenario
- 33 Figure 6.4 Comparison of biodiesel production costs
- 33 Figure 6.5 Cost and benefit summary for large scale biodiesel scenarios
- 36 Figure 7.1 GHG emissions of different sugar-based ethanol configurations
- 36 Figure 7.2 Breakdown of GHG emissions by step for sugar-based ethanol scenarios
- 37 Figure 7.3 GHG emissions of different cassava-based ethanol configurations
- 38 Figure 7.4 Breakdown of GHG emissions by step for cassava-based ethanol scenarios
- 38 Figure 7.5 Influence of LUC and CC on the medium efficiency fossil scenario
- 39 Figure 7.6 GHG emissions of different biodiesel configurations
- 40 Figure 7.7 Breakdown of GHG emissions by step for crude palm oil biodiesel scenarios
- 40 Figure 7.8 Renewable energy potential of medium sized CPO mill
- 42 Figure 8.1 Poverty incidence by area, 1986-2009
- 43 Figure 8.2 Food price and farm income 1990-2008
- 46 Figure 8.3 Location of small-scale bioenergy projects

TABLES

- 11 Table 3.1 Ethanol targets
- 12 Table 3.2 Share of ethanol targets by feedstock
- 12 Table 3.3 Biodiesel targets
- 17 Table 4.1 Attainable yield by suitability class for the key biofuel crops
- 29 Table 6.1 Characteristics of sugar-based ethanol configurations
- 30 Table 6.2 Characteristics of cassava-based ethanol configurations
- 32 Table 6.3 Characteristics of biodiesel configurations
- 35 Table 7.1 Additional sugar-based ethanol processing scenarios
- 39 Table 7.2 Additional biodiesel processing scenarios
- 42 Table 8.1 Per capita income and expenditure, poverty line and incidence by region in 2009
- 44 Table 8.2 Scenario assumptions
- 44 Table 8.3 Changes in poverty incidence by household type
- 45 Table 8.4 Impact of one percent increase in import food price on economic growth and price levels

ACRONYMS

AEDP	Alternative Energy Development Plan
AF	Analytical Framework
B2	Biodiesel blending target at 2 percent
B5	Biodiesel blending target at 5 percent
BEFS	Bioenergy and Food Security
CGE	Computable general equilibrium
COSIMO	Commodity Simulation Model
DEDE	Department of Alternative Energy Development and Efficiency
EU	European Union
FAO	Food and Agriculture Organization
GDP	Gross domestic product
GHG	Greenhouse gas
IRR	Internal rate of return
JGSEE	Joint Graduate School of Energy and Environment
LCA	Life cycle analysis
LDD	Land Development Department
LEF	Low efficiency fossil
LSA	Land Suitability Assessment
LUC	Land use change
MDG	Millennium Development Goal
MEF	Medium efficiency fossil
MOAC	Ministry of Agriculture and Cooperatives
MoE	Ministry of Energy
MoU	Memorandum of Understanding
NESDB	National Economic and Social Development Board
NSO	National Statistical Office
OAE	Office of Agricultural Economics
RASMI	Rural and Social Management Institute
RE	Renewable energy
R&D	Research and Development
TDRI	Thailand Development Research Institute
TRWR	Total renewable water resource
UN	United Nations
UNDP	United Nation Development Programme
WF	Water footprint

UNIT OF MEASURES

\$	United States dollar
g	Gram
ha	Hectare
kg	Kilogram
L	Litre
m ³	Meter cubic
MJ	megajoule
MLPD	Million litre per day
MLPY	Million litre per year
MW	Megawatt
THB	Thailand bath (local currency unit)
ton	Tonne