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RELATION OF WATERSHED TO CULTIVATED LAND PLANNING

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The major portion of the cultivated lands in the eleven western states are dependent for irrigation water upon the mountainous areas where the major share of the precipitation of the region occurs either as rain or winter snow which feed the streams and underground storage basins. As water supply is essential to land cultivation in the West, so is the proper handling of the watershed lands essential to the water supply and its use. It is coming to be realized more and more that suitable conditions must be maintained on these watershed areas if maximum sustained use of the available water supply is to be maintained. Plans for the development and maintenance of cultivated lands which involves irrigation must take into consideration the hinterland which serves as the catchment area for the water which later becomes available as streamflow or ground water. The destiny of watershed lands, therefore, becomes a definite part of land planning in the West. The watershed values themselves are intangible, that is, they are of little direct commercial value.

The ability of watershed lands to yield water depends upon the amount, character and distribution of precipitation, the underlying geologic formations, the topography, the character of soil mantle, and the vegetation. The maximum yield of water for a given precipitation may be expected where the watershed has a maximum area of barren rock exposure of steep topography so that precipitation runs quickly over the surface directly into the streams. Such watersheds have a minimum natural storage capacity so that run-off is sudden but of short duration. For such conditions a maximum of artificial storage is essential to provide water for seasonal irrigation needs. On the other hand, the maximum regularity of streamflow for irrigation and other uses may be expected from watersheds having a deep, loose soil mantle, that absorbs water readily, an impervious substrata that prevents deep seepage and a gentle topography. Such a watershed quickly absorbs the precipitation and feeds it gradually into the streams.

The major portion of the watershed areas of the West, however, lie between these two extremes. They have more or less of a soil mantle that varies in ability quickly to absorb rain or snow water and conduct it through underground channels into the streams. The soil mantle usually supports more or less of a plant cover which influences the ability of the watershed to absorb water and thus to influence seepage and the portion that runs off on the surface direct into the streams. Man can have little influence upon such factors as quantity of precipitation, or the geology, topography or main features of the soil mantle of a watershed. The plant cover on the other hand may be subject to grazing, logging, fire damage and other influences so that man is in a position to exercise control over the plant cover in relation to run-off and streamflow.

Experiments and experience have shown that a plant cover influences the discharge of precipitation from a watershed in a number of ways. The standing vegetation acts as a retardant to run-off and keeps it spread over the surface, thus aiding in the absorption of water by the soil. The litter and humus which accumulates from the vegetation further obstructs run-off and forms a filter that removes soil particles from the water, thus permitting the water to remain reasonably clear so that it may percolate through the intersticos of the soil instead of clogging them. Plant roots form openings in the soil through which water may pass to the impervious substratum. On barren impervious soils the water quickly gathers into streamlets which rush down the slopes directly into the streams, thus accelerating the rate of surface run-off. Precipitation on slopes covered with vegetation and a surface layer of soil high in decaying vegetable material has a better opportunity to be absorbed and percolate through the soil into the water table.

Of equal or greater importance is the influence of the plant cover in reducing erosion with respect both to maintaining the production of native plant crops on the watershed and keeping streams, storage reservoirs, farm lands and other places free of obnoxious silt. Instead of keeping spread out and being slowly disposed of as occurs on a well-vegetated watershed, water falling on bare soil soon accumulates into streamlets which begin to erode and form gullies. The earth materials gathered from these gullies and the intervening surfaces further add to both the erosive and carrying power of the water. The most productive soil is removed from the surface where it is most needed to support a plant cover and is carried downstream along with heavier dislodged material to be deposited along the streambed, in storage reservoirs and even upon the cultivated land itself. In fact, the accumulation of soil on sloping lands is a product of the holding power of vegetation and the destructive power of erosion. The present soil has been gradually built up in place because vegetation has held it in place against the erosive action of run-off. Usually the ability of the vegetation and its products, - litter and humus, - to hold soil in place against the erosive action of water represents a delicate balance. Where the balance is slightly in favor of the vegetation the soil is gradually built up. When the balance is thrown the other way, through the reduction of the plant cover, the destructive process of accelerated erosion sets in.

Against this value of vegetation in reducing surface run-off and increasing absorption of moisture by the watershed and controlling erosion must be measured the amount of water utilized by the vegetation in excess of that which would otherwise be lost through evaporation direct from the soil. Under certain conditions it is evident that the total yield of water is actually reduced in some measure by vegetation. This occurs partly through interception of moisture by the exposed parts of the plant and the evaporation of this moisture into the air before it reaches the soil. Vegetation also extracts a large quantity of water from the soil in its growth processes. However, the value of the increased total yield of water which could be obtained by denudation of a watershed, in most cases, would be more than offset by the earlier and more dangerous flood crests

which would result and the damage to streams, reservoirs and other values that would result from the accelerated erosion that would be caused.

The value of plant cover on watershed lands in relation to farm land development may best be shown by a number of examples of what has or is happening where the plant cover has been impaired.

A survey of the Rio Grande River watershed that feeds the Elephant Butte reservoir in New Mexico, discloses rapid erosion to be taking place on 35 per cent of the watershed, moderate erosion on 40 per cent and little erosion on only 25 per cent. In 17 years, 15 per cent of the capacity of the reservoir has been filled with silt. A similar survey on the Colorado River upon which the Hoover Dam is now being built indicates 50 per cent of the area to be eroding seriously, 27 per cent moderately and 23 per cent little at all. In southern Utah, on the Colorado River drainage, many valley bottoms have been cut out to a depth of 40 to 60 feet and a width of a few to many several hundred feet in width, since settlement of the region beginning shortly after 1850. In other places parts of valleys such as on the Virgin, Paria and Fremont rivers which were formerly cultivated, have been eaten away by accelerated erosion and are now abandoned. All of this eroded material is being slowly transported down the Colorado river where it will find lodgment behind the Hoover Dam when it is completed.

A detailed survey of 371,313 acres of the Boise river watershed in Idaho showed that the 38 per cent of the area covered with dense brush, grass or timber was not eroding. The remaining 62 per cent upon which there is varying degrees of plant depletion shows various stages of erosion. Two per cent of the total has serious gully erosion, 8 per cent light gully erosion and 52 per cent shows accelerated sheet erosion. The silt, being moved by the accelerated erosion, has already filled 8 to 9 per cent of the storage capacity of the area with reservoir and has destroyed an investment of $100,000.

The Gibraltar reservoir, which supplies water to the city of Santa Barbara, California, depends upon a watershed of 133,000 acres. Fifteen per cent of this watershed was burned over in 1923 and by 1927 the eroded material from the burned area had filled 5.7 per cent of the storage capacity of the reservoir. The first 4 heavy rains which followed a fire that burned over all of the Fish Creek drainage - a small stream which debauches from the mountains near Monrovia, California - caused severe floods carrying a heavy load of debris which resulted in heavy damage to orchard, farm and city property and to highways and railroads.

In southern California where water is at a high premium, the run-off from many of the canyon drainages which occurs from the winter rain, flows out upon the alluvial fans at the canyon mouths where it sinks into a natural underground storage basin, later to be pumped and used for irrigation and other purposes. Denudation by fire of parts of these watersheds is found to result in run-off so laden with silt that the water will not enter the ground and pass into the natural drainage basins. Instead it runs off on the surface and escapes unused into the ocean and thus is lost.

This has necessitated the installation of settling dams and spreading grounds to insure underground storage of the water, thus adding to the expense of irrigation.

Utah floods. In 1923, 1927 and again in 1930 devastating floods swept out of many Utah canyons causing excessive damage to farm lands, irrigation works, homes, highways, railroads, power developments and what not. The heaviest of these floods occurred in the Salt Lake Valley just north of Salt Lake City. There the toll consisted of 9 human lives, large areas of the most valuable farm land in Utah being covered with gravel and boulders, in places filling irrigation canals with silt and in other places washing them out, blocking railroads and highways for weeks at a time and depreciating the value of farm lands because of the danger of future floods.

All of these disasters are attributable in great degree to the partial devegetation of the canyon watersheds by injudicious grazing of livestock.

It is sometimes contended that the soil removed from the watershed lands serves a useful purpose in enriching the soil of the land upon which it is deposited. This assumption is dangerous. One of the big expenses incident to the development of the Imperial Valley has been the installation of works to desilt the water taken from the Colorado River. This silt is so inert as to be a detriment rather than an asset to the land. Even though the silt load of a stream consists only of the richer, better soil from the watershed and may have a value on the land where it is deposited, its removal is reducing the ability of the watershed to maintain a plant cover and it will be only a matter of time until erosion will have progressed to a point where the material being transported is of little value for land improvement. Soils of valley lands were built up by the process of natural or geological erosion and deposition. This process will continue but it is likely to prove a fallacy if attempt is made to hasten this land building process by accelerating the rate of erosion.

Overgrazing and fire are the chief causes of the destruction of the protective plant cover and the organic material in the surface soil which results in modified streamflow, increased floods and accelerated erosion. Agricultural development on marginal lands which later are abandoned, as well as unwise methods of culture on the more productive lands, improper location and care of roads and trails and carelessness with waste water from irrigated lands, further contribute to this serious problem of streamflow, floods and erosion. The control of agricultural development on marginal lands is largely a matter of better land planning and use. Better practices need to be developed for methods of culture on the better farm lands, for the location and control of minor roads and for the care of waste water. The disastrous effects of fire are fairly well recognized, yet there are large areas of watershed land in the West that are being burned over annually owing to inadequate protection. Overgrazing has received even less recognition than fire and yet it is taking place over a much wider area than is being burned over. Moreover, the effect of overgrazing is accumulative from year to year.

In this connection it is unnecessary to hold that overgrazing is responsible for all of the accelerated erosion from grazed watershed lands. Variable climate undoubtedly is an important factor. However, where the balance is so delicate as it is on many watershed or other lands tributary to streams used for irrigation, overgrazing may be the factor which turns the balance in the wrong direction and gives full effect to the natural destructive forces.

So much of the continued welfare of the West is dependent on ample protection of watersheds against conditions which lead to damage to the character of streamflow, to floods and to accelerated erosion and their attendant evils that any scheme for land utilization which omits due regard for the security of watershed lands will be grossly defective. We are living in an age of exploitation of the available natural resources with too little regard for the future. The most important of these natural resources is that condition on watershed lands which is conducive to desirable character of water supply and the control of erosion. It is extremely false economy to over-utilize the forage and timber or neglect watershed lands for temporary saving or gains and thereby jeopardize the welfare of land or other values directly or indirectly dependent upon the watershed areas. The ultimate aim should be to so manage and protect watershed lands that they will yield the maximum water supply, taking into account the necessity for the desired character as well as quantity of streamflow, will be free of excessive erosion of the soil and will produce the maximum sustained yield of forage, timber or other resources consistent with the requirements for conserving the water supply and the soil.

The science and art of watershed protection and management is still in its infancy. Far more research and study to develop the necessary practices, than is now under way, is needed. Nevertheless, sufficient facts are available upon which to lay a foundation for the development and protection of watershed areas. It may be considered as axiomatic that the basic principle in watershed protection is the maintenance of an adequate plant cover upon all lands capable of supporting such a cover. Manipulation of the plant cover best to meet the needs is a problem of future research but the necessity of a plant cover is no longer a matter of question.

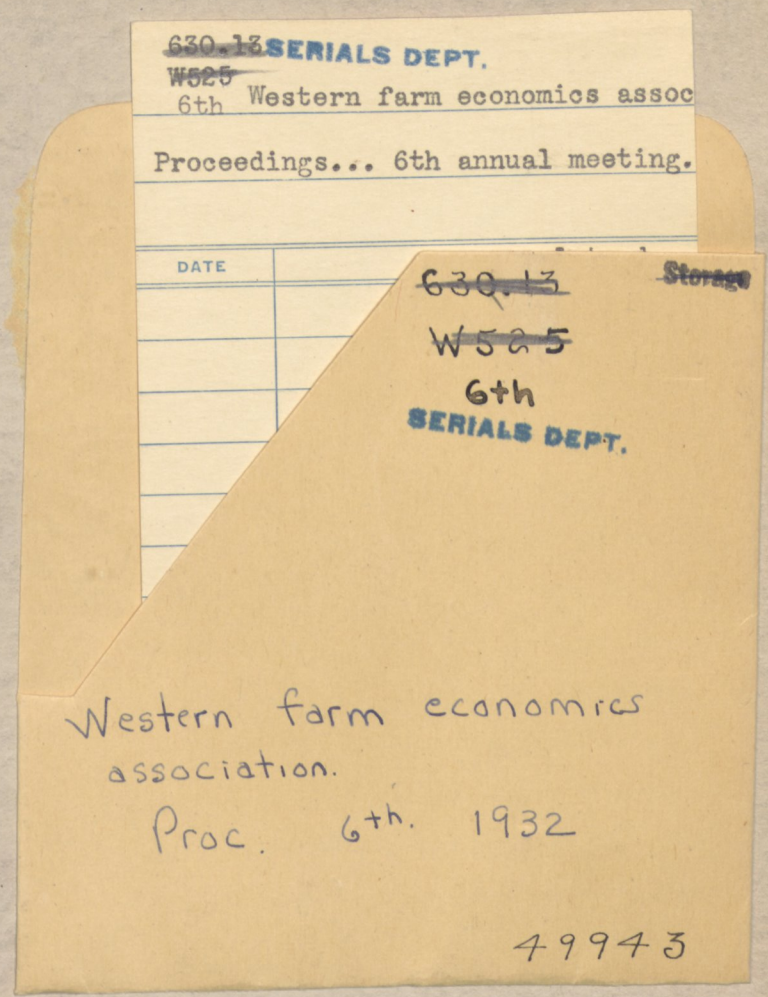
Many factors enter in to complicate the problem of maintaining a plant cover. One of the most important of these factors is the policy or lack of policy for the utilization, development and distribution of land. The situation applying on the open public domain is conducive to the destruction rather than maintenance of a suitable plant cover. Although the remaining open public domain is of relatively little importance for the yield of water the accelerated erosion which is occurring is materially contributing to the silt load of many important streams. The control of accelerated erosion is a dominant reason why a suitable system for handling the remaining open public domain should be developed.

Several circumstances operate to cause the neglect of adequate watershed protection on many privately-owned lands. Many privately-owned lands are marginal lands and economic circumstances, often beyond the

control of the individual, operate to force overutilization and destruction of the plant cover. Numerous instances can be cited where purchasers or renters of watershed lands are forced by excessive purchase price, taxes, rent or other carrying charges, to overutilize the land in an attempt to break even on the investment. In other instances lack of knowledge of the requirements of land management and protection, or of the consequences of misuse have lead to serious damage. Usually the owner of private land is not in a position directly to benefit from special precautions necessary for the protection of watershed values essential to some remote but dependent development and consequently does not exercise the necessary precautions with his land. However, community interest should not be left to the mercy of the limited ability of a few owners to adequately protect watershed values on which the community and not the private owner are dependent. Some system of public aid, public control or public acquisition should be developed to insure the management necessary in the public interest of important watershed lands now in private ownership.

The watershed protection problem is further complicated by the interstate character of most of the important streams. The Colorado and Columbia river drainages, for example, each involve seven states. The six states which adjoin Colorado are dependent on the watersheds of that state as are the six states which adjoin Wyoming. These examples indicate the interstate character of watershed protection in the West and point to the need for interstate and Federal cooperation where the existing measures in one state may not meet the needs of another state.

The sub-marginal character of much of the watershed lands in the West for grazing, timber production and other uses is unfavorable to private ownership, under present economic conditions and taxation. In the East millions of acres of land that have been stripped of their vegetation and soil, much of which was originally more or less marginal, have been abandoned and allowed to revert to public ownership after being stripped of their cover and top soil. Thus a new public domain is being created. The West should profit by that experience and avoid the pitfalls of an improvident land policy which leads to devegetation that exposes the land surfaces to the full forces of erosion, increases surface run-off and intensifies the peak and damage of floods and reduces the productivity of the land. There is needed a coordinated land planning that will safeguard the value of related lands which must be worked out for the community welfare regardless of the sanctity of personal property rights in land and regardless of differences of opinion as to private, state or Federal jurisdiction. Cultivated land planning, especially here in the West where a sustained water supply for irrigation is a prerequisite, will not be on a firm foundation unless the watersheds are given due regard in the picture.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