

Developing Tools to Optimize Beneficial Use of Water in the Rio Grande Basin

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Project Overview

Water is a limited resource in New Mexico's Rio Grande Valley. Demand for water is increasing.

Flooding is the predominant method of irrigation in the area, and there is limited potential for irrigation scheduling.

There is a serious need to identify methods to improve water use efficiency in the region.

This project involves the first systematic, wide-scale examination of Elephant Butte Irrigation District (EBID) water application data at the field scale.

These data have only recently become available as a result of EBID's ongoing comprehensive database development.

Analysis of EBID 2001 Irrigation Season Data

Current Research...

- Analysis of EBID records for 2001
- Alfalfa, Pecan, Cotton
- Fields <2 acres
- Spreadsheet format

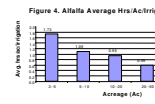
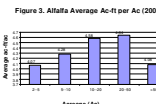
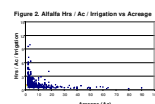
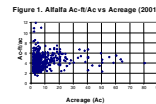
- Spreadsheet files include
- Account data
- Time & duration of irrigation
- Water content
- Irrigated acreage
- Relevant canal

- Spreadsheet data merged with soil type data
- Permeability Index (PI) has been developed

- Data analysis is for farms with only one account representing only one crop, and for fields where EBID water was ordered 5+ times during the 2001 irrigation season.

- Research is examining patterns of water application or irrigation scheduling

- Fieldwork currently underway
- To provide further insight into the results of EBID data analysis



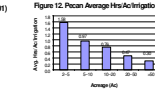
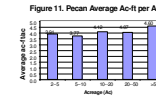
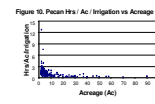
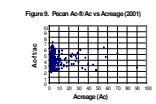
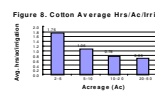
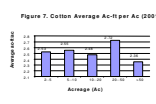
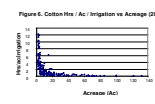
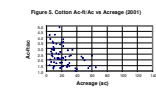
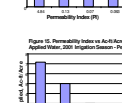
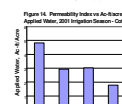
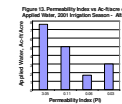
Effect of Soil Permeability on Applied Water

- The effect of soil permeability on the total amount of irrigation water applied to the EBID during the 2001

- As shown in the charts to the right, more permeable (higher PI) soils require greater amounts of irrigation water.

- Less permeable, clay soils are currently irrigated with less water.

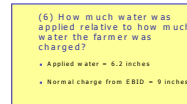
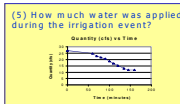
- Fields and crop quality are likely affected by the amount of water applied throughout the EBID.



Project Objectives

- Identify parameters affecting
 - Water needs
 - Water use efficiency
 - Economic returns from water in agriculture in Southern New Mexico's Rio Grande Basin.
- Develop tools which can be used to optimize ag water use across the broad spectrum of water users.
- Develop tools to determine crop water needs and improve irrigation efficiency incorporating information on
 - Crop areas, types
 - Soil types and conditions
 - Climate
 - Available discharge rate
 - Irrigation methods & frequency
 - Farm sizes
 - Farmer socio-economic characteristics
 - Farmer irrigation knowledge

Summer 2002 Fieldwork



Irrigation Scheduling

- The technology transfer aspect of this research project involves training farmers in irrigation scheduling.
- Irrigation scheduling is a management technique to apply the sufficient amount of water at the right time.
- Proper irrigation scheduling includes
 - Measuring soil properties
 - Monitoring soil moisture
 - Identifying irrigation time
 - Measuring flow rate
 - Applying the right amount of water

Permeability Index Description and Application to EBID

Description of the Permeability Index (PI)

- Soil type is an important factor in determining irrigation intervals and potential irrigation efficiency. Soil type is a controlling factor in flood irrigation. Soil type determines the advance rate and frequency of irrigation. Soil type also affects both water use and irrigation efficiency.

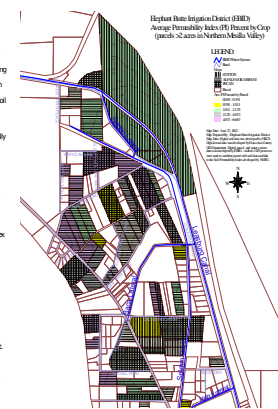
- Since soil characteristics change both laterally and vertically, a method was developed to combine the heterogeneous soil properties into a single parameter called the "Permeability Index" or "PI".

- The PI is a measure of the time required to subdivide the topsoil of soil based on infiltration rate and soil water holding capacity. The PI is first calculated based on vertical soil characteristics and then is averaged across the field using a weighted average approach. The end result is an index which shows the capacity of the field for infiltration and water retention.

- A soil with a high PI indicates potential for low irrigation efficiency and more frequent irrigation. On the other hand, a soil with a low PI indicates potential for high irrigation efficiency, but potential ponding which in turn results in crop stress.

- The PI can be used to identify soils which require more attention in water management.

- The PI has been calculated for EBID soils, with the results shown in the map to the right. This map is for the northern region of the Rio Valley.



Conclusions

- As the competition for water increases, the only way to accommodate various water users, will be by improving water use efficiency. There is the potential to improve on-farm irrigation efficiencies in the study area.
- Alfalfa, cotton, and pecan constitute 75% of EBID's irrigated area. Figures 1, 5, and 9 show applied water per acre for the farms analyzed (using EBID data).

- The following table compares consumptive use for the three major crops and the number of farms exceeding consumptive use (from EBID data):

| Crop | Consumptive Use (Ac-ft/Ac) | Farms Exceeding Consumptive Use in 2001 (from EBID data) |
|---------|----------------------------|--|
| Alfalfa | 4.0 | 52% |
| Pecan | 5.0 | 16% |
| Cotton | 2.5 | 44% |

- The primary reason for over application of water in the study region is lack of irrigation scheduling. Irrigation scheduling is the practice of identifying the proper time of irrigation and the amount of water to be applied. Irrigation scheduling must also be accompanied by flow measurement at farm turnouts.
- Additional insight into potential over-watering is reflected by the duration of irrigation (hrs/acre/irrigation) data. As figures 2, 6, and 10 show, there are wide differences in duration of irrigation. Extended periods of irrigation are often an indication of over application of water.
- The long irrigation durations are caused by various factors, including:
 - Water righted acreage exceeding the actual irrigated acreage
 - Uneveled fields
 - Low discharge rate at the farm turnouts
 - Small farm turnouts
 - Unlined or poorly maintained ditches which force irrigators to work with low discharge to avoid breakage
 - Lack of training and/or lack of economic incentive to conserve water

Acknowledgements

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