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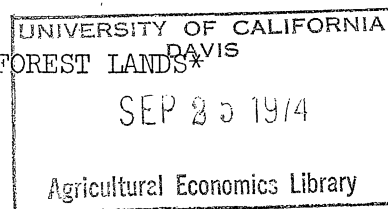
1974

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ECONOMIC TRADE-OFFS IN MULTIPLE-USE MANAGEMENT OF FOREST LANDS*

by

Marion Clawson



"Multiple-use" is a term with great emotional appeal, but it is more a slogan than a management guide, and its meaning often varies according to the user. If one implies that every conceivable use of forest land should occur on every acre every year, multiple use is impossible, even nonsensical; if one means that some uses can be accommodated to some other uses on the same land at the same time, there exists more but still rather limited possibilities; but if one means that various uses can take place on closely intermingled tracts of land at the same time, or on the same land at different times, with the whole management area managed for multiple uses, then the possibilities widen greatly. There is great need to give "multiple-use" some operational content, and hopefully this paper is a modest step in that direction.

First of all, we must realize there is an enormous variety of forest situations in the United States. Taking into account major

* This article draws heavily upon a book length manuscript in press at Resources for the Future, entitled Forests for Whom and for What?, by Marion Clawson, to be published within the next year; and upon a recently published working paper by RFF, Forest Policy - Conflict, Compromise, Consensus, which grew out of a recent forum on forest policy, held under RFF sponsorship. Readers should also refer to the recent Report of the President's Advisory Panel on Timber and the Environment (Government Printing Office, Washington, 1973) for specific data as well as for analysis.

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Contributed paper, AAEA, College Station, Texas, Aug. 1974

forest types (the Forest Service recognizes 20, for some purposes I have compressed these into 14), several major regions of the nation, (however these are defined), 5 productivity site classes, at least 4 major ownership categories, and several stocking types and volumes, I have concluded that there are at least 4,000 forest situations in the United States significantly different as to management possibilities or purposes. For some purposes, it is as valid to generalize about "forests" as it is to generalize about "farms" or factories or schools; but for many purposes it is necessary to distinguish carefully among these many different forest management situations. In this paper, because of space limitations, I shall generalize at a level which would be unacceptable if one were trying to work out a management program for a specific forest type, in a specific location, with certain site qualities and existing timber stand, and for an owner with specific goals, objectives, and limitations.

For our purposes, forests have four major characteristics or attributes (Table 1). All forests occupy land, and land is essential to each of the uses shown in the Table; while uses might be defined differently by other workers, any definition of forest uses will reveal land area as a necessary characteristic for each use. Forests also have timber stands, which may range from zero on a recently cut or burned tract to the biological maximum the site will support, in a mature stand not reduced recently by fire, insects, or disease. Timber stand volume has a different significance to the different uses of the forest; wood production requires a thriftily growing stand, neither the

Table 1. Interrelations of Forest Characteristics and Forest Uses

Forest characteristic	Relationship of the forest characteristic to the following forest uses						
	Maintain attractive environment	Provide recreation opportunity	Wilderness	Wildlife	Natural watershed	General conservation	Wood production
Land area	Essential	Essential	Essential	Essential	Essential	Essential	Essential
Timber stand volume	Modest stand attractive, but most productive stand not required	Moderate importance; open stand often more attractive than full stand	Volume at maximum site will produce but actual volume unimportant	Kind and numbers of wildlife responsive to stand characteristics	Important to have good cover but timber volume of limited importance	Helpful to have good cover	Thrifty growing stand essential; too small or too large volume reduces growth possibilities
Annual growth	Not very important	Limited value	Unimportant; in practice, often close to zero	Limited importance	Relatively unimportant	Relatively unimportant	Critical for long run rate of harvest but growth rate also dependent upon harvest
Annual harvest	Inimical but careful planning and operation can reduce impact greatly, and may enhance appearance in some instances	Possible under carefully controlled conditions and on rotation	Unacceptable; destroys basic value of experience	Acceptable under proper controls; desirable for some species	Acceptable under proper controls	Acceptable under proper controls	Critical both for use of wood and for its further growth

very low volume of a poorly stocked stand nor the maximum volume of a mature stand on which net growth approaches or reaches zero; in contrast, wilderness use requires the maximum volume the site will support as a natural timber stand, but some wilderness areas have no commercial timber on them. Active outdoor recreation is generally more pleasant on a forested than on a nonforested site, but a light and open stand is likely to be more attractive to most users than is a dense stand. As the Table indicates, other uses have other requirements for timber stand.

Annual growth, the third major characteristic of forests, also has differing significance for the different forest users. Wood production depends, in the longrun, on wood growth; in contrast, annual growth is of limited importance to the other major uses, if adequate timber stands are present; in a wilderness area, if the stand is really at the natural stand maximum the site will support, then net annual growth is zero. Annual harvest of timber, wildlife, or even recreation opportunity is the fourth major characteristic of forests. This is, of course, critical to wood production, for it is harvest which produces income; harvest is also often an important point in the life cycle of the forest at which management practices can be applied; and, in the longrun, harvest is critical to timber growth. A forest landowner cannot long cut more timber than he grows, for at some point he uses up all his inventory; but equally he cannot grow for very long more than he harvests, for in time inventory reaches a level from which no more net growth is possible. In sharp contrast, timber harvest is

completely antithetical to wilderness preservation and use; it is, or can be made, acceptable to most of the other uses, if proper and adequate measures are taken in the timber harvest to reduce adverse impacts on other uses.

Table 1 is in very general terms, applicable in large degree to all forests. The relationships between uses and characteristics are more physical than economic, although they have economic implications. Different forest owners, with different objectives or purposes in ownership, might well utilize these interrelationships differently. The differing requirements of the differing forest uses suggest some possibilities for reconciling their apparent conflicts.

The different forest uses shown in Table 1 have differing degrees of compatibility or conflict with other possible uses (Table 2). The greatest incompatibilities exist between wilderness, moderately intensive outdoor recreation, and timber harvest. Wilderness is completely incompatible with the other two; timber harvest destroys the undisturbed ecological system which the wilderness lover values so highly, but intensive recreation as surely destroys the character of the wilderness experience. Limited compatibility exists between timber production and recreation (other than wilderness); some such recreation, especially hunting, can take place on cutover areas, may indeed be facilitated by timber harvest; and some timber harvest may take place on recreation areas, either by carefully managed cutting or by rotation of recreation sites, such as campgrounds, and timber harvest areas.

The other uses of the forest generally range from moderately to fully compatible with each of these three "incompatibles", if adequate

Table 2. Degree of Compatibility among Various Forest Uses

Primary use	Maintain attractive environment	Provide recreation opportunity	Wilderness	Wildlife	Natural watershed	General Conservation	Wood production and harvest
Maintain attractive environment	XXXXXXXXXX	Moderately compatible; may limit intensity of use	Not inimical to wilderness but does not insure	Compatible to most wildlife, less so to a few	Fully compatible	Fully compatible	Limited compatibility; often affects amount of harvest
Provide recreation opportunity	Moderately compatible unless use intensity excessive	XXXXXXXXXXXXXXXXXX	Incompatible; would destroy wilderness character	Incompatible for some kinds; others can tolerate	Moderately compatible; depends on intensity of recreation use	Moderately compatible; incompatible if use too heavy	Limited compatibility depends on harvest timing and intensity; roads provide access
Wilderness	Fully compatible	Completely incompatible, can't tolerate heavy use	XXXXXXXXXX	Highly compatible to much wildlife, less so to others	Fully compatible	Fully compatible	Completely incompatible, precludes all harvest
Wildlife	Generally compatible	Limited compatibility; use intensity must be limited	Mostly compatible though some wildlife require vegetative manipulation	XXXXXXXXXXXXXX	Generally fully compatible	Generally fully compatible	Generally limits volume or conditions of harvest
Natural watershed	Fully compatible	Moderate compatibility; may require limitation on intensity	Not inimical to wilderness but does not insure	Generally compatible	XXXXXXXXXXXXXX	Fully compatible	Moderate compatibility; restricts harvest methods but does not prevent timber harvest
General Conservation	Fully compatible	Moderately compatible; if use not excessive	Not inimical to wilderness but does not insure	Generally compatible	Fully compatible	XXXXXXXXXXXXXX	Compatible but requires modifications in methods of timber harvest
Wood production and harvest	Compatible if harvest methods strictly controlled	Moderately compatible	Completely incompatible; would destroy wilderness	Compatible if harvest methods fully controlled	Compatible if harvest methods fully controlled	Compatible if harvest methods fully controlled	XXXXXXXXXXXXXX

measures are taken. Timber harvest, for instance, can be so conducted as to avoid severe disturbance to watershed and to stream flows, both quantity and quality; or to reduce greatly the aesthetic shock of harvest; or to maintain, and sometimes to improve, the wildlife habitat. Wilderness, while incompatible with timber harvest and intensive outdoor recreation, maintains watersheds in natural conditions and is favorable to many kinds of wildlife.

Neither Table shows certain land uses which may occur on forested sites but do not really use the forest. Highways and transmission lines are good examples; so is mining. Even grazing, which may take place on a forested area but mostly utilizes vegetation other than the trees, may be an example of this kind of use. So may the "second home", which utilizes the trees of the forested tract about as the suburbanite utilizes the trees on his lot. While these uses do compete for forest land, they are largely irrespective to the forest -- indeed, for them, the forest is frequently a liability, something to be gotten rid of.

Transformation Functions

The foregoing type of analysis is suggestive but inadequate for the economist; it is too subjective, verbal when it should be quantitative, and does not recognize that the nature of the relationship between outputs depends to some degree on the scale of one or the other. The

economist needs, as a first step, transformation functions -- when the output of some product or use is increased, what effect does this have on the output of some other output or service of the forest? Even when outputs are generally compatible, they are often not in fixed proportions; and when compatibility is more limited, the trade-offs between more of one output and less of another become more important.

For instance, wildlife specialists often talk about leaving unharvested some old trees, often snags or "wolf trees", frequently malformed for conversion into lumber, which may be vital to some species of wildlife. But how much wildlife, of what kinds, are so produced? Is the production of some wildlife increased while that of others is decreased, and, if so, how much? How much loss, of what kinds, and on what time scale, would such measures mean for the production of wood? Or, to take another example, it is often urged that trees along streams or around lakes be left unharvested, to provide shade over the water and a screen of vegetation against erosion, when a major timber harvest is undertaken. But how wide a belt of unharvested trees should be left? What is the risk that wind will bring them down, and thus perhaps cause more damage to the quality of stream flow than if they had all been harvested in the first place? Can the reserved trees later be harvested without ill effect? Or may it become uneconomic to go back for their comparatively small volume? In other words, how much water quality is obtained at how much loss in wood output, now and for what time stream in the future?

This type of example, of trade-off of one output for another, in the mix of outputs from the forest, could be multiplied many times.

Obviously, the nature of the trade-off would depend upon forest type, site class of the area, present condition of the stand, and many of the other variables briefly mentioned above. The trade-off may depend on the volume of one or more outputs -- one effect of timber harvest upon wildlife when the volume of timber harvest is low, another effect when it is large, and so on. I am now talking about physical trade-offs; the valuation problem is discussed later. Some information exists on these physical trade-offs, but often it is woefully weak. To use the examples above, the wildlife specialists or the watershed specialists can often prescribe the measures they think are needed for a desired degree of output of the service they are interested in; but only rarely can they provide information as to what is given up thereby -- they are likely to prescribe certain rules, more or less absolutes, without specific information on trade-offs.

But the economist also needs information on input-output relationships for each kind of forest output. Inputs of labor, capital, and entrepreneurship are needed for forest management, for any forest output or combination of outputs. The management of the forest may be extensive, ranging from virtually no management beyond periodically cutting everything on the site that can be run through a saw profitably, to various measures designed to improve the future stand by selective cutting of the present stand or by insuring in various ways natural

seeding of young trees on a site after harvest. The various extensive forms of forest management mostly involve manipulation of "natural" stands of trees -- "wild" trees, which seed by their own efforts, at their own spacing, no thinning by man but only by the natural forces of competition for sun and water, and so on. Extensive forest management includes comparatively low quantities of inputs.

Various gradations in intensive forestry are available. For instance, genetically superior seedlings can be grown and planted, and the natural reproduction of unimproved stands suppressed or replaced by the prompt planting of the improved seedlings. Trees in almost every forest stand are, by and large, extremely mixed in genetic make-up; the competitive process whereby hundreds or thousands of small seedlings grow into a comparatively few mature trees per acre often eliminates most of the "unfit" seedlings. But genetic improvement by sheer selection of superior individuals, permitting them to reproduce, and using their progeny for another round of selection -- a process which was once highly important for farm crops, but which is now largely unproductive there because most of its gains have been achieved -- is thoroughly practical for forestry today. Various ingenious ways have been devised to identify the superior individuals when they are mere seedlings, and various other ingenious methods of speeding up reproduction are now being developed, to greatly speed up the process of genetic improvement.

Intensive forestry includes far more than selection of genetically superior seedlings. Planting to attain a desired degree of stocking,

precommercial and commercial thinnings at appropriate intervals, fertilization in some cases, sometimes eradication of "weeds", and other measures may increase wood production greatly. These measures are likely to be much more productive in combination than when taken singly; there will likely be less response to fertilizer on a lightly stocked stand than on a fully stocked one, for instance. Intensification measures are likely to increase annual wood production per acre more or less proportionately on forest sites of various productive potentials, but the absolute amount of the increase will be far higher on better than poor sites. The Forest Service and other foresters often employ a five-fold site classification, dependent upon the ability of a "fully stocked natural stand" to produce wood annually. Site Class I can produce 165 or more cubic feet per acre annually; Site Class V can produce only from 20 to 50 cubic feet of wood annually. This classification is wholly in physical terms; it takes no account of the value of the wood per cubic foot nor of the costs of harvesting it. A package of intensive forestry practices may double annual output per acre, but this may mean only 35 extra cubic feet of wood on a relatively poor site and as much as 175 cubic feet of wood per acre annually on the best site -- and at per acre costs or inputs not too greatly different.

Information on input-output relationships is best for wood production, although it is less complete here than would be desirable. Presumably, similar information could be developed for each of the other outputs or services of the forest. A basic item of needed information

is a site classification for each output; for instance, how would a wildlife specialist classify a forest for its ability to produce some species of wildlife, both as a natural forest and as a managed one? And how would the classification for wildlife production compare with the classification for wood production -- would the most productive wood producing sites also be the most productive wildlife sites? How might one increase the numbers of some desired wildlife species, and what effect would these management practices have on other wildlife or upon other outputs of the forest? One can multiply this wildlife example for every forest use shown in the Tables, and for every combination of two or more uses.

Economic Efficiency

For the economist, information on the physical trade-offs and physical transformation functions is a natural prelude to an economic analysis, and it is the latter which is truly significant. Does a 50% increase in wildlife production from some area have more value than a 1% reduction in timber output, assuming that this might be the physical trade-off in some area? For economic calculations, information on markets, prices, and costs are necessary; because of the time dimension of most forestry, interest or discount rates ~~assume unusual importance~~. Benefit-cost ratios and absolute margins between benefits and costs can

be calculated for different scales of intensity of management, different mixes of outputs, and other different conditions. These are familiar subject matter to economists; it is not necessary for me to explore them here today, and I prefer to use my limited time and space to consider other aspects of the multiple use forestry problem.

One problem, however, is rather more difficult for forestry than for many other resource management situations. A great many of the outputs of the forest listed in Tables 1 and 2 are not sold on a market, hence it becomes necessary to estimate shadow prices of their outputs. This, too, is a complex problem about which economists have been increasingly concerned in recent years, but I do not choose to explore it today. Sometimes, when the valuation problem becomes intolerably difficult and the results of various approaches have impossibly great dubiousness, one may resort to cost effectiveness approaches with better sense. Without attempting to measure the value of a minimum breeding stock of grizzly bears in some forest situation, for instance, one might calculate the cheapest way of achieving this end, and thereby provide information to rule out some method of forest management designed to achieve the result of maintaining a viable breeding stock of grizzly bears.

Compared with many other resource management problems, forest management presents two somewhat different or somewhat more than usually difficult problems. In the first place, wood is both output and capital; when the tree is cut and the log marketed, the wood is

output; when the tree is allowed to grow another year or longer, the same wood is capital, or productive equipment. By whatever method of analysis one seeks to decide whether to harvest a tree this year or in the future, a major item of cost in growing more timber is the interest that might be earned from investing elsewhere the capital which could be obtained by cutting the tree.) The bigger the tree gets, the more capital is tied up in it, all else being equal, and the culmination of mean annual growth, which is often the forester's standard for forest maturity, occurs long after the culmination of rate of return (current growth over stand volume). In some forests where the annual rate of growth is low, both in cubic feet per acre annually and as a percentage of standing wood volume, the most economic management practice is to cut as soon as a minimally economic volume for harvesting has been attained.

The other problem, not unique to forestry in kind but nearly so in degree, is the trend in output prices. When a forest management decision is under study, a relevant fact is the price or value of the outputs when they are ready to be sold. Lumber prices in the United States have advanced for nearly two centuries, at an average rate of about 1.8% annually, compounded. But this average rate of advance has included periods of several years when lumber prices were fairly steady, as well as periods when lumber prices moved up very rapidly. Stumpage prices have moved upward as much, or more, than lumber prices. Seedlings planted today are likely to be marketed some day as logs at prices far

above log prices today, but the precise date of marketing may greatly affect their prices. It is often argued that the value of wilderness is moving upward even faster than is stumpage price. We have no generally accepted value or price data on wilderness today, much less on economic value of wilderness at some past dates, hence quantitative calculations of trends in wilderness value are impossible, and we must perforce rely on logic or argument.

Equity or Income Distributional Effects

Although economists were long content to calculate benefit/cost, each as a single total, I regard this as unacceptably incomplete for policy decisions today. Even if the benefit-cost calculations are impeccable, and even if they properly show the total social cost and the total social benefit, this does not touch the difficult and slippery matter of [who pays the costs and who gains the benefits]. As a matter of fact, in forestry there is a large disassociation of costs and benefits. The forest owner, whether public or private, gains nothing from the value of the water which flows off the forest land, irrespective of its value and irrespective of the costs he may have incurred to maintain the watershed in desired condition; wildlife in forests rarely provide any income to the forest owner, however great their value to society may be; much outdoor recreation is provided free or at charges far below either cost to the forest landowner or value to the recreationist; those who enjoy the aesthetic values of forest rarely pay much of the cost

incurred in preservation of those values. The disassociation of costs and benefits is not only between persons, and often between social groups, but also between a local area and a national interest.

Social scientists have not yet invented, and probably never will invent, a simple measure of income distributional effects, such as benefit-cost is for economic efficiency. Among other problems, that of comparing costs and gains for different individuals gets into interpersonal comparisons of utility or value; is the gain to the local economy from operation of a sawmill which harvests timber from a potential wilderness area more important than a national gain from the wilderness, assuming that the monetary values of each could be measured in a way everyone would accept and that the values were equal? Though we as economists cannot answer such questions with any assurance, it seems to me we have, as a minimum, an obligation to make all the facts, or as many of the facts as we can find, available to the decision-maker, whether he be public land manager, politician, or private landowner. To me, who gains and who pays is as critical a lot of information as how much value at what cost.

Social or Cultural Acceptability

Measurement of the economic efficiency of different physically practical forest management programs, and estimation of the income and

cost incidence of each, will generally not be enough for forest policy decisions. We, or someone, must also consider the cultural or social acceptability of each proposed management alternative. Today, for instance, large numbers of people will reject a forest management program of letting fires burn uncontrolled, even if benefits to be gained from fire control do not equal costs; large numbers of people have reacted strongly against allowing slash and waste from harvested sites to rot naturally, because they find its appearance offensive, and are not moved by silvicultural or economic analyses of its efficiency as a forest management practice; clearcutting has become an emotional issue, largely without respect to its silvicultural or economic aspects; and one could go on, listing other issues in forest management where cultural or social attitudes are important if not dominant.

I include here attitudes other than, or in addition to, those which show up in value estimates. The value of any forest output is largely an expression of human attitudes toward it; if people thought less highly of wilderness or of outdoor recreation, then a reasonable value estimate would be lower than if they thought more highly of it. But I think that every society has certain standards of social acceptability for which it is extremely difficult if not impossible to attribute any economic value; some things are simply not done, or others are simply necessary in a civilized society, and cost-benefit is not the criterion. Attitudes may and often do seem irrational to those who do not hold them, and they may change over time -- and economic profitability can be a powerful force toward change; but, while the attitude persists, it may be as powerful a constraining force upon the forester as is the species, age, volume, and

other characteristics of the present stand of timber. No small part of the forest controversies of recent years has its origin in the (largely unconscious) neglect of social attitudes by foresters.

Administrative or Operational Feasibility

A final aspect of multiple use forest management must be the administrative or operational feasibility of the program proposed. Two illustrations may make the point: oftentimes a forest management program on a small privately owned forest would be physically practical, economically efficient, the bearer of the costs would secure the gains, and the suggested program is culturally acceptable; yet the program is not carried out; why? The answer, practically, lies in the fact that the small private owner simply lacks the managerial capacity, and is unable to hire it, to accomplish the desired management program. Secondly, various programs might be devised for national forests which also met all the foregoing tests, and yet could not be carried out, either because the agency is precluded by various bureaucratic restraints from practicing economic forest management or is not provided with adequate funds to implement management decisions.

The forester, the economist, and everyone else concerned with forest management must take the capacity of the management organization into account in his analysis and into his recommendations for forest management. I am not talking here about goals in forest management; the small private forest owner may choose not to harvest any trees because he likes to look

at the forest as it is, but many a small private forest owner who would like to harvest some of his trees, or to carry out some other forest management practice, is simply unable to do so for lack of administrative or operational capacity. Most managers of public forests would like to do many things which they are unable to do. One may argue, as I have, that many of the programs foresters would like to carry out are dubious on the grounds of economic efficiency, distribution of economic costs and returns, or social unacceptability; but, even when these tests are met satisfactorily, operational capacity may still be the governing constraint on actual multiple use forest management.

Scale for Application of Multiple Use Forest Management

At what scale should multiple use planning, multiple use management, and trade-offs in multiple decision-making of forests be employed? It is tempting to answer: at the scale at which the decision-maker must make decisions -- the individual property for the small private forest owner, the whole forest property for the larger industrial forest owner, the unit of administration (forest, ranger district, etc.) for the public forest manager. Such an answer is correct but incomplete. Multiple use analysis, planning, and operation must indeed take place at this scale; most of the literature on multiple use forestry is concerned with this operational unit scale. The problem is to reconcile one use with another, to decide upon the scale of each, to find and implement programs

which reduce conflict, etc. -- and all with regard to the criteria of physical practicality, economic efficiency, distribution of economic gains and costs, social or cultural acceptability, and administrative or operational feasibility which I have outlined in this paper. To the extent multiple use forestry is practical on this scale, it realizes the potential of the area concerned.

But I think that multiple use forestry must be approached on a national scale also, and it is here that the enormous variability among forests in the United States, briefly mentioned at the beginning of this paper, is so important. We know a great deal more about the wood-producing attributes of our forests than we do about their ability to produce any other output, hence my illustrations will focus on wood production, but if data were available a similar analysis could be made for the other outputs of the forest.

In 1970, according to Forest Service estimates, all the commercial forests of the United States grew 18 billion cubic feet of wood; if all stands had been producing at their potential for fully stocked natural stands, growth would have been just double, or 37 billion cubic feet of wood. We do not know how much of the actual growth took place on forest sites of different productive capacities, but only 12% of the potential growth could take place on the 27% of the commercial forest acreage classified as Class V sites -- those capable of producing only 20 to 50 cubic feet of wood per acre annually. I have elsewhere expressed doubt that these Class V sites, by and large, can really be considered commercial forest lands -- their annual output is too low to justify the necessary costs of growing wood on them. An economic

classification of forest sites might reveal some of these forests as supramarginal but it might equally reveal some Class IV sites as sub-marginal. Many of the poorer sites in public ownership still have accumulated volumes of timber, the result of centuries of nonforestry before white man settled the North American continent, and these accumulated volumes can often be harvested at a profit to the harvester, if we choose to make them available for this purpose; but more timber cannot economically be grown on them.

Had all the forest lands, of all site classes and all ownerships, been managed intensively for wood production, annual growth would be nearly double that possible under full natural stocking -- 68 billion cubic feet per acre annually, I estimate. Some of this wood growth would be uneconomic under probable future cost-price relationships, but much of it on the better sites would be economic. We have estimated (in the sources cited at the beginning of the paper) supply curves for wood growing, on sites of different productive capacities and under different intensities of management. I have set up a very rough national model of high-intensity low-harvest-acreage, which takes into account annual output of wood per acre, annual and periodic costs per acre, assumed objectives and organizational limitations of different classes of owners, and -- above all -- productive capacity by site class, which could grow more than 22 billion cubic feet of wood annually on less than 40% of the commercial forest land (as the Forest Service defines the latter) -- and do so economically. This type of intensive forestry on some sites would have some repercussions on the other outputs of the forest from these lands; such effects could be greatly reduced if not eliminated by careful management practices. More importantly, more than 60% of the assumed commercial forest acreage could be used for purposes other than wood

growing and wood harvest -- wilderness, intensive recreation, specialized watersheds, specialized wildlife production, and others. Much of the latter would be hardwood forests in the East and South, which produce relatively little wood annually per acre and/or produce wood of species not in high demand; these forests are conveniently located to millions of urban dwellers and could produce services in high demand -- including restored "wilderness".

I do not expect, and indeed I do not advocate, that American forest management go to the extreme of this high-intensity low-harvest-acreage model; but I do say it could and should go a considerable distance in this direction. Over the past 100 to 200 years, farming has greatly intensified operations on the best lands, at the intensive margin of cultivation; and has simultaneously retreated from extensive areas once cultivated, at the extensive margin of cultivation. I expect American forestry in the next generation or two to move substantially in the same direction. As I see it, forest economists have a major responsibility in pointing out the direction of future forestry, to foresters, to legislators, to property owners, and to the many conservation groups. We surely need to make many studies, more innovative and more imaginative than we have made in the past, to point the way. It is my considered judgment that economists, as a group, have greater competence to do this than any other single professional group -- not that we can do it alone, by any means, or even do the half of it, but we can surely supply some critical ingredients.

Forests of all types, all site classes, all ownerships, in all parts of the country could thus be fitted into a truly national system of multiple use forestry.