A method for analyzing environmental effects of impacting activities
by Louis Theodore Egging

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Industrial and Management Engineering
Montana State University

Abstract:
The public land manager is directed by law to manage for multiple use and sustained yield of goods and services. This must be accomplished without long term detriment to the environment. He must also analyze the environmental consequences of any proposed management action. These impacts might not only be short term effects, but may be long range as well.

The ecosystem, impacted by the activity, is a complex maze of relationships. An impact directed at one resource will influence not only that resource but others as well. Some effects are immediate, others are not apparent until after a considerable time period. This complexity requires the ecosystem to be analyzed as a whole. It must be perceived as a complete system.

A method is proposed to help the manager analyze the environmental impacts of an activity. Using systems analysis and computer simulation techniques, a two-phased simulation model is presented. This approach models the activity as the micro phase. If desired, this phase can be modeled in detail suitable for productivity optimization, or it can be modeled simply. The macro phase of the approach models the ecosystem. This phase simulates the dynamic response of the ecosystem to the impact.

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Date 10/22/76

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ABSTRACT

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Chapter 1

INTRODUCTION

Multiple Use Management

Society's growing concern for "conservation" and "ecology" has caused the U.S. Forest Service to pursue with renewed vigor, the directive of "multiple use" and "sustained yield" in its public land management. This policy was established by Congress in 1960 when Public Law 86-517 was handed down on June 12. This, the Multiple Use - Sustained Yield Act states in part:

> It is the policy of the Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes.
>
> The Secretary of Agriculture is authorized and directed to develop and administer the renewable surface resources of the national forests for multiple use and sustained yield of the several products and services obtained therefrom. (USDA, 1963).

The objective of multiple use management is to manage the resource complex for the most beneficial combination of both present and future uses. This idea of deriving maximum benefit from a given resource base is not new, but it becomes more important and complicated as the competition for limited and interrelated resources increases.

While the basic concept of multiple use is generally accepted, its application is still a difficult process. As outlined by Ridd (1964) the term "multiple use" may be applied to areas of land or to particular resources available on that land. When applied to land areas, it refers to the production and management of the various resources or resource combinations on that land area. These managed resources may be competative or complementary to one another. When applied to resources, "multiple use" refers to the various uses of those resources. For example, the water resource can be used for irrigation, municipal and industrial water, esthetics or recreation. Timber can be used for lumber, pulpwood, esthetics or recreation. Figure 1 (Ridd, 1964) provides an overview of possible relationships between resources and resource uses.

Multiple use land management involves both the multiple use of individual resources and the multiple use of the land areas. A demand for a particular resource for a specific use will place demands on a land area where that resource is produced.

When speaking of multiple use, the four resources; water, timber, forage, and wildlife, are generally discussed along with recreation. However, recreation is actually a use to which the resources are put. This recreational use is centered primarily on one resource; however, the "quality" of the recreation is influenced by several resources comprising the environmental complex.

In managing a land area, no resource or use can be isolated. Any management action, even when directed at one resource, is going to have an affect on the other resources and their uses. A logging operation started in any forest will affect not only the timber resource, but also

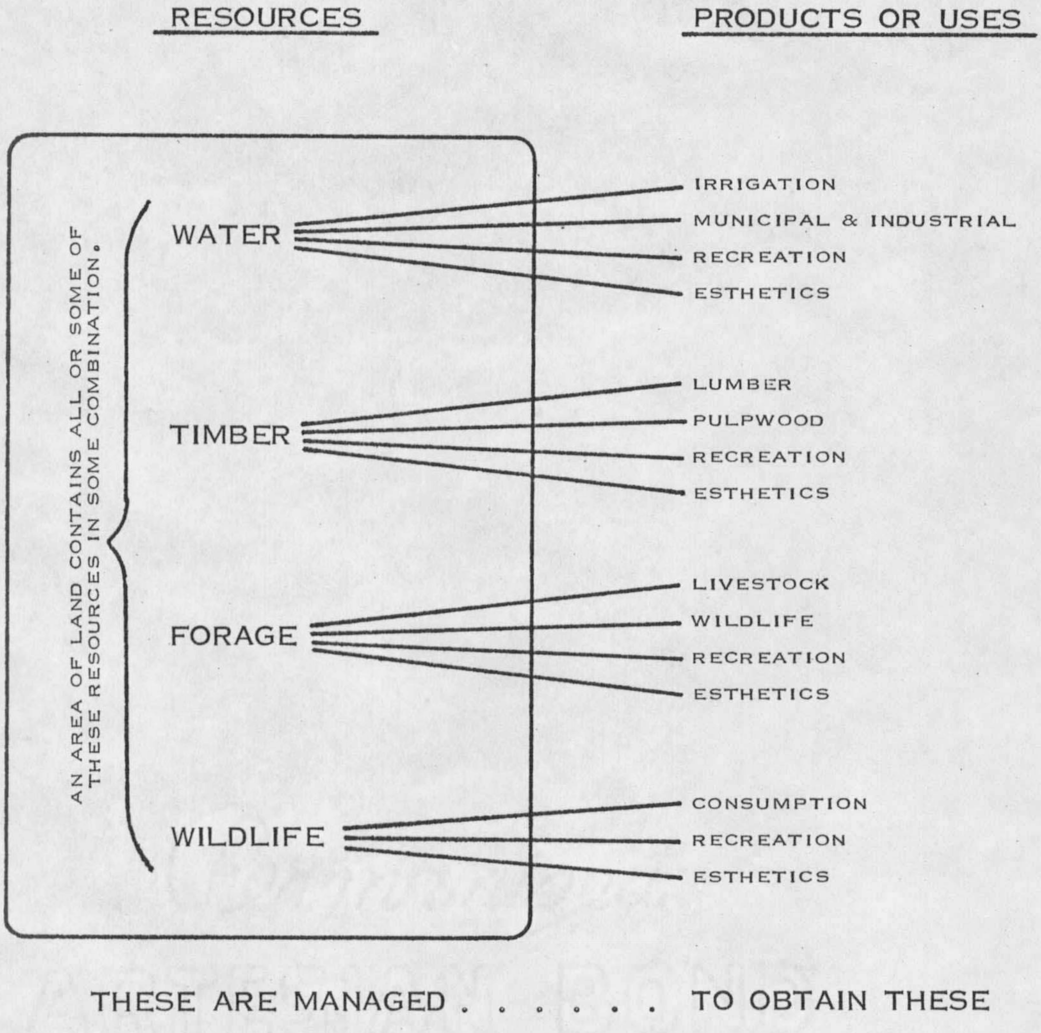

Figure 1. Resources and Resource Uses

the water, forage, and wildlife resources. For this reason, the overall area with all its resources must be viewed as a whole in making any management decisions on a proposed activity.

Land Use Planning

Over half the land area in the United States is in forest, brush, or rangeland. Of this area, the Forest Service has the responsibility for managing 187 million acres to obtain sustained flows of goods and services under the multiple use management concept. This philosophy requires the balancing of various land uses to minimize conflicts while providing for a sustained yield over an extended time period.

With growing pressures from timber and cattle interests for specific resource uses, the Forest Service became more and more production oriented in its management. This was at times accomplished to the long term detriment of the total environment. Timber and forage production increased to satisfy demand. Irreversible consequences to the ecosystem were not a prime consideration.

In 1968, Congress enacted into law the National Environmental Policy Act. This Act directs the land manager to assess his management activities from an environmental impact standpoint. The Act declared it "a national policy [to] encourage productive and enjoyable harmony between man and his environment; [and] to promote efforts which will prevent or eliminate damage to the environment" (USDA, 1974:243). "This policy is one of balancing the amenities or quality of life against the continued use of renewable resources" (Leopold, 1975:609). Recognizing that man's activities do impact the interrelationships of the ecosystem components, the manager must prepare a detailed statement of the environmental impacts of any proposed action that might have an effect on the quality of the human environment.

The Forest Service has been preparing "Multiple Use" or "Land Use" Plans to implement these directives. A Land Use Plan is intended to be a planning document directed at a specific area of land. Resource capabilities are identified, demands and resource uses are estimated for the present and future, and management alternatives are identified and presented to the public for scrutiny. These documents are prepared and presented to the public soliciting and encouraging public involvement and participation in determining management direction. Coupled with the Land Use Plan is the Environmental Impact Statement which must be prepared for any proposed management action. This statement is an attempt to identify and quantify the environmental impacts of the activity. These impacts must include not only the short term immediate effects, but also the long range effects of the activity.

The public land manager is directed by law to manage on a multiple use and sustained yield basis. He must analyze and document the environmental consequences of proposed activities. This can be a difficult task as the system being impacted consists of numerous interacting relationships. The area must be viewed as a whole in making management decisions.

The Problem

The problem is basically that of identifying the impacts or effects of a given activity upon an area's ecosystem. The impacts cannot be limited only to short term immediate effects, but must also include the long range time dependent effects. The system being impacted is a complex maze of interrelated interacting cause-effect relationships.

As an example of man's activities impacting the ecosystem, we might look at timber harvesting. The interactive influences of timber harvesting on the system might be illustrated as in Figure 2. For measurable impacts, we are primarily interested in the effects on the other resources and resource uses for the area. The harvesting of timber from a given area and the method used in harvesting will have a direct effect upon other resources such as water quality and quantity, timber availability now and in the future, forage quality and quantity, and the amount of type of wildlife present. These can be both short and long range effects.

In addition to these primary effects, the changes brought on by the primary influences in the available resources will also cause secondary changes in the resources and uses of the area. Recreation and esthetics will be influenced secondarily. Changes in the resources will change the recreational appeal of the area. There are also secondary