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Supplying Wood Products for More People - A Challenge to the Forest Industry

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SUPPLYING WOOD PRODUCTS FOR MORE PEOPLE — A CHALLENGE TO THE FOREST INDUSTRY

By

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A Note to Readers
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FOREWORD

The U. S. Plywood-Champion Papers Inc. lectures[1] for 1968-69 were given as a series of three separate but closely related lectures as follows:

Population and the Forest Industry
April 15, 1969

John A. Segur, Business Consultant. Formerly Vice President and Treasurer, Riegel Paper Corporation. Director of several corporations

World Forest Resources Tributary to the North American Sphere of Development
April 17, 1969

F. Bruce Lamb, Technical Director Forest Resources, U. S. Plywood-Champion Papers Inc.

Industrial Forest Land Management - Progress and Problems
April 22, 1969

Basil E. Allen, Director Woodlands Division, Union Camp Corporation

These lectures, although much different in subject material, all relate directly to problems of timber supply. They were given by three men with very different professional background and outlook.

Mr. Segur is a businessman, not a forester by education, but has long experience in business finance and management both in and out of forest industry. Presently an industry consultant, he has a broad and independent outlook and capacity to view industry situations both internally and externally to forestry.

Dr. Lamb has had over twenty-five years of international experience, mainly in South America but also world-wide, in forest resource investigation and development. He has worked with public agencies, governments, and for the last ten years with forest industry. Educated in forestry, his lecture deals with the increasingly important dimension of foreign wood supplies in relation to the United States and Canada.

Mr. Allen is a practicing forester in the South having thirty years of active forestry experience of increasing responsibility. He is active in many forestry

1 Made possible on a continuing annual basis, beginning in 1967, by an endowment to the Yale School of Forestry by the U.S. Plywood-Champion Papers Inc.

organizations. In his present capacity of Director of Woodlands for the Union Camp Corporation he has major responsibility for wood supply to a number of mills and for the management of a multi-million dollar investment in forest lands.

These three men each give a basic dimension to the collective title of the lectures: Supplying Wood Products for More People - a Challenge to the Forest Industry.

Kenneth P. Davis
David T. Mason Professor
of Forest Land Use
Yale School of Forestry

POPULATION AND THE FOREST INDUSTRY

John A. Segur

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Preface

The discussion today is about a growing population, a fixed amount of land, and an industry caught in the middle trying to determine its place in the scheme of things. My role is that of a generalist, like yourselves trying to piece the puzzle together, with a bias to the business side. What I have to say *is* probably not representative of industry's thoughts on the matter and should be taken principally as a springboard for discussion.

We are talking about 325 million people in the year 2000, and what they will want to do with the nearly 2 billion acres of usable land they will inherit. The industry involved, of course, is the forest industry which depends upon 500 million of those acres for a livelihood. My conclusion in brief: The forest industry in the United States may be wise to limit its expansion to a more efficient use of what it now controls in land, water, and waste materials.

I Exploding Population versus Fixed Natural Resources

DURING the last fifty years, the population of the United States has doubled, from 100 to 200 million. Demographic experts expect it to more than double again in the next fifty, passing 325 million around the turn of the century. In the USA 1969 population growth is still generally equated with progress - the joy of the marketeers and economists and the thrust behind the fantastic stock market.

The container of this exploding population, Continental USA, however is a fixed space of 3 million square miles containing a fixed amount of natural resources. With increasing population, the share per person of such land and raw resources will of course decrease, but the point at which we will see a major degradation of our living standard is hard to predict. There seems to be plenty of open land still around us, we appear to enjoy living in density in the the cities, and we have great resources in technology not yet applied. As we continue to grow, however, certain strains which are already apparent are bound to worsen; the old free way of determining land use in assumption of abundance must certainly be replaced by an increasingly regulated one.

With two thirds of the population now living in cities (and expected to go to 80%) occupying directly less than 2% of the land, we tend to forget how dependent we are on the other 98% for the natural resources which support our standard of living. Our past prosperity has drawn heavily on resources that took millenniums to produce at no cost to us. Most of the best (and cheapest) sources of our water, wood, oil, minerals, and cropland are now depleted or deteriorated. As population increases, our use of second-line and marginal resources must necessarily involve greater and greater effort, invention and efficiency in use and waste recovery to maintain the present standard of living. At some point, ingenuity can no longer balance population increase, and beyond this point the standard must decrease. The level of population at which the standard can be maintained ad infinitum is unknown; some experts say our optimum population was reached at 150 million.

With current agricultural surpluses and improving technologies, it does not appear that land for food will be a primary concern during the next generation.

However, many experts feel we are even now mining out land (losing topsoil) and overgrazing. The truth is our experience with superintensive farming has been of very short duration. Furthermore, the still prevalent idea that we have land to burn just isn't so. Each person's share of supporting land (cropland, grazing and timberlands) will be reduced in the next doubling of population from 8 to 4 acres. More important, the arable portion of this share will be cut from two acres to one acre, or about the same as the present world average (although still well above China and the United Kingdom's present share of 0.3 acre). Moreover, as the rest of the world population in turn doubles, approaching a total world population of six to seven billion, we may very well find more supplicants at our doorstep demanding to be fed from our one acre share. Thus, although there may be no short-range food problem, the long-range prudent course is to husband our arable acres.

The maximum density in which man can live happily with his environment on a sustained basis is not known today. It is most certainly substantially lower than his simple ability to feed himself. It has been said that, at Asiatic standards, North America could support a population of 577 million, which is certainly not a pleasant prospect. Whatever the ultimate density balance, however, it is clear that man, to live with his environment, must have a clear set of rules to restrain him from fouling his nest, as do other species.

As population increases from this point on, therefore, we can expect to see a national land use policy evolve. Ideally, such a policy will be designed to produce the greatest good for the ultimate level of population. On the basis of past history it is not likely the best use of resources will evolve under the criteria of business economics. Such a policy, rather, must evaluate the claims on land for food, fiber, minerals, petroleum, transportation, cities, and industry on the one hand while maintaining environmental quality on the other - Le. enough privacy, trees, recreation and watershed to make life worth living. Popular support for such action is increasing steadily. Efforts are being made to draft guidelines, first for public lands under the Public Land Law Review Commission, perhaps to be followed by an all inclusive plan for all land.

It will take a long time to evolve such a policy in our democratic society. In the first place, the greatest good on an ultimate basis may conflct with the greatest good on an interim basis. Furthermore, what does the "greatest good" mean? Some urge that it means to provide the maximum number of jobs. The job of feeding people concerns others; in spite of current surpluses, some experts foresee real problems developing from overintensive farming and overgrazed pastures. The urban problem is another; can a national land policy

sponsor a return to rural areas and relieve the social and economic pressure on the cities? Finally, an increasing number of people are becoming involved in movements towards more recreational areas which, with or without a plan, may shift as much as 60 to 75 million acres to urban and recreation land uses.

It is anyone's guess how guidelines may develop; but a growing awareness of the environmental theme by the U.S. voter, and the new one-man one-vote rule may actually result in massive shifts towards some such plan of land use regulation.

Like land, the nation's supply of fresh water is also limited, and must be included in any national allocation policy. Annual withdrawals, principally by irrigation, industry and power plants have now reached a point where they equal about 30% of the annual runoff. Since practical recovery of runoff is probably no more than 50%, a doubling of demand without substantial increase in supply or reuse will place water supply in a critical category.

The quality of water in many areas is already critical and strict laws are being drawn in all states, after twenty years in the making, under the Water Quality Act of 1965 and the Clean Water Restoration Act of 1966. The general intent of these laws is to limit organic and chemical wastes to an amount each stream can digest without destroying its life or filling it with growth. The Stanford Research Institute estimated in 1960 that the total national flow necessary to provide adequate dilution for industrial and thermal waste at that time was already equal to about 55% of the runoff, a critical figure even at that time.

All the figures quoted are national averages. The practical limits in many areas have already been reached, as evidenced by Class D (or worse) rivers, by saline infiltration of wells, and by fall-off of groundwater levels. Furthermore, the figures quoted are yearly averages, with a substantial part of the runoff occurring in a few months of the year, reducing the available runoff to less than 50% in many areas.

Obviously, major changes must be made if industrial production dependent on water is to keep pace with population increase. Fortunately this is something technology can solve. We can increase supply by dams, recirculation and desalinization; we can improve quality by clarifiers, settling basins, activators, and neutralizers. Water will no longer be free, however, but a very expensive commodity.

In summary, we appear to be on the threshold of a new era in the determination of the use of land and water; and the industries directly dependent on their use which were born and nurtured under laissez-faire and economic pragmatism will have to adjust their sights accordingly.

II Timber Supply Problems in the Year 2000

UNTIL complete guidelines are available, industries which may be affected by land and water allocation are in a dilemma, particularly those requiring long lead times and heavy capital investment. The oil, chemical, power and forest industries, for example, must begin planning now if they are to provide for 3₂5 million in 30 years. Although I haven't noticed any tendency by industry to hold up expansion, the ordinary difficulties of site selection are now substantially compounded by the uncertainty of a shifting use base. Without guidelines, massive misplacements of capital could occur in the next decade.

The forest industry perhaps has the most difficult job of all, because it must make many timberland decisions now in order to have trees available in 30 years. The danger is that, with so many imponderables in the picture, no decision will be made at all.

To understand these problems, it is first necessary to review the projected supply-demand picture. The U.S. Forest Service reported in 1965[1] that, as of 1962, total annual fiber consumed in the USA (including roundwood, waste, imports and other fiber) had increased to 13 billion cubic feet; and projected for the year 2000 a total fiber demand of 23 billion cubic feet, (based on a population of 325 million), almost doubling 1962 consumption. The amount of roundwood cut from domestic growing stock in 2000 was projected to be 29% in excess of projected growth in all sizes and 33% in sawtimber sizes alone unless substantial efforts to improve growth are initiated soon. The Service was careful to point out that this is not a prediction but a projection based on current practices and trends. At the same time it pointed out that the biotic potential is substantially higher and the deficit could be easily remedied by raising the management level.

By 1967, three years later, demand for paper and board had increased sharply and production was well in advance of the expansion schedule esti-

1 Timber Trends in the United States. Forest Service, U.S. Dept. of Agriculture, Forest Resource Report No. 17.

mated in the 1964 report. New extrapolations by the Forest Service[2] then appeared for pulp and paper consumption projecting an increase in annual use per capita to 797 pounds in the year 1985. At the same rate of increase, this projects to 1000 in the year 2000 as compared with the 711 used in the earlier survey and with an actual of 453 in 1962. This increase boosted the total projected fiber consumption in the year 2000 to 28 billion cubic feet.

At this rate of 1000 pounds per capita per year, we are talking about 134 million tons of pulp or more than 3 times current U.S. capacity (1969). To meet this demand would require either tripling the size of every domestic mill we have or adding 270 new 1000 ton mills or some combination thereof. The problem facing the industry of organizing such a program, of preparing" to almost triple pulpwood cut, of locating additional mill sites, and of solving the accelerating pollution problems are fantastic, involving at a guess over $50 billion (excluding land acquisition), or four times the present total capital investment of the industry.

As to the wood problem, the experts seem to be in agreement that it should be possible to raise timber growth sufficiently to take care of the projected total demand. Roughly it means raising total average growth from .4 cord per acre to .6 if land now in timberlands remains unchanged. If all commercial forest lands were managed as well as the better managed properties, the total growth resulting would be about 27 billion cubic feet, or about equal to the projected total demand for fiber. At the present time perhaps less than 50% of our timberlands are well managed, and over 110 million acres are poorly stocked (0 to 40%). The whole program requires a national movement in timberland improvement, thinning, planting and seeding, fire protection, better use of residue, and accelerated road building. This is a mammoth program estimated by Forest Service to cost $21 billion over the next 30 years in addition to our present rate of spending.

Many of the assumptions in this program are, however, of very marginal probability. For example, it counts on pulping the big excess of hardwoods in the North and the softwoods in the Rockies although special effort and expense will be required to bring them into use. It counts on persuading the small landowner who controls 70% of the land in the South to invest the time and money needed to improve his timber growth; it assumes that the necessary capital will be made available although at best it promises a 3% return on the

2 Hair, Dwight, 1967. Use of Regression Equations for Projecting Trends in Demand for Paper and Board. Forest Service, U.S. Dept. of Agriculture, Forest Resource Report No. 18.

incremental investment. Finally, it assumes the present 500 million acres will remain available to forestry under an evolving land use policy.

Of these assumptions, the last is the most important and the most difficult to predict. The Forest Service estimated that land gains would offset losses-that is, no net change in timberlands in 30 years. Clawson in "Land for the Future,"[1] estimated a loss of 30 million acres as part of a total shift of 100 million acres to urban and recreational uses. The Southern Forest Resource Analysis Committee[2] estimated a loss of only 13 million acres in the South. All estimates are influenced heavily by the current agricultural surplus and increase in farming efficiency. The fact is, however, that we have had very few years of experience in which to judge the long term effects of intensified farming, and have no really clear idea of our future responsibilities for feeding of others. It is conceivable that Mexico, South America and Great Britain, as well as others may draw from our bread basket before we are through. If all land clearly suited to cultivation were reserved to crops (and usable for timberlands only in resting periods), timberland would suffer a loss of 125 million acres of its best site land.

It is difficult to assess how far we are willing to go in land allocation to keep supplied with paper and board which use two thirds of the fiber available. How valid is the assumption of 1000 pounds per capita or even 711? I can't help but be impressed by the waste we see everyday in paper use. Compared to our present rate of 500 pounds per capita, Northern Europe uses only 250 and Central Europe 100, while we project to 1000! In any master plan which concerns our cultivatable acres, it is difficult to see the assignment of any priority to the projected rate of 1000 pounds per capita.

Similarly, how far are we willing to go in land allocation to keep supplied with lumber? Higher prices bring in new materials, and aluminum, steel, plastic, and masonry will all play a bigger part, particularly as the proportion of apartment houses and mobile homes increase. All these materials, however, are natural resources, like trees; but unlike trees they are not renewable. I would be inclined to believe, therefore, that lumber would remain a basic necessity in the amount projected.

In the evolution of a land use policy over the next fifty years, it therefore seems unlikely the policy makers will assign a very high priority to timber

1 Clawson, Marion, R. Burwell Held, and Charles H. Stoddard, 1960. Land for the Future, Johns Hopkins Press, Baltimore.

2 The South's Third Forest. A Report of the Southern Forest Resource Analysis Committee, 1969. [No publisher given]

growing, with the possible exception of lumber needs for homes and to supporting roles such as green belt, watershed, and alternating crops. In the end, timber growing is most likely to be assigned to residual or marginal lands *after* reservation of land for agriculture, industry and city expansion and dispersion, and recreation. The sooner we plan to live with this the better.

III Location of Future Forest Industry

THE job of planning to meet the projected demand for timber logically begins with an attempt to make "assignments" to various regions. Based on Forest Resource Reports 17 and 18 by the Forest Service[1], total timber and other fiber sources and the projected distribution by timber source in the U.S. works out as follows:

Source of Fiber	Billion Cubic Feet	
	1962	2000
Roundwood USA, North	1.95	3.75
Roundwood USA, South	4.18	12.90
Roundwood USA, West	4.19	5.96
Imports (net)	1.48	2.64
Waste and Other Fiber	1.25	3.41
Total Fibrous Materials	13.05	28.66

In this allocation, the South bears the brunt of the load, requiring it to more than triple its fiber production (versus 1962). Furthermore, because the increases assigned to the North, (where there is an excess of hardwoods) and to the Rocky Mountains area may be difficult to effect, the load on the South may be greater than shown.

[1] Forest Service, U.S. Dept. of Agriculture, 1965. Timber Trends in the United States, Forest Resource Report, No. 17.

Dwight Hair, 1967. Use of Regression Equations for projecting Trends in Demand for Paper and Board. Forest Service, U.S. Dept. of Agriculture, Forest Resource Report No. 18.

Note: The allocations in Forest Resource Report No. 17 in the year 2000 were based on consumption of paper and board of 711 pounds per capita. Based on extrapolation of Report No. 18, this has been increased to 1,000 and, under the philosophy expressed in Report No. 17, the additional amount has been added to the South.

Regarding the pulp source segment of the allocation only, the load on the South is even heavier:

	Paper, Board, and Pulp (Million tons of fiber)	
	1962	2000
USA Pulp — North	5	19
USA Pulp — South	16	81
USA Pulp — West	6	24
Imports (net) — Pulp	6	10
Waste and Other Fiber	10	31
Total	43	165

The South, for its part, appears willing and able to assume the task. The Southern Forest Resource Analysis Committee, in a comprehensive study made in 1969[1], recommended a program which would enable industry in the South to meet its "assignment" in the year 2000. Essentially it concluded that, in order to increase productivity effectively, industry and public ownership would have to control at least 43% of commercial timberlands in the South; and undertake a major educational program to get private landowners to make at least modest improvements. On this basis, the following objectives were recommended as to land ownership and growth improvement to meet the foregoing "assignment" of 12.75 billion cubic feet (BCF) per year:

Ownership of Timberlands	Million Acres		Estimated growth in cords per acre[2]		Ave. annual growth improvement needed, billion cubic feet
	1962	2000	1962	2000	
Pulp and Paper Industry	22	46	0.67	1.18	5.55
Other Industry	15	14			
National and Other Public	17	21	.62	.95	1.55
Farm and Other Private	147	107	.47	.67	5.65
Total	201	188			12.75
Average (weighted)			0.52	0.86	

The key assumptions, of course, are (1) that only 13 million acres will be lost to other uses; and (2) that industry will acquire 24 million more acres.

[1] The South's Third Forest. A Report of the Southern Forest Resource Analysis Committee. [no publisher given]

[2] One cord assumed to equal 78 cubic feet

These are optimistic assumptions. If the population in the South triples by 2000, as predicted by some experts, the loss of timberlands to homes, recreation, roads and other uses could substantially exceed 13 million acres. Furthermore, the number of small woodlot owners not interested in forestry for wood production will increase sharply, pricing a lot of land out of the market. Finally, if arable land should be reserved for edible crops under a developing land use policy) timberlands in the South would stand to lose 30 million acres of its best site land.

Although the study is an excellent beginning, the business planners trying to decide on the wisdom of investing an additional 25-50 billion dollars in the Southern timber industry must find answers to a number of very difficult questions:

1) Will future land use regulations *allow* the forest industry to control 60 million acres in an area highly suited to growing edible crops, small city and industrial development, and retirement population?
2) Regardless of regulatory policy, to what extent can the forest industry *afford* to own land in such an area?
3) Under conditions of increasing population and affluence, can the industry afford to rely on the whim of the small landowner for almost half its timber supply?
4) To expand pulp capacity to 81 million tons requires the addition of 186 new units (versus 1962) of 1000 tons per day each, of which 30 have been added in the 1962-9 period. With chemical pulp requiring 30- to 4°,000 gallons of water per ton, the availability of sites with adequate water is a major question mark. The best informed engineers today are hard put to identify even 15 new sites.
5) Can industry itself be expected to act in concert, or will the needs of lumber and pulp conflict?

The last item is not the least. A tree today as lumber is worth perhaps 3-4 times its value as pulpwood - but you must wait 20-40 years longer before selling and pay taxes and maintenance while waiting. With the virgin stands of the West disappearing, the pines of the third forest of the South are expected to supply a substantial part of our lumber needs in the future, particularly in the next 30 years. However, will the tree owners elect to wait, against the vigorous bidding of an expanding pulp industry? The pressure of quintupling pulp production in the South (2000 versus 1962) is certain to bid up the price of pulpwood stumpage until it approaches that of lumber.

It is quite possible that the choice (between lumber and pulp) will eventu-

ally be made by regulation. Since 1O a million homes must be built in the next 3 0 years, it may be expected lumber will win over paper in any showdown (In this regard, it is interesting that British Columbia has moved to protect its lumber industry against pulp encroachment). In this case, pulp production could be limited in the areas capable of producing sawtimber to the use of lumber by-products or rejects, such as forest residue, tops, thinnings and plant residue.

In such a lumber-oriented forest economy, the amount of pulpwood which could be produced would range from 22% to 68% of the total fiber available, the amount depending upon the effort and expense applied to the recovery of fiber now wasted, or used for fuel, or currently unusable. At the mean level, which is probably currently feasible, this would limit pulp production in the South to about its present volume; at the higher level, the South would be limited to about half of the "assignment."

It is also possible, of course, that sawtimber as such may largely disappear from the scene and all lumber will be pressure formed from chip derivatives. In this case lumber could perhaps be produced from all trees and in all areas. Trees would be harvested as crops, like pulpwoods plantations, rather than by selective cutting, and the time and price differentials would disappear.

Looking at other parts of the Forest Service allocations, it seems likely that the West can fill its quota, partly because so much of its timber is under Forest Service control. In the West, the pulp industry has enjoyed particularly low manufacturing costs due to the availability of a large supply of chips and other residue associated with the lumber operation. But this advantage has been more than offset by the high freight cost to the eastern markets, and the West has tended to produce principally for the western market and for export. An increase in allowable cut of sawtimber, as proposed by the Forest Service, plus some increase in thinning would provide sufficient pulpwood to meet the quota. However, this would utilize only a very small part of the three billion cubic feet of annual mortality in the Pacific and Rocky Mountain areas. Including this source, and assuming increase in product price levels to cover the cost of such recovery, the cost of solving the water problem, and the freight disadvantage, the quota of the West could be substantially increased.

In the Northeast and North Central areas, the best means of utilizing its excess hardwood growth is to pulp it. This can be done, but the problems are substantial. Rivers are smaller, pollution problems greater, and conflict with future recreational programs considerable. Growth rate is lower and a substantial area is needed to support a mill. The mills generally therefore must

tend to be smaller and less efficient; and in addition will probably have to import softwood in order to fully integrate. This pulp assignment seems ambitious to me and perhaps should also be limited, initially at least, to sawtimber by-products, reducing it about in half.

The assumption as to the reuse of paper waste has, of course, a major effect on the projected roundwood requirements. The decreasing use of paper waste (from 35% in 1952 to the projected 19% in the year 2000) has been due in part to the cheapness and superiority of prime fiber, the increase in integration, the contamination of waste with plastics, resins, foils, and other materials, and the high labor cost of collection and sorting. These are all a function of cost which can be improved by technology. The have-not countries are steadily increasing their usage and the substantial price increase which may be necessary to bring in marginal prime fiber should also justify the increased use of waste, at least back to former levels. In such cases the mills located close to the population centers, the major source of supply, will have an important place in the overall picture.

This leaves us with imports to supply the deficiency, and a whole new set of problems. Most of the potential supply in Canada and Central America, the most likely sources, are situated in undeveloped areas, and the excess cost of frontier construction is substantial. In addition, both economics and national interests tend to dictate that fiber be fully converted at the source and this may not be in accord with the best interest of the United States customer. Furthermore, tariffs on paper would have to be eliminated, improved methods of transportation developed, and means found to protect foreign investments.

Nevertheless, it seems most likely that we will eventually tie United States and Canada into one land economy; and Canada will assume the major role in North America as a supplier of prime fiber, as Scandinavia does for Europe. Canada has as much timberland as the whole United States; and has a growth potential of 9 billion cubic feet per year.

It seems obvious that a tremendous amount of groundwork needs to be done before many new plants are built. If the premise is accepted that timber growing must eventually be assigned to marginal land, (other than green belt, watershed and alternating crops), we must give much more weight to the 500 million acres of timberlands in Canada which are marginal for other uses; more weight to reclaiming waste; more weight to the 3 billion cubic feet annual mortality in the west; more weight to possibilities of fiber production in Central America; and much less weight to land in the South which has other uses.

IV Coming Changes in Forest Industry Economics

IN the evolution toward the day of classified controls of land and water, the economics of the forest industry must be expected to change substantially. The industry has been geared in the past to low cost raw material, water, and freight, which, with a high degree of plant automation, has produced inexpensive products and broad utilization. The low cost of raw material in turn has rested on the availability of a large supply of low-priced stumpage, cheap woods labor, (in the South at least), and limited capital expenditure in land and timber. Furthermore, availability of sites with heavy concentrations of wood supply and stream flow have encouraged the development of 1000 ton pulp mills with consequent economies of scale. Finally the tremendous pulp expansion in the 1950-68 period, accounting for more than 70% of the current capacity, was fueled by exceptionally easy credit and financial aids. This included accelerated amortization under the National Emergency Act, tax exempt revenue bonds, accelerated depreciation, the 7% Investment Credit, and last but not least a tremendous expansion of the industry's debt from 10% of total capitalization to 35%. Keep in mind that most of these advantages have been passed on to the customer in low prices - that the industry in 1967 earned only 7% on its total capitalization.

As I see it, none of the more favorable elements of the last expansion will be available in the next. Moreover, as we head towards regulation of land and water, by far the greatest impact on future forest economics will come from substantial increases in delivered wood costs in the South, under the pressure of competition for the use of land and rising labor costs in the woods.

This is a vicious circle, in which the rising value of land and the increasing use alternatives available to the timberlands owner will tend to force stumpage values up, while also making the owner reluctant to commit to long term programs. At the same time, the sharply rising cost of woods labor (over and above national labor escalation) will tend to make it uneconomical to harvest the small owners' scattered 2-3 cords per acre, resulting in reduction of this supply. Since the remedy, the increase of forest yield and stand size at harvest, requires long term programs, the circle never closes unless the industry dependent on the wood supply moves to acquire control or offers incentives to someone else to do so. Either way, a substantial investment is involved.

The cost of timberlands in the South required to provide full support to forest industry is much greater than generally realized. A bleached pulp mill producing 1000 tons per day, for example, requires 415,000 acres of good (site 80) fully stocked timberlands at maximum efficiency to provide its full requirements. At current prices, such lands, including a bare land value of about $40 per acre, would cost if you could buy it, about $60 million, or 75% of the cost of the base pulpmill itself.

Furthermore, the comparable investment to support a lumber operation, is substantially higher, because of the longer cycle and higher unit value of its stocking. For this reason, a completely integrated unit (lumber, pulp and paper), balanced around its lumber output, requires a forest investment of almost 150% its' investment in plant at maximum efficiency level.

The size of these investments relative to the cost of the base plant not only offer problems in financing if you are trying to accumulate for control purposes; more important, they represent a factor which has not been fully recognized up to now in the price of the end product (paper and lumber). Because of superabundance in the past, this has not been necessary. The return on investment in timberlands has been notoriously low, averaging around 3%, partly due to low efficiency and partly to excess supply.

Future pricing of end product however will have to contain an adequate return for the forest investment, whoever is the owner. It is not known today what return would be ttadequate" to bring out long term commitments and assure continuity of supply. My own opinion is that, in normal times, a return of 5½% (after taxes on total investment might do it. At this level, I believe timberlands could conceivably stand on their own feet, as a separate entity.

At $30 per acre for bare land, the price adjustment for stumpage necessary to yield 5½% would not be great, if the timber yield were at maximum efficiency. For example, pine pulpwood plantations in 30 year cycle on good sites are capable of earning 5½% and more at today's level of prices for pulpwood and land. The same land on a 60 year sawtimber cycle, however, can earn only 4Y2% at maximum efficiency and would not meet the criteria. To bring the return up to 5Y2%, I estimate would require an increase in stumpage value equal to about a 7% increase in the price of the end products of a fully integrated mill.

Although timberlands at maximum efficiency are reasonably close under this criterion to offering ttadequate" returns with bare land at $30 per acre, an increase in bare land value to $100 per acre, (bringing it into the current price range of cropland), would have a more substantial effect. In the case of the

bleached pulp mill, such an increase would result in raising the total timberland investment to 200% of the cost of base plant, and require a 20% increase in the price of pulp to offset. In the case of the fully integrated mill in a sawtimber economy, the increase would result in a timberland investment equal to 400% of the cost of base plant, and would require price increases equal to 30% of the pulp and lumber prices to maintain the 5½% return.

Hopefully, at this level, timberlands could compete with other crops at the marginal level. Neither could compete with city encroachment, however, and would require zoning for protection.

In addition to increased cost of wood in the South, the capital cost of the base plant everywhere will certainly increase (over and above inflation). With very few prime water sites left and with increasingly severe restrictions on water and air pollution, the cost of bringing in new mills and improving old ones will increase substantially. This includes dams, accumulation basins, pipelines and wells to provide water, in addition to piping and pumps to recirculate more water. It also includes clarifiers, settling basins, neutralizers, and activators for waste treatment as well as precipitators or scrubbers for air pollution. All of this eventually is estimated to increase base mill cost by 15 to 20% and will apply to all sections of the U.S.A. and to Southern Canada. In addition, to utilize more marginal sites, the size of the modern mill may have to recede from the 1000 ton level recently attained to perhaps 300-400, adding another 10% to the base plant cost.

On the other side of the coin, heavy excess capital costs will be required to bring in new mills in frontier areas in Canada and elsewhere, including access roads, railroads, towns, logging roads, woods equipment and wharfs. Although no land investment is involved, initial ground payments to the government must be made. Finally, higher inventories must be carried and investment in maintenance is substantially higher, since five to six acres are needed in Canada on the average to one in the South. All of this is estimated to add 50% to the base capital cost of a bleached pulp mill, perhaps less for a larger integrated mill.

To justify the building of the frontier mill, I estimate, the price of pulp would have to be increased 20%; the price of a fully integrated products mill perhaps less.

In summary, a rise of up to 7% in the price of lumber and paper passed on to the timberland owner could conceivably assure continuity of supply in the South, assuming maximum efficiency and bare land values at $30 per acre. If, as appears likely, however, timberland values increase to the level of crop

land values, a further increase in end-product prices of the order of 20-30% will be necessary to assure continuity. In comparison, the frontier mill in Canada will require price increases up to 20% to justify. All such price increases are on top of 20 to 25% increases, industry-wide, needed to correct the weakness of the oversupply situation in the last four years and to cover the cost of pollution abatement.

At some point in the near future, therefore, it is conceivable that the economic advantage may pass to the frontier mill, particularly if and when timberland values in the South exceed present cropland values.

V Make the Most of What You Have

THE somewhat blue sky nature of the foregoing discussion leads to questions concerning practical applications in today's world. Since it takes thirty years to grow a tree, however, many decisions must be made today about the location and supply of future plants, without the benefit of more precise information.

The odds at this time point strongly to to ultimate close regulation of land and water, and to the limitation of pulp production except as a by-product of sawtimber. Until more unfolds, therefore, the forest industry might be wise to anticipate this trend and to concentrate its energies and capital in getting the most out of the land, water and waste it now controls, and in working with the government in the development of techniques for utilizing marginal land and timber now wasted. Thus, it is not only important to improve yield on the lands owned by industry in the South by genetics and good management but it is just as important to find economic means of recapturing the 40% of our prime fiber which is now unused and also to develop better methods for the collection and processing of waste fibers.

It will undoubtedly be a long time before it will be economically feasible to recapture much of the fiber now lost. For some time it will remain cheaper to produce pulp from new trees grown on good southern land than from dead trees out of the wilds of the Rockies, or from reclaimed residue, or from paper waste collected in New York; just as it is cheaper to buy a new appliance than repair it. There is little information available, to my knowledge, to help establish at what price level for forest products it will become feasible to recapture these materials. At some point, however, the cost of land in the South, the extra cost of the frontier mill, and the extra cost of reclaiming such fiber will surely come into equilibrium.

It is possible, of course, that it may never become feasible to recapture much of the fiber except in conjunction with social programs; i.e. paper waste collection and sorting in conjunction with pollution control, wilderness areas with recreation. However, more difficult problems than these have been solved by applied technology, and the industry should at least be prepared to lead the way.

In such a recovery effort, the paper and board segment of the industry has the most at stake. If its production is in fact limited to lumber by-products,

further expansion in the U.S.A. will largely depend upon its success in the recovery of wood and waste, as well as water. Of the 28.7 BCF total estimated fiber demand (see section **III),** only 11 BCF represents sawtimber going into lumber and plywood. To produce this amount of sawtimber under good management, it would require a gross annual growth of about 20 BCF, the balance representing forest residue, thinnings, culls, and dead wood.

As previously stated, the amount of prime fiber available as by-product in a lumber oriented forest economy varies from 22% to 68% of the gross annual growth of prime fiber (including all sources), the amount depending upon the effort and expense applied to the recovery of residue and particularly of non-growing stock. Probably at least 48% is economically feasible under present technology. The amount of paper and board producible from a gross annual growth of 20 billion cubic feet (BCF), assuming use of paper waste and other fibers to increase back to the 35% level, would be as follows:

	Paper & board producible as lumber by-product.	
	Feasible	Maximum
Total BCF of prime fiber available as by-product (48% and 68%) *	9.6	13.6
Total BCF of by-product fiber allocated to paper and board	8.7	12.2
Equivalent in million tons of pulp	79.0	110.0
Add paper waste and other fiber (35% of total) - million tons	43·0	61.0
Total paper and board - million tons	122.0	171.0
Equivalent pounds per capita	750.0	1,060.0

These figures indicate that, given the projected level of sawtimber production for lumber and plywood, there would be sufficient by-product prime fiber to permit substantial increases in production of paper and board, at both levels of recovery, at such time as the recovery of such fiber can be accomplished economically. At that time, however, the area distribution would be substantially different from that contemplated under Section **III.**

*Assuming basic sawtimber production for lumber of 11 BCF, requiring gross annual growth of 20 BCF (billion cubic feet)

Using the sawtimber allocations of Forest Resource Report No. 17[1] as a base, and following the foregoing procedure, the allocation of gross annual growth and the resultant by-product in the year 2000 works out as follows:

	Prime fiber, BCF		Paper & board, million tons	
Source of fiber	Sawtimber to Lumber	Gross Annual Growth	Feasible	Maximum
Roundwood USA, North	1.66	2.96	11.7	16·5
Roundwood USA, South	4·34	7·80	31.2	43.2
Roundwood USA, West	3·50	6.30	24·7	35·0
Imports (net)	1.58	2.82	11.4	16.3
Total Prime fiber	11.08	19·88	79·0	111.0
Waste and Other Material			43·0	60.0
Total Fibrous Materials			122.0	171.0

The ultimate level of paper and board production probably lies somewhere in the middle. In comparison, the total fiber assigned to the South is substantially less than projected in Section III. In fact, it is about the same as its present annual growth. Assuming gradual improvement in yield by management, most of it could eventually be grown on land presently controlled by industry and government, thus permitting gradual attrition of private land as a source of wood.

However, this calls for "looking across the valley". As long as current operating costs continue to favor the South (and sites can be found), individual companies will continue to build in the South without regard to their ultimate investment in timberlands. In the aggregate, therefore, there is real danger that pulp production will be expanded beyond its proper sustainable place in the future pattern, leading gradually to non-productive and self-destructive competition for land, wood, and water. Until more is known, therefore, such investment would be better directed to improving and utilizing what we already have.

1 Lit cit. p. 4

VI Summary and Conclusion

THE explosive increase of population which we are experiencing in the United States does not appear likely to strain our physical capacities within our lifetime or that of our children. Long before we reach such a point, however, we may expect to experience a substantial loss in environmental quality unless guidelines are laid down for priorities in the use of the non-expandable irreplaceable assets, such as land and water. The mood of the voters seems to be changing and we can look for early regulation of some sort under a national land and water policy.

To provide for the new population arrivals, industry has a job to do which, in many cases like the forest, industry requires a substantial lead time. The forest industry needs guidelines now to avoid massive mistakes in the placement of new plants. Under a land policy which among other things may sponsor a spreading of population to relieve the cities, customary economic criteria may no longer be the principal determinant.

In any long term evolution of land use it is rational to expect that timber g.rowing will be allocated to lands which are marginal for other purposes, of which Canada has 5oo million acres. It is difficult to assign a higher priority except in the case of lumber, the growing of which may have to be regulated.

As population increases, it is quite likely that the population of the South will at least triple (assuming jobs are provided) and heavy pressure can be expected on timberlands suitable for home sites, recreation and agriculture. A point may well be reached where the cost of carrying land in the South will exceed the extra costs of the frontier mill in Canada, the extra costs of reclaiming the 4o % of our prime fiber now left in the woods, or the extra cost of reclaiming paper waste.

The pulp and paper industry in the United States has already reached a point where most of the prime mill sites with water and timberlands have been taken, and constantly increasing prices of end products will be necessary to bring in the marginal ones. An eventual price rise of 40 - 55% (in constant dollars) is not unlikely. Such an increase may limit growth of usage per capita somewhat, both because of price and because of influx of competitive materials. The main effect of such increase should be to encourage the collection and reuse of more waste, (itself desirable from an air pollution viewpoint), the reclaiming of unused prime fiber, and also the opening of frontier mills.

There is a real danger that the pulp mill population density in the South will be increased beyond its proper sustainable place in the future pattern. The industry may be wise to limit its expansion in the United States to the optimizing of what it now has in land, waste material supplies, and water, relying much more heavily on Canada's forestlands which are likely to so remain.

WORLD FOREST RESOURCES TRIBUTARY TO THE NORTH AMERICAN SPHERE OF DEVELOPMENT

F. Bruce Lamb

REFERENCE to the current scene in the building trades will serve to set the stage for my remarks on the availability of overseas forest resources as related to trade in forest products. The level of activity in the building trades has a major influence on trends in the markets for forest products, especially outside the field of pulp and paper.

George Romney, Secretary of the Department of Housing and Urban Development, spoke of this relationship late in March of 1969. I quote from the Christian Science Monitor: "As a nation we must take the long-range steps to increase our lumber production or we are headed for a housing production disaster." Much more has been said recently in the news media about forest resources to meet the housing shortage, but further comment is unnecessary for our purposes here.

I am not a participant in the "timber famine" approach to resource planning. Therefore, before we blast off in all directions around the world looking for forest resources to meet what some people consider a crisis, I would like to develop the framework for a rational approach. I agree with Professor John Zivnuska, one of the foremost forest economists in this country, when he says that the U.S. timber resource position should be conceived in terms of a functional rather than a physical concept.

Our wood industry, especially in the West, still has an historical orientation toward oldgrowth virgin timber liquidation. The required readjustment from this position to the utilization of the type of timber available from managed forests now and in the future is a long and difficult one. We still have far to go to adjust to sustainable economic timber supplies. This does not, however, mean a reduction in the volume of wood being harvested. It does mean drastic changes in technologies and product mixes to utilize the type of raw material now becoming increasingly available from managed forests. With these changes, and intensified forest management to the level of present European forest practice, our forest resource base can sustain a cut of two to three times the current harvest volume; but not, however, of oldgrowth Douglas-fir.

Considering Canada and the United States as a single economic region in production and marketing forest products, as suggested by Zivnuska,[1] a forest resource base exists to sustain a major increase in export trade even with a rapid rise in domestic markets.

As the adjustments take place in resource management and utilization, perhaps surpluses of certain types of new products may develop, along with a scarcity of traditional wood products. Therefore, the establishment of multipath trade patterns in forest products, working under the principle of comparative economic advantages, can be an important factor in adjusting to the economic dynamics of our forest resource position. The solution is not so simple, however, as merely seeking locations in the underdeveloped regions of the tropics where, to satisfy a current shortage at home, we can repeat the traditional process of oldgrowth timber liquidation.

Adequate development programs will require managerial talent with a high order of flexibility, investment funds from various sources both public and private, development of new utilization techniques and new products. With these must go market research and development to supply both local and export demands, sales and distribution systems, and the installation and management of integrated wood utilization complexes adapted to the raw material resource. With perhaps one regional exception, Southeast Asia, tropical log export to overseas installations is a diminishing prospect for utilization programs and planning must no longer be undertaken with this purpose in mind.

Tropical Forest Regions

The tropical forests make up 47% of the total world forest area of 4.4 billion hectares (10.7) billion acres). Figure 1 gives general orientation to tropical in relation to other forest regions of the world. I will discuss the tropical forest regions in order of their present and potential importance to world trade. And in discussing the several aspects of trade patterns in relation to undeveloped forest resources in various parts of the world, I will consider North America, including Canada and the United States, as a single economic whole.

Southeast Asia

The forests of Insular Southeast Asia make up approximately 11% of the world tropical forests. The relatively homogeneous dipterocarp forests of this

[1] Zivnuska, John A. 1967. U.S. Resources in a World Economy. Resources for the Future, Inc. John Hopkins Press. Baltimore.

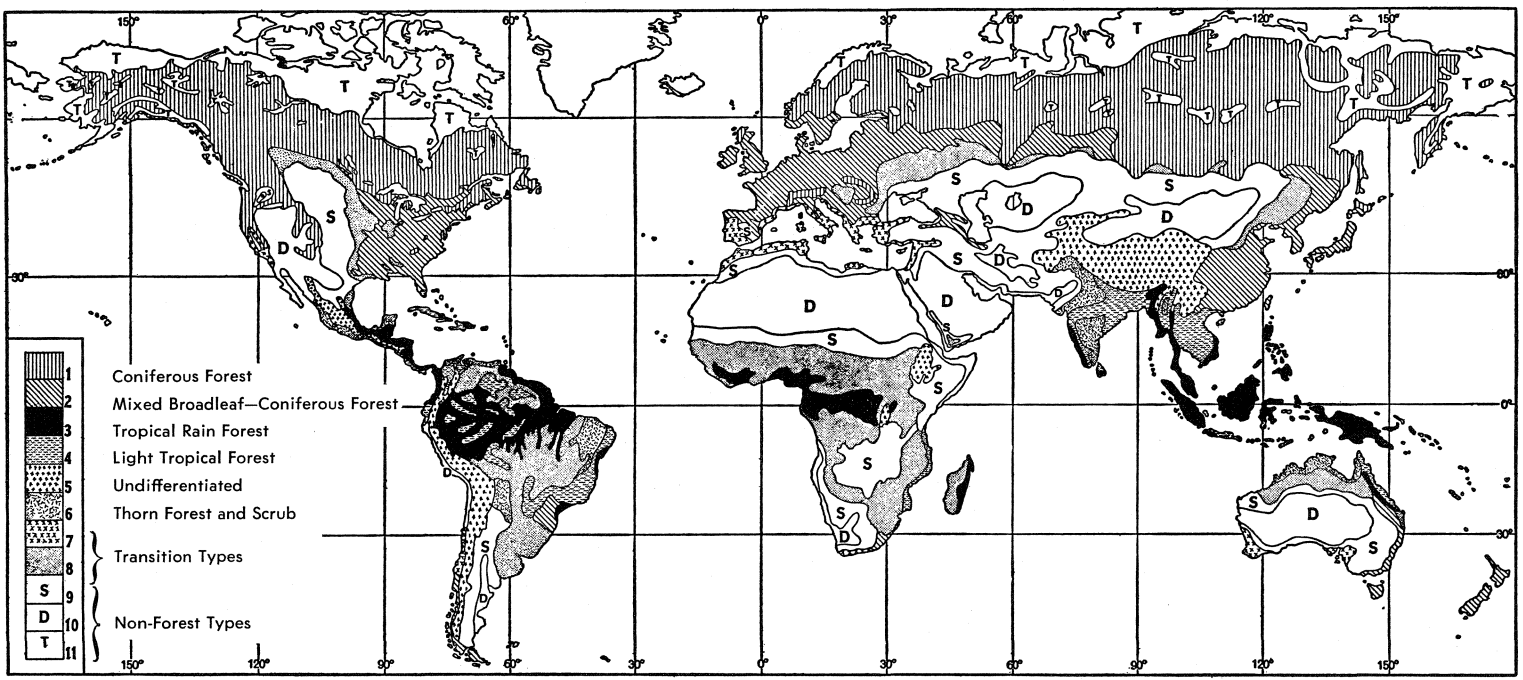

FIGURE 1. Forest Regions of the World (From World Geography of Forest Resources, Special Publication No. 33, 1956. American Geographical Society)

region have provided the basis for remarkable developments in tropical forest resource utilization in comparison to other tropical forest areas. This has been a result of three factors: I) the relative homogeneity in forest composition and characteristics of the woods available; 2) the high volume of commercial standing timber per unit of area that provides for low cost log production; and 3) the accessibility of the forest areas to ocean shipping facilities.

In these forests there is often 25 MBF or more per acre of commercial species. These are the Lauan type woods, medium in density, easy to cut on a veneer lathe, and ranging in color from dark red through brown and tan to shades of light pink or whites.

In the late 194$_0$'s, the movement of veneer and plywood products into North American markets from production facilities in Japan and the Philippine Islands caused a complete re-orientation in domestic hardwood plywood manufacturing and distribution activities. The result has been spectacular market growth in many unexpected areas. In 1968, 100 million panels of Lauan type panels were imported. Production from Japan and the Philippines continues to be important in the market for hardwood panel products in North America, with production centers in Korea, Taiwan, Hong Kong and Singapore increasing their role in the market.

In the past the raw material for this commerce came largely from the magnificent dipterocarp forests of the Philippines, which exported 3 billion board feet of logs in 1967. As these oldgrowth forests are being depleted, exploration and logging operation efforts are moving at an accelerating rate to Indonesia, Malaysia and to other areas.

The economic factors that control the movement of logs from the forest to the various manufacturing centers mentioned are: political policy controlling the forest resource, the comparative degree of integration of the manufacturing process at the various industrial locations, efficiency and cost of labor, comparative shipping costs and advantages, and an ability to exploit differences in the value of monetary exchange rates.

The volume of logs coming to North America from Southeast Asian sources is only a very minor part (less than 1%) of the total annual log movement in that area where the wood goes into specialty products. However, over 80% of the veneer and plywood exported by the Southeast Asian countries and produced from internal log sources came to the North American market in 1966.

As the forest resource center of gravity moves from the Island of Mindanao in the Philippines to the Island of Borneo in Indonesia and Malaysia, political and economic strains and stresses develop, and they control the nature and

direction of trade. Borneo, or Kalimantan as the Indonesians call it, is the area where the action is developing now in Southeast Asia.

Geographically, the Island of New Guinea appears to be a major tropical forest resource area. Unfortunately, the composition of the forest on this island is unfavorable to development, when compared to the species mix in the forests of the Philippines, Malaysia and Kalimantan (Borneo), Indonesia. New Guinea does not have the homogeneous dipterocarp type forests that have favored developments in nearby areas. Occasional reports appear in the trade journals about the difficulties of selling logs in Japan, produced by exploratory operations in New Guinea. This applies also to some of the smaller neighboring islands. Perhaps the development of these resources will take place as shortages appear elsewhere, and new technologies develop.

Africa

West Africa is the only area of this continent that contributes significantly to world trade in forest products. The tropical forests of this region make up 23% of the tropical forests of the world. The forest area is larger in extent than that of Insular Southeast Asia. However, the forest composition and volume per unit area of commercial timber is Inuch less favorable than that of the dipterocarp forest of Malaysia, Indonesia and the Philippines.

The direction of trade in logs and wood products from the West African forests has been predominantly oriented toward European markets. Logs still make up by far the greatest volume of this export trade. However, in recent years there has been considerable pressure applied to large timber concession holders in this area to establish wood manufacturing operations locally.

During the period from 1953 to 1963 the predominant place in volume of log shipments shifted between Ghana and Ivory Coast, with Nigeria and Gabon also maintaining an important position in the trade. Out of the 30 species moving in West African wood trade, six species make up over 50% of the volume. They are, in order of diminishing volume: Okume, Obeche, Sipo, Limba, African Mahogany, and Sapelli.

With independence from colonial administrations in Africa has come a shift in administrative policies for the forest resource. In many areas large concessions or administrative units have been broken up and the conservative cutting cycles shortened. This has been done to increase production and consequent cash flow and foreign exchange earnings. Where these policies were earliest put into effect, shortages are already showing up in resources capable of producing traditional log exports. It is these countries that are putting on the

greatest pressure to establish local manufacturing facilities, capable of using a wider range of species and log grades than are now being exported.

In several instances that have come to my attention, the manufacturing installations established have not been well adapted to existing resource situations nor to the markets they were expected to serve. The difficulties of making the adjustment in tropical countries from log export programs to modern local manufacturing regimes are formidable. Just to mention one aspect of this situation, log export programs are seasonal, taking advantage of favorable weather. However, efficient wood product manufacturing installations require a continuous and adequate supply of logs. This is physically difficult to accomplish in many tropical situations because of adverse weather conditions.

Plywood manufacturing installations in Africa, if they are oriented toward the North American market, have to meet the competition from plants in Southeast Asia. This is not an easy economic equation to solve. Veneer and plywood shipments from Africa to Europe meet the resistance of established production facilities there that expect to continue to import logs. The control of adequate inventories of standing timber to sustain a manufacturing installation for a reasonable period of time is a key factor, often ignored, to a profitable enterprise.

Some inaccessible and unexploited areas of forest remain in central West Africa. Perhaps as the infrastructure develops in these regions, opportunities will develop for profitable enterprise to supply local and export markets with wood products.

Latin America

The extremely complex mixture of species and the consequent low concentration of marketable woods per unit of area place the tropical American forest at a distinct disadvantage when compared with the dipterocarp forest of Southeast Asia and the mixed tropical forest of West Africa. Perhaps the tropical American forests have some slight geographical advantage in being nearer to North American markets than are the other tropical areas.

The tropical forests of Latin America make up 45.% of the tropical forest area of the world. However, of the *900* million hectares (2.2 billion acres) in tropical American forests, only 27% are considered accessible under present harvesting methods.

From Table I it may be seen that, in spite of having the major tropical forest area of the world, exports of wood products from tropical America hold a minor position in the tropical wood trade except in lumber. Reliable figures

are not available on local use for many countries, but wood exports from tropical America have failed to keep pace with increases from other tropical regions.

Because of local areas of abundance, the woods Cativo and Virola in tropical forests, over limited areas, are an exception to the predominance of complex mixed tropical forests. Because of their medium density, abundance, and accessibility, they have achieved a prominent place in both local and export markets for lumber, veneer and plywood in recent years.

Virola occurs in Guatemala and south to the Amazon Valley. It is sometimes found concentrated in almost pure stands in fresh water swamps in the delta areas of some of the larger rivers. At the mouth of the Rio Mira near Tumaco, Colombia, stands with volumes as high as 20 MBF per acre are found. Stands with smaller volumes per acre are found in the deltas of the Orinoco and the Amazon Rivers, and in swamp areas along the Guiana coast.

TABLE 1. TROPICAL TIMBER TRADE EXPORTS

(Exports in 000 cubic meters)

Product	Americas		Africa		S.E. Asia		Total	
	1964	1966	1964	1966	1964	1966	1964	1966
Sawlogs	455	582	5,601	5,081	11,907	16,651	17,963	22,314
Lumber	1,724	1,796	730	782	1,783	2,202	4,237	4,780
Plywood	29	51	115	111	891	1,284	1,035	1,446
Veneer	16	21	85	124	120	257	221	402
Totals	2,224	2,450	6,531	6,098	14,701	20,394	23,456	28,942
Tropical World Forest Area	45%		36%		19%		100%	

Source: FAO Yearbook of forest products statistics, 1966, 1967.

Cativo has a more limited distribution, occurring from Costa Rica to Colombia. It is also a swamp species found in river overflow areas. Because of its dimensional stability, this wood has become accepted as pattern stock lumber, in addition to being used for plywood veneers.

Aside from the Virola and Cativo forest areas, only general indications of standing timber volumes for tropical American forests are available. FAO's "Latin American Timber Trends and Prospects"[1] pinpoints the situation when it says, "nowhere else in the world is there such a large area of forests about

[1] Latin American Timber Trends and Prospects. Economic Commission for Latin America. Food and Agriculture Organization of the United Nations, New York, 1963.

which so little is known." Estimates of the average timber volume in the forests which are being worked range up to 190 M^3 per hectare or 20,000 board feet per acre log scale, with some exceptions running higher. However, only a very small portion of this volume can be harvested under the present methods of utilization.

A feeling for the complexity of these tropical American forests can perhaps be given by referring to the FAO report "Forest Inventory in the Amazon Valley" 1958. In the area between the Tocantines and Xingu Rivers one major forest type had a total volume of 27 MBF per acre above 10 inches DBH. However, it took 46 of the most abundant species combined to make up 50% of the total stand volume. These woods are mostly unkown commercially. Because of the physical characteristics of the woods and scattered occurrence of the species, commercial development by conventional methods is presently impossible. To obtain the remaining 50% of the volume would add over 100 more species to the list.

The question of increased utilization of tropical American woods is more complex than merely determining the physical characteristics of the woods available and undertaking market research and development. With the trend to limit the export of logs from tropical forest areas in order to favor investment in local utilization projects, has come the need to plan continuous log production programs to justify and safeguard this investment. The facts of forest composition as related to logging economics may determine the possibilities of local utilization development. As long as such developments are limited to plants using a restricted number of species, the outlook is only rarely favorable.

To achieve viable economic projects in most areas of the American tropics, requires integration of various utilization technologies and may require investment funds from various sources. Only by achievement of significant breakthroughs in utilizing the heterogeneous wood resource of the mixed upland forest which makes up the bulk of the remaining tropical American forest resource, plus injection of the required investment capital and intensive sales efforts in local and export markets, can tropical America begin to produce forest products in a quantity commensurate with the size of that resource as compared with the other tropical forest regions of the world. It may be of interest to note, in connection with need for such efforts, that tropical hardwoods now represent less than 1% of the total wood product consumption of the North American market.

The technological advances needed are in the area of wood chip and fiber

utilization from a wide variety of woods with differing characteristics. If panel and paper products can be produced and sold at a profit from the wood chips and fibers of these mixed tropical forests, in combination with the conventional sawmill and plywood operations, then there is some hope of developing the programs needed. To continue to exploit these forests with conventional sawmill and plywood programs by themselves will result merely in highgrading the forests and leaving them depleted of the presently commercially-valuable species.

The area drained by the Amazon River and its tributaries is the largest continuous block of tropical forest in the world, an estimated 700 million hectares (1.7 billion acres). However, the obstacles to development in this region are formidable and account for the lack of any successful major wood utilization complex in this vast area up to the present time.

Other major forest areas awaiting development are those of Peten, Guatemala; the Atlantic coast of Honduras, Nicaragua, Costa Rica and Panama; Venezuela and the Guiana uplands; and the Pacific upland coastal forest of Panama, Colombia and Ecuador.

There are, perhaps, a few selected opportunities along the major tropical American rivers where conventional utilization operations such as sawmills, veneer and plywood plants can be located successfully. By taking advantage of economical water transportation, selected logs of acceptable species can be extracted from the river bank forest and delivered to strategically located mills. Log export to overseas markets is, however, rapidly becoming a thing of the past.

Woods for decorative applications or other specialty uses are as numerous as the trees of the complex tropical forest. Utilization depends on matching resource with a need or a market, and organizing an operation of enough different species to make logging of the mixed forest pay its way against low cost woods from other tropical forest areas of the world.

Harvesting trees from the forest for useful products is only the initial step in resource management programs necessary to protect the environment at the same time that it is producing the materials required for use by the growing world population. It is necessary to view the timber resource position, of itself, in terms of economic dynamics, as a part of the large world-wide economic and industrial picture.

The mixed tropical forest of equatorial regions has been characterized as making the maximum capture and re-utilization of incident energy from the sun of any vegetative formation on the earth; and also as being a hydrocarbon

factory of enormous productivity. However, there is still a very long way from having the knowledge which is needed to enable science and industry to take advantage of this situation in the American tropics.

Other Sources

Russia and the Scandinavian countries compete with the North American for European, and other world markets, especially in the field of pulp and paper products. Finland is the second largest exporter of birch plywood to North America, and at one time before the war Russia participated in this trade. Presumably there are no opportunities at this time for us to participate in the production of these trade items.

However, the region of Eastern Siberia in Russia might in the future present a development challenge in which we could participate. Russia has been exporting logs from this area to Japan and it is possible that products from these logs reach our markets. Negotiations are going on intermittently between Russia and Japan to establish joint venture forest resource development programs in Eastern Siberia to supply export markets. Our participation in such programs perhaps seems remote at this time, but presumably not forever. The temperate hardwoods of birch, maple, oak and others could move in our markets in addition to products from existing coniferous species. The FAO World Forest Inventory gives no break-down of resources for this area, so one can only speculate on the possibilities for development programs.

Australia and New Zealand have forest resources, especially pine plantations, that may have a future impact on the Pacific area trade.

East and South Africa are not self-sufficient in their forest resource position. However, recent pine plantation programs in this area may cause a gradual change in the movement of trade, especially in pulp and paper products.

Chile is a forest resource area that comes to our attention as needing venture capital and technological know-how to develop both plantation and natural forest resources. Because of geographical location with relation to our markets little positive response is evident to proposals from this area.

Conclusion

In recent years the Forest and Forest Products Division of FAO has published a great volume of pertinent information on the resources and trade from some of the areas we have been discussing. Forest inventory projects are active in many areas. A study currently in progress is one to chart and project the growth in GNP as related to forest resources and forest product requirements

in the underdeveloped countries. These studies will be of significance in planning for the future.

In conclusion, the tropical forests of the world contribute not more than 1% of the North American volume of wood consumption at present. Perhaps this should be taken as an indicator and not expect a sudden surge of products to relieve our responsibility for planning and managing the utilization of our own tremendous North American forest resource. We come back then to Zivnuska's conclusion that we must solve our own forest resource problems based on what is ours to manage. If we have investment capital, brain and muscle power left over, there certainly is an export market for these, with opportunity for rewarding accomplishments, in solving the problems of the under-developed tropical forest resources of the world.

INDUSTRIAL FOREST MANAGEMENT

B. E. Allen

My assignment here today deals with progress and problems of industrial forest management. As a preface to what is to be presented, you should know my woodlands experience has been in the South with a pulp and paper company, and has been concerned principally with pine silviculture and management.

In the brief time allotted to me, we will rapidly up-date your thinking by looking at the First, Second, and Third Forests, with which the southern wood using industries have had to deal. We will discuss at length the Third Forest, break it down into some of its major components, identify the variables which can be controlled, and express some possibilities which exist for intensifying forest management and making it more profitable. My remarks will deal entirely with pine. Each projection will refer carefully to the profit concept, the cost calculations which attend all corporate investments, and to the external and internal pressures always attendant to the decision-making process.

It might be well at the outset to define the characteristics of industrial forest management. In general, there is substantial agreement that the forest is a competitive enterprise. As it relates to the operation of a pulp and paper mill or to any wood-based industrial concept, the forest exists for its contribution to the manufacturer that owns it. Its purpose is to provide all or a portion of the wood resource needs of the corporate entity at a reasonable and acceptable cost. Forest management for wood fibre production is not an end in itself. Trees are just a crop and they must be manipulated, managed and manufactured as such. They must be treated in a way to produce recurring harvests of wood - dollars if you please - at a profit, on projected and precise time schedules.

Objectives of industrial forest management, of course, are basically those of the parent company. These goals may not necessarily coincide in every instance with those sometimes thought of as classical forestry. The substantial *invest*-ment in the basic,manufacturing facilities and the marked dependence on controlled resources dictate a continuing sustained yield management for corporate forests. Short range requirements external to the forestry organization will require a flexible program and regime that may have to periodically depart from rigid concepts of forest regulation. A case in point, of course, is to recognize the pressures arising from time to time from non-controllable external factors.

Weather, labor and rail car shortages, along with difficulties in purchasing open market stumpage, may require substantial departures from strict regulation of the cut to supply the wood necessary to keep the mill going.

Then there is the demand on the corporate treasury for substantial amounts of money to finance a forestry enterprise and at the same time to satisfy the many fiscal requirements of all the other segments of the corporation itself. This simply means that any forest manager in the industrial household is competitive with the others in the corporation who are seeking capital to expand a pulp and paper mill, build a new box plant, renovate or replace manufacturing machinery, or purchase another profit-making enterprise. In some instances, the forest itself must generate the capital to perpetuate itself or add to its length, breadth, and depth.

It might be well to look back down the road and see where we have been and then, of course, to look forward to the future. Much has been said and written in recent times about the First, Second, and Third Forests. Indeed, the theme of the recent 1969 American Pulpwood Association meeting in New York was "The Third Forest".

Up to 1925 the industrial woodland ownership in the South was largely held by big sawmills. This was the First Forest. Most of these early operations were on a cut-out and get-out policy. There transpired many land use changes, influenced principally by the effect of the boll weevil on cotton growing, the abandonment of farms, and the movement of rural population to urban centers. Many agricultural farms lay idle and reseeded naturally. Such was also the case for much of the cut-over timberlands, particularly where a semblance of fire protection existed. These particular circumstances brought about the Second Forest, which is still furnishing most of the raw material to industry.

The Second Forest was not without certain hurdles to overcome. In the South we have lived with the age old problem of fire. We are happy now to say that mass education, plus public laws which have been passed, and an enlightened public, have greatly lessened the impact of the fire problem, although it is certainly not eliminated.

Even as late as 1955, many of the expert forest practitioners were utilizing natural regeneration systems, seed trees, and in some few instances, direct seeding. The bad fire seasons of 1954 and 1955, in which hundreds of thousands of acres were burned over, introduced intensive site preparation and artificial reforestation en masse, which today characterizes most of the enlightened industry effort in forest management - particularly in slash pine - and is being initiated in loblolly pine.

There has been a tremendous amount of tree planting on abandoned farm land. The recent Soil Bank action by the Federal Government accounted for the reforestation of hundreds of thousands of acres. Today, many of those tree farm plantings are now available as pulpwood for either a harvest cut where short rotations are desirable or for thinnings at the end of twelve to fifteen years. We are mindful, of course, that along with this planting on abandoned farm land, there has been a distinct decline in the amount of natural pine reproduction. This has been particularly true of long-leaf pine.

All of these practices have brought about the change from forests of mixed ages to even-aged management. Today, most of the artificial reforestation effort is taking place on true forest sites. There is a tremendous amount of intensive site preparation and costly type conversion taking place. Expenditures of $35 — $40 per acre are commonplace. Initial costs up to $65 — $75 per acre can be currently justified on high quality sites. Site preparation in this sense consists of using heavy, specially built equipment and machinery which shears, chops, piles, harrows and plows up the forest cover and prepares the site for planting. Bedding to consolidate and raise its level along planting rows, is frequently used to improve soil moisture conditions and thereby upgrade the site. In many instances, forest type conversion is taking place through elimination of the scrub hardwoods and low grade cull trees. Most of the higher quality upland sites are being put back into pine — but a few to high quality hardwoods. Calculations will reveal that such heavy expenditures can only be economically justified with high yields, early returns and lower harvesting costs.

This brings us up to the Third Forest, which is the artificial, manmade forest. It is characterized by being largely planted in rows, with the trees in the rows also spaced uniformly, relatively speaking. This forest structure is going to provide some very interesting possibilities for mechanization as it relates to harvesting regimes.

Today, in 1969, we are taking a last look at our First and Second Forests, which are in the process of being cut over and replaced with the Third Forest. Our management and harvesting efforts have had to work in large measure with what nature provided. We are now trying to improve on Mother Nature by artificially reproducing the Third Forest.

By and large, the major elements of the industry in the South, and particularly in the slash pine belt, are presently accomplishing their woodlands regeneration by practicing intensive site preparation, using seedlings grown from genetically improved seed, and applying fertilizer at appropriate times. In some instances, fertilizer is applied at time of planting, and in other in-

stances three to five years prior to time of harvest. Several sophisticated forest fertilization research programs are now under way to shed light on economic possibilities and growth potentials.

In this Third Forest with which we are concerned, we are controlling more aspects of its environment, makeup and protection. At the same time, our corporate managements are insistent that we consider, project, and account for the cost of creating the end product. Any expenditure put into the Third Forest must be measured by what its ultimate cost will be at time of harvest and compared to return. Most of the industry is quite familiar with the financial importance of interest in forest production planning. We should hope and pray that our present calculations will not require the use of interest rates significantly above the 6% level which for so many years was the favorite working rate of the company comptrollers.

As previously mentioned, one of the significant features of the Third Forest is the matter of tree improvement by genetically controlling both parents of the tree seed. Much has been said about this phase of forest management, and I will not dwell at length on it except to state that it has tremendous promise. Evidence accumulates yearly showing that growth rates, as well as specific gravity and resistance to insects and diseases, can be significantly increased. Certain strains of trees are demonstrating more significant response to fertilization. These and other important factors can be genetically manipulated and improvements obtained by controlling both parents.

The intensification of management on the Third Forest is now a matter of accomplished fact. Undoubtedly the cultural refinements, as site preparation and fertilization, may and will be extended and intensified.

The establishment of this new Third Forest has created an entirely new ball game, with different ground rules than ever before encountered, substantially varying configurations, and a whole set of distinctly new problems. For instance, fire fighting in the man-made forest is a real challenge. A typical ten year old pine plantation may provide a mass of fuels one-half mile square and thirty feet high, to which access is extremely difficult, the fuels highly volatile, and on a Class 5 fire day a worthy adversary to any fire control organization.

The widespread use of pine monoculture by artificial regeneration has, in the opinion of many skilled forest managers, opened up possibilities for other disasters such as insect and disease epidemics. Particularly vulnerable will be those pine plantations which have been established beyond their normal and natural area of occurrence.

With all the plusses that accrue from growth acceleration introduced by

genetical control and application of fertilizer, there might be produced a progeny with less desirable characteristics, including wood of lower specific gravity and inferior insect and disease resistance. In short, this new man-made forest structure provides many opportunities for the forest manager for substantial improvement of management and utilization; however, associated problems must not be overlooked.

We cannot omit the fact that intensive forest management also provides the opportunity for improved utilization. There are many harvesting regimes that contemplate chipping in the woods. Indeed, one company has a method whereby barky chips made from slabs and small pine trees can be economically separated into bark (which is burned for fuel) and usable wood (which is pulped) at its plant. Some mills are now incorporating sawdust into their wood requirements. It is not too hard to predict that, with the spiraling increase in stumpage costs, the utilization of more tops, limbs, and perhaps even root systems will become attractive possibilities to supplement the wood resource. Systems delivering tree lengths and multi-length logs are in widespread use in many areas.

Many new mechanized harvesting techniques and machines are on the drawing boards. Indeed, within the last eighteen months, six companies have banded together and pledged a maximum of $900,000 per year to finance a five-year program of intensive evaluation and basic research in mechanical harvesting of pulpwood. It might be interesting to look back at the American Pulpwood Association Directory of Research and the Growing and Harvesting of Pulpwood of 1956 - and that is only thirteen short years ago. In their "Tools, Equipment and Material Section", there is no reference to Busch-combines, rubber-tired skidders, or hydraulic shears; only bow and cross-cut saws, a brief review of wheel power saws, peavies, cant hooks, and a short chapter on transport by man and animal power - horses if you please.

One of the most interesting concepts of ultra-modern forest management is the use of operations research utilizing the sophisticated computer complexes. We are quite familiar in our organization with forest operations simulation, whereby a computer can be programmed to simulate and duplicate a model of a forest. With this type program, the forest manager can actually simulate any type, schedule or regime of forest management and obtain a print-out of varying results in short order. The forest manager consequently can test theories, practices, cutting cycles, rotations, costs, production, and other controllable variables at will, all measured with the common denominator of present net worth.

The Third Forest and its intensive management is making us aware of problems we did not know we had. Actually, all new problems are old and have always been present, but now these puzzlers can be arithmetically identified· and mathematically equated. As with any complex corporate endeavor, there are always manifold complications.

It should be observed that no wood-using industry, or even a single mill, will be able to justify and sustain complete dependence for its supply on fee ownership or long-term leases. The outside, non-industry ownership will play a major role in growing the raw material supply. The farm woodlot will always be of interest to major wood-users.

One ever-present factor of concern to the forest manager is the matter of communication. This particularly has to do with the establishment of the forester's goals and objectives. It is necessary to differentiate between various and changing targets, keeping in mind that often the short range or even long range corporate view may be contrary to a rigid woodland management plan. The communication effort must be concerned with, recognize and translate, the long term versus the short term goals. The matter of corporate policy and its concern with the elements and principles of forest management is something that requires extra effort on behalf of all levels of corporate administration and supervision to be sure that the communication channels are kept open. All.personnel should fully understand the ultimate objectives - even though the precise pathways for attainment might sometimes be slightly obscure.

The responsible forest manager, regardless of his particular echelon or position, must remember to provide his superior with the best information possible on which policy and management decisions can be based. It is important to be objective, trying to recognize all sides of the problem. The presentation of thinking, philosophy, and the recommended plan of action should be as forceful as necessary; then the decision of future action *is* up to management. Once the decision as to future action is handed down, the forest manager must then be concerned with *its* implementation. Management has the concurrent responsibility of accepting recommendations from the field in good faith. Should there be over-riding factors which require a departure from the forest manager's original recommendation, then the management has the obligation of communicating back to the field as to why there must be a substantial variation. In this way, the field -implementation of the job will be with the proper attitude and with full knowledge of the whys and wherefores.

The entire subject of communications is one that could well be explored in depth. There is no segment of the industrial forest community that is exempt from this vexing question in a complex corporate picture, complete with major

management, professional foresters, engineers, salesmen, accountants, and others. The communication problem constantly exists.

The pressure on land use in the immediate near-term and the years ahead is something to which any forest manager must give full recognition. There are the demands of recreation, compounded by the shorter and shorter work week. Some well-meaning individuals and strongly motivated groups are militantly opposed to some of the newer silvicultural techniques in forest management - especially where clear-cutting the mature or present timber stand is involved. The affluent American families who are seeking places to go and things to do are contributing to the difficulty as they find themselves with more leisure time on their hands and more money to spend. The encroachment of roads and highways, the requirements for rights-of-way, the constant demands on the clearing of strips of forest lands for telephone, telegraph, and utility lines are most significant.

One of the biggest puzzles of all is that of forest land ad valorem taxes. In some counties today our 1969 tax rate will be as high as $1.50 per acre for the year. It does not take much of a mathematician to translate this type of annual expenditure at 6% or 7% compound interest into a very significant investment, even on a relatively short rotation. This is a real stickler of a problem that ultimately will have to be mutually and satisfactorily resolved. Otherwise, burdensome taxes approaching confiscatory proportions will play a deciding and perhaps depreciating role in the determination of forest rotation ages and the size trees that will be grown. One favorable tax aspect that has been successfully established in Alabama is to exempt all trees and timber from taxation, and place all the ad valorem tax load on the forest land itself. Some refinements of this particular concept is to classify the basic productivity of the land so that various woodland sites will carry different tax rates. Ultimately, unwise and oppressive taxes could result in enough pressure to require serious evaluation of alternate land use as opposed to growing a long-term crop like trees.

Some areas in the South, particularly in the Mississippi Delta Region, are subject to heavy agricultural use demands. The widespread growth of the soybean industry has taken hundreds of thousands of acres of land out of timber production - principally hardwoods. Along the North Carolina coast today there are a number of areas that are being cleared up for large-scale agricultural endeavors. We anticipate that, over the entire South, the high quality forest land that has been planted with trees or allowed to grow up in seedlings will come under strong pressure to go back to agricultural crops and permanent pastures.

You are familiar with the U. S. Forest Service policy and their concept of

forest management, and their repeated reference to the principle of multiple use. Any industrial forest manager must also think in terms of equating multiple use versus specialized use. The modern concept of intensive industrial forestry almost requires that large areas be dedicated to wood and tree production. Some other uses can be brought into the picture, but they must be subordinated to maximum wood production. This, of course, is due to the fact that the high cost of owning land — taxes, management expense, the accumulation of interest on the investment, and limited acreage in really highly productive forest sites — require that wood production be paramount on certain acres.

While our discussion here today is limited almost exclusively to basic forest management, we must remember that forest mensuration is an important element of successful woodlands administration. Thirty years ago, to students at Schools of Forestry, there did not seem to be many new concepts and techniques of forest mensuration to be developed. Now each cultural change in our concept of the tree crop and forest operation requires a new evaluation of growth and yield and the mensurational procedures necessary to evaluate and measure same. We not only need to know in detail our wood inventory in volume, sizes and species, but we must be able to carefully evaluate the cost impact of varying cultural practices. We have to be able to predict rapidly and fairly precisely the volumes of wood that will result from given cultural refinements and on different forest site classes 10 — 15 — 20 — 30 years hence. We must also have a pretty good idea of what diameter and height ranges will be available. Some sophisticates would require forecasts of weight, quality, and possible pulp yields. Due to the intensity of competitive markets, the forest manager no longer can hide behind the built-in over-run of the Doyle Rule that was 10% plus or minus on the cruise and yielded an additional 40% to 50% favorable overrun factor due to the mathematics of constructing this particular scale rule.

Any forest manager worth his salt must constantly come to grips with the age-old problems of supply and demand. Forest production as an industrial concept is not an end in itself; it is simply a working part of the corporate machine. The forest manager must consider the overall projected national and world demands for the final product he is seeking to achieve. He must keep in mind the wood resource statistics nationally, regionally, and for the state (or certain parts thereof).

Needed estimates can be made by projecting the overall corporate wood requirements by regions and by years. Then, with reference to corporate policy, determine the percentage of the total wood requirements that should be controlled and harvested annually from company ownership. This readily can be

translated to how much woodland area a company should own, considering its total needs and the internal demands for financial requirements and/or other limitations. The growth rate of the species, what influence the potential genetic improvement will have, and the possible impact of fertilization must also be considered. An estimate must also be made of attrition to the land base due to the demands of other land uses, such as recreation, reservoirs, highways, and other rights-of-way.

Basically, the forest investment comes down to a matter of economic justification. The woodlands manager must relate the production of company wood to open market purchases. In so doing a rather complex evaluation of today's wood prices and the cost of forest management needs to be developed. It is then necessary to project this to the future to make a determination of what values can be put on the production of company wood versus buying in the open market. Keep in mind that levels of justification will vary for different regions — depending on overall stumpage availability and marketability.

A number of large wood-using companies have tried the policy of having no back-up of company land in supplying wood for their mills. In my opinion they are headed for rough sledding down the road to supply their mills. A major wood consumer today in the South should be able to own, or at least control by contractual cutting rights, a substantial portion of its annual wood requirements.

This particular policy is much easier to say than to prove to some corporate managements. In any company there is constant competition for funds. Specific forestry investments are not only compared with other alternative forestry investments, but against all other investing opportunities, some of which have very high payback or return on investment. Woodlands management is constantly reminded that a 6% return on forestry investments does not stack up too well against a 15% return on manufacturing investments — even when allowance is made for favorable tax liabilities such as capital gains that is obtained from selling or utilizing owned stumpage. This naturally leads to the question of how much company controlled stumpage is really worth to the firm. It is truly a strategic situation, and if so how do you evaluate and measure in dollars and cents? What is the true value of your own wood in smoothing out spiraling increases in the cost of open market wood?

One of the more interesting concepts that a forest manager must master is the economics of his specific management area. What type of forest product is he shooting for? Should the pulp manufacturer grow other products, such as sawtimber and poles on their forested acres? How is this established in stra-

tegic and tactical planning, so that markets are anticipated? What length rotation to use is an interesting exercise. What about thinnings? Is maximization of present net worth, which is another way of saying discounting cash flow, the goal, or should wood volume production be given top emphasis? How can we manipulate forest management to contribute most to corporate earnings? How do you subordinate or expand a woodlands division operation to the best interests of the overall corporate picture? An easier way to perhaps state all of this is to paraphrase Charlie Wilson's famous expression and say, "What's best for the woodlands division is best for Union Camp."

As we conclude, let us not forget another controversial but challenging feature of forest management, and that is: "To what extent is it a social science?" The biological posture of forestry can be an abstract science, while other forest management aspects have social implications. Time does not permit exploring this topic in depth. There are basic and wide variances that exist between industrial forest management and idealized forestry. The interesting question is how to resolve these inconsistencies, and, if not resolved, how to continue justification of the difference.

A number of informed industrial foresters today are of the opinion that a portion of industrial problems of properly controlling air and water pollution can be handled in some meritorious manner by the wise use and management of growing trees and forests. Much research is necessary before this hypothesis can be explored.

What is the ultimate determinant of forest policy? Is it the high dollar? Ten dollar bills, of course, provide a suitable and easy measure for determining the profitable production of any operation and to calibrate a corporate justification. Dollars produced by steady employment are really what make the grist mills grind. The old agricultural economy of the South of past years broke down. It was replaced by a thrifty, sparkling, industrial boom which is being paced largely by the forest based industries.

It would appear that today's industrial forest manager has the unique opportunity to make major contributions to his company's profits; to assure the perpetuation of his employer's operation into the future; to assist in solving some of the more complex social problems of the day; possibly shed light on making our world a cleaner and healthier place in which to live; and perhaps — most importantly of all — to make this old world a little better place for us all.

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