ORGANIZATION OF AGRICULTURAL, FORESTRY, FISHERY, AND RURAL ENTERPRISES

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Summary

Resources are features of the environment that are considered to have value. Humans seek to control their environment by exploitation of those resources. The extraordinary capacity of humans to exploit resources has led to explosive population growth and to the productivity paradigm, which seeks continually to increase productivity. Technology and culture are the keys to this exploitation. Approaches to resource use change with technology and culture, but within the constraints of biological systems. Organizational phenomena such as vertical integration are cultural manifestations of the doctrine of systemology, which is the recognition that living things exist in systems. The exploitation of resources will continue to change with technology and culture, as humans continue their quest to control the environment.

This article deals with the ways humans organize themselves as families, communities, cooperatives, and corporations to exploit natural resources related to food, fiber, and

fish. As a backdrop to these organizational adaptations, this article outlines the basic principles of resource use.

1. The Nature of Resources

Resources are features of the environment that are considered to have value. The features can be tangible (e.g. iron ore, oil) or intangible (e.g. solitude), and the values can also be tangible (e.g. food, fuel) or intangible (e.g. aesthetics, spirituality). Resources can be the items of interest themselves (e.g. a tree that is logged, a plant that is consumed) or the conditions required to create them (e.g. the soil that the tree grows in, water). They can be "natural," in that they are present without prior input or influence from humans (e.g. a soil deposit), or they can be anthropogenic in origin (e.g. hydrostatic pressure that accumulates behind a dam). Conspecifics are part of an organism's environment and can have value to the individual. Therefore, members of the same species can be viewed as a resource. The presence of conspecifics has great influence on how organisms view and use resources. For example, the presence of other people empowers humans to do things that they would otherwise be unable to do. This is acknowledged with the use of the term 'human resources'. The value assigned to a resource is determined by a combination of how essential that resource is perceived to be and its availability. The latter includes the rate at which the resource is supplied and how easy it is to obtain.

Philosophically speaking, all resources are "natural" whether they are anthropogenic in origin or not, since humans are themselves the product of natural processes, and resources derived from human activity often have a natural origin. In practice, however, it is sometimes necessary to distinguish between natural and unnatural (i.e. human-generated or modified) resources because humans are able to change their environment and to exploit resources in ways other species are not.

Humans exist in ecosystems, just like other organisms. The resources that humans use are part of their ecosystem. But humans interact with their environment in ways that are quantitatively and qualitatively different from all other organisms. For example, the physical and temporal scales of human interaction with the environment are such that there is now functionally only one human ecosystem, with all areas of the globe affected in some way or another by human activity. Humans also differ from other organisms in their capacity to exploit resources. Humans are not limited, either physically or operationally, to the resources available to them at any one moment. Thus, that which comprises a resource can change quickly over time as new applications, new access, and new materials are developed.

2. Major Factors Determining Resource Use

There is enormous historical and spatial diversity in patterns of resource use. However, there are just a few fundamental principles determining human orientation towards resource use. The main ones are the human quest to control the environment, the inherent productivity of living systems, the productivity paradigm, and the doctrine of systemology.

2.1 The Quest for Control

There is considerable short-term advantage for an organism to control its environment, because this leads to mediation of environmental pressures. All organisms modify their environment passively by their very presence, but some organisms also modify their environment actively, sometimes with spectacular results (e.g. beehives, termite mounds). Humans have unparalleled ability to modify their environment, and do so with the basic motive of ameliorating its negative impacts on the species. Unlike other species that are fundamentally constrained in the ways in which they can change their environment, humans readily adjust their actions to environmental conditions in order to create for themselves microenvironments to their liking. From the human perspective, resources are the materials in the environment humans use to sustain themselves and to achieve environmental control. This relates directly to the value of a resource: the greater the contribution a resource is seen to make to the control of the environment, the greater the value the resource is considered to have.

2.2 Productivity of Living Systems

The populations of most living things are held in check by the availability (or, more correctly, the non-availability) of resources. For example, limitations of food supply and other essential resources limit the reproductive capacity of the organism. Explosive growth of a population occurs when one or more limiting resources cease to be limiting. This is because all living things have the tendency to reproduce in excess of replacement. This is a result of the extraordinary power of selection for fecundity. This is a tautology: the genes of those organisms that reproduce the most have the greatest representation in subsequent generations. It is this tendency that causes populations to grow. For all populations in the past, some resource eventually became limiting, and population growth was curtailed.

This tendency to reproduce in excess of replacement has two important consequences with respect to resource use by humans. First, it is this reproductive potential that humans tap when they use what are termed renewable resources. It is also this excess production that is stored in non-renewable resources of biotic origin (i.e. oil, gas). Resources such as this are non-renewable only relatively speaking: it all depends on the rate of consumption relative to the rate of production. In the case of oil and gas, for example, the rate of consumption is vastly greater than the rate of formation. Hence, the resource is considered non-renewable. If human sequestering of metallic elements into items of use is viewed as consumption, then the rate of consumption of iron, for example, is so much greater than the rate of formation of iron ore that iron is an example of a functionally non-renewable resource. But even this is not clear-cut. For example, iron can be recycled, so the used iron itself becomes a resource. Furthermore, the amount of iron ore that is available is much greater than the amount consumed, so it might be difficult to consider it limiting at all, at least for now. Finally, iron is still being produced (i.e. in stars), but this new iron is not available to humans at this time.

The second important consequence is that humans are like other organisms in having the tendency to reproduce in excess of replacement. Humans have a physiology and a vast array of inclinations and responses to stimuli that have ensured this is the case. But tendency is not the same as performance (this is the difference between fecundity and fertility). Humans have coupled the inherent tendency for population growth with an unprecedented ability to exploit resources. Most organisms must wait for the environment to change in order to increase the supply of limiting resources. Not so humans, who have the capacity to change the environment to control the supply even of limiting resources. Most technological and organizational developments in resource use of the past have been directed towards enhancing this ability to exploit resources.

2.3 The Productivity Paradigm

The productivity paradigm holds that it is good, even essential, to increase the capacity for production. It is important to differentiate between the amount of production and the capacity to produce. It is not always considered good to increase the amount of production or rate of supply. Indeed, production is sometimes suppressed or otherwise regulated in order to control the rate of supply. Until recently, however, it has always been considered good to increase the capacity to produce. For resources, this has usually meant increasing the amount of the resource available for use. Ironically, one of the outcomes of this continual increase in capacity to produce has been the regulation of production (e.g. quota imposed by supply management marketing boards) (see *Marketing Boards: An International Overview*).

It is easy to see why the productivity paradigm reigns in production systems based on natural resources. For most of human history, the primary effort in natural resource exploitation has been to increase productivity. There has been much effort to increase efficiency, but even increasing efficiency can be seen as a special case of the productivity paradigm. That is, if you can produce more with less (i.e. increased efficiency), then you can produce much more with the original investment (i.e. increased productivity). There have always been those, from Lucretius through Rachel Carson to Greenpeace, who have cautioned against this fixation, but only in recent years has broad consideration been given to the consequences of this paradigm.

2.4 The Doctrine of Systemology

The doctrine of systemology holds that resources exist in systems, and that exploitation of those resources must be conducted according to the rules of operation governing the relevant systems. A system is a collection of interacting parts, the action of one of which affects the action of others. The parts interact in specific ways determined by the characteristics of the parts themselves. Systems continue to operate as long as the parts interact in prescribed ways. Biotic resources exist in complex ecosystems that involve interactions among organisms and between organisms and abiotic features of their environment. Collection, processing, and distribution of resources occur through large human-generated systems of operation. The doctrine of systemology dictates that manipulation of these systems must comply with a set of rules of operation in order to exploit resources effectively. It has always been thus: the world’s first ecologists were hunter/gatherers. The rules were initially set by the resource (e.g. in order to be a successful hunter, a human had to go where the prey was, avoid detection, find the prey, and kill it). It is still the same today. The only things that have changed are the tools (technological and cultural) humans use to exploit resources and the perception held by humans of their ability to set the rules themselves. Initially, humans held no pretense to being able to set the rules of how the system operated. As human capacity to control the environment increased, so too did human perception of their ability to control all aspects of resource use. Humans now recognize that industrialized society may be less able to control all aspects of production systems than may once have been thought.

3. Major Factors Affecting Natural Resource Use

3.1 The Anthropic Revolution

The agricultural revolution (ca. 10 000 BCE) and the industrial revolution (over 11 000 years later, during the eighteenth century) had enormous impact on natural resource use. However, an even earlier and more fundamental shift in the development of natural resource enterprises occurred when the extraction and use of natural resources changed from being dominated by natural forces to being dominated by cultural forces.

This is here referred to as the anthropic revolution, in recognition of the importance of the transition to environmental interactions that were uniquely human. This transition probably occurred sometime after the control of fire (ca. 500,000 years ago), and before the advent of agriculture.

Natural forces remain, but they came to be viewed as mere constraints to be overcome. The factors that drove this transition were technology and culture.

3.2 Technology

Early technological developments in resource use involved simple manipulations of physical conditions. These manipulations became more effective as technology developed. Slash-and-burn technology removed overstory and exposed soil for the production of native plants. Native plants that were once gathered in situ became crops when their growth was manipulated.

The plow facilitated the placement of seeds into the soil. Water was transported through irrigation and supporting technology (e.g. wells, pumps, ditches, the Archimedes Screw) in order to support plant growth in areas where the availability of water was otherwise limiting.

A few plant species were selected for cultivation and animal species for husbanding. Selective breeding of plants and animals was part of the earliest efforts at domestication. The invention of the kiln and the ability to increase combustion temperatures led to the altering of material states and the production of pottery and metal, both of which had large impacts on resource use.

Tree harvest changed, as stone tools and fire, and ultimately metal tools powered by combustion, were used to fell trees. Transportation of resources became much wider with the advent of large sailing vessels, but it was the invention of the internal combustion engine that enabled transport of resources at a level that unshackled the distribution of humans from the natural distribution of resources.

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Biographical Sketch

Alex Hawley is a faculty member at the University of Northern British Columbia where he was the inaugural Chair of Biology and the Director of the Northern Land Use Institute. His primary area of intellectual interest involves the interactions of organisms with their environment. He initially focused on wildlife species but now investigates the interaction of humans with their environment. He has worked extensively with First Nations, co-authoring a book documenting some of the traditional knowledge of an Aboriginal elder and healer, and investigating communication alternatives for coalescing a traditional Aboriginal worldview with that of western science-based resource management.