UNITED STATES DEPARTMENT OF AGRICULTURE

REPORT OF REAPPRAISAL OF DIRECT AGRICULTURAL BENEFITS & PROJECT IMPACTS

PAONIA PROJECT

COLORADO

COLORADO RIVER STORAGE PROJECT

COOPERATING AGENCIES

Soil Conservation Service
Agricultural Research Service
Forest Service
Farmers Home Administration
Agricultural Stabilization & Conservation Committees
Colorado Agricultural Experiment Station
Colorado Cooperative Extension Service
State of Colorado

In Coordination With
Bureau of Reclamation
United States Department of the Interior

Report Prepared By

USDA Field Advisory Committee & USDA Field Party

Salt Lake City, Utah - April 1957

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SUMMARY OF REPORT ON
REAPPRAISAL OF DIRECT AGRICULTURAL BENEFITS AND PROJECT IMPACTS

PAONIA PROJECT - COLORADO

Authority and Scope

This report on the Paonia Project, Colorado River Storage Project, has been prepared by the U. S. Department of Agriculture in response to the President's letters of March 19, 1954 to the Secretary of Agriculture and the Secretary of the Interior. In his letters the President requested that a reappraisal of the direct agricultural benefits anticipated from the participating projects of the Colorado River Storage Project be made by the Department of Agriculture in cooperation with the Department of the Interior. Following the authorization of the Colorado River Storage Project by Congress, an understanding was reached late in July 1956 between the Secretary of Agriculture and the Secretary of the Interior regarding conduct of a survey to reappraise these direct agricultural benefits and to appraise project impacts. The Department of Agriculture survey was made under the authority of Section 6, Public Law 566, 83d Congress, as amended, which authorizes the Department to cooperate with other Federal, state, and local agencies in surveys and investigations of watersheds. The Colorado A & M College cooperated in the survey.

In addition to the agricultural phases, this report deals with the impacts of the project on the national forests and the relation of watershed conditions to the project. The report is intended to aid the Bureau of Reclamation in developing a sound project plan and to provide information bearing on regular programs of this department.

General Description

The Paonia Project is located on the North Fork of the Gunnison River, a major tributary of the Gunnison River, in Delta and Gunnison Counties, western Colorado. Elevation of the town of Paonia is 6,200 feet. The climate is semiarid, with average annual precipitation of 14.95 inches and an average frost-free season for the project area of 145 to 160 days. Irrigation is essential to successful crop production and has been practiced in this and nearby areas since the early 1880's.

Evaluation of Expected Direct Agricultural Benefits

Procedures and Sources of Information

This report is based on available field data, published reports, and the combined judgment of agricultural technicians familiar with the project area, and its agricultural problems and conditions.

Preliminary reports, land classification maps and field sheets, farm schedules, and other data collected by the Bureau of Reclamation were made available and have been used to acquaint technicians with proposed developments.

The above information was used to augment soil surveys, field investigations, engineering surveys, crop yield determinations, and irrigation water investigations made by members of the Field Party as well as local representatives of the U. S. Forest Service, Soil Conservation Service, Agricultural Research Service, and Bureau of Reclamation.

In addition, assistance from representatives of the Colorado Cooperative Extension Service, Colorado Agricultural Experiment Station, Colorado Water Conservation Board, Farmers Home Administration, State and County Agricultural Stabilization and Conservation Committees, Bureau of Land Management, and others has been valuable in preparing the report.

Soils

Farm-to-farm soil surveys have been made by the Soil Conservation Service, cooperating with the Delta Soil Conservation District, on a total of 5,274 acres, which is a 16-percent sample of the total acreage in the project. Land classification field sheets of the Bureau of Reclamation were used as reference material. Soils in the Paonia Project are fairly uniform in potential productivity. Chiefly because of differences in topography, these soils have been divided into land capability classes I, II, III, and IV--each class requiring different treatment and management. Based on this sample, which is representative of the project area, there is ample land within the Paonia Project suitable for long-continued irrigation to provide the 14,380 acres for which the Bureau of Reclamation plans to provide irrigation water.

Land Improvement

Of the 14,380 acres to be irrigated in the Paonia Project, 12,280 acres are now cultivated. This land has all been developed to some extent and has farm ditches which deliver water to the fields. Considerable improvement is needed in land leveling and farm ditches to enable farmers to irrigate with higher efficiency than that which now prevails. The estimated costs for the immediately necessary improvements on presently irrigated land will average $12 an acre. The 2,100 acres of new land are generally in small tracts and are now undeveloped. They will need clearing of brush at an average estimated cost of $19 an acre, removal of rocks on and near the surface at $150, leveling at an average of $98, and construction of farm ditches at $14 an acre. The estimated development cost for new land during the development period averages $281 an acre. These costs and the associated crop yields resulting from these improvements are considered in the economic analysis of this project.

Estimates have also been made of additional irrigation improvements which farmers are expected to make over a longer time to bring the presently cultivated land to a higher level of productivity. Experience in other areas has shown that after farmers have a dependable water supply, they gradually improve their irrigation to the highest practical extent. This additional improvement usually takes a good many years so it is not considered in evaluating this project.

Drainage

About 300 acres of presently irrigated lands will need farm drainage. Drainage will not be difficult and the necessary outlets are readily available. Based on the cost of comparable drainage work in this vicinity, drainage measures are estimated to cost $150 an acre on the average for the 300 acres.

Irrigation Requirements

Considerable information from past studies is available from which to determine probable irrigation requirements in the Paonia Project. Consumptive water use varies slightly between the Leroux Creek and Fire Mountain Divisions but averages about 20 inches per year. Irrigation efficiencies are now low but anticipated improvement in irrigation facilities and management resulting from the improved water supply is expected to produce an over-all farm efficiency of 57 percent. This results in irrigation water requirements at the farm headgate of 34.7 inches in the Leroux Creek Division and 36.0 inches in the Fire Mountain Division.

The 12,280 acres of presently irrigated lands will need an average of 8.5 inches of supplemental water. The 2,100 acres of new land proposed for irrigation will need a full supply of about 35 inches. The Paonia Project should deliver sufficient water to supply these requirements in almost all years. As is true of virtually all irrigation projects, the Paonia Project probably will occasionally experience slight deficiencies in water supply in years of extremely low water yield.

Projected Agricultural Economy

To obtain data for the economic analysis of the Paonia Project, economists of the Department of Agriculture and Bureau of Reclamation jointly collected information from 43 farms. The total acreage on the 43-farm sample was 25 percent of the land now irrigated.

Three general farm types are found. In the report these are called fruit farms, fruit-general, and general. These farms average 27, 60, and 100 acres, respectively. The fruit farms are almost entirely in peaches, apricots, cherries, and apples with only a few acres of general crops. Fruit-general farms have considerable acreage of apples but most of the farm is in general crops. General farms produce virtually no fruit and the irrigated crops are chiefly fed to livestock. The livestock enterprises include grade-A dairy and beef production.

Because all soils have about the same potential productivity, only one set of crop yields (shown in table 12 of the report) was used. Land development costs and annual production costs will vary among the land capability classes and these are used in the economic analysis. When all anticipated costs and returns are considered, anticipated net farm returns of projected budgets with the project are estimated at $3,135 as a weighted average. These net returns allow a charge for

interest on investment averaging about $1,893 per farm. This return on investment is also available for family living, investment, and other purposes. Incomes for several farm budgets appear low when compared with some irrigation projects under more favorable climatic and soil conditions. However, many farmers also have nonfarm incomes. The Paonia Project has evidently furnished a satisfactory living because farmers have irrigated under present conditions for many years. Future incomes with the project would be considerably higher than at present.

Increased incomes or benefits associated with proposed additional irrigation water are estimated at $15 per acre on 12,280 acres of presently irrigated farms. If this same benefit is applied on a per-acre basis to 2,100 acres of new land, the total annual direct benefits on 14,380 acres of project land would be about $215,000.

Impacts of the Paonia Project on the Gunnison National Forest

As far as can now be foreseen, construction and operation of the project will not require any changes in management, objectives, and physical plant or services now provided on the Gunnison National Forest. However, increased fire prevention services will be needed during and after the construction period.

The county road which now serves a portion of the national forest will need to be relocated. Grazing, timber, wildlife, and other resource values and uses will not be affected. However, it is anticipated that visitors attracted to the reservoir and the adjacent mountainous areas will increase future recreational uses on nearby forest lands.

Construction of the proposed Paonia Reservoir will undoubtedly attract large numbers of people for recreation. Therefore, recreational uses of the reservoir and adjacent land should be planned and facilities installed which will meet basic requirements for public health, safety, property protection, and prevention of pollution.

Suitable lands, adjacent to the reservoir, should be reserved or acquired to be retained in public ownership for these purposes. These lands and the recreational facilities needed should be administered and maintained by a Federal, state, or local government agency to insure and protect the public interests and provide adequate public access to the reservoir area.

Relationship of Watershed Conditions to the Paonia Project

The watershed above the Paonia Project covers about 791 square miles and includes the Anthracite-Deep Creek, Muddy Creek, Hubbard-Terror Creek, and Leroux Creek subwatersheds. The area includes various types of topography with considerable mountainous land. There is no cultivated land in the upper watershed. All lands are used either for grazing by livestock and big game animals, timber production, watershed protection, or recreation and wildlife areas. Land ownership is 81 percent Fedral and 19 percent privately owned. Vegetative cover in the upper watershed is generally good. Localized

Areas will need more intensive measures but generally good watershed conditions can be maintained by sound range and timber management. Some land slide areas produce large quantities of sediment. It does not seem practical to improve and restore vegetation on them.

However, efforts should be made to provide ungrazed areas immediately below these land slides to trap the sediment and keep it out of the stream. Aside from the land slide areas, there are no major floodwater or sediment problems due to watershed conditions. Plans developed by the Bureau of Reclamation have given full consideration to sediment and floodwater problems. Design of the proposed Paonia Reservoir provides 10,000 acre feet for storage of sediment in addition to 11,000 acre feet provided for irrigation storage. Design of the main project canals includes protective structures in those cases where side drainages would cause serious problems.

CHAPTER I

GENERAL INFORMATION

Organization

Pursuant to the U. S. Department of Agriculture Memorandum of Understanding between the Soil Conservation Service, Forest Service, and Agricultural Research Service dated February 2, 1956, a Field Advisory Committee, Colorado River Storage Project, was established. The committee is composed of representatives of the above-mentioned agencies and a representative of the concerned state agricultural colleges. Principal duties of the committee are to maintain appropriate liaison and to facilitate coordination of activities by the respective services and the state agricultural colleges in the survey. Field survey relationships with the Bureau of Reclamation and other interested state and Federal agencies are also a responsibility of the committee.

A Field Party, working under the direction of the Field Advisory Committee and operating within a plan of work dated August 22, 1956, was responsible for the collection and analysis of data and for the preparation of this report.

Location and Physical Features 1/

The valley of the North Fork of the Gunnison River and adjacent mesas, in which the Paonia Project is located, are situated in Delta and Gunnison Counties in west-central Colorado about 50 miles southeast of the city of Grand Junction. The valley begins about 7 miles above the town of Paonia where the steep-walled canyon of the North Fork of the Gunnison River, also known as the North Fork River, gives way to a narrow alluvial floor. From this point the valley extends 21 miles southwest terminating at the junction of the North Fork River with the main Gunnison River near the town of Delta. At no point is the valley floor more than 3 miles wide.

Lands are cultivated in the valley proper and irrigated crops are grown on several mesas and terraces at various elevations and on lands extending along streams affluent to the North Fork River. The project lands are located in two areas or divisions: (1) The Fire Mountain Division, comprised of lands under the existing Fire Mountain Canal and the extension of the canal, which are located in a narrow discontinuous belt extending from near Somerset to about 5 miles west of Hotchkiss, including Rogers Mesa, and (2) the Leroux Creek Division comprised of lands adjacent to Leroux Creek above the service area of the Fire Mountain Canal, including Redlands Mesa.

Elevation of the town of Paonia is 6,200 feet.

1/ Much of the information for chapter 1 has been supplied by the Bureau of Reclamation, Paonia Project Planning Report No. 4-8a.4-3, Feb. 1951.

The North Fork River and many steep, deeply entrenched tributaries constitute the drainage system of the valley and surrounding area and provide water presently used for irrigation. The river is formed by Muddy Creek and Anthracite Creek which meet at Bardine, some 14 miles northeast of Paonia. From this point the North Fork River flows southwest through a steep narrow canyon, emerges into North Fork Valley near Paonia, and continues on in the same general direction to its junction with the Gunnison River. Among the important tributaries of the North Fork River is Leroux Creek which now provides irrigation water for project lands.

Climate

The region has a temperate, semiarid climate. Records from Weather Bureau stations at Montrose and Grand Junction have shown the average relative humidity to be only 39 percent. Dryland farming is impractical.

A Weather Bureau station has been maintained in the vicinity of Paonia since 1892. Precipitation averages 14.95 inches annually. It has varied from a low of 7.67 inches in 1898 to a high of 22.99 inches in 1914. Temperatures generally range from 80° F. to 90° F. in the daytime during the months of July and August with a mean of 67° F. to 69° F. for these months. The highest recorded temperature is 100° F. and the lowest is -28° F.

The general climate is satisfactory for diversified irrigation farming as practiced in the area. The position of the project lands, with the mountains to the east and lower lands to the west, causes local air currents to pass across the farmland. This condition has proved valuable in the control of frost action during the spring months and has contributed to the successful production of fruit in the project area. The average frost-free season for the project area varies from 145 to 160 days.

Present Agriculture

History of Development

Mining led to the early settlement of western Colorado and brought the area's first railroad service. The Ute Indians originally occupied the lower sections of west-central Colorado, including the North Fork River Valley. Early efforts by the whites to inhabit the area were retarded by the indians until a compromise agreement between the United States Government and the Ute Indians was reached on September 4, 1881 providing for the Ute Indians to locate on the Uintah Reservation in the territory of Utah. Settlers exploring western Colorado were advised of the pending negotiations and the first group of whites started settling the North Fork River Valley about the time the pact was signed.

Water rights in the valley date from 1882. The rate of settlement and population growth paralleled the development of irrigation facilities in the area and proceeded rapidly until the turn of the century when the natural river flow was fully appropriated. Development became stabilized

prior to 1920 and has remained more or less static since that time although population did increase some between 1930-40. The agricultural economy is augmented by the operation of numerous mines in the nearby mountains.

Agricultural Development

Agriculture, the basic industry of the region, consists primarily of the production of livestock and fruit. Thousands of acres of rangeland and national forest lands surround the cultivated areas of the region, providing summer grazing for livestock.

In general the cultivated lands of Delta County are located in valleys along stream channels and on flat terraces or mesas. Approximately 20 percent of all cultivated land in the county is within the proposed project area.

The towns of Paonia and Hotchkiss are the trading and shipping centers for the population engaged in the farming of approximately 26,000 acres of land, the grazing of livestock on many thousand acres of rangeland, and the operation of North Fork Valley coal mines.

With the large volume of fruit produced in surrounding areas, an extensive fruit packing industry has developed in these towns. The livestock crops are sold mainly on the Denver or Kansas City markets. Milk and butterfat have, in past years, been sold to creameries and dairies in Paonia, Hotchkiss, Cedaredge, Delta, and Grand Junction. The dairy market, however, is shifting to the west coast as a result of increased local activity of large western distributors.

Farm Organization

There are approximately 238 farm units within the project area. The irrigated cropland is used as follows: alfalfa, 32 percent; irrigated pasture, 26 percent; fruit, 17 percent; small grain--principally barley, 11 percent; corn, 8 percent (about equally divided between that harvested for grain and that harvested as silage); and idle, 6 percent.

The over-all land use percentages indicate a general farming area. There is, however, some intensive farming represented in the 17 percent of land used for fruit. Fruit farms are concentrated in certain localities less susceptible to damaging frosts. Fruit production accounts for a large portion of the area's farm income even though it occupies a small portion of the irrigated land.

Farms are of three main types: fruit, fruit-general, and general. There are about 15 Grade A dairy farms.

In addition to fruit and general farm crops, livestock and livestock products are also important. There are 36 farm operators within the project area who have permits to graze livestock on Federal rangeland. National forest records show 30 operators graze 1,656 head of cattle during summer months on the Gunnison and Grand Mesa National Forests. Six other operators graze 9,546 head of sheep during summer months on

the Gunnison National Forest. Grazing permits on public domain lands furnish spring and fall grazing for these same livestock. (The number of operators and number of livestock indicate use only by project operators and not total use of Federal range resources in this vicinity.)

Crop Adaptations

The growing season is long enough for most field crops grown in Colorado. The temperature is mild, even with the high altitude, and is quite favorable for fruit, particularly apples, peaches, and sweet cherries.

The fruit-type farms are located in areas with the best air drainage. The fruit-general farms are usually in areas of less favorable climate for peaches and sweet cherries; therefore, apples are the main fruit grown.

Soils within the project area apply no restriction on selection of crop, except for steep slopes and stoniness. Much of the steep slopes are protected from erosion by use of close-growing crops, such as hay, pastures, grain, or orchard with cover. Row crops produce well but are restricted to the flatter land without stones.

Soil Fertility

Good soil fertility maintenance practices are not applied by all operators within the project area. Specialized farmers--mostly fruit growers--employ the most progressive methods to maintain soil fertility. Shortage of irrigation water has retarded the application of soil fertility maintenance practices over the area as a whole.

Soil-building crop rotations are not used over much of the project area. There is a favorable relationship, however, between sod-crops acreage, such as alfalfa and pasture, with clean cultivated acreage. This relationship is the result of the water shortage.

Commercial fertilizers are used on most orchardland. The application of commercial fertilizer on field crops, particularly hay and pasture, is not a general practice. Livestock are few in numbers so organic fertilizer is below the required amount to maintain high fertility or production. Soils will respond to soil management practices.

Irrigation Development

Early settlers found irrigation to be essential for successful farming. Diversion facilities were rapidly developed and by the turn of the century practically all of the natural flow of the river and its tributaries had been appropriated for irrigation and domestic use. To permit further development of irrigation, reservoirs were constructed on high tributary streams and flood flows and winter runoff were appropriated for storage. Such reservoir development, however, was limited by the character of the various watersheds. All tributaries are steep in gradient, narrow, and deeply entrenched and the reservoirs are of relatively small capacity. During continued attempts to irrigate more lands, new ditches were

constructed and existing ditches were extended. As a result, the irrigation systems became over expanded. Severe late-season shortages are experienced by irrigated lands served under junior water rights.

Irrigation has been developed by individuals, partnerships, and cooperatives or incorporated irrigation companies formed through the pooling of interests of various groups. Except for small individually owned developments, irrigation facilities now serving irrigated lands of the project were developed and are presently operated by four principal organizations: Fire Mountain Canal and Reservoir Company, Overland Ditch and Reservoir Company, Leroux Ditch and Enlargement Company, and Turner Ditch Company.

Mining

Mining, as in all western Colorado, is a major industry of the region. Large deposits of coal, including considerable amounts of high grade coking coal, are found throughout the North Fork River area. Records show that production averaged 577,000 tons of coal annually from 1942-46, inclusive.

Other Land Uses

Numerous streams, lakes, and spectacular mountains of Delta and Gunnison Counties provide scenic attractions and opportunities for camping, picnicking, fishing, and big game hunting. Annual use for these purposes has increased significantly in recent years. Tourist trade furnishes a substantial income each year.

The local lumber industry supplies an important part of the regional demands for lumber.

Economic Conditions

The general economy of Delta County is good. It is supported mainly by fruit production, coal mining, livestock production, and raising of livestock feeds supplemented by general farming, local fruit packing, and attendant wholesale and retail trade. The inhabitants of North Fork River Valley have enjoyed a prosperous economy through the large volume of wealth-producing resources rather than from the intensive development of any particular industry. Many operators of irrigated farms supplement their income by working in coal mines or fruit packing houses or lumbering in the nearby national forests.

Farm mortgages are in good order and farm credit is readily available. In 1940 mortgages were recorded on approximately 13 percent of the farm units in the project area. Individual indebtedness ranged from $50 to $8,000. During 1942-46, which were years of high prices, much of the property indebtedness was cleared. Since the war, as construction materials have become available, sound investments have been made in property repair and operational expansion. As a result of these investments, mortgages have now been placed on about 30 percent of the farms. They are, however, far under the assessed valuation of the property.

Further development of agricultural resources is dependent upon an adequate supply of irrigation water. The agricultural lands produce fair yields of fruit and general farm crops in years of good water supply. Even in years of exceptionally high runoff, late-season water is inadequate for all crops. In years of low runoff partial or total crop failures result. Additional irrigation water would stabilize crop production, increase total crop yields, and permit development of new lands now idle because of insufficient water. Returns from agricultural products would be increased and made more stable if the project area were provided a full irrigation supply.

General

The population of the area is predominantly of English, Scotch, and Balkan descent. In recent years migration has consisted mainly of the movement of transient coal miners to and from the area and the influx of families interested in fruit production in North Fork River Valley.

Trends in population in the project area have been up and down during the period 1930-50. The communities of Bowie, Hotchkiss, Lazear, Midway, Paonia, Payne-Rogers Mesa, Somerset, and Ragged Mountain include most of the people living in the project area. Bureau of Census records for these communities show a population of approximately 5,300 in 1930, 6,100 in 1940, and 6,300 in 1950.

The project area has good transportation facilities. A standard gage railroad parallels the North Fork River and passes through Paonia. A surfaced road extends from the project area to Delta where it is joined by U. S. Highway 50. The distance from Paonia to Denver is 352 miles by rail and 316 miles by highway. The distance to Salt Lake City is 372 miles by rail and 356 miles by highway.

Electric power is distributed to the population centers by the Western Colorado Power Company and to the rural areas by a local cooperative financed by the Rural Electrification Administration.

Telephone and telegraph facilities are adequate.

Educational facilities are provided throughout the North Fork River Valley. Grammar schools are accessible to all communities and high schools are located at Paonia and Hotchkiss. An accredited junior college is located at Grand Junction. Other institutions of higher learning are situated in Gunnison and eastern Colorado.

Resources of the region, which have not been fully developed, include timber in the national forests, unmined coal and other minerals, recreational potentialities, and hydroelectric power.

Although sawmills have existed in the region for several years, the very large areas of unharvested forest provide a potential for a large increase in timber harvesting.

Coal has recently assumed major importance with the discovery of large beds of high grade coking coal south of the North Fork River near Bardine. Coal resources are estimated to total some 5.6 billion tons.

Proposed Development

The Paonia Project would meet the irrigation water needs of the area by storage, regulation, and exchange of present water supplies. Excess runoff would be stored in a proposed Paonia Reservoir on Muddy Creek, a tributary to the North Fork of the Gunnison River. The reservoir would partly equalize the flows on this stream and substantially augment the late-season irrigation water supplies.

The Paonia Reservoir on Muddy Creek, with a capacity of 11,000 acre feet of irrigation water and an estimated 10,000 acre feet of silt, would be formed by an earthfill dam approximately 17 miles east of the town of Paonia. The reservoir would provide additional water for the 14,380-acre project.

CHAPTER II

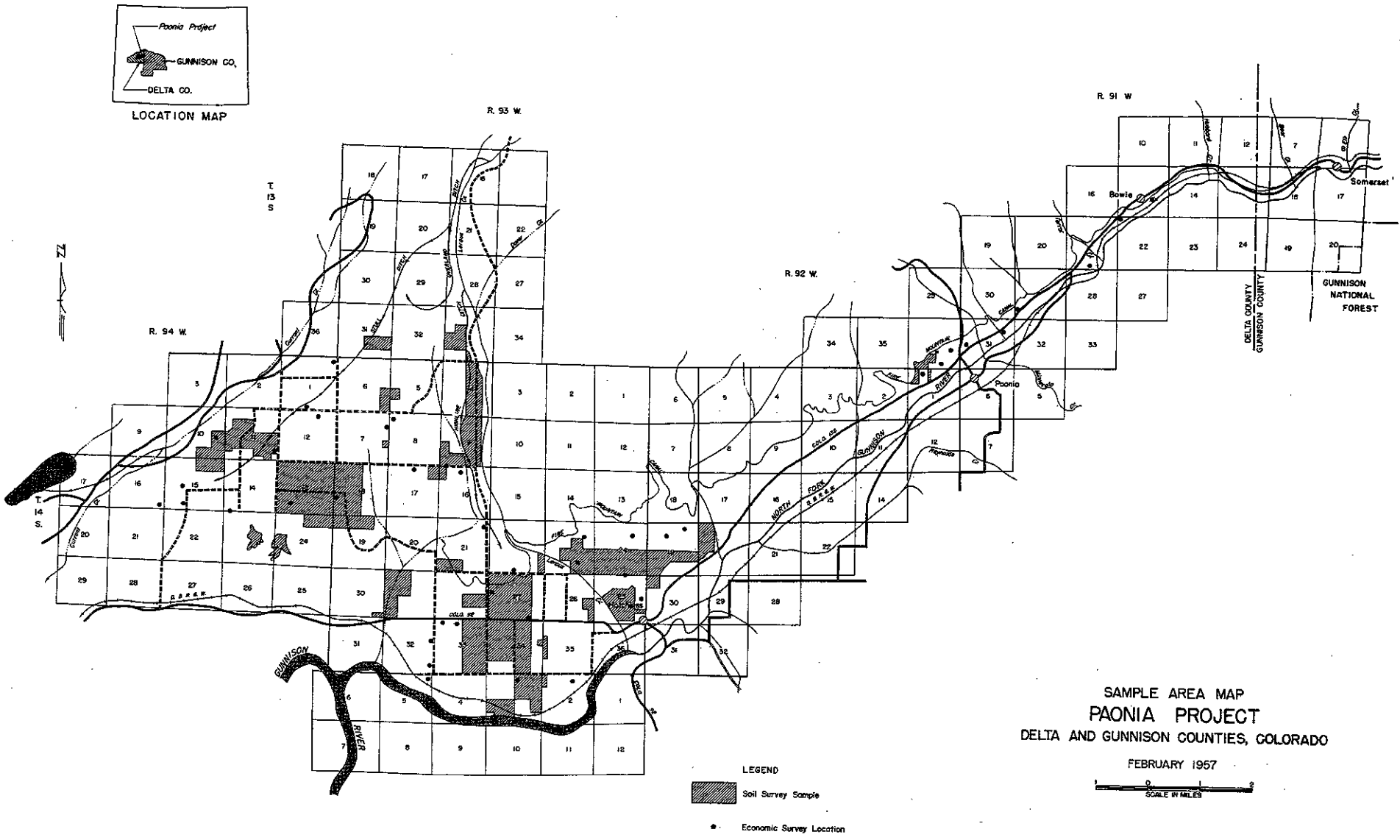
EVALUATION OF DIRECT AGRICULTURAL BENEFITS TO BE EXPECTED FROM PAONIA PROJECT

This report is based on field data, published reports, and on the combined judgment of agricultural technicians familiar with the project area and its agricultural problems and conditions.

Preliminary project reports, land classification maps and field sheets, field investigations, and other data collected by the Bureau of Reclamation have been used to acquaint technicians with present conditions and proposed developments.

The above information was used to augment soil surveys, field investigations, engineering surveys, crop yield determinations, and irrigation water investigations by members of the Field Party as well as local representatives of the U. S. Forest Service, Soil Conservation Service, Agricultural Research Service, and Bureau of Reclamation.

In addition, assistance from representatives of the Colorado Cooperative Extension Service, Colorado Agricultural Experiment Station, Farmers Home Administration, state and county Agricultural Stabilization and Conservation Committees, Bureau of Land Management, and others have been valuable in preparing the report.



SAMPLE AREA MAP

PAONIA PROJECT

DELTA AND GUNNISON COUNTIES, COLORADO

FEBRUARY 1957

SCALE IN MILES

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE M-1197

7-S-17186-N

Soils Inventory

General Soils Description

Soils survey data for this study were obtained from farm-to-farm conservation surveys made by the Soil Conservation Service cooperating with the Delta Soil Conservation District. The total of surveyed farms is 5,274 acres which is 16 percent of the gross acres in the project. Distribution of the surveys and percentage sample is considered adequate in this area. In addition to these data, the Bureau of Reclamation land classification survey field sheets, tabulated survey data, and 1951 report of the Paonia Project were used as reference material.

Soils of the irrigated and potentially irrigable areas in the project are on high mesas north of the North Fork of the Gunnison River. These mesas have a general slope of about 3 percent toward the south. They are dissected by numerous shallow drainageways and an occasional deep, steep-sided drainageway. Topography is gently undulating-to-rolling and land leveling is a prerequisite to controlled application of irrigation water.

Origin of the soils on these mesas has not been precisely determined but they appear to be glacial till with water-modified loessial material. Their uniformity in color and texture are typical of the loess soils farther south.

Soils are relatively homogeneous as expressed by uniform texture and size of stones through the profile. Variations exist in depth to the lime layer and degree of stoniness. These soil variations do not alter the productive capacity of the soil. Soil problems common to the project are stoniness, uneven topography, fertility maintenance, and erosion.

Basaltic stones are found throughout the soil profile, increasing with depth. Removal of the stones is an expense required to make land suitable for cultivation and harvesting of annual crops.

A zone of high lime accumulation is associated with these stones at a depth between 18 and 30 inches. However, roots extend through the lime layer and apparently water penetrates with little difficulty.

Much of the land is undulating and uniform water application is difficult until it is leveled. Occasionally land leveling cuts will expose the high lime layer which ties up phosphorous needed for plant development. However, heavy applications of manure for several years on the exposed lime layer will restore it to a high level of production.

Soil organic matter is low and special care is needed to maintain soil fertility. Nutrients available to crops are reduced by high crop production under irrigation, leaching through the solum, tie-up of phosphorous in highly calcareous soils, and soil erosion. The fertility level, however, may be kept high through proper crop rotations, green manure, and commercial fertilizer accompanied by proper irrigation water management.

Soil erosion is evident, particularly on the steeper slopes, where clean tilled irrigated crops are grown. Such erosion may be controlled by close-growing erosion-resistant crops, land leveling, careful irrigation water application, and use of cover crops in orchards.

Drainage has not presented a serious problem to-date. Only 254 acres affected by high water table and salinity were mapped in the project area. These areas are primarily confined to the shallow drainageways.

Land Capability Classification

The U. S. Department of Agriculture grouping of soils into land capability classes recognized seven classes: I, II, III, IV, VI, VII, and VIII. Classes I, II, and III are suitable for irrigation and growing of all climatically adapted crops provided certain land treatment is applied. In this project class IV is suitable for irrigation but should be used for close-growing crops or orchard. Classes VI and VII are best suited to range or woodland use and class VIII is suitable only for recreation or wildlife. 1/

Projected acreages from the soil survey sample are given in the following table for land capability classes I through IV.

Table 1.- Projected acreages of soil inventory, Paonia project.

Land capability classes	Gross acres	Net acres 1/
I	15	14
II	4,984	4,585
III	12,067	11,102
IV	10,075	9,269
Total	27,141	24,970

1/ Net acres after an 8 percent reduction for roads and farmsteads.

Because of the homogeneity of soils, there is little difference in the potential productivity of land capability classes I through IV; however, the classes do reflect changes in the slope or potential erosion hazard. Changes in slope require different degrees of land treatment and management to protect against soil erosion and insure long-continued farming under irrigation.

1/ Hockensmith, Roy D. "Classification of land according to its capability as a basis for a soil conservation program", 1949

Lands considered suitable for cultivation include new land with temporary limitations of uneven topography, stones, brush, or trees. With these limitations removed, this land will have the same productive capacity of presently irrigated lands under similar management.

Findings

Based on the U.S. Department of Agriculture survey of a representative sample of soils in the project area, it is concluded that there is ample acreage of land suitable for cultivation, under irrigation, to provide the 12,280 acres of presently irrigated land and 2,100 acres of new land for which the Bureau of Reclamation plans to supply irrigation water.

Land Improvement and Development

Sources of Data

A considerable amount of land development and improvement has been accomplished on project lands over the years. However, little information, adequate for conversion to present-day values, is available concerning the early development costs within the area. The principal source of information, adequate for the study, has been records of the Delta Soil Conservation District. Additional information was gathered from other agencies and technicians working in related activities within the area. Some data have been obtained from existing topographical and other maps and surveys. While the amount of available information has been limited, it is fairly detailed and is generally representative for the area. Land development and improvement cost estimates are based on the composite index for construction included in the U. S. Department of Agriculture pamphlet "Agricultural Price and Cost Projection" published in June 1956.

Analysis of Data

Project plans estimate the development of 1,410 acres of new land on the Fire Mountain Division and 690 acres on the Leroux Creek Division. Soils inventory data indicate that these new lands will probably be in land capability classes III and IV. An estimated distribution based on the selection of the best available lands first gives an acreage in these classes of about 800 acres in class III and 1,300 acres in class IV. Cost estimates for the new lands are based on this distribution.

Most of the new lands probably will be developed in conjunction with present farms. They will frequently be adjacent to existing fields and, in many cases, after development, they will be an integral part of these fields.

Costs of development work on new land probably will be higher than past costs for the same type of work over the project because the least difficult lands have already been developed and the generally small areas remaining will entail higher unit costs.

Land Clearing

All new lands in the project will require clearing and brush removal. Present cover ranges from a sparse growth of low sagebrush on the more level portions of Redlands Mesa to dense cover of mature juniper and pinon. There has been some clearing accomplished during recent years on or near the project. Costs of clearing new lands have been estimated by comparison with previously incurred costs for similar work.

Rock and Stone Removal

A great deal of work has been required to remove rock and stone from the cultivated lands. The new lands will, in all cases, require the removal of substantial volumes of rock and stone. Cost for this practice has been estimated on the basis of comparable costs incurred for similar lands nearby.

On Redlands Mesa during recent years rock removal costs have occasionally been $75 per acre or less. On the Fire Mountain Division some recent costs have been about $165 per acre with occasional small areas running near $300 per acre.

Land Leveling

Leveling will be required on new land to be irrigated and will constitute a major expense in the improvement of this land. It is defined as "the reshaping of land surface to a planned grade to permit uniform distribution of irrigation water without erosion or to provide necessary surface drainage." The operation does not necessarily imply the removal of all slope or gradient from the land surface but rather the elimination of surface irregularities which impair the uniform application of irrigation water.

Recent leveling operations within the project have required earthwork quantities as high as 1,300 cubic yards per acre for fields 3 acres in size. Earthwork requirements have varied from 500 to 700 cubic yards per acre on some leveling jobs ranging up to 30 acres in size. The average earthwork requirement for eleven leveling jobs recently completed on 133 acres, with technical assistance from the Soil Conservation Service, was 438 cubic yards per acre. These jobs were mostly on presently cultivated lands and, in general, required less earthwork than will be necessary on much of the new lands.

The class III lands to be developed will be suitable for general crops and will, in general, justify a higher degree of leveling than will class IV lands that are restricted to close-growing crops or orchard. Leveling for orchard use will often require less earthwork than leveling for general crops.

Farm Irrigation Systems

Farm irrigation systems must be developed for all new lands. There has been some development of farm irrigation systems on limited acreages of similar lands during the past several years. Most of this has been accomplished in accordance with cooperative agreements between farmers and the Delta Soil Conservation District and with technical assistance being furnished by the Soil Conservation Service.

For most new lands farm irrigation systems will be extensions or additions to the systems serving presently cultivated lands. Many farm irrigation systems serving presently cultivated lands, particularly those in classes III and IV, will require extensive improvement. Since the new lands are generally comparable and the farm irrigation system requirements are similar, costs for the new lands will be approximately the same.

Drainage

Most lands of the Paonia Project are on mesa tops and are physically so located as to minimize the development of drainage problems. Small areas of wet or seeped lands might develop in connection with the irrigation of new lands. This appears improbable, however, since the improved water supply should result in increased efficiency of water application and elimination of early-season over-irrigation. Development of isolated areas of perched water tables might occur but these would be small and necessary drainage could be accomplished as a part of the regular farm management operations.

No drainage costs are estimated in connection with the development of new land.

Improvement of Existing Farm Irrigation Systems

Existing farm irrigation systems are not efficient and considerable improvement is necessary before irrigation efficiencies can be increased. Ultimate development should include concrete or other lining for practically all canals, laterals, farm ditches, and the installation of permanent ditch structures. Technicians feel that development of these facilities to a high standard will be slow. Therefore, estimates are based on only moderate improvement of present installations.

In addition some farms will require larger structures, such as flumes, drops, or dividers. Each will present special problems and will be designed to meet the needs of the specific situation. No attempt, therefore, has been made to estimate over-all requirements for these special structures.

Findings

Weighted average per-acre estimates of costs for development of new lands are given in table 2. Also included is the weighted average estimated cost for improvement of existing farm irrigation systems serving presently cultivated lands to obtain optimum benefits from project development.

Table 2.- Weighted average development costs per acre, Paonia project. 1/

Item	New lands 2/ 3/	Presently cultivated lands 4/ 5/
	Dollars	Dollars
Clearing	19	--
Rock and stone removal	150	--
Leveling	98	--
Irrigation systems	14	12
Total	281	12

1/ Excluding drainage.
2/ For the 2,100 acres of new lands, initial development costs for the economic study have been estimated at 50 percent of this potential investment required for optimum development. It is assumed that this degree of development would be roughly comparable to the existing development status of the lands in the project now being irrigated and so furnish a realistic basis for economic evaluation of the project benefits with new lands and presently irrigated lands assumed to be at about the present level of development.
3/ 2,100 acres.
4/ 12,280 acres.
5/ Potential costs of needed or desirable improvements not directly related to project development and not required in the economic studies are treated separately in the following section.

Additional Improvement of Presently Cultivated Lands

Sources of Data

Farm-to-farm conservation surveys are available for a considerable acreage within the project area. The information from these surveys is directly related to the Technical Guide of the Delta Soil Conservation District. Bureau of Reclamation land classification survey sheets cover the entire project area and furnish detailed supplemental information. Direct inspection of field conditions and review with technicians familiar with the area have furnished additional basic data. Records of field work accomplished with assistance of Soil Conservation Service technicians assigned to the Delta Soil Conservation District have been used.

Analysis of Data

In their native state the project lands all had varying degrees of physical limitations, such as steep or undulating slopes, stoniness, etc., which restricted their full agricultural usage.

All presently irrigated lands have had considerable land development but additional improvement to a higher standard may be desirable to increase crop yields and irrigation efficiency. In the past the water supply has been so deficient during the critical part of the growing season that there was little inducement to bring the land to its maximum development. Experience on other irrigation projects shows that farmers on the Paonia Project can be expected to invest more money in increased land development after the water supply is adequate as to amount and seasonal distribution. Cost of the improved land treatment and management will be repaid in a few years by increased yields, decreased operating costs, or both.

The rate at which additional land improvement will be accomplished on lands now in cultivation is expected to be rather slow since most of these lands can now be irrigated after a fashion. Hence, for the purpose of the economic study, the yield estimates for project lands have been based on the existing status of land development on the presently cultivated land with the improved water supply being the only variable producing crop yield differences. Thus, no yield increases directly or solely attributable to land development or improvement of presently irrigated lands have been included in the economic evaluation. For the relationship of land development costs on new land, see footnote 2, table 2.

The following discussion of the requirements for the optimum development of presently irrigated lands is for the purpose of indicating the estimated cost of placing these lands in a condition to attain the most efficient use of the available land and water resources. If this development is carried out, the project would produce higher average crop yields and income than are obtained at the present level of development.

It should be noted that to facilitate the analysis of project benefits, which result principally from improvement in the water supply, and to provide a realistic basis for economic comparisons, only the present level of development has been used for the economic evaluation of the project. Increased crop yields and the additional land improvement costs that would result from a higher level of management and land improvement have not been used in the economic analysis.

Land Clearing

No additional land clearing will be required on lands that are now in cultivation.

Rock and Stone Removal

A considerable acreage in land capability classes II and III has had all necessary rock and stone removal work accomplished. The remaining acreage of presently cultivated lands will require varying amounts of additional work for complete development. Land in capability class IV has substantial amounts of rock and stone still remaining in practically all fields. In their present condition these fields are suitable only for orchard or pasture but with removal of the excessive rock and stone content, they may also be used for alfalfa and small grain.

Land Leveling

Leveling requirements and costs vary widely with soils and site conditions. Low farm incomes due to deficient and uncertain water supplies have precluded the application of this practice on most of the lands. Furthermore, adequate technical assistance in the on-site application of this practice has been available within the project area for only the last four years. As a result a substantial amount of land leveling is still needed on presently cultivated lands for optimum production.

A part of the acreage in all land capability classes has been more or less adequately leveled in the course of their initial development and can now be irrigated without additional leveling. However, more refined leveling with consequent greater investments can be economically justified for many of these lands by producing higher net returns resulting from better land and water management.

Drainage

The presently cultivated lands that have been mapped as requiring drainage are generally located along swales and drainageways that are lower than surrounding lands. Their present condition may in part be caused by comparatively shallow depths to underlying shales or other less permeable material at these sites.

The improved seasonal distribution of irrigation water under project operation may provide some correction of existing wet areas by elimination of excessive spring irrigation. There remains, however, the possibility of slight extensions of the boundaries of at least a portion of the presently wet areas due to the extended period of irrigation. Present indications are that the maximum area requiring drainage will not exceed 310 acres.

No unusual difficulties are anticipated in accomplishing any required drainage. Surface gradients are such that necessary drain outlets will be readily available. Several small drainage works have been installed in recent years in this general vicinity. On the basis of the costs of accomplishing these small projects, drainage costs on the lands of the Paonia Project have been estimated as follows:

Table 3.- Estimated drainage costs to obtain optimum crop production, Paonia project.

Estimated acres requiring drainage	Estimated cost per acre
310	$150

Farm Irrigation Systems

The farm irrigation systems on presently cultivated lands are generally at a low level of development and will require substantial improvement to meet project operating conditions. They have, therefore, been included in the previous section of this report dealing with development costs.

Findings

Present farm irrigation systems and land development and improvements are below the standard necessary to obtain optimum crop production and the most efficient use of irrigation water. Average per-acre costs associated with the needed and desirable additional improvement of existing croplands to attain the most efficient use of available land and water resources are as follows:

Table 4.- Average improvement costs per acre to obtain optimum crop production and use of irrigation water, Paonia project. 1/ 2/

Item	Presently cultivated lands 3/
Clearing	$ 0
Rock and stone removal	45
Leveling	20
Total	65

1/ Weighted average
2/ Excluding drainage
3/ 12,280 acres

Irrigation Requirements

Sources of Data

A number of studies have been made of irrigation requirements in the general vicinity of the Paonia Project. Among the most intensive and complete are "Consumptive Use and Irrigation Water Requirements of Crops in Colorado" by Harry F. Blaney and Wayne D. Criddle and appendix B of the Record of the Upper Colorado River Basin Compact Commission. Additional related information is contained in the water supply papers of the U. S. Geological Survey, Climatological Data of the U. S. Weather Bureau, and "Colorado Heat and Moisture Indexes for Use in Land Capability Classification" by the Soil Conservation Service. These reports and others have been carefully reviewed and abstracted for the purpose of this study. In addition, information has been supplied by technicians of the Agricultural Research Service, Colorado Agricultural Experiment Station, Colorado Cooperative Extension Service, Colorado Agricultural and Mechanics College, Bureau of Reclamation, Soil Conservation Service, and others familiar with the area.

Analysis of Data

The lands of the Paonia Project have been supplied with irrigation water from two sources: (1) The North Fork of the Gunnison River, the unregulated flow of which was diverted as required or available and delivered to the original Fire Mountain Canal service area, and (2) Leroux Creek, with some storage of spring flows, which served the remainder of the area, including Rogers and Redlands Mesas and the Leroux Creek Valley.

The rate of flow in the North Fork is subject to wide fluctuation throughout the irrigation season, varying from excessive floods during the spring snowmelt season to a mere trickle during the late summer. The same is true of Leroux Creek despite construction by the farmers of a number of small storage reservoirs in an attempt to equalize seasonal flows. The situation has resulted in substantial over irrigation, during the spring when water was available, in a vain attempt to offset the severe deficiency in water supply occurring during the latter part of the irrigation season.

Using the available records, covering the years 1934-53, an analysis by inflow-outflow consumptive use methods, based on normal water demand and eliminating excessive irrigation during the spring period, shows that without the project the average shortage occurring in years of deficient water supply would be 41 percent of the requirements for lands in the Leroux Creek Division. For lands in the Fire Mountain Division the shortage would be 51 percent of requirements.

The project plan proposes the construction of the Paonia Reservoir on Muddy Creek, a tributary of the North Fork, which would partially equalize the flows on this stream and substantially augment the late-season irrigation water supplies. As a consequence of the stream flow regulation and availability of adequate late-season water, most of the Rogers Mesa area would receive its irrigation supplies through an extension of the enlarged Fire Mountain Canal. The water heretofore delivered to this part of Rogers Mesa from the Leroux Creek system would then be available for redistribution to the remaining users on that system and would be sufficient to meet their irrigation requirements. In the process sufficient water would be made available to supply an estimated additional 1,410 acres on the Fire Mountain Division and 690 acres on the Leroux Creek Division of land not previously irrigated.

Consumptive use requirements for the principal crops grown in the area have been estimated by the Blaney-Criddle procedures. Effective growing season precipitation has been estimated at 85 percent of the average for the lowest five-year period of record, or 3.28 inches, in accordance with accepted Bureau of Reclamation standards. Based on probably future crop distribution, the resulting average seasonal consumptive use requirements for the two divisions of the project are shown in table 5.

Table 5.- Consumptive water requirements, Paonia project 1/

Crop	Leroux Creek Division		Fire Mountain Division	
	Percent or area	Net seasonal consumptive use requirements	Percent of area	Net seasonal consumptive use requirements
		Inches		Inches
Alfalfa	36	25.1	33	26.1
Pasture	18	21.7	17	22.6
Corn	21	15.9	12	16.6
Small grain	13	11.0	12	11.6
Orchard	12	17.2	26	17.9
Weighted average requirement per acre		19.8		20.5

1/ Effective precipitation has been subtracted.

Farm irrigation efficiencies are affected by several factors, including method of delivery of water, amount of water or size of stream, condition of farm irrigation system, etc. The principal sources of water loss resulting in lowered farm irrigation efficiencies are: (1) seepage from farm ditches and laterals, (2) waste or tail-water not reused on the farm, (3) deep percolation, and (4) increased evaporative losses from unduly light and frequent irrigations.

Farm irrigation efficiencies on the Paonia Project have not been extensively studied. They are generally recognized as being rather low. Drastic changes in the pattern of water delivery will occur when the project is completed and the improved water supply is available. It is estimated that under these conditions irrigation application will approximate 3 to 4 inches on the field--varying somewhat with the crop, its degree of maturity, and other considerations. Applications of these amounts can be made in the area with maximum efficiencies.

Experience elsewhere indicates that under climatic, soil, and water supply conditions similar to those of the Paonia Project, total losses would be about 40 to 45 percent of the water delivered at the farm headgate. An approximate average of 43 percent losses would make the over-all farm efficiency 57 percent.

Obviously this degree of water application efficiency will not be attained immediately. Considerable improvement of the farm irrigation systems and supply laterals will be necessary to eliminate excessive losses and permit better control of the water. Improved methods of irrigation water application will have to be adopted by the farmers in order to improve existing efficiencies to this degree. These improvements in irrigation facilities and water management on the farm will proceed

slowly--probably over several years. This should not impair the adequacy of the water supply which the project will provide because development and irrigation of the 2,100 acres of new lands probably will proceed at about the same pace. By the time the new lands are in position to use all water allocated to them, the supplemental water allocated to presently irrigated lands should be adequate for their irrigation needs. Table 6 gives a summary of the project water supply requirements.

Table 6.- Summary of irrigation water requirements, Paonia project.

	Leroux Creek Division	Fire Mountain Division
	Acre inches per acre	Acre inches per acre
Weighted average consumptive use requirements from table 5	19.8	20.5
Farm losses at 57 percent efficiency	14.9	15.5
Weighted average delivery requirements at farm headgate	34.7	36.0

On the basis of inflow-outflow consumptive use studies, the Paonia Project will provide adequate irrigation water for the lands it is proposed to serve. Table 7 gives a summary of the water supply without the project and as it would be for the same runoff conditions with the project. Since the lands of the Rogers Mesa area have previously received their water supply from Leroux Creek but will be under the Fire Mountain Division of the project, the acreages represented "before project" and "with project" are dissimilar and not directly comparable.

The wide variations in yearly runoff in streams comprising the water source for the project will occasionally result in periods when total runoff will not provide storage water sufficient to meet irrigation requirements. Hence, there will remain an apparent minor average supply deficiency. There would be an actual water supply deficiency under project operation in only 27 percent of the years comprising the runoff record. In the years of maximum deficient runoff, the water supply under project operation will be improved to approximately equal to the average water supply for all years without the project.

Table 7.- Summary of water supply deficiencies without and with the project, Paonia project. 1/ 2/

	Minimum annual deficiency in water supply	Average water supply deficiency over period of record	Maximum water shortage in years of deficient runoff
	Percent	Percent	Percent
Leroux Creek Division			
Without project	4/ 0	29	47
With project	3/ 0	5	29
Fire Mountain Division			
Without project	10	26	62
With project	3/ 0	2	31
Increase in water supply for Fire Mountain Division lands with project 5/	4,100 acre feet	9,600 acre feet	12,700 acre feet

1/ Based on water supply records of years 1934-53, inclusive.
2/ At farm headgate.
3/ 73 percent of the years.
4/ Indeterminate from available data. Apparently zero percent.
5/ Reflects changes in source of water supply for Rogers Mesa area from Leroux Creek to Fire Mountain Division.

Extension of the cooperative snow survey and water supply forecast program in the area and operation of the reservoir and adjustment of farm cropping plans in accordance with the resulting forecasts of stream flow, would help to further minimize the effect of future runoff deficiencies.

Findings

Based on average consumptive use requirements, estimated crop distribution patterns, and attainable farm irrigation efficiencies, the water supply needs at the farm headgate are 34.7 acre inches per acre on the Leroux Creek Division and 36 acre inches per acre on the Fire Mountain Division. The Paonia Project facilities will meet these requirements by providing approximately 8.5 acre inches per acre of additional water at the farm headgate for late-season irrigation on the 12,280 acres of presently cultivated lands and by providing approximately 35 acre inches per acre for full-season irrigation of the 2,100 acres of proposed new lands. Table 8 summarizes the average improvement in water supply on each division as a result of project operation.

Table 8.- Water supply increase at farm headgate, Paonia project.

	Presently cultivated lands	New lands
	Inches	Inches
Fire Mountain Division average	9	35.5
Rogers Mesa	12	35.5
Leroux Creek Division	8	34.2

Projected Agricultural Economy

The present agricultural economy and its physical resources are basic to projections in an area where most of the land proposed to receive project water is already under irrigated crop production. Thus, data regarding the Paonia area, as now constituted, will comprise the primary basis of the analysis of agricultural incomes and direct agricultural benefits. Various projections and estimates will be related in each instance to findings about the existing agriculture.

Projections are based also on important assumptions about economic and physical conditions. The more significant of these assumptions will be described as the analysis proceeds. It is emphasized that forecasts are not being made. Rather, estimates are made within the framework of certain assumptions.

Sources of Information

A leading source of data for the economic analysis is information compiled from a sample of 43 farms and farm families in the Paonia area. These data were collected jointly by Department of Agriculture and Bureau of Reclamation economists. Other economic and production data were collected by the USDA Field Party from many sources and informed individuals. Findings of surveys on soils and irrigation resources and needs are fundamental and have been utilized to the extent feasible. A meeting of Colorado A & M College specialists and representatives of Federal agencies contributed substantially to projections of crop yields and land use patterns. Some information on farm numbers and acreages was gathered in complete coverage of subareas and the total project. Numerous research studies and published reports have been utilized as sources of information, especially in arriving at input figures.

Objectives of the Analysis

Two general, related objectives are set forth. The first is to estimate or project farm and family incomes with the proposed water development. These estimates are made for various combinations and arrangements of resource control and use. This analysis serves as the basis for achieving the second objective and for appraising the prospects for a successful, stable irrigated agriculture under the proposed water development.

The second objective is to estimate the direct agricultural benefits expected from development of additional water. This estimate will be made by comparing incomes expected with additional water and incomes expected with the present water supply.

Types of Farming

Three main farm types of full-time family farms occur on the Paonia Project. These types are fruit, fruit-general, and general. Relatively large numbers of part-time farms and small farms operated by persons in retirement status also prevail.

The sample of 43 farms served as the chief basis of the analysis. The general-type group includes 23 farms and the other two types each contained 10 farms. This sample included 25 percent of the total land now irrigated. Part-time farms and several extremely large farms were not included in the sample. Also, the 43 sample farms are not all full-time farms under the usual definition. Several farmers in this group work off their farms and other farmers in the group are not fully employed throughout the year.

These three farm types are concentrated by areas, to a large extent. This situation arises mainly because of climatic influences. Thus, a given farm type and land use essentially cover a particular geographic portion of the project. In turn, soil investigations indicate the soils are relatively homogeneous with respect to crop productivity and adaptability.

Primarily as a result of the above considerations, the analysis to follow centers around three farm types and a common set of yields. At one extreme, fruit areas and farms are almost entirely in fruit production--peaches, cherries, and apples. The other extreme is areas and farms where only general extensive crops are produced.

Land Use

The 43 sample farms averaged 60 acres of general irrigated cropland and 10 acres of fruit per farm. This land was mostly owner-operated. Fruit farms averaged 21 acres of fruit and 5 acres of general cropland (table 9). Fruit-general farms had 17 acres of fruit and 56 acres of general cropland. The general farms produced virtually no fruit; they contained 91 acres of irrigated land used for extensive crops.

On the basis of the above cropping pattern, data on Bureau of Reclamation land classification sheets, and other sources, total land use was projected without and with the project. Irrigated crop production now

utilizes 12,280 acres (table 10). Plans include the development of a water supply to meet adequate water requirements for 2,100 additional acres so that 14,380 acres could be fully irrigated with the project, except for infrequent years of water shortage. Present and projected land use patterns by farm type for presently irrigated and new lands are shown in table 10.

Table 9.- Selected size and type of data per farm for 43 farms surveyed, Paonia project, 1956

Item	Unit	Farm type		
		Fruit	Fruit-general	General
Farms	Number	10	10	23
Cropland	Acres	26	73	92
Fruit	Acres	21	17	1
Other irrigated	Acres	5	56	91
Dairy cows	Number	1/ 0	2/ 5	2/ 9
Beef cows	Number	0	3/ 14	3/ 21
Ewes	Number	0	4/ 6	4/ 76

1/ Less than 1.
2/ 7 and 19 farms, respectively.
3/ 7 and 5 farms, respectively.
4/ 3 and 7 farms, respectively.

Table 10.- Projected land use without project water and with project water, by types of farming, Paonia project 1/

Item	Fruit		Fruit-general		General		Total project	
	Without	With	Without	With	Without	With	Without	With
	Acres							
Presently irrigated land								
General crops	222	148	2,047	1,780	7,209	7,836	9,478	9,764
Fruit	1,196	1,329	920	1,187	0	0	2,116	2,516
Idle	59	0	0	0	627	0	686	0
New land	0	125	0	670	0	1,305	0	2,100
Total	1,477	1,602	2,967	3,637	7,836	9,141	12,280	14,380

1/ Without - Essentially present land use.
With - New land use assumed same cropping pattern as for old land.

Size and Type of Farms

Fruit farms have virtually no livestock (table 9). On other farms livestock comprise small enterprises, except for about 15 grade-A dairies and about 36 beef and sheep units with public grazing permits. A cream-base dairy and a cash-crop farm have been selected to represent the fruit-general farms. On the general farms, the projected budgets are based on a beef cattle enterprise and a grade-A dairy.

On the basis of all fruit-general farms, it was concluded that the size of fruit-general farms in the sample is probably larger than the average for the area. The fruit farms have only sufficient acreage in general crops to fit a program of new plantings of fruit. The ratio between bearing and nonbearing fruit acreage is about 5 to 1.

Without additional water, marked changes in land use and size are not expected. Some increase in farm size undoubtedly would occur in all three farm types. The greatest enlargement, however, would probably be in the general farm category.

With a full water supply, an increase is expected in fruit acreage. On many farms, some land now idle would be irrigated, thus, effectively enlarging farm size.

Fruit production is restricted to certain areas by climatic conditions. The fruit-type farms are located in areas with the best air drainage where cherries and peaches can be produced successfully. The fruit-general farms are usually in areas of less favorable climate for peaches and sweet cherries so that the main fruit grown is apples.

Projections of average farm size or cropland by type on presently irrigable land--both without and with additional project water--are 27 acres on fruit farms, 60 acres on fruit-general, and an average of 100 acres on general farms (table 11). This reflects an estimated shift to more fruit and an increase in cropland.

Projected numbers of farms would be 57, 54, and 85, respectively, by types. This total of 196 farms is based on present irrigable land (table 11).

Table 11.- Projected farm size and general cropping pattern, by farm type, Paonia project

Item	Fruit		Fruit-general		General	
	Without project	With project	Without project	With project	Without project	With project
	Acres					
Total	27	27.0	60	60	100	100
Fruit	20	21.5	17	22	0	0
Other crops	4	3.5	38	35	85	92
Idle	1	0	2	0	7	0
Farmstead	2	2.0	3	3	8	8
	Number		Number		Number	
Farms	57		54		85	

Production Rates

Due to the homogeneity of soil productivity, only one set of yields was considered. Yields on the 43 sample farms were supplemented with estimates by several leaders in the area, specialists of Colorado A & M College, and census data.

Projected crop yields without and with the project are shown in table 12. Estimated average yields for general crops, even with a full water supply, are comparatively low. However, it appears that the increase in production with additional water would be substantial for most general and fruit crops. This differential, of course, is significant to the estimate of direct benefits expected from the project.

A rate of 275 pounds of butterfat per cow was assumed for sweetcream enterprises and a rate of 300 pounds was assumed for grade-A dairies. The annual output of beef was assumed to be 632 lbs. per breeding cow. A lamb crop of 120 percent and a wool crop of 10 pounds were assumed.

Table 12.- Estimated projected yields used in analysis, without and with project, Paonia project

Crop	Unit	Without project	With project	Increase
Alfalfa	Ton	2.8	3.8	1.0
Rotation pasture	AUM	4.0	7.0	3.0
Barley	Bu.	50.0	55.0	5.0
Corn silage	Ton	9.0	13.0	4.0
Corn grain	Bu.	50.0	65.0	15.0
Apples 1/	Bu.	380.0	430.0	50.0
Peaches 1/	Bu.	190.0	230.0	40.0
Cherries, sweet 1/	Ton	2.8	3.0	0.2

1/ Marketable fruit.

Projected Prices

The income analysis is based on "Agricultural Price and Cost Projections" developed by the U. S. Department of Agriculture. These projections were published in June 1956 for official use by this Department in benefit-cost and repayment-capacity analyses. The projected prices are based on "relatively high employment, a trend toward peace, continued population and economic growth, and a stable general price level."

The national long-term projected index of prices received for all farm commodities is 235, base period 1910-14. A comparable index is 265 for prices paid, including interest, wages, and taxes.

The level of projected prices for the Paonia Project is indicated by specific prices used in the analysis (table 13). Many cost items on the projected basis are similar to those paid during the 1953-55 period. Seasonal projected prices for fruit in Colorado are somewhat less than farmers have received the last 5 years. Prices received vary somewhat more than prices paid in terms of the last several years.

Table 13.- Long-term projected prices received, Paonia project

Item	Unit	Prices
		Dollars
All hay, baled	Ton	--
Alfalfa	Ton	21.00
Barley	Bu.	.98
Corn grain	Bu.	1.40
Corn silage	Ton	7.50
Apples 1/	Bu.	2.05
Peaches 1/	Bu.	2.40
Cherries, sweet 1/	Ton	275.00
Butterfat	Lb.	.58
Market milk (b.f.)	Lb.	2/ 1.14
Fat steers	Lb.	.21
Fat heifers	Lb.	.20
Slaughter hogs	Lb.	.18
Cull dairy cows (1,200 lbs.)	Lb.	.10
Cull beef cows (1,000 lbs.)	Lb.	.12
Lambs	Lb.	.20
Wool	Lb.	.48
Cull ewes	Lb.	.06

1/ Seasonal prices, including container.
2/ Includes $0.08 allowance for use of tank.

Some Other Assumptions

Farm budgets require many kinds of input and price information. Labor requirements, machinery and building needs, land investment, feed requirements, and other data are needed. Research in similar irrigated areas has been relied on heavily for this information. It has been supplemented by information obtained locally. Prices received and expense rates were also obtained in the Paonia area. A large portion of the prices and inputs used in the budgets is shown in tables 14 to 17, inclusive.

An opportunity-cost approach has been used as the basis of the return allowed for operator and family management and labor. That is, an attempt is made to evaluate operator and family management and labor in the same manner as other resources.

In addition to return to management and labor, farm families will have a return on their equity in the farm. Many families will also have nonfarm income. Out of all sources of income, families must obtain or provide cash living expenses, farm privileges (considered as farm income), a residence, savings, income taxes, social security taxes, and other living needs.

Table 14.- Estimated prices paid for goods and services used in production, Paonia project

Item	Unit	Price
		Dollars
Seed		
Alfalfa	Pound	.30
Pasture	Pound	.30
Corn	Pound	.17
Young trees		
Apples (80 trees)	Each	1.00
Peaches (108 trees)	Each	1.00
Cherries (80 trees)	Each	1.00
Labor	Hour	1.00
Custom and contract hire		
Baling and raking		
Hay	Ton	6.25
Straw	Ton	8.00
Combining grain	Acre	7.00
Chopping corn	Hour	8.00
Hauling corn	Hour	3.00
Picking corn	Hour	8.00
Shelling corn	Bushel	.06
Spraying fruit		
Apples	Acre	95.00
Peaches and cherries	Acre	15.00
Thinning fruit		
Apples (chemical)	Acre	40.00
Peaches (hand)	Acre	40.00
Picking fruit		
Apples	Bushel	.13
Peaches	Bushel	.18
Cherries	Pound	.033
Marketing fruit 1/		
Apples	Bushel	1.00
Peaches	Bushel	.65
Cherries	13# lug	.70
Veterinary	Per cow	3.00
Artificial insemination	Cow and heifer over 1 yr.	7.00
Breeding fee	Brood sows	3.50
Cow death loss	Per cow	6.00

Based on price projections by the U. S. Department of Agriculture released in 1956

1/ Sorting, sizing, brushing, grading, packing, container, loading, handling, and selling.

Table 15.- Estimated new cost, repairs and service life of farm equipment, Paonia project

Item	Description	Cost	Annual repairs 1/	Service life 2/
		Dollars	Percent	Years
Tractor		2,450	1¼¢ hour	10
Truck	1 ton, dump-hoist	2,450	5.0	10
Plow	2 x 14" tumble	3/ 549	5.0	16
Disk	Offset	300	5.0	15
Grain drill	10'	3/ 314	2.0	16
Harrow	3 section	3/ 196	1.0	15
Sprayer	Barrels and pump	148	2.0	10
Corrugator	Shovels	10	0.0	10
Tool bar	Attachment bars	88	1.0	10
Feed grinder	10"	98	3.0	15
Mower	7'	323	3.0	10
Siderake	Custom hire			
Baler	Custom hire			
Manure spreader	75 bu.	3/ 274	3.0	15
Land leveler	Eversman	3/ 196	2.0	20
Ditcher & diker		3/ 108	2.0	20
Manure loader		3/ 279	3.0	15
Milking machine	2 units	425	6.0	15
Milk cans		10	1.0	10
Separator	75 gal. hr.	181	2.0	15
Electric fence control		25	5.0	11
Low boy trailer		98	1.0	20
Fruit picking equipment	Bags, boxes, ladders	350		
Other equipment used on larger farms				
Baler PTO	"55"	2,360	5.0	12
Chopper PTO	w/corn head	1,960	3.0	10
Wagons (2)	w/attachments	500	1.0	20
Rake	Side delivery 7'	473	3.0	15
Small tools 4/				

Cost is based on projected prices by the U. S. Department of Agriculture released in 1956.

1/ Percentage of new cost.
2/ Based on a straight line depreciation and with a salvage value of 10 percent.
3/ 50 percent ownership.
4/ 5 percent of new cost, except tractor and truck.

Table 16.- Total projected man, truck, and tractor hours per unit of crops and livestock, Paonia project 1/

Item	Without project water			With project water		
	Man hours	Tractor hours	Truck hours	Man hours	Tractor hours	Truck hours
Crops						
Alfalfa	13.5	5.6	2.2	15.5	5.6	2.6
Rotation pasture	4.5	1.5		8.1	1.5	
Barley	12.0	6.3	.5	12.0	6.3	.5
Corn silage	15.0	8.1	3.0	19.8	9.3	4.0
Corn grain	12.7	6.6	1.1	16.8	7.3	1.5
Apples 2/	156.8	19.6	10.0	167.4	20.8	10.0
Peaches 3/	133.2	16.4	4.0	141.8	15.6	4.0
Sweet cherries 3/	241.8	14.4	5.0	255.4	12.6	5.0
Nonbearing fruit 4/	24.8	4.1	.9	27.1	4.2	.9
Livestock						
Dairy cows (Grade A) 5/	110.0			105.0		
Dairy cows (other) 5/	120.0			120.0		
Beef cows 5/	11.0			11.0		
Fattening steers 6/	10.0			10.0		
Fattening heifers 6/	10.0			10.0		
Brood sows 7/	60.0			60.0		
Ewes	6.0			5.0		
Miscellaneous						
Overhead	5.0 percent of total crop and livestock labor					
Hauling manure	0.4 hour per ton of manure					
Fence repair 8/	4.0 hours per 100 rods of fence.					
Machinery repair 8/	0.5 hour per $100 of machinery inventory					

1/ Crop yields are shown in table 12.
2/ Does not include chemical thinning, spraying, and marketing.
3/ Does not include spraying and marketing.
4/ Does not include pushing over old trees nor setting out young ones.
5/ Includes replacement stock. Based on use of tank for hauling milk.
6/ 200 days feeding period.
7/ Includes sow and 7-pig litter.
8/ Man-hours only.

Table 17.- Livestock feed requirements, Paonia project

Item	Total animal units 1/	Total digestible nutrients	Source		
			Forage 2/	Grain 3/	Other
	Number	Number	TDN	TDN	TDN
Dairy cow					
(1,200 lbs-300 bf)	1.35	6,921	6,471	450	
(1,200 lbs-275 bf)	1.27	6,471	6,471		
Dairy heifers					
over 1 year	.74	3,800	3,800		
Dairy heifers					
under 1 year	.37	1,900	1,487	300	4/ 113
Beef cow 5/					
(1,000 lbs)	1.00	6/ 5,110	5,110		
Beef heifers					
over 1 year	.50	6/ 2,555	2,555		
Beef bulls	1.00	6/ 5,110	5,110		
Fattening steers 7/	.50	2,500	1,000	1,500	
Fattening heifers 7/	.50	2,500	1,000	1,500	
Brood sow 8/	.38	1,800	800	900	200
Slaughter hogs 9/	.11	515	80	315	120
Breeding ewe	.26	1,331	1,172	159	

1/ One animal unit equals 5,110 TDN or 14 TDN per day.
2/ Alfalfa equivalent. Assumes 50 percent TDN and 10 percent loss in harvesting and feeding. This is 420 TDN per AUM plus 10 percent loss.
3/ Total digestible nutrients calculated as 75 percent.
4/ 700 lbs. whole milk or equivalent.
5/ Includes cow and calf to weaning age.
6/ 50 percent of feed from forest permit and field residue.
7/ Fattening beef calves, 200 days.
8/ Includes sow and 1½ 7-pig litters to 40 pounds.
9/ Includes hogs and gilts, 160-pound gain.

Projected Agricultural Incomes

Incomes have been estimated first with the project for five farm types and sizes. Later these incomes will be compared with projected incomes for the same budgets without additional water as a basis for estimating direct agricultural benefits. "Expected" rather than what "ought to be" is the concept used in making these estimates.

Methodology

The farm budget approach has been used. Typical farms were set up and net incomes estimated on the basis of projected prices and other assumptions.

The residual approach is customarily used to determine an average return or benefit to irrigation water. The total income is allocated among various claimants, with water being the last claimant in terms of a return. In the budget analysis for supplemental water, the residual is a return to family labor and management and to irrigation water. An estimate of net benefits is derived by deducting the value of additional labor from the difference in net return between the with and without budgets.

Some details of the several projected budgets can be observed in table 18. The narrative is restricted largely to results associated with each budget or farm.

The Projected "With" Budgets

Estimates of incomes that can be expected under the assumed conditions have been made for a fruit farm, two fruit-general farms, and two general farms (table 18). The three main types have been described in terms of the projected cropping patterns. Variations within the three cropping patterns depend on kinds of livestock and whether crops are sold or fed. These projected budgets and farm types are realistic in terms of the area and probably will occur in significant numbers. But the incomes for these budgets are not necessarily representative of a projected income of the entire project. Additional analysis, especially with reference to other sizes of farms within types, would be essential for estimating the total farm income for the project.

The fruit farm of 27 acres is almost entirely fruit. No livestock occurs on this farm. With a full water supply, 21.5 acres of fruit (cherries, peaches, apples) are grown.

Two 60-acre fruit-general farms raise 22 acres of fruit--all apples. These farms also have 35 acres of general crops which provide feed for dairy cattle or for sale. Milk is sold on a cream basis. There are 10 cows on the dairy farm.

Two farms shown under the general cropping pattern are based on a beef cattle enterprise and a grade-A dairy. It is expected that a beef cattle setup would contain a larger acreage than the average of all general farms. Thus, 120 acres comprise this farm compared with the average of 100 acres for the general-farm type and 80 acres for the dairy farm. The beef farm also includes a summer grazing permit on public land. Some of the beef calves are fattened on this farm.

Table 18.- Selected income, size, and organizational items from several projected farm budgets with a full water supply, Paonia project

Item	Unit	Fruit	Fruit-dairy	Fruit-general	General-beef	General-dairy
Total land	Acres	27.0	60.0	60.0	120.0	80.0
General crops	Acres	3.5	35.0	35.0	111.0	74.0
Peaches	Acres	5.0				
Cherries	Acres	5.0				
Apples	Acres	8.0	18.0	18.0		
Nonbearing fruit	Acres	3.5	4.0	4.0		
Farmstead, etc.	Acres	2.0	3.0	3.0	9.0	6.0
Total labor	Days 1/	369	526	378	342	358
Operator & family labor	Days	271	343	253	342	358
Investment:	Dollars	24,118	37,366	32,874	55,521	36,352
Irrigated land	Dollars	18,299	25,420	25,420	25,440	16,960
Bldgs. & imprvts.	Dollars	1,908	3,972	3,016	4,488	4,932
Machinery	Dollars	3,911	5,151	4,438	6,888	6,750
Livestock	Dollars	0	2,408	0	16,850	6,800
Other	Dollars	0	415	0	1,855	910
Receipts:	Dollars	14,316	19,037	18,697	10,648	9,869
Crop sales	Dollars	14,216	15,977	18,597	0	1,249
Livestock & products	Dollars	0	2,902	0	10,548	8,406
Other	Dollars	100	158	100	100	214
Expenses 2/	Dollars	10,071	15,420	14,681	4,737	4,682
Net farm income	Dollars	4,245	3,617	4,016	5,911	5,187
Interest 3/	Dollars	1,023	1,614	1,390	2,522	1,648
Net returns 4/	Dollars	3,222	2,003	2,626	3,389	3,539
Weight 5/	Percent	11	13	12	40	24

Based on price projections by U. S. Department of Agriculture released in 1956

1/ Ten-hour days.
2/ Excluding interest and irrigation water costs.
3/ At rates of 4 percent on land and 5 percent on other capital.
4/ Return to operator and family management and labor and to irrigation water, including O & M costs.
5/ Based on proportion of land in each cropping pattern.

Capital Investment

The total investment ranges from $24,000 for the fruit farm to $56,000 for the general-beef farm. The larger acreage of the general-beef farm more than offsets the much larger investment per acre for fruit land. The general-beef farm also has $17,000 investment in livestock. Operators of fruit-type farms own much less equipment than other farmers because it is customary to hire most of the needed equipment on fruit farms. Apparently it is not economical to own this equipment for small acreages of fruit. Interest on investment is substantial on these farms. On the general-beef farms, interest exceeds $2,500.

Receipts

The fruit-dairy and fruit-general farms have considerably greater gross income than the other-type farms. This results from a combination of fruit and dairy cattle enterprises. Gross income is around $19,000 on these farms. The fruit farm has gross receipts of $14,000. The general-beef and dairy farms have gross incomes of about $10,000 each.

Gross income from fruit is exaggerated in a sense. The sale price includes large off-farm expenses in the nature of what may be viewed as marketing costs (table 14). This cost includes container, grading, packing, and a selling fee. For apples, it amounts to $1 per bushel out of a sale price of $2.05 per bushel. For peaches and cherries, this cost is $0.65 per bushel and $0.70 per 13-pound lug, respectively.

Expenses

Expenses for the five farms range from $4,682 to $15,420. Interest on all investment and irrigation water costs are not included in these amounts. Note has been made that fruit marketing costs are an important segment of these totals. This cost is highest for apples. Thus, the large expenses are on the fruit-general farms which include a large acreage of apples.

Net Incomes

Net farm income is $5,028 for the five projected budgets weighted according to land use. The range among budgets is $3,617 to $5,911. All irrigation water costs have to be paid out of these incomes. The remainder would be available for family living, investment and savings, interest payments, and similar purposes.

Interest on investment averages $1,893 per farm. Returns above this amount would be $3,135--again as a weighted average. Under a residual procedure, this amount is left as return to operator and family management and labor and for payment of all irrigation water costs.

Incomes on several farms in this group would not fully compensate all resources at rates usually assumed in budget analyses. After interest on investment, water and labor on some farms would receive substantially less than market rates for hired labor or for irrigation water.

Thus, while farm families in most instances may have an adequate level of living (for example, if they had no indebtedness), rates of returns to labor and other resources may still be low. This situation probably exists on many farms. Obstacles to adjustments often prevent the most efficient use of resources in terms of profits and net incomes.

Projected returns to operator and family management and labor would average substantially larger per hour on fruit farms than on other farms in the group (table 18). However, fruit production is characterized by greater instability and uncertainty of incomes than most kinds of general farming.

The fruit-general farms appear least adequate in terms of family incomes. Less net income is received from apples than from the peaches and cherries on the fruit farms. Also, the dairy enterprise and sale of field crops are not especially profitable on these farms.

Fruit and fruit-general farms utilize least effectively the available operator and family labor. The problem is one of seasonal distribution of labor needs.

At the present time, farm incomes are frequently supplemented by off-farm income in the Paonia area. It is expected that this situation will continue and that it may increase. Many opportunities exist and are utilized for work off the farm. Thus, farm incomes must be viewed in terms of being supplemented by off-farm work and other off-farm income.

In summary, a goal here is to give an indication of prospective incomes for several farm types and sizes. This analysis will be used in arriving at an estimate of direct agricultural benefits from additional water. For supplemental water, crops and cropping patterns appear more important to direct benefits than farm size. Yield differentials between the "with" and "without" conditions, in combination with variations in income differences among crops, are the more critical elements of the benefit analysis.

Direct Agricultural Benefits

A primary purpose of investigations summarized in the report to this point has been to develop a foundation for estimating direct agricultural benefits from the proposed development of supplemental irrigation water on the Paonia Project. Before pursuing the analysis further , a definition of terms, a statement of some underlying concepts, and a statement of assumptions underlying the estimate of direct benefits seem desirable.

Direct agricultural benefits are defined as the value of farm production expected with project development in excess of the value of farm production anticipated without project development less the value of additional farm inputs or associated costs required. The concepts and assumptions on the specific composition of "additional farm inputs or associated costs," as used in this report, are outlined below.

Two basic assumptions relate to the national and local economy: (1) That the national economy will operate at essentially full employment for the period of analysis. Price projection, for example, are premised partly

on this assumption. This means that many alternative opportunities would exist in the national economy for use of resources, including the labor and skills of farm operators and family members. It means also that farm prices received and paid are higher than they would be with unemployment. (2) That, because of relatively fixed and enduring local obstacles to economic adjustments, some under-employment of resources may exist for a relatively long period on Paonia Project farms without additional water. Partly, this means that some increased employment of local resources may be attributable to additional irrigation water, depending on the present farm size and organization.

Yield Increase With Additional Water

Estimates have been made that the following average yield increases would occur if a water supply adequate to meet irrigation requirements were achieved as proposed under the Paonia Project:

Crop	Unit	Yield increases
Alfalfa	Ton	1.0
Rotation pasture	AUM	3.0
Barley	Bu.	5.0
Corn silage	Ton	4.0
Corn grain	Bu.	15.0
Apples	Bu.	50.0
Peaches	Bu.	40.0
Cherries, sweet	Ton	0.2

Net Incomes Associated With Increased Crop Yields on Presently Irrigated Land

On the basis of projected prices the indicated yield increases, and the expected cropping patterns, the average net income would be increased $14.44 per acre on those lands receiving additional irrigation water (table 19). Charges for additional operation and maintenance have been regarded as project costs rather than farm costs.

A similar comparison has been made for each of the three projected cropping patterns--fruit, fruit-general, and general--which serve as a basis for the projected budgets. The increased net incomes associated with additional water would be $26.18, $17.72, and $11.01 per acre for these three groups, respectively, compared with the weighted average for all cropland of $14.44 per acre.

Table 19.- Net crop income changes associated with additional irrigation water, Paonia project

Crop	Yield difference	Projected land use	Gross income per acre	Expenses per acre 2/	Net increase per acre
		Acres	Dollars	Dollars	Dollars
Alfalfa	1.0	6,274	21.00	8.85	12.15
Rotation pasture 1/	3.0	--	--	--	--
Barley	5.0	1,531	4.90	3.60	1.30
Corn silage	4.0	784	30.00	11.65	18.35
Corn grain	15.0	1,175	21.00	9.75	11.25
Apples	50.0	1,494	102.50	66.30	36.20
Peaches	40.0	300	96.00	42.30	53.70
Cherries, sweet	0.2	294	55.00	42.75	12.25
Nonbearing fruit	--	427	--	4.95	-4.95
Total	--	12,280	--	--	14.44

1/ Rotation pasture acreage included with alfalfa. Increase in net incomes assumed equal for the two crops.
2/ Excluding O & M costs for water.

Comparison of "With-Without" Incomes for Projected Budgets

This comparison has been made for five projected farm budgets (table 20). Before looking at the incomes, several points of significance should be observed about these farms and the area.

The project proposes to achieve a full water supply for 12,280 acres of presently irrigated land by furnishing an average of 8.5 inches per acre of additional water and by providing 35 inches of water per acre for 2,100 acres of new land. The assumption is made that the benefits for a full supply of water on the new land would be the same per acre as the benefits per acre for a supplemental supply.

Several further points of procedure are important: (1) Additional family and operator labor required in the "with" budget is considered as an expense in deriving benefits, (2) land investment or development has been increased $12 per acre to meet the needs of additional irrigation water and of water efficiency standards, (3) the assumption has been made that dairymen selling market milk would receive a larger price for a smaller quantity without the project, and (4) interest rates in the budgets are 4 percent for land and water and 5 percent for other investment. These rates represent an estimate of a return to the operator and owner on his investments in land and capital.

Fully irrigated farms will require considerably more labor, including operator and family labor (table 20). This additional labor has been charged as an expense at the rate of $1 per hour.

Table 20.- Selected data relating to direct agricultural benefits from supplemental water, by projected farm budgets, Paonia project

Item	Unit	Fruit		Fruit-dairy		Fruit-general		General-beef		Gen.-grade A dairy	
		Without project	With project	Without project	With project	Without project	With project	Without project	With project	Without project	With project
Weighting	Percent	-	11.0	-	13.0	-	12.0	-	40.0	-	24.0
Cropland, irrigated	Acres	24.0	25.0	55.0	57.0	55.0	57.0	102.0	111.0	68.0	74.0
Operator and family labor	Hours	2,459	2,713	3,027	3,434	2,288	2,534	2,335	3,415	2,497	3,585
Receipts	Dollars	11,527	14,316	13,369	19,037	13,318	18,697	7,132	10,648	6,390	9,869
Expenses 1/	Dollars	8,306	10,071	11,177	15,420	10,640	14,681	3,914	4,737	3,799	4,682
Net farm income	Dollars	3,223	4,245	2,192	3,617	2,678	4,016	3,218	5,911	2,591	5,187
Interest on investment	Dollars	971	1,023	1,444	1,614	1,247	1,390	2,099	2,522	1,477	1,648
Net returns	Dollars	2,252	3,222	748	2,003	1,431	2,626	1,119	3,389	1,114	3,539
Difference	Dollars	-	970	-	1,255	-	1,195	-	2,270	-	2,425
Cost of extra family labor 2/	Dollars	-	254	-	407	-	246	-	1,080	-	1,088
Increased income total	Dollars	-	716	-	848	-	949	-	1,190	-	1,337
Increased income per acre	Dollars	-	28.64	-	14.87	-	16.65	-	10.72	-	18.07

1/ O & M and interest not included.

2/ At $1 per hour. To a large extent, the extra labor on these farms must be hired. The farm wage rate of $1 per hour has been allowed since there appears to be numerous opportunities for the family to work as hired laborers on fruit farms and elsewhere.

Benefits from additional water and the increased incomes associated with more water may be substantial even though total net returns to some farm families are relatively low. This point is illustrated by the fruit-general budget. This farm has next to the lowest net returns of the farms budgeted (table 18) but the increased income per acre with additional water would be substantially greater than the average of all farms.

The estimated agricultural benefit on the projected fruit budget is $28.64 per acre (table 20). A comparable benefit figure is $15.75 per acre for the two fruit-general farms. On the two projected general farm budgets, the annual benefit is estimated at $13.50 per acre. These estimates are based on net irrigated acres.

If these per-acre incomes are applied to the respective acreages under each cropping pattern or farm type, the annual increase in agricultural incomes associated with the project would be about $15.75 per acre.

Findings

Several estimates have been made above of increased incomes that may be associated with additional irrigation water on the Paonia Project. These estimates are as follows:

Farm type	Cropping pattern	Budget
	Dollars	Dollars
General	11.01	13.50
Fruit-general	17.72	15.75
Fruit	26.18	28.64
Project	14.44	15.71

It is evident that a wide difference in net increase prevails between general and fruit crops. The two main procedures arrive at projected estimates which are about $1.27 apart. Increased incomes or benefits associated with proposed additional irrigation water are estimated at $15 per acre on 12,280 acres of presently irrigated farms. If this same benefit is applied on a per-acre basis to 2,100 acres of new land, the total annual direct benefits on 14,380 acres of project land would be about $215,000.

CHAPTER III

IMPACT OF THE PAONIA PROJECT UPON THE ADMINISTRATION, MANAGEMENT, AND USE OF THE GUNNISON NATIONAL FOREST, OTHER FOREST LANDS, AND UPON FOREST RESOURCES

Area and Ownership Concerned

This section of the report considers the impact of the Paonia Project on the Gunnison National Forest and on other forest and rangelands. It is aimed at determining what facilities, resources, and uses will be affected and at evaluating these effects.

While there are about 791 square miles in the total watershed area of the project, impacts of project construction and operation upon national forest lands and forest resources will be confined to the Muddy Creek drainage (see map) lying above the dam site. This part of the project area contains about 255 square miles of which 75 percent is national forest lands, 19 percent is privately owned, and 6 percent is public domain.

Present Status

Current Use

Annual timber cut from national forest lands averages approximately 100,000 board feet of timber with a minimum stumpage value of $500 per year.

On the national forest 48 permittees graze 2,138 cattle and horses as well as 17,890 sheep for a total of 17,100 animal unit months. Total receipts from this use amounted to $8,924 in 1956.

Private and Bureau of Land Management lands within the watershed are also grazed but at different times of the year.

While recreational use on the watershed is moderate, it is estimated that the use for hunting, fishing, camping, picnicking, and sightseeing has risen to about 11,000 visits annually.

Both deer and elk are plentiful; 1,500 hunters and 1,300 fishermen visit the area annually.

All national forest lands within the watershed are covered by U. S. Department of the Interior oil and gas leases. A number of oil wells have been drilled, some striking gas.

Sixty-seven special use permits are in effect which authorize corrals, range fences, pastures, stock water, cabins, roads, and telephone lines on the national forest. Thirty-three additional permits authorize dams, reservoirs, diversions, and ditches.

Land use withdrawals include only those made by the Bureau of Reclamation in connection with this project.

One research study area for range reseeding and seed testing is conducted by the Rocky Mountain Forest and Range Experiment Station on national forest lands.

Present Developments

Project construction and operation will not affect any existing Forest Service developments, improvements, or services now provided.

Current Management

The forest area involved within the watershed is under good administration and management which are compatible with the proposed project.

Estimated Future Status Without Project Development

It is anticipated that the volume of conifer timber harvest will continue to increase slowly until the allowable annual cut is reached.

Moderate reductions in grazing use are being made to bring stocking and actual use into agreement with carrying capacities and proper use of the range. This action will provide for better protection of the project watershed.

A moderate increase is anticipated in recreational use of national forest over that of the past several years. Hunting and fishing are expected to increase in a similar manner.

There is an increasing demand for dams, reservoirs, and ditches for irrigation and stock watering purposes. The trend in other special uses is stationary.

Exploration for minerals, oil, and gas has probably not reached its peak.

Impacts of the Project

National Forest

Construction and operation of the project will not require any changes in principles or objectives of management on the national forest. No changes will be necessary in the physical plant needed for administration, protection, or services now provided on the national forest. The relocation of the county road will be necessary. Although this road is outside the national forest boundary, it is on the forest highway system and serves a portion of the national forest area in the Muddy Creek drainage. If the project is constructed, additional facilities will be needed outside the national forest to serve the anticipated increased recreational use, as noted below. Due to the proximity of national forest lands, such facilities will relieve a possible recreational burden that might otherwise fall in part on the national forest.

The project will have no foreseeable effect upon obligations or commitments to forest users, such as grazing permittees, timber sales, summer homes, and other land use permits. The current range improvement and management program on national forest lands should be stepped up with the objective of improving watershed conditions as much as is possible and feasible by the time the project is put into operation.

No additional physical improvements or equipment will be needed for fire control, either during or after construction. However, increased services, especially in fire prevention, will be necessary during the construction period and afterwards, as dictated by increased public use.

Other Forest and Forest Rangelands Immediately Adjacent to the National Forest

The principal reservoir to be constructed will lie in Muddy Creek Canyon just outside the national forest boundary. The reservoir will be flanked on each side at a distance of one to four miles by the national forest boundary. Because steep mountain slopes covered with timber and brush rise directly up to the national forest lands, fires that might originate at the reservoir will pose a threat to national forest lands which may require Forest Service action to suppress. This geographical location of the reservoir site gives the Forest Service justifiable concern and interest regarding the character of use and development that will take place around the reservoir perimeter.

It is anticipated that the proposed reservoir in Muddy Creek Canyon will attract many visitors for camping, picnicking, boating, and fishing. Some of this increased recreational use will probably also be extended to adjacent national forest lands. Providing protection from fire to adjoining national forest and privately owned forest lands, safeguarding the health and safety of these public users, and insuring against pollution of water supplied by the project should be adequately included in plans for project construction and operation.

It is recommended, therefore, that certain lands adjacent to the reservoir be reserved or acquired to be retained in public ownership and administered by a Federal, state, or local government agency to insure and protect the public interests and to provide for adequate public access to the reservoir. Areas recommended for such uses should include: (1) A tract immediately above the reservoir, (2) a tract below the dam extending to and including the flat at Bardine, and (3) a buffer zone surrounding the reservoir of sufficient width to include the area between the relocated road and reservoir and extending about 330 feet west of the road and a strip about 660 feet wide along the east shore of the reservoir.

Reservation or acquisition of these tracts will provide areas for recreational use on which campgrounds, picnic grounds, observation points, parking areas, etc., should be developed. It would insure that the shoreline would be accessible to the public and would provide needed control of the type of developments and use with particular reference to the prevention of fire and health hazards.

A preliminary appraisal has been made of the expected future recreational use of the project area. This has included tentative estimates of the nature and approximate cost of facilities which should be included as a part of project development and operation. These estimates are presented in latter sections of the report.

It is recommended that the Bureau of Reclamation arrange to have more detailed surveys, plans, and estimates made for public use areas and recreational facilities. Furthermore, provision should be made to include the costs of land acquisition and construction costs of campgrounds, picnic grounds, observation points, parking areas, and appurtenant facilities in the project plan report.

There will be no other effect on these lands with the exception of the direct losses or impairment of ranchlands and improvements brought about by project construction. These latter effects will not significantly affect grazing use of national forest lands. Relatively little privately owned timber land will be taken out of production.

Estimated Costs

Included herein are estimates based on 1956 values and costs of the probable monetary effects of project construction and operation upon present facilities, services, and uses of the Gunnison National Forest, together with estimates of the cost of meeting new demands for services and use which will be created by the project, including areas outside but immediately adjacent to the national forest.

Item	Units	Costs
National Forest Lands		
Facilities required to maintain present level of management and services.	None required except relocation of Muddy Creek road outside national forest; cost not estimated.	
Advance planning, administrative and protective services required through the construction period.		
1. Increased administrative costs and accelerated fire control, especially fire prevention during the construction period.		$ 1,000
Contingency allowance (10 percent)		100
Subtotal		$ 1,100

Item	Units	Costs
Other Forest and Forest Rangelands Immediately Adjacent to the National Forest		
Project-imposed developments for public health, safety, and property protection.		
1. Acquisition or reservation of land adjacent to the reservoir as described under "Impacts of the Project."		Not determined
2. Surveys and preparation of detailed plans for new facilities.	3 units general plan	$ 1,500
3. Develop 3 areas for campgrounds, picnic areas, observation points, parking areas, and associated facilities as previously mentioned.	3 areas	20,000
Contingency allowance (10 percent of items 2 and 3)		2,150
Subtotal		$23,650 1/
GRAND TOTAL		$24,750
Average annual equivalent based on amortization over 50 years at 2.5 percent interest.		$ 872.68

1/ Does not include cost of land to be acquired.

This report has been reviewed with members of the National Park Service. The Forest Service and the National Park Service are in general accord, differing only as to extent of recreational development around the reservoir site proper. The Forest Service has recommended optimum development to temper indirect impacts on adjacent forest lands. The National Park Service has geared their planned developments to their ability to obtain a sponsor willing to accept the responsibility of future operation and maintenance. Should one be obtained, they will favorably consider additional facilities.

Other Project-Imposed Costs

Administration, operation, maintenance, and servicing of the recreation areas and facilities which should be developed will be required for the adequate protection of public health, safety, and property. This will be a continuing job which should be included in plans for project operation.

The influx of public users to the reservoir and surrounding areas will impose additional requirements for fire prevention and fire control and may require a small increase in annual expenditures by all agencies concerned for these purposes.

Benefits

The attractions in this area will be enhanced by the reservoir. Greater recreational use is inevitable, which may divert some of the excess recreation demand and load from the Lakes Area on Grand Mesa National Forest and other nearby areas.

The reservoir will undoubtedly increase and improve fish habitat and this may reduce present fishing pressure on other nearby heavily used areas.

Findings

Certain selected sites surrounding and in the vicinity of the reservoir should be acquired to be retained in public ownership and administered by a Federal, state, or local government agency for recreational purposes to protect the public interests. Campgrounds, picnic grounds, and other recreation areas should be planned and developed to serve the people who will be attracted to this locality and to safeguard adjoining national forest values. Such facilities and developments should be limited to those necessary for the adequate protection of public health, safety, and property. Provision for the planning, development, and construction of such recreational facilities should be an integral part of project plans and appropriation. The proposed campgrounds, picnic areas, and other recreational areas will need to be maintained and serviced.

Fire prevention work after completion of the project will be increased because of the greater number of people attracted to the area. It is anticipated that these circumstances will increase the present administrative jobload on the Gunnison National Forest to a limited extent.

A part of the county road, which now serves the Muddy Creek drainage and provides access to a portion of the Gunnison National Forest, will need to be relocated.

There will be no appreciable losses in resource values now provided by the forest and rangelands. The project will improve the general area for recreation, fishing, and hunting.

CHAPTER IV

THE RELATIONSHIP OF WATERSHED CONDITIONS TO THE PAONIA PROJECT

Watershed conditions covered in this report are common to most irrigation projects. They do not materially affect feasibility of the project. However, improvement of watershed conditions will extend the life of the project and reduce operating difficulties and maintenance expenses. They are pointed out here so that local, state, and Federal agencies which deal with watershed lands can orient their regular and special programs to the eventual solution of these problems.

Subwatersheds

The watershed area is divided into the following subwatersheds:

Anthracite and Deep Creeks	266 sq. mi.
Muddy Creek	255 sq. mi.
Hubbard, Terror, Roatcap Gulch, and Jay Creeks	150 sq. mi.
Leroux Creek	120 sq. mi.
Total	791 sq. mi.

Watershed Characteristics

The topography ranges from gently sloping bench land or mesas with very steep gravelly edges to steep rugged mountainous land. Relatively flat-to-sloping alluvial bottom lands are located along the main streams.

The major portion of the watershed is made up geologically of two formations--the Mesaverde sandstone and the Wasatch shales. The Redlands Mesa area dips below the Mesaverde into the Mancos shale formation. Some of the watershed appears to have been originally overlain by a lava flow, several remnants of which are still visible. In addition most of the higher mountain peaks, including the Grand Mesa summit, are composed of basaltic or other igneous materials.

Over most of the watershed the soil mantle has been influenced by the higher-lying basaltic materials. This mantle of soil is quite variable as to depth and amount of gravel and stone within the profile but the texture of the top soil and subsoil are quite uniformly clay and clay loams. The gravel and stone content, as well as the rather good surface soil condition, combine to make the soil somewhat resistant to gully erosion.

Good vegetative cover has also helped to retard erosion. Moderate sheet erosion is present in a few places where the cover has been heavily used. There is some soil movement on the steep mesa edges and especially on the steep sides of Ragged Mountain where it descends to both Muddy Creek and Anthracite Creek.

Sheet and gully erosion over a majority of the watershed is rated as "none" to "slight" with perhaps 20 percent as "moderate" and a very small portion near the newer slides as "severe."

Near the headwaters of East Muddy Creek and West Muddy Creek some areas have only a thin mantle of soil over the Wasatch formation. In those areas the characteristic land slips or "slide" areas are considered a normal geologic occurrence.

Principal vegetative type	Percent of total forest area	Watershed condition
Aspen	55	Good
Dense conifer timber	3	Good
Open conifer timber	10	Good
Oakbrush	14	Mostly good
Sagebrush	4	Generally fair
Grass	11	Mostly fair
Barren	3	Mostly rock & slide areas

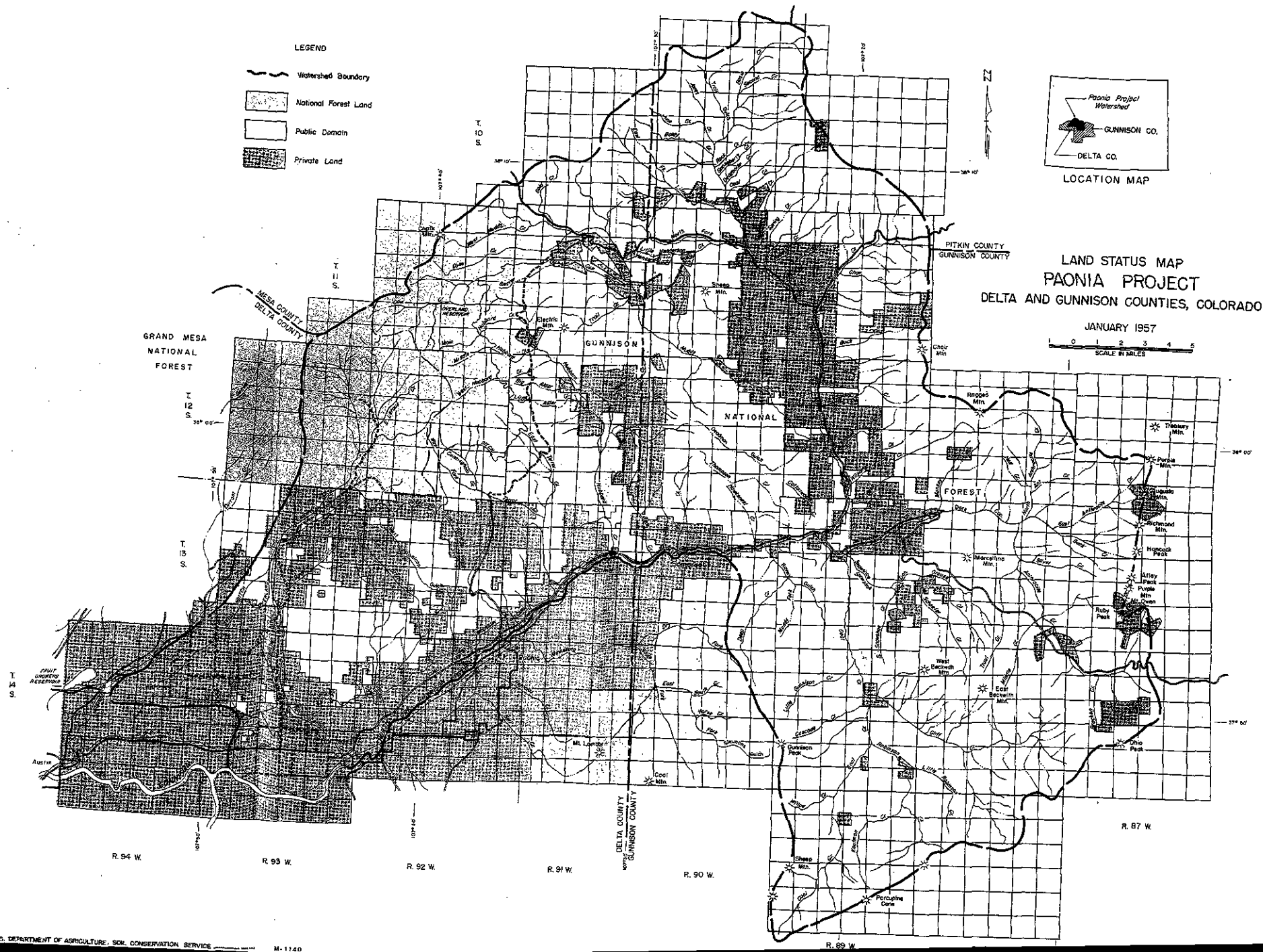
Snowmelt runoff frequently produces flood stages during the period of late April through early June. High intensity rains also cause some floodwater runoff during June, July, and August. With the exception of small local areas, little floodwater runoff can now be attributed to poor cover on the watershed. Seeps and springs interspersed through the watershed feed perennial streams by subsurface flow following the melting of the heavy winter snow. There are numerous storage reservoirs in the higher elevations in the Leroux Creek watershed. Flood plain areas are relatively minor in extent within the watershed and are used mostly for irrigated meadows.

There is no cultivated land lying above the flood plain. A few abandoned but well stabilized fields are located at widely spaced locations. Watershed lands are used for grazing by domestic animals and big game, for timber production, watershed protection, recreation, and as wildlife areas. Grass, timber, and shrub cover as a whole is rated fair to good.

Ownership

Land ownership is as follows:

Federal	
National forest	75 percent
Public domain	6 percent
State	
There are no state lands	0 percent
Private	19 percent
	100 percent



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Watershed Problems

Generally, the lower portion of the watershed, which contributes materially to volume of runoff, has deeply entrenched channels which normally contain flood flows. Over-bank flooding in these areas is a minor problem. Flooding in the upper reaches of the watershed has caused very little damage and if the generally good condition of the vegetative cover is maintained, future floodwater damage should be low.

Drainage areas above both the Overland Ditch and Fire Mountain Canal may contribute channelized flows which interfere with normal canal operations. Generally, areas where such trouble is experienced will be quite localized and since the watershed characteristics do not indicate any potential sites for small flood control structures, such localized trouble spots can be best controlled by means of overshots, syphons, etc.

Sediment carried down by the larger streams is the principal problem. Most sediment is coming from slides that are considered geologic in nature. These slide areas do not respond to any practical methods of sediment control. Sediment damage will consist principally in reduction of storage in the main reservoir and since this factor is being considered in the reservoir design by the Bureau of Reclamation, no additional consideration appears justified. The design provides for 10,000 acre feet of sediment storage. Continued and improved management of watershed lands will decrease the potential sediment hazard from lands other than slide areas.

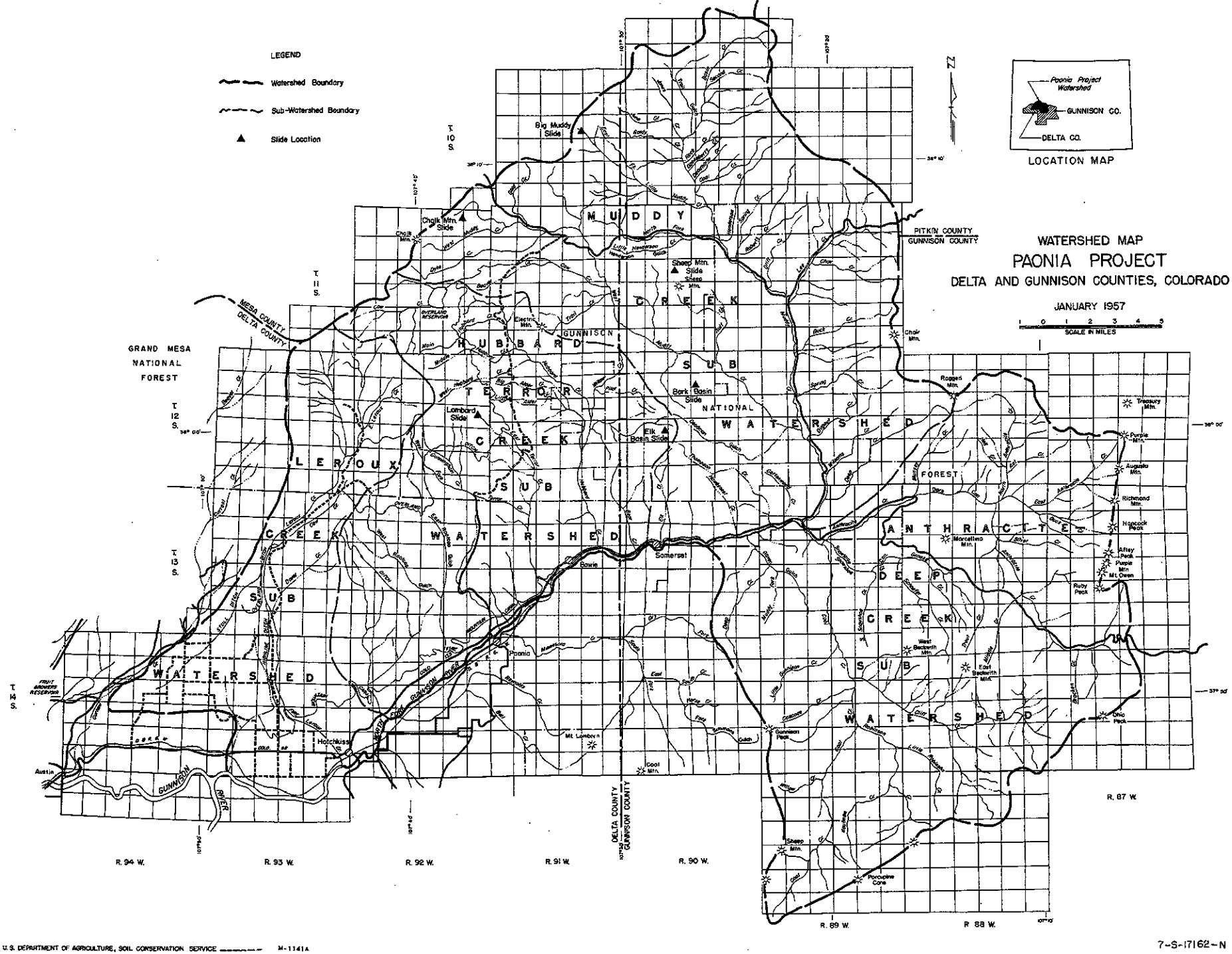
The effect of sediment on water supply, channels, drainage ditches, and irrigation systems located on the watershed is of minor importance. Watershed characteristics and problems are enumerated by subwatersheds. Relation of subwatershed to the total watershed and location of slide areas can be determined by referring to the watershed map.

Muddy Creek Subwatershed

The entire subwatershed of Muddy Creek is characterized as a very fine textured, highly erosive soil type. These soils remain in suspension a long time and are carried far downstream.

The subwatershed as a whole has a good vegetative cover. Aspen and oak are the major plant-cover types for the subwatershed lands. Soil loss is very light for both of these plant-cover types.

The principal sources of silt are from four major slides on Muddy Creek and other small ones scattered over the subwatershed. These major landslide areas are: (1) The Big Muddy slide area at the head of the East Fork of Muddy Creek, (2) Chalk Mountain at the head of West Muddy Creek, (3) Bar K Basin north of Pilot Knob, and (4) at the head of Foote Draw on Sheep Mountain.



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Anthracite-Deep Creek Subwatershed

The Anthracite, Coal Creek, and Deep Creek subwatersheds will not drain into the Paonia Reservoir. They will, however, empty into the North Fork of the Gunnison River above the heading of the Fire Mountain Canal.

The Bureau of Reclamation has given full consideration to the effects of siltload at this point in designing the headworks and silt traps on the canal. Long-time erosion potential of these subwatersheds, however, should not be overlooked. The drainages are characterized by steep slopes with thin soil cover. They support brush-type cover on the lower slopes and mixed conifer timber and aspen with intermingled grass parks at the higher elevation. The lower main streams have a low gradient while the feeder streams have a steep gradient.

Generally speaking, vegetative cover is in poor condition and the slopes are eroding at an accelerated rate. Considerable reduction in livestock use and improved management has been accomplished in recent years.

The escarpments contribute considerable sediment with no chance of correction. Intermediary slopes contribute sediment from sheet and gully erosion. Streams are subject to moderate-to-heavy streambank erosion.

Hubbard Creek-Terror Creek and Adjacent North Fork River Slope Subwatersheds

Hubbard Creek and Terror Creek will not drain directly into the Paonia Reservoir but both drainages are above the Fire Mountain Canal. The watersheds are characterized by very fine textured soils. Both soil and vegetative cover are generally in fair condition. Aspen and oakbrush plant-cover types occupy most of the area. To-date very little soil loss has taken place under the aspen but the oakbrush at lower elevations has been grazed heavier and suffered some soil loss.

The sources of sediment on Terror and Hubbard Creeks are from: (1) Lombard slides at head of West Hubbard Creek, (2) Elk Basin slide at head of Elk Creek, and (3) small slides scattered over the watershed on and below the national forest. Individual slides usually occupy from one to ten acres; separately they are not highly significant but collectively they supply a considerable amount of sediment.

The area along the north side of the North Fork of the Gunnison River is characterized by extremely steep slopes with a sparse juniper-type plant cover. Each year numerous mud flows occur as a result of heavy rains on these steep slopes. Drainages have been flumed over the Fire Mountain Canal for canal protection.

Leroux Creek Subwatershed

The upper drainage of Leroux Creek was denuded by fire about the turn of the century. Revegetation has been slow and much of this old burn is sparsely covered. Sheet erosion is prevalent along with varying amounts of gully erosion although most of the gullies are now fairly well healed.

In the lower portion of the drainage, within the national forest boundary, soils are less erodible and there is a reasonably good cover of aspen and oakbrush. At present this part of the subwatershed is well stabilized and no serious erosion or sediment problems are anticipated.

Land Treatment on Private Land

Conservation measures needed center around range management programs and will include the estimated amounts of the following practices:

Proper use of forage resources	75,000 acres
Stock water development to improve grazing distribution	250 each
Water spreading	2,400 acres
Fences for grazing distribution	64 miles
Timbered areas requiring grazing management, sustained yield cutting, and protection from fire	1,600 acres
Brush and weed control	3,700 acres

Of the landowners in the project, 106 have signed cooperative agreements with the Delta Soil Conservation District. The district program is active in Delta County. The portion of the watershed lying in Gunnison County is being added to the district. There are approximately 70 landowners in this addition and 66 have petitioned to add their lands to the district.

The Soil Conservation Service has assisted with some work in this area, such as stock water development and improvement of irrigation ditches and canals. Planning for a range improvement program on private land is under way. Group enterprise agreements with four ditch companies in the project have been signed.

In general, the attitude of the people in the watershed is excellent and they are aware of the conservation needs of the land. The possibility of accelerating the application of conservation practices is very good.

Land Treatment on Federal Land

National Forest Lands

On the national forest lands the protection and conservation measures needed can be accomplished by proper land use and proper management of all resources. The greatest amount of protection will be accomplished through range management.

A good practical range improvement and management program is being carried out on the national forest as rapidly as available funds and time permit. It is believed that this program will satisfactorily meet the watershed protection needs on these lands; however, it may need to be accelerated so as to complete the improvement program as rapidly as practicable. It includes: (1) Completion of range analysis study, (2) completion of range management action plans, (3) initiation of indicated adjustment in range use, (4) construction of 52 miles of fence and 100 small stock water ponds in order to improve management of the range, (5) spraying approximately 3,000 acres of sagebrush to increase available forage and improve range cover, (6) encourage permittees and other ranchers to utilize best range management practices, and (7) completion of accurate planimetric base maps.

Some timber cutting is anticipated within the next few years. Extreme care should be given to proper road location and logging methods to prevent unnecessary erosion.

Public Domain

Lands controlled by the Bureau of Land Management are the extremely steep breaks and slopes between the irrigated lands and the better private rangelands below the national forest boundaries. The land pattern includes the larger blocks of land from Hubbard Creek west to Leroux Creek and isolated tracts or smaller blocks of land in the Muddy and Anthracite drainage. The smaller tracts are either subject to or are in the process of disposal. These areas are covered by pinon and juniper giving way to mountain browse and a scattering of sagebrush parks on the high elevations.

The use and treatment of the above lands, with reference to this project, are confined to grazing and driveway use and the proper control thereof. The immediate need includes the completion of the unit analysis and adjustments of use currently in progress.

Many of the tributary drainages are contributing heavily to the siltload of the river proper but are not currently causing damage to the Paonia Project. This situation should be studied whenever other downstream projects are analyzed.

Flood Prevention Structural Measures

The existing reservoirs on the watershed decrease the flood peaks. Due to topography and low flood drainages, large water-flow retardation structures are not recommended.

Irrigation Aspects

The Fire Mountain Canal and other canals have been improved recently and most of the formerly hazardous conditions have been adequately corrected. The Paonia Reservoir has adequate provision for sediment storage. Other private reservoirs are located high enough on the watershed so that dangers from sediment or floods are minimized. Canals have been adequately located and protected so that severe damage to farm units is limited.

Small control structures may be required in some locations and water management should be stressed when working with irrigators.

Findings

Generally, watershed lands have a good cover and are not contributing dangerous amounts of sediment or flood flows, except for the slide areas. No practical treatment is effective on active slide areas but efforts should be made to provide ungrazed areas below the slides to trap as much sediment as possible before it reaches the stream system. No flood prevention structures appear needed or justified. Remedial measures mentioned previously and as may be determined by more detailed study should be installed in the watershed to further improve its forage and timber production and to reduce operating difficulties for the Paonia Project. Means should be provided land-administering agencies and assistance provided to private operators of watershed lands so this watershed can be further improved. The watershed program described herein is not a prerequisite to the development of the Paonia Project and is not essential to its feasibility. However, improvement of this watershed will benefit the project by prolonging its usefulness. Improvements should be carried out through regular and special agricultural programs as rapidly as practicable.

CHAPTER V

REGULAR ACTIVITIES OF THE U. S. DEPARTMENT OF AGRICULTURE PARTICULARLY AFFECTED BY THE PAONIA PROJECT

Introduction

The U. S. Department of Agriculture and Colorado A & M College are presently carrying out agricultural activities in the project area under regularly established programs. Supplemental water will be furnished to 12,280 acres of presently irrigated land and 2,100 acres will be newly irrigated. With the increased agricultural activity caused by the project, these regular programs will need to be correspondingly increased or accelerated.

Agricultural Education and Information

The Colorado Cooperative Extension Service maintains an office at Delta. The services of a resident extension agent, assistant extension agent, home demonstration agent, and the nonresident specialists located on the campus at Fort Collins are available to farmers in the project area. Additional information and educational services will be required. This is particularly true in connection with any expansion in fruit or livestock production. Some additional information and education in connection with better irrigation water management and pasture development will also be needed.

Technical Services

The Paonia Project lies within the Delta Soil Conservation District. The Soil Conservation Service has a work unit at Paonia staffed with a work unit conservationist and an engineering aid. Other Soil Conservation Service assistance is available through their offices at Delta and Grand Junction, including specialist assistance in soils, engineering, agronomy, and range management.

Additional technical services and on-site assistance from Soil Conservation Service technicians will be required in connection with the planning and application of conservation measures, such as land leveling, improvement of farm irrigation systems, improved water management, grass management, and soil fertility management.

Farm Financing

Most of the presently established farmers and ranchers in the project area will increase irrigated acreage and develop better diversified crop and livestock programs. Farm housing and farm improvements will be necessary in several under-developed communities. Land development involving soil and water conservation measures will also be necessary. Farm enlargement by purchase of undeveloped land will permit some presently inefficient units to be enlarged to economic units.

Farmers Home Administration credit programs will need to be increased because local commercial credit sources, which provide long-time credit, are limited.

Cost-Sharing for Conservation Measures

The Delta County ASC Committee has encouraged the improvement of farm irrigation systems throughout the county for more effective and beneficial use of available water. Emphasis has been and will continue to be placed upon the installation and relocation of permanent ditches and ditch structures, land leveling, and construction and improvement of small irrigation reservoirs.

The use of pooling agreements will be widely used to offer cost-sharing to groups of farmers to solve conservation problems jointly confronting them. Their cooperative efforts encourage farmers to carry out other needed conservation measures on their own farms, which would be ineffectual without the joint improvement measures.

Acceleration in the pace of program activity will call for additional technical help as well as for supplemental funds for cost-sharing.

National Forest Lands

Restoration, proper management of plant cover, and stabilization of the soil mantle are prime objectives of the Gunnison and Grand Mesa National Forests. While programs aimed at these objectives are now under way and have achieved good results, construction of the project will add further impetus to early accomplishment of range improvement and range management aspects of these programs.

It is also anticipated that increased public use of the general area will accompany and follow project construction.

Additional administrative personnel and other services may be required to provide adequate fire prevention and to manage and service recreational use and facilities.

Research Needs

A comprehensive report covering all research needs for the entire Colorado River Storage Project area will be developed by representatives of the U.S. Department of Agriculture research agencies, state agricultural colleges, and experiment stations as these studies proceed on additional participating projects.

In addition to these general research needs, it is felt that there is a need for the following specific research investigations in the Paonia Project area:

(1) Determine the kinds, amounts, methods, and time of application of fertilizers for sustained high yields and quality of adapted irrigated crops.

(2) Determine the effect of previous cropping practices, legumes, plant residues, barnyard manure, irrigation, and other management practices on fertilizer requirements and available nutrients.

(3) Study methods of water application best adapted for efficient distribution and maximum utilization of limited water supplies in relation to slope, size of stream, length of run, etc., on existing irrigated farms and additional new lands proposed for development.

(4) Determine consumptive use, irrigation frequencies, and quantities of water to apply for maximum water use efficiency and crop yields of adapted crops.

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