SOUTH CAROLINA IRRIGATION GUIDE

CHAPTER 7. CONSERVATION IRRIGATION PLANNING

Contents

	Page
General	7-1
Definition of Conservation Irrigation Planning	7-1
Plan Requirement	7-1
Irrigation System Plan	7-1
Irrigation Water Management Plan	7-2
Planning Steps	7-3
Preliminary Considerations	7-3
Collecting Basic Data	7-4
Planning the System	7-5

SOUTH CAROLINA IRRIGATION GUIDE

CHAPTER 7. CONSERVATION IRRIGATION PLANNING

GENERAL

The material in this section of the Irrigation Guide is intended to help planners assist landowners in planning their irrigation system(s). For more specific information, planners should refer to:

SCS - National Engineering Handbook - Section 15
Chapter 1 - Soil-Plant-Water Relationships
Chapter 3 - Planning Farm Irrigation Systems

DEFINITION OF CONSERVATION IRRIGATION

The use of irrigated soils and irrigation water in a way that insures high production without wasting either water or soil. To an irrigator conservation irrigation can mean saving water, controlling erosion, better crop yields, lower production costs, and continued productivity of his irrigated land.

A conservation irrigation system is the completed arrangement of the delivery and application facilities needed to distribute irrigation water efficiently for all land served by the system.

PLAN REQUIREMENT

An irrigation plan can be divided into two parts:

1. An irrigation system plan which provides for a system of delivery, application and disposal of the water that is consistent with the soil and relief of the land being irrigated and the crops to be grown. The system should apply irrigation water efficiently.

2. An irrigation water management plan which provides for the proper use of water delivered. The document should provide only that data that can be used by the landowner based on his management ability and degree of expertise in irrigation.

IRRIGATION SYSTEM PLAN

The irrigation system plan should provide for the following:

1. The amount and kinds of the crops to be grown, the irrigation requirements of the crops and the expected costs and returns of the system.

2. A water supply that is adequate to meet the requirements of the plan. The supply must be balanced with the irrigation requirements as well as other uses (frost protection, etc.). This may require a water budget.

3. The size and layout of the distribution system needed to supply the water as well as the needed components.

4. The pumping plant requirements to supply the system at the specified rate and pressure.

5. The selected irrigation method capable of applying irrigation water consistent with the soil characteristics and crop requirements.

   a. Subsurface irrigation systems must be capable of moving water to the root zone of the crop at a rate sufficient to supply the plant requirements during peak use periods. Also, it must be capable of draining excess water from the soil profile during periods of high rainfall at a rate sufficient to prevent crop damage due to poor aeration.

   b. In sprinkler irrigation, the sprinkler spacing, nozzle sizes and operating pressure that will most nearly meet the planned application rate and distribution will be used. The main lines, lateral lines, hoses, etc., must be able to supply the water to the sprinklers at the rate and pressure required.

   c. In trickle irrigation the emitters must be capable of providing the peak consumptive use of the crop on a daily basis with a wetted area that will provide good distribution to the root zone. The main lines, submains and lateral lines must be capable of supplying the water to the emitters.

6. Tailwater recovery system when needed for efficient use of water.

7. The necessary practices to remove runoff and excess subsurface water without excessive erosion or other problems.

8. A flow meter or other type of measuring devise that measures the rate of flow and total water use, so the irrigation efficiency and proper water use can be determined quickly.

9. Access to all areas for easy operation of the irrigation system, normal farming operations and removal of crops. This may involve access roads, culverts in ditches, etc.

10. Cost estimates for installation and operation of the irrigation system. Energy cost may be included.

IRRIGATION WATER MANAGEMENT PLAN

The irrigation water management plan should provide for the following items:

1. The water supply quantity and flow rates available, the water holding capacity for the rooting depths of the crops to be grown, the estimated crop water requirements, and the soil intake rates.

2. The estimated application rate, irrigation time required and irrigation interval.

3. A method or methods to measure the soil moisture content.

4. A method or methods to determine when to irrigate (irrigation scheduling procedure).

5. A procedure of how to compute the amount of water to apply each irrigation.

6. The soil moisture level when irrigation is needed and priority water needs of crops to be grown.

7. A method of evaluating the uniformity and adequacy of irrigations and suggestions for improvement.

PLANNING STEPS

The planning aspects of irrigation system cannot be over emphasized. A quality irrigation system plan and water management plan does not happen accidentally but comes about through quality planning. Planning can be divided into three phases consisting of (1) preliminary considerations, (2) collecting basic data, and (3) planning the system.

PRELIMINARY CONSIDERATIONS

The major items requiring preliminary considerations are discussed below:

1. Consider the capability of the soil to be irrigated. Irrigation should be confined to land that is capable of sustaining yields high enough for the land user to get a profit from irrigation without soil deterioration.

2. Consider the entire farm unit even if the landowner is interested in only one field. This will make sure that pipelines will be of an adequate size and elevations to service the rest of the land unit. Implementation of the plan will usually begin with one field or one pipeline and normally will continue over a period of time. Revisions will normally be necessary before the entire system is installed.

3. Landowners preference - Each landowner has a preference as to the kind of farm enterprise he wishes, which may dictate the kind of irrigation system and application method. He may have some strong feelings about one system over another. He will operate it much more effectively if he hasn't been pressured into a system. The planner needs to layout the pros and cons including the labor requirements and economic considerations of the "best fit" system.

4. Quantity and Quality of Water - An adequate source of good quality irrigation water must be available or there must be the possibility

of developing an adequate source. If the quantity of water is inadequate during the growing season, there could be crop loss even with an irrigation system. The landowner should be presented with an estimated seasonal water demand and peak use rate of the crop to be grown.

5. Wildlife wetland - locate on map all wildlife wetland in area planned for irrigation, prepare an Environmental Evaluation, and explain SCS policy concerning drainage and alteration of wetlands to land user.

6. Consider that erosion control practices may need to be installed or strengthened to protect the land from more intense use. The erosion control system may need to be modified to prevent interference with the irrigation system.

COLLECTING BASIC DATA

After the preliminary meeting with the landowner and considerations are given to the items discussed above, basic data should be collected. Listed below are basic data that should be obtained.

1. List the following soil and cropping system data:

   a. Soil types and area of each soil type.

   b. Amount and kind of crops to be grown.

   c. Water holding capacity to the depth of root zone of the crops grown.

   d. Intake rate of the soils under the cropping conditions that may occur during irrigation.

   e. Production costs before and after irrigation for crops to be grown.

2. The water supply quantity, quality and location should be determined.

3. Physical features that will affect the system design and location should be placed on the layout map. This includes such items as roads, utility lines, buildings, etc.

4. A complete topographic map may be required but in some areas the following topographic information may be all that is needed:

   a. Expected Low elevation of water supply.

   b. Ground elevation of pump location.

c. Ground elevation of low and high points, along the supply system and the irrigation system.

d. Intake rate of the soils under the cropping conditions that may occur during irrigation.

e. Production costs before and after irrigation for crops to be grown.

5. Locate on map all existing surface and subsurface drainage features such as terraces, waterways, tile drains, ditches, washes, etc., so the irrigation system can be properly planned and cost of making the needed changes to these features can be estimated.

6. Locate on map the needed surface and subsurface drainage practices, such as terraces, waterways, ditches, subsurface drains, etc. This information should be in enough detail to estimate the cost for each needed practice.

7. The location and sizes of the existing system should be checked. It should be determined if it is adequate in part or in whole and how it will fit with the proposed system. The best kind of transition from the present system to the future system should be determined.

PLANNING THE SYSTEM

The actual irrigation system can be planned once the basic data has been collected. Listed below are some steps to follow in planning the system:

1. Decide on the type(s) of systems that will be used. Sprinkler, trickle, subirrigation, etc. Develop alternatives for each practical system.

   Develop and plan field arrangement, consider:

   a. Method of irrigation.

   b. Workability, shape and access to field. Make the field as big and as square as possible.

   c. Direction of irrigation. Would changing the direction of irrigation have any benefits?

2. Prepare the irrigation system plan:

   a. Sprinkler irrigation:

      (1) Determine type of sprinkler system to use: center pivot, single sprinkler, volume gun (manual move or self move), portable or permanent solid set.

(2) Spacing of sprinkler heads on lateral.

(3) Spacing of laterals or lane spacing.

(4) Discharge (gpm) per sprinkler head.

(5) Sprinkler discharge pressure.

(6) Lateral and mainline pressure.

(7) Application rate.

b. Trickle irrigation:

(1) Determine type of trickle irrigation: drip, spray, etc.

(2) Spacing of emitters along lateral

(3) Lateral spacing

(4) Percent of design area covered by emitters

(5) Lateral and mainline pressure

(6) Discharge rate of emitter

c. Subsurface irrigation:

(1) Determine type of subsurface irrigation: open ditches, underground pipes, or combination.

(2) Spacing of ditches and/or pipes.

(3) Number and location of water control structures.

(4) Tail water recovery or disposal.

(5) Number and location of water table measuring structures.

3. Plan the Water Distribution System:

a. Ditch or Pipeline:

(1) Cost of each.

(2) Convenience in farming over pipeline.

(3) Value of land displaced by surface ditch. How much income would be generated if it was in production?

b. Type of turnout to field:

(1) Gated concrete turnout, port, or siphon for ditch.

(2) Alfalfa valve turnout for pipeline can be automated.

c. Measurement of water:

(1) Parshall flume, propeller meter, etc.

(2) Consider totalizer as well as flow meter when possible so total quantity is known.

4. Plan water disposal and/or tailwater resuse system:

a. Tailwater pit size (volume of storage).

b. Pineline if pump back system.

c. Gravity flow to downslope field.

d. Pump size needed - head and capacity.

e. Location of tailwater pump and other structures.

5. Plan farm road system:

a. Access to all parts of the irrigation distribution system for maintenance and operational ease.

b. Access to all fields for planting, tillage, and harvesting operations.

c. All season roads needed? In whole or in part?

d. Don't use bottom of Grass Waterway for road.

6. Plan subsurface drainage system:

a. Size of drains.

b. Depth of drains.

c. Filter material required.

d. Outlet necessary - gravity or pump.

7. Plan erosion control measures - may need terraces, diversions, mulch left on ground, etc.

a. Erosion control measures should be compatible w/operation of irrigation system.

b. Consider use of Water and Sediment Control Basin and underground outlets when possible.

8. Develop a maintenance program for the following (minimum):

   a. Ditches - maintenance of berms, removal of vegetation when necessary, cleanout of debris and soil from ditch.

   b. Erosion control practices such as terraces, grass waterways, and field boders.

   c. Pipelines and components valves working properly, any leaks?

   d. Turnout structures and measuring devices in proper working order?

   e. Sprinklers - check for wear.

   f. Pumps and motors - Maintenance not performed will cost money because of shutdowns at critical times, lowered efficiency so more fuel use, etc.

   g. Trickle irrigation - check for clogging, make schedule for flushing system out and operating system off-season to reduce emitters clogging.

   h. Schedule a time to perform maintenance. Off-season if possible, preparation for winter, etc.

9. Develop cost guidelines:

   a. Cost per unit and total cost for all alternatives considered.

   b. Cost of energy, i.e., hours system in operation times cost of fuel used per hour.

10. Prepare a development schedule:

   a. Least costly segments with greatest returns first.

   b. How will the new pieces fit in with the existing system, i.e., dirt ditch to pipeline?

11. Consider automation - more automation means more water efficiency and less labor.

12. Prepare a water management plan - specify operating criteria for application of water under varying conditions.