CATCHMENT MANAGEMENT – A FRAMEWORK FOR MANAGING RANGELANDS

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Contents

Summary

Rangelands management plans must define a balance between immediate productive use and longer-term sustainability by protecting the natural environment. The use of processes developed for managing catchments (referred to as watersheds in some countries) – upland areas of river basins – can be usefully applied to this end. Six principles to be considered in catchment management are presented and discussed, the last of which is the need to manage grazing.

Catchment management promotes a process of: data gathering information knowledge policies strategies and actions. It is both a scientific and socio-political process. It requires on-going and stable funding. Developing catchment management plans in conjunction with the community is essential to effective plan implementation. Such community involvement provides the community with a sense of ownership of the plans.

By way of illustration, experience of catchment management, community participation and grazing management of rangelands in Qinghai Province of China are analyzed. The

case for rangeland management planning to be conducted on a catchment by catchment basis is outlined.

1. Introduction

Rangeland management plans (RMP) should be developed on the basis of catchments. Catchment management principles should therefore be applied to rangeland management. This chapter aims to outline the general principles of catchment management and to consider how these might be applied to rangeland management.

Rangelands are broad areas of mostly native vegetation dominated by grasses, forbs and shrubs (See *People in rangelands: their role and influence on rangeland utilization* and *Rangeland plants: role and function (Grasses, forbs, shrubs and trees*). Rangeland may also refer to areas seeded to native or adapted introduced species that are managed like native vegetation. Rangelands include natural grasslands, savannas, shrublands, many deserts, tundra, alpine communities, coastal marshes, and wet meadows. Rangelands are generally arid, semi-arid, or may be otherwise unsuitable for cultivation because of restrictions such as slope, temperature or pH. (see *People in rangelands: their role and influence on rangeland utilization* and references 1 and 2 in Bibliography)

The vegetation and physical features of rangelands which make rangelands unsuitable for agriculture and result in the slow growth of vegetation are important in defining their hydrology. An understanding of the hydrology of the rangeland being managed is important in developing a catchment management plan for that area. In addition, rangelands because of their size and location, usually in the upper catchment, are important component areas in many river basins. In smaller areas, rangelands may comprise an entire catchment (see *Habitat and Riparian management in rangeland ecosystems.*)

The main productive use of rangelands is grazing for meat, milk and wool production. It is important to consider water source protection and water management when rangelands are used for grazing because of the impact that grazing animals have on the vegetation and soil, and hence on the hydrology (see *Environmental Soil Management*)

2. Why Should RMP be Based on Catchments

All land areas can be divided into catchments or river basins of varying sizes. Precipitation falling within a catchment makes its way over land or through soil and rock to the catchment outlet – the point where the stream or river flows into another or into a sea. Management of land on the basis of catchments and river basins is appropriate as water is generally the dominant medium for conveying land use impacts from one location to another. Changes in the quality and quantity of the water flowing from the catchment under some baseline condition to some later condition provide a measure of impact land and water use change within that area since the baseline was established.

Rangelands are often upland, water source, areas and the management of these areas has major implications for downstream areas in a river basin. To be fully sustainable,

upland land-use must not degrade the land or impose costs on future generations who may wish to continue with that use or change to an alternate use. At the same time, the use of upland areas must not impose costs on downstream areas.

The objectives of rangeland management are to increase the sustainability of grazing production and prevent over-exploitation. A balance needs to be achieved between the productive use of the land and the land's function as a sustainable reserve of natural resources. Rangeland management thus protects the environment, including plant and animal communities (see *Range and Animal Sciences and Resources Management*).

The concepts of catchment management are important in developing plans for sustainable use of natural resources. Catchments usually define sets of vegetation types growing in response to differing conditions of geology, soil, water availability, exposure to sunlight, wind etc. Developing a plan for a catchment allows a consistent plan to be developed for a set of vegetation types (see *Habitat and Riparian management in rangeland ecosystems;* and *Science and the Community: Role of the Ecological Approach in Sustainable Rangeland*). The priority for land use management within a catchment depends on the likelihood of land use affecting the quality or quantity of flow in watercourses. Generally, the closer the area is to a watercourse, the greater is the priority for good land management. However, the management (or mis-management) of upland, non-riparian areas in a catchment can also have big effects on the magnitude and timing of overland flow, the production of sediment, and the quality of water arriving at a riparian area, and thus affect the functioning of riparian areas (see below).

Management of grazing animals is of major importance in both rangeland and catchment management (see below) because in arid rangelands cattle often focus grazing near wetlands and in riparian areas, and although in more humid areas cattle may be more evenly distributed across the catchment area, they will congregate in these areas some times during the day for watering. An important mechanism for management of grazing is the location of watering points and control of access to water by grazing animals. Impacts of cattle grazing and trampling can be a major reason for changes in the hydrologic characteristics by affecting the vegetation types (see *Behavior -The keystone in Optimizing Free-ranging ungulate Production*).

3. Catchments and Watersheds – Definition of Terms

In Europe, and particularly Britain and its previous colonies, such as Australia, "catchment" means an area of land that drains water, sediment and dissolved materials into a river system or other body of water. Sometimes the terms "catchment area" is used. "River basin" is mostly used for larger areas where the runoff forms a river. The synonymous term used in the North American region is "watershed".

In the places where the term catchment is used, the term "watershed" has the meaning of a ridge of high land dividing two areas that are drained by different river systems. This feature is known in North America as a "drainage divide" or "water divide".

Often the terms watershed and catchment carry the idea of upland areas in a river basin. Upland areas are the major source of water in most river systems.

3.1. Catchments and Water Bodies

A catchment is simply the land that water flows across or through on its way to a common stream, river, or lake (Figure 1). A catchment can be very large (e.g. draining thousands of square kilometers to a major river, and hence often called a river basin, or to a lake or to the ocean); or it can be very small, such as a 20ha catchment that drains to a pond, or into another stream.

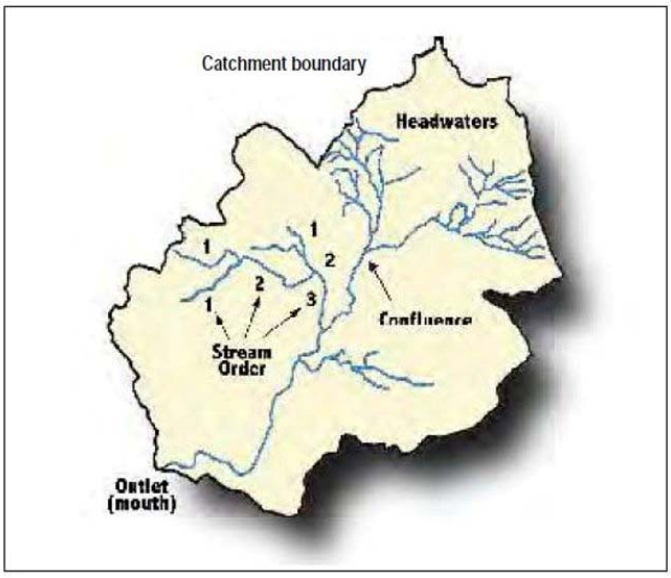

Figure 1. Key map information for catchment management includes the catchment boundary and the network of streams involved in drainage

A small catchment that nests inside a larger catchment is sometimes referred to as a sub-catchment (Figure 2).

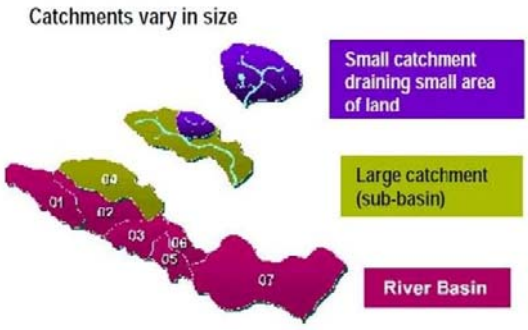

Figure 2. A small catchment inside a larger one is referred to as a sub-catchment

A catchment (or many catchments) can be delineated on a topographic map using lines symbolizing rivers and streams and contour lines indicating the height above sea level.

Since water flows downhill from higher elevations to a common body of water, a line along the ridge tops connecting the highest elevation points surrounding a lake or stream delineates the catchment boundary for a particular place on a stream or lake.

A junction with another stream is called a confluence. The lowest confluence (with a stream, river, lake or the sea) is the mouth or outlet of the catchment. The water bodies within a catchment are classified by stream order. For example, the small streams that first define water flowing on the ground from rainfall, snowmelt, or springs are called a *first order streams*; when two first-order streams join, the water below the junction is called a *second order stream*, etc. In this classification system, the next higher order stream is formed when two of the immediately lower order streams have joined.

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Biographical Sketch

Hugh Milner is an independent water resource consultant with 30 years experience working in Australia and in developing countries on:

- Sustainable management of water resources
- Policy development
- Institutional development and capacity building
- River basin planning
- Irrigation and water supply management
- Surface water hydrology
- Water resources development
- Data management for water resource systems
- Water allocation issues and property rights
- Environmental impact assessment

Hugh worked for the Department of Land and Water Conservation (and its predecessors) in Australia for 26 years. His final position in the Department was Senior Hydrologist, Water Resource Management Directorate. In this position he was responsible for a number of policy and technical aspects of inter-state and inter-governmental water resource planning and management, particularly the Murray Darling Basin Commission (total area about 500,000 km^2, affecting four State Governments and the Commonwealth of Australia) and the Snowy Mountains Scheme, jointly operated to produce electricity and divert water into the Murray-Darling Basin. Since the late 1990s he has worked as an international consultant and team leader in water resources management and water policy in several countries in Asia, including China, Afghanistan, Lao PDR and Cambodia.