2005 Irrigation Research Priority List: Agriculture

The Research Committee of the Irrigation Association® reviews and recommends research needs for the irrigation industry and reports to the IA Board of Directors. With input from the Chairs of the IA technical committees, the Research Committee prioritizes items within each topic area or group. The IA Board of Directors approves the recommendations made by the Research Committee either annually or semiannually.

Items within Groups I through IV are targeted to federal research agencies, university scientists, and industry research specialists. Items within Group V are specific to the research needs of irrigation manufacturers. Only the items within the groups are arranged in their priority of importance with the highest-ranking item listed first.

■ *Group I: Irrigation Water Management Practices and Systems*

Develop more efficient, economical, and environmentally sound agricultural irrigation systems and practices that conserve natural resources while increasing crop production/quality and enhancing agricultural income. Irrigated agriculture provides nearly 50 percent of food security needs for this nation. However, current irrigation practices can utilize in excess of 80% of freshwater supplies in some regions of the United States during peak-use months.

Increase Irrigation Water Efficiency Methods: Irrigation practices and systems (frequency, amount, method of application) need to effectively use water and crop production chemicals for specific crops, field, climate, and soil conditions. Increasing costs of irrigation systems must be offset by more efficient use of water, energy, and chemicals and by increases in quantity and/or quality of product sales. Optimum returns for available water must be the objective for conditions where water is limited by short supplies and, inevitably, increased competition. Increased emphasis must be placed on the use of irrigation systems to sustain, or improve, environmental quality.

Wind Effects: A more clear understanding of the effects of wind on sprinkler irrigation patterns (i.e. wind drift and pattern distortion) and evaporation is needed for improving the design and operations of sprinkler irrigation systems.

Energy Efficient Irrigation Technologies: The inefficient use of energy associated with irrigation pumping and water delivery systems leads not only to increased production costs but also competes with other energy needs. Irrigation technologies and management practice as well as alternative energy sources need to be developed that conserve both water and energy.

Irrigation Databases: Readily available databases providing information on soils, water supplies, crop water requirements, and climatic conditions are needed for the design and operation of efficient irrigation systems and transfer of improved technology. All knowledge bases need to be reviewed and reformatted as new technology is developed.

Crop-Specific Water Requirements: The design of irrigation systems and scheduling of irrigations require that timing and amount of water be specified for all crops grown under irrigation. Research data on evapotranspiration rates (real-time crop water requirements) needs to be developed for different climates and crop conditions in order to improve many of the computer models currently used for irrigation scheduling.

Temperature Control Methods: Irrigation systems have the potential for use in crop cooling and prevention of freeze damage. These capabilities must be researched so that systems may be properly designed and managed to obtain the highest efficiencies and most effective systems available.

Humid Area Irrigation Practices: Schemes for irrigation in humid areas need to be improved. Specific irrigation practices, systems, and recommendations are needed where rainfall can exceed the annual irrigation application amount.

Salinity Management: Agricultural crops extract nearly pure water, leaving salts and toxic trace elements behind to accumulate around the crop roots. The development of improved methods for managing and disposal of the salts and trace elements in irrigation and drainage waters can reduce their harmful effects on soils, ground water quality, and crop productivity.

Reuse of Drainage Waters: Water supplies are limited in many parts of the United States. This has resulted in increased reuse or recycling of drainage waters. In many cases, the reuse or recycling of drainage waters can degrade surface and ground waters, cause soil salinization and deterioration, or result in real or perceived threats to public health. Best Management Practices (BMPs) for use of drainage waters associated with irrigated agriculture need to be developed for specific climatic and soil conditions. The research needs associated with the use of wastewaters are discussed in Group III priorities.

Water Resource Benefits of Agricultural Irrigation Systems: Irrigation and drainage practices can improve or degrade water quality and the environment. The effects of irrigation and drainage practices on the movement of nutrients, pesticides, sediments, pathogens, salts, and trace elements need to be determined for different hydrologic conditions and soil types at the field, farm, and watershed scales.

Other Environmental Benefits of Agricultural Irrigation Systems: Intensively managed agricultural irrigation systems can provide other environmental benefits such as environmental cooling, improved timing and uniformity of nutrient applications, reduced soil erosion, and enhanced habitats for wildlife. Best Management Practices (BMPs) need to be developed and evaluated that will maximize all the potential environmental benefits associated with agricultural irrigation systems.

■ *Group II: Wastewater Utilization on Irrigated Land*

Develop economical irrigation technologies that utilize biological and chemical wastes to prevent environmental degradation and wasted natural resources.

Rural, Residential, Municipal, Food Processing and Industrial Wastes: Disposal of these wastes is often accomplished by using irrigation systems dedicated specifically to this purpose. It is important to determine the design, management and operation criteria for each application.

Animal Manure Systems: Animal manure in solid form is often applied to the land directly. Animal manure in liquid form is typically applied through irrigation systems. Design criteria are required to prevent the degradation of both the surface and ground water sources while maximizing the nutritional benefit of applying the waste on farmlands.

Aesthetic and Health Considerations: Waste disposal can often cause unsightly and other unpleasant conditions. Understanding and development of systems that can be integrated into the surroundings is required. Consideration of insects, odors, and other health affecting issues require added databases and management criteria.

Air and Water Pollution Control Systems: Irrigation systems may offer solutions to controlling air and water pollution as well as providing ways to rehabilitating polluted conditions. Increased information is needed for appropriate selection and management of these systems.

Nutrient Management Considerations: In addition to system design criteria, improved management of irrigation systems is important for the proper utilization of wastes to prevent environmental damage and provide a beneficial use of nutrients contained in the wastes.

■ *Group III: Irrigation Standards and Evaluation Guidelines*

Irrigation standards and evaluation guidelines are needed to improve performance, operator safety, and management of all irrigation systems (turf, ornamental, and agricultural).

Uniformity of Water Applications: Criteria are needed for evaluation procedures that appropriately compare water application, techniques and methods for all irrigation systems.

Optimization of Chemical Applications: Chemicals are often applied with surface, sprinkler, and microirrigation systems. The economics, efficiency and environmental safety of chemical use are not clearly understood. The amount of each chemical and its safe use are important issues and need extensive research for each chemical applied with irrigation water.

Development of ANSI/ISO/EC Standards: The ability to compete in the market place and to provide for the interchangeability of like components can be accomplished only with appropriate standardization. The development of standards is important to the industry and can be greatly enhanced with assistance of university and government scientists. Proper Standards can increase ease of maintenance, safety and operational efficiency for the end user.

Operator Safety Requirements: Safety must be an important aspect of all irrigation operations. The dangers of working with electricity, mechanical devices, and chemicals all must be considered in the design and operation of irrigation systems.

Equipment Safety Requirements: In addition to initial cost and performance, different materials, chemicals, water qualities, and operational environments need to be understood for evaluating different components of systems, and need consideration in the safe and effective design life of systems.

Long vs. Short Term Performance Requirements: Crop and ornamental plant growth may influence the operation of a system. This may yield non-representative results when comparing operational systems to design conditions.

Seasonal vs. Single-Event Evaluation Methods: Many irrigation systems are evaluated at a single point in time. Because a system is used many times during the season, this evaluation may not be representative of overall system management. Uniformity of application over the full growing season is a major issue.

Total Area vs. Inappropriate Subset Evaluations: Often evaluations are made with a sub-sample under an irrigation system. Because of edge effects and system non-uniformity, the sub-sample may yield significantly inaccurate overall performance data. Criteria for evaluating total areas are needed to account for system soil and micrometeorological conditions.

Material Suitability Requirements: The operating environment in terms of water quality, chemical application, and animal pressures is an important consideration in selecting the most appropriate materials. Since most irrigation systems distribute chemicals, standards should be set for chemical interactions and concentrations.

Interchangeability and Compatibility Requirements: The maintenance and operation of systems are much easier when repair parts are compatible and readily available. This also enhances maintenance and operational efficiency of an irrigation system.

■ *Group IV: Irrigation Sensors, Controls and Information Technologies*

Adapt and promote adoption of new computer technologies for irrigation scheduling, system control and operation, and precision irrigated agriculture. These must be consistent with current economic and environmental constraints and must improve collection, processing and management of data by today's irrigation community.

Field and Remote Sensors: Additional data, which can be sensed automatically and retrieved in real time, can provide the necessary input to automate and computer controlled irrigation systems. Crop conditions, soil water status, climatic conditions, and water availability are important parameters that potentially can be monitored and improve irrigation management.

Computer Technologies: Personal computers provide an economically available means to process data and can be programmed for the control and operation of irrigation systems. These technologies can also be adapted to special uses and applications with irrigation systems.

Automated Control Systems: The efficient use of irrigation systems depends on the timely control of the water and chemicals being applied. Improved control can reduce human error or ability to control the system appropriately, thus improving operational efficiency.

Cost Effective Communication Systems: Sensors and computers are ineffective if data cannot be readily transferred between them and to automatic controllers. Reliable communications technology is required.

Geographic Information Systems (GIS): Areas being irrigated are not necessarily uniform. GIS systems provide a technology to process data over space and time. These systems can provide the necessary outputs to permit differential control of the application of water and chemicals and their efficient use.

Global Positioning Systems (GPS): Many remote-sensing options can be more readily accomplished by scanning large areas rapidly. GPS technology can be used to resolve the location of remotely sensed data for direct input to a GIS system and its subsequent use in both design and operation of irrigation systems.

Precision Irrigation Databases: Cooperation by industry, growers, university, states and federal research institutions are needed to develop quality databases for precision irrigation. Readily available databases providing information on soils, water supplies, crop water requirements, and climatic conditions are needed before the design of irrigation systems.

■ *Group V: Irrigation System Manufacturing and Recycling*

Develop efficient, economical environmentally sound manufacturing, recovery and recycling techniques for irrigation systems and components.

System Component Requirements: Compatible materials must be used in manufacturing, design and installation of irrigation systems. Irrigation manufacturers should also account for the recovery of obsolete equipment using appropriate recycling and material disposal techniques.

Manufacturing Process and Disposition Requirements: Pollution of water and air must be minimized during the manufacturing process. It is important to recognize the problems associated with the abandonment of obsolete piping materials, structures and other irrigation equipment, which can be addressed with proper design.

Respectfully submitted by the Research Committee for the IA Board of Directors review and adoption at the 2004 November meeting in Tampa, Florida.

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