Better Research-Extension-Farmer Interaction can Improve the Impact of Irrigation Scheduling Techniques

L.C. Tollefson¹ and M.N.J. Wahab²
(¹Centre Manager and ²Specialty Crops Agronomist)

SUMMARY

Competition for agricultural water increases as the price of water escalates. Irrigation scheduling methodology based on sound scientific practice will gain greater importance as water becomes scarce. Many methods exist currently to schedule irrigation. They are based on soil, plant, and climatic measurements. However, these techniques are not being utilized productively in many parts of the world. There is an obvious need to improve the adoption of irrigation scheduling techniques.

The challenge to researchers must be to develop methodology useful to the irrigation community. Without proper utilization, the research developed is wasted. Acceptance of this technology is dependent upon the economic incentives to farmers. This is where transfer of technology and extension are critical. A well trained and motivated extension staff is crucial for effective information transfer. In addition, the research-extension interface is often weak and must be improved. The technology developed must provide directly measurable results or perceived benefits. Otherwise, the acceptance and usefulness will be limited unless highly subsidized. Better research-extension-farmer interaction is the key to the success of irrigation scheduling techniques. Farmer input in the development of research programs is also critical in improving communication.

INTRODUCTION

Competition for agricultural water is rapidly increasing due to urban expansion, industrial needs, and recreational uses. Efficient irrigation scheduling based on sound methodology is becoming more important as water supplies become scarce and the price of water increases. Irrigation scheduling is often defined as determining when to irrigate and the amount of water to apply. The major objective of irrigation is to produce optimum economic returns through increased productivity by maximizing water use efficiency while reducing irrigation costs (Heerman et al. 1990). Successful irrigation depends on: i) the proper understanding of irrigation scheduling principles and, ii) the development and utilization of appropriate management plans (Martin et al. 1990).

The challenge for irrigation scheduling is to develop methodology, e.g. real time procedures, to suit crop types and/or different environmental conditions. Despite technological advancements, most irrigators do not use real time procedures due to the lack of economic and soil incentives for scientific scheduling. Techniques must be developed and disseminated effectively so that producers can use them. Otherwise, research and demonstration efforts are wasted (Martin et al. 1990).

The issue for researchers is to develop economically viable technology that is readily adaptable to rural society. To be effective, agricultural research must be directed to producer needs and results made available to producers readily and conveniently (Seegers and Kaimowitz 1990). The challenge to extension staff is to deliver this information effectively and ensure proper utilization by the farm clients.

This paper examines the need for the interactive communication between researchers, extensionists and farmers for improving transferability and applicability of irrigation scheduling techniques.

2.1 PROBLEMS WITH IRRIGATION SCHEDULING
In developing countries, approximately 80% of the total water used is for agricultural purposes. Domestic and industrial needs are relatively low. Demand for water is expected to increase in all sectors which will require considerable improvements in efficiency. Major refinement must come from the dominant user, irrigation (Hennessy, 1993). There are various methods for scheduling irrigation based on soil, plant, and/or microclimate parameters (Hillel 1990).

2.1. Irrigation Scheduling Techniques

Irrigation scheduling provides information that can be used to develop irrigation systems for different crops under varying soil and climatic conditions. These strategies may be determined using long term data representing average conditions or in-season factors based on real time information and short term predictions (Martin et al. 1990). Although there are many methods available to determine irrigation scheduling, their applicability is limited due to technical and operational constraints. For example: i) Soil based measurements require tedious calibration procedures, frequent servicing and supervision. These measurements are site specific and need many observations for accurate characterization of a field: this is laborious and expensive. ii) Plant based measurements are usually dependent on visual expression of moisture stress. It is likely that when external symptoms of moisture stress are evident, the crop may be permanently set back. More recent methods of using infra-red thermometry for scheduling irrigation have limited success (Anon. 1988). iii) Irrigation scheduling based on potential evapotranspirational demand described by Penman and other formulae is a widely used concept in different parts of the world. Precise scheduling using meterological data requires well equipped meterological station including irriometers and lysimeters. iv) Irrigation scheduling based on evapotranspiration are being used worldwide (Jensen et al. 1971). Micro-computer capability has vastly improved this technology. The drawbacks in this scheduling technique include the development of appropriate crop coefficients suited for different areas and crop types, and the non-availability of computing facilities to small scale farmers particularly in the arid regions and developing countries.

2.2. Water Pricing

Irrigation systems have traditionally been built, operated and maintained by public agencies with minimal charge for the services. It is estimated that in the third world, the average government revenue from irrigation is only 10-20% of the total delivery cost (Postel, 1990). In the developed world, water is allocated to irrigation districts at costs which do not reflect the real market values (Ives, 1993). This promotes inefficient water management practices. By contrast, when prices reflect scarcity, farmers will use water productively and more efficiently.

2.3. Cost of Scheduling

Irrigation scheduling methods can be costly and time consuming. Unless properly monitored and maintained, they are unreliable. Economic benefits through irrigation can be minimal for low value crops.

Many farmers practice proper irrigation scheduling without using sophisticated instruments and with limited decision making skills (Jensen, 1981). This will continue until any new technology developed would provide directly measurable results or perceived benefits with minimal cost or demand for time. If the benefits are not evident, the acceptance and use of such technology will be limited unless highly subsidized.

Many developing countries (particularly the Asian and African tropics) are characterized by very small land holdings and predominantly a rice-based cropping systems. These conditions of rotational water supply and the supplemental nature of irrigation render many of the modern irrigation scheduling techniques impractical. Further, the benefits through improved water use efficiency and labour utilization are not the most important considerations to these farmers. Viable methodology must be developed to suit these situations (Bhuiyan and Undan, 1990).
2.4. Flexibility

Flexibility in irrigation scheduling is essential. Irrigation scheduling becomes redundant if water is not available when required or if supplied on a rigid schedule without considering diverse crop water needs. This is common in many older irrigation projects where water is delivered to farmers on a predetermined schedule. Lack of flexibility can also be caused by system limitations. In the midwestern U.S.A., when it is hot and dry, the ET for corn can reach 12 mm/day. A centre pivot system designed to provide 63 l/sec can apply 10 mm in a 24 hour period to a 53 ha area, i.e. a shortfall of 2-4 mm per day. Irrigation scheduling here is designed for operating the system 24 hrs per day, seven days per week (Wenstrom, 1980).

2.5. Education

The degree of acceptance of irrigation scheduling technology through extension depends directly on the literacy levels of the farming community. Unfortunately, most of the traditional irrigation systems are located in areas where educational standards are low. It is essential that reliable information is developed and disseminated in a simplified manner understandable to the trainers and end users (Hasan et al. 1993). Government agencies, along with universities and the private sector, must deliver the required training.

2.6. Institutional Concerns

In most countries, the institutions and organizations dealing with water management are many and complex (Tollefson, 1993). Often the assessment of water resources along with the planning and construction of irrigation schemes is the responsibility of national water resources institutes staffed primarily by engineers. On-farm management is usually handled by the ministry of agriculture. Lack of coordination and cooperation between these agencies have contributed to poor water use efficiency. It is difficult to implement a useful irrigation scheduling process under this scenario.

2.7. Behavioral Adaptation

Technology transfer dictates a change in the way people think and behave. Successful technology transfer should take into consideration the expected behavioral changes of people rather than only the physical impact of the new technology in a new environment (Shearer and Vomocil, 1982).

3. TECHNOLOGY TRANSFER

3.1. Role of the Extension Service

Agricultural extension is vital to the development of irrigated agriculture. The extension service is responsible to simplify research information and deliver it to farmers in an effective and easy to understand manner. The extension service also is a feedback mechanism to researchers on problems faced by farmers (Bhuiyan, 1978). The research-extension-farmer relationship should be viewed as an interdependent and inter-related continuum.

Although irrigation scheduling methodology can improve water use, farmers must be convinced of its profitability and applicability. Further, farmers should have sufficient resources and proper knowledge before adopting any new technology. Since the science of irrigation is complex and comprehensive, the irrigation extension worker must have comprehensive expertise and should have good relationship with subject matter specialists.
Extension workers must be devoted and be in close liaison with the farmers they serve. Confidence of the farmers is achieved by well planned and gradual introduction of proven new technology. Useful means of introducing new technologies include demonstration plots, field tours, and instructional meetings.

Knowledgeable and innovative farmers tend to seek advisory help on their own initiative. Unfortunately, this is not the case with less skilled farmers. Ironically, it is this group which badly needs extension help (Sne, 1988).

3.2. Problems with the Extension Service

The research-extension-farmer relationship, although seems ideal in theory, has not been successful in many parts of the world. Extension services in Asia and in several developing countries are under-equipped in terms of staff, transport and accommodation. They often lack the technical skills, particularly in water management. Further, in developing countries, where small scale agriculture is the norm, a wide array of crops are grown in a particular region. This adds another dimension to the level of technical skills and expertise needed by the extensionists. This inadequacy of resources and skills reflect the low priority given by most governments to agricultural extension. This generates poor morale that leads to general ineffectiveness. Benor and Harrison (1977) attribute the following reasons for the malaise of the extension service: i) dilution of effort, ii) coverage and mobility problems (some extension workers deal with 2000-4000 farm families spread over a wide area, iii) lack of training, iv) lack of ties with research, and v) low status in society (low pay, few incentives, poor facility).

In developed countries, there tends to be a greater commitment to acceptance of new knowledge and promoting new practices. This allows technology to be advanced more rapidly. In developing countries, however, information is often not freely shared, authority is not delegated and value systems are different. Despite these differences, farmers and extension workers in developing countries respond positively to recognition, praise, and reward similar to those in developed countries (Shearer, 1987).

3.3. Public Extension Versus Private Consultants

There is a role for both the public and private sector for irrigation related research and extension. Increased involvement of the private sector has often resulted in rapid acceptance, higher efficiency, and increased profitability. The public sector must also be involved, to ensure proper service is extended to more needy farmers and socio-political and equity reasons (Barghouti and Hayward, 1988). A blend of the two will probably produce the best and most sustainable result. The generation of knowledge and dissemination of technology are complex. A structured extension service with effective interaction with farm groups linked to subject matter specialists can be of immense benefit.

In many developed agricultural regions, e.g. in the intensively irrigated areas of the U.S.A., irrigation scheduling consultants offer pay for service. This includes updates, summaries and projections of the water status of individual fields. It works effectively but has a cost involved.

3.4. Research-Extension Interface

The challenge for researchers today is to develop economically viable technology that is easily adaptable to the rural society. Much of the developed world has traditionally followed the paradigm where research is conducted at universities and the resultant technology is transferred through various extension mechanisms to the producer (Tollefson, 1992). Watkins (1990) states that the U.S. land grant institutions follow a "top-down" model of research and demonstration where farmers are the passive recipients of research results based on perceived needs identified by scientists with little input from the end user. Here, scientists are the source of creative thinking. New technologies developed are passed to the extension staff who refine the technology and disseminate it to producers in a easily understandable manner. This model assumes minimal interaction among the various groups. This has
resulted in a uni-directional information flow, i.e. from researchers to producers. A more interactive approach in communication can be very beneficial.

According to the FAO (Anon. 1984), public agricultural research institutions often have poor relations with extension agencies. The World Bank (Anon. 1985) states that, bridging the gap between research and extension is the most serious institutional problem in developing research and extension programs. Extension workers often see researchers working in an ivory tower generating technologies not applicable to the farm (Anon. 1984), whereas researchers often question the ability of the extension agents to perform their jobs effectively (Quimsumbing, 1984).

Thornley (1990) suggests that farmer involvement in agricultural research has been limited by inadequate funding, institutional policies and hierarchies, specialization, and incompatible personalities. He suggests that priorities for agricultural research using public funding should be identified through a democratic process involving farmers in order to provide a better balance between basic/applied research and demonstration.

Better communication among the researchers, extension workers, and farmers is an essential component for improving transferability of technology.

### 3.5. Participatory Research

It is necessary that any technology developed should be adaptable to a wide range of soil and climatic conditions. Gomez and Gomez (1984) describe that in agricultural field research, the effects of uncontrollable factors (e.g. climate) on crop performance is more important than controllable factors (e.g. cultivars, fertilizer rates, etc.). This is particularly important with irrigation scheduling research as irrigation scheduling is based primarily on factors such as precipitation and evapotranspiration that, although predictable, are uncontrollable. More recently, the importance of producer and public participation in research, development and extension has been better recognized. Presently, in Agriculture and Agri-Food Canada, greater emphasis is being placed on identification, recognition and satisfaction of client needs. Cooperative ventures with private sector involvement are being encouraged and pursued.

Changes to the more traditional way of conducting research have raised concerns with some agricultural scientists. Scientists in their search for universal truth, tend to overlook situations at the farm level. Further, scientists are inclined to design their research projects with the view of producing publications, rather than answering on-farm problems. This is due to the fact that under the current set up their career advancements are based mainly on publications and not their contribution to farming. Producers on the other hand want immediate answers to local problems, and are not concerned with the career achievement goals of scientists. Farmers are not interested in experimental details, such as treatments and replications. Some producers are satisfied with decisions based on one year’s data. Many researchers, however, are not prepared to allocate time to projects that are not statistically viable and does not withstand peer review. In many cases, lack of communication between farmers and researchers is a major concern.

According to Francis et al. (1989), the characteristics of a research project useful to producers are: i) plots large enough to provide clear visual results, ii) treatments that require minimal investment or modifications to equipment, iii) focus on yield, profitability and risk reduction, and iv) results that can be utilized on their own farm. By contrast, characteristics of research projects that are useful to a scientist include: i) plots designed for statistical validity, ii) treatments that allow control of non-treatment variables, iii) focus on publishable results, iv) experimental conditions representative of a large region, and v) results that yield universal truth (Gerber, 1992).

It has been suggested that a shift must occur away from the top down hierarchial approach, criticized by farmers as elitist, to an egalitarian and participatory approach in which farmers, researchers and extensionists serve as peers (Watkins, 1990). Thornley (1990) suggests that if we want more public and farmer involvement, the following should be examined: i) basic research is viewed as more
important than applied research in the promotional system, ii) researchers are specialized with often a reductionist view, therefore, researchers should take a systems approach, iii) lack of communication between farmers and researchers (some researchers display a sense of superiority which enrages farmers, farmers conversely feel researchers simply do not understand their problems), iv) researchers should work on issues of priority established by a democratic process. Farmers should help set the course and have some decision making authority and monetary reward. A mechanism is required to satisfy the needs of both groups. Communications is the key to successful participation and interaction of farmers, scientists, and extension personnel. Only through improved communication of these groups that any irrigation scheduling methodology developed will be utilized effectively on a field scale.

**LITERATURE CITED**


For more information, please contact:
Canada-Saskatchewan Irrigation Diversification Centre
901 McKenzie St. S
Outlook, Saskatchewan