INSPECTION REPORT OF THE VEGETATIVE CONDITIONS ON THE SAFFORD EROSION PROJECT

October 23 to 26, 1934

by

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INSPECTION REPORT OF THE VEGETATIVE CONDITIONS ON THE SAFFORD MISSION PROJECT

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FOREWORD

In accordance with the plans developed last spring, the writers made an inspection of the Safford erosion project in order that any changes which have taken place might be noted. In the light of future developments, especially the impending survey of the Upper Gila Drainage, we are taking the liberty of expanding the scope of our report to include certain recommendations based on the preliminary results obtained in the present study. It is expected that this report will be of a confidential nature and on such a basis, we would like to comment freely on the work as we see it. We wish it to be understood, however, that this discussion and these recommendations are the product of investigators trained in Botany and Range Ecology with practically no engineering training or experience.

Previous Work: In order to classify certain observations to follow, it might be well at this time to present a brief review of the work carried on by the Artificial Revegetation Branch of Federal C.W.A., Project #22, Arizona, from January 19, 1934 to May 1, 1934.

In general, the work consisted of sowing various kinds of seed around engineering structures of all types, the establishment of fenced plots and the location of permanent photographic stations, the latter for the purpose of providing permanent records on vegetation and engineering work so that any future change in either might be observed. The plots were established for the purpose of providing an opportunity to study the response

ponse of natural vegetation to protection from grazing by the larger rodents and cattle as well as the effect of this protection on artificial reseeding work.

Growth conditions at the time the work was being carried on were very unfavorable, as an extreme drought was being experienced. Because of this, the growth of perennial plants was very limited and there were few or no annual plants in evidence. During the summer, especially during the period from the 17th to the 19th of July, extremely heavy rains fell in this region producing a very pronounced effect upon the range vegetation. As a result of these rains, the recovery of the perennial plants is very encouraging especially where grazing has been either light or entirely eliminated. Many of the grass crowns which appeared dead last spring have made some growth and the healthier plants have made considerable growth. Everywhere annual grasses and weeds have grown abundantly and in the more favorable situations have formed a continuous cover.

EXPERIMENTAL RESULTS

Graham County Plots: There are seven plots located in Graham County. In general there is no great change noticeable in these up to the present date, as might be expected due to the fact that they have been established for such a short period of time.

Plot No.1: located in Freeman Flat, is two acres in area, one acre being fenced against cattle and rodents and one against cattle only. A strip one half the width of the entire plot and running down the middle, extending out the ends of the plot was seeded to chamiza (Atriplex canescens). In this way,

planting is subjected to three grazing conditions. The extreme ends of the seeded strip is grazed by both cattle and rodents, this area being one acre in area - (one half acre at each end) while one half acre of seeded ground lies within the cattle exclosure and one half within the plot protected from both cattle and rodent grazing. To date no chamiza seedlings have been discovered. The largest change in the plot was the heavy growth of annuals which has appeared since the completion of the plot. The area within which this plot is located evidently received its share of rainfall during the past summer. There is a good growth of annuals everywhere, but the protected areas showed a noticeably greater number of individual plants and a larger volume of growth. The annuals are made up in general of the following species:

Pursley (Portulaca sp); six weeks gramas (Bouteloua aristidoides and B. barbata); sand verbenas (Abronia sp and Boerhaavia torreyana); little lemon weed (Pectis sp); spurge (Euphorbia sp) and (Tidestromia sp); annual panic grass (Panicum sp); and careless weed or red root (Amaranthus palmeri).

While they are not of great forage value, these plants are of great value in building up the soil by providing organic matter, a very important item as all the soils in the areas at lower elevations are very badly in need of this material. The continued addition of organic matter will in time bring back the soil to the point where the more valuable forage species may become established more easily.

Under conditions of vegetational deterioration such as

have occurred in the Safford area, it is necessary to build back the vegetative cover by a series of successional stages. The first stage is represented by annual grasses and weeds. In the second stage, short lived perennials appear and in the third stage, these may be replaced by such grasses as the gramas (Bouteloua spp), sand dropseed (Sporobolus cryptandrus), galleta (Hilaria mutica) and others. Each of these stages may occupy the ground for several to many years, the speed of regeneration depending upon climatic conditions and the degree of grazing use.

Plot No.2 is located in upper Freeman and is one acre in size, the entire plot being fenced against both cattle and rodents. It lies within an area that is at the present time closed to stock grazing. No seed was planted in this plot as the natural vegetation is in fair shape. As might be expected, there was little difference within the plot as compared to the outside range, as there is no grazing on the outside except by rodents.

Plot No.3 is located in what is known as the upper reservoir site. This plot is two acres in size and was seeded to crested wheat grass (Agropyron cristatum) in the same manner as described for plot No.1. To date no seedlings have been observed and very little change in the plot is apparent. Crested wheat grass normally grows at higher elevations and it may be that conditions here are not suitable for it. However, it did seem to be the most likely grass of any for which seed was available at the time of planting.

Plot No.4 is located in Hawk Hollow Canyon. It was also

seeded to crested wheat grass in the manner described above. No seedlings were found and aside from a fair stand of annuals, composed largely of six weeks gramas and sand verbenas, no change was noted.

Plot No.5 is located on Frye Mesa at the elevation of 4900 feet. It is 100 feet square and is fenced against both cattle and rodents. No seed was planted in this plot, and other than a quite noticeable difference in volume of forage present, there was no apparent change.

Plot No.6 is located in upper Frye Canyon near its junction with Cane Creek. It is two acres in size, one acre fenced against cattle and one against both cattle and rodents. As no seed was planted and the grazing on the outside is very light, no difference within the plot was noted.

Plot No.7 is located on the ridge east of the lower reservoir site at an elevation of about 3300 feet. No seed was sown, and due to very light grazing on the outside, no change was observed.

Greenlee County Plots: Two observation plots very similar to those in Graham County, were established south of Duncan in the Black Canyon country.

Plot No.1 is laid out on the watershed above Black Canyon. It is two acres in size, one half fenced against cattle and rodents and one half against cattle. There was no treatment made of this plot and little change was noted at the time of inspection.

Plot No.2 is located in the bottom of Black Canyon in an area in which the forage is badly depleted and which exhibits rather pronounced sheet and gully erosion. This plot is also two acres in size and was seeded to chamiza in the same

manner as was described for plot No.1 in Graham County. No seedlings were found but there is a very marked difference in the volume of native vegetation within the plot, and as this plot has been completed for only six and one half months, it would indicate that this particular type of country would recover very rapidly with a little protection from grazing.

As the dikes in this area are still holding water, thus tending to bring about a congregation of stock around them, an already badly overgrazed condition is being aggravated. For this reason, it is strongly recommended that the engineering works in this area be fenced, at least in part.

Other Areas: Several unfenced plots were laid out and seeded; three to ehamiza, one to filaree (Erodium cicutarium) and one to African saltbush (Atriplex garrvatta). None of these seedling attempts have shown success as yet with the exception of the diversion work in lower Freeman. This entire area was sown to ehamiza and approximately twenty seedlings of this plant were found along the canal and between the diversion dikes. The fact that this area received more water than any other on the entire project due to the character of the engineering work, would probably account for this success as compared to apparently total failure elsewhere. However, it is believed by the writers that there is a fair possibility that the seed planted last year will germinate the coming spring if soil moisture conditions are favorable.

It was not expected that filaree would germinate until after the fall rains and it may be that some results will be evident next spring.

The planting around dams has shown very little results so far. Because of the high floods during the past summer, it is feared that a great deal of this work may be lost.

DISCUSSION OF RESULTS

After making a study of the area this fall, the possibility of vegetative erosion control seemed to appear more feasible than it did last spring. This statement holds in spite of the apparent failure along several lines of work. Favorable growing conditions during the past summer have indicated greater potentialities than were anticipated for the re-vegetation on many of the areas. While some of the engineering structures were lost and the artificial reseeding work was not highly successful, there still seems to be a great deal which can be learned from these failures.

In order to facilitate discussion, the erosion control work might be divided into three classes, namely: (1) primary control on the ground where precipitation falls and including small shoestring or feeder gullies; (2) secondary control - control within the area where precipitation falls but where definite though small drainage channels have been developed, each system including an area of one to several and/or many acres; (3) tertiary control on drainage lines which carry the runoff away from the areas in which the precipitation falls. This class includes the individual drainage basins usually several miles in extent. From the vegetational viewpoint, these represent distinct erosion problems.

Primary Erosion Control: Many ecologists hold to the hypothesis that moisture can be most efficiently used in the place where it is first available and further that in the majority of cases that where there is sufficient precipitation to produce runoff, there is sufficient moisture available to produce vegetation which will largely prevent such runoff. Where conditions have been altered, the vegetation partly destroyed and drainage channels developed, it is still possible to check this runoff with the aid of some engineering structures by natural or artificial reseeding. We feel that this is the most important phase of the problems to be attacked, particularly from the viewpoint of range ecology. While it still seems to be open to argument as to whether or not more water will be delivered to the irrigation districts below under conditions of over grazing and depletion, there is no question but that the supply of water will be better regulated and carry less silt under conditions where the vegetative cover is in a thrifty condition. As far as the ranges themselves are concerned, we know that a mistake has been made in overgrazing them resulting in depletion of vegetation, decreased grazing capacity and loss of surface soil. The conditions brought about by such abuse are unsatisfactory from the stockman's viewpoint and at the same time there is no adequate proof that this has resulted in a greater delivery of water. On the other hand, if we should build back the ranges on the Gila and find that such vegetation conditions were not conducive to the best interests of the irrigation projects, it would be a very simple matter to correct the situation by overgrazing again.

However, observations under a wide variety of conditions have led us to believe that where a range is maintained at its maximum grazing capacity the most favorable conditions for control of erosion and runoff will result.

One of the most outstanding features noted on the Safford area was the rather remarkable recovery of Mr. Wilson's higher ranges. Since he has obtained control of these ranges, the grazing use has been reduced to about one fifth of what it was formerly. This coupled with rather favorable moisture conditions during the summer of 1934 has brought about a strong reaction on the part of the vegetation. It is believed that the recovery could be hastened by the aid of small dams where incipient drainage lines have been developed under the past heavy use. A moderate amount of planting might speed up the recovery, but the present indications are that this area will re-vegetate naturally.

At the lower elevations there has been an unusual growth of annuals, particularly the six weeks grasses. At this time the observer is apt to be misled and to become too optimistic over the conditions without realizing that within a month or two these annual plants will have disappeared and the ground will be nearly as bare as it was last spring. However, these annuals have played their part in checking erosion to some degree and have led the way for the establishment of more valuable perennial plants. On the lower areas, it will take many years to repair the damage of overgrazing and will necessitate the aid of all known devices to bring about recovery. From the grazing viewpoint the value of this land would not justify the amount of work necessary. But from the

erosion viewpoint, it may be that an expenditure based on the value of the lands for watershed purposes is justified in order to prevent the destructive erosion and silting which has occurred in the past.

Along Black Canyon near Duncan, many examples of the rapidity with which natural vegetation can start to heal erosion scars are shown. Photograph No.1 gives an idea as to the results of one seasons protection on an alluvial flat. Here the tobosa grass has made an excellent growth under protection and if given an opportunity will again form a protective sod. Photograph No.2 shows how an incipient drainage line may be checked by natural re-vegetation. Photograph No.3 shows a drainage line in which a cutting has reached the stage where it will be necessary to use a few rock dams if rapid recovery is to be expected.

The principal objectives of primary erosion control should be to stop erosion before it gets started and if erosion has started, to check the destructive forces as rapidly as possible. The first step in vegetative control is the stabilization of the substratum. Where there is active erosion or deposition, there can be little growth of vegetation. On depleted ranges where sheet or shoestring erosion is active, various engineering works are effective in bringing about a greater degree of stabilization as shown in photographs Nos.4 and 5. Such works accumulate soils and improve moisture conditions, making it possible for vegetation to grow. The vegetation in turn brings about more stabilization and promotes further vegetational development. It makes no difference whether dependence is placed on natural vegetation or artificial planting. The habitat must be stabilized and properly developed before the

plants can survive. Furthermore in either case the grazing must be regulated if any progress is expected. Artificial planting may speed up control but it can not be expected to perform miracles. The basic principles promoting growth and development of vegetation are the same in both cases.

It is believed that money expended for primary erosion control will bring about the greatest returns in control of runoff and erosion. A program including the construction of small dams, control of livestock grazing, control of rodents and revegetation work should bring about satisfactory primary erosion control and would go a long way toward solving the problems on the Gila watershed.

Secondary Erosion Control: From the vegetative side, secondary erosion control does not hold as much promise as primary control. The movement of water is through definite channels and where there is much rainfall, the volume of water is large. However, if the primary control is effective, it should be possible to effectively retard the flow of water by dams and other artifices. It cannot be expected that there will be much continuous growth of vegetation unless the erosive effect of the runoff can be checked. Secondary control might be considered as a second line of defense, supporting the primary control where necessary.

It may be that through the proper selection of damsites, considerable water can be sunk to replenish the ground water supplies. In some cases the water can be successfully spread and the production of vegetation thereby increased. Under such conditions artificial planting might prove to be advantageous.

Tertiary Erosion Control: The control of runoff and erosion in the larger drainage channels offers the poorest possibilities from the vegetative standpoint. There are two general types of drainage lines to consider: (1) rather steep, dry canyons leading out from the mountains or hills, (2) washes or arroyos in the rather flat valley lands.

The results from attempted erosion control seem to be least satisfactory along the steeper, large drainage areas leading out from the higher mountain areas. The force of water involved is indicated by the complete removal of some of the large rock dams placed in these canyons. The force of water and the abrasive effect of the material carried with it is so great that it could not be expected that vegetation could survive where exposed to such conditions. It is felt that little success can be expected from efforts to control runoff in these areas unless an effective primary and secondary control is in operation above.

The dams and spreading systems on Freeman Flat have demonstrated some of the possibilities for the second type of drainage system. Although a mis-calculation was made in the artificial reseeding work, Nature has pointed the way for future operations. The healthy volunteer corn plants on the flood area give an indication of moisture conditions. The very robust growth of various weedy annuals indicates that natural revegetation will render a great deal of assistance where it is given the advantage of carefully planned and controlled engineering devices. The control of grazing should not be overlooked.

Photograph No.9, taken near the protected plot on Black Canyon shows the concentration of live stock along the dam because of the water remaining at the close of the rainy season. This is one feature which will probably have to be corrected. At present the dams have resulted in increasing the intensity of grazing whereas if optimum results are to be expected, the degree of grazing should be decreased in the vicinity of dams, especially those located on the deep alluvial flats. In such locations as this, it is expected that artificial re-seeding and planting will prove to be most effective and of greatest economic value. However, it is almost certain that such operations will fail unless grazing by domestic stock and rodents is controlled.

SUMMARY AND CONCLUSIONS

1. The artificial reseeding work has not been successful so far, but even the negative results have indicated possibilities for further experimentation.

2. Natural revegetation has exceeded the most optimistic expectancies. Considerable promise for revegetation is shown where grazing has been controlled and reduced to a point where the vegetation has been given a chance to recover.

3. Control of erosion and runoff at the source by means of small and simple dams, control of livestock, control of rodents, and revegetation work appears to offer the greatest opportunity for the efficient and economic control of erosion.

Photograph No.1: The effect of one year's protection - Black Canyon, Plot No.2

Total protection is effective, but it is not necessary in many instances. Controlled grazing may allow for rapid recovery and at the same time provide for an income from the land.

Photograph No.2: Primary Erosion Control - Black Canyon, Plot No.2

Vegetation often proves to be an efficient and powerful agent in the control of runoff and destructive erosion, as shown in the central portion of this photograph.

Photograph No.3: Primary Erosion Control - Black Canyon, Plot No.2

A few dollars spent for dams and control of grazing will save many areas such as this.

Photograph No.4: Primary Erosion Control - Hawk Hollow.

Hardly more than a pile of rocks in a depression, but it is holding back its share of water and silt and creating a favorable habitat for the growth of vegetation.

Photograph No.5: Primary Erosion Control - Hawk Hollow.

This unpretentious dam is successful in checking erosion, and revegetation has started after one season.

Photograph No.6: Secondary Erosion Control on a Short Drainage - Hawk Hollow.

This dam has been effective in the control of erosion. It offers limited possibilities for revegetation.

Photograph No.7: Secondary Erosion Control - Hawk Hollow;

A series of such dams might sink a considerable volume of water to replenish the ground water supplies.

Photograph No.6: Tertiary Erosion Control - Hawk Hollow.

The forces to which dams such as this are exposed may be terrific. There is little opportunity for revegetation here.

Photograph No.9: Tertiary Control on an Alluvial Flat - Black Canyon, Plot No.2

The heavy grazing here is going a long way toward nullifying the beneficial effects of man's efforts for regeneration.