Chapter 1
FOREST RESOURCE ACCOUNTS AND TRADE MODEL

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Contents

1.INTRODUCTION

In Agenda 21, the action program adopted at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, it is explicitly stated that all members should develop systems for integrated environmental and economic accounting. The UN, through its statistical secretariat, the United Nations Statistical Division (UNSD), sets the standards of the System of National Accounts (SNA), using a satellite system to the SNA called the System of integrated Environmental and Economic Accounts (SEEA). The purpose of the SEEA is to show the impacts of economic activities on the natural environment.

The SEEA consists of several parts including both physical and monetary accounts. The first step is to link environmental data, expressed in physical units, with the national accounting system. The second step is making monetary accounts based on the physical accounts, in order to evaluate the impacts in economic terms. This would mean to estimate, for example, the costs of damage caused by pollution emissions. Furthermore, an accounting system entails that data compilation is made in terms of balanced accounts.

A detailed study of natural resource accounts was made in Nordic countries and western European countries. The development of natural resource accounts started in Norway as early as the 1970s. Since Nordic countries have large forested areas and produce a significant output of forest products, forest resource accounts are one of main fields of study available there from early on. The theme of forest resources is still a crucial theme in natural resource accounting even now.

The purpose of this paper is to consider the significance of forest resource accounts within the trade model. In order to explain it, we are mainly concerned with two concepts. One is forest resource accounts; the other is land accounts.

2.GENERAL STRUCTURE OF FOREST RESOURCE ACCOUNTS

What is forest resource accounting? In brief, it can be defined as a consistent accounting framework used to adjust forest-related resource and environmental information. Figure 1 represents the placement of each component of a forest account.

Forest resource accounts include four components: (1) forest accounts, (2) forestland accounts, (3) forest product accounts and (4) forest management accounts.Forest accounts represent the initial stock, flow over time, and final stock of trees growing in forests in terms of the tree volume. What should be noted is that the increase and decrease of tree volume is caused, not only by tree growth, but also by changes of the forestland area. In order to solve this problem, we can adopt forestland accounts.

Forest product accounts use weight, volume, or other physical measurements to describe the process of the varieties of use from raw logs to waste. Forest resource accounts include two accounts: the forest sector/product balance table and the forest mass balance table. When we combine forest accounts and forest product accounts into one united account, we can describe

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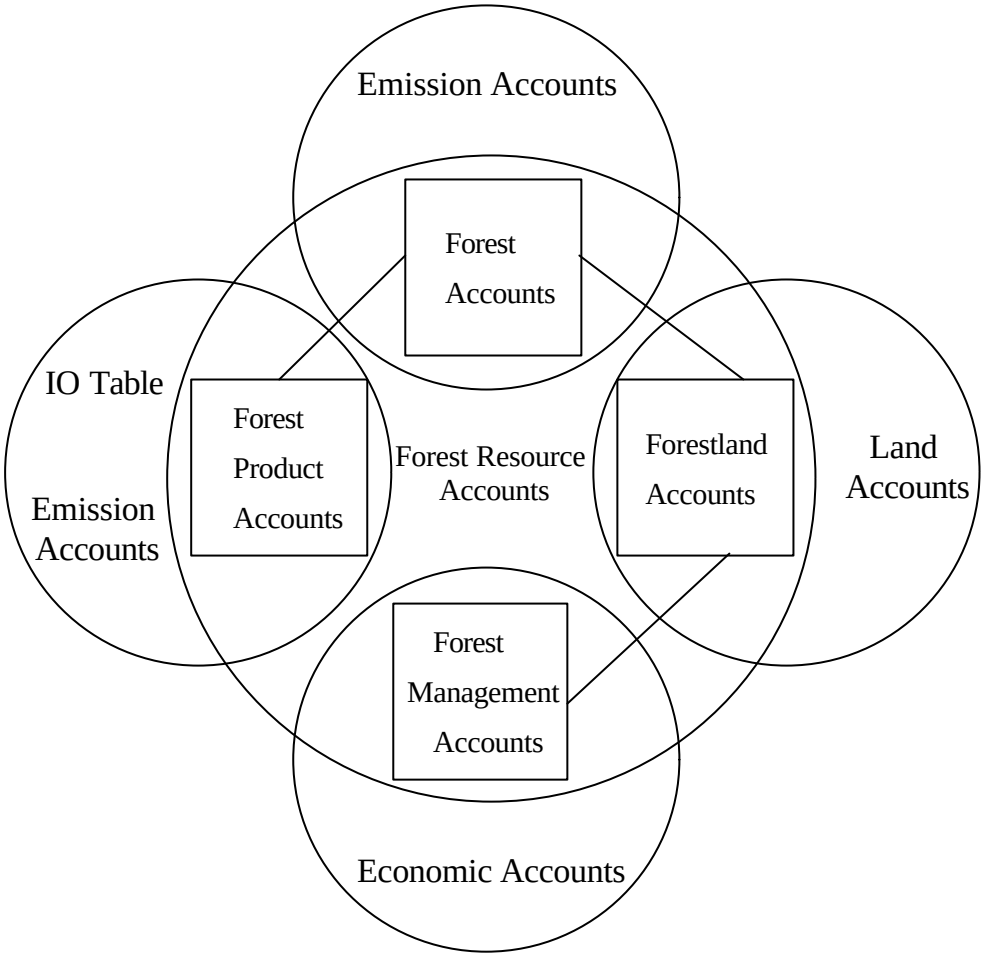

Figure 1. The Structure of Forest Resource Accounts

consistent systems from forest growth to the abandonment of wood residues.

Forest management accounts use monetary terms to show the flow of funds used in managing forests. Various monetary flows, such as subsidies, taxes and investments, are described in these accounts. All of the monetary flows represented in these accounts are real money which are transacted in actual markets.

Within forest resource accounts, the forestland accounts serve to directly link forest accounts with forest management accounts, and provide for their consistency. Inputs and outputs for forest management necessarily reflect the current state of the forest through forestland. In these systems, the most difficult challenge is linking forest accounts with forest management accounts, because it means linking land accounts and economic accounts, that is, physical accounts and monetary accounts. In order to construct forestland accounts, it is appropriate to utilize GIS (Geographic Information Systems) or LIS (Land Information Systems).

3.THE SIGNIFICANCE OF FOREST RESOURCE ACCOUNTS IN THE TRADE MODEL

3-1. Problems involved with the Trade Model

When we analyze the timber trade problem and gain some insight, we apply quantitative methods to frequently. Indeed, the quantitative model is effectual for the trade problem, because in many cases we can find commodity markets that measure quantity. But once we try to think about the linkages between trade and the environment, we will see there are various limits to the quantitative model.

One of the limits is the problem of data availability. We have relatively abundant data about economic markets. But data showing the relationship between the economy and the natural environment are hardly ever included. As the natural environment has been placed out of the

market's interests that pay attention to only economic profits until quite recently, data that represent linkages between economy and the natural environment have scarcely been collected.

The same may be said of applying quantitative methods to forest problems. Unlike other industrial sectors, we have been taking notice of the linkages in the forestry sector comparatively early. But we do not have as much useful data available as before. This is the reason we face the difficulty of data-collecting immediately, when we try to apply quantitative models to forestry problems.

3-2. Data Availability in the Forest Sector in Japan

I would like to focus attention on the following three points. (a) Data for non-timber use and recreational use are not as available as data for timber use. (b) Governments have not gathered data representing the linkages between forest resources and forest management. (c) In Japan, forest inventories were conducted only twice; in 1961 and 1966, and their quality and comparability are very poor.

To put it another way, we can describe it as a poverty of forest stock statistics that are closely related to the linkages between the economy and the natural environment in the forest sector.

These problems are applied not only to Japan. What is true for forest sector data in Japan is true to a considerable extent for other countries as well. The problem of poor data availability is serious, especially after analyzing timber issues in developing countries.

When we discuss the lack of data internationally, it is useful to refer to the "International Statistics Source". Though the "International Statistics Source" is the book that examines international comparability of statistical data by field, we think we can infer actual conditions in each country.

This book has 46 rough fields, which include four forest-related fields : construction, environment, forestry and land. They have more detailed fields as follows: (a) Construction: earnings, employment, industry, materials, prices and production; (b) Environment (related to forestry): damage, forest cover, wood area, ownership, production and trade in forest industry products; , (c) Forestry: consumption, damage, employment, financial accounts, holdings/wooded area, industry, investment, prices and production; (d) Land: agriculture, forestry, land area and land use.

We would like to emphasize two points of view. First, statistics on environment and land is generally poorer than industrial statistics such as construction and forestry. Second, in European countries they have comparatively more statistics on the environment and land than other countries. We can say that progress of natural resource accounting in European countries is a major trend.

3-3. Use of Forest Resource Accounts in the Trade Model

So far, we have seen the difficulties with the trade model. We think that forest resource accounts resolve these problems to some degree, because forest resource accounts supplement the lack of data and offer consistent environmental data to contrast the trade model, as mentioned chapter 2.

Then if we could get accurate statistical data, how could we apply the framework of forest resource accounts to the trade model?

One answer is simply defining forest resource accounts as consistent data sources for the trade model. This seems very simple, but it's important. We have hardly had any consistent environment statistics that we can utilize in the trade model yet. We have referred to this repeatedly.

Another answer is constructing international forest resource accounts. The concept of international forest resource accounts is linking forest resource accounts in some regions. If we succeeded in constructing these accounts, the linkage between forest products trade and the natural environment can be well drawn. When we think about international forest resource accounts, it is useful for us to refer to the CSEEA as a Global Accounting Matrix (Ariyoshi, 1997). CSEEA is a Complete System for integrated Environmental and Economic Accounting that is an extension of the SEEA (United Nations, 1993) with the Social Accounting Matrix (SAM) and a detailed rest-of-the-world account. The CSEEA is also an extended form of the NAMEA (de Haan and Keuning, 1996) with a full balance sheet and a detailed rest-of-the-world account.

However, the plan of the international forest resource accounts may be too grand for us

presently. We have just arrived at the beginning of constructing forest resource accounts at last. In the first place, it is appropriate to aim for a consistent data source.

4.FOREST ACCOUNTS AND FOREST PRODUCT ACCOUNTS

4-1.Material Energy Balance Approach

A close study of natural resource accounts has been made in Nordic countries. The development of natural resource accounts started in Norway as early as the 1970s. The concept of these accounts is founded on the Material Energy Balance (MEB) approach.

The MEB approach is a resource and environmental evaluation method. It can represent the social utilization process of material and energy from extraction to abandonment. OECD countries have studied positively, and developed accounts on some themes, such as inland waters, forests, forest products, air pollution, energy and so on.

MEB is generally constructed from three accounts:

1) stock accounts
2) sector/commodity table
3) mass balance table

Stock accounts describe the level of physical stocks of various resources at the beginning and the end of a given accounting period. It compares each physical stock and shows the change. Sector/commodity tables trace the flow of physical resources and products from extraction to final use. Mass balance tables convert sector/commodity tables into common mass numbers that balance material inputs on one hand with material outputs, energy outputs and environmental discharges on the other hand.

Since Nordic countries have large forested areas and produce significant outputs of forest products, forest resource accounts are a major field. At first, Sweden took the initiative in this field. Nowadays, in Finland they eagerly study this approach, because they have abundant forest sector statistics. Some work has also been done in Japan.

4-2.The Structure of Forest Accounts and Forest Product Accounts

The Norwegian model for forest resource accounts has the same components as the MEB approach. That is to say that it consists of the following three tables:

1) the forest balance table
2) the forest sector/product balance table
3) the forest mass balance table.

The concept of each table is basically derived from the MEB model. The forest balance table describes the level of physical stocks of forest resources at the beginning and the end of a given accounting period. It compares each physical forest resource stock and shows the change. The forest sector/product balance table traces the flow of physical forest resources and products from extraction to final use via forest processing sectors. The forest mass balance table converts forest sector/product balance tables into common mass numbers that balance material inputs with material outputs, energy outputs and environmental discharges.

In the framework of figure 1, the forest balance table corresponds to forest accounts. Both the forest sector/product balance table and the forest mass balance table are included in forest product accounts. Concrete examples are covered in the rest of this chapter.

Table 1. Physical Sector Commodity Table in Indonesia (1990)

		Industrial round wood (1000CUM)	Firewood (1000CUM)	Charcoal (1000CUM)	Other forest (1000CUM)	Sawnwood (1000CUM)	Board (1000CUM)	Pulp (1000CUM)	Paper (1000CUM)	Paper recycled (1000CUM)
Removal		30970	50025							1715
Import		393		0		37	21	1152	799	152
Export			9684	703		332	6562	349	643	183
Change in Stocks										
Total Primary Supply		31362	40341	703	0	295	6541	803	156	1684
(Wood-Processing Sector)										
1 Sawmill Industry	(I)	5350				26				
	(O)					3032				
2 Charcoal Industry	(I)	1407		0						
	(O)			973						
3 Other forest products	(I)	0							4	
	(O)									
4 Board Industry	(I)	14140				24	65		6	
	(O)						7988			
5 Pulp Industry	(I)	122				2	0	8	58	221
	(O)							132		
6 Paper Industry	(I)					3	0	1832	57	1392
	(O)								2954	
Total Input	(I)	21020	0	0	0	56	65	1840	126	1613
Total Secondary Supply	(O)	0	0	973	0	3032	7988	132	2954	0
(Final Demand for wood)										
1 Agriculture	(I)	158				0	0	0	19	
2 Livestock	(I)	103				0			0	
3 Fishery	(I)	67	1138			11			0	
4 Sugar	(I)	13	881						7	
5 Tabacco	(I)								566	
6 Apparel	(I)					0	10		11	
7 Furniture	(I)	533				429	106		0	
8 Paper products	(I)						0		1563	70
9 Medicine	(I)	0							14	
10 Rubber	(I)								0	
11 Ceramic	(I)		1280			3			79	
12 Ship Building	(I)	29				67	1		0	
13 Automobile/Vehicle	(I)					36	3		0	
14 Moulding	(I)	71				610	8		0	
15 Wood & cork products	(I)	27	1141			89			1	
16 Other manufucturing	(I)	120	82	0		46	19	0	3190	
17 Construction	(I)	6527				2320	2819		219	
18 Trade, rest & hotel	(I)	1	1448	2					492	
19 Service & other sectors	(I)	67	13	23		16	8		1242	
20 Household	(I)	1	37789	1256						
Total		7715	43772	1281	0	3630	2974	0	8062	70
Total Demand		28736	43772	1281	0	3686	3039	1840	8187	1683
Total Supply		31362	40341	271	0	2738	1448	935	3109	1684
Errors & Leakages		2627	3430	1011	0	948	1591	905	5078	0

Source : La Ode Syafiuddin et al. "Mass Balance Table of Wood for Indonesia",Koike K. and S. Fujisaki ed." Forest Resource Accounting – The Nordic Experience and Asian Experiments", Institute of Developing Economies, 1997, 250pp, p125-143 (modified)

3.Forest Sector/Product Balance Table in Southeast Asian Countries

First of all, let us consider the forest sector/product balance table. Tables 1, 2, and 3 indicate forest sector/product balance tables in Indonesia, the Philippines and Thailand. In the project of the Institute of Developing Economies (Japan), these tables were completed in a united effort between Japan and the statistical sections in each southeast Asian country.

Let us explain how to interpret the typical forest sector/product balance table in Table 2.

Table 2. Physical Sector Commodity Table in Philippines (1990)

		Logs (1000CUM)	Fuelwood (1000CUM)	Charcoal (1000CUM)	Residues (1000CUM)	Lumber (1000CUM)	Plywood / Veneer (1000CUM)	Pulp (ton)	Paper (ton)	Paperboard & Others (ton)	Waste Paper (ton)
Removal		8155	28984								102332
Import		381				4	4	67000	26000	228653	264000
Export		51	0	1		77	223	10000	4000	6305	
Change in Stocks		389	34	2		58	95	-9000	-30000	-34000	-8453
Total Primary Supply		8874	29018	1		-15	-124	48000	-8000	188348	357879
(Wood-Processing Sector)											
1 Sawmill Industry	(I)	6816	1151		822						
	(O)		2469		793	4210					
2 Fuelwood products	(I)		26485								
	(O)		26485								
3 Charcoal Industry	(I)		3851								
	(O)			1926							
4 Veneer/Plywood	(I)	1123	206		16						
	(O)		207		143		596				
5 Pulp Industry	(I)	531	275		99			24342			356238
	(O)		275					446739			
6 Paper Industry	(I)							186045			
	(O)								194000		
7 Paperboard Industry	(I)							260694			
	(O)									271840	
Total Input to WP sector		8470	31968	0	937	0	0	471081	0	0	356238
Total Secondary Supply		0	29436	1926	936	4210	596	446739	194000	271840	0
(Final Demand for wood)											
1 Agriculture	(I)					91	6		1950	9820	
2 Food manufacturing	(I)		105	96		3	0		19565	156453	
3 Mining, construction	(I)	376				1653	184		2751	13854	
4 Trade, transport	(I)	0				101	89		15723	55879	
5 Publishing, printing	(I)					0			100113	88953	
6 Other manufucturing	(I)	0	2048			29	3		19782	70308	
7 Furniture & fixtures	(I)					600	58				
8 Millworks, miscellaneou	(I)					1462	64				
9 Services & commerce	(I)	28	1407	289		160	8		9504	47850	985
10 Government services	(I)					4	1		15269	13567	656
11 Household	(I)		22926	1550		90	59		2123	3504	
Total Input to FD		404	26486	1935	0	4193	472	0	186780	460188	1641
Total Demand		8874	58454	1935	937	4193	472	471081	186780	460188	357879
Total Supply		8874	58454	1927	936	4195	472	494739	186000	460188	357879
Errors & Leakages		0	0	8	1	2	0	23658	780	0	0

Source : Rapera C.L. "Environmental Accounting for the Forest and Timber Resources : The case of the Philippines", Koike K. and S. Fujisaki ed." Forest Resource Accounting – The Nordic Experience and Asian Experiments", Institute of Developing Economies, 1997, 250pp, p27-124 (modified)

Each row shows a sector. The wood processing sectors have seven sectors ranging from the sawmill industry to the paperboard industry. The other sectors, which are called “the final demand for wood” have 11 sectors ranging from the agricultural sector to the household sector. Four rows from the top represent removal, that is, cutting the forest, importing, exporting and changes in stocks, respectively. The total primary supply is the consequence of balancing them. The notations “I ” and “O” represent the inputs and outputs of each sector.

Each column shows commodities. There are 10 commodities in Table 2 ranging from logs to waste paper. The unit of commodities in Table 2 is converted into cubic meters and metric tonnes.

Table 3. Physical Sector Commodity Table in Thailand (1990)

		Industrial round wood (1000CUM)	Firewood (1000CUM)	Charcoal (1000CUM)	Other forest products (ton)	Sawnwood (1000CUM)	Board (ton)	Pulp (ton)	Paper (ton)	Paper recycled (ton)
Removal		524			308063					
Import		2313	2575	152	16453	1494	64906	169225	361421	214064
Export		0	1	135	598	49	7925	1900	48518	
Change in Stocks			0							
Total Primary Supply		2837	2576	16	323918	1445	56981	167325	312903	214064
(Wood-Processing Sector)										
1 Sawmill Industry	(I)	2665	24							
	(O)					2132				
2 Charcoal Industry	(I)	65	2407			1				
	(O)			2473						
3 Other forest products	(I)					108				
	(O)									
4 Board Industry	(I)									
	(O)						94719			
5 Pulp Industry	(I)	0			46160					136175
	(O)							159148		
6 Paper Industry	(I)							326473		537553
	(O)								794272	459664
Total Input	(I)	2730	2431	0	46160	109	0	326473	0	673728
Total Secondary Supply	(O)	0	0	2473	0	2132	94719	159148	794272	459604
(Final Demand for wood)										
1 Agriculture	(I)	0	5	108	10019	2	188			
2 Mining & Quarrying	(I)	0			23	0	29		210	
3 Slaughtering	(I)		9	191					737	
4 Sugar	(I)		4			0	103			
5 Tabacco	(I)				156		1054		61949	
6 Apparel	(I)						3226		17472	
7 Furniture	(I)	1			69211	908	3282			
8 Paper products	(I)						2627		195186	
9 Printing	(I)						1859		192502	
10 Medicine	(I)		1		6305		2322		16910	
11 Rubber	(I)		12			0	343		2	
12 Ceramic	(I)		3		36	1	164		831	
13 Communication	(I)						757		394	
14 Ship Building	(I)					5	102			
15 Automobile	(I)					68	2210		2671	
16 Other manufacturing	(I)				12949	66	1750		56285	
17 Construction	(I)	12	2	37	2513	2043	1612		3732	
18 Civil Engineering	(I)					1	1566		12190	
19 Commerce	(I)					49	6465		11248	
20 Restaurant	(I)		13	278	77930	0	133		1264	
21 Financial	(I)						9897		46718	
22 Other	(I)	92	8	136	93673	313	89147		446585	
23 Government	(I)					0	3564		33906	
24 Household	(I)		88	1739	4943	12	19300		6383	
Total		107	145	2490	277758	3468	151700	0	1107175	0
Total Demand		2837	2576	2490	323918	3577	151700	326473	1107175	673728
Total Supply		2837	2576	2490	323918	3577	151700	326473	1107175	673728
Errors & Leakages		0	0	0	0	0	0	0	0	0

Source : Damrongsak Chindakul et al. "Environmental and Natural Resource Accounting : The case of the Forest Accounting in Thailand", Koike K. and S. Fujisaki ed." Forest Resource Accounting – The Nordic Experience and Asian Experiments", Institute of Developing Economies, 1997, 250pp, p144-172 (modified)

Table 4. Mass Balance Table in Indonesia (1990)

(unit: 1000ton)

		Logs	Sawnwood	Charcoal	Particle board	Pulp	Paper	Paper recycled	Residuals	By product	Fuel	Emission	Transfer	Bads	Total
1. Sawmill Industry	(I)	4440	21												4461
	(O)		2517						230	208	581	214	298	414	4461
2. Charcoal Industry	(I)	873													873
	(O)			603								135	135		873
3. Board Industry	(I)	10888	17		47		4								10956
	(O)				6149				38	379	3769	534	1	87	10956
4. Pulp Industry	(I)	40				3	19	73							136
	(O)					44						92			136
5. Paper Industry	(I)					605	19	459							1084
	(O)						975		5	101		3			1084

Source : La Ode Syafiuddin et al. "Mass Balance Table of Wood for Indonesia",Koike K. and S. Fujisaki ed." Forest Resource Accounting – The Nordic Experience and Asian Experiments", Institute of Developing Economies, 1997, 250pp, p125-143 (modified)

Table 5. Mass Balance Table in Philippines (1990)

(unit: 1000ton, bone dry weight)

		Logs	Sawnwood	Fuelwood	Charcoal	Plywood / Veneer	Pulp	Paper	Paper recycled	Residuals	Fuel	Emission	Transfer	Bads	Total
1. Sawmill Industry	(I)	3197								13					3210
	(O)		1975	404	39					26	540	47	175	5	3211
2. Fuelwood products	(I)			12422											12422
	(O)			12422											12422
3. Charcoal Industry	(I)			1806											1806
	(O)				967							840			1807
4. Board Industry	(I)	479													479
	(O)			1		335				54	88		1		479
5. Pulp Industry	(I)	172								34					206
	(O)						110				93	2			205
6. Paper Industry	(I)						55								55
	(O)							194							194
7. Paperboard Industry	(I)						55								55
	(O)								272						272

Source : Rapera C.L. "Environmental Accounting for the Forest and Timber Resources : The case of the Philippines", Koike K. and S. Fujisaki ed." Forest Resource Accounting – The Nordic Experience and Asian Experiments", Institute of Developing Economies, 1997, 250pp, p27-124 (modified)

Table 6. Mass Balance Table in Thailand (1990)

(unit: 1,000ton)

		Industrial round wood	Sawnwood	Firewood	Charcoal	Plywood / Veneer	Fibre board	Particle board	Pulp	Paper	Paper recycled	Residuals	Fuel	Air	Water	Soil	Total
1. Sawmill Industry	(I)	1739															1739
	(O)		1057										524	17		141	1739
2. Charcoal Industry	(I)			1101													1101
	(O)				413								220	358		110	1101
3. Plywood/ Veneer	(I)	295															295
	(O)					147							124	9		15	295
4. Fibre Board Industry	(I)	209															209
	(O)						160						36	13			209
5. Particle Board	(I)											346					346
	(O)							242						69		35	346
6. Mechanical Pulp	(I)																0
	(O)																0
7. Chemical Pulp	(I)	180										182					362
	(O)								159					19	157	27	362
8. Paper Industry	(I)								326		652						978
	(O)									877				14	61	26	978

Source : Damrongsak Chindakul et al. "Environmental and Natural Resource Accounting : The case of the Forest Accounting in Thailand", Koike K. and S. Fujisaki ed." Forest Resource Accounting – The Nordic Experience and Asian Experiments", Institute of Developing Economies, 1997, 250pp, p144-172 (modified)

We can interpret Table 2 as follows:

The amount of timber felled from domestic forests was 8,155,000 cubic meters (CUM) with 51,000 CUM exported. They imported 381,000 CUM from foreign countries. The change in stock was 389,000 CUM. Lastly, 8,874,000 CUM were supplied to other domestic sectors as the total primary supply. The destination of their logs includes 6,816,000 CUM of wood to the sawmill industry, 1,123,000 CUM to the board industry, 531,000 CUM to the pulp industry and 404,000 into other sectors.

Inputs to the sawmill industry consisted of 1,151,000 CUM for fuelwood and 822,000 CUM excluding logs. Their inputs make the sawmill industry output 4,210,000 CUM in lumber with 2,469,000 CUM in fiuelwood and 2,469,000 CUM in residues.

Judging from the above, we can see that the sum of each column theoretically balances to zero. However, since the data in this table was collected from different sources which are not necessarily consistent, errors are generally unavoidable in the sector/commodity table.

4-4. Forest Mass Balance Table in Southeast Asian Countries

In this paragraph, we examine the forest mass balance table. Tables 4, 5, and 6 indicate the forest mass balance tables in Indonesia, the Philippines and Thailand. These tables are based on the forest sector/product balance table. That is, the forest mass balance table converts the forest sector/product balance table into common mass numbers that balance material inputs with material outputs, energy outputs and environmental discharges.

How to interpret the forest mass balance table in Table 6:

Each row shows sectors that include the five sectors from the sawmill industry to the paper industry. The notations "I" and "O" represent the inputs and outputs of each sector. These are similar to the forest sector/product balance table.

Each column shows commodity and environmental discharges. There are 10 commodities ranging from logs to fuel and 3 environmental discharges ranging from emissions to bads in Table 4. The units of all commodities in Table 4 are converted into metric tonnes.

Theoretically, the sum of each row balances. For example, let us explain by using the sawmill industry in Indonesia. According to Table 4, inputs into the sawmill industry were 4,440,000 tonnes of logs and 21,000 tonnes of sawn wood. Outputs from the sawmill industry were 2,517,000 tonnes with sawn woods as the main products, 214,000 tonnes in emissions and so forth. We can see that the sum of each column balances theoretically to zero. But in Table 5, in the case of the Philippines, two columns of totals regarding the paper industry and the paperboard industry are unbalanced. The reason is that only in the case of the Philippines accounts, everything except for paper is measured by bone dry weight.

5.LAND ACCOUNTS

5-1. Importance of Land Accounts

One need not go on repeatedly into the importance of land as regards its importance in carrying on our daily socio-economic activities. Especially in a discussion of forests, the importance of land cannot be disregarded, because forest cannot exist without the land.

In the developing countries as well, many problems considered environmental, such as deforestation and soil erosion, are closely linked to the land. But the critical lack of statistical information on land is a serious impediment to solving these problems.

In recent years, we are seeing attempts at solutions by employing the rapidly developing remote- sensing technologies. These involve using data from satellite imagery and other sources to continuously observe changes in developing countries' land cover and land use. But it is evident that using only aerial photographs makes it difficult to determine the complex causes of deforestation and other phenomena.

Land use is dependent on natural conditions and the socio-economic conditions of each geographical region. And land cover is determined by the impacts of land use and based on the land's natural conditions. The state of the land in any one region is therefore determined by a combination of its natural and socio-economic conditions. This shows the great importance of starting by building a statistical system that relates these various kinds of information organically and continues to collect information, while maintaining consistency. In doing so, the concept of

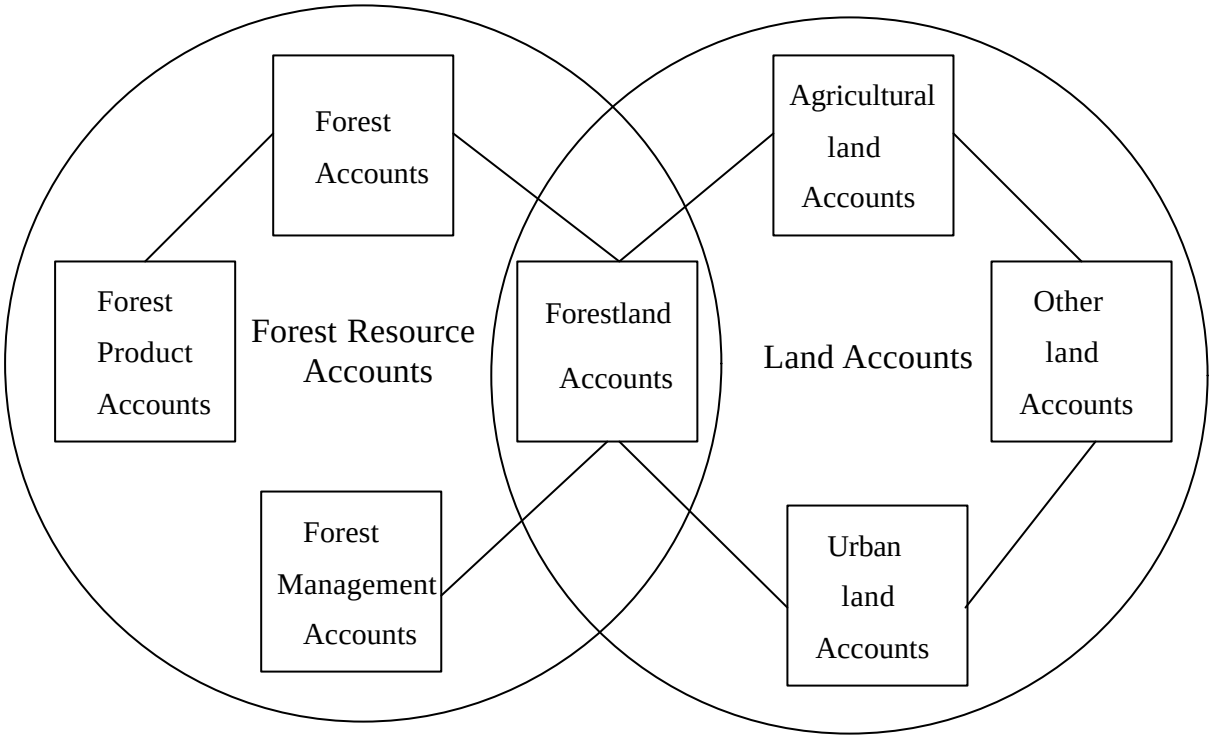

Figure 2. The Linkage between Forest Resource Accounts and Land Accounts

accounts is useful.

5-2. Two Perspectives for Forestland

Roughly speaking, there are two ways to perceive forests, depending on the point of view. One is to describe everything related to forests by looking down from above. This means grasping the forest from the forestry sector's point of view. The other is to see forests from the ground up, which sees them as one form of land use among others, such as agriculture and residential tracts. This means grasping forests from the point of view of total land uses.

As shown in Figure 2, forestland accounts can be seen as accounts that link two systems of forest resource accounts and land accounts. When we look down at forests from above, we put forestland accounts in forest accounts. On the other hand, we put it in land accounts.

We have already explained forestland accounts in forest accounts in chapter 2. Now let us proceed to an explanation of land accounts.

Land accounts are composed of not only forest land accounts, but also agricultural accounts and accounts for other land uses that includes residential land accounts, accounts for unused land, and so on. Each type of land accounts is meant to describe the state of and changes in land. If the state of land is its stock, and the changes among various states constitute flow, it is possible to put it down in the form of an account. Of the various kinds of land accounts, it is the forestland accounts that divides the forestland portion from the land accounts for a number of different uses.

5-3. Forestland Accounts

Within forest resource accounts, the forestland accounts serve to directly link forest accounts with forest management accounts, and provide for their consistency. Inputs and outputs for forest management necessarily reflect the current state of forests through forestland.

In most societies that property rights develop in, they have a delimitation for land and manage their land by cadastral??? parcel, that is, a continuous tract of land within which unique tenure interests are recognized. Namely, just one who has property rights for land can dispose of the land basically. That goes for forestland, too. In such a society, it is appropriate to construct forestland accounts based on land parcels.

Figure 3 indicates this concept graphically. Land tenure in the figure means one cadastral parcel

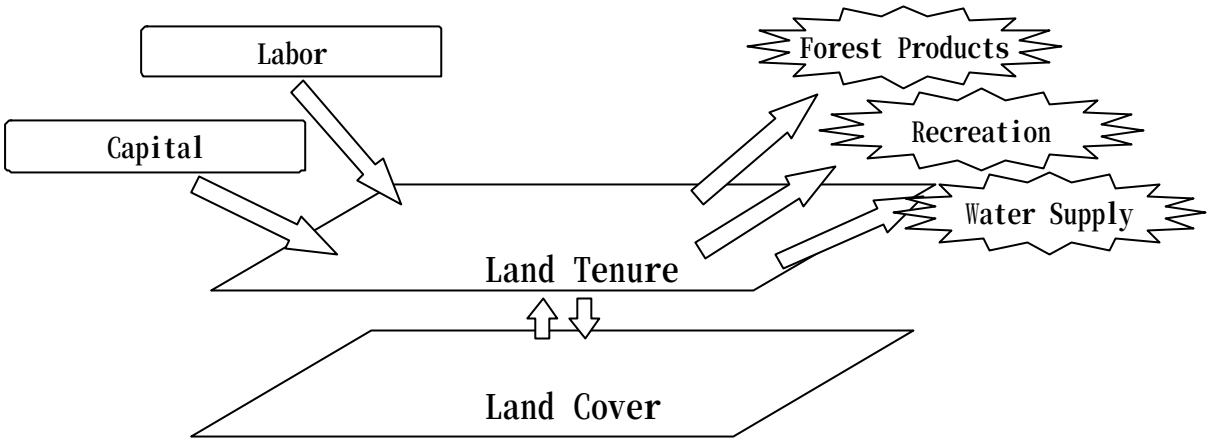

Figure 3. The Structure of Forestland Accounts

that has its own boundary. One who has property rights for this land decides how to manage his holding lands. He inputs some productive factor such as labor and capital. This will cause his land to output some fruits, such as forest products, water supply and recreational effects. Additionally, that will have some influence on the land cover as part of the natural environment.

In order to represent such forestland accounts, it is appropriate to apply Land Information System (LIS) or Geographic Information System (GIS) information. Actually, in northern European countries, such as Denmark, Sweden, Finland and so on, they have built and used cadastral and land registration systems based on LIS for whole lands. We may say that forestland accounts are included in their system. We may also think that forest inventory systems in France, Swiss, Canada and so forth have the possibility that they develop their forestland accounts.

So far we have outlined forestland accounts. However, in many cases of the developing countries it would be inappropriate to apply forestland accounts as mentioned above, because they don't establish definite boundaries of land. Although we can think about using group registration and so on, it would be difficult at the moment, except as part of an urban area. First of all it, is prohibitively expensive to construct forestland accounts from scratch. Accordingly, we shall leave it as it is for the future, turn to forestland accounts in land accounts that are built inexpensively than in forest resource accounts.

5-4. Land Accounts

Land accounts are composed of not only forest land accounts, but also agricultural accounts, urban land accounts and accounts for other land uses, including industrial land accounts, accounts for unused land and so on. Each type of land accounts is meant to describe the state of and changes to the land. So because we use land accounts, we are interested in the interaction among various land uses.

Land accounts have been developed mainly by western European countries, such as France, Germany and the U.K. with the support of EUROSTAT. They have systematized it as Land Use/Land Cover Accounting (LUCA). LUCA is an attempt to organize information bases for environmental integrated assessment purposes. Indicators derived from Land Cover inventories, as well as field data from monitoring networks (including biodiversity aspects), actual use and related socio-economic data are taken into consideration in the accounting

Figure 4 shows the general framework of land cover and land use accounts. Accounts comprise core accounts that represent changes in land cover and use, as well as supplementary accounts meant for certain purposes. The two main elements of supplementary accounts are pressures by human socio-economic activities and the natural potential of the land such as climate, flora and so on. These are ultimately connected through core accounts.

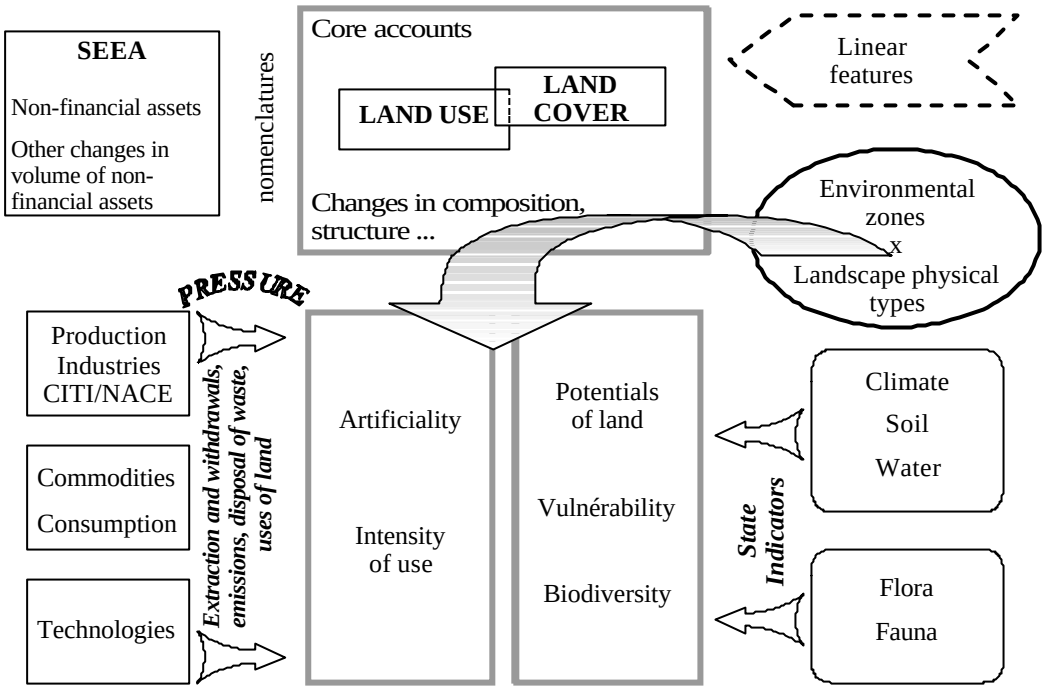

Figure 4. Framework of Land Use / Land Cover Accounts

Source: Weber J.L. "Landscape analysis and the assessment of causal links between anthropic pressure and the availability and vulnerability of natural resource in an accounting framework", the paper distributed at the Progress in Environment and Resource Accounting Approach - A principle to the Global Environmental Issues -, Matsue, 13-15 October, 1997, 62pp, p45-50

Core accounts provide basic information on the structure of and changes in land cover and land use. This information is brought together by land observation techniques such as remote sensing like satellite imagery and aerial photography. Other data sources are necessary to give a detailed account of actual land use affecting land cover. Fundamentally, accounts use data collected from either directly observed values (by remote sensing and the like) or sample plots (land use maps and the like) by extrapolating them onto larger geographical areas.

Let us explain our trial for building land accounts in a certain Japanese rural area.

Our test area is Kisuki town, Shimane Prefecture in Japan. This town has a population of more than 10,000 and is located in a typical rural area. We tried to construct land flow accounts for about 90 years in this area by using some topographical maps that also have the characteristics of a land use map. At the beginning, we built GIS data by comparing an 1899 topographical map with a 1990 topographical map (Okanishi M., 1999), then we constructed land flow accounts by using GIS.

Table 7 shows land flow accounts in the Japanese rural area from 1899 to 1990. The row indicates land use in 1899, and the column indicates that in 1990. So each section shows changes in land use from 1899 to 1990. Now we shall pick up just two points that we can see from the data in this table.

First we will consider changes in forest area. The forest area in this town decreased from 4,856 hectares to 4,748 hectares. As shown in Table 7, the change, in fact, is various. Namely, the forest area decreased in one place, but increased in another. And land use before the changes are also different respectively. We can understand that the paddy field is the most interactive with the forest. Table 8 accounts for areas cut down for 200m in width on both banks of rivers. This account shows paddy fields increased near rivers, contrary to Table 7.

The examples of land accounts discussed so far in this paper are all from the developed

Table 7. Land Flow Accounts in a certain Japanese Rural Area from 1899 to 1990

(unit : hectare)

1899 ＼ 1990	1. Forest	2. Paddy Field	3. Vegetable Field	4. Mulbery Field	5. Tea Plantation	6. Nursery	7. Orchard	8. Housing	9. Industrial	10. Gravel	11. River	12. Vacant	Error	Total
1. Forest	4146	392	94	62	0	0	0	52	27	8	9	2	64	4856
1.1 Coniferous	925	152	39	25			0	27	17	2	3	1	20	1213
1.2 Broadleaved	677	37	14	5				13	1		2		10	759
1.3 Mixed	2121	146	33	22				4		4	3	0	30	2363
1.4 No used	422	58	7	10				8	8	2	2		4	521
2. Paddy Field	264	465	48	18			3	72	8	8	8	2	2	898
3. Vegetable Field	112	47	10	14				17		3	2		4	210
4. Mulbery Field								2						2
8. Housing	85	61	17	16				74	1	0	2	0	0	257
11. River	54	28	4	1				6	0	14	31	1	11	149
Error	87	13	1	1				0	0	1	11			115
Total	4748	1007	174	111	0	0	3	224	36	35	63	4	82	6487

Table 8. Land Flow Accounts in a certain Japanese Rural Area from 1899 to 1990
(The case of 200m in wideth on both banks of rivers)

(unit : hectare)

1899 ＼ 1990	1. Forest	2. Paddy Field	3. Vegetable Field	4. Mulbery Field	5. Tea Plantation	6. Nursery	7. Orchard	8. Housing	9. Industrial	10. Gravel	11. River	12. Vacant	Error	Total
1. Forest	1199	138	54	23	0	0	0	29	4	8	9	1	16	1482
1.1 Coniferous	268	47	24	11				15	3	2	3	0	3	378
1.2 Broadleaved	226	15	11	4				5	1		2		6	271
1.3 Mixed	648	70	17	6				3		4	3	0	7	757
1.4 No used	57	6	2	2				6	0	2	2		0	76
2. Paddy Field	129	328	36	9			0	63	5	8	8	1	1	587
3. Vegetable Field	36	22	4	8				11		3	2		4	90
4. Mulbery Field								2					0	2
8. Housing	56	46	15	15				52	1	0	3	0	0	189
11. River	54	28	4	1				6	0	14	31	1	11	149
Error	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1474	561	113	56	0	0	0	164	10	34	52	2	32	2499

countries.

In consideration of the serious lack of statistical information on land, it seems extremely difficult to prepare land accounts in the developing countries, in contrast to the seriousness of the problem.

However, in recent years we have at last begun to see a way to surmount these difficulties through recent developments in remote sensing technologies. As with the United Nations Environment Programme's (UNEP) Global Resource Information Database (GRID) project, theInternational Geosphere-Biosphere Programme and the Human Dimensions of Global Environment Change Programme's (IGBP-HDP) Land-
Use and Land-Cover Change (LUCC) project, people are using satellite imagery and other remote-sensing data to continuously observe changes in the developing countries' land cover and land use.

But it is also clear that finding the causes of complex phenomena such as forest loss is difficult using only aerial photographs and satellite imagery. Land use depends on both

the land's natural conditions and a region's socioeconomic conditions. And land cover is determined by the impacts of land use, while it is at the same time based on the land's natural conditions.

In this way natural and socioeconomic conditions combine to determine the state of the land in any one region. It is therefore of the greatest importance to begin by building a statistical system that organically relates various kinds of information and amasses it, while maintaining consistency. The application of land accounts to developing countries can be conceived in this context.

6.CONCLUSION

So far, we discussed the significance of forest resource accounts within the trade model. We explained two concepts: forest resource accounts and land accounts. We said repeatedly that it is important to construct forest resource accounts as a consistent framework in order to consider the

relationship between the social economy and the natural environment.

It is obvious that we still face much difficulty in constructing that system. However, it may be more effecient to reconstruct positive social science for environmental problems.

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