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APPENDIX II: PART F

REPORT OF THE WORKING GROUP ON NATURAL RESOURCES WEALTH

Prepared by NEAL POTTER

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PREFACE

The Working Group on Natural Resources Wealth met as a whole on September 9 and December 11, 1963.

The Subgroup on Minerals met on September 9 and October 2, 1963.

The Water Subgroup met on September 9 and November 23, 1963; it met briefly without the Chairman on October 29, 1963.

The Timber Resources Subgroup met on September 27 and December 11–12, 1963.

The Fish and Wildlife Subgroup met on September 9, 1963, and January 31, 1964.

The Public Lands Subgroup met on October 3 and October 29, 1963.

Mr. Allen V. Kneese, of Resources for the Future; Mr. James Flannery, of the U.S. Public Health Service; and Mr. Walter Langbein, of the U.S. Geological Survey, assisted at certain stages of the Water Subgroup report. Mr. Donald C. Duncan of the U.S. Geological Survey assisted as alternate for Mr. McKelvey. Mr. John Ryan assisted as alternate for Mr. Kruizenga.

Much assistance and many helpful suggestions were given by Mr. John W. Kendrick and Mr. Joel Popkin of the staff of the study.

All members of the working group have aided in the preparation of, and have had an opportunity to review a draft of this report; however, final responsibility for the group report rests with the group secretary. The subgroup reports were drafted in each case by the chairman of the subgroup; these drafts were discussed, modified, and approved by members of the subgroup, except as noted by footnotes of dissent or supplementary views.

NEAL POTTER.

NATURAL RESOURCES

I. Possible Uses of an Inventory of Natural Resources

Inventories of the physical resources available to the Nation can be of great importance to both public and private policymaking. Such estimates contribute to rational decisions related to conservation and development of natural resources, to national defense policies in stockpiling and other critical fields, to import and export policies, to policies for depressed areas, to retraining of workers, etc. Solutions to many problems related to geopolitics—alliances, defense preparations, foreign aid, etc.—may be aided by such information. Important decisions in the field of private business also depend in part on data in this field: orderly marketing, avoiding the periods of speculative excesses resulting from shortages or surpluses; investment in exploration, development and extraction facilities; investments in conservation, holding, and development of resources; the economical location of manufacturing facilities; etc.

The simple physical counts of available units are of course not adequate as a basis for developing answers to all the questions that arise in these fields. Geographic location, physical qualities, freedom from impurities, degree of accessibility, costs of extraction, and similar attributes need to be specified. Each of these aspects is generally somewhat complex and in the last analysis can best be described in quantitative terms. These measurements generally have no common denominator, so it is desirable for practical purposes to place an economic value upon the resource, as a measure of the various quality aspects taken together. The importance of a timber stand to the national wealth, prosperity, or security is dependent not only on the volume of the stand, but on its average size, freedom from defects, cost of transporting to market, year of expected salability, etc. The significance of an oil deposit depends on its total quantity, depth, gravity, sulfur content, gas pressure, distance from refineries or tidewater, etc. These qualities can be summarized, for many purposes, in one datum—market value.

Thus, value data are a most important adjunct to physical data to make possible rational decisions in the allocation of funds to conservation; to projects of exploration, research, or development; to research and development for the production of substitutes; to the finding of proper answers in the fields of area redevelopment, local taxation bases, etc. Without value figures, it is impossible to determine the most economical course of conduct; lack of such data is one of the causes of the numerous decisions made irrationally and wastefully in this portion of the national economy. There are serious charges that much of our most valuable heritage of natural resources has been wastefully used and foolishly allowed to deteriorate; there are also

charges that many conservation efforts are largely wasted expenditures. Even moderately good wealth data would go far to guide public and private decisions into more economical and productive lines.

II. Problems of an Inventory

The enormous dimensions of the problems which a moderately good wealth inventory could contribute to solving are matched by the dimensions of the difficulties involved in getting such data.

In principle the ways of making a wealth inventory in the field of natural resources [1] and the importance of making such an inventory are no different from the problems and values in any other field of the economy. Natural resources are traded in the market, they are involved in economizing decisions, they should not be wasted, they are substitutable for each other and for manmade goods in greater or lesser degree. Nevertheless, they have certain peculiarities in common which make them difficult to handle:

1. They are nonreproducible, either for long periods or forever. The possibilities of substitution, and of devoting more capital to refining low-grade ores, to exploring for and to reducing the use of scarce resources, etc., somewhat impair this generalization, but it is a significant one nevertheless. While fish, wildlife, and timber reproduce, the time required to establish or restore commercially usable stocks is quite long compared to that needed for production of large outputs of manufactured products and most farm products. Water supplies are renewed by the rains at least annually; but the supply available for actual consumption is rather strictly limited in any given river basin.

2. Natural resources have traditionally been free for the taking (originally from the Indians or from the Government) thereby having an initial price of zero.[2]

3. The extent and quality of the physical inventory is often unknown, as in the case of most minerals and many varieties of fish. Many of the important physical aspects of water and of lands are also unknown.

1. The quality of nonreproducibility makes natural resource materials unstable in price, since supply is quite inelastic as contrasted with a nearly infinite elasticity for many manmade goods. Demand also tends to be inelastic because of the quality of uniqueness or poor substitutability. Highly variable prices make difficult the writing of price tags even for a known physical inventory.

2. The tradition of a zero price for the first claimant of resources newly discovered or made available, makes historic price or "book value" unusable for natural resources in many cases. It is true that sales by the original claimants and by subsequent owners of resources have eliminated this problem for most land in private hands but the problem still remains for most of the public lands and remains in the case of water (except where water rights are sold separately from land), and in the case of fish and wildlife. The problem also persists

[1] Here taken to include all natural resources, industries, and assets except agricultural and site land.

[2] In recent years Federal policies have changed with respect to some important mineral leases and timber sales.

in the case of minerals, because free staking of claims is permitted on the Federal lands and because transactions in known or proved mineral properties are uncommon except for petroleum and gas.

3. The lack of knowledge of physical inventories may make impossible a straightforward census in the case of most minerals. It may still be possible, however, to get value and quantity figures on *developed* properties; and to supplement these data by figures on the *total* physical inventory, estimated by methods of geological inference.

The great difficulty of finding market values in the natural resources field has led to exploration of the possibility of capitalizing an expected income as a means to estimating values. The explorations have however led to a general rejection of this approach because where resource commodities are sold in the market, the great bulk of their prices usually consists of the costs of locating, extracting, and processing them. Much doubt was expressed as to whether mineral reserves would show any value at all in many cases, if the price in the ground were estimated from the market price of a processed ore or an ingot metal by subtracting the costs of extracting and processing it. Small errors in estimating these costs could lead to large relative errors in the residual value assigned to a ton of the mineral; and a significant error in the price per ton of the mineral could lead to a large error in the value assigned to the total tonnage in estimated reserves.

The general lack of a market—or in other terms, the general tradition of making goods free for the taking—may make valuations of water resources and of fish and wildlife impractical. There are undoubtedly large social values attached to these resources; but these values can be reduced to dollar or market terms only through the use of complex and debatable analyses which make values in these fields a better subject for special studies in universities than for a census-type inventory. The inventory may well, however, cover the physical aspects of these resources, since these data have great usefulness apart from value figures. In the case of water, the need for systematic planning for development of the resource has long been recognized; improved hydrologic and water-quality data are needed for this purpose. These data can also furnish important basic material for the value studies mentioned above, which can lead to further great improvements in public and private planning. Value data can be collected in these fields on the structures and equipment used to capture and handle the resource: dams, conduits, sewers, boats, fishing gear, etc.

III. Summary Conclusions

The diverse natures of the industries and of the problems that come under the heading of "Natural Resources" led to the formation of five working subgroups to deal with them:

(1) Minerals.
(2) Timber resources.
(3) Fish and wildlife.
(4) Water.
(5) Public lands.

The reports of each of the subgroups appear at the end of this group report. Their conclusions are summarized here, with a few comments.

Minerals.—It is assumed that the considerable investments in ore mills, transportation equipment, etc., can best be valued by the methods

that will be used in manufacturing. Mineral reserves and their inseparably associated extraction facilities, such as wells, shafts, valves, elevators, etc., should be valued by (a) using the prices in sales of comparable properties, in the case of oil and gas; (b) simply asking the owners to estimate present values in the cases of all other minerals (checking this latter category by estimates of other knowledgeable parties). Annual updating would be based on capital outlays and depreciation and depletion allowances, probably on an annual sample basis, as income tax data are probably not usable for this purpose Quinquennial censuses would probably require major adjustment of the annual series for the most recent 5 years, as mineral discovery and development is a notably uncertain and variable line of enterprise.

Timber resources.—A good physical inventory of standing timber is now available, as of 1952 and as of 1962, prepared by the U.S. Forest Service. Valuations are lacking.

For solid stands of mature timber, valuation seems fairly simple. The physical aggregates, by categories, can be multiplied by the prices established in market sales of "comparable" stands.

In the case of mixed stands of mature timber and growing stock or of growing stock alone, one cannot properly value the timber without knowing its opportunity to remain on the land and grow to maturity—in other words, the land and the growing timber are a unit that cannot be valued separately. The timber resources subgroup proposes that the valuation be done on an acreage basis, by finding prices on market sales of comparable land with growing stock on it. It appears to this writer, however, that only the greatest care can prevent the mixing of speculative values on such land with its value as a timber resource. A great deal of timbered land has value for recreational, suburban residential, commercial, or industrial purposes. It would seem to be a better approximation to the value of the timber resource if the volumes of all marketable or accessible growing stock were estimated separately from the value of the land, probably by the use of estimates based on sales of tracts where speculative values for other purposes are known to play no part; or by discounting the value of a mature stand from the year in which maturity is expected. A few cases, in which small timber values will be lost through premature cutting at the time of bulldozing for suburban development or the like, will not cause a great error in the value of the total timber resource; but erroneous inclusions of speculative values of land could cause large errors in the valuation placed on the timber resource. Moreover it will not be possible to ascertain any values of timber on the large acreage of farm woodlots unless it is done by the method suggested here. Most farm woodlots are sold as part of farms, and timber values can probably not be ascertained at all except by some method which applies a timber price to a volume of wood.

If the problem of pricing stumpage can be solved along these lines, the necessary physical data to which to apply to such unit prices is available in good detail from the forest surveys conducted by the U.S. Forest Service.

Water.—A great deal of physical data with respect to waterflows and qualities is needed to prepare programs to meet effectively the Nation's rapidly growing needs for water; the subgroup's report indicates how very extensive are the requirements in this area. Valuation

of water is unfortunately made difficult or impossible in most cases because charges for water, beyond the cost of collection and distribution, are rare. The water rights transactions in the arid West are the principal instance of such a market value. The subgroup nevertheless proposes some pilot studies of ways to assign values to water itself, because rational allocation of water to one or more of a number of competing uses requires such data, and the need becomes greater as water grows scarcer and greater decisions hang on the availability of such estimates. Agencies now having some expert abilities in obtaining of physical and value data are listed.

Fish and wildlife.—Because most fish and wildlife are not made subject to private ownership or management, they have no market values. In important cases this no-charge policy results in the devotion of excessive amounts of labor and capital to fishing, as free enterprise responds to high prices and low costs.[3] It is suggested that rational allocation of scarce factors of production would be aided by collection and estimation of data showing the *necessary*, as well as the actual, fishing vessels, equipment, and men devoted to taking the existing levels of catch. The capitalized value of the excess of the actual over the necessary inputs would provide an estimate of the value of the fish resource itself, and would aid in designing measures of taxation or control to rationalize the industries.

Without such estimates of wasted capacity, the only portions of the resource that can be given a market value are those subject to private ownership, such as certain oyster beds, fishponds, and private game reserves. The chief capital to be enumerated would be the equipment used in fishing, including excess as well as necessary vessels and gear.

Public lands.—The public lands are a large group of assets for which value data are inadequate because of the lack of transactions. Many of these lands have been held since the beginning of the Republic, and have never entered a market transaction. Others were bought so long ago that the price is irrelevant to today's values. Values of public properties transferred to private owners are frequently set by such special legal formulas as to have little relationship to market value.

For these reasons it is proposed to set up appraisal boards in each State or area to make estimates of values in view of all the circumstances and conditions applying to each parcel and kind of public land. Standards and procedures for determining these values would of course need to be established by, and supervision supplied from, a central office, to insure comparability among estimates.

It is recommended also that the values estimated by these boards be those for land alone, not including the timber or mineral values on or under the land. These values should be covered by the methods of the mineral and timber inventories.

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[3] This is only one of many instances throughout the economy in which excessive inputs are applied, causing significant wastes. Probably most are due to some form of monopolistic competition; some are due to "external diseconomies," in which real costs of production are not paid by the producers, but are put upon others, like the noxious effluents of mines or chemical plants, or the noise and dirt of highway traffic. Because of the prevalence of excess inputs, there are substantial doubts related to whether estimating their extent in commercial fishing would involve the wealth inventory in problems of too broad a scope.

IV. Existing Data on Natural Resources and Their Values

Existing published data on values or quantities of natural resources, and data which are believed to be useful in estimating such values and quantities are summarized here. The subgroup reports, which follow this concluding section of the group's report, deal mainly with problems of, and recommendations for, strengthening and expanding natural resource wealth data.

Minerals.—The chief source of direct data on wealth in the mining industry is the data tabulated by the Internal Revenue Service from balance sheets of business firms, principally corporations, submitted with their annual income tax returns and published as "Statistics of Income." Additional data, particularly the more complex cross tabulations and greater industry detail are available in the source book of worksheets available at the IRS in Washington.

Data are available by size-of-total-assets classes, by size-of-business-receipts classes, by size-of-income classes, by IRS district of principal office of business, and for eight subindustries (iron; copper, lead, zinc, gold, silver; other metals; bituminous coal; oil and gas; oil and gas services; stone, sand, and gravel; and other nonmetals (including anthracite)).

Balance sheet items given separately include cash, receivables, inventories, investments, depreciable assets, depreciation, depletable assets, depletion, land, intangible assets, and other assets. Liabilities are also given, with the following listed separately: Accounts payable, deposits, notes, other current liabilities, bonds, other liabilities, preferred stock, common stock, capital surplus, and earned surplus. Receipts and deductions are also itemized, although the great bulk are listed as "business receipts" and "cost of sales and operations." However, items of interest for a study of wealth include "rent paid on business property," "amortization," "depreciation," and "depletion."

The fact that these data are classified on a company basis rather than by establishments taken singly impairs their value for both industry and subindustry breakdowns, as well as for geographical distributions, which are based only on the district in which returns are filed, which generally means the State in which the principal office of business is located. Thus we note that for 1959–60 the "depletable assets" listed in the manufacturing industry, "Petroleum Refining and Related Industries" were 60 percent *larger* than those listed under the mining industry "Crude Petroleum and Natural Gas" and that the depletable assets listed under "Metal Mining" were a little smaller than those listed under the manufacturing "Primary Metal Industries."

No State (district of filing) data are published by industry, as the IRS regards such cross tabulations as of little value ("Statistics of Income, 1959–1960: Corporation Returns," p. 36).

A special survey of large corporations in 1960 provides a cross tabulation of depreciable assets devoted to activities in various industries, classified by industry in which each corporation was classified. This provides a biased sample of diversification, but does little to pro-

vide a basis for correcting the distribution of assets given in the regular "Statistics of Income" tables, not only because large corporations are not representative of all corporations, but because the industrial classification used in this table (pp. 18–20 of the "1959–60 Corporation Statistics of Income" was not the same as that employed in the tables covering all active corporations.

The aggregate values of depreciable assets of all corporations reported in "Statistics of Income," however, were found by Goldsmith to correspond fairly closely to his own estimates based on the perpetual inventory method (aggregating assets purchased or constructed, less estimated depreciation), though he notes that the agreement of aggregates might occur as a result of many offsetting differences.[4]

Whatever the value of the aggregate figures on depreciable assets, the data on depletable assets are probably much more dubious, not only because of the inherent difficulties in valuation, but because the depletion allowances taken by most mining companies ("percentage depletion") have no relation to the value of the assets; hence there is no motivation to give the IRS a true value. It seems likely that undervaluation is general in these data.[5]

The various censuses of mineral industries made by the Bureau of the Census (most recently published, 1958) since 1919 have provided no data on values of assets, but do provide figures which cover the universe on an establishment basis in various ways which may help in taking a census of wealth, or in making estimates based on a properly stratified sample. Among these are—

Value of shipments.
Value added in mining.
Products shipped, with quantities.
Number of employees.
Horsepower of equipment, separately for prime movers and electric motors, and in some cases by type of equipment and of motor used.

While assets on hand are not listed in the census tabulations, there are data on dollars of new capital expenditures made during the year, classified as "Development and Exploration," "Preparation Plants Constructed," "Other Construction," "New Machinery and Equipment," and "Used Plant and Equipment." A separate classification gives the value of "Purchased Machinery Installed During the Year." The crude petroleum and natural gas industry report gives a table on the number, footage, and cost of drilling and equipping oil and gas wells.

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[4] Raymond W. Goldsmith, "The National Wealth of the United States in the Postwar Period" (Princeton University Press, 1962), pp. 83–86.

[5] For a notable effort in using "Statistics of Income" in combination with census data to estimate mining wealth by large industry classes, see Daniel Creamer, Sergei P. Dobrovolsky, and Israel Borenstein, "Capital in Manufacturing and Mining" (published by Princeton University Press for the National Bureau of Economic Research, 1960). These authors also present a more optimistic view of this data than that given here.

Most of the census data are tabulated by State and/or by producing district; by size of establishment; and by type of operation (strip, shaft, placer, with and without preparation plant, producing and nonproducing, etc.). Many are also tabulated by number of employees; by output per man-hour; and by ratio of payroll to value added. In some cases there are data tabulated by county for principal producing areas.

The physical data on mineral reserves come from a number of independent sources, and are generally unassociated with value tags of any sort. Largest source of original estimates is the U.S. Geological Survey; the Bureau of Mines publishes these estimates (generally on a national basis, rather than for States or mining fields separately) in the annual "Minerals Yearbook" and the occasional volumes of "Mineral Facts and Problems."

Trade associations are another source of data: for petroleum, "proved" reserves are reported annually by the American Petroleum Institute; this was supplemented in 1961 by the National Petroleum Council's report on petroleum and natural gas reserves; it is supplemented biennially by estimates of secondary recovery possibilities by a committee of the Interstate Oil Compact Commission. For natural gas, annual estimates are published by the American Gas Association.

Thus it appears that for mining as a whole, and for the various subindustries, there are no data on wealth which are sufficient for analyzing investment, productivity, or economic development problems, though there are a number of landmarks which establish orders of magnitude and provide guidance for sampling stratification and physical volumes requiring unit value data.

Some of the existing figures from the "1958 Census of Mineral Industries" and the "1959–60 Statistics of Income" (corporations only) are transcribed below. The figures are uncoordinated; they are simply offered as a handy reference to systems of tabulation now used, and to the relative importance of the subindustries. The serious deficiencies of the "Statistics of Income" data were noted above. It is well also to remember that the same difficulty besets the census data in lesser degree: some data on manufacturing operations are included, where the particular establishments were engaged principally in mining operations; some data on mining operations are omitted, where the establishments tabulated were engaged primarily in manufacturing. However, a number of separate tabulations were made which make possible the separation of some data for the two aspects of such mixed establishments.

[Dollar amounts in millions]

Industry	Mineral industries (census 1958)			Mining capital assets (corporation tax returns, 1959–60)	
	Value added	Persons engaged (000)	Capital expenditures	Depreciable	Depletable
All mineral operations	$13,681	790.4	[1] $2,800.0		
All mineral industry establishments	13,381	769.5	2,798.0	$11,920 [2] 5,804	$3,739 [2] 1,614
Metals	1,187	94.3	214.0	2,682 [2] 1,211	967 [2] 377
Iron	500	31.7	43.0		
Copper	266	27.7	45.0		
Lead	48	7.1	4.5		
Zinc	26	4.4	4.1		
Gold and silver	38	4.3	3.2		
Bauxite	15	.7	1.4		
Manganese	20	2.3	2.2		
Tungsten	8	.7	.1		
Other ferroalloys	46	2.8	4.2		
Mercury	7	.7	.9		
Titanium	13	1.0	2.5		
Uranium-radium-vanadium	175	8.4	102.0		
Not elsewhere classified	2	.3	.7		
Services	23	2.3	1.3		
Anthracite	164	24.7	17.0		
Bituminous coal and lignite	1,610	195.0	188.0	1,820 [2] 884	410 [2] 167
Oil and gas	9,035	333.2	2,190.0	5,650 [2] 2,868	2,174 [2] 1,012
Petroleum	6,823	177.1	1,707.0		
Natural gas	517	17.2	236.0		
Natural gas liquids	588	16.6	95.0		
Services	1,108	122.3	151.0		
Nonfuel nonmetals:					
All operations	1,684	143.1	[1] 192.0	1,768 [2] 841	189 [2] 59
All mineral industry establishments	1,384	122.2	189.0		
Establishments included in manufacturing industries	299	20.9	[3] 2.5		
Stone, dimension:					
Included in mineral industries	13	2.6	1.2		
Included in manufacturing industries	54	9.9	2.5		
Stone, crushed:					
Included in mineral industries	446	42.7	69.0		
Included in manufacturing industry	117	5.0	[4]		
Sand and gravel	434	40.0	57.0		
Included in manufacturing industry	63	2.5	[4]		
Clay and related minerals	129	11.6	13.0		
Chemicals and fertilizer	335	20.7	39.0		
Potash, soda, borate minerals	111	6.7	11.0		
Phosphate	64	5.4	5.7		
Sulfur	94	3.7	16.0		
Other	66	4.9	5.7		
Services	6	1.2	.8		
Miscellaneous (gypsum, talc, peat, etc.)	86	6.9	9.3		

[1] This figure includes, from among operations classified as "manufacturing," only dimension-stone quarries with dressing plants.
[2] Accumulated depreciation or depletion against assets in preceding line.
[3] Represents dimension-stone quarries with dressing plants only.
[4] Not available.

Timber resources

The corresponding industry in the standard industrial classification is "forestry," which includes only planting, growing, holding, and caring for trees, plus gathering of gums, bark, and miscellaneous materials like nuts and balsam needles.

Logging and sawmills, pulpmills, etc. are included in manufacturing.

There are few data covering the values in this field. However, the forest surveys, complete for 23 States and partial for others, provided a basis for good quantitative estimates of the timberlands and stands in the United States as of 1952; 1952 data were reported in the U.S. Forest Service's "Timber Resources for America's Future," published in 1958. These estimates were given by State and region and by principal species of trees. Estimates were also provided on sizes of trees; certain quality classes; rates of growth; cut, fire, and disease losses; uses of timber cut; ownership of lands; etc. Breakdowns were given for commercial and noncommercial stands, and private and public ownership.

A separate appendix in this book rated the "Adequacy of Data." In it the authors indicated that the figures were good enough for national and regional analyses, and for some but not all State comparisons.

A similar comprehensive tabulation of forest survey data, for the year 1962, is scheduled for publication in 1964.

Limited valuation efforts have been made from time to time, as for example the national forest public domain values submitted to the House Government Operations (Dawson) Committee, and the tentative estimates adding up to $8 billion prepared for the National Bureau of Economic Research in 1947. The latter may be found on page 233 of "Studies in Income and Wealth," volume 12 (1950).

Some possibly helpful data are contained in the census of manufactures (industry 2421) including cost (but not quantity) of stumpage cut, value and quantity of logs and bolts bought (and sold), and value and quantity of pulpwood sold.

Water

There are no adequate wealth data in the field of water resources or water facilities, though expenditures on new construction are given for Federal facilities in the annual budget, and for State, local, and Federal facilities in the Census Bureau's annual "Government Finances."

There is a considerable quantity of data available on the physical aspects of water resources. The most extensive sources on water supply are the "Water Supply Papers" of the U.S. Geological Survey, of which over 1,800 have been published. Summary reports on streamflow through 1950 are contained in papers 1301 through 1319; each volume covers a major river basin. Summary reports covering 1951–60 are in process of publication. Other summary reports describe gound water levels and artesian pressures, and the chemical quality and sediment characteristics of streams. Most comprehensive is Water Supply Paper 1800, "The Role of Ground Water in the National Water Situation." Further information on sources is given in "Publications of the Geological Survey."

USGS circulars also describe water conditions in certain local areas. Maps and graphic descriptions, with brief accompanying texts, are

published in a series called "Hydrologic Atlases." Much information on streamflow and other water conditions can be obtained from State offices of the USGS.

Water quality information is published by the U.S. Public Health Service in "National Water Quality Network: Annual Compilation of Data." A biennial report, "Municipal Water Facilities Inventory," is published for communities with a population over 25,000. Data for communities down to a population of 100 are published at 5-year intervals. The Public Health Service also publishes data on waste treatment facilities, at 5-year intervals. Nine volumes have been issued, latest of which is "1962 Inventory of Municipal Waste Facilities" (Public Health Service Publication No. 1065).

A comprehensive survey entitled "Federal Water Resources Research Activities" was compiled by a task force of the Federal Council for Science and Technology and published in 1963 as a committee print of the Senate Committee on Interior and Insular Affairs.

A number of significant studies were prepared by the staff of the Senate Select Committee on National Water Resources, and published in 1959–60.

The U.S. Army Corps of Engineers and other public agencies are responsible for comprehensive river basin planning efforts which result in compilation and projection of water use and water quality statistics for certain river basins.

Many States collect data on their water resources, notably the more arid States, and particularly California. Several of the major cities and metropolitan areas have published data on local water supplies; New York and Los Angeles reports are most comprehensive.

Regional organizations, such as the Ohio River Valley Sanitation Commission (Orsanco) and the Interstate Commission on the Potomac (Incopot) publish data on their respective river basins.

Data on water use are relatively scarce but are increasing. The U.S. Geological Survey has published summary data for 1950, 1955, and 1960 in Circulars 115, 398, and 456. Other Federal agencies have tabulated certain uses of water in connection with censuses or regulatory functions.

Fisheries

Fisheries industry definition (SIC): This industry includes salt and fresh water catching of fish, whales, shellfish, sponges, etc., and fish hatcheries, fish farms, etc.

Independent dock establishments fall in the transportation industry, rather than in fisheries. Independent cleaning, etc., plants are in food manufacture.

As of January 1964, there were no data on the aggregate value of capital in fisheries. "The Statistics of Income" do not separate this industry from agriculture and forestry, and the Bureau of Commercial Fisheries' annual "Fishery Statistics" gives no value figures. The latter does, however, list vessels, boats, and gear in some detail by States and regions. Data are given for number of motor vessels and total tonnage, number of sailing vessels and tonnage, number of motorboats and of other boats, number and length of different types of nets, and number of traps, lines, spears, dredges, hooks, tongs, etc. The 1961 volume (pp. 80–101) gives age of all vessels 5 years old or older.

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The Bureau of the Census is expected to secure in 1964 the first capital value data for the industry. Questionnaires will ask original cost of vessels and their age. The tabulations of these reports, by States, form of business organizations, etc., should provide a useful landmark, though depreciation charges and the value of boats and gear will not be available.

The available physical data should constitute a reasonably good basis for estimating current values if the current market prices of sample vessels, gear, etc. can be collected. Fairly active markets exist for used boats, vessels, and gear.

Estimates of the values of commercial fisheries that would exist if these fisheries were *rented* instead of being open on a free-for-all basis are available in a few cases (cited in footnote 3 of the subgroup report below).

The values attributable to sports fishing and hunting resources are currently derived from data on fees charged for private facilities, total sportsmen's expenditures, total participation estimates, and other related materials which constitute a basis for further studies which may yield national wealth estimates. The data are available in the Department of Interior's Bureau of Sports Fisheries and Wildlife.

Public lands

Private lands fall in the categories of consumers' capital and capital in the agriculture, real estate, forest, mining, manufacturing, transportation, and other industries. Public lands fall in the categories of Federal, State, or municipal governments; many of them present problems which are different from those presented by the capital associated with Government activities, and different also from those presented by land in private ownership. Thus they may be worth special consideration and a special report.

The largest in size and probably in value are the holdings of the Federal Government. The General Services Administration reported Federal holdings in the United States at 770 million acres as of June 30, 1963 ("Inventory Report on Real Property Owned by the United States Throughout the World"). Of this, 719 million acres was "public domain," held by the Government since acquisition through agreement with the Original Thirteen States, treaties with foreign countries, et cetera. Only 51 million acres had been purchased or otherwise acquired from private owners so that a dollar "cost" figure could be attached to it. The sum of these cost figures was $3.5 billion; the present value of these lands is probably several times this. In addition, the estimated present value of the "public domain" is $18 billion (U.S. Congress, House Government Operations Committee, "Federal Real and Personal Property Inventory Report," as of June 30, 1963, p. 319).

In addition, on the same date some 1.7 million acres were involved in Federal leases in the United States and some 0.1 million acres in leases outside the United States.

The method of acquisition, surface area, and using or holding agency is given by States in the annual "Public Land Statistics" published by the U.S. Department of Interior, Bureau of Land Management. This report also gives much information on the entry of mineral claims, homesteads, oil and gas leases, timber sales, grazing leases, and other disposition of Federal lands and their products.

In the State and municipal fields, Marion Clawson has compiled and adjusted data from the National Recreation Association on the number and acreage of State parks and municipal parks by city, for cities of 100,000 population and over. These are to be found in his "Statistics on Outdoor Recreation" (published by Resources for the Future, Inc.), in appendix tables 11, 12, 13, and 17. Capital expenditures on municipal and county parks are given by States and regions in reports of the National Recreation Association, published annually in the U.S. "Statistical Abstract." Capital expenditures on State parks are given in the National Park Service's "State Park Statistics" (also given in U.S. "Statistical Abstract").

V. Minerals Subgroup Report

This memorandum is intended to reflect the consensus on the measurement of mineral wealth which has been reached in the meetings of the minerals subgroup. The consensus is limited, but since we are not concerned to present an appearance of unity, divergent or supplemental ideas are freely included, with any isolated position labelled as such.

Although it is a mistake to insist that all potential uses be foreseen clearly before initiating a new program of data collection, some uses of wealth data for the mineral industries can be foreseen. Wealth data for these industries are necessary for the handling of all questions involving the quantity of capital in use in these industries, in regions, or in all industries. John Kendrick's work on productivity and Edward Denison's work on economic growth come readily to mind as examples. Clearly a wealth inventory will improve the income accounts series and their interpretation.

There are uses of such data that are more narrowly applicable to the mineral industries, however. These center around the problems of search and exploration. In some of the mineral industries—and to some degree in all—we know very little in a statistical way about the relations between outlays directed to these ends and the results therefrom. A wealth inventory, together with data on certain outlays between inventory dates, could contribute to further progress on such questions.

A minerals wealth inventory inevitably will reveal mineral deposits in many areas which are known or are thought to be rich deposits in the physical sense but which in fact have very little value. Many people persist in associating economic value with physical richness, and as a result sometimes come to espouse positions on various questions of public policy which are economically indefensible. The effects of bringing into the open the facts on economic value of mineral deposits can be only salutary, for this will stimulate inquiry into the reasons for these values.

Wealth estimates are difficult to make at best, but they are especially so for the mineral industries because the physical description of the asset in question is far less definite than is the case with assets that are entirely visible, such as agricultural or site land or depreciables. We are not sure that a good inventory of the wealth of the mineral industries can be made. It is altogether likely that estimates will turn out to be wide of the mark or that some procedures may be too expensive to be used on any but a very small scale. Therefore, the sug-

gestions made here are very tentative. Initial efforts to produce a wealth inventory for these industries should avoid a large commitment to a particular method. Instead, the problem of valuation should be approached in different ways to obtain that weak check on accuracy—consistency of results obtained by different methods.

Scope of mineral industries wealth estimate

In the case of petroleum, the bulk of the wealth is in proved reserves of oil and gas and should include on-lease production facilities. Mineral rights on undeveloped oil and gas lands under lease should be included and probably can be with a fair degree of success. Unleased mineral rights ought to be included where it is reasonably clear they have a market value, but it may be difficult to do so.

In the case of the other mineral industries, all mineral rights which have a market value ought to be included in principle but initial efforts obviously should be concentrated on operating mineral properties and on idle but developed properties. These categories contain the bulk of the market value of the properties. It may prove possible to include undeveloped properties for a few special cases and locations.

In the case of operating establishments, the "Standard Industrial Classification" definitions should be used to divide mining establishments from nonmining, following the usage of the census of mineral industries. This mode of definition will not only provide a suitable line of separation, but is especially appropriate in view of our later suggestion that consideration should be given to using the Bureau of the Census as the instrument for assembling some of the desired data.

We note in passing that geothermal energy sources should be included, although their market value at present is negligible.

The general procedure envisaged

We doubt that book value figures as of a given date are of much use to a wealth inventory for several reasons. The lack of correspondence between book values and market values is much more serious for the mineral industries than for others even in the absence of price level and technological change. The age distributions of the "items" in the capital stocks (or the lives of the "items") are but poorly known. Hence any corrections for price level changes would have to be rather speculative.

The following program for a wealth inventory may be feasible:

(1) A *market value estimate* of mineral industry properties would be prepared initially and thereafter at intervals of, say, 5 or 10 years.

In neither the petroleum nor the other mineral industries does it appear feasible to estimate the value of mineral resources separately from the value of the manmade capital that has been invested in them or is so intimately associated with them. It may be possible, however, to estimate separately the value of certain tangible categories of manmade capital. We have in mind especially mobile equipment, concentrating units, and so on. For these categories it should be feasible to collect comprehensive data on book value, which would be on an original cost basis. Data on detailed type of asset and year of acquisition could be developed by sampling rather than comprehensive collection, as probably would be done with capital in manufacturing.

However, these categories of tangible capital almost certainly could not be so extensive as to embrace all outlays on mine development,

and even if they did, the difference between the value of the mineral property as a whole and the value of these categories (which presumably would be derived from a cost basis unless they are movable) would be only a difference and should not be taken as a measure of the value of the natural resource "per se." The value of a natural resource associated with a going mine is something different from the value of the same natural resource before development has taken place.

This problem suffers from still another complication, in that the existence of many deposits would not even be known were it not for earlier capital outlays directed to the uncovering of their existence. We should expect some tendency—how strong may be conjectural—for these outlays to be reflected in the value of producing properties.

One possibility for valuing the wealth of the mineral industries is to use stock market values. This method might be feasible if most companies had only domestic operations, if they confined their operations to "Standard Industrial Classification" categories, and if their stocks were active. Since these conditions are not present, the method has been rejected. Even if these conditions were met, there would still be difficulty in separating property beyond the mineral stage and in allocating property to regions or States.

(2) As a means of periodic adjustments to the benchmark market value appraisals, annual estimates of *capital outlays* and *capital depreciation and depletion* would be prepared. For the tangible capital categories for which separate sample data on age, et cetera, could be developed, depreciation estimates would be an easily derived by-product.

(3) It would be found that the initial market value plus net capital outlays in, say, the next 5 years would not be equal to the market value estimates 5 years from now. An important part of the exercise would be to try to account for this difference, which would be ascribable to such factors as investment mistakes and windfalls (including changes in prospects for the commodity and discoveries made cheaply), errors in capital consumption charges, error in the initial level of market value relative to the later one, price level change, change in value from holding for later exploitation, and technological change.

Estimating market value of petroleum properties

The main reliance for doing the first of these three steps, the market value estimate, can and probably should be different for petroleum and the other mineral industries. The market for petroleum properties is more active than it is for other mineral properties and hence is more reliable as a generator of prices for these properties. While there are difficulties in evaluating the "price" of some of the larger transactions in petroleum properties, both because of many factors affecting the value of a purchase which do not get expressed in a simple price and because of the different kinds of properties included in the aggregate consideration, the problem of valuation is far easier than for non-petroleum properties.

There are two general approaches to the valuation problem that could be used. The first would begin by examining known large market transactions in petroleum properties. Possible sources of information on transactions would be the producing companies, banking institutions that specialize in the financing of petroleum land transac-

tions, and occasional published information. The payments in these transactions would be expressed as payment per barrel or per cubic foot of proved reserves. These values would then be applied to "similar" proved reserves in the same or possibly in other producing areas.

The above method would not automatically produce a good estimate. The difficulties are very real. First is the question of the representativeness of the transactions, a difficulty suggested above by the use of quotation marks around "similar" when applied to other proved reserves. Second is the difficulty of putting the "proved reserve" data from the known transactions on the same basis as the comprehensive reserve estimates (e.g., the API estimates) which would be the means for deriving the value totals for most of the industry.

The handling of other petroleum lands would depend on the amount of time and money that could be devoted to them. There are numerous transactions in them, and prices can be found for local areas. Estimates of acreage under lease, which may be useful in spite of sizable differences, are made, e.g., by the IPAA and are also available from the Scouts' "Yearbook."

One possibility that should be investigated is to use the mineral census machinery to collect information on transactions prices for mineral rights, both for the transactions in lands with proved reserves (producing and nonproducing) and for the potential petroleum lands, although the canvass would have to be limited to properties purchased by establishments in the petroleum industry under present census procedures.

The mineral rights on land not under lease may have a positive value and in some cases may be high. It might prove possible to include some of these lands, depending on how much information is developed on prices of mineral rights, but the relative error caused by omission of potential unleased petroleum lands from the total value of petroleum lands would be small.

In an area where the total inventory of leased acreage is constant, the average year's outlay on bonuses, rentals, and royalties could form the basis for an estimate of the mineral rights.

Another general avenue of approach, which can be used to supplement and check the first, is to value proved reserves by applying field prices to an estimated schedule of production from proved reserves, then work back to the net annual income of the properties by applying appropriate expense ratios derived from census and other data, and finally to reduce these annual values to a present capital sum. This method has been tried in a preliminary study by an associate of one of the committee members and yields plausible results.

Each of these methods can yield estimates of wealth with sufficient geographical detail for purposes of the wealth inventory.

Market value estimates for nonpetroleum minerals

Transactions in nonpetroleum mineral properties are so infrequent that to rely mainly on transactions prices, as was suggested for petroleum lands, does not seem to be feasible. The goal is to obtain an estimate of the market value of mineral properties, just as with petroleum properties, but the method for doing so must be different.

If prices of properties cannot be had from market transactions, there seem to be only two ways to estimate value of these mineral properties.

One is to ask those who know something about the property in question what they think it might sell for in a voluntary sale (voluntary as opposed to forced). The other method is the same as the second one suggested for petroleum—to work from mine value of product back to a net profit or net royalty for the mine, finally reducing this to a present value capital sum.

The first method would involve direct interviews with company officials, property owners, State tax officials, or any other persons in a position to have detailed knowledge of properties. They would be asked to estimate the price at which the mine in question and the accompanying mineral lands could be sold. Since the formation of such an estimate would require consideration of the mine's reserve status, this would be a convenient point at which to collect such information. There may be possibilities here for fruitful collaboration among the Bureau of the Census, the U.S. Geological Survey, and the U.S. Bureau of Mines.

The unit for which such an estimate of market value would be made would be the mine, which would be substantially the same as the census mineral establishment. Careful attention would have to be paid to the scope of the value estimate. Adjustment probably would be necessary to make it conform to the scope of the data on capital outlays collected by the census.

Estimates for nonoperating properties should be kept separate from those for operating properties, of course. The latter estimates would be more reliable.

We wish to emphasize the great difficulty that is present in any attempt to appraise the value of mineral properties. Property owners are notoriously unreliable sources of information about the value of their own property, even in properties such as houses in which transactions frequently occur. Where transactions are infrequent, the property owner has even less information upon which to base an estimated value, and in such cases the estimate probably would be considerably less reliable. In any case, it would be desirable that the value of the particular properties selected for evaluation be estimated by different people and by different methods so as to obtain something of a check on the results. It may be possible, at least for some of the particular properties investigated, to work back from mine value of ore or concentrate to a net "profit" per unit of product. This figure, together with information on reserves of the particular properties investigated, could be made to yield a present value capital sum to be compared with values estimated by those who are able to appraise the value of the property directly, perhaps on the basis of their familiarity with transactions or offers for similar properties in the area.

Direct investigation of property values and related quantities would have to be on a sample basis, although it may be possible to produce complete coverage estimates for particular areas where such estimates or similar estimates have been made for other purposes.

The problem of blowing up the sample data to universe size would have to be studied carefully. One possibility is to use already assembled reserve data as the vehicle, assuming that comparable reserve data can be had for the properties that are studied intensively. Another possibility is to use annual production data which are available for each operating unit. The choice between these two methods

will depend on the variability among properties of the value per unit of reserves as compared with the variability of value per unit of annual product.

The expense of a large sampling operation could be avoided by making an *aggregate* estimate of the value of mineral properties in an industry in the same way as was described earlier for petroleum (i.e., the sum of discounted net revenues from an estimated time schedule of production of present reserves). It is the opinion of at least some members of the subgroup that the method is of doubtful feasibility for nonpetroleum minerals with the possible exception of coal. The difficulties involve two, and perhaps all three, of the factors required for the calculation of current net rents. Reserve estimates are probably less reliable for various reasons than for petroleum. Nor is it clear that a reliable average ratio of net rent to gross mine receipts can be derived from available data. Even if this ratio can be estimated, some way is needed to check whether reserve data and the ratio of net to gross in fact fit together or match each other in such a way as to yield a useful estimate of the value of the mineral properties. If these difficulties are important in fact, the conclusion seems to be that there would be sizable risk of large error if sole reliance were placed on an aggregative estimate of the type described.

If valuations are to be developed by an interview-appraisal procedure, it is not clear which of the existing agencies working in this field would be best fitted to handle the program but it should be borne in mind that the Geological Survey and the Bureau of Mines already conduct programs for the collection of reserve data and other types of information from mining establishments. A possibility to be considered is a test of the feasibility of expanding the coverage of these efforts to include valuations, reserve, and other related data for a sample of nonpetroleum properties as described earlier.

Earlier it was suggested that the Bureau of the Census might find it possible to collect data on actual transactions prices for petroleum properties purchased by establishments regularly canvassed for the census. The feasibility of the same procedure for nonpetroleum mineral industries should be considered.

Capital outlays

The collection of data on capital outlays in these industries is already a part of the census operation. This program would need to be reexamined, however, to insure that the definitions of "capital outlays" will yield data that can be related to the estimate of the market value of mineral properties. In particular, outlays on dry holes should be regarded—for wealth inventory purposes—as on the same footing as outlays resulting in productive wells.

Special estimates of annual depreciation and depletion would be necessary since accounting estimates of depreciation and depletion for financial reporting would not be consistent with periodic estimates of mineral wealth because of differences between book investment and market value. It is clear that the figures now developed for tax purposes would be of limited use.[1]

[1] One of the group's members suggests, however, that income tax forms could be a valuable source of information on certain types of expenditures if separate identifications of them were required. Similarly, information could be required on IRS forms which would permit an effective division between extractive and manufacturing activities.

In this connection, information on reserves could be of considerable value. It has already been suggested that it may be desirable to collect reserve information at the time when the attempt is being made to ascertain the value of particular properties. In the collection of reserve information on these and other occasions, however, it may be useful to give attention to the usability of this information for valuation purposes, both total value and annual charges.

We wish to emphasize once again the tentative nature of the suggestions that have been made. The feasibility of some of these suggestions is difficult to predict and can be determined only by a test, which might be of quite limited scope. Nor is there any single cost for a wealth data program for the mineral industries. This cost could vary from a few days of highly competent and skilled manpower using available data and heroic assumptions to a painstaking on-the-spot investigation of a sample of properties large enough to yield considerable geographical detail. We are not in a position to suggest what level would be best, for that would depend on the annual amount of money available and the costs of preparing estimates for other sectors.

SUPPLEMENTAL STATEMENT BY MILTON LIPTON

I feel that in any inventory of wealth, and particularly for minerals industries, a clear distinction should be made between the cost of reproducible assets and the market value of all assets including natural resources.

The former has to do with outlays required to find and develop subsequent production and to generate future income from production. Whether measured by depreciated original cost or replacement cost, an inventory of wealth so defined would be a meaningful measure of capital inputs that could be related to "the results therefrom." (I would note that the potential uses identified in the introduction to the minerals subgroup report apparently without exception involve this perspective on wealth data.)

An inventory of wealth based on market value of assets would necessarily encompass both reproducible assets and natural resources since in most instances installations have no real market value apart from their immediate use in resource development. It will be recognized, of course, that market valuations subsume a wide range of considerations, including *expected* future prices, production rates, and capital costs. And there may be many reasons periodically to attempt to assess market valuations, as a reflection of such expectations by the market place. I question, however, whether the data would be available accurately to estimate market valuations for minerals industries—and I feel that the inevitable imputations from limited and scattered evidence would not really provide a reasonably useful approximation to market valuations. Perhaps the effort should be made; but the conceptual and analytical distinction between the two approaches—cost and value—should be recognized.

At the risk of unnecessary repetition, I would stress that the approach to an inventory of wealth via capital outlays and depreciation provides an input/cost perspective on investment in minerals industries. The approach via market valuation provides an output/income perspective. Each may have its uses—and the ratio between the two

could be of considerable interest. But they are quite different perspectives on wealth—and the differences warrant much more attention than is briefly set down in the report, e.g., paragraph 3, page 565.

VI. Timber Resources Subgroup Report

Definition of the resource

For a wealth inventory, the forest land resource must be distinguished from other natural resources. The definitions used by the U.S. Forest Service in its nationwide forest inventory are those on which the available physical data are based and should be followed in the wealth inventory.

Forest land is "land at least 10 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for nonforest use."

Three broad classes of forest land are recognized which differ significantly in their characteristics as wealth. These are:

Commercial forest land—"land which is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation."

Productive reserved forest land—"productive public forest land withdrawn from timber utilization through statute or administrative regulation."

Unproductive forest land—"land incapable of yielding crops of industrial wood because of adverse site conditions."

Scope of this report

Only the commercial forest land has value for the production of timber. But all of the classes of forest land may have value for one or more of the following ends: water, recreation, wildlife, grazing by domestic livestock, and esthetics. On the commercial forest land, these other values—where they exist—are in addition to the timber value.

Timber values are concrete and can be estimated with reasonable accuracy. Grazing values are also concrete but are closely tied to the value for the same use of nonforest pasture and range lands, and are best estimated in conjunction with the valuation of those lands. The other values are intangible or very difficult to quantify. They definitely exist, but do not generally have a market price and at present we do not know how to estimate them.

This report will be limited to the determination of the timber resource wealth. It will point out the existence of the other forest resource values but will not give recommendations for their estimation.

Reasons for making an estimate of timber resource wealth

Representing one-fourth of the Nation's land area and providing the raw material base for timber-connected activities accounting for some 5 percent of national income, our commercial forest land and timber resource forms an essential component of any national wealth estimates.

Within the forest economy itself, timber wealth estimates provide a guide for determining the economically justified scale for forest protection, development and research programs in both the public and private sectors. In addition such estimates throw light on the im-

portance of timber resources in the tax base of local government and facilitate the development of forest credit and insurance facilities through improved knowledge of resource values. Periodic extensions of benchmark estimates throw light on the changing structure of the forest economy and aid in regional planning and development.

The data needed for a wealth inventory

Forest land area.—The area of all forest land should be determined and classified as to whether it is commercial, productive-reserved, or unproductive. The areas of the productive-reserved and unproductive forest lands should be shown in the wealth inventory regardless of whether values can be assigned to such lands or not. As economic, social, and political conditions change with passing time, some lands will change from one classification to another. They should be classified as of the 1970 wealth inventory target year and then reclassified as necessary for succeeding inventories.

Commercial forest land area.—This should be classified according to site quality, area condition, stocking, forest type, and accessibility.

Timber of commercial size.—The volume of this timber should be determined on all commercial forest land. It should be measured in volume units suitable for the various possible products. It should be classified according to suitability for sawlog or other products, major species, diameter class, log grade, and volume per acre.

The productive-reserved forest lands also contain some timber volumes of commercial size. The value of this timber cannot be included in the wealth inventory because it is reserved from cutting. However, a physical inventory of the timber on these productive-reserved lands would be useful for various purposes and should be included in the wealth inventory.

Forest growing stock.—This consists of all live trees with the exception of those which for any reason are not producing usable wood. The volume of this growing stock should be determined on all commercial forest land. It should be classified according to forest type, species, stand size, and stocking.

Annual timber yield.—This is the total volume of timber produced during the year. In order to determine it, information is needed on the net annual growth of timber (the annual change in net volume of live trees resulting from natural causes) and the annual volume of timber cut. The difference between the net annual growth and the volume of timber cut represents an addition to or subtraction from the standing timber inventory.

Ownership.—All of the above data should be classified by broad ownership classes.

Regional detail.—Timber resource data should be available for geographical areas smaller than States, if it is to be most useful. The data should be on a county basis with provision for combining groups of counties in order to reduce sampling error for some items.

Stumpage prices.—These are the prices paid for standing timber of commercial size before it has been cut. They must be in sufficient detail to recognize differences in the products for which the timber is suitable, species, diameter class, log grade, volume per acre, physical accessibility, logging and transportation costs, and the markets available for the products removed.

Timberland prices.—These are the prices paid for land and timber together when forest properties are sold. They must be in sufficient detail to recognize differences in site quality, forest type, growing stock volume, accessibility, and geographic location with respect to markets for timber.

Existing data

The U.S. Forest Service conducts a nationwide forest inventory on a continuous basis. Individual States have been remeasured at about 10-year intervals. The Forest Service periodically makes the necessary adjustments to bring the inventory up to a common year for the entire country. This is now being done for the year 1962 and publication is anticipated in 1964.

This nationwide forest survey is now collecting most of the physical data specified above for a wealth inventory. Up to now, it has not classified this data as to accessibility of the forest land. The survey also has not inventoried the timber of commercial size on the productive-reserved forest lands. The forest survey is made in sufficient regional detail to satisfy the needs of a wealth inventory.

Much less information is available on prices. The census of agriculture includes the value of forest products sold for farm woodlands only. The census of manufactures includes the cost of stumpage cut, the quantity and value of products shipped, and the value added for lumber and other wood products.

The stumpage prices received on national forest timber sales are compiled and published regularly. Similar prices are available from other public forest agencies. A few States now attempt to collect and publish prices for private timber sales. A nationwide stumpage price reporting service has been proposed but has not yet been brought into being.

Prices paid for timberland are not being compiled or published by anyone at the present time.

The problem of valuation

The most serious difficulty in preparing an inventory of timber resource wealth will lie in assigning values to the physical assets.

Cost or book value does not appear to be useful for this inventory. Such book values do not exist for most of the publicly owned timber resources and these make up one-fourth of the commercial forest land area and 40 percent of the timber volume. The book values in the records of private owners are often the 1913 values required for income tax purposes or are otherwise badly out of line with present values.

There appear to be two other possible approaches. The following discussion will try to make clear the characteristics and weaknesses of these approaches.

The first approach is to apply current market prices to the existing physical inventory. This physical inventory consists of two different kinds of assets. One is a stock of commercial-size timber which can be sold to processors for conversion into wood products. The other is a timber-growing machine consisting of land and growing stock and capable of producing wood each year on a continuous basis.

The price which people pay in the market for units of the timber-growing machine (tracts of timberland) presumably is based on the

income which they expect to get from their investment by growing wood. It seems reasonable, therefore, that the value of all of such timberland in the country should be equal to the total number of acres of that land multiplied by the average price per acre being paid for such land in the current market.

The stock of commercial size timber is of a different nature, however. People buy such timber in the current market with the intention of logging it within a short time and selling the products they can get from it to the consumers of those products. This consumer market will absorb only a limited amount of these products during a year. The purchasers of stumpage on the average buy during 1 year only the amount they need to produce the quantity of products that the consumers will buy. If they buy more than this amount, they will have to hold it for use during a future year with the consequent cost of interest on the capital they have invested. It appears, therefore, that all of the existing stock of commercial size timber cannot be assigned the value per unit that such timber is selling for in the current market. The portion of the existing stock which exceeds the amount that can be converted into consumer products and sold during this year must have a lower value than the current market price.[1]

In trying to decide what price is legitimate for this excess existing stock, a further complication arises.

If the forest growing stock is properly regulated by size and age classes, a tract of timberland will produce a certain yield of wood that may be cut each year in perpetuity without changing the volume remaining in the growing stock or the size of the future annual yields. However, some more of the growing stock besides just those trees that should be removed as annual yield will always be large enough for use and could be sold at the present time. This merchantable portion of the growing stock can be valued as a part of the timber growing machine or as a product salable in the present market. But both of these values cannot legitimately be assigned to these same trees.

In regions of the country where mature virgin timber still exists, many forests contain a greater volume of growing stock than is needed to maintain a maximum sustained yield. This surplus timber can only be valued as product and not as part of the machine. Market prices for land with timber may well include the value of some of this kind of surplus growing stock. By contrast, if market prices for timber alone (stumpage) are applied to all of the merchantable timber on a tract, the result will not include the value of the submerchantable sized growing stock and the land. The market price approach will require a careful combination of the market prices of both stumpage and complete timberland properties in order to avoid either double counting or omission of part of the asset in the valuation.

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[1] This statement appears to be in contradiction to the principle that in a competitive market, goods of identical qualities cannot sell for different prices. In the present instance, buyers of timber in the "current" market would switch to buying in the "deferred cutting" market, if there were any distinction between the markets, and if timber in the latter market bore a discount. Differences in prices can result only from differences in quality of wood, uniformity of stand, accessibility, monopolistic influences among buyers and/or sellers, ignorance on the part of buyers or sellers, special conditions imposed on the cutter (such as cutting only designated trees, avoiding damage to undergrowth, replanting, or tie-in sale of unwanted stands with desired stands), etc. Holders of mature timber for future sale must expect a rise in price sufficient to cover the cost of holding (interest, taxes, insurance, protection, etc.), or they would be acting irrationally and uneconomically—Neal Potter, Secretary.

The second possible approach is to calculate a capital value for the timber resource on the basis of the net annual revenue expected from the resource. If the amount of timber cut annually from the forest is known, this can be valued at market prices in the region for such timber. The value (also at market prices) of the change in the standing timber inventory during the year must be added to or subtracted from the value of the annual cut (depending on whether the growing stock volume increased or decreased) to obtained the gross value of the total yield. From this gross value must be subtracted all of the costs of managing the timberland and retaining ownership during the year (except for interest on the investment in timberland). The resulting net value of the total yield is attributable to the timber resource. The value of that resource can be obtained by capitalizing this net annual revenue at an acceptable rate of interest.

Although this capitalization approach avoids many of the problems of the market value approach, it has its own share of difficulties. Reliable data on the current management costs either are not available or will be difficult to segregate from the other costs of administering organizations. A more serious problem is the rate of interest to be used in the capitalization. Part of this capitalization rate is an allowance for risk. In order for the timber wealth estimates to be comparable with those for other sectors of the economy, it will be necessary to estimate the relative riskiness of an investment in timber resources. Since a substantial segment of this resource is in public ownership, there is also a question of whether the same rate of interest is acceptable for both public and private investments.

The problem of overlap

The nationwide forest survey obtains information for all commercial forest land in the United States. A value based on this inventory will therefore be a complete figure for the timber wealth of the country. However, some of this same timberland will be picked up in other wealth inventories. The agriculture inventory will include the value of farm woodland. The public lands inventory may include the value of publicly owned timberlands. The real estate inventory may include timberland being held for future development for other purposes. The manufacturing sector inventory may include the value of timberlands owned by wood using and mining firms. It will be necessary in consolidating the total wealth inventory to eliminate these duplications. For this purpose, timberland values should be identified and shown separately in every sector inventory where they may exist.

One important natural resource in the United States is the range and pasture land used for the production of domestic livestock. A part of the rangeland is forest range and is included in the forest land area. Some of this forest range is commercial forest land and produces or is capable of producing timber as well as forage. The area of land grazed is known to the people who use it and should be available from the public land managing agencies and from the census of agriculture. Grazing values can be placed on this land and in the case of commercial timberland these will be in addition to the timber value.

Some of the existing forest land is potentially suitable for conversion to agricultural, residential, industrial, or other uses because of its quality or geographical location. The current market value of such land is often based on its probable future conversion to these other uses and in such cases is usually higher than its value for timber production. Since these lands are actually forested at present, they will be picked up in the timberland inventory. It does not appear that the total timber values involved are sufficient to justify much concern on account of the timber resource inventory. However, where they can be recognized, such lands should be picked up in the real estate inventory and excluded from timber values.

Forest wealth compared to timber wealth

The total value of the Nation's forest resources is a composite of their value for timber, recreation, grazing, water production, flood control, wildlife, protection from wind and adverse weather, and esthetic enjoyment. This is the value which really should be included in the national wealth inventory. However, with the exception of timber and grazing these are very difficult values to measure. The protection and esthetic values are almost entirely intangible. No satisfactory method has so far been developed for imputing back to the land resource its share of the value of the water and wildlife produced on it. More progress has been made on recreation but the valuation of land and forests for recreational use is still in a very primitive stage of development.

It seems best to place monetary values only on the timber- and forage-producing aspects of the forest resource. However, it is entirely possible that the Nation's forest resources actually have a greater real value for the other products and services they produce than they do for timber and forage. In order that the relative importance of the forest resources not be understated in the total wealth inventory, we suggest that this inventory include a section which describes in qualitative terms these total forest values and points out the significance for national wealth of the extensive forest resources possessed by the United States.[2]

Proposals for data collection

We feel that to a large extent the basic physical data required for an inventory of forest resource wealth are being collected currently by the Forest Service in its nationwide forest inventory. The Forest Service has been constantly improving the techniques and coverage of this inventory, and we may anticipate further improvements in it.

Accessibility is a prime factor in the value of a forest. The separation of forests into accessible and not accessible would be very useful from a wealth viewpoint. The statistics produced by the nationwide forest inventory do not at present provide any such separation. We recommend that the Forest Service be requested to study the possibility of classifying commercial timberland in the forest survey on some basis of accessibility that will be usable for wealth inventory purposes.

[2] It should also be noted that the restrictive conditions often imposed on the cutting of timber in municipal watersheds, conservation areas, etc., may make the timber worth less to the buyer than timber sold under ordinary commercial conditions, which impose few limitations on the freedom to use the most economical methods of harvesting. These differences will need to be borne in mind in applying prices in particular sales to other "comparable" timber stands.

The greatest difficulty in preparing an inventory of timber resource wealth will lie in placing values on the physical assets. Because of the complexity of this problem, it seems best that some one agency be given the responsibility for studying it, developing procedures for accomplishing it, and making the necessary arrangements to obtain the price data for that purpose. We recommend that the U.S. Forest Service be asked to assume this responsibility since it is already collecting the physical resource data for the whole country.

We believe that the most fruitful immediate approach would be for the Forest Service to undertake a series of pilot studies designed to cover the range of conditions that affect the value of timber and timberland. Such pilot studies might be made of the value of the timberland resources of individual counties or similar areas. In these pilot studies, the Forest Service should have the cooperation of other landowning agencies and the assistance of advisory boards made up of people with experience and knowledge in the evaluation of timberlands.

Although it should be the responsibility of the Forest Service to work out satisfactory techniques for valuing the forest resource, we have some suggestions as to how they might start. It appears that it will be desirable to separate the resource into two parts: (*a*) mature merchantable timber and (*b*) land and immature growing stock. Because of the double-counting possibilities mentioned earlier, these two values will have to be combined and not merely added together. The only reliable source of information on prices appears to be transaction evidence from current sales. Such transaction information should be collected from all possible sources and compiled for areas in which conditions are reasonably similar. Since timberland sales are infrequent in some areas, it will probably be necessary to supplement this information with the estimates of knowledgeable local people.

As a check on the values obtained for timberlands from transaction evidence, it appears that it will be desirable to calculate values by capitalizing the value of the current annual timber yields. The same kind of a check on stumpage prices may be made by appraising stumpage value through a residual rent approach similar to that used on the national forest timber sales.

This approach starts with current market prices for the final products which could be manufactured from the timber; subtracts manufacturing, transportation, and logging costs typical of a local operator of average efficiency; and then subtracts an allowance for profit and risk sufficient to maintain an average operator in business in the long term. The residual is considered to be a fair value for the timber on the stump in the forest.

In carrying out these pilot studies, the Forest Service should have the overall guidance of the agency responsible for compiling the national wealth inventory in order that the methods used for valuing the timber resources will be consistent with those used in other sectors of the wealth inventory.

Annual extensions of the benchmark estimates

The timber resource inventories could be extended annually by using the information collected on the annual net growth and the annual timber cut. It would be best if the entire timber resource inventory

could be brought up to date at 5-year intervals instead of at 10-year intervals such as passed between 1952 and 1962. If careful estimates of net growth are prepared at 5-year intervals, they will be sufficiently accurate for annual adjustments during the succeeding 5-year period, perhaps with additional corrections in areas where new data become available. The timber cut figures could be adjusted annually to conform to the statistics obtained from other sources on the production and consumption of wood products. Such annual extensions would become less accurate with each succeeding year but should not be badly out of line by the time the whole inventory is revised in the 5th year.

VII. Water Resources Subgroup Report

PREFACE

Subcommittee on Water Resources.[1]

The Subcommittee on Water Resources recommends that a physical inventory of water supplies, including lakes, reservoirs, and ground water, be included in the national wealth inventory. Measures should cover quality as well as quantity. (See secs. II and III.)

Capital facilities pertaining to storage, delivery, intake, water treatment, waste treatment, hydroelectric power, navigation, irrigation, and so forth, should be inventoried (as to physical characteristics and value), and are included in this report (secs. IV and V), even though some of these items may be in the jurisdiction of other Wealth Inventory Planning Study groups. It is also recommended that some information bearing upon the value of water per se be collected (sec. VI), and that further study be given to ways of improving information of this character.

Data sources are suggested at various points in the report. Agencies now largely concerned with each type of data are listed in section VII of the outline.

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INTRODUCTION

Man's development and use of water resources is characterized by direct interdependencies between otherwise independent decision units (individual households, business enterprises, units of local government). As a consequence it is frequently possible for such units to escape certain costs of water uses, for example, when quality deteriorates. Similarly they often fail to obtain any payment for utilities which are provided other parties, for example, all downstream parties may benefit when a particular user regulates streamflow for his own purposes. Consequently, the market fails to perform its ordinary allocative function adequately with respect to water.

Furthermore, structures such as dams involve far-reaching economies of large scale. Because of hydrological interdependency between flow-regulating structures scale economies may extend to the planning and operation of basinwide systems of reservoirs.

[1] The subcommittee is deeply indebted to Allen V. Kneese for his invaluable assistance.

For these reasons, collective (government) action with respect to the development and use of water resources has long been recognized as essential. In this regard water differs at least in degree from other natural resource commodities.

This distinction has several implications for collection of data in general and particularly with respect to physical and economic wealth data.

1. Data collection must be planned and implemented with a view to its utility in planning for the *specific* allocation of the resource.

2. For reasons apparent from the above discussion, watersheds and river basins are significant water resource management units. Water resource data have little utility, even for projections as to its general availability, unless they relate to specific watersheds and basins. For many purposes, quality management is an example, they must be even more localized.

3. Detailed data on physical availability are particularly important in the case of water resources.

4. From a planning standpoint value data have their primary utility in aiding forecasts of demand and accordingly for estimation of the productivity of water in alternative uses. Unfortunately, the market provides comparatively few dependable guidelines. Even where water rights are exchanged, as in western priority doctrine States, subsidy and other legal institutional factors make the resulting values less than ideal. Nevertheless, systematic information on such transactions could have considerable utility and should be developed. In riparian doctrine areas, useful information can be obtained from data concerning the relative valuation of riparian and nonriparian lands especially if distinctions between types of water use and quality of water can be drawn.

The data on investment in facilities which is described in some detail in subsequent sections is of less utility for management purposes in specific basins and watersheds. These data will, however, be of considerable general interest and will be a significant element in the overall estimates of national and regional wealth.

I. GEOGRAPHIC DISTRIBUTION

A. Insofar as practicable all data should be tabulated by county. While it would be useful to have data tabulated for all counties the expense of doing so for many of the less important ones might not be warranted. It is suggested that detailed information be provided for perhaps 500 counties. The USPHS and the USGS should determine these counties on the basis of criteria such as importance as a source of water and importance of points of water use and waste disposal. These agencies should also investigate the practicality of recording specific points of streamflow measurement and major points of water intake and waste discharge on the basis of some form of coding system.

B. For purposes of additional data tabulation, the United States should be divided into major drainage divisions with appropriate subdivision, all boundaries to follow county lines. Basically the 22 regions used by the Senate Select Committee on National Water Re-

sources can be used. The following modifications should, however, be considered:

1. Rebound the lower Missouri to follow a watershed boundary.
2. Divide the Western Gulf by a north-south line in the neighborhood of the 20-inch rainfall line.
3. The lower Arkansas-White-Red Basin can be merged with the lower Mississippi, leaving 22 major regions. Alternatively the lower AWR, the lower Mississippi, and the eastern half of the Western Gulf can be combined into a single region.
4. Each major region should be subdivided into appropriate subbasins, also along county lines. For example, the Colorado region might be divided as follows: Upper Main Stem, Green, San Juan, Little Colorado, Gila, Lower Main Stem.
5. Counties should be grouped by State segments within subbasin or major region. This would facilitate combining counties into State totals.

C. All relevant counties should be coded by subbasin, major region and, of course, State. Where appropriate, data should be aggregated by State segment of subbasin, by State, by subbasin, and by major resource region.

II. PHYSICAL INVENTORY: QUANTITY

A. Surface waters:
1. Streams, at specified points of discharge:
   (*a*) Flow equal to or more than designated quantities 95, 90, 80, 70, and 50 percent of the time.
   (*b*) Mean flow.
   (*c*) The following special computations should be considered:
      1. Reconstituted undepleted flows with their respective probabilities.
      2. Mean velocity.
      3. Mean length of reach.
      4. Mean depth at mean velocity.
2. Lakes (including reservoirs):
   (*a*) Average, minimum, maximum volume, and durations.
   (*b*) Surface area—as in (*a*).
   (*c*) Depth—as in (*a*).
   (*d*) Outlet control.
   (*e*) Other data.
3. Reservoir sites* (assume "full development"):
   (*a*) Volume.
   (*b*) Depth.
   (*c*) Surface area.
   (*d*) Physiographic characteristics.

B. Ground water:
1. Estimated cumulative volume available at various depths.
2. Depth to water table.
3. Well capacities.
4. Rates of natural recharge.
5. Rates of depletion—drop of water table over last 5 years.
6. Transmissivity of aquifer. Artificial recharge capacity at least as a rank.

*Identify in relation to specified points of flow control.

C. Water supply productivity of watersheds: Study of methods to determine runoff and ground water as a function of precipitation and wild evapotranspiration is needed.

NOTE.—Items under II fall within normal range of responsibility of USGS.

Item C may be best done through university research.

III. PHYSICAL INVENTORY: QUALITY

A. Surface waters: Quality measurements interact with quantity measurements. It is important therefore to develop statistical summaries for relevant characteristics analogous to a flow-duration curve, e.g., values equalled or exceeded percentages of time.

1. Quality measurements as given in National Water Quality Network reports. County data will not be available from this source but it provides consistent measures at a number of points for a large number of parameters. These data as a minimum should be subjected to the statistical treatment indicated above.

2. Waste discharged into fresh water [2]—

(*a*) Into streams.

I. Level of treatment prior to discharge, by type of discharger.

II. BOD, by volume, by type of discharger (municipal, industrial, government agency).

III. Other pollutants by type of discharger, including nitrogen and phosphorus discharged from waste treatment plants and pollutants carried by surface runoff and drainage.

(*b*) Into lakes: I, II, III as in (*a*).

(*c*) Into coastal or estuarine waters: I, II, III as in (*a*).

B. Ground waters:

1. Identification of mineralized waters, degree of mineralization, volume, etc.

2. Identification of other types of pollution, amount of water affected, degree of pollution, type of discharger, as under III, A, 2.

NOTES.—Quality characteristics of ground water may be integrated with quantity measurements.

Items under III are dealt with by USGS and USPHS at the Federal level. Large amounts of data are, however, in the hands of municipalities and industries.

IV. CAPITAL INVESTMENT IN WATER USE AND CONTROL FACILITIES

All capital values should be measured by original cost and by reproduction cost less depreciation. All value figures should be accompanied by relevant physical capacity data.

[2] Large amounts of data of this type are in the hands of individual industrial plants and municipalities. They have never been systematically collected and tabulated and it may be difficult to get many of them. One improvement urgently needed is better census of manufactures data. Presently the census does not even distinguish polluted process water from unpolluted cooling water. A committee should be convened to consider revision of the census data collection in view of current needs for information. This note also applies to IV F below.

A. Dams and reservoirs (all purposes): Separate categories for all single-purpose dams. All multipurpose dams should be put together in a separate category.[3] Include dam, administrative facilities, land, access facilities, and costs of displacement and relocation of utilities, roads, communities, etc. (Number and major purpose or purposes of dams should be included.)

B. Hydroelectric power installations except dams and reservoirs.

C. Recreation facilities at dams and reservoirs.

1. Boat ramps, camping facilities, etc., public and private (exclusive of hotels, motels, etc., unless operated in direct connection with the reservoir).

D. Water delivery systems:

1. Long-distance aqueducts, canals, pipelines, tunnels, siphons, diversion weirs, channel improvements, etc.
2. Irrigation distribution facilities:
   (*a*) Mains and laterals, pumps, etc.
   (*b*) On the farm distribution and drainage.

E. Flood control:

1. Channel improvements.
2. Levees, floodwalls, floodways.
3. Flood proofing of buildings.
4. Shore protection works and hurricane barriers.
5. Storm sewers.

F. Pollution abatement:

1. Sanitary sewers.
2. Household and community septic tanks.
3. Waste treatment plants:
   (*a*) Municipal.
   (*b*) Industrial.
4. Lagoons and ponds:
   (*a*) For retention of wastes.
   (*b*) For finishing of treatment.
5. Barges and other facilities to dispose of solids.
   (*a*) Should fertilizer plants be included?
6. Effluent disposal facilities:
   (*a*) Ground water recharge fields.
   (*b*) Special outfall sewers.
   (*c*) Other (some irrigation gets picked up here).

G. Heat reduction facilities:

1. Cooling towers, spray ponds, etc.:
   (*a*) Steam-electric power.
   (*b*) Manufacturing.

H. Drainage facilities:

1. Is this properly a value attached to land? Will it be picked up by group measuring land values?

[3] There was some question among the subgroup members as to whether there should be any recommendation calling for the allocation of joint costs of dams among the different uses which they serve.

I. Local treatment and distribution facilities:
  1. Municipal:
    (a) Water supply treatment.
    (b) Distribution facilities—pumps, mains, laterals, etc.
    (c) Local storage.
  2. Industrial.
    (a) Water supply treatment.
    (b) Local storage.

J. Fresh water navigation facilities:
  1. Docks, canals, locks, channel improvements.

K. Ground water facilities:
  1. Wells, pumps, windmills:
    (a) Irrigation and other agricultural uses.
    (b) Municipal.
    (c) Industrial.
    (d) Domestic.
  2. Well drilling facilities.
  3. Storage ponds and tanks, not elsewhere classified.
  4. Other related facilities—troughs, conveyances, etc.
  5. Ground water recharge facilities.

L. Coastal facilities:
  1. Navigation channels, seawalls, breakwaters, docking facilities, intercoastal waterways, navigation aids.
  2. Salt water intrusion control works:
    (a) Surface water barriers.
    (b) Ground water barriers.

  NOTE.—Responsibility for collection of data under IV is widely diffused.

V. CAPITAL INVESTMENTS IN WATER PRODUCTION AND RESEARCH FACILITIES

(Original cost and, where applicable, reproduction cost less depreciation.)

A. Soil and moisture conservation:
  1. On the farm.
  2. On public domain.
  3. Silt detention dams.
  4. Channels to reduce evaporation and nonbeneficial consumption.
  5. Modifications of land cover to enhance water production.
  6. Evaporation suppression devices for lakes and reservoirs.

B. Desalination plants.

C. Water resource research facilities.
  1. Agricultural research leading to improved adaptation to limited water supplies.
  2. Water and waste water research.
  3. Engineering research.
  4. Hydrologic research.

  NOTE.—No systematic collection of data.

VI. VALUE OF WATER PER SE

Because this section poses some rather formidable conceptual issues somewhat more detailed discussion of the various problems and possibilities is provided than in previous sections.

A. Value of water under appropriation law: In 17 Western States the "appropriation rights" doctrine prevails to one or another degree. In several States rights exchange independently of land. In the latter instances the market value of rights yields information concerning the discounted marginal value of water.

Even in these areas however it must be noted that markets are sometimes thin and that the taxing power is frequently used by public districts and other agencies to provide water to users below cost. Where this occurs the value of rights cannot be added to the value of dam and irrigation facilities without danger of some double counting. It would appear to be possible to reasonably adjust the data for this factor, however. Accordingly, a systematic effort should be made to collect data on the value of water rights.

In several Western States water rights are considered to adhere to parcels of land. In these instances the two are traded as a package and the transaction will reveal nothing concerning the separate value of either. In such cases the only possibility of obtaining an estimate of value of water per se would appear to be in comparisons of land value with water rights and the value of land otherwise equivalent but without water rights. The agencies responsible for collecting land value data should be encouraged to obtain information suitable for making such comparisons. Even in strict appropriation law States riparian owners without diversion rights will obtain some value from adjoining bodies of water. This may take the form of sport fishing, boating, swimming, or other recreation use or simply the esthetic amenity which propinquity with water offers.

Another important riparian benefit is low-cost waste disposal into the water course.[4] Again land value data should be collected in a form which permits comparison of the value of riparian land without water rights and otherwise equivalent land. Accompanying this should be information concerning the character of the benefit which contiguous water confers—waste disposal, recreation by type, amenity, etc., and the character of the water body—lake or stream and ideally also volume, physiographic characteristics, quality, etc.

In at least nine Western States there are important elements of "riparian doctrine" in water laws. In these States security attaches to ownership of an appropriation right and information on the value placed upon such rights would be valuable. The comments above concerning the values not "captured" by the appropriation right hold with additional force in these States and riparian nonriparian land value comparisons will be especially important.

Values derived from comparisons of riparian and nonriparian land prices may involve some double counting if they incorporate capital values of water use and control facilities. This results if the use of water yielded by such facilities is subsidized. In this case an appro-

[4] Waste disposal and some other water uses impose external diseconomies. At any given time internal economies and external diseconomies might not be in optimum balance. There is presumably a set of restrictions on riparian rights, which would tend to result in maximum asset value of the resource. In an estimate of existing wealth we can accept the asset value which corresponds to a given set of rights and restrictions.

priate portion of reproduction less depreciation of such facilities should be subtracted from land value.

One other important utility yielded by water is not captured by appropriation rights under current interpretation of the law. This is the value of head and flow for hydropower generation. This aspect is discussed subsequently.

B. The value of water under riparian law: The "riparian doctrine" which does not confer rights to specific amounts of water but permits the riparian owner to use any amount of water so long as he leaves it "reasonably" unimpaired in quantity and quality holds in the Eastern States. Where this doctrine prevails, market transactions reflect the value of water use per se through the values of riparian real estate and much more indirectly through the transportation and access costs which nonriparian users incur.

The first of these—real estate values—which result largely from relatively inexpensive water supply and waste disposal and the value of navigation, recreation, and amenity, is at least in principle subject to census. It would be desirable to collect land value data in such a way as to permit comparisons between riparian and nonriparian lands with the former classified by use and character of the contiguous water body.

The second type of utility which the market reveals is payment for access by nonriparians—largely for recreation use.[5] This is an important element in the value of almost all large bodies of water. Research has shown that a consistent measure of demand can be derived from such data. Questionnaire methods may also be useful for getting at the evaluation of nonriparian users. These methods are still under development, however, and while the committee sees great value in and wishes to encourage research along these lines, it does not feel that a stage has been reached where appropriate data could be included in a census-type activity.

It should be noted of course that the comments made with respect to the possible incorporation of capital value of flow regulation facilities in riparian land prices under point A apply to point B as well.

C. The value of head and flow for hydro power: It has been noted that the full benefit accruing from recreation is not captured in land values although a major part of it probably is. The benefit least likely to be reflected in land values appears to be hydropower. The huge uncertainty involved in anticipating the timing and value of specific hydroelectric developments probably means that very little of the hydro protential is capitalized in advance. After development there is (in contrast to say, recreation or navigation value) no opportunity to do so if the potential is publicly developed.

For hydropower the value of the benefit stream minus associated operation, maintenance and replacement costs (in principle including internal opportunity cost such as reduced recreation value due to reservoir drawdown) is the asset value of existing installations. The benefit stream could be estimated for various regions by the alternate cost technique. Similar calculations could presumably be made for economically feasible but not yet developed installations by discounting

[5] The value of recreation as such either as reflected in land values or as deducible from willingness to pay for access does not appear in the national income accounts.

the overall cost and benefit streams if some timing of development is assumed. The committee believes it would be worthwhile to experiment with calculations of this kind utilizing data from Federal agency studies. If these prove feasible, results should be included in the wealth estimates.[6]

VII. DATA SOURCES

A. Possible assignment of responsibility for data collection and coordination. It is not meant to imply that the agency listed will always be the primary *source* of data.

1. Item I: Federal Interagency Committee and interested research institutions.
2. Item II: USGS.
3. Item III: USGS and PHS.
4. Item IV:

A. Federal construction agencies (Corps of Engineers, Bureau of Reclamation, Soil Conservation Service, Tennessee Valley Authority); other authorities and Federal-State agencies (e.g., Idaho Power and Light, etc.).

B. Federal Power Commission.

C. Federal and State agencies—maybe Bureau of Outdoor Recreation can do the job.

D. 1. Corps of Engineers, Bureau of Reclamation, and States: 2. Bureau of Reclamation and USDA.

E. Corps of Engineers, Bureau of Reclamation, Soil Conservation Service.

F. All except 3(b) USPHS: 3(b)—Bureau of the Census (censuses of manufacturing and mining)

G. USPHS.

H. USDA.

I. 1. USPHS; 2. Bureau of the Census (censuses of manufacturing and mining).

J. Corps of Engineers.

K. USDA.

L. Corps of Engineers.

5. Item V:

A. Soil Conservation Service.

B. Office of Saline Water.

C. USDA, PHS, SCS, Bureau of Reclamation, Corps of Engineers.

6. Item VI:

A, B. Land and water right sales and records are State and local. It will require specific research to supply this information. Normal recordkeeping will not reveal the requisite data. Perhaps a grant can be made to a university or research foundation.

C. Corps of Engineers, Bureau of Reclamation, and Fish and Wildlife Service; States; river basin authorities; Federal Power Commission.

[6] Again possible double counting may occur if subsidized electric power rates are capitalized into real property included in other parts of the wealth study. The committee believes this can be neglected for the time being.

B. Data for the physical inventory and for inventory of capital facilities are either already being acquired or capable of being acquired with relatively little additional difficulty by agencies engaged in census and inventory activities. Data on various measurements of the value of water per se are not likely to be available in such form as can be acquired by routine collection methods. Special research projects can, however, supply benchmark data on at least a sample basis from which estimates of the entire universe can be constructed.

VIII. Fish and Wildlife Subgroup Report

ISSUES

The problems that must be solved to measure the national wealth in the commercial fisheries and in recreational fishing and hunting are as follows:

1. To markedly increase the amount, quality, and kinds of statistical data available.
2. To establish for purposes of estimating the national wealth meaningful and logically defensible values for the American commercial fisheries and for outdoor recreational activity dependent upon fish and wildlife resources.

Data are needed on values in the commercial fisheries to enable private investors and Government policymakers to better gage the importance, profitability, and efficiency of the industry, and to judge the wisdom of various proposals for regulating, aiding and taxing the industry.

An inventory of fish and wildlife populations is needed for the guidance of Federal and State administrators of fish and wildlife programs, for outdoor recreational planners, and for land and water use planners. The International Association of Game, Fish, and Conservation Commissioners at their September 1962 meeting expressed the need as follows: "A thorough knowledge of present and future fish and wildlife needs and potentials is necessary to adequately plan for and justify future fishing and hunting space."

The U.S. Fish and Wildlife Service and representatives of the association were asked to investigate possible sources of funds to "organize and conduct standardized State surveys which will result in a national survey of fish and wildlife resources, future needs and potentials." The resolution is interpreted by association officials to extend, not only to surveys of users of the resource, but also to an inventory of the resource itself in depth, with a view to determining its size and distribution. Projection of future demand and supply were also to be covered. The Fish and Wildlife Service has estimated minimum costs on the order of $12 million assuming the complete cooperation of State fish and game agencies. There is no present source of funds.

SUGGESTED SOLUTIONS

A. The problem of adequate data

(1) 1963 census data on commercial fisheries: A progressive step is being taken to improve the data available on the commercial fisheries. In 1964 the Bureau of Census will conduct a census of commercial fishing. One question on the reporting form (as presently drafted),

will solicit information on the capital investment in fishing vessels (including engines). It is planned to obtain the data on the basis of original investment value together with data on the age of the vessel, making it possible to calculate estimated depreciated book value. The information to be obtained for year 1963 will be broken down on a State basis. Also it will be available by ownership unit, i.e., individual, corporate, or other.

These data represent a benchmark for investment data on the commercial fisheries. This benchmark may become the basis for future censuses of fisheries and intercensus estimates by Federal Government statisticians.

(2) Sport fish and wildlife data: As indicated in 2, above, the data on sport fish and wildlife populations and utilization are inadequate. Estimates on the size and distribution of the various resources can be prepared, given sufficient funds and personnel for a coordinated national effort involving sample population surveys and habitat evaluations. This would require close cooperation with State fish and game agencies which generally exercise principal responsibility for resource management of resident species. Surveys of recreational participation in activities based on these resources are needed to establish the level of current utilization for many species.

National surveys of participation in sport fishing and hunting, including monetary expenditures, were made for 1955 and 1960. It is tentatively planned to update these studies in 1971 to cover the calendar year 1970.

B. The valuation process

The determination of the market value of any asset involves two basic estimation processes. It is necessary to estimate the revenue the asset will generate in the future, and the rate of discount appropriate to the particular asset.

The present value of the discounted future revenue provides a basis for determining the market value of the asset. The future returns estimated to be generated by the asset are net returns, i.e., gross revenue less expenses of using the asset (carrying on the business).

This set of calculations, simple in theory, is of course, very complex in practice. Where it is necessary to secure agreement on the calculations involved in valuing specific assets, as in property taxation or public utility regulation, the process may take years, and involve arbitrary assumptions and compromises. When it is possible, on the other hand, to find a reasonably competitive market, in which the prices are set by the calculations and competitive bidding of a number of buyers and sellers, the existing market price is taken as the best current evidence of true value.

In the case of fish and wildlife resources, however, markets for establishing the capital value of the resource in the wild state are rare. Most are available with a zero or nominal charge, though frequently with some restrictions on methods and quantity of capture. Under conditions of free access to the resource in the long run the theory of fisheries points out that the net economic yield will be driven to zero; i.e., the resource will not have any market value. Any value over and above the cost of capture will provide commercial fishermen with an excess profit or wage which, over the long run, will attract more participants to the industry or area, until the catch per man is worth

just enough to keep the labor and capital in the industry.[1] As long as present conditions of exploitation remain, the tendency will be for these resources to have no market value, except in the cases where private ownership or leases currently exist (as in fishponds, private hunting preserves, and leased oyster beds). If the wealth inventory is to be confined to coverage of market values, the only things to cover will be the vessels, boats, gear, docks, etc., plus a few privately owned or State-leased resources.

However, limiting the wealth inventory in this way will make impossible the use of the resulting data for the primary purpose for which economic data are gathered; viz, the rational organization of production. If no value is assigned to the resource, it cannot enter into economic calculations in either the public or private sphere; it cannot be a guide to decisions about investment or regulation—such decisions will perforce continue to be made either arbitrarily, or by political pressures, or by standards which are not precisely relevant, such as maximum biological potential. Where values in fish and wildlife compete with other values—as in the case of dams which interfere with salmon runs, or where lack of sewage treatment spoils oyster beds, or land drainage destroys spawning or nesting grounds—lack of value data may be quite a serious detriment to policy decisions.

For this reason we wish to enter a plea for estimates of the value of the resource as it would be under rational conditions of use. Such estimates can be made in many if not most cases without excessive difficulty. Moreover, both the commercial and recreational aspects of fishing are expected to rise greatly in importance in the decades ahead. It is high time to establish some benchmarks for future research and policy decisions.

(*a*) Commercial fisheries: The most practical method for valuation of commercial fisheries appears to be through estimation of the manpower and equipment technically required to make the optimum catch; i.e., the catch which would yield the maximum gross income over costs of capture and protection.[2]

Pilot studies of this kind have been made by Crutchfield, by Donald H. Frye, and by Lynch, Doherty, and Draheim.[3] The difference between total costs (including wages) at the optimum level of operation and the gross revenue expected at that level of operation would provide an estimate of the annual rent to be expected from a rationally operated fishery. This annual yield could then be capitalized at some acceptable rate of interest to give the desired estimate of capital value of the resource. A somewhat simpler calculation, yielding nearly the same results for many fisheries, would be to estimate the manpower and equipment charges minimally required to take in the present levels of catch. Subtracting these costs from those now in-

[1] James A. Crutchfield, "Valuation of Fishery Resources," Land Economics, May 1962, p. 146.

[2] One difficulty in this connection is that there is frequently only limited knowledge about the most effective techniques or their costs. Gear restrictions, season limitations, etc. are imposed for the purpose of decreasing efficiency, and the drive of the entrepreneurs for efficiency is pushed into artificial channels, such as vessels of excessive size or speed.

[3] William F. Royce, James A. Crutchfield, et al., "Salmon Gear Limitation in Northern Washington Waters" (Seattle, University of Washington Publications in Fisheries, vol. II, No. 1, 1963); D. H. Frye, "Potential Profits in the California Salmon Fishery," California Fish and Game, vol. 48, No. 4, October 1962; Edward J. Lynch, Richard M. Doherty, and George P. Draheim, "The Goundfish Industries of New England and Canada" (Washington, U.S. Fish and Wildlife Service, Circular 121, July 1961), in particular ch. III on haddock.

curred (which tend to equal total revenue) would give the annual yield of the resource to be capitalized.

These estimates can be supplemented in some cases by estimates based on the observed market value of fishing grounds where access has been limited and leased to particular fishing firms, as in the case of some oyster beds.

The most severe limitations on this approach to valuation of commercial fisheries will arise from (1) conditions in the high seas fisheries, where the share available to U.S. fishermen is not determinate, and competitive waste will be inevitable until adequate international agreements on sharing are reached; (2) uncertainty in the data, because of wide variations in the catch, or because exploitation of the species is new or underdeveloped.

(*b*) Sport fishing and hunting: The case of sport fishing and hunting is different, for the object here is not maximum efficiency in harvesting food, but maximum efficiency in providing recreation. Arbitrary limitations are generally provided to preserve the species and the sport, but monetary charges, other than license fees, are rare.

Nevertheless, it is proposed that admission or privilege fees charged by private operators be used as the basis for estimating the daily values of the different kinds and locations of recreational opportunities based on wildlife and fish. These daily values, multiplied by total use of each class of fishing or hunting resource—estimated along lines already begun in the National Survey of Hunting and Fishing—will yield estimates of total gross annual receipts for recreational use of these resources. The problems of comparability among different fishing and hunting opportunities will of course loom large in such an operation; but we believe the results will be well worth the effort. Some indication of the importance of the industry may be obtained from the fact that private expenditures on various goods and services in connection with fishing and hunting were estimated at $3.85 billion in 1960 (as against $2.85 billion in 1955),[4] and from the fact that large public expenditures will probably be needed soon in the field of recreation.[5]

The paucity of data on private charges for fishing and hunting will no doubt force resort to alternative approaches of a more hypothetical nature. One of considerable interest is that based on an inferred demand curve, derived from the rate of use (per 1,000 of population) of recreational sites by residents of cities of varying distances from the site.[6] Capitalizing of the maximum net income estimated to be derivable from user charges based on such a demand curve, would constitute the estimated marketable value of the resource.

Numerous considerations enter into judgments concerning the collectible charges on particular facilities, however, and amenities other than the fish and wildlife are certainly a consideration for most fishermen and hunters, so that it will not be possible to attribute the entire "rent" to the fauna. However, for lack of more solid ground, those working on development of water resources are currently using

[4] U.S. Fish and Wildlife Service, Circular 120, "1960 National Survey of Fishing and Hunting" (Washington, 1961), pp. 4–5.
[5] Marion Clawson, "The Crisis in Outdoor Recreation," in American Forests, March and April 1959.
[6] Marion Clawson, "Methods of Measuring the Demand for and Value of Outdoor Recreation," reprint 10, Resources for the Future, Inc., Washington, February 1959.

a "judgment" table of daily unit values representing net income an operator might derive from fees for hunting and fishing. These range from $0.50 to $6, and were based in part on a limited survey of establishments levying such charges.[7]

APPLICATION OF THE VALUATION PROCESS

The census of fisheries described in (1) above will provide some basic data for valuation of the commercial fisheries. This should be supplemented by the considerable amount of related data available on the value of these manmade assets

For many specific fisheries it will be reasonable to assume that output is at or above the maximum physical yield the resource will sustain. In those instances it will be possible to estimate yield of the fishery with a rationalized number of inputs. In certain cases these estimates have already been prepared in usable form; in some additional cases, data are available which can be used as a basis for such estimates, for example the Pacific halibut fishery.[8]

This estimation process can be carried out largely by the economists and gear technologists of the Bureau of Commercial Fisheries. Given knowledge of the peculiarities of individual fisheries and especially of the relative productivity of particular units of gear, reasonable estimates can be prepared without extensive investigation in the field.

In the case of fish and wildlife resources as a base for recreational activity it will be necessary to continue and extend current efforts to estimate the demand for the utilization of those resources. Some complete and many partial estimates are available, based on demand studies already carried out.

On the valuation aspects of recreational fishing and hunting, administrative values assignable to daily units of activity are in regular use in river basin analysis. These values are considered to be net of associated development and operating costs. The $0.50 to $6 range of daily values chosen is based on a limited survey of operators of private shooting and fishing preserves and on the informed judgment of persons knowledgeable in the field.

In addition to the several thousand going operations in which daily fees are charged for hunting or fishing, there are a number of examples of leases of hunting and fishing rights which might assist in the establishment of values. It was recently estimated that seasonal leases for hunting deer in Texas, where hunting leases or charges are almost universal, range from $15 to $75 annually per hunter for "fair" hunting to $100 to $150 for "excellent" hunting. A Minnesota survey of 49 waterfowl hunting leases in 1959 found the average annual payment (revenue) to be $409, or $5.10 per acre. These are representative of a great and increasing number of hunting and fishing leases which might yield information of importance in establishing values.

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[7] Inter-Agency Committee on Water Resources, Subcommittee on Evaluation Standards, "Report of the Panel on Recreational Values on a Proposed Interim Schedule of Values for Recreational Aspects of Fish and Wildlife," Washington, U.S. Department of the Interior, May 24, 1960.

[8] James Crutchfield and Arnold Zellner, "Economic Aspects of the Pacific Halibut Fishery," U.S. Department of the Interior, Bureau of Commercial Fisheries, April 1962.

IX. Public Lands Subgroup Report

One basic issue is which "public" lands to include. The attached checklist briefly describes the chief Federal, State, county, and city lands to be included. Although the Federal lands are grouped according to managing agency rather than according to land type, this is operationally sound because the estimates will almost surely be made by agencies and because there is some interest in separate figures for the lands administered by each agency. The checklist includes Indian lands, which are privately owned, but which might otherwise be overlooked. Their value should be included with the values of other private land. Similarly for privately owned in-holdings, within the various public land areas, which should not be overlooked, but included in private property.

Estimates of values of public land (as defined above) should exclude the values of commercial and other timber on the land, of minerals in the land, of publicly owned streets and highways not primarily for the use and enjoyment of these lands, and water originated from these lands. These values are excluded here because it is assumed that they will be included in the estimates of forests, minerals, etc. However, this requires that the groups estimating these latter values have separate subcategories for the forests, minerals, etc., on public lands, so that these values can be added to the values included in this statement, in order to get a total for public lands. The land value estimates to be covered in the public land category are those for the land alone, excluding values of the forests, minerals, etc. The land value of cutover forests would be included, for instance; also the bare land value of forest land, the value of whose trees was included under forest values. The value of grazing land, including grass and other forage, would be included since forage ordinarily does not have a value separate from the land.

One major problem is the degree of double counting involved in estimating values of public land. It seems probable that much, perhaps nearly all, of the values of the public land have been capitalized in the values of the private land, because the income from the use of public land generally accrues to the owners of private land used in the same productive enterprises. This is especially likely to be the case for grazing land values, less so for timberland and mineral values, and least of all for recreational values. However, there is much interest and value in separate estimates for public land. We propose that they be made on the basis described below, but that the values of the separate items be excluded from national totals of all wealth, to the extent that the various items represent double counting.

A related matter is the values arising out of multiple use of much public land. One can estimate separately a grazing value for a tract, a recreational value, a wildlife value, etc.; but in this case one must be careful that one type of value does not unintentionally include some of the value arising out of other uses. Or one can estimate a single value for each tract, which takes into account its manifold possibilities and uses. If done carefully, each method should yield the same or closely comparable results; the essential consideration is that the process be explicit.

Data are generally available on acreages of land in the various categories of public land shown in the attached checklist. While such data

are neither completely accurate nor perhaps wholly inclusive of all public land, yet the errors here are small compared with those in the land prices field.

The most serious deficiency for valuing public lands lies in the appropriate price to apply to acreage figures. For several reasons, it is not possible to use commercial sales prices. Much public land is never sold—one reason why national and other parks are in public ownership is to prevent their public sale. Purchase costs, even when known, are often irrelevant to present-day prices. Some public lands are sold, but often under prices or conditions determined by law, definitely divergent from competitive sales prices. Such sales prices in many instances would be more misleading than helpful. Use of public lands is also generally at charges or fees lower than commercial rates, ranging from zero or nearly so for many parks, to grazing fees well below commercial fees, and to other charges that more nearly approximate a full commercial lease price. Capitalization of such artificially low rentals would therefore be highly misleading.

After consideration of all approaches, and in full recognition of all the difficulties, the subcommittee proposes the establishment of a system of "shadow prices" for public lands. Specifically, we propose that there be established in every major area (a State, usually) an appraisal board. We think that, on the whole, it would be better to have a single board for each geographic area, to appraise the value of all public lands, than to have separate boards for the different kinds of land; but administrative or other reasons might lead to the establishment of different boards for different kinds of land. We think such boards should include the chief administrative officer for each major kind of public land within the general area (or his representative); any specialized appraisal personnel (such as Federal land bank appraisers) that might be available; agricultural college and other educational institutions personnel familiar with land values and incomes; and perhaps simply knowledgeable citizens in the area.

Such boards should seek to estimate the price per acre that the various types of public land would bring in the open market, if offered for sale in optimum size parcels. In arriving at this estimate, the board should use any and all relevant data—sales prices, when the sales reflected truly competitive sales conditions; sales prices of physically similar but privately owned land; any appraisals that might exist; or any other data. We judge, however, that most boards would be forced to come up with a "judgment" figure. We think it would be impossible for such boards to undertake research specifically for this problem, but of course they should use the results of any research existent. Moreover, given the intangibility of many of the values, we think boards should be discouraged from detailed appraisals; the desired figure is a reasonably accurate general average for rather large areas, not a specifically accurate figure for particular tracts.

In making this suggestion, the Subgroup is fully aware of the difficulties of arriving at such shadow prices, but we think this method more defensible than any other. As carefully drawn instruction as can be written and careful supervision during the process of estimating the shadow prices would help to produce more consistent, if not more accurate, results. We think it better to have a rough estimate for the properly defined price than to have an exact figure for the wrong kind of price.

CHECKLIST

I. Governmental units and jurisdictions to be considered in an inventory of public land resources: [1]

A. Federal Government:
1. Bureau of Land Management.
2. Bureau of Sport Fisheries and Wildlife.
3. Bureau of Indian Affairs.[2]
4. Bureau of Reclamation.
5. Park Service.
6. Forest Service.
7. Soil Conservation Service.
8. Department of Defense.[3]
9. Veterans' Administration.[3]
10. Tennessee Valley Authority.[4]
11. Bonneville Power Administration.[4]
12. General Services Administration.[4 5]

B. State governments.
C. Counties.
D. Cities and towns.
E. Other political subdivisions:
1. Water districts.
2. Drainage districts.
3. School districts.
4. Other.

II. Uses of land to be considered in an inventory of public land resources,[6] and recommended jurisdiction:

Uses	*Recommended jurisdiction*
A. Forests and woodlands	Forest resources subgroup.
1. Commercial	Do.
2. Noncommercial	Do.
B. Minerals and petroleum	Minerals subgroup.
C. Grazing	
1. Domestic livestock	Public lands subgroup.
2. Wildlife [7]	Fisheries and wildlife.
D. Wildlife habitat	Do.
E. Recreation	Public lands subgroup.
1. Designated areas [8]	Do.
2. Nondesignated areas	Do.
F. Watershed [9]	Water resources subgroup.
1. Designated areas [10]	Do.
2. Nondesignated areas	Do.

[1] The estimates of public land wealth should be made in recognition of the concept of "multiple use"; any given parcel of land may have more than one use and yield more than one product or service. Thus an inventory might well include some values within the public lands concept as well as within some other concepts (e.g., grazing land within national forests or on military reservations, etc.) This checklist serves to indicate those agencies holding public lands that should be screened for inclusion in the "public land" concept by virtue of their uses, services, and product.

[2] Indian lands properly must be considered as private lands. They are owned by Indians and only held in trust by the Federal Government. They should be inventoried in the private sector, and are included in this list only as a reminder, lest they be overlooked.

[3] Some lands held by these agencies are used for grazing or other "public land" uses in addition to their primary purposes.

[4] Should be screened for appropriate inventory listings.

[5] Also a source of information about "public land" holdings of agencies not included in this checklist.

[6] Any given parcel of land may have more than one use, product, or service. For example, one area of publicly owned land may yield water, timber, and minerals, and be used for recreation, grazing, and wildlife habitat. This checklist of uses should be cross-referenced, in each category, against the checklist of governmental units.

[7] Grazing by "big game" such as deer, elk, moose, antelope, etc.

[8] "Designated areas" refers to National parks, State parks, and other identified campgrounds and recreation facilities. Much recreational use is made of publicly owned lands on areas not specifically identified or improved.

[9] Includes water management areas such as reservoirs.

[10] Some areas of publicly owned lands are set aside, or "designated," specifically as watersheds, but most watersheds are open to other uses.