USDA Forest Service
Research Paper INT-92
1971

SOME ECONOMIC CONSIDERATIONS OF WATERSHED STABILIZATION ON NATIONAL FORESTS

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Alan W. Green began his Forest Service career in 1955 at the Central States Station office in Carbondale, Illinois, as a Research Forester in silviculture and regeneration. From 1958 until 1961 he was superintendent of the Amana Experimental Forest in Iowa. In 1961 he was assigned to the Foreign Forestry Services branch in the Washington Office as an analyst of timber resources and industries on an international basis. He joined the Timber Production and Multiple Use Economics Project at the Intermountain Station in Ogden, Utah, in 1964 and is currently the Project Scientist in Research Work for Evaluation of Timber Growing Opportunities and Forestry Program. In addition to a degree in economics, he also holds both Bachelor and Master of Science degrees in forestry from Purdue University.

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ABSTRACT

The Forest Service is responsible for protecting and managing nearly half the major watersheds in the high mountain areas of the Western States. By 1985, water demands of people in the Western States probably will have doubled. Sites for storage and distribution facilities to assure adequate and timely delivery of water are limited, and in many areas alternate sites are nonexistent. Consequently, the Forest Service must look ahead in its watershed management planning to assure that such projects are given every opportunity for continued efficient operation.

Appropriate long-term planning means that use damaging to watersheds must be stopped, damaged watersheds repaired, and control of use gained before water storage projects are undertaken, not afterward. The kind and level of land use on watersheds must have protection as the primary goal rather than predicating protection and rehabilitation activities on desired land use patterns.

Limited budgets demand a careful evaluation of stabilization and rehabilitation activities in terms of costs, probable results, and accomplishment of basic goals and objectives. Alternative measures must be considered in relation to effectiveness and overall efficiency of water management.

INTRODUCTION

For many years the Forest Service has been conscious of its watershed responsibilities in the Western States. The high mountain country in the 11-State area from New Mexico to Montana and westward provides the water necessary for the survival and well-being of some 32 million persons. About 18.5 percent of the land area in these States is administered by the Forest Service and nearly 50 percent of the major water producing areas fall within National Forest boundaries. Acting as managers of watersheds that supply the needs of so many people is indeed a grave responsibility.

The Forest Service, throughout its history as a public land management agency, has given special attention to problems of water production and quality in conjunction with its management and protection of other land resources and within the framework of its land stewardship commitment. A major consideration in regulating timber harvest, range use, and the general development of forest land has been to maintain or improve watershed and streamflow conditions. The concern for these critical watersheds is reflected in the policy to rehabilitate, as promptly as funds permit, those watersheds damaged by fire or past management practices.

Damage to watersheds is not a problem the Forest Service alone faces nor is it a problem peculiar to the West. Moreover, not all such damage can be called "historical." Although it is true that before National Forests were established the millions of sheep and cattle that roamed the open ranges did irreparable damage, overgrazing continued long afterward on the Forests and on other public lands. Although the Taylor Grazing Act and actions by the Forest Service have succeeded in substantially reducing the impact of heavy grazing, there have been many instances where public land agencies, including the Forest Service, have permitted a level of grazing that has since proved far too heavy.

Overgrazing cannot, however, be blamed for all watershed damage either past or present. Careless logging operations, poorly-constructed road systems, mining activities, and excessive concentrations of big game in small areas, coincident or subsequent to depletion of larger game-range areas, also contributed to many of the current watershed problems.

During the time the Forest Service has been attempting to conquer its watershed management and rehabilitation problems, the rapidly developing West has placed even greater demands on watersheds. These demands are both for water production and other onsite uses at levels that are potentially damaging. As the development of the land and communities moved out of the valley bottoms, there was a need for increasing numbers of storage and distribution facilities. As a result, such facilities were often constructed before the land use and land management problems on the watersheds could be brought under control. Consequently, many small reservoirs filled with sediment at such rates that they virtually had no chance to function as designed.

These pressures for more water and increased onsite uses likely will continue. Current projections of population growth indicate that by 1985 about 45 million persons will be relying on the same watershed areas for a water demand that could double. Consequently, an increasing number of water development projects are being undertaken, and they are expensive. In the West the precipitation is highly seasonal over most of the region where water is most needed. Providing adequate water at desired times requires large storage facilities in areas where alternative storage sites are very limited, if they exist at all. Limited sites and few alternatives make it imperative that completed storage and distribution projects be given every chance for long-term effective operation. A reservoir that is rapidly filling with sediment cannot be useful for very long.

In the past, construction of many water development projects has been established under the assumption that the Forest Service, or other responsible agency, would be able to stop all but "natural erosion" immediately to assure maximum benefits from such projects. While such an assumption is not inconsistent with the desires of the Forest Service, such control is very difficult and rarely has been achieved. This general lack of control stems from several reasons and their economic implications are important and point to one fact: water development projects are more expensive in the long run when the normal erosion and sedimentation rate is not achieved.

In the first place, the extremely complex patterns of land use and their attendant socio-economic institutions have often resulted in damaging use of watershed resources. Changing these patterns so that they are compatible with environmental and biological constraints of the watershed is a slow and most difficult task. In many cases, communities have developed far beyond the capacity of the land and resources to sustain them.

In addition, greater public interest in environmental quality and resource protection is being expressed today; however, there remains a real lack of understanding by the public of the environment-resource use relationship as it applies to watersheds. Unfortunately, it is only when the public understands these relationships that they are willing to finance needed watershed work. The willingness to finance depends on the value seen in such work, but the simple fact is that value is a social expression and water has value in relation to a watershed only to the extent that society understands such relationships. Because the concepts of value in relation to environment are only now beginning to materialize, they cannot be adequately considered in feasibility analyses of watershed improvement opportunities.

Somewhat related to the two situations mentioned above, there seems to be a general lack of knowledge about the capacity of watersheds to withstand use. Such information is basic to the determination of watershed use level, rehabilitation needs and opportunities, techniques, and probable success. Again, the lack of public understanding has seriously limited the financing of the research necessary for managers to learn how to deal with watershed problems.

The fourth factor, land ownership patterns, makes control of watershed conditions difficult if not impossible. Seldom is all the land on a large watershed under the jurisdiction of a single government agency. More commonly, private land is intermingled with public lands administered by one or more federal agencies. Adequate and coordinated watershed management and use is hard to achieve under this situation.

All generations face decisions involving consumption of certain resources in favor of economic growth. They must either set resource use limits or define a desired economic growth rate. If the present course is continued with regard to watersheds, it is doubtful that this generation will look any better to its descendants than do our ancestors to us. While all generations are willing to make some sacrifices in the name of resource protection, they do look for some indication of parity between generations so that no one generation becomes unduly burdened because of the mistakes or foolishness of their predecessors.

This resource-decision dilemma leads to two kinds of economic considerations--economic efficiency for the current generation and some kind of economic resource ethic for the next. The current generation can do its part in support of parity by doing foolish things with our resources less frequently and by being more efficient in achieving our own shortrun desires. As far as water development projects are concerned, the last sites available (such as Grand Canyon and Yosemite Park) will cost dearly in terms of other things that will have to be given up. Therefore, taking steps to assure some longevity to current and future water projects is imperative.

Watersheds differ in so many respects that it is difficult to say what is an "average" watershed. Yet the situation at Joes Valley Reservoir on the Manti-LaSal National Forest in north central Utah typifies many of the problems the Forest Service has to deal with in the present and in the future.

The purpose of this discussion is to examine some of the economic factors (relating to public needs and influences described above) that must be considered when planning for watershed stabilization and rehabilitation. Although data from a portion of the Joes Valley watershed will be used for purposes of discussion, this is not an after-the-fact evaluation of the desirability of the Joes Valley (Emery County) Project or the feasibility of stabilization and rehabilitation of that watershed. Rather, it is a look at some typical factors that should be emphasized in planning similar future projects.

Data from the North Dragon Creek subwatershed which drains into Joes Valley Reservoir will be used to illustrate specific points about the typical problems discussed. The area is heavily grazed, is a heavy producer of sediment, and the data on the watershed are more complete than for any other watersheds serving the reservoir.

IMPORTANT CONSIDERATIONS

There is seldom doubt about the worth of establishing water projects; however, for particular locations there may be great disagreement as to the propriety of this use of resources. But once a project has been approved and installed, the conclusion would have to be drawn that society as a whole deemed it worthwhile; certainly the provision for meeting increasing water demands would seem wise. However, water storage and distribution facilities are not cheap, either in terms of dollars or in total resource use, and there is no reason to expect the cost of such projects not to go up in the future.

Preplanned Project Life

A conservative cost estimate of the Joes Valley Reservoir construction and distribution system attendant to that storage is about $7.5 million, which provided 62,500 acre-feet of storage capacity:

Component	*Volume (acre-feet)*
Dead storage (sediment pool)	8,500
Inactive storage (conservation pool)	4,000
Active storage	50,000
Total	62,500

The installation of this system was approved on the basis of a 100-year expected life. This life expectancy was provided by creating the 8,500 acre-feet of dead storage to accommodate the sedimentation which was estimated at a rate of 85 acre-feet per year.

This points up an element of illusion in an analysis that assumes some specified life span such as 50, 100, or 120 years for a reservoir. If the sediment pool is expected to fill within a specified period either due to natural erosion and sedimentation rate or to an accelerated rate caused by damaging use, then it must be assumed that the site either will be abandoned or removal of silt will be necessary to provide additional years of service. But what is the reasoning that makes abandonment more acceptable than dredging? Dredging is expensive, but so is the construction of a dam; therefore, if we accept the idea that water is becoming an increasingly coveted commodity, then regardless of the investment, the stating of a life expectancy for the reservoir is open to criticism. This criticism is even more justified if alternative project sites are limited or nonexistent.

From this standpoint, Joes Valley is not typical because, if necessary, the dam that now cuts off a deep, narrow canyon could be raised and thus would provide additional storage area. The cost would include loss of established recreation and administrative facilities, grazing land and roads.

The main point, however, is that planning a specified project life for critical projects such as water development is questionable considering the surety of increasing water needs, limited project sites, high and rising costs in resources required, and increasing public concern over environmental stewardship.

But there is a more important consideration than preplanning effective reservoir life. It is precisely because water projects are expensive, sites are limited, water is critical, and society is concerned for the environment, that protection and control of management on the critical watersheds must be obtained before, not after, the dams are built. This is vital not only to the success of the water development project, but to the overall goals set by society for natural resource and environment protection.

The responsibility of the Forest Service to provide "post construction" assurance of water project success is not an enviable burden, especially considering the extent of demands upon many of the critical watersheds.

Grazing, a Major Problem

With few exceptions, on watersheds in the western mountains where high intensity summer storms are common, if not frequent, some erosion must be considered normal. The amount of erosion and the deposition of sediment into streams, lakes, reservoirs, and valleys depends on many factors, among which are terrain, geology of the area, character of the soil, and vegetative cover, in conjunction with intensity, duration, and frequency of storms. This "geologic" erosion and subsequent sediment deposit must be dealt with as a part of any water project. The amount of sedimentation that cannot be economically or feasibly stopped must be designed into the capacity of the storage facility as was done in Joes Valley.

The abnormal sediment produced by damaging intensities of land use on watersheds is not so easily dealt with. The single most damaging use of watersheds in much of the Intermountain West has been overgrazing by domestic livestock. Unfortunately, our ancestors grazed the range down to the bare soil on many critical watersheds that were at best unstable. This has the appearance of a sort of capital borrowing against the future in order to develop an economy of more substantial and lasting quality for their descendants. Even if we assume their thinking was along this line, it takes a great deal of charity for many in this generation to accept such motives, although in some instances this same outlook persists.

It is fortunate that the current generations have sufficient funds for correcting the situations we inherited; this money should be spent wisely if the commitments to resource development and protection are to be met.

Unfortunately, the social institutions of public grazing lands and subsidies are still with us, and there remain far too many watersheds being grazed to a degree that is damaging. And, here again, there is an element of illusion in the land use associated with watershed or environmental management. The real cost in resources is <u>not</u> met by incomes paid to the responsible agency or generally by incomes received by the user if the resource is utilized to the extent it is damaged. While it is a general economic truth that the cost of any resource use is measurable in terms of the alternative uses foregone, it makes little sense to sacrifice the resource, as well as the option to use the resource in the future, by being wasteful or damaging now. This is

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precisely what happens when watersheds are used at a damaging intensity. When alternative project sites are too few or lacking, such use not only fouls the existing project, it also makes the future installation of as yet unplanned projects more expensive and more risky.

Still another illusion, therefore, exists concerning analyses related to stabilization and rehabilitation. The value of keeping sediment out of a reservoir is usually weighed against the cost of physically removing it once deposited, or against the cost of creating storage. However, this ignores the real cost of site deterioration on the land from which the sediment came. It is obviously false to assume that accelerated erosion caused by misuse of land does not have a cost to society. The productivity of rangeland deteriorates, erosion increases, reservoirs and streams wash out or clog up, and the results are expensive to repair, if indeed they can be repaired within a reasonable time.

In Joes Valley, the grazing intensity on North Dragon was about 1,200 to 1,500 AUM's (animal-unit-months) before the dam was built, and continued for several years. The extent to which such use is damaging is reflected, though not precisely determined, by two other figures. First, it is estimated that the potential safe grazing intensity is about 550 AUM's. Second, the natural rate of sediment production on North Dragon is estimated to be about 22 acre-feet per year; however, past grazing practices have resulted in delivery of some 32 acre-feet of sediment per year. The natural, or geologic rate, can be achieved when reduced grazing intensity, better range management, and rehabilitation are effected.

It is doubtful that income from grazing at Joes Valley in excess of 550 AUM's would ever equal the cost of removing sediment at some future time to keep the reservoir operating at designed capability. Grazing reductions and better range management alone (without rehabilitation treatments) would reduce sedimentation by about 5 acre-feet per year. The estimated cost of removing sediment from the reservoir would be between $1,326 and $3,978 per acre-foot; consequently, an additional 500 AUM's of grazing, resulting in 5 acre-feet of sedimentation, would need to be worth approximately $6,630 to $19,890 to compensate for only the cost of handling the sediment created--a value most difficult, if not impossible, to achieve. In simpler arithmetic, this amounts to between $13 and $40 per cow month. This assigns no cost to the loss of soil that, because of the deposition of soil on lands between erosion location and the reservoir, exceeds 5 acre-feet per year.

The public pressure for grazing is an important consideration in Joes Valley, as in other areas. In fact, water project benefits to ranchers downstream were predicated partially on the use of the watershed for summer grazing. There is a question as to whether even nondamaging grazing is economical, or in the best interests of society; the answer depends on the investment of all the resources required to provide a given amount of grazing.

The cost of fencing required for the management of a rest-rotation program on North Dragon is estimated at $25,000. It is assumed that the 550 AUM's planned for the area is a nondamaging level for the range and watershed resource. The annual receipts from grazing fees would be less than $550, hardly enough to cover the administrative cost of providing the grazing. The $25,000 would be largely subsidy to ranchers. On areas where more than dollar resources are expended (i.e., soil loss from grazing) the real cost of grazing is even more. The conclusion is obvious: utilizing forage on critical watersheds, even when it can be done safely, often is a costly operation because of the high cost of the developments needed to assure proper use and control.

Obviously, balancing dollar costs of providing grazing with grazing receipts is not the only consideration for public land management decisions relative to grazing. There may, or may not, be other benefits, tangible or intangible, to consider. However,

a comparison of dollar costs and grazing receipts affords a point at which to start an evaluation; and if costs exceed receipts, or other dollar incomes, such a comparison indicates the real cost of providing any intangible benefits. Total costs are a basic consideration in any decision regarding provision of intangible benefits.

It cannot be assumed that the tangible and intangible benefits associated with the provision of grazing are worth, to the community or nation, the total cost measured in dollars, physical consumption, or resource deterioration. Society has placed an undetermined but not unlimited value on the provision of grazing and other resource use and protection programs. In land management planning, it is inconsistent to consider only the intangible benefits associated with grazing and ignore the actual costs in dollars and resources. Actual costs must include the total values lost through resource consumption or deterioration as well as dollar costs. Multiple use is a land stewardship principle, not a license to provide a consumptive subsidy in order to get a particular use at any price.

This is not to say that grazing should be eliminated from the plans for watershed management. The point is that land use has a cost and the real cost of any use should be considered in the management of the area, and control of the land use should be achieved before, not after, water projects are undertaken. To assume control will be gained afterward is no guarantee of project success. Therefore, it makes no sense to tolerate a kind and level of use that consumes or damages resources vital to the success of a water project thought desirable for the well-being of society. If water projects are vital enough to justify their high cost, any sediment not kept out of the reservoir by the most judicious management must eventually be hauled out; an expensive alternative at best.

Establishing Priorities

The Forest Service has always recognized the importance of prudent watershed management. As previously stated, the guiding policy for watersheds damaged by fire or past management practices has been to rehabilitate them as promptly as funds permit. Because funds are always limited, priorities for treating watersheds must be established and money available for a given watershed project must be carefully used.

Because of the inherent variations in soil and ecological conditions on most watersheds, there are many ways in which rehabilitation goals can be realized.

Opportunities for natural recovery are present on all watersheds and they should always be given full consideration. The natural restoration of adequate vegetative cover may require elimination of use and varying degrees of biological or physical help. Later, some use may be tolerated on some areas. On other parts of the watershed, conditions of soil and capacity to provide adequate vegetative cover may preclude any direct use. The choice of more intensive and costly rehabilitation techniques such as one of several forms of mechanical stabilization requires an equally serious and thorough examination.

The hydrologic situations (hydrologic types[1]) encountered on a watershed must be evaluated in terms of cost of treatment, probable treatment response, available funds or the likelihood of obtaining adequate financing, land use constraints, and the basic goals and objectives of managing and using the watershed. Land use should be tailored to the effective operation of the watershed rather than tailoring the watershed management and rehabilitation to the use of the land.

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[1]A hydrologic type or unit is an area which, considering soil, slope, and vegetation, will react similarly to a given amount of water in terms of runoff, erosion, absorption, and so on.

Some parts of a watershed may require such costly treatments for stabilization that their application for sediment reduction is not feasible; it would be far less expensive to dredge out an equivalent amount of deposit. Other parts of a watershed may feasibly be trenched, furrowed, ripped, or harrowed at reasonable cost. The costs and benefits of various treatment schedules must be evaluated in order to rank treatable areas by priority for treatment.

When grazing opportunities are included in the evaluation, priorities might change. With good cost-treatment response data coupled with information on consequences of grazing intensity, a Linear Program solution to optimize some objective function, subject to budget and land use constraints, would indicate different priorities depending on the levels of use and money specified as available. The data for North Dragon indicated that using a given budget, sediment reduction could be increased 15 acre-inches per year (from 117 to 132) by dropping grazing from 500 to 100 AUM's. The areas designated for treatment (priorities for treatment) also changed. This simply means that the kind and level of any land use affect not only the final results of treatment, but also influence the preferred ranking of treatments and selection of areas to treat in order to meet objectives and stay within the bounds of the constraints. These influences must be taken into account early in the planning of watershed projects.

Budget Levels

Establishing a budget level for a particular watershed project is a most difficult task; many factors must be considered and good cost-response data are mandatory. Also, some definite goals or objectives must be set--how much erosion is to be stopped or sediment delivery reduction to be achieved. The "Let's git 'er!" approach to stabilization and rehabilitation implies at least two things, both of which are untrue. First, it implies that given enough money, all erosion on the watershed could be stopped. Second, it implies that stopping as much erosion as is physically possible is worth whatever it will cost.

It is unreal to assume that all erosion and sedimentation can be stopped. On North Dragon, only about 10 acre-feet of sediment can be kept out of the reservoir annually by the best and most appropriate treatment of areas where treatment is feasible; geologic erosion cannot be stopped.

It is equally unreal to assume that whatever it would cost to achieve the minimum erosion and sediment delivery would be worth it. For North Dragon, the marginal cost of reducing sediment skyrockets after the use of treatments costing up to about $30 per acre-inch reduction (for hydrologic type 1P) as the data for furrowing illustrate (table 1). (The same is also true for trenching on North Dragon.) By treating hydrologic types 9C through 1P, costs of $30,840 result in a total sediment reduction of 1,743 acre-inches (145 acre-feet) over an 80-year period. Treating the remaining hydrologic areas resulted in a total furrowing cost of $37,980 and a total sediment reduction of 1,819 acre-inches (151 acre-feet). That means that the last 76 acre-inches (6 acre-feet) cost $7,140, or about $94 per acre-inch (or an average of $1,128 per acre-foot). The sediment reduction on hydrologic type 4C costs $133 per acre-inch ($1,596 per acre-foot) by furrowing, and on hydrologic type 5E a treatment cost of $225 resulted in no additional sediment reduction. (It might well be cheaper to haul out the last 6 acre-feet of sediment after it is deposited.)

As in all spending situations, beyond some point the marginal cost of additional benefits becomes excessive. That is, an infinite amount of money will buy virtually no additional benefits. In this case it appears that no more than $32,000 could be justified on furrowing (fig. 1).

Table 1.--*Furrowing costs and 80-year sediment reduction by hydrologic types*

Hydrologic type	Total treatment cost	Sediment reduction	Cost/AI	Cumulative cost	Cumulative sediment reduction
	Dollars	*Acre-inches*	*Dollars*	*Dollars*	*Acre-inches*
9C	75	27.91	2.69	75	28
9B	120	20.36	5.98	195	48
9A	195	30.20	6.45	390	78
4L	450	36.67	12.27	840	115
1E	1,200	85.77	13.99	2,040	201
1XX	6,345	441.27	14.38	8,385	642
6N	345	23.84	14.47	8,730	666
4H	450	30.83	14.60	9,180	697
4D	11,970	659.72	18.14	21,150	1,357
1F	1,170	59.50	19.66	22,320	1,416
4P	300	14.23	21.08	22,620	1,430
1-0	7,545	289.18	26.10	30,165	1,719
1CB2	150	5.72	26.22	30,315	1,725
4F	75	2.55	29.41	30,390	1,728
1P	450	15.10	29.80	30,840	1,743
1CB3	825	16.52	49.94	31,665	1,759
1F3	975	14.50	67.24	32,640	1,774
1YY	150	1.65	90.91	32,790	1,776
4K	1,545	16.63	92.90	34,335	1,792
4E	1,095	10.23	107.04	35,430	1,802
4C	2,325	17.48	133.01	37,755	1,819
5E	225	0	0	37,980	1,819

For the hydrologic types on which furrowing was appropriate, ranking the types in ascending order of cost of achieving an acre-inch of sediment reduction, the total cost of treatment, and the total sediment reduction can be cumulatively added (table 1) to provide a total cost-sediment reduction curve (fig. 1). By spending $1,000, about 125 acre-inches of sediment can be kept out of the reservoir. For an additional $1,000, another 75 acre-inches can be stopped. Each additional $1,000 results in less and less sediment reduction until finally, after about a $35,000 expenditure, there is virtually no additional sediment reduction achieved regardless of how much money is spent. Even understanding the relationship between costs and expected treatment response gives no indication as to whether any level of expenditure is worth the money. Such an understanding can, however, keep the managers out of the area of obvious foolish spending.

For purposes of determining a budget, the planner-manager must come to a decision as to how far to go in treatments once it has been determined that the stabilization and rehabilitation goals have been set and achievement has been judged feasible. Where the marginal cost of a particular treatment exceeds the estimated benefits from the treatment, or where total costs for the treatment become excessive, less expensive means for reducing sediment delivery or erosion should be sought. This could mean evaluating other treatments on a particular area, the same treatment on other areas, or sediment removal schedules. Where the prescription approach to stabilization is used, the marginal cost, and total cost data, must be used to indicate the point beyond which additional spending is inefficient.

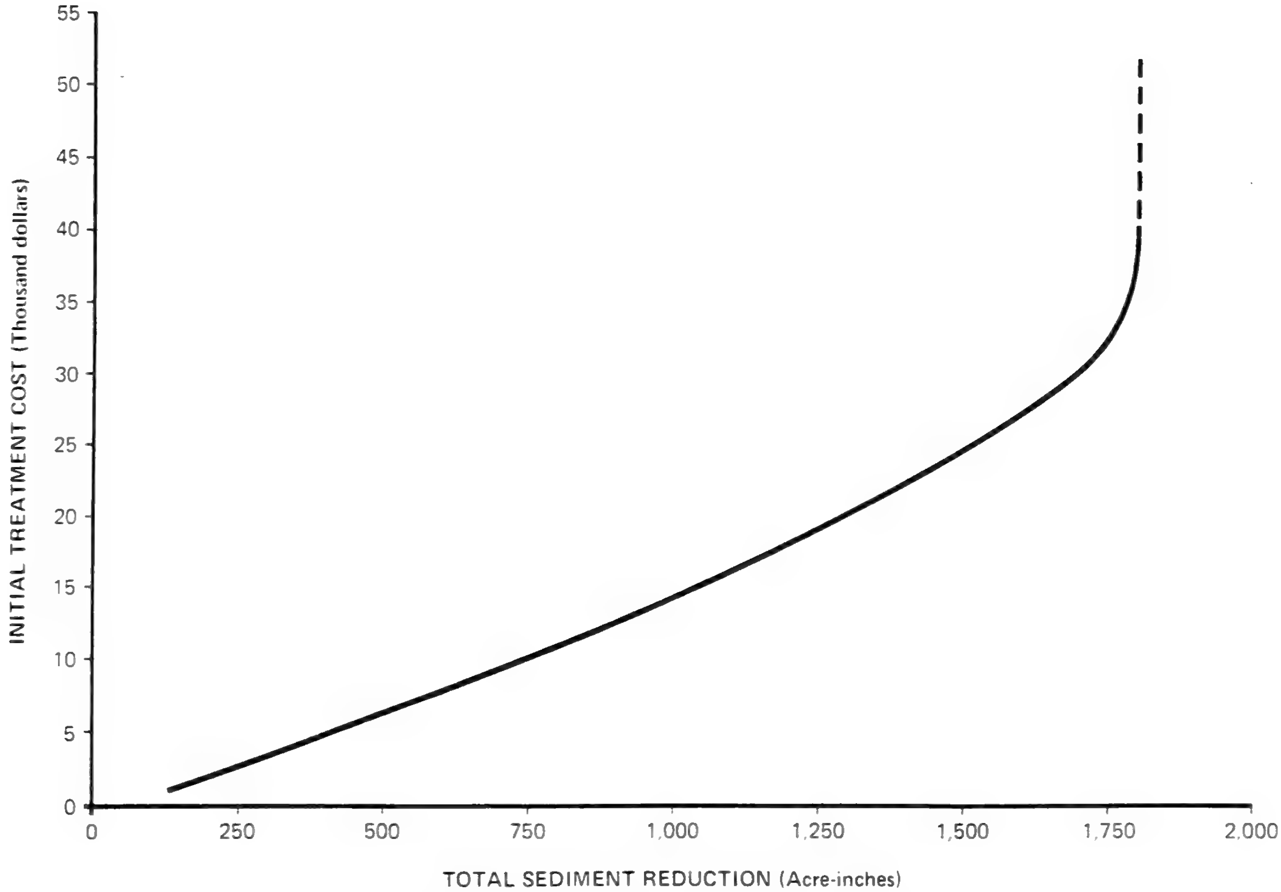

Figure 1.--Total cost-total sediment reduction for 80-year period on areas furrowed.

While economic analysis is an important tool in determining the budget required to achieve given goals and objectives, it is also important in allocating provided funds for a specific project or program. Managers have no choice but to be critical of their own spending proposals. The most difficult job is to guard against negating the benefits of spending by accommodating public pressures for certain types of land use that can either act counter to the goals of watershed management or increase the management cost of rehabilitation activity. The public land manager is no less responsible for fiscal integrity than he is for biological, ecological, and physical concern for the resource.

"Resource stewardship" is the phrase usually used to describe this obligation to the public, and it should be used as a guideline for management rather than a license to spend. The additional costs necessary to accommodate kinds and levels of uses that are generally local in scope and of limited value are direct subsidies to the user when the marginal costs exceed the marginal benefits for those who pay for them. It is presumptuous to assume society is willing to pay for something for which it has not recognized a value.

SUMMARY

Nearly half the major water producing areas in the high mountain areas of the Western States lie within National Forest boundaries. Presently, some 32 million people rely on water from these areas and by 1985 water demands will probably be double those of the present.

Sites for water development projects to assure timely and adequate water distribution are becoming limited and, in many cases, alternative sites are nonexistent. Such projects are not only expensive (and likely to become more so), they often are established in areas where they are served by watersheds damaged by past and current use and before adequate protection and control of the use and management of these watersheds is achieved.

The Forest Service is being put in a potentially untenable position regarding the use and management of critical watersheds by a public that needs increasing quantities of water and at the same time is making increasing demands as to land use and land use constraints. Because water development sites are limited and because future projects will be more and more expensive, the Forest Service must be able to look ahead through its watershed management planning to assure that such critical projects are given every chance to succeed.

Not only must watersheds damaged by past use and fire be stabilized and rehabilitated as present policy dictates, but also any use potentially damaging to fragile watershed areas must be eliminated. This means getting control of watershed management before, not after, water projects are established. The total cost of resources required for the use of watersheds must be evaluated in terms of the benefits generated from such use.

In addition, to meet the water needs for the future, money spent on the provision of adequate water must be spent efficiently in terms of priorities and the kind and extent of mechanical treatments required to provide a watershed condition that will assure the required performance of water storage and distribution systems.

Headquarters for the Intermountain Forest and Range Experiment Station are in Ogden, Utah. Field Research Work Units are maintained in:

- Boise, Idaho
- Bozeman, Montana (in cooperation with Montana State University)
- Logan, Utah (in cooperation with Utah State University)
- Missoula, Montana (in cooperation with University of Montana)
- Moscow, Idaho (in cooperation with the University of Idaho)
- Provo, Utah (in cooperation with Brigham Young University)