Irrigation Enhancement Index Tool for Water Quantity Enhancements

This evaluation is designed to help planners conduct an assessment for existing irrigation systems and evaluate to a planned condition in order to determine if enhancements are eligible. It may also serve as a means of documenting irrigation system components that can be utilized during individual interviews.

This procedure is to be utilized on irrigated lands and will result in assigning an Irrigation Enhancement Index value to the irrigation system being evaluated.

This procedure starts with a base value that is assigned to the specific type of irrigation system in use. Systems that commonly have higher irrigation efficiencies and/or are easier to manage are assigned higher values. Modifiers are applied based on the level of management and the efficiency of the on-farm water delivery system. A bonus is given if runoff from the irrigated field is captured for reuse.

The final calculation will require a value of the Soil Condition Index (SCI) multiplier. The exact value of this multiplier will be provided to you when NRCS computes your final SCI during your interview. The multiplier will be a value from 0.9 to 1.0 depending on your SCI.

A basic hand calculator is recommended. In addition, basic knowledge of the irrigation system and management practices is necessary. Definitions of the various terms are included in this evaluation.

When the assessment is complete, the planner will have calculated an irrigation enhancement index value for the irrigation system. The Enhancement Index is not an efficiency number, but an indicator of how well the system may perform.

The Irrigation Enhancement Index value for the planned system must be 20% or more than the existing system.

Irrigation System Index

Irrigation System Type	
Border	
☐ Graded Border	80
☐ Level or Basin	90
☐ Guide	70
☐ Contour Level Field Crop	70
☐ Contour Level Rice	80
☐ Contour Level Rice Side Inlets	85
☐ Border Ditch	60
Furrow	
☐ Level or Basin	90
☐ Graded Furrow	75
☐ Contour Furrow	75
☐ Corrugations	75
☐ Surge	80
Flood	
☐ Controlled	60
☐ Uncontrolled	50
☐ Contour Ditch	60
Sprinkler	
☐ Big Gun or Boom	60
☐ Hand Line or Wheel Line	70
☐ Solid Set (above canopy)	75
☐ Solid Set (below canopy)	80
Center Pivot	
☐ Generic	80
☐ Low Pressure Improved	83
☐ LEPA	92
☐ LESA	89
☐ LPIC	87
☐ MESA	85
☐ Variable Rate Irrigation (VRI)	87
Lateral Move	
☐ Generic	82
☐ LEPA, LESA, LPIC, MESA	87
Micro	
☐ Point Source	90
☐ Sprays	85
☐ Continuous Tape	90
☐ Subsurface Drip irrigation	92
Subirrigation	
☐ Subirrigated	75

Method of Measuring Flow	
☐ No Flow Measuring device	0.90
Flow Measurement Used	
☐ whole farm-manually recorded	0.93
☐ whole farm-automatic recorded	0.95
☐ whole farm plus individual field manual	0.97
☐ whole farm plus individual field automatic recorded	1.00

Method of Scheduling Irrigation	
☐ Visual crop stress	0.90
☐ Soil moisture by NRCS feel method	0.93
☐ Check book scheduling, irrigation scheduler, etc	0.96
☐ Irrigation scheduling via pan evaporation or atmometer for field	0.97
☐ Irrigation scheduling via regional weather network	0.98
☐ Soil moisture using Gypsum blocks, moisture probe, etc	0.99
☐ Continuous measurement of soil moisture, water applied and ET	1.00

Ability to Control Water Distribution	
☐ Very poor diversion facilities. Little control of flow rate to farm	0.90
☐ Can control flow rates to farm, but the on-farm delivery system is such that it is very hard to deliver the desired flow to any given field.	0.94
☐ Flow rates to each field are adequately controlled. Flow rates to each set are difficult to control	0.98
☐ All flow rates to each set are adequately controlled	1.00

Soil Condition Index (SCI)

Note: The multiplier will be a value within the range of 0.9 to 1.0 depending on the computed SCI. Use 0.9 for existing system

SCI near 0 - 0.90

SCI (+) - 0.94 or SCI (++) - 0.98 or SCI (+++) - 1.00

A positive SCI rating (zero and above) suggest that soil organic matter levels are predicted to increase

Water Conveyance	
☐ Open ditch or canal - sand/gravel	0.90
☐ Open ditch or canal - sandy loam	0.93
☐ Open ditch or canal - clay soil	0.96
☐ Open canal – lined	0.98
☐ Closed conduit pipeline	1.00

Precision of Land Slope	
☐ Land smoothed	0.90
☐ Land leveled	0.94
☐ Land precision leveled	0.98
☐ Land precision leveled - slope <= .005	1.00
☐ A sprinkler system is utilized	1.00

Tailwater Capture and Reuse	
☐ No Tailwater or Tailwater not captured	1.00
Tailwater Captured	
☐ Irrigation System Type less than or equal to 60	1.25
☐ Irrigation System Type between 61 and 80	1.15
☐ Irrigation System Type greater than 80	1.10

To Calculate Your Irrigation Index Value, MULTIPLY Each of the Values Found for Your Irrigation System

Example in Italics	*Example*	Existing System	Planned System
System type *Graded Furrow*	*75*		
Measurement Method *Whole Farm- manually recorded*	*0.93*		
Scheduling Method *Soil Moisture by NRCS feel method*	*0.93*		
Water Control *Flow rates are adequately controlled.*	*0.98*		
SCI Index *RUSLE 2*	*0.90*		
Water Conveyance *Open Channel - Lined*	*0.98*		
Land Slope *Land Leveled*	*0.94*		
Tailwater Capture and Reuse *Tailwater not Captured*	*1.00*		
Irrigation Index *75 × 0.93 × 0.93 × 0.98 × 0 .90 × 0. 98 × 0.94 × 1.0 = 52.7*	*52.7*		

Descriptions and Definitions

Irrigation System Type: This section represents the system type associated with the field or farm. Some systems are clearly more efficient and easier to manage than other systems. Simply select the system that best describes your system. Local terminology may be slightly different but the system names should be adequate to describe most systems.

Definition of terms related to Center Pivots:

LEPA - Low Energy Precision Application
a) Farmed in Circular Rows (except Linear Move Systems)
b) Nozzle Height is no more than 18 inches above soil surface
c) Nozzle Spacing is alternate row, up to a maximum of 80 inches
d) Discharge is through a drag sock or hose on the ground, or through a bubble shield or pad
e) Only applicable to crops planted with furrows or beds
f) Maximum of 1% slope in most of field
g) Furrow Diked or other means of preventing irrigation water movement away from point of application

LESA - Low Elevation Spray Application
a) Farmed in any row direction
b) Nozzle Height is no more than 18 inches above soil surface
c) Nozzle Spacing is alternate row, up to a maximum of 80 inches
d) Discharge is through spray nozzles
e) Applicable on crops flat planted, drilled, or planted with furrows or beds
f) Maximum of 3% slope in most of field
g) Furrow Diked or other means of preventing irrigation water movement away from point of application

LPIC - Low Pressure In Canopy
a) Farmed in any row direction
b) Nozzle Height is 18 inches to 36 inches above soil surface
c) Nozzle Spacing up to 120 inches (10 feet)
d) Discharge is in the crop canopy
e) Maximum of 3% slope in most of field
f) Systems that utilize bubble nozzles or drag hoses for a portion of the crop year and spray nozzles for a portion of the crop year but do not meet all LEPA criteria should be considered LPIC systems

MESA - Mid Elevation Spray Application
a) Farmed in any row direction
b) Nozzle Height is more than 36 inches (3 feet) and less than 84 inches (7 feet) above soil surface
c) Nozzle Spacing up to 120 inches (10 feet)
d) Discharge is above the crop canopy
e) Maximum of 3% slope in most of field

Variable-Rate Irrigation (VRI), also called site-specific irrigation or precision irrigation, is a relatively new concept in agriculture. Variable-rate irrigation is a tool of Precision Farming that involves the delivery of irrigation water in optimum amounts over an entire field. This system relies heavily on automation with computer control of the pivot movement and pivot angle. The controller cycles air valves to set application rates considering such factors as soil, plant, fertility, and topography.

Method of Measuring Flow: Water measurement is a critical component of any well planned and managed irrigation system. Knowing how much water is delivered to a farm, field, or irrigation set is critical to making efficient use of water.

- **No flow measuring devices** - No flow measuring devices are present. The applicant has no way of measuring and recording the amount of water delivered to the farm, to the fields, or to the irrigation set.

- **Flow measurement - whole farm, manually recorded** - The applicant has a measuring device (calibrated flume or flow meter) that can be used to measure the amount of water that is delivered to the farm. It may be a flow meter on a well that serves one field or a calibrated flume that measures water delivered through a distribution system to the farm. The measurement system does not automatically record the measurement. The applicant must inspect the measurement device and manually record the results in a routine manner and the results used in irrigation planning and scheduling.

- **Flow measurement - whole farm, automatic recorded** - Flow measurement are taken utilizing the process described immediately above but the measurements are automatically recorded and are used in planning and scheduling irrigations.

- **Flow measurement - whole farm plus individual field, manual** - The applicant has the ability to measure water that comes to the whole farm as well as to each individual field. The flow measurements are obtained utilizing a measuring device such as a flow meter. In this instance the applicant can measure the water flowing to the farm and to each field. He routinely checks and records the data manually and uses the results to plan and schedule irrigations.

- **Flow measurement - whole farm plus individual field, automatic recorded** - The applicant has the ability to measure water flowing to the farm and to each field using flow meters or flumes. The results are automatically recorded using a recording device and used for planning and scheduling irrigations.

Method of Scheduling Irrigation

- **Visual crop stress** - Water management decisions are made from visual indicators related to crop growth. In some instances the crops may be stressed before decisions are made to add needed water.

- **Soil moisture by NRCS feel method** - Soil moisture is used as the factor to determine when water is to be added using the NRCS feel method. The manager has received some training and has a publication that describes the NRCS feel method.

- **Check book scheduling, irrigation scheduler, etc.** - A check book method is used to track and schedule irrigations. Training and fact sheets are available from land grant universities and the results are commonly utilized to manage timing and application of irrigation water.

- **Irrigation scheduling via pan evaporation or atmometer for field** - Other slightly more sophisticated systems provide reliable methods for scheduling irrigation water applications. Pan evaporation and atmometers are listed here but other devices may be available.

- **Irrigation scheduling via regional weather network** - An irrigation scheduling system or network that includes weather stations that track climatic conditions and predict irrigation water needs is utilized. These may include on site weather stations or regional weather stations that are operated by commercial or public entities. These networks may be on-line or a group of operators within the watershed area that are moving toward precision water application.
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- **Soil moisture using gypsum blocks, moisture probe, etc.** - Methods to track soil moisture including gypsum block, tensiometers, soil moisture probes and other similar tools are used. With calibration these methods become very accurate.

- **Continuous measurement of soil moisture, water applied and ET** - This combines all methods soil Climate and Checkbook to perform Precision application

Ability to Control Water Distribution: This management enhancement recognizes the ability of the irrigator to manage, direct and control the water flow stream on to the farm, across the farm to one or more fields, and to multiple irrigation sets that may be on the farm or field. The better the control, the higher the irrigation enhancement. Most pumped and piped distribution systems provide adequate control to each set.

- Very poor diversion facilities, little control of flow rate to farm
- Can control flow rates to farm, but the on farm delivery system is such that it is very hard to deliver the desired flow to any given field
- Flow rates to each field are adequately controlled. Flow rates to each set are difficult to control
- All flow rates to each set are adequately controlled – Should be selected for Center Pivots and other pumped and piped distribution systems

Water Conveyance: Water movement across the farm is a critical component. Losses occur from evaporation and deep percolation within the ditch. Sandy soils have more potential for water losses than clay soils. Lined ditches and canals have evaporation losses but limited deep percolation losses. Closed conduits are the most efficient water delivery systems.

- **Open ditch or canal, sand/gravel** - Ditches and canals may involve a combination of soils with part of the conveyance in sandy soils and part in clay soils. Select the factor that is predominant

- **Open ditch or canal, sandy loam** - Ditches and canals may involve a combination of soils with part of the conveyance in sandy soils and part in clay soils. Select the factor that is predominant

- **Open ditch or canal, clay soil** - Ditches and canals may involve a combination of soils with part of the conveyance in sandy soils and part in clay soils. Select the factor that is predominant

- **Open canal, lined** – Concrete, plastic, or other impervious materials

- **Closed conduit pipeline** – Plastic, concrete, or other pipeline materials

Precision of Land Slope: Precision leveled fields have higher efficiency potential and are easier to manage that less controlled grades and slopes. This enhancement category recognizes this factor.

- **Land smoothed** - This factor represents land that has been smoothed. Highs and lows have been manipulated to provide a more uniform flow of water but not to the precision listed below. This is the value that should be selected if any of the factors below do not apply.

- **Land leveled** - Land that has been leveled but conventional survey and construction equipment has been utilized.

- **Land precision leveled** - This factor represents land that has been precision leveled utilizing laser controlled equipment with high quality control. The grade will be more than 1/2%.

- **Land precision leveled, slope <= .005** - This factor represents precision leveled land that is 1/2 % grade or less.

- **A sprinkler system is utilized** - Land leveling is not a component that is considered in any of the sprinkler systems. It is only considered for surface systems.

Tailwater Capture and Reuse: A planned system to collect, store, and transport irrigation tailwater for reuse. This system is used to conserve irrigation water supplies and improve water quality through capture and reuse of the water that runs off the field This system normally includes a combination of practices and appurtenances that collect, convey, store, and recycle irrigation runoff water for re-use. Common components include pickup ditches, sumps, pits, pumps, and pipelines.

The Soil Conditioning Index (SCI): estimates the trend in soil organic matter.
SCI =OM+FO+ER Organic Matter (OM) is the crop biomass factor of the equation while Field Operations (FO) show the intensity that farm equipment breaks down the OM. Added to this environment, the Erosive Factors(ER) or the effect of removal and sorting of soil OM by sheet and rill erosion.

A positive SCI rating (zero and above) suggest that soil organic matter levels are predicted to increase under that cropping system.
However, a near zero or a negative rating suggests the need for an alternative combination of crop rotations and/or a change in the farm equipment or date of implementation. Soil organic matter levels are predicted to decline under that cropping system.