

CLEAN DEVELOPMENT MECHANISM (CDM) SOLAR COOKER PROJECT ACEH 1, INDONESIA

Herliyani Suharta
The Agency for the Assessment
and Application of Technology
at The Center for Energy Technology
(BPPT-BBTE).
c/o PUSPIPTEK, Serpong,
Tangerang, Indonesia
Email: herli@iptek.net.id

Dieter Seifert
Advisor on
CDM Solar Cooker Project
Development Germany.
Email: bdiv.seifert@t-online.de

AAM Sayigh
The World Renewable Energy
Network,
Brighton, United Kingdom.
Email: asayigh@netcomuk.co.uk

ABSTRACT

Firewood is used in almost all rural areas for cooking. Smoke exposure from firewood seriously affects the children's growth and the health of women, increasing burden and poverty. Its greenhouse gas (GHG) emissions contribute to global climate change. This is one of the greatest challenges of humanity. The CDM Solar Cooker Project in Sabang Islands and city of Badar in South-East Aceh was arranged to lay down a better energy path scenario for the future. Solar concentrator cookers "K14" and heat retaining containers "Wonderbox" will be transferred to the people. This project avoids 3.5 tonnes CO₂ emissions per year per K14 and applies for a renewable crediting CER in the period of 7 years. This project is the first project that applies the funding mechanism of CDM to finance solar cookers. Those projects are very useful to directly improve the standard of living of firewood consumers and demonstrate the spirit of Article 12 of Kyoto Protocol in poverty alleviation. This article also shows the consequences caused by the recent deletion by the U.N. agency of the methodology used by the project.

Keywords:

Aceh-Indonesia, chronic disease, CDM, forest, solar cooker, wonderbox.

1. INTRODUCTION

Firewood is used in almost all rural areas around the world. This leads to consequences such as: loss of forest area, loss of fertile soil caused by erosion, desertification, increase of poverty and conflicts.

The Global Forest Resources Assessment 2005 coordinates a global effort involving 172 national assessment teams to provide data to FAO (1).

Forests now cover nearly 4 billion hectares or 30% of the world's land area. Two-thirds of all forest areas are in Australia, Brazil, Canada, China, the Democratic Republic of the Congo, India, Indonesia, Peru, the Russian Federation and the United States of America. Primary forests (forests with no visible signs of past or present human activities) account for 36 % of total forest area, but are being lost or modified at a rate of 6 million ha/year through deforestation or selective logging.

Through the 1990s the annual net loss was 8.9 million hectares per year and down to 7.3 million ha/year between 2000 and 2005, equivalent to a net loss of 0.18 % of the world's forests annually. Asia moved from a net loss of around 800 000 ha/year in the 1990s to a net gain of one million ha/year between 2000 and 2005, primarily as a result of large-scale afforestation reported by China. Forest areas in Europe continued to expand but at a slower rate than that in the 1990s. The largest net loss of forests between 2000 and 2005:

- South America lost 4.3 million ha/year
- Africa lost 4.0 million ha/year. In dry climate replanting is one of the greatest problems
- Oceania had a net loss of 356 000 ha/year
- North and Central America together had a net loss of 333 000 ha/year.

Forests are important to the global balance as havens of biological diversity, recreational resources and sources of wood products. Eleven % of the world's forests is used principally for the conservation of biological diversity. Such areas have increased by an estimated 96 million hectares since 1990. Around 348 million hectares of forests are used to conserve soil and water, control avalanches and desertification, stabilize sand dunes and protect coastal areas. Forests also act as carbon sinks absorbing excessive carbon dioxide in the atmosphere. The amount of carbon stored in forest

biomass alone is about 283 gigatonnes of carbon. It decreased globally by 1.1 gigatonnes annually between 1990 and 2005.

Smoke and Health

Of the estimated 57 million global deaths last year, 33 million were attributed to chronic diseases such as cardiovascular diseases, cancers, diabetes and chronic respiratory diseases. *“Chronic diseases are a major global health problem and a key barrier to development, to alleviating poverty and to making progress towards the Millennium Development Goals. Cost-effective preventive and clinical interventions need to be implemented globally”* said Lee Jong Wook, WHO Director General. Smoking-related diseases are a major global health issue with serious financial and social implications for all countries, therefore the Framework Convention on Tobacco Control was endorsed last year and expected to be in legal force by 2005 (2).

Worldwide, yearly more than 1.6 million children die because of interior cooking, while smoke exposure throughout their life seriously affects the development of more than 100 million children. These are the obstacles to successful socioeconomic development. Other diseases in developing countries are water-borne that can be avoided by boiling of water. Therefore, these problems urgently need to be brought to the governments of the world to draw more attention to worldwide prevention efforts. They need to move the resources to action. A strong leadership is needed to coordinate national action.

2. CDM, A CHANCE FOR TECHNOLOGY TRANSFER OF SOLAR COOKING

Most low income rural houses use firewood for cooking. They are gathered from surroundings rather than being purchased. Wealthier households use kerosene. In Aceh, 66% of households use firewood, 27% use kerosene and 7% use gas and electricity, see **Fig. 1**. The poverty line in Aceh is Rp70,000 and 17% of Aceh's population lives below this poverty line, which means their incomes are below Rp70,000 (3). When the kerosene price rises, the kerosene consumers tend to switch to firewood to save cash.

Parameters that are considered in socio-economic development of the firewood consumers are low quality of human resources, low income per capita, limited infrastructure and service, land division as archipelago country, high dependency on the government, low public participation and limited funding. Indonesia is a country with a huge population. Human capital is seen as the basic resource in the economy to improve the welfare of the population. Three essential elements in human development are education, health and freedom from fear. The last is not being discussed here. The education is not limited to formal education; but is geared to the

achievement of a well-informed society. Smoke from traditional cooking endangers the health of women and children. Introducing solar cooking is seen as an alternative to reduce smoke exposure and give a chance to improve the health of firewood consumers. However the major targets people are poor and cannot afford the solar cooker. This means the main barrier is financial.

2.1 Financial mechanism through CDM

The burning of one billion cubic meters of firewood causes an emission of about 820 million tonnes of CO₂ per year. This emission is equivalent to the annual CO₂ emission of Germany in the year 2000, about 867 million tonnes. More than 200 million K14 solar cookers are necessary to help solve these problems (4). Knowing these situations, a global solution named Kyoto Protocol was derived. Its Article 12 says:

- To assist Non-Annex I countries (developing countries) in achieving sustainable development.
- To assist Annex I countries in achieving their emission reduction commitments.

The Clean Development Mechanism is derived for executing actions. This means the governments and private sectors in Annex I countries can develop or invest in greenhouse gas mitigation projects in developing countries. The developing country gains technology and finance for sustainable development. Proved reduced emissions will be certified. Certified Emission Reductions (CERs) will be credited to the investing country and will be counted against the national CO₂ emission reduction targets. By simply using the transferred solar cookers, firewood consumers have made an effort to save GHG-emission. The saving of CO₂-emission is credited to those who provide the solar cookers. Free energy will give extra profit for food sellers who use solar cookers for cooking. Assembling, spreading and using of solar cookers create jobs.

2.2 Solar Concentrator Cooker K14 and Heat Retaining Box ("Wonderbox")

The cooking technologies that will be transferred in the CDMSCP Aceh 1 are the Solar Concentrator Cooker K14 plus the heat retaining box "Wonderbox" for simmering.

The K14 evolved with twenty years of development and experiences. It has a reflector diameter of 140 cm. Its life span is about 20 years. Annual operation time is assumed 1500 hours/year. The K14 can bring 6 liters water from 20°C to boiling within 55 minutes. It can be used for frying, steaming, baking, etc. Constructing of solar concentrator cookers K14 from the prefabricated kits can be done through community education training. The cookers can be assembled locally in a simple workshop. Due to prefabrication a high quality product results, and in a

short time even high quantities of solar cookers are produced.

Figure 2 gives results of a test of K14 on 1 October 2002, at Neuoetting, Germany (48.2° north latitude 12.7° east longitude) from 11:00 in the morning with a clear sky and no wind. Temperature measurement used a digital thermometer having a range of -10 °C to 200°C. The cooking pot of 12 liters volume was made of steel with a black enamel surface and 28 cm in diameter. The lid used for the first run was made of black enamel; for the second and third runs a glass lid was used.

Simmering in the heat retaining Wonderbox takes place without energy and without intervention (5). The field test in Kupang, East Nusa Tenggara on 26 September 2005 proved that the Wonderbox is very useful to keep food / water hot till mealtime. The pot filled with 6 liters of boiling water was stored in the Wonderbox at 23:15 local time. The next morning at 6:15, after 7 hours, the water temperature was still 70 °C (7).

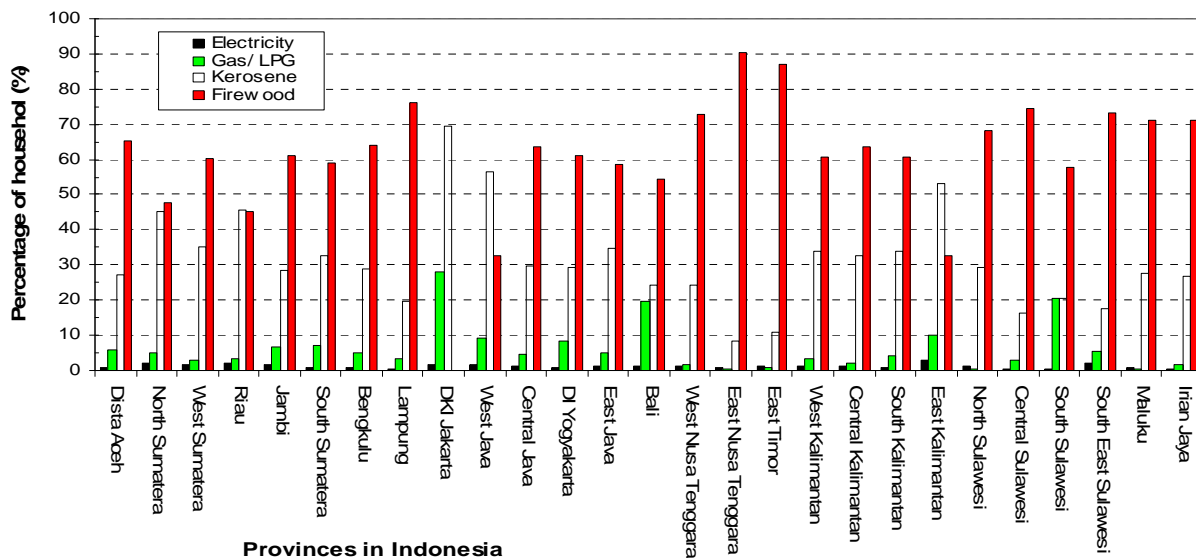


Fig. 1 Percentage of Households by Province and types of cooking fuel (electricity / LPG / kerosene and firewood). More than 90% of total houses in East Nusa Tenggara Province use firewood to fulfill their primary energy need. Source: Statistik Indonesia 1999, BPS (2000, p 127).

3. CDM SOLAR COOKER PROJECT ACEH 1

The CDM Solar Cooker Project Aceh 1 (CDMSP Aceh 1) had been initiated before the Tsunami disaster. The selected locations are Sabang Islands and the city of Badar in South East Aceh. Target users are fisherman, households, small-scale industries, and community kitchens.

Indonesia had not healed yet from the monetary crisis, when a severe natural disaster hit Aceh. The energy infrastructures were washed away to the sea. Everybody was panicked, hoarding and shocked. It resulted in unrivaled suffering. This situation drove all proponents to make the project succeed and to lay down a better energy path scenario for the future. The German proponent considered the existing expertise with experiences in sun cooking and its dissemination in Indonesia. Therefore, it is hoped that CDMSP Aceh 1 in Indonesia becomes a successful example to be applied worldwide.

Chronology of CDMSP Aceh 1:

- August 2004: Discussion with Regional Parliament of Aceh about the potential of CDM Solar Cooker Project in Aceh.
 - 16 December 2004: Presentation of solar cooking in front of Government of Aceh by Klaus Trifellner, project initiator and administrator, Klimaschutz e.V.
 - Acceptance of Government of Aceh for CDM Solar Cooker Project in Aceh. The letters of Approval from Government of Aceh, from Walikota of Sabang, from Bupati of Aceh Tenggara and from Bapedalda of Sabang Island are given.
 - 20 December 2004: Submission of first proposal to Mr. Sudariyono, CDM Focal Point at the Ministry of Environment Office, Jakarta.
 - 26 December 2004: Tsunami destroyed Aceh.
 - February 2005: Instruction of TÜV SÜD for Validation
 - April 2005: Submission of PDD of CDMSP Aceh1 to TÜV SÜD in Munich, Germany.
 - June 2005: Completion of Verification of PDD.
 - July 2005: Publication of CDMSP Aceh1 through web pages of UNFCCC for global stakeholder process.
- No comments on project activity.

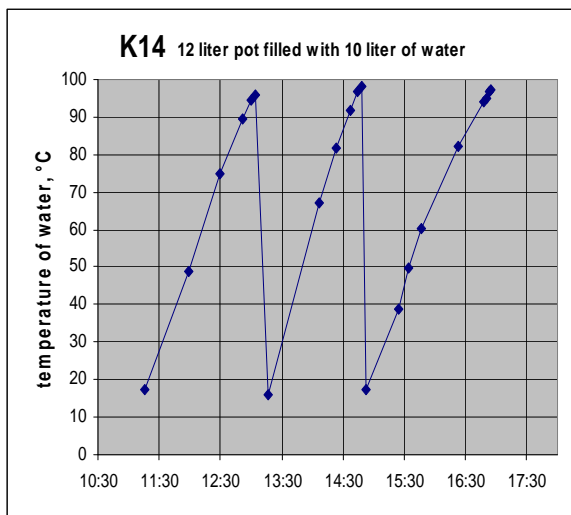
- August 2005: Visit of Validator from TUEV SUED - Manila to Jakarta, to meet Regional Parliament of Aceh and to meet the staffs of the Ministry of Energy and Mining Office in Jakarta.
 - Meeting of project developer Klimaschutz e.V. with Mrs. Nelly Hilman, the head of Indonesian DNA and delegates of Regional Parliament of Aceh in Jakarta. .
 - September 2005: Submission of CDMSCP Aceh 1 to Indonesian DNA for process of approval.
 - November 2005: CDMSCP Aceh1 was validated.
 - This CDMSCP Aceh 1 will avoid non-sustainable harvested firewood and the project is a small scale category I.C.
- On 26 November 2005, Executive Board of UNFCCC has deleted *non-renewable biomass of SSC I.C.*, however any project seeks credit from switching non-renewable biomass and had been validated was given a chance to submit a National Approval by 26 December 2005
- 20 December 2005: Discussion with Indonesian DNA at the Ministry of Environment Office, Jakarta.
 - 23 December 2005: Indonesian DNA released the letter of approval for CDMSCP Aceh 1. The Letters of Approval of German and Indonesian Government that were necessary for registration were submitted on 23rd December 2005.
 - Klimaschutz e.V. succeeded to submit the project document to UNFCCC, before the deadline of 26th December 2005

- 6 February 2006: CDMSCP Aceh1 was registered formally by UNFCCC in Bonn.

The project design document (PDD), finance of project, supply of solar cookers and supervision of monitoring are the share of Klimaschutz e.V., Bonn, Germany. Distribution of the solar cookers and monitoring of project activity will be done by PT. Petromat Agrotech based in Jakarta in corporate with two local NGOs in Aceh.

3.1 Planning for implementation of CDM Solar Cooker Project Aceh 1 (8)

After 6 February 2006, Klimaschutz e.V. is preparing the project implementation phase. Before this date, it was not able to raise the funding for this project due to the deletion of non-renewable biomass from the methodology for crediting emission reductions on 26 November 2005. That made most of the potential partners who were willing to give funding to the project withdrew their participation.



K 14	
12 liter pot filled with 10 liter of water.	
time	°C
11:16	17.3
11:59	48.8
12:30	74.7
12:51	89.3
13:00	94.7
13:04	96.0
13:16	16.2
14:06	66.9
14:24	81.7
14:37	91.7
14:44	97.0
14:49	98.0
14:52	17.3
15:24	38.8
15:34	49.7
15:47	60.1
16:23	82.0
16:48	94.0
16:51	95.1
16:54	96.8
16:55	97.1
cooked quantity:	
30 liter of water	



Fig. 2 Test result of solar concentrator cooker K14 on 1 October 2002 at latitude 48°N (6)

Discussion with the new strategic investors started again after 6 February 2006 and now they are preparing to provide a budget for the project. The budgeting process is scheduled to be completed by the end of April 2006.

As soon as the funding is available, Klimaschutz e.V. will order the production of solar cooker kits and the heat retaining containers for the CDMSCP Aceh 1. It is planned that:

- Production of the kits needs 6 weeks.
- Delivery to Indonesia by ship needs 6 weeks.
- Announcement in project area will be done within the production and delivery period.

- Delivery all solar cookers K14 and the Wonderboxes to the project areas in Sabang and South East Aceh needs 10 days.
- Assembly of all Solar cookers and distribution to the households needs 60 days

This means on 10 October 2006 the users will start to use the K14 cookers and the Wonderboxes for cooking.

Provision of the spare parts and maintenance for the entire project duration is the responsibility of Klimaschutz e. V. The local governments have provided a place to assemble the equipment. Two NGOs and one private company will assemble the

solar cookers. They have been trained for this job. It is well planned by the local authority to include this program in national programs named as Life-Skill Programs. As the project includes households in coastal villages therefore the fisherman families are taught to use the solar cooker for boiling the fish for preserving. They can sell the cooked fish to generate income. In this way, they can save household expenses for fuel.

The start of monitoring is expected 5 months after the funding for the project is confirmed.

Monitoring is very important, as this process will determine the hours of usage of the solar cookers and the amount of emission reductions gained. The quantity of emission reduction will be decisive for being able to pay back the costs of the project. One of the main intentions of this pilot CDMSCP Aceh 1 is to demonstrate that solar cooker projects can be purely financed by the revenues generated by the sale of Certified Emission Reductions.

While the experimental phase of monitoring commences,

- The user will sign an agreement that obliges him to use the equipment and to participate in the monitoring activity. If the user does not perform the agreed-upon obligations, the monitoring team has the right to hand over the solar cooker to another interested user.
- Monitoring will be done by filling out simple monitoring cards, which will be provided to every user.
- The user has to draw a line indicating the number of hours of his daily usage.
- The sum of the usage hours in every household equipped with this new cooking technology will be counted to be converted into emission reduction by using a formula published in the Project Design Document (5).

The monitoring report will be done together between the parties.

4. SAVED AMOUNT OF CARBON DIOXIDE GENERATED BY THE USE OF SOLAR COOKER K14

This project avoids 3.5 tonnes of CO₂ emissions per year per K14 solar cooker and applies for a renewable crediting CER in the period of 7 years (5). The following is the shortened calculation.

The nominal power P of cooker K14 is written as:

$$P = \{(T_2 - T_1) * c_p * m\} / t \quad (1)$$

This gives $P = \{(100 - 20) \text{ K} * 4.18 \text{ kJ/kg/K} * 6 \text{ kg}\} / (55 * 60 \text{ second}) = 600 \text{ Watt}$.

UNDP (9) survey found: *“The most common method of cooking throughout rural areas in the developing world is the open hearth or three stone fire, which typically transfers only 5-15 percent of the fuel’s energy into the cooking pot”*.

The following calculation uses $\eta = 10\%$ as value for overall efficiency.

In comparison with the open fire, saved primary energy SPE of K14 is written as:

$$SPE = P / \eta \quad (2)$$

Annual saved primary energy is:

$$SPE_{\text{annually}} = (P / \eta) * t \quad (3)$$

IPCC (10) states that Carbon Emission Factor CEF of solid biomass is 29.9 kg C/GJ or 0.0299 kg C/MJ. Saved Carbon Emission m_C is written as:

$$m_C = (P / \eta) * t * CEF \quad (4)$$

Conversion Ratio of saved amount of carbon m_C to saved amount of carbon dioxide m_{CO_2} is equal to molecule weight ratio of CO₂ to C, which is equal to: 44 kg CO₂ / 12 kg C, thus

$$m_{CO_2} = m_C * 44 \text{ kg CO}_2 / 12 \text{ kg C} \quad (5)$$

$$= 3.5 \text{ tonnes CO}_2/\text{device/year}$$

For 7 years and for 1000 solar cookers K14, CO₂ abatement cumulative becomes 24,500 tonnes.

5. CONCLUSION and SUGGESTIONS

There are many people on earth who excessively deplete natural resources. People need to change their habits to fit nature's capabilities. Overuse of natural resources around the world leads to climate change that causes natural disasters, famine, epidemics and wars. The capabilities for sustainable development in some countries declined due to huge funding losses because of both natural and human created disasters.

The international crude petroleum price has raised and will not return down and therefore the governments have had to work within highly acute political risks to derive right decisions to secure national energy provision. In such a situation CDM could bring hope to the poor.

5.1 Consequences of the deletion of non-sustainable biomass, small scale category (SSC) I. C.

“When I came back from Indonesia, I was informed about the decision of the Executive Board that temporarily stops the possibility to submit CDM projects based on non-renewable biomass SSC I.C.; World Bank and the government of Nepal complained. This stops the possibility to submit new CDM Solar Cooker Projects..... (11)

Other countries did not complain. This obviously means that the spirit of Kyoto Protocol and clean development mechanism are not well understood, and this further leads to a lack of awareness of the urgency worldwide. If industries or people who have the ability to help are not well informed about this mechanism, the funding difficulties will not be solved. The UNFCCC decision has made CDM Solar Cooker Project impossible to be financed worldwide and eliminated a chance to improve living conditions for hundreds of millions of poor people in the world.

CO₂ emissions will increase continuously and green areas will continue to disappear. By this decision all UN Millennium Goals are fully ignored. If Non-Annex 1 countries representatives are made aware about what happens, logically, they should stand up and make a complaint to the Executive Board to encourage them to withdraw their decision.

5.2 Impacts of CDMSCP Aceh 1

CDMSCP Aceh 1 is the first solar cooker project that applied to the funding mechanism of CER trading. It is the only chance to exhibit the importance of the CDM based on *non-renewable biomass of Small Scale Category I.C.* that use the CDM financing mechanism to improve a standard of living of firewood consumers and demonstrate all aspects of the spirit of Article 12 of Kyoto Protocol in poverty alleviation.

Global importance of CDM for financing the solar cooker project will demonstrate a comprehensive program that covers:

- a chance to apply solar cookers to reduce firewood consumption in many areas of the world to a sustainable level to heal the environment,
- an active chance to reduce CO₂ emissions,
- a chance to avoid interior cooking, to reduce the risk of lung and eye diseases that affect millions of people world wide,
- a chance to transfer an applicable high-technology for sustainable development and to provide jobs in rural areas,
- a chain of community education along the project, since transferring technology and monitoring of project will be combined with an enduring educational program to ensure best use of the cooking devices,
- a chance to investigate a sustainable path to follow and an approach that gives a better sustainable development in the future.

Indeed, we need to encourage future projects and to multiply CDM Solar Cooker Projects.

6. REFERENCES

- (1) FAO (2005), *Destruction of World Forest's Continues, but Slows*, the Food and Agriculture Organization of the United Nations, 14 November 2005, Rome, Italy.
- (2) WHO news release (2005), *The Fourth World Health Organization (WHO) Global Forum on Chronic Disease Prevention and Control*, 3 November 2004, Ottawa, Canada.
- (3) Herliyani Suharta and Ali Sayigh (2005), *Cooking With The Sun*, in RENEWABLE ENERGY 2005, an Official publication of WREN affiliate with UNESCO

(2005), *Renewable Energy 2005*, David Flin (editor), Sovereign Publications Ltd, London, UK.

- (4) Deepak Gadhia, Birgit and Dieter Seifert (2004), *Solar Cooking Against Poverty*. Presentation, Youth Energy Summit (YES2004), Bonn, Germany, 29 May 2004.
- (5) Project Design Document (2005), *CDM SOLAR COOKER PROJECT Aceh 1 Indonesia. Small Scale Project Category I.C., final PDD Version*, 10 October 2005. <http://cdm.unfccc.int/Projects/TUEV-SUED1135345789.43/view.html>
- (6) Dieter Seifert (2002), *Test of Solar Concentrator Cooker*, D-84524 Neuoetting, Germany, 1st October 2002. Email: bdiv.seifert@t-online.de
- (7) Herliyani Suharta (2005), CDM Solar Cooker and Cook Stove Save80, photographic report of field test and promotion in Kupang, BPPT-B2TE, Serpong, Indonesia.
- (8) Klaus Trifellner (2006), *Private Communication through Email*, 15 April 2006
- (9) UNDP-ESDP (2002), *Clean Energy for Development and Economic Growth: Biomass and Other Renewable Energy Options to Meet Energy and Development Needs in Poor Nations*, published by UNDP, Kingdom of Morocco and GEF. http://www.undp.org/energy/publications/2002/Clean_Energy_Biomass.pdf
- (10) IPCC (1996), *Workbook of Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, Vol. 2, Energy, IPCC. <http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1wb1.pdf>
- (11) Klaus Trifellner (2005), *Private Communication through Email*, Nov. 2005.