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IMPROVING OF IRRIGATION MANAGEMENT: A LEARNING BASED APPROACH

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ABSTRACT

Farmers draw upon a wide range of sources for learning, and change to irrigation management are influenced by the quality of information networks between stakeholders (researcher, extensionist and farmers as part of the agricultural knowledge triangle), and their means of accessing outside information are important adoption factors. As in the case of most occupational groupings, farmers belong to various information networks and have a wide range of abilities and knowledge. However not all farmers learn in the same manner. These factors suggest that to encourage better understanding and implementation of irrigation scheduling practices it is important to focus on how irrigation farmers might learn about these practices.

This paper presents the findings of a study that was conducted to identify social, cultural, economic and technological factors, which influence the adoption of irrigation scheduling practices on the farm. The study showed that irrigation farmers use different learning sources and that informal interaction and social networks play an important role in farmer learning.

1. INTRODUCTION

There is an increasing recognition that in order to understand information seeking, we need to understand the context in which it takes place and which factors to some extent shape it (Chang & Lee, 2000; Cool, 2001 & Solomon, 2002). Information seeking in its broader context is often termed "information behaviour", which is defined by

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Wilson (1999) to include the activities a person engage in when identifying his or her own needs for information, searching for such information and using that information for decision-making.

Today, more than ever, a wide range of information sources on new innovative irrigation practices is available to farmers. The science of irrigation scheduling has a long, illustrious pedigree and a large number of methods and models have been developed to determine when crops require water, and how much irrigation needs to be applied. Studies however, have indicated that farmers do not make use of scientific tools as expected. A national census in South Africa, as part of a Water Research Commission project during 2000–2004, revealed that 18% of the irrigation farmers used scientific–based tools or objective scheduling methods, whereas the majority relied heavily on local knowledge (Stevens, Düvel, Steyn & Marobane, 2005).

Information sharing and dissemination through agricultural extension has been inadequate in the past because of the lack of effective extension units (Shearer, 1987). Furthermore, information left sitting idle in research centres because of inappropriate information dissemination strategies (Malton, Cantrell, King & Bennet-Cattin., 1984). The obstacle has often been the communication gap between researchers and extension personnel on the one hand and farmers on the other. The contention is that the existing communication gap emanates not so much from the language or cultural differences but rather from the methods employed for dissemination of agricultural information.

As in the case of most occupational groupings, farmers belong to various information networks, which include both formal and informal information networks and have a wide range of abilities and knowledge (Kilpatrick, 1997). The quality of information networks between stakeholders (researcher, extensionist and farmers as part of the agricultural knowledge triangle), and their means of accessing outside information are important factors that influence the adoption behaviour as it pertains to irrigation farmers in South Africa. This paper draws on fieldwork conducted among irrigation farmers in South Africa identifying and assessing the dominant learning preferences.

2. LEARNING BY FARMERS

Irrigation farms are small businesses and like any other business, the managers or owners have a wide variety of skills and formal qualifications. Farmers however differ in the length of their experience in farming and their business goals. A variation in styles, preferences and motivation for learning is to be expected. Field (1997) argues that most learning in small business is self-directed, experiential and action–oriented; therefore the emphasis on "delivery of formal training" is often inappropriate. Networks of relationships with other role-players like industry, extension agencies and private firms are particularly important.

The term "learning" is slippery. Learning includes both single loop learning (what and how) as well as double loop learning (why learning). Falk & Harrison (1998) suggest learning has two components: its process and the outcomes of that process. The association between learning and information processing (that is where information is incorporated into the users' framework of knowledge, beliefs and values) is so close as to be almost identical, and therefore only the learning theory has been covered in this paper. Learning has been conceptualized as a process of "intuitive hypothesis testing" with individuals adapting beliefs in order to make sense of new information (Bandura, 1986). Change of behaviour in particular is one of the outcomes of learning. Learning assists people to receive, decode and understand information, and hence make decisions (Thomas, Ladewig & McIntosh, 1990; Welch, 1970).

Adoption of new innovations is a social process, which builds on existing knowledge and practices through interactive learning and collaboration between individuals within networks of organizations and the organization itself (Lundvall, 1992). Farmers network *via* farmer organizations, informal social contact with other farmers, government and cooperative extensionists, producer-purchaser arrangements with food processing companies and retailer–consumer relationships with input suppliers (Phillips, 1987). These networks have features of learning organizations (Senge, 1993), because they enable the social, contextual learning on which farmers respond.

Often literature on farmer decision-making ignores a very important part of the process, which occurs within the farm business, concentrating only on the external information sources and communication channels used by farmers. Phillips (1985) is one of the few studies, which described the role of "intimates", whom he referred to as a checkpoint for information and decision-making, reflecting the importance of trust, support in decision-making and intimacy.

3. METHODOLOGY

This paper uses data that was collected between 2000 and 2004 from a study where the aim was to identify social, cultural, economic and technological factors, which influence the adoption of irrigation scheduling practices on the farm. The research was undertaken in various provinces of South Africa and the project consisted of four parts:

- A quantitative assessment conducted on a national basis amongst 332 irrigation schemes in South Africa, which provides an overview of the implementation and distribution of irrigation scheduling methods and computer models amongst commercial and small-scale irrigation farmers.

- Semi-structured interviews conducted with several small-scale irrigation farmers and key informants on the small-scale irrigation schemes throughout South Africa.

- A stratified sampling method was used to interview 134 commercial irrigation farmers from eight different provinces (Northwest, Eastern Cape, KwaZulu Natal, Western Cape, Limpopo, Northern Cape, Free State and Mpumalanga). The aim was to determine the possible human factors and constraints that impact on the adoption of irrigation practises on-farm.

- The case study research method was used to investigate the different training and development strategies used to enable small-scale farmers to implement objective irrigation scheduling methods on the following four small- scale irrigation projects:

- Tshiombo Irrigation Scheme, Limpopo Province
- Nkomazi Irrigation Project (Low's Creek, Walda, Figtree and Boschfontein), Mpumalanga Province
- Bethlehem Apple Project, Free State Province
- Taung Irrigation Scheme, Northwest Province

The data collected from the studies was verified to ensure accurate presentation and analysis using the Statistical Package for the Social Science (SPSS).

4. RESULTS AND DISCUSSION

4.1 Learning sources consulted by irrigation farmers for irrigation management

The need for the identification of dominant learning preferences by irrigation farmers is useful in designing communication strategies to facilitate learning and to capitalise on the individual's potential. Farmers often differ in the learning sources they access, the manner in which the information is available to them and their motivations for learning. The process of introducing an irrigation scheduling method into the farmers' psychological field or life space requires an appropriate support and communication structures between researchers, irrigation system managers, extensionists, consultants, advisors and farmers.

Farmers draw from a range of sources in their learning about irrigation management and scheduling, and possible changes in irrigation management is likely to be influenced by a number of information sources (Figure 1).

1. Private irrigation consultants
2. Cooperative extension officials
3. Representatives of seed, fertilizer and pharmaceutical companies
4. Fellow farmers or the farmer himself
5. Extension officers from the Department of Agriculture and officials from Department of Water Affairs and Forestry
6. Farmer study groups and growers' societies *inter alia*, avocado, banana, and table grape
7. Representatives and advisors from irrigation companies

8. Commodity institutions or industry specialists *inter alia* , Vinpro (KWV), Cape span (citrus and deciduous fruit), SASRI (South African Sugar Research Institute)
9. Irrigation board scheme or Water Users Association officials

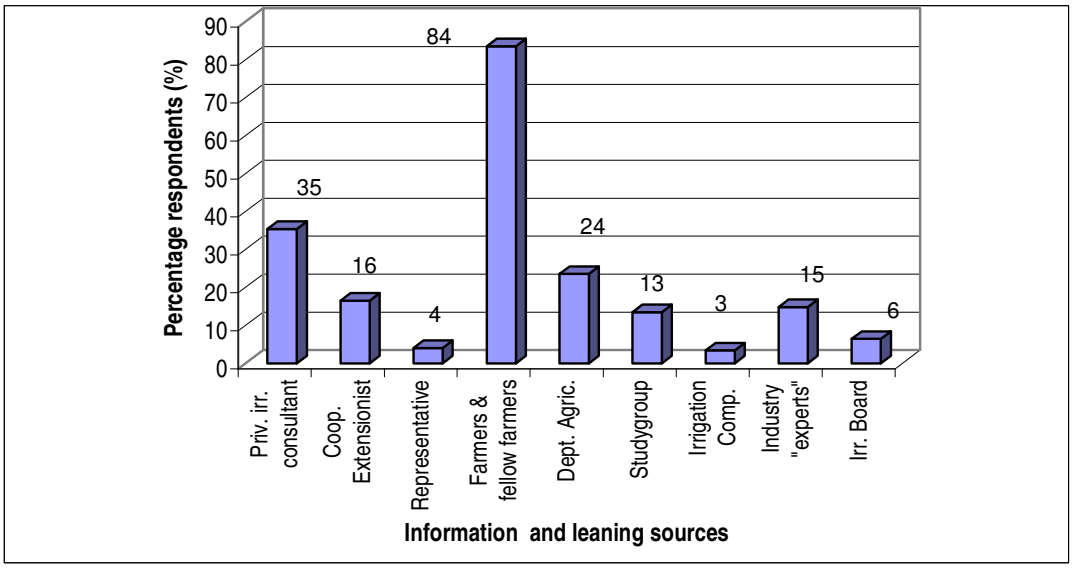

Figure 1: Distribution of respondents according to their use of various information and support system regarding irrigation scheduling (N=297)

Figure 1 indicates that the majority of respondents (84%) identified their fellow farmers and themselves as their primary source for information and support regarding irrigation management- decisions. Farmers often have extensive knowledge of their own farming situations through close observations of the changes on the farm and years of experimentation (through trial and error). Local farm knowledge was regarded as imperative supplementary information needed to understand the scientific "facts" provided by the "experts". This is an important step underlying the process of technology adoption decisions.

Farmers also seek advice from fellow farmers, perceived as "opinion leaders" by their peers. The respondents perceive these "opinion leaders", usually experienced and relatively progressive irrigation farmers, as important sources of information and learning. Informal interaction with other irrigation farmers and social networks played a

very important role in farmer learning. Such farmer-to-farmer interactions provide opportunities for farmers to compare views on how the "new" information could be contextualised within their own situation and to test each other's values, perceptions and attitudes towards making changes based on this information. Knowledge and opinions gained from fellow farmers is perceived to be very valuable to irrigation farmers since it is local and comes from direct experience and observation over time. The information and opinions of fellow farmers are perceived as an important source for both learning for change and continuous learning.

Evidence from discussions with respondents suggested that family members (especially the father of the family) often play an important role in decisions to be taken on the farm, which also includes decisions regarding irrigation scheduling. Many young farmers also referred to the potential "mentor role" that some of the experienced fellow farmers play regarding irrigation scheduling, farm management and decision-making. This acknowledgement of the value of "farmer knowledge and experience" and the interaction between farmers of a community, contribute to the building of social capital of a community which plays an important role in the dissemination of information, learning outcomes and interaction that takes place.

The services of private irrigation consultants and/or other professionals from the cooperatives and industry operating in a specific area are often used in cases where farmers apply computer irrigation scheduling models and/or the use of highly sophisticated scheduling devices like the neutron probe, capacitance sensors, etc. The important roles that farmer study groups and commodity institutions *inter alia* Cape span, Vinpro, and SASRI play in the learning and support rendered to farmers regarding irrigation scheduling were highlighted.

A general tendency that occurs is that "new farmers" in irrigation are more prepared to rely on the support and advice of industrial experts and/or consultants than on opinions shared by fellow farmers. The valuable input received from irrigation consultants and industrial experts was acknowledged especially during the initial phases of irrigation farming. "Industrial experts" are taken here to include professionals that belong to a specific commodity or industry i.e. deciduous fruit, sugar, wine cellars or citrus.

However, amongst the small-scale farmers departmental extension officers are the most frequently used learning source used for irrigation management decisions. Of the 51 small-scale irrigation schemes involved in the survey, contact with private industry experts was limited (14%). The majority of the irrigation schemes depend upon support rendered by governmental extension officers. This tendency is because the focus of extension has changed since 1994. There has been a withdrawal from departmental extension officers serving the commercial irrigator perceived to be adequately supplied, or having the potential of being adequately supplied by the private sector, partly because of funding restrictions but rather because of policy directives to address areas of public rather than private goods. In general departmental extension officers are perceived by many small-scale irrigation farmers as actually responsible for decision-making, while with the majority of commercial irrigation farmers, the "expert learning source" was perceived as a source to aide decision-making.

Irrigation farmers also identified the relative unavailability of appropriate technical support from some research institutions in certain commodities like subtropical fruit and citrus. In these industries, farmers overcame these constraints through the establishment of respective growers' societies and study groups *viz* avocado, banana, mango and citrus. These "interest specific groups" often appoint their own advisors to support farmers with the different production aspects, which also includes irrigation management.

In some irrigation areas where the local cooperative and private consultants for whatever reason are not rendering irrigation scheduling services and support, irrigation farmers (4%) often rely on the consultation from representatives of fertilizer, agrochemical and seed companies. Farmers acknowledged the fact that these representatives are not irrigation "experts", but they identified them as important supportive role-players in irrigation management and excellent linkages with the "outside world". Usually a "recipe" or fixed irrigation-scheduling calendar based on crop growth stage and the number of days after sowing or planting is offered to farmers rather than an irrigation calendar that takes the phenological stage of the crop into consideration.

4.2 Categorizing the learning focus

Farmers approach problem solving and learning in different ways, according to the different styles of farming, the farmers' personal and family business and industry characteristics (Vanclay & Lawrence, 2001). Some farmers prefer listening, others reading, while others learn-by-doing *(experiential learning) (*Dunn & Dunn, 1978). Based on the different information and learning sources that irrigation farmers consult before management decisions are taken regarding irrigation scheduling, farmers can be categorized into four different groups:

- *Localized information source:* This local focused group of farmers makes use of information and advice mainly from fellow farmers, study groups, local experts like departmental extension officers, irrigation board scheme officials, water user association officials and local cooperative officials. This group also perceived local field days and representatives of seed, agrochemical and fertilizer companies as important information sources for decision-making.

- *Specialist or expert advice information source:* This group of farmers consults private irrigation consultants, specialists from the Agricultural Research Council (ARC), industry related expertise like SASRI, Cape span, Vinpro, professionals from universities or tertiary institutions, and designers and planners from irrigation companies in their learning process.

- *Formal and informal training in irrigation scheduling*: Fifty eight percent of the irrigation farmers interviewed indicated that they have attended formal training in irrigation management. Farmers however differ in their preference for using formal or informal training opportunities. The majority of irrigation farmers (62%) interviewed prefers informal sources of learning mainly because they are familiar with these known sources and they can choose learning sources, which fits their specific needs and situation (preference for independence). Fellow farmers and neighbours are often approached for background information and for opinions on the practical implementation of irrigation scheduling.

- *The use of the printed media and information technology (IT) as sources of informal learning:* The most important printed media source used by

the majority of commercial farmers (72%) is either the newsletter or information leaflet from the local cooperative or relevant commodity institution like sugar, barley, or popular articles that occurs in magazines like Farmers Weekly, Landbouweekblad or Nufarmer (small-scale irrigation farmer). The printed media is often used to increase awareness relating to a practice like irrigation scheduling and often acts as a stimulus for further discussion and debate between farmers.

Although computer usage by commercial farmers was found to be common, it is often not used for "learning" about irrigation management, but rather for record keeping, financial management and for obtaining quick and up to date information on marketing and research. The use of existing computer irrigation scheduling models, often built with rigid mathematical methodologies, is still limited (18%) and the majority of irrigation farmers found the use of models and computer programs without the necessary support complex or difficult to interpret.

Understanding the different cognitive styles of individual irrigation farmers or the individual groups of irrigation farmers can assist the extensionist or advisor to exploit the most appropriate means of offering an "irrigation-scheduling package" to farmers. Based on the response of respondents about the information or learning sources they accessed regarding irrigation scheduling, four learning pattern groups of farmers could be identified:

- Farmers who do not consult an additional information source regarding irrigation scheduling on the farm, but mainly rely on their local experience and knowledge in the irrigation decision.

- Farmers that regularly consult at least another learning source before management decisions are taken on irrigation scheduling.

- Farmers that consult at least two additional information sources regarding irrigation scheduling, before making decisions regarding irrigation scheduling.

- Farm businesses that use a wide range of information sources (three or more additional learning sources) before decisions are taken

regarding irrigation scheduling. These sources may include experts, training, fellow farmers, media and general observations.

Figure 2 reflects the degree to which farmers use a multitude of learning sources in the implementation of irrigation scheduling.

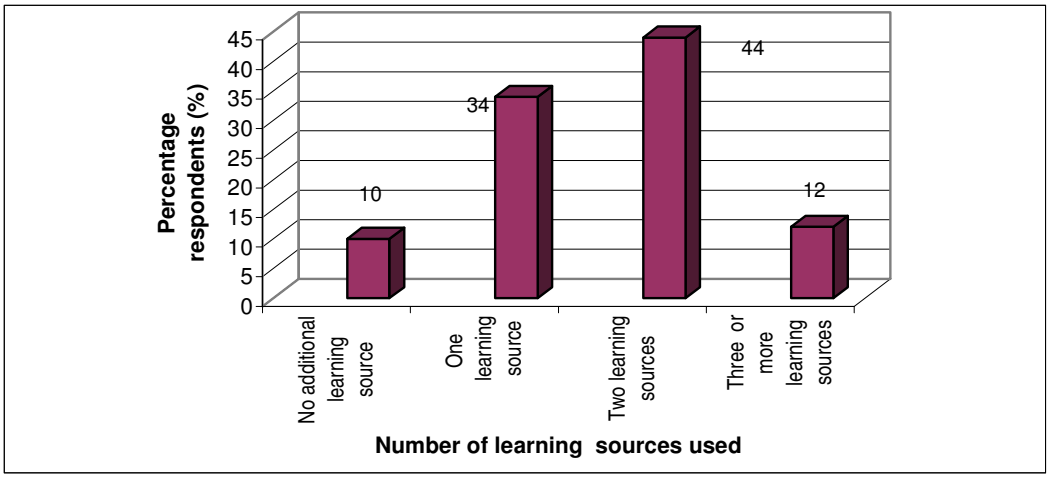

Figure 2: Distribution of farmers according to their use of multitudes of learning sources (N=134)

It is clear from Figure 2 that the majority of irrigation farmers (90%) make use of one or more additional learning sources, while 10% respondents indicated that they rely only upon themselves for decision-making regarding the implementation of irrigation scheduling practices.

A tendency was found that younger farmers are in general more willing to make use of additional learning sources, especially computer-assisted decision support and publications than farmers aged 66 years and older ($r=-0.17$, $p>0.05$). It was also found that as the size of irrigation area increase farmers are generally more prepared to use additional learning sources ($r=0.23$, $p<0.05$) for decision-making. This supports the contention that scheduling is too complex, expensive and time consuming for all but the large grower who often has higher levels of education, higher incomes and flexibility with labour. Farmers with formal tertiary education, in general were more prepared to make use of additional learning sources, while farmers with secondary education

rely more on their local experience. A X^2-test indicated that this was a significant result (p=0.037).

Figure 3 highlights the interrelationship between the number of learning sources used by farmers and the implementation of objective and subjective irrigation scheduling methods.

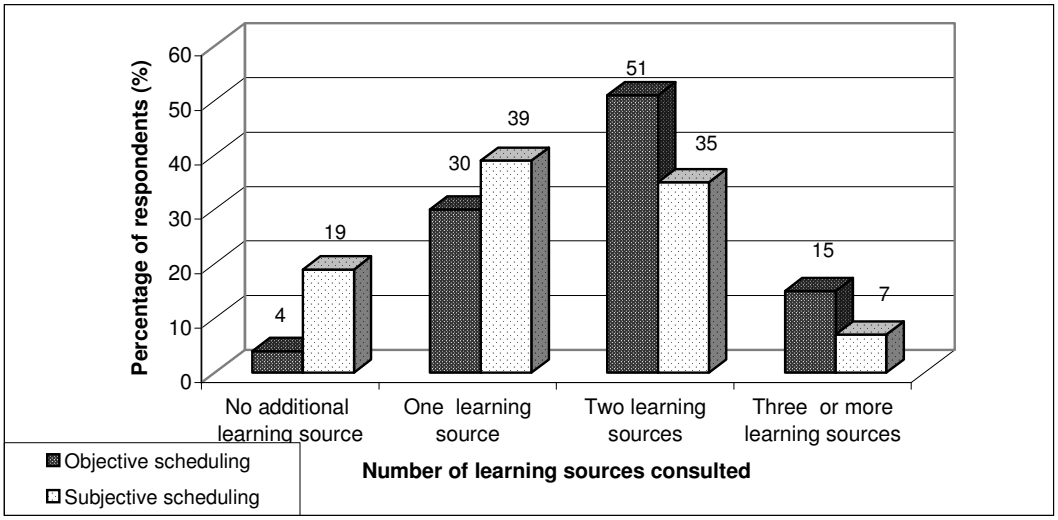

Figure 3: The frequency of learning sources regularly consulted by irrigation farmers and the interrelationship with the application of irrigation scheduling (N=134)

A statistically significant correlation was found between the number of information sources used and the implementation of the type of irrigation scheduling methods (X^2=8.90, df=2, p=0.012). This implies that farmers, who apply objective irrigation scheduling methods, are more inclined to use more than one information or learning source, which often includes the use of specialists or experts in irrigation management. Irrigation farmers involved in the application of subjective scheduling methods are on the other hand more willing to rely on personal experience and perhaps one additional source of information, usually within the boundaries of a specific irrigation area ("localized knowledge").

5. CONCLUSION

These findings proves that it will be incorrect to believe that "science" does have automatic credibility, and legitimacy, but rather that farmers create their own knowledge through external information networks, on-farm trialing and experimentation. Farmers will only use scientific knowledge when it is consistent with their own understanding.

Barriers to participation in learning or change opportunities are factors that are related to individuals, their spouse and family situation; the specific characteristics of their farm and farm business; rural communities or industry. They may also be related to the content, accessibility or delivery of learning and change opportunities present. The challenge exists for scientists and advisors to understand how relatively straightforward scientific concepts manifest in a more complex production system.

The findings also support the general expectation that the technology level of the farmers and their approach to management determines their choice of the irrigation scheduling method selected and eventually the number of learning sources used. Typically farmers choose learning sources according to their needs. Farmers that make use of objective irrigation scheduling methods (fruit/citrus/grape) are more willing to rely on the support from professionals like irrigation consultants and scientific equipment for decision-making. However, farmers that are not involved in the production of high value/high input crops like pastures will most probably use fixed pre-scheduled irrigation scheduling programs based on local knowledge with little or no objective monitoring of soil water.

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