

# Agroforestry on the Interface of Orangutan Conservation and Sustainable Livelihoods in Batang Toru (North Sumatra)

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## **Abstract**

The Batang Toru area in North Sumatra supports the largest population of Sumatran Orangutan outside of formal conservation areas, as well as, a large human population. ICRAF and Winrock International analyzed the rich agroforestry livelihood systems of the area to: strengthen local support for conservation-based income alternatives to destructive forest practices; and catalyze local entrepreneurs to create sustainable economic alternative activities. The ICRAF-Winrock team conducted socioeconomic, land tenure assessment, spatial analysis, macroeconomic, and market studies to identify key threats, opportunities and the communities best positioned and most interested to collaborate in the effort. The *Conservation and Livelihood Index* was developed as a spatial analysis tool for landuse based negotiations between stakeholders. Five focal communities were selected and priority agroforestry crops identified as rubber (*Hevea brasiliensis*), cacao (*Theobroma cacao*), sugar palm (*Arenga pinnata*), durian (*Durio zibethinus*) and fruit and vegetable tree-products. The Team worked with participating farmer groups in each focal community to develop community priorities, enhance agroforestry skills, strengthen conservation awareness, and develop market understanding and linkages. An agroforestry extension approach evolved that held biweekly meetings with focal communities and utilized international, national, and local (farmer) technical and private sector specialists. Achievements include: over 1300 farmers trained at 13 events, rubber and cacao production increased by 10-15%, 6 new farmer enterprises developed to increase household incomes, and 5 communities developed livelihood-conservation strategies. Key lessons learned include: traditional agroforestry livelihood systems are compatible with orangutan habitat conservation; ignoring valid land claims, particularly from conservation-minded communities, risks an escalation of tension and possible conflict that may make conservation efforts counter-productive; and conservation-livelihood strategy agreements are a valuable tool to achieve both community livelihood objectives and public conservation goals.

## **Keywords**

Community-based conservation, agroforestry livelihood systems, sustainable economic alternatives, conservation-livelihood strategies, land tenure assessment, spatial analysis, agroforestry extension.

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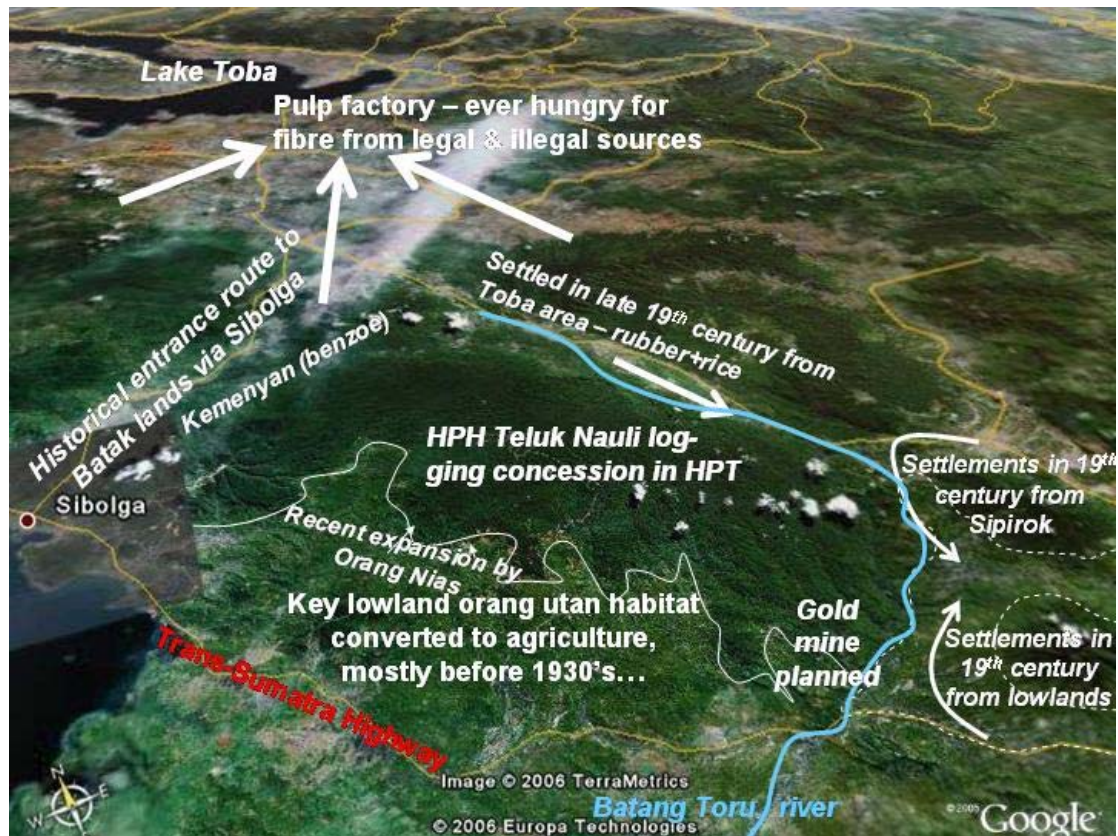
## **Acronyms**

BPN:	Badan Pertanahan Nasional
CI:	Conservation International
CIFOR:	Center for International Forestry Research
GIS:	Geographic Information System
NGO:	Non-Government Organization
NTFP:	Non-Timber Forest Product
RATA:	Rapid Land Tenure Assessment
USAID:	United States Agency for International Development

## Introduction

The Batang Toru area in North Sumatra has a long history of human use, with the benzoin trade to India through the Sibolga harbor probably two thousands year old. The area also supports the largest population of the Sumatran Orangutan outside of government's formal conservation areas; this population is also the largest south of Lake Toba.

Through the USAID-funded *Development of Collaborative Orangutan Habitat Protection in Batang Toru Watershed, North Sumatra Project* implemented by Conservation International (CI) and the World Agroforestry Centre (ICRAF) – which explored the current conditions and opportunities for securing long-term orangutan conservation in the area – we analyzed the rich agroforestry tradition of the area and worked with the farmers to enhance their livelihoods through sustainable landuse systems that also supported conservation efforts.



**Figure 1.** Overview of the Batang Toru area and a number of the influences on land use

The project's second component, *Support Communities and Partners to Develop Sustainable Economic Alternatives in Batang Toru*, was implemented by ICRAF and Winrock International with assistance by local partners. The component included two objectives and a number of activities, as summarized in Box 1.

**Box 1. Objectives and activities of the project's second component - 'Support Communities and Partners to Develop Sustainable Economic Alternatives in Batang Toru'**

Objective 2.1 Develop local support for conservation-based income alternatives

Activity 2.1.1 Help community members to identify the socio-economic threats and opportunities of local livelihood systems, macro-economic development, and markets

Activity 2.1.2 Mapping landuse and land cover

Objective 2.2 Catalyze local entrepreneurs to create sustainable economic alternatives

Activity 2.2.1 Facilitate and support participatory process for communities to design a strategy to develop sustainable alternatives to destructive forest activities

Activity 2.2.2 Implement the strategy for promoting sustainable economic activities

Activity 2.2.3 Monitoring and Evaluation of sustainable economic alternatives

To develop and implement a strategy to achieve these objectives, ICRAF stationed two full-time technical staff in the Sibolga office with the CI staff. Those ICRAF staff were an *Agroforestry Tree Specialist* and an *Agroforestry Livelihood Specialist*. They were assisted with technical backstopping from ICRAF and Winrock Bogor-based staff with expertise in: smallholder tree-based systems, tree nurseries, community forestry, rubber agroforestry systems, agroforestry livelihoods, GIS, landuse modeling, natural resource economics, marketing, and natural resource policy. The main beneficiaries of the *livelihood component* strategy were five focal villages. Local partners that assisted with livelihood component activities included community institutions, NGOs, and local government agencies.

## Preparatory Measures

CI and ICRAF-Winrock held a number of meetings between May and October 2005 to initiate planning and build partnership for the *Development of Collaborative Orangutan Habitat Protection in Batang Toru Watershed, North Sumatra Project*. Key meetings were held on May 12, June 10, August 3 and October 4. Consolidation meetings were held in January and February 2006.

The main purpose of these meetings were to enable the CI and ICRAF-Winrock staffs to become acquainted, develop a deep awareness and understanding of conditions in Batang Toru, begin the process of building a united and strong Sibolga Team, and develop a detailed work plan for the first year. Key points or outputs of these meetings included:

- CI-ICRAF Terms of Reference regarding Administrative, Financial, and Operational details.
- Evaluation of field office sites – Sibolga selected and field office established.
- Criteria, selection and training of project staff.
- Objectives, expected outputs, and timing of the baseline studies (orangutan habitat evaluation, macroeconomic and policy issues, marketing, socioeconomic, and livelihoods).
- Overview of conditions in Batang Toru: key communities, ethnic/religious characteristics, infrastructure and related issues, entry points to communities (the importance of traditional leaders and indigenous structures), key crops, landuse and land status, key threats, stakeholders active in the area (government agencies, conservation organizations, NGOs and community organizations, private sector – industrial, market agents, and other organizations), and past/current activities in the area.
- Priority sites of orangutan habitat conservation and community livelihood enhancement activities.
- Integration of habitat conservation and livelihood enhancement activities after the initial conservation/community evaluation and needs assessment.
- Agendas for the Project Inception Workshop and the First Farmers Workshop.

The ICRAF-Winrock *Livelihood Specialist* and *Agroforestry Tree Specialist* positions were advertised June-July, with interviews held in July and August. The positions were filled in September, staff training and assigned to the Sibolga office in October. Successful candidates were:

- Livelihood Specialist – Jusupta Tarigan, formerly employed with CIFOR Livelihood Enhancement Program.
- Agroforestry Tree Specialist – Endri Martini, formerly assigned to ICRAF's Jambi field office.

# Implementation and Accomplishments

*Objective 1. Developing local support for conservation-based income alternatives*

*Activity 2.1.1 Help community members to identify the socio-economic threats and opportunities of local livelihood systems, macro-economic development, and markets*

## Site Evaluation and Selection

The ICRAF Bogor based Team conducted three site evaluation trips between October 2005 and January 2006. The purpose of the trips were: i) characterization and identification of socioeconomic, farming system and marketing systems of the greater Batang Toru watershed; ii) identification of threats, opportunity, land-use system, priority species, socioeconomics, land-tenure status, extension-marketing issue, and c) identify priority actions. Additionally the ICRAF Sibolga staff conducted a minimum of twelve follow-up visits with partners and candidate communities during the same period. The primary purpose of these visits was: i) socialization of the project; ii) introduction of staff and ICRAF; iii) deeper exploration of the existing agroforestry systems and sustainable economic alternatives; and iv) collecting and cross-checking baseline data. Through this evaluation process approximately 50 villages were visited by the ICRAF teams. By combining the results of the socioeconomic studies and those of the environmental evaluation process ICRAF and CI selected the focal villages for Component 2 activities. Selected villages were:

- Sibulan-bulan, North Tapanuli
- Sitandiang, South Tapanuli
- WEK I, South Tapanuli
- Hutagurgur, Central Tapanuli
- Aek Nabara, South Tapanuli

## Demographics, Landuse, and Livelihoods

The Batang Toru watershed includes part of three different districts - North Tapanuli, Central Tapanuli, and South Tapanuli. These three districts have similar history, demographic, livelihood, and economic characteristics. All three have large rural-based human populations with population densities varying from 126/km<sup>2</sup> in Central Tapanuli, to 69/km<sup>2</sup> in North Tapanuli, to 54/km<sup>2</sup> in South Tapanuli. The population is dominated by the indigenous Batak Toba, Batak Pesisir, and Batak Angkola-Mandailang ethnic groups with some communities of Javanese or Nias. The watershed covers approximately 100,000 ha, includes 251 villages with a total human population of 133,971 in 27,906 households.

Natural forest and agroforests are the primary land cover. Elevations range from 200 m to 1500 m, with slopes of 30° to 60°. The local communities have a long history of sustainable forest resource management through a gradient of landuse intensities ranging from mixed tree

gardens where species composition is largely controlled by farmers and management is intermediate, to natural forests where impact from human intervention is light with small quantities of products harvested. In between are various types to agroforests (forest farming systems) where human management favors plant species that provide useful/valuable products but management remains extension rather than intensive. In those agroforest systems there are many non-priority species that are ‘tolerated’ – as long as they do not negatively impact a priority species – or ‘managed’ to yield a useful product. Mixed tree garden and agroforest systems are collectively referred to as upland agroforestry systems.

Land ownership varies from 1 to 2 hectares/family. Agriculture is dominated by irrigated rice production and upland agroforestry systems, which include: 1) rubber agroforestry (jungle rubber) systems; 2) durian agroforestry systems; 3) rubber monoculture systems; 4) homegarden systems; 5) fruit-cacao systems; 6) pinang-cacao agroforestry systems; 7) cinnamon monoculture systems; 8) upland rice-banana-cassava-cacao systems, and 9) coffee monoculture systems.

Key products of these systems include rice (*Oryza sativa*), rubber (*Hevea brasiliensis*), cacao (*Theobroma cacao*), coffee (*Coffea arabica* and *C. robusta*), kemenyan or benzoin (*Styrax benzoin*), aren (*Arenga pinnata*), durian (*Durio zibethinus*), petai (*Parkia speciosa*), candlenut (*Aleurites moluccana*), salak (*Salacca zalacca*), and banana (*Musa* sp). Other fruits, medicinal crops, and timber are also produced in these systems. Rice, medicinal crops, and timber are primarily produced for home use. Rubber, cacao, and kemenyan are exclusively market crops. Other crops are both consumed in the home and marketed. None of the agroforestry systems are intensely managed as farmers lack access to high quality germplasm, technical support, infrastructure, and market information.

Average annual farm-based income per household in the project area is approximately US\$650, with total annual income about US\$1000/household. Common off-farm income sources include operating small shops, government service, trade of agricultural crops, and remittance. Livestock production and non-timber forest products (NTFPs), which may be collected from natural forests or cultivated in tree gardens or agroforests, provide secondary but important sources of income – particularly during holidays and to fill seasonal income needs or other cash flow gaps. More details regarding socioeconomic characteristics of the project area are available in Budidarsono et al. (2006).

## Market Analysis

The ICRAF-Winrock team conducted market surveys (Tukan and Roshetko, 2005) and related activities to identify:

- Agroforestry products (including specification, quantity, quality, seasonality, etc) that hold potential for smallholder farmers;
- Market channels used by or that hold potential for smallholder farmers;
- Marketing problems commonly experienced by farmer and market agents;
- Opportunities to enhance farmer’s knowledge regarding markets/marketing; and
- Opportunities to expand farmer’s market role.

Initial surveys identified rubber, durian, cacao, sugar palm, and kemenyan (benzoin) as important sources of income in the five focal villages. At the Batang Toru level four of these crops contribute greatly to household farm incomes: rubber 40%; durian 18%, cacao 9%, and sugar palm 5%. In Aek Nabara and Sitandieng sugar palm is the main agricultural crop. (Across Batang Toru coffee, betlenut (pinang), coconut, kemenyan, and cinnamon are also economically importance to smallholder crops, but are only minor crops in the five focal villages. Oil palm is also an important agricultural crop in the area but not for smallholder farmers.)

Subsequent activities and surveys also identified the following smallholder products as currently or potentially important: gaharu (*Aquillaria* sp), petai (*Parkia speciosa*), nilam (*Pogostemon cablin*), flowers (*Nepenthes* spp, *Amorphophallus* spp, and orchids), high-quality rubber seedlings, medicinal plants, mushrooms, vegetables, and goats. However income generation from these crops is limited by a number of technical and marketing issues. Farmers practice traditional non-intensive management, lack access to technical assistance, and are not familiar with grafting techniques. Farmers lack market information and have limited market options because of poor infrastructure and their remote location. Farmers also require advance payment, which reduces their income.

Agents complain that smallholder products are of uncertain quality, quantity, and reliability (yields fluctuate), that the location is remote and there is no farmer’s association to facilitate transactions. Existing smallholder market linkages and an ‘illustrative’ improved smallholder market link for the future are shown below (Tukan and Roshetko, 2005):

**Rubber**

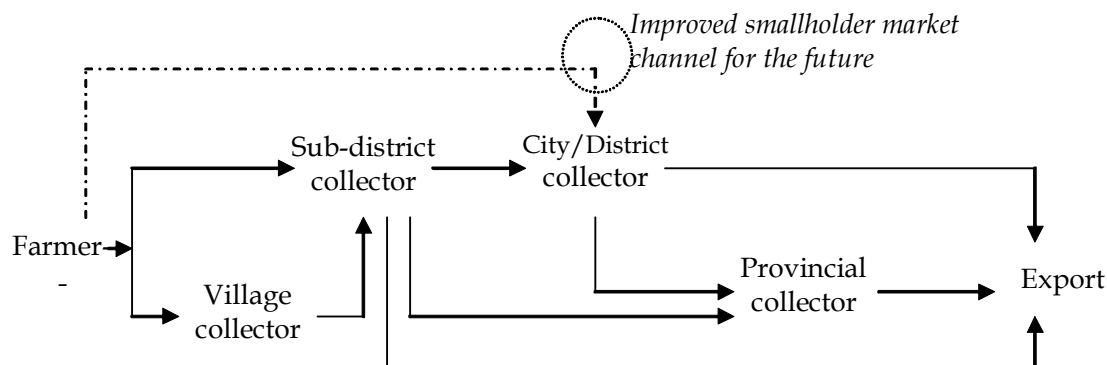
- Farmer --- Local collector --- District broker --- Factory

**Cacao and Coffee**

- Farmer ---Local collector --- District broker --- Exporter (Lampung, Medan, Padang)

**Salak**

- Farmer ---Local collector --- Salak market ---- District collector ---- retailer/grocer
- Farmer --- Local collector or roadside retailer



**Figure 1.** Improved smallholder market channel for the future (for cacao and coffee)

## Macroeconomic Conditions

Agricultural production is the largest single contributor to the economy of all three districts in which Batang Toru is located. Based on the government's *Gross Regional Domestic Production* statistics for 2003, agriculture production accounts for 42.3% of the South Tapanuli economy (BPS South Tapanuli, 2003), 53.5% of Central Tapanuli economy (BPS North Tapanuli, 2003), and 60.6% of the North Tapanuli economy (BPS Central Tapanuli, 2003). The contribution of agriculture in all three districts is greater than the provincial figure of 30.6% (BPS North Sumatra, 2004).

Landuse/land cover in project area is dominated by forests (4500 sq.km) and agroforest (2500 to 3000 sq.km). Between 1999 - 2001 logging concessions have been active in both South Tapanuli and Central Tapanuli. However, the contribution of the timber sector to district economies has been very low; and incomes from harvest timber in natural forests primarily benefit corporations. Local communities make extensive, sustainable use of all forest-based systems - tree gardens, agroforests, and natural forest systems. Tree crops form the main source of rural livelihood the Batang Toru project area. Oil palm is an important tree crops at the provincial level, but contribute very little to smallholder economies and causes significant loss of forest cover. By contrast, smallholder management of tree gardens, agroforests, and natural forests are sustainable. Spatial analysis and land tenure studies both indicate that tree-based landuse systems under smallholder are not being converted to other landuse systems and maintaining environmental services. Supporting smallholder farmers to improve their tree based landuse systems will benefit both for regional economy as well as the environment.

## Land Tenure Assessment

A *Rapid Land Tenure Assessment (RATA)* was conducted to explore conflicting claims among the stakeholders, linked to property rights and legal terms (Sirait, 2007). The RATA tool (Galudra et al., 2007) was developed at ICRAF as a first step in location-specific negotiations of land tenure and as assessment of the risk of conflict. The study also focused on historical land tenure, landuse, and land access and recognized community's traditional role in natural resource conservation. It also intended to provide policy options to avoid/resolve landuse conflict. The biggest potential for landuse conflict is the proposal to develop a national park in Batang Toru based on the forest gazettement. Some of the Batang Toru Area was gazetted as state forest land in the 1920s, and many of the areas indicated as 'forest reserve' at that time are still in good condition. Later expansions of the 'forest reserve' area in the Batang Toru Area did not follow the legal gazettement process. Legally, the unfinished gazettement process leaves the land open to claims by local communities. The designation of the state forest zone in North Sumatra, based on Ministry Decree No. 44/2006 and 201/2006, has not been accepted by either communities or local governments. Some of the designated area had already been allocated by local governments for development or infrastructure. Local government and community resistance has been recorded in North Tapanuli and Central Tapanuli. Contrary to central government assertions, communities do have traditional and legal claims to some Batang Toru forests, which are recognized by the National Land Agency.

In 2006, the provincial government in North Sumatra allocated 148,570 ha of forest for orangutan conservation and proposed development of a Batang Toru National Park to



encompass land in North Tapanuli, Central Tapanuli and South Tapanuli districts. To study how the proposed park would affect people's customary rights, RATA assessments were conducted in 2006 and 2007. Results showed that an area of about 32,573 ha has long been controlled by local people and should be classified as agroforests. Half of the area (17,931 ha) is legalized by the National Land Agency (BPN) as customary land, but that *legal process* has been rejected by the forestry authorities. Current efforts to enhance orangutan conservation in the area need to take the views of stakeholders outside the Ministry of Forestry into account, otherwise conflicts may render conservation efforts counterproductive.

## Consultations with stakeholders

The project was socialized and sites evaluated through visits to 50 villages and meetings with a minimum of 500 farmers plus other stakeholders.

To develop local support and opportunities for conservation-based economic alternatives the following stakeholder consultations were held:

- NGO Stakeholder Meeting in Medan, December 2005. Attended by 15 NGO staff.
- Regional Meeting in Medan, January 2006. Attended by 80 stakeholders - national and local government officials, NGOs and farmers.
- Farmers Workshop in Sibulan-bulan, March 2006. Attended by 30 farmers, 5 subdistrict chiefs, 15 other local government officials, 5 extension agents.
- Regional Meeting in Medan, March 2007. Attended by 150 stakeholders representing NGOs, conservation organizations, farming communities, universities, national and local governments (provincial, district, subdistrict, and village), technical agencies, the private sector, and donors.
- Farmers Workshops in focal villages, May 2007. Attended by 70 stakeholders.

***Activity 2.1.2 Mapping landuse and land cover***

## Landuse and land cover mapping and analysis

ICRAF's Spatial Analysis Unit supported the project by compiling, collecting and analyzing secondary and primary spatial data. Secondary data was compiled by means of reviewing in-house data, downloading available data from the internet, exchanging data with colleagues from other institutions, digitizing hardcopies of maps, mapping points and tracks visited in the field, and purchasing. Thirty-four maps compiled and produced from secondary data covering terrain, topography, forests, land tenure, satellite imagery, and GPS data. A list of those maps and relevant details are found in Appendix 1. Two field trips were conducted to collect data, assess the accuracy of land cover maps, and consult with stakeholders.

Spatial analysis of the data compiled and collected resulted in three key outputs: i) land cover mapping; ii) land cover change analysis; and iii) conservation and livelihood index mapping. Details regarding these outputs are found in Appendix 2. Sixteen land cover classes were

identified, ranged from natural forest and complex agroforestry systems to various agricultural systems (Dewi, 2007). In general, the time series map showed that despite the common perception that forest cover is declining in the watershed, the agroforestry systems managed by farmer remain primarily unchanged. Those agroforestry systems provide livelihood support for the community and at the same time provide environmental services and act as a buffer to the natural forest area. The analysis concludes that efforts to reduce threats to natural habitat by developing protected areas (national park, protected forests, nature reserves, etc.) must consider existing local livelihood activities and potential opportunities/threats from the surrounding areas. The ICRAF team developed the *Conservation and Livelihood Index (C & L Index)* as a base map tool for landuse based negotiations between stakeholders. The results from C & L Index analysis were shared with stakeholders in Medan and an international forum of conservationists in Hanoi (Tarigan et al, 2007). Details regarding the components of the index are found in Appendix 3 (Dewi, 2007).

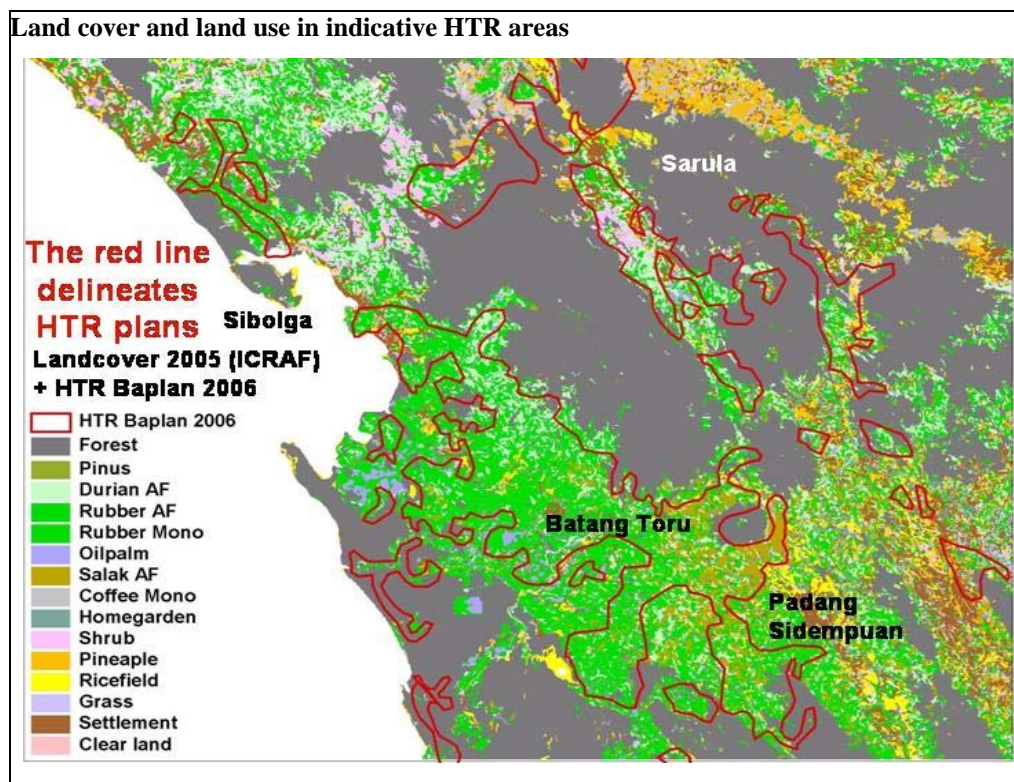
**Box 2. A case study of areas indicated for HTR in Batang Toru, North Sumatra**

As part of the ‘peoples plantation’ or Hutan Tanaman Rakyat (HTR) plans, the Ministry of Forestry, through its Planning Body and FORDA (Forest Research and Development Agency), prepared maps for various provinces of the area where HTR rules could be applied, plus an indication of what species would be suitable for the local soil and climate. These are ‘indicative’ at this stage. As a ‘case study’ we analyzed these maps and reports for the Batang Toru area (van Noordwijk et al., 2007). We overlaid the map that indicated areas that could be used for HTR according to a recent FORDA report, with three other datasets in our geographic information system:

- current vegetation maps based on an interpreted 2005 satellite image, with the expectation that most HTR would have a ‘shrub’ type of land cover,
- indicative forest function (landuse) maps, with the expectation that all HTR would be in ‘production forests’,
- land ownership data, with the expectation that HTR would be part of the National Forest Reserve, where the Ministry of Forestry has indeed the right to develop contracts such as HTR.

In fact, all three expectations provided to be in serious conflict with the data.

Box 2. A case study of areas indicated for HTR in Batang Toru, North Sumatra (continuation)



Land cover	Area (ha)	%
Early forest regrowth	361	2
Shrub	99	1
Open land	3	0
No data	255	2
Rubber Agroforest	4200	28
Forest + Kemenyan agroforest	2762	18
Durian Agroforest	1746	12
Monoculture rubber	1742	12
Salak Agroforest	1008	7
Settlements	740	5
Mixed Tree Gardens	639	4
Rice Fields	364	2
Pineapple Plantation	164	1
Oil Palm Plantation	162	1
Coffee monoculture	106	1
Swamp forest	659	4
Pine plantation	37	0
<b>Total</b>	<b>15,047</b>	<b>100</b>

***Objective 2.2 Catalyze local entrepreneurs to create sustainable economic alternatives***

***Activity 2.2.1 Facilitate and support participatory process for communities to design a strategy to develop sustainable alternatives to destructive forest activities***

## Community conservation-livelihood strategies

To facilitate the participatory design of community-based strategies to develop sustainable economic alternatives bi-weekly meetings were held with farmer groups in the five focal villages commencing in April 2006. One-hundred twenty farmers were active members of the five focal farmer groups and regularly participated in the bi-weekly meetings; 22.5% of the members were women. The gradient of landuse systems practiced by Batang Toru communities are compatible with conservation of the area's unique and globally important biodiversity. Concern exist that population and economic pressure could result in adoption of destructive landuse systems, if suitable alternative livelihoods option were not identified and developed. The approach adopted by ICRAF, Winrock and partners was to worked with communities and local government agencies to develop *community conservation-livelihood strategies* that provide frameworks for the: i) recognition of communities' traditional role in conserving natural resources; ii) recognition that local agricultural/forest livelihood systems are compatible with environmental conservation; and iii) strengthening of communities/other stakeholders understanding/commitment to conservation as an approach to protect the environmental services (biodiversity, watersheds and carbon stocks). Strategies also identified/facilitated technical and marketing services/improvements that enabled communities to enhance the productivity/profitability of their agroforestry livelihood systems. All five focal villages developed conservation-livelihood strategies that included recognition of priority crops, a prioritization of technical training and relevant follow-up activities, and commitment to conservation. Three of the communities – Sibulanbulan, Aek Nabara and Sitandiang – developed working versions of *livelihood-conservation strategy agreements*. Those agreements consist of an introduction, background, goal, objectives, plans to achieve objectives, roles and responsibilities of the stakeholders, terms of the agreement, activities, and monitoring plan. Additional clauses can be included as necessary. Agreements are intend to be transparent, equitable, realistic and flexible.

As a result of developing livelihood-conservation strategies traditional sustainable natural resource management practices have been strengthened or maintained; and appreciation of the value of the natural forest renewed. Through the implementation of the strategies (see *Activity 2.2.2*) more intensive, yet sustainable, management is practiced on roughly 600 hectares of smallholder tree garden Additionally 10,000 hectares of natural forests surrounding focal communities benefit directly from improved natural resource manage. Potentially, all 100,000 hectares of the Batang Toru watershed could benefit from the improved natural resource management initiated.

## Priority Crop

Based on existing farm resources, farmers experience, project expertise, market study results, and accessible extension support the following priority crops were identified by the focal communities: rubber, cacao, durian and sugar palm. Crops of secondary importance included gaharu (*Aquillaria* sp), petai (*Parkia speciosa*), nilam (*Pogostemon cablin*), flowers (*Nepenthes* spp, *Amorphophallus* spp, and orchids), high-quality rubber seedlings, medicinal plants, mushrooms, vegetables, and goats.

## Model Simulation of Durian-Rubber Agroforestry System

The ICRAF Team conducted a simulation study with the SeXI-FS (Spatially Explicit Individual-based Forest Simulator) model to predict the dynamic growth and yield of durian-rubber agroforestry systems in the Batang Toru area. Rubber was selected because it is the main smallholder crop in Batang Toru. Durian was selected because it is favored by farmers, has a high and lucrative market demand, and also sustains orangutan populations by providing both food and habitat. The data used in the model was based on biophysical and farmer surveys that determined the relationship between durian fruit production and tree structure. Four durian-rubber compositions were compared, durian as 7%, 17%, 33% and 50% of the tree component of a 1 ha agroforestry system. Other parameters were: durian production starts at 15 years with fruits harvested every 2 years; rubber production starts after its diameter is 15 cm; the price for durian is Rp 3000/fruit and the price for rubber is Rp 6000/kg of dry latex.

Model results show that increases in the durian component increased overall income of the system, although not at a statistically significant level. Changes in the species composition have little impact on the overall income from rubber-durian agroforest, when prices of both commodities are constant. However, the prices of both durian and rubber commonly fluctuate. Farmers constantly alter their management practices, and even the components of their agroforestry systems, based their expectation of future prices. Mixed agroforestry systems provide farmers greater flexibility to respond to dynamic market forces and price fluctuations. The model results support the development of multiple species agroforestry systems. More details regarding the simulation are provided in Harja et al. (2008).

***Activity 2.2.2 Implement the strategy for promoting sustainable economic activities***

## Trainings and Expert Consultations

To assist focal villages implement their livelihood-conservation strategies, the ICRAF team with strong input from Winrock, conducted a number of trainings and expert consultations (Table 1). Winrock supported five international consultants at no cost to the project.

**Table 1.** Trainings and expert consultations conducted.

Activity	Specialist	Date
Agroforestry Product Marketing	ICRAF Bogor & Sibolga Teams	May 2006
Rubber Seedling Production & Management	ICRAF Sibolga Team	July 2006
Conservation-Livelihood Strategy Development	Melissa Abdo, Conservation-Livelihood Specialist	July 2006
Vegetable Production and Marketing	Greg Fonsah, Smallholder Vegetable Production and Marketing Specialist	August 2006
Rubber Management and Tapping	Arifin Kairun, Rubber Specialist	September 2006
Cacao Management and Production	Lam Lam Tarigan, Farmer Specialist	October 2006
Tree System Management	ICRAF Bogor & Sibolga Teams	November 2006
Smallholder Livestock Production	Nancy Morey, Livestock Specialist	November 2006
Rubber Seedling Grafting	Arifin Kairun and 2 other specialists	Jan-April 2007
Rubber Pest & Disease Management	Suyitno, Rubber Pathologist	April 2007
Cacao Production & Post-Harvest Management	Juan Guazman, Cacao Specialist	April 2007
Sugar Palm Production & Processing	Gunarif, Andalas University, Padang	April 2007
Conservation-Livelihood Strategy Development	Melissa Abdo, Conservation-Livelihood Specialist	June-July 2007

Most of these activities were held in all five focal villages or the activity was held in a centralized location with two or more villages attending. Exceptions include *conservation-livelihood strategy development* with focused in the three communities mentioned previously; *sugar palm production and processing* which was held in Aek Nabara and Sitandiang; and *vegetable production and marketing* which occurred in Aek Nabara, WEK I and Sibulan-bulan. On average about 100 farmers and other stakeholders attended each of the activities listed in Table 1, so total number of direct beneficiaries from these activities is approximately 1300. The training activities were interrelated and mutually supportive to maximize capacity enhancement and the development of sound sustainable economic alternatives. ICRAF Sibolga Team met with every farmer group on a bi-weekly basis to develop and implement plans related the training/consultation topics. Details regarding the implementation of these capacity building activities are provided by Martini et al. (in preparation).

Impacts from these technical capacity building activities have been realized. Based on experience and observations at the site a 10-15% increase in rubber and cacao production is estimated in communities that have adapted improved management of those crops. Additionally, a total of 25,000 rubber seedlings have been produced in focal villages. This is enough to establish approximately 80 hectares of smallholder rubber agroforestry systems. Experience at similar sites indicate that under smallholder management conditions clonal rubber seedlings will start to produce latex 5-6 years after establishment and yield a minimum of 100% more latex annually compared to local rubber germplasm, which generally does not produce latex until 10-15 years after establishment.

## Meetings Between Community Groups and Private Sector/Business Development Specialists

Five of the trainings and expert consultations list in Table 1 included information on improving smallholder business position by enhancing product quality, market knowledge, and market linkages. Additionally, meetings/visits were held with private sector entities to help farmer groups develop their business orientation (Table 2). Multiple meetings were held with some of these private sector entities.

**Table 2.** Meetings/visits held with private sector entities.

Private Sector Entities	Commodity	First Visit
Local Collectors/Traders	Rubber	October 2005
Factory Tebing Tinggi and Sibolga	Rubber	January 2006
Smallscale Entrepreneur in Tanah Karo	Cacao	March 2006
Traders in Sibolga	Palm sugar	April 2006
Farmer Entrepreneur in Tanah Karo	Palm sugar	April 2006
Traders in Padang Sidempuan	Salak	April-May 2006
Traders in Padang Sidempuan	Cacao and Coffee	May 2006
Traders in Padang Sidempuan	Flowers	July & Aug 2006

The ‘hard numbers’ discussed during these meetings/visits helped convinced participating farmers that adopting a market orientation through their integrated livelihood-conservation strategies was a valid concept (Abdo, 2006). Project beneficiaries have begun to develop agroforestry-based, conservation-friendly enterprises to enhance household income. The number of households involved is still small and business operations simple, but this is good initial impact. The *new* incomes generate are significant additions to current farm-based annual incomes, which are US\$650/household. *New farmer enterprises*, defined as any new farm-based *venture, endeavor, or activity* that enhances household livelihoods or incomes (Roshetko et al. 2007), resulting from project activities include:

- **Rubber seedling.** Farmers sold approximately 2,000 high-quality clonal rubber seedlings to local farmers, government agencies and other customers. Nursery materials were supplied through the project. Total income seedling sales is estimated as Rp 4,000,000 or US\$444 (2,000 seedlings x Rp2000).
- **Flower.** Five families in Sibulan-bulan started to collect or propagat indigenous flowers (*Nepenthes* spp, *Amorphophallus* spp, and orchids) in October 2006. Sale price is Rp 50,000/flower, but can be as high as Rp 100,000/flower. Over the period of a year approximately 50 flowers had been sold to urban based market agents or customers. There are no monetary operational costs, as all material inputs are locally available. Total annual income is estimated to be a minimum of Rp 2,500,000 or US\$278 (Rp 50,000 x 50); averaging US\$56/family.
- **Mushroom.** Five other families in Sibulan-bulan started to collect, process, and market forest mushrooms (Danburabi) in May 2007. Based on experience to date, it is estimated

that each family can collect a minimum of 5 kg (dry weight) of mushroom annually. Sale price is Rp 80,000/kg (dry weight). There are no monetary operational costs. Annual income is estimated to be Rp 2,000,000 or US\$222 (5 kg x 5 families x Rp80,000); averaging US\$44/family.

- **Livestock.** Approximately 35 households have adopted recommendations regarding minimum level of goat management, which are yielding one additional buck annually. Income projections indicate additional income of US\$85/household/year.
- **Jamu.** A women's group (20 members) in Sibulan-bulan developed a jamu (traditional herbal medical tonic) enterprise in April 2007. The group sells about 50 packets of jamu/event at Rp 10,000/packet. There are approximately 4 events per year. Operational costs (herbs, other ingredients, & packaging) account for approximately 35% of sales price. Annual income for the group is Rp 2,000,000 (US\$222) with a profit of Rp 1,200,000 (US\$144).
- **Traditional medicines.** Some families in the three villages have switched to using traditional medicines. It is estimate that 30-40% of households income (approximately Rp 500,000/month) is used for medical expenses and that the use of traditional medicines would save 20% of medical expenses. The use of traditional medicines represents an annual cash savings of Rp 420,000/family or US\$47/family.

Farmers have not been able to adapt all recommendations provided through the project. For example while interested in market-oriented vegetable production, farmers face barriers related to limited land availability, labor shortages, lack of technical inputs, limited access to quality germplasm, poor infrastructure, and weak market positions. Farmers are not willing to forsake their traditional sustainable multi-species perennial farming systems for annual crop oriented systems that are financially and environmentally riskier. Local food and livelihood security are better served by diverse, mutli-product agroforestry systems. Similarly, improved rubber market channels have been identified but socioeconomic and transparency barriers remain problematic. Additional work is required before the new market channel identified above under *Market Analysis* can be actualized.

## Model Sites

Livelihood and food security activities implemented at the five focal communities include: i) farmer group organizing and strengthening; ii) livelihood-conservation strategy development; iii) biweekly meeting to continue development and implementation of conservation-livelihood strategies; iv) rubber nursery establishment, training and management; v) additional technical trainings and expert consultations; vi) meetings with private sector entities; and vii) development of new farmer enterprises.

Additionally, ICRAF-Winrock and CI established a *community information centre* to build awareness regarding the importance of integrating conservation with livelihood activities. The centre provides: i) information on the production and marketing of priority agricultural and commodity crops (rubber, cacao, coffee, durian, ...) – including pest and disease management; ii) information regarding the domestication of non-timber forest products; iii) general information on the importance of maintaining diverse agroecosystems (tree gardens, agroforests, and natural forests); and v) open spaces for announcements and information



sharing. The centre is located in Sibulanbulan, but available to serve the needs of all focal villages and other interested communities.

***Activity 2.2.3 Monitoring and Evaluation of sustainable economic alternatives***

## Monitoring and Evaluation

A participatory monitoring and evaluation (M&E) tool was developed with the focal farmer groups. To instill local responsibility and control the tool was designed as *community self-monitoring and evaluation* of the group activities and of ICRAF as the implementer of Component 2 and facilitation of the livelihood-conservation related activities. Initial discuss of the tool occurred shortly after focal groups were formed (April 2006) and develop in June-July 2006. Thirteen parameters were selected with rankings of green (good), yellow (average), and red (bad). Monitoring was conducted periodically, roughly on a quarterly basis, by both the ICRAF Sibolga Team and farmer groups. Final results of the M&E tool are provided in Table 3 as approved at the final farmer workshop held in May 2007.

**Table 3.** Results of Self-Monitoring and Evaluation Tools

Parameter	Ranking	Comments
Nursery Establishment	Green	All necessary arrangements were made. Nurseries are functioning, according to the commitment of each group.
Regular Meetings/Activities	Green	Activities were held according to pre-arranged schedules, which considered farmers' other commitments.
Activities Conducted on Time	Yellow	Activities frequently started late, but within time frames that are culturally acceptable.
Attendance to Group Activities	Yellow, Red	Three groups averaged over 75% attendance; 2 groups (Sitandiang and Aek Nabara) averaged below 75%.
Minutes of Activities	Yellow	Minutes of activities were recorded, but not read at subsequent activities.
Accounting of Group Finances	Yellow	Accounting of finances were frequently late, but approved by groups.
Collective Decision Making	Green	Collective planning and decision making was implemented.
Group Discussion and Action	Green	Group activities were discussed, planned and implemented: livelihood-conservation strategies, trainings, expert consultations, visits with private sector, seedling sales, etc.
Sharing of Responsibilities	Yellow	In all groups at least 50% of members shared in responsibilities.
Trainings/Related Activities	Green	The planning and implementation of training activities exceeded expectations.
Formation of New Farmer Groups	Yellow	Assistance was not provided to help form other groups. This was anticipated, but time and resource limitations proved to be barriers.
Community Development	Green	More than four community development activities were implemented that identified opportunities for individuals or sub-groups to develop enterprises.
Annual Group Meeting	Yellow	Only Sibulanbulan held an annual meeting. For the other groups the <i>farmer workshop</i> held in May 2007 functioned as an annual meeting.

Ranking: Green (good), Yellow (average), and Red (bad).

Farmer participants stated that they greatly benefited from activities implemented under Component 2. Of the activities conducted, those related to rubber management and production had the greatest impact. Farmers agree they need additional technical and marketing assistance to maintain the current momentum in improving their agroforestry systems and strengthening community-based conservation. Three of the farmer groups have official registered as community organizations with district forest offices and anticipate, expect, technical support from those agencies. Farmer groups in all five communities agree to continue their agroforestry and conservation activities, and volunteer to transfer their knowledge to other interested individuals and communities. They hope to expand their information network with other farmers, NGOs, government agencies, and the private sector to enhance their agroforestry and forest management capacity. Farmer groups request the ICRAF, Winrock, CI and USAID continue their support of Batang Toru communities.

## Summary of Project Achievements

- Site selection consultations conducted with 50 villages and over 500 farmers, plus other stakeholders
- Livelihoods and Economic Options Report
- Macroeconomic and Policy Analysis
- Economic Valuation of Batang Toru Watershed Report, under CI lead
- Market Study Report and Presentation
- 3 regional planning meetings conducted, in collaboration with CI
- 2 farmer workshops held and attended by all focal villages, in collaboration with CI
- 120 farmers (22.5% women) in 5 focal groups active in all project activities
- 34 maps or imagery compiled from existing data/information sources
- 3 new maps created
- 5 focal villages implemented livelihood-conservation strategies and model sites
- over 1300 farmers trained in 13 trainings/consultations in focal villages
- bi-weekly planning and implementation meetings held with 5 focal villages
- 10-15% increase in smallholder farmer rubber and cacao production
- 5 nurseries established and 25,000 high-quality rubber seedlings produced
- 600 hectares of farmer agroforestry systems under improved management
- 10,000 ha of natural forest benefiting from improved natural resource management
- Modeling simulation of durian-rubber agroforestry systems conducted
- Rapid Land Tenure Assessment (RATA) conducted and documented
- Non-timber forest products as a source of livelihood diversification paper published
- 8 meetings held with private sector entities (for some topics multiple meetings held)
- 6 new types of farmer enterprises developed to increase household incomes
- 1 community information centre developed, in collaboration with CI
- monitoring and evaluation tool developed and implemented

## Lessons Learned

- Smallholder tree-based systems are compatible with conservation of orangutan habitat.
- Smallholder management of tree gardens, agroforests, and natural forests has not resulted in the conversion of those tree-based systems to other landuses.
- By ignoring valid local claims, particularly from conservation-minded communities, forest authorities risk an escalation of tension and possible conflict that may make non-participatory, non-transparent conservation efforts counter-productive.
- Livelihood-Conservation Strategy Agreements are a valuable tool to recognize farmers' traditional sustainable natural resource management practices and strengthening local commitment to conservation.
- Livelihood-Conservation Strategy Agreements must be developed in a participatory, transparent, and equitable manner. The process will be iterative and flexible to address the actual conditions of relevant farming communities.
- Smallscale agroforestry enterprises can have significant positive impacts on household incomes.

## Appendix 1 Maps and Imagery of Batang Toru compiled.

NO	CATEGORY/NAME	SOURCE	FORMAT	SCALE/ RESOLUTION	NOTE
1	<b>Terrain</b>				
1.1	Shuttle Radar Topographic Mission (STRM) Digital Elevation Model	USGS-NASA	Digital Raster	90m	Public data-freely downloadable
2	<b>Satellite Image</b>				
2.1	Landsat ETM+ SLC Off-Gap filled, Path 129 Row 059, Acquisition date 2005-07-27	USGS-BTIC BIOTROP	Digital Raster	30m	
2.2	Landsat ETM+ SLC Off-Gap filled, Path 128 Row 059, Acquisition date 2006-01-28	USGS-BTIC BIOTROP	Digital Raster	30m	
2.3	Landsat ETM Path 128 Row 59 Acquisition date 9 July 2001	USGS-Landsat.org	Digital Raster	30m	ICRAF Internal Archive
2.4	Landsat ETM Path 129 Row 59 Acquisition date 13 July 2000	USGS-Landsat.org	Digital Raster	30m	ICRAF Internal Archive
2.5	Landsat TM_Path 128 Row 59 Acquisition date 4 July_1994	USGS-Landsat.org	Digital Raster	30m	ICRAF Internal Archive
2.6	Landsat TM_Path 129 Row 59 Acquisition date 23 July_1989	USGS-Landsat.org	Digital Raster	60m	ICRAF Internal Archive
2.7	LandsatMSS Path 136 Row 60 Acquisition date 20 June 1979	USGS-Landsat.org	Digital Raster	60m	ICRAF Internal Archive
2.8	Quickbird Image, Acquisition date 23 January 2005	Pacific Disaster Centre	Digital Raster	2.4m	Public data-freely downloadable
3	<b>Topography</b>				
3.1	Population and District Boundary of North Sumatra	Bakosurtanal, 2001	Digital Vector	1:250,000	
3.2	Population and Sub-district Boundary of North Sumatra	Bakosurtanal, 2002	Digital Vector	1:250,000	
3.3	Villages of North Tapanuli	BPS, 2003	Digital Vector	1:50,000	
3.4	Villages of Central Tapanuli	BPS, 2003	Digital Vector	1:50,000	
3.5	Villages of South Tapanuli	BPS, 2003	Digital Vector	1:50,000	
3.6	Road of North Sumatra	Repprot Bakosurtanal	Digital Vector	1:250000	

<b>4 Forestry</b>			
4.1	Forest Area in North Sumatra, sheet 0717 (Padang Sidempuan)	MOF, 2005	Hardcopy 1:250000
4.2	Identification & Rehabilitation Forest in Tapanuli Selatan, North Sumatra	MOF, (unknown publication year)	Hardcopy 1:250000
4.3	Landcover Forest	MOF, 1999	Digital Vector 1:250000
4.4	TGHK North Sumatra	MOF, 1985	Digital Vector 1:250000
4.5	HPH North Sumatra	MOF, 1996	Digital Vector 1:250000
4.6	HTI North Sumatra	MOF, (unknown publication year)	Digital Vector 1:250000
4.7	Forest Area in South Tapanuli	unknown	Digital Vector unknown
4.8	Forest Area (SK Menteri No. 44/Menhut - II / 2005) in Batang Toru Watershed	MOF, 2005	Hardcopy 1:250000
4.9	Forest delineation map from July 1936 "Boschareaalkaart Dienstkring Tapanoeli"	National Archive, 1936	Softcopy 1: 500 000
4.10	Forest Boundary of Dolok Sibual-buali	BKSDA	Digital Vector
<b>5 Tenure</b>			
5.1	Land Tenure in District South Tapanuli, North Sumatra	BPN, 2005	Digital Vector 1:50,000
5.2	Land Tenure in District Central Tapanuli, North Sumatra	BPN, 2006	Digital Vector 1:50,000
5.3	Land Tenure in District North Tapanuli, North Sumatra	BPN, 2007	Digital Vector 1:50,000
5.4	RTRW Sumatra (Draft)	Bappeda Central Tapanuli	Softcopy 1: 1.000.000
<b>6 GPS Data</b>			
6.1	Sample points for land use	ICRAF, 2006 & 2007	Digital Vector Na
6.2	Market location	ICRAF, 2006 & 2007	Digital Vector Na
6.3	Villages location	ICRAF, 2006 & 2007	Digital Vector Na

## Appendix 2 Maps of Batang Toru produced.

NO	CATEGORY/NAME	FORMAT	SCALE/ RESOLUTION
1	Landcover Map 2000's of Batang Toru area	Digital raster	Eq. 1:100,000
2	Landcover Map 2005 of Batang Toru area	Digital raster	Eq. 1:100,000
3	Conservation and Livelihood Index Map	Digital raster	Eq. 1:100,000

### Appendix 3 Conservation & Livelihoods Index (C & L Index).

$C \& L \text{ Index} = \text{Ecological index} + \text{External environmental threat} - \text{Livelihoods index} - \text{External economic drivers}$ , where:

- *Ecological index* is based on a site's potential orangutan habitat value (delineated by Conservation International (CI)) combined with present land use/cover maps;
- *External environmental threats* are identified as logging concession, land conversion (primarily by Nias migrants), planned gold mining, unstable tenurial conditions (based on results of scoping studies and zoning maps);
- *Livelihoods index* is formulated as a combination of the valuation of current land cover/uses and market access (derived from road access);
- *External economic driver* considered here is the population density in the surrounding area (at the subdistrict level)

Using spatial analysis, *C & L Index* is calculated by overlaying different map layers described above and the final map is smoothed over 0.5 km radius. The *C & L Index* map is proposed to be a base map for negotiation among stakeholders.

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52. Towards Towards community-driven conservation in southwest China: Reconciling state and local perceptions.
53. Biofuels in China: An Analysis of the Opportunities and Challenges of *Jatropha curcas* in Southwest China.
54. *Jatropha curcas* biodiesel production in Kenya: Economics and potential value chain development for smallholder farmers
55. Livelihoods and Forest Resources in Aceh and Nias for a Sustainable Forest Resource Management and Economic Progress.
56. Agroforestry on the interface of Orangutan Conservation and Sustainable Livelihoods in Batang Toru, North Sumatra.

## 2008

57. Assessing Hydrological Situation of Kapuas Hulu Basin, Kapuas Hulu Regency, West Kalimantan.
58. Assessing the Hydrological Situation of Talau Watershed, Belu Regency, East Nusa Tenggara.
59. Kajian Kondisi Hidrologis DAS Talau, Kabupaten Belu, Nusa Tenggara Timur.
60. Kajian Kondisi Hidrologis DAS Kapuas Hulu, Kabupaten Kapuas Hulu, Kalimantan Barat.

## Who we are

The World Agroforestry Centre is the international leader in the science and practice of integrating 'working trees' on small farms and in rural landscapes. We have invigorated the ancient practice of growing trees on farms, using innovative science for development to transform lives and landscapes.

## Our vision

Our Vision is an 'Agroforestry Transformation' in the developing world resulting in a massive increase in the use of working trees on working landscapes by smallholder rural households that helps ensure security in food, nutrition, income, health, shelter and energy and a regenerated environment.

## Our mission

Our mission is to advance the science and practice of agroforestry to help realize an 'Agroforestry Transformation' throughout the developing world.



A Future Harvest Centre supported by the CGIAR



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