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WHAT'S HAPPENING TO THE WORLD'S FOREST RESOURCES

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This paper discusses the current information base available on global forest resources. The focus includes: the extent of forest cover based on the most widely-used data base; the accuracy of this data base; other estimates of forest resources; the special case of tropical forests; the extent to which deforestation in the tropics is factored into the global forest resource estimates; and emerging patterns of demand and utilization of forests. The paper concludes with a brief discussion of what information is needed to obtain a more comprehensive assessment of forest resource status.

I. FOREST RESOURCES DATA BASE

When we mention forest resources, we refer to a multitude of goods and services: timber, biomass and carbon in a traditional production context; watershed protection, wildlife habitat, and germplasm banks in a nouveau environmental context. Because forests are a dynamic resource, fundamental questions by the forest user at a macro-level include: How much land area does it cover? How fast does it grow? How fast is it being utilized? How fast will it come back, once cut? How much biomass does it contain? How much carbon does it absorb and store, or release when burned? These questions rely on a similar data base, as one can observe from companion papers in this Symposium.

About 50% of the global forests are located in the tropics; the rest are found in extra-tropical latitudes to about 65° north and south, where the tree line appears due to the presence of the persistent cold air masses that prevent the balancing of heat budgets by tall vegetation (Figure 1).

There are two data bases from which one can determine the areal extent of forests throughout the world.^{1,2} The earlier work by Zon and Sparhawk is considered by many to be a valid data base, but it relies on less than adequate quantitative methods of assessment.³ The data base compiled by Reidar Persson,

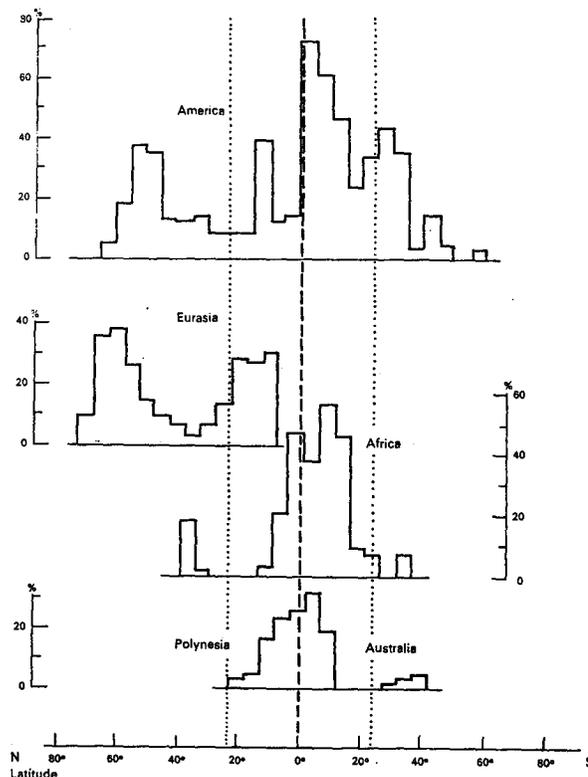


Figure 1. Distribution of forested area expressed as a percentage of total land area in 5° latitudinal zones of the continents (From A. Baumgartner, University of Munich, F.R.G.)

which was a continuation of the work begun in in the 1950's and 1960's by the Food and Agricultural Organization (FAO) of the United Nations towards a World Forest Inventory, is the most widely accepted of its kind. This inventory focused on all regions of the globe and was compiled from questionnaires sent to individual countries, personal visits and interviews by the author, and FAO progress reports. From Table 1, it is apparent that in relation

to total land area, the main concentrations of closed forest (land areas with tree crowns covering more than 20%) are found in North and South America, Europe and the USSR. Africa and Asia have small forest resources compared to total land area. In terms of accuracy of data, Persson himself concludes: 33% of the information was of poor quality; 46% was $\pm 10\%$ accurate; and 21% was $\pm 20\%$ accurate. The best quantitative data exists for the USSR and Europe ($\pm 10\%$ accurate); better data for North America, where half is $\pm 10\%$ and half $\pm 20\%$ accurate; and good data ($\pm 20\%$) for about one-third of the tropics, the remaining two-thirds being very inaccurate. With respect to real inventories of forest resources, Persson concludes that about 30-40% of the closed forests have adequate inventory information. The rest are merely guesses regarding nature and extent of the resource base. Given the fact that many countries have access to the latest quantitative remote sensing devices, it is problematic that detailed, quantitative inventories are available for such a small fraction of forests. Some countries in the tropics, for example, Brazil, the Philippines, Thailand, Costa Rica, Nigeria, Benin, Togo, Ghana, and some others, have used these monitoring systems; most others have not.⁵ FAO maintains a list of large scale forest inventories for most regions of the world.

II. TROPICAL FORESTS AND DEFORESTATION

A. CAUSES OF DEFORESTATION

Without a doubt, the hottest issue confronting the global community is deforestation in the tropics. The implications of this activity has been cited on numerous occasions to have serious repercussions for the global carbon dioxide balance,⁴ for local rainfall patterns,¹¹ for the welfare of human populations in those areas,^{5,6} especially with regard to the loss of options for more sustainable uses of forested lands.^{6,8} For example, the irreversible loss of genetic resources harbored in such forests -- the living banks upon which humans depend for their food, fiber and medicinal needs -- could have catastrophic effects on our long-term abilities to manage for production. The forcing functions, or agents of change, in the tropics are a highly disaggregated suite of activities: shifting cultivation; commercial logging operations; firewood gathering; cattle ranching; crop monocultures and tree plantations; road-building related to oil and mineral exploration; hydro-power development; and many other development activities. Some of these activities are more intensive in some areas than in others. Generalizations are difficult to make in most cases, but several recent studies have attempted such appraisals.^{5,7} It would appear, however, that little quantitative data is available on the nature and areal extent of

each of these activities on a systematic basis throughout the tropics.

For example, firewood consumption is one factor influencing deforestation in the tropics, but one which I will mention briefly to show the basic human dependence on forests. Firewood consumption is considered to be a noncommercial use of wood resources, with most being used for cooking and food processing. Table 3 demonstrates this dependence on firewood, the oldest fuel: In 67 countries with 41% of the world's population, firewood supplies 25% of local energy needs; in 61 countries with 38% of the world's population, firewood supplies 33% of the energy needs; and in 48 countries with 16% of the world's population more than 50% of all conventional energy needs are met by firewood.¹⁰

B. MITIGATION OF DEFORESTATION

Man-made forests are considered to be a viable alternative to deforestation in the tropics.¹² The ready availability of wood supplies from such plantation forests of fast-growing tree species could change the world wood balance in favor of the supply side. Such plantations, or tree farms, could take the pressure off virgin tropical forest to supply commercial and noncommercial demands.^{13,14} Although the projected planting rate of 0.5 million ha/yr will show a doubling of area in such plantations by the year 2000 (Table 2), the question is: will such a rate of growth meet the estimated demand?

C. PROJECTED LOSS OF TROPICAL FORESTS

A considerable amount of controversy centers around the rate of deforestation in the tropics. A major concern is the "net loss" term implicit in deforestation. Also, the degree of forest regrowth, or reforestation, following clearing is rarely factored into estimates. These questions of quantitative assessment are serious and appear aggravated by the fact that human institutions exhibit some difficulties in employing rapid, sequential sampling techniques such as remote sensing.

Recent estimates of deforestation can vary from 0.4 - 2% of the total area of the tropics per year. Again, it is implied that this estimate is a net loss of forest cover. Table 4 examines one of several existing projections of tropical deforestation.^{5,7,15} This scenario assumes for the worst case a deforestation rate of 20 million ha/yr; for the best case, about 5 million ha/yr. Again, the Persson data base is fundamental to these and other projections.

Table 1. World forested area by region, 1973².

	Forest Land	Closed Land	Open Wood-land	Total Land Area	Closed Forest (% of land area)
	Millions of hectares				Percent
North America	630	470	(176)	1,841	25
Central America	65	60	(2)	272	22
South America	730	530	(150)	1,760	30
Africa	800	190	(570)	2,970	6
Europe	170	140	29	474	30
U.S.S.R.	915	785	115	2,144	35
Asia	530	400	(60)	2,700	15
Pacific area	190	80	105	842	10
World	4,030	2,655	(1,200)	13,003	20

Table 2. Industrial plantations: Tropics and subtropics (millions of hectares)

Region	1975	1980 (projected)	2000 (projected)
Central and South America	2.8	4.1	10.7
Africa, south of the Sahara ^a	1	1.2	2.1
Asia and the Far East ^b	2.9	3.7	8.2

^a excluding South Africa^b from Pakistan east, excluding China(PRC), Mongolia and Japan

Source: FAO, Rome.

Table 3. Firewood consumption relative to commercial energy¹⁰

Region	Firewood as percent of total (firewood energy + commercial energy)					
	> 50%		> 25%		> 20%	
	Number of countries	Population (millions)	Number of countries	Population (millions)	Number of countries	Population (millions)
Africa	32	279	35	292	37	317
Asia	9	363	14	1095	15	1172
Latin America and the Caribbean	6	23.4	10	168	13	181
Oceania	1	30	2	3.2	2	3.2
Totals	48	668	61	1558	67	1674
Percent of world population (4.1 x 10 ⁸)		16.3		38		41

TABLE 4. PROJECTED LOSS OF CLOSED TROPICAL FORESTS BY THE YEAR 2000 (area in millions of hectares)

Region	Present Forest	Expected Loss	Possible Loss	Residual
Latin America	590	106	201	283
Asia & Australia	300	72	136	92
Africa	210	22	20	168
Total	1100	200	357	543

Source: U.S. Department of State (1980)

Expected Loss = forest expected to disappear by 2000 under best case assumptions

Possible Loss = additional forest loss by year 2000 under worst case assumptions

Residual = forest remaining in 2000 if worst case scenario is realized

Table 5. Estimates of world forest resources, 1978 and 2000.

	Closed Forest (millions of hectares)		Growing Stock (billions cu m overbark)	
	1978	2000	1978	2000
U.S.S.R.	785	775	79	77
Europe	140	150	15	13
North America	470	464	58	55
Japan, Australia, New Zealand	69	68	4	4
Subtotal	1,464	1,457	156	149
Latin America	550	329	94	54
Africa	188	150	39	31
Asia and Pacific				
LDCs	361	181	38	19
Subtotal (LDCs)	1,099	660	171	104
Total (world)	2,563	2,117	327	253
			Growing Stock per Capita (cu m biomass)	
Industrial countries			142	114
LDCs			57	21
Global			76	40

Source: Global 2000 Report (1980)

Table 6. Global forest trends: Sedjo scenario^a

1. U.S. forest products trade balance shows deficit from 1950-1976
2. Geographic shift of global forest resource production from temperate to tropical zones
3. Increasing population influences greater use of nonindustrial wood
4. Rising real prices of fossil fuels exacerbate (3)
5. Developing nations need forest resources to support economic expansion
6. Growing worldwide demand for roundwood
7. Increased role for non-traditional producers as traditional N hemisphere producer regions decline
8. Slow shift from natural forests to plantations

^a Source: Roger Sedjo, Resources for the Future, Washington, D.C. (1981)Table 7. Global forest trends: Grainger scenario.^a

1. Shortfall predicted between world wood supply and demand: 40 million m³ (2000 AD); 3 billion m³ (2025 AD)
2. Supply side projections overly optimistic
3. U.S. forests in a confused state of affairs: management funds down; production cuts; 30% of forests out of production; new housing starts down; sawmills closing; regional dominance changing hands from West to Southeast; exports declining; net importer status
4. Canada's forests in poor health: 38% forests clearcut from 1974-78 replanted; 10% production forest inadequately stocked
5. Sweden's forests in bad shape: yearly deficit= 15-20 million m³; increasing mechanization has been detrimental to growing forests
6. Soviet Union in a major production slump, exports down
7. Europe - 50% self sufficient, but declining every year
8. Japan - 30% self-sufficient, but increasingly dependent on tropics for wood
9. Tropics are suffering a loss (not know if a "net" loss) of 10-20 million ha/yr of forested lands

^a Source: Alan Grainger, Commonwealth Forestry Institute, U.K. (1981)

III. EMERGING TRENDS IN GLOBAL FOREST RESOURCES

Recent projections of forest resources show a drastic decline in global forest area and a concurrent growth in demand for wood products (Table 5). Two additional scenarios predict very similar trends: a decreased stock of forest resources and an increased demand for roundwood (Tables 6,7), with the tropics emerging as perhaps a major force in the world wood marketplace.^{14,16} On the positive side, Roger Sedjo of Resources for the Future in Washington, D.C., believes that to meet the projected commercial wood demand of 2 billion m³ by the year 2000 it will require only 1 m³/ha of average annual production from each of the world's major forest areas. Industrial plantations, according to Sedjo, can now yield 15 m³/ha of roundwood per year. If pines are used, for example, the entire industrial roundwood requirements could be met by 100 million ha of plantations, or less than 4% of existing forest lands. This, of course, does not account for noncommercial wood needs, as discussed in the previous section. Firewood consumption by an ever-increasing global population has not been factored into such estimates. On the negative side, political considerations rarely seem to support supply enhancement of the wood resource base because of the continued support by most governments for growth-type economies.¹⁷ Such policies usually depend on old growth reserves, or virgin forest for needed capital and do not provide for reforestation. Also, biological problems with monocultures, especially in the tropics, the dependence on only a handful of tree species (pines and eucalypts, mostly) for plantation and reforestation activities, and the loss of forest germplasm in indigenous stands due to conversion of complex forests to simplified systems are receiving less than adequate attention by most agencies responsible for stewardship of the global forest resource base.^{6,7}

IV. WAYS TO IMPROVE THE FOREST RESOURCE INFORMATION BASE

The work of Persson, as well as any other study, indicates the need for an improved data base on global forest resources. The following points deserve priority attention:

1. Establishment of a forest resources data base that is compatible with the latest techniques in forest inventory assessment;
2. Establishment of a global monitoring system for forests at an operational level that builds upon the experimental satellite and other remote sensing systems in existence; such a dynamic system would feed into the forest resources data base;
3. Integration of use of forests in a land-capability classification system that accounts

for ecological and other constraints and provides alternatives to forest usage, if need be;

4. Improvement of the ground reference information base, especially for tropical forests, in a scientific-management/policy-making framework.

The bottom line in any discussion of the forest resource baseline is more accurate area estimates and more detailed inventories of particularly promising areas. Without reliable information from the scientific-management community, the appropriate planning decisions and economic forecasts about natural resources cannot be made.

V. CONCLUSIONS

Scientists must assume a larger burden of responsibility in policy making if the global community is to respond appropriately to the projected demands made on the forest resource base. Policy decisions will affect the outcome of events related to wood supply enhancement.

Quantitative data gathered by scientists can be used to influence such decisions by identifying constraints to forest usage and by providing alternatives. For example, the error term is significant with respect to estimates of areal extent of certain forests. Remote sensing appears to be an ideal arbitrator in this instance because of its dynamic, monitoring capabilities. By establishing a more accurate data base humans can better understand the forest resource base. Deforestation, as a particular example in this "pol-econ-ecologic" confrontation, denotes a net loss. But, it is difficult to determine without quantitative, sequential data from unit areas of habitat. Presently, the estimates of deforestation and regrowth of forests are imprecise and inaccurate. With better information about deforestation and reforestation, our levels of resolution from forester to planner to modelers and back again could improve our sensitivity to diverse human needs for forest resources, beyond timber supply and demand forecasts.

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AUTHOR BIOGRAPHICAL DATA

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Dr. Talbot was trained at the University of Southern California as an ecologist. He taught environmental sciences at the Universidad Nacional de Asuncion, Paraguay, 1976-77, and was a consulting ecologist to a large architecture-engineering firm in Philadelphia before joining the National Research Council in 1978. He is currently Staff Officer for the Committee on Selected Biological Problems in the Humid Tropics, and served on a previous Committee on Research Priorities in Tropical Biology in a similar capacity. His interests cover ecology and development in rural areas as well as the more classical ecological-evolutionary biology of vertebrates.