A CONCEPTUAL FRAMEWORK OF A POSSIBLE CURRICULUM FOR TRAINING OF EXTENSIONISTS AND ADVISORS IN IRRIGATION MANAGEMENT

Report to the
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by

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1. INTRODUCTION

It is generally recognised that extensionists provide an essential link between research output and solving the perceived problems which irrigation farmers experience. All types of farmers, but specifically smallholder farmers, are dependant on extension services as a source of information and knowledge. This has been confirmed by a survey amongst emerging irrigation farmers (Water Research Commission, 2003). Discussion forums organised by the Water Research Commission in all provinces between 2000 and 2003, in which a wide range of farmers participated, have highlighted that the extension link has deteriorated in recent years and become less effective.

This report summarises the research findings as derived from consultations held with various stakeholders from the irrigation industry and from baseline surveys conducted among extension officers, subject matter specialists, commercial farmers and irrigation consultants. The aim with these consultations and surveys conducted was to identify the current status of training of irrigation extensionists as well as to identify possible shortcomings with regard to occupational profile of irrigation extensionists and the training curriculum offered to them in irrigation management. A panel of selected delegates discussed these preliminary research findings reached during a workshop held at the University of Pretoria during June 2006 to refine a possible list of modules to be included in the conceptualised curriculum framework for training of extensionists in irrigation management.

2. METHODOLOGY

Guided by the terms of reference the following objectives were set to achieve the deliverables identified for the project:

- Identify extension workers involved with small-scale irrigation farming.

- Identify irrigation training programme offered to extensionists by tertiary and other relevant institutions in South Africa.
- Report on current status of irrigation management training, knowledge and competency of extensionists responsible for the serving of small-scale irrigation farmers.
- Identification of extension workers' perceived preferences of learning about irrigation management (self directed, formal training or informal training viz. experiential learning, short courses, etc.).
- Identification of specific training needs with regard to irrigation management.
- Determine the perceived shortcomings in the occupational profile of irrigation extensionists.
- Identify shortcomings in the current training curricula in irrigation management offered at various training institutions.
- Development of curriculum framework with the main learning areas and objectives.

The database compiled for the search of an appropriate extension approach for South Africa (Düvel, 2002) served as a baseline document for the identification of extension officers serving commercial and small-scale irrigation farmers. It was found to be insufficient to make any profound conclusions with regard to the status of irrigation management training and competency of irrigation extension officers. The current educational curricula regarding irrigation management offered by tertiary organisations (NQF levels 5 and 6) on a national basis were assessed.

This was followed by a quantitative assessment of a stratified sample of 83 extension officers from KwaZulu-Natal, Eastern Cape, Limpopo, Northwest and Mpumalanga working on small-scale irrigation schemes to identify their current competency level with regard to irrigation management. The choice of selection of the survey areas were based on its representativeness of typical situation that exists on the 202 small-scale irrigation schemes that could be ascertained in South Africa (Backeberg *et al*., 1996) and accessibility

(Table 2.1). The latter was an important consideration in view of limited financial resources available for the research.

TABLE 2.1 DISTRIBUTION OF RESPONDENTS INVOLVED IN THE SURVEY AS PER PROVINCE (N=83)

Province	**Small scale irrigation scheme**	**n**	**%**
KwaZulu-Natal	Tugela Ferry	2	3
Northwest	Taung	1	1
Eastern-Cape	Zanyokwe, Keiskammahoek, Qamata, Rainbow, Masinecedane	11	13
Limpopo	Tshiombo, Tshudulu, Dzindzi, Dingleydale, Diepkloof, Khumbe, Palmaryville, Mandiwana, Phadzima	47	57
Mpumalanga	Nkomazi east	22	26
Total		**83**	**100**

Approximately 21% of the 387 extension workers responsible for serving the small-scale irrigation farmers on the irrigation schemes in the RSA were involved in this field survey. These respondents are representative of the perceptions and aspirations of extension workers that are responsible for serving the small-scale irrigation farmers, as it represents the bigger irrigation schemes in the country.

The structured interview of extension workers that serve small-scale irrigation farmers were followed by personal interviews of a stratified sample comprising 32 subject matters specialists, commercial irrigation farmers and experienced irrigation consultants and advisors in the irrigation industry. These respondents act as a soundboard to provide insight into possible shortcomings in the occupational profile of irrigation extensionists.

Previous interim reports indicated that a participatory curriculum development approach was adopted for the development of a framework of possible training curricula for irrigation extensionists. This approach accepts the principle that a training curriculum should never be rigid and inflexible in structure and content, but rather be a dynamic instrument that reflects the education objectives that

are to be attained. After the training needs of the extensionists and the existing educational curriculum offered in irrigation management by tertiary organisations were assessed, key stakeholders were identified and selected to attend a workshop in an endeavour to help with the development of a curriculum framework that reflects the changing perspectives on the nature of irrigation management. The methodology selected for this workshop was based on effective dialogue and interaction between the stakeholders, which serves to incorporate the various interests and a common understanding in the curriculum framework development process.

The analysis of the data involved the use of the statistical package for social science (SPSS Version 12). Before the data was analysed, it was coded, edited and cleansed and modifications were made where necessary.

3. OVERVIEW OF STATUS OF TRAINING OF EXTENSION WORKERS

This part of the report presents an overview of the size of the extension corps, the current status of training and competency of irrigation extension workers as depicted from the baseline study by Düvel (2002), as well as the quantitative assessment among 83 extension workers on small-scale irrigation schemes.

3.1 SIZE OF EXTENSION CORPS SERVING THE SMALL-SCALE IRRIGATION FARMERS

The findings in this part of the report are derived from the database of 1199 extensionists included in the baseline study by Düvel (2002) where 387 extensionists responsible for serving irrigation farmers on irrigation schemes were identified. The distribution frequency of extension workers on the irrigation schemes is indicated in Table 3.1.

TABLE 3.1 THE DISTRIBUTION OF EXTENSIONISTS INVOLVED IN SUPPORTING SMALL-AND COMMERCIAL IRRIGATION FARMERS (N=387)

PROVINCE	Number of irrigation extension workers (N)	%
Eastern Cape	65	17
Free State	3	1
Gauteng	2	1
KwaZulu-Natal	67	17
Limpopo	192	50
Mpumalanga	36	9
Northern Cape	3	1
North West	8	2
Western Cape	11	2
TOTAL	**387**	**100**

Ninety three percent of the extension workers responsible for serving irrigation farmers are found in the Eastern Cape, KwaZulu-Natal, Limpopo and Mpumalanga provinces. This makes sense since 79% of the 202 small-scale irrigation schemes are situated in the Limpopo, KwaZulu-Natal and Eastern Cape provinces (Stevens *et al.,* 2005).

3.2 AGE OF IRRIGATION EXTENSION WORKERS

Figure 3.1 indicates that the majority of respondents (83%) are younger than fifty years of age, which has promising implications for additional training in irrigation management. Younger people are in general more keen and eager to learn about “new technology” and to change their perceptions regarding the potential use of new technology for irrigation management.

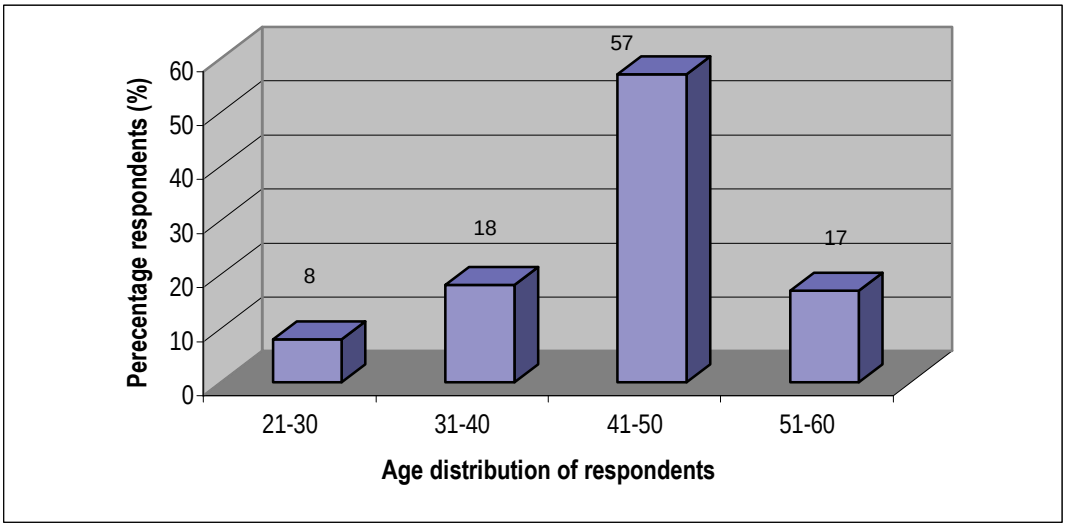


FIGURE 3.1 PERCENTAGE DISTRIBUTION OF RESPONDENTS ACCORDING TO AGE (N=83)

3.3 AUDIENCE FOCUS

Since 1995 the change in policy has led to an increased focus on the subsistence and small-scale farmers as indicated in Figure 3.2.

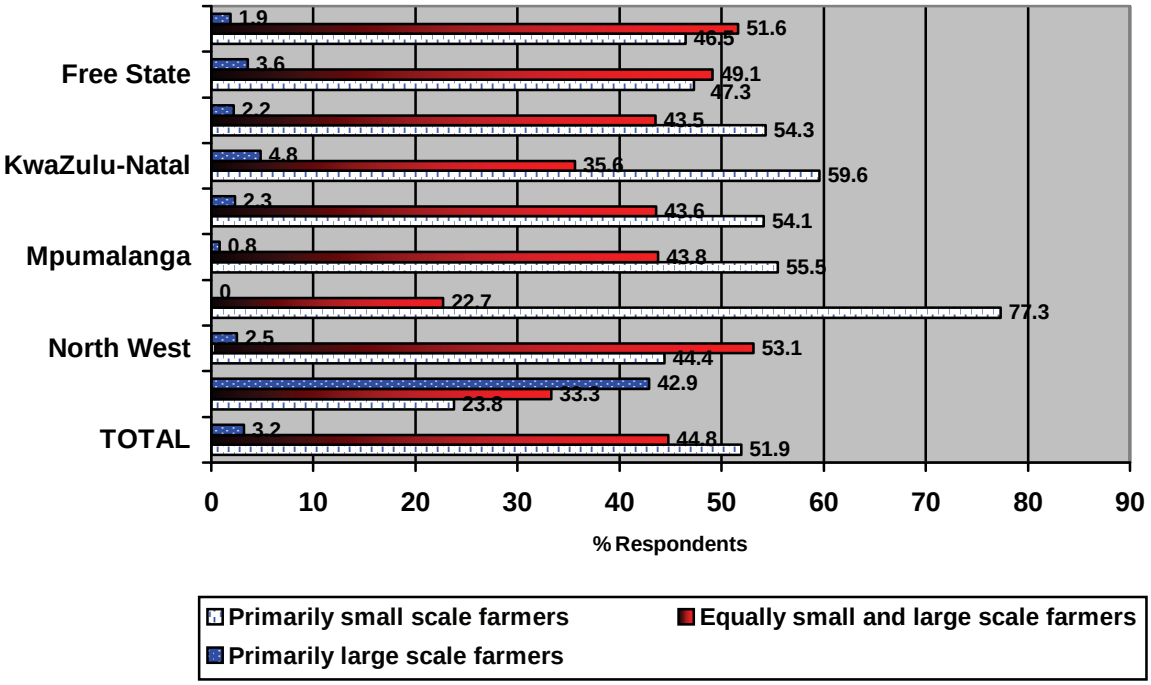


FIGURE 3.2 PERCENTAGE DISTRIBUTION OF RESPONDENTS ACCORDING TO THEIR FOCUS ON SMALL OR COMMERCIAL SCALE FARMERS (N=1199)

51.9 percent extension workers indicated that they primarily serve the small-scale farmers. Even the 44.8 percent respondents classified as serving equally small and commercial-scale farmers, must according to clear evidence obtained, be seen as focusing primarily on small scale farmers. This would imply that 96.8 percent of extension workers in the Department of Agriculture focus on small-scale farming. A clear exception in this regard is the Western Cape; where about 43 percent extension workers serve primarily the commercial farmer.

The focus of extension workers serving small-scale irrigation farmers is illustrated in Figure 3.3.

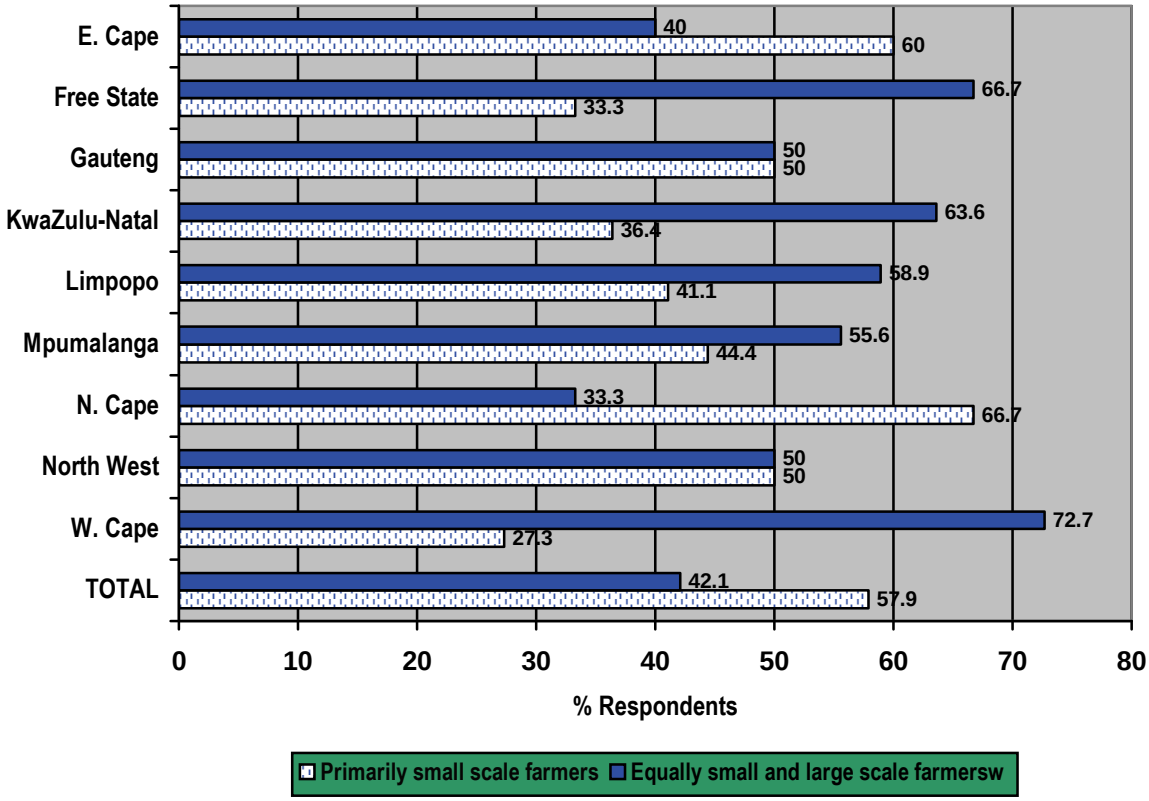


FIGURE 3.3 PERCENTAGE DISTRIBUTION OF EXTENSION WORKERS RESPONSIBLE FOR IRRIGATION SCHEMES ACCORDING TO THEIR FOCUS ON SMALL OR COMMERCIAL SCALE FARMERS (N=387)

Fifty eight percent of the extensionists responsible for irrigation farmers indicated that they primarily serve the small-scale farmers, while the rest

respectively classified as serving equally small and commercial irrigation farmers.

3.4 EXPERIENCE IN IRRIGATION

The extension workers' experience in irrigation was assessed from the time that they have been employed in irrigation areas as well as their involvement with small-scale irrigation farmers (Figure 3.4).

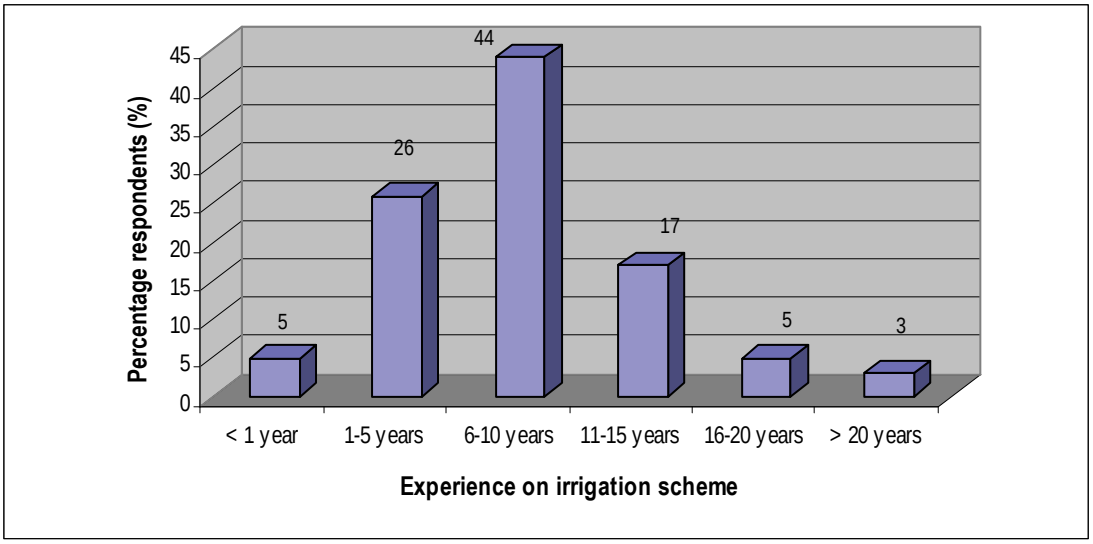


FIGURE 3.4 THE PERCENTAGE DISTRIBUTION OF EXTENSION WORKERS ACCORDING TO THEIR EXPERIENCE IN IRRIGATION (N=83)

Forty four percent of the extension workers are employed on irrigation schemes between six and ten years, with 28% extension workers serving irrigation farmers more than 10 years. With this vast experience amongst extension workers it was assumed that the majority of extensionists would exist of an extensive knowledge of the agro-ecological conditions on the irrigation scheme. The sad fact however is that during the interviews conducted with the sample of 83 extension workers, it became clear that many of them lack basic knowledge and skills required to support farmers with regard to adapted farming practices. They also lack basic knowledge regarding the specific irrigation management preferences and dislikes of their clients. The reasons for this situation could be either that many extension officers lack the necessary aspiration or positive attitude to really become involve in the development of small-scale irrigation

farmers. It may also be because of the current policy adopted by the Department of Agriculture, where extensionists are mainly involved with the regulatory aspects regarding the implementation of development aid programmes like CASP and Massive Food Project, and not necessarily involved with the practising of agricultural extension *per se*.

A significant negative relationship (r=-0.368; p=0.006) exists between the experience of extension workers in irrigation and the formal training in irrigation completed. This implies that more experienced extension workers have less formal training in irrigation management. One interpretation is that this finding is encouraging, since it implies that the younger generation of extension workers are perhaps more appropriately trained and equipped to do the job expected of them. However, it also implies that younger irrigation extension workers cannot expect the necessary knowledge support from their seniors, which has serious implications regarding a possible "mentoring role" that senior extension staff could play in the service.

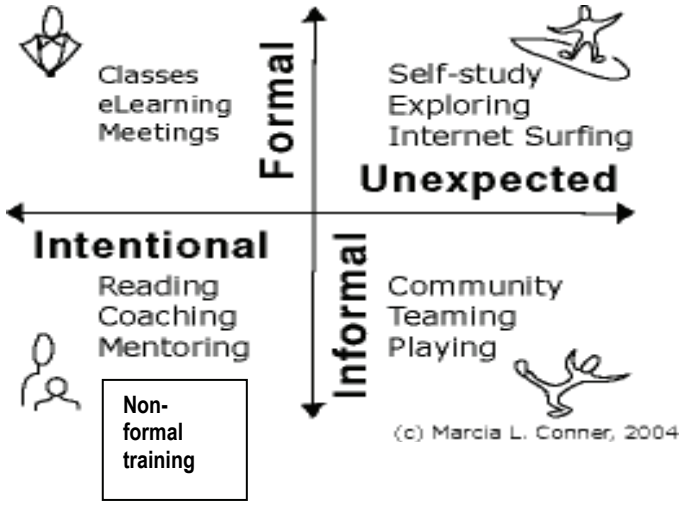
3.5 FORMAL AND NON-FORMAL TRAINING OF EXTENSION WORKERS

The effectiveness and efficiency of extension is a direct function of the competency of the extension staff. This is particularly the case in irrigation extension, where the professional nature of extension lies in the fact that it does not only deal with profound irrigation management techniques or recipes, but has to adapt its message according to the unique environmental, economic, managerial and human specific situation of the irrigation farmer.

Probably the factor that contributes the most to the competence of the irrigation extensionist is his knowledge and skills in both the disciplines of agriculture and extension. Most training, whether formal, in formal or non-formal is focussed on improving of the knowledge and skills base. The distinctions between formal, informal, and non-formal training are only meaningful drawn in relation to a particular context and situation (Conner, 2004). For more on the clarity on

the discussion that will follow, it is essential to differentiate between formal, non-formal training, informal training, intentionally and accidentally learning.

- **Formal learning** includes the hierarchically structured school system that runs from primary school through the university and organized school-like programs created in business for technical and professional training.
- **Non-formal learning** we define as any organized educational activity outside the established formal educational and training system whether operating separately or as an important feature of some broader activity intended to serve identifiable learning objectives.
- **Informal learning** describes a lifelong process whereby individuals acquire attitudes, values, skills and knowledge from daily experience and the educative influences and resources in his or her environment, from family, neighbours, the market place and mass media.
- **Intentional learning** is the process whereby an individual aims to learn something and goes about achieving that objective.
- **Accidental learning** happens when in everyday activities an individual learns something that he or she had not intended or expected.



3.5.1 Formal education level

The highest formal qualifications of extension staff, consisting of frontline extension workers and those associated with support services to small-scale irrigation schemes, are summarised in Table 3.2.

TABLE 3.2 FREQUENCY DISTRIBUTION OF EXTENSIONISTS ACCORDING TO THEIR EXTENSION POSITION AND HIGHEST TERTIARY QUALIFICATION (N = 387)

Position	National Certificate/Diploma in Agriculture		Advanced Dipl/BTech/D-degree		BSc/BSc (Hons)		Masters/MSc/ PhD	
	n	%	n	%	n	%	n	%
Agricultural Technicians	274	84.8	47	14.6	0	0	2	0.6
Scientist	2	10	6	30	7	35	5	25
Supervisors & Managers	5	33	4	27	3	20	3	20
Other support services	9	32	7	24	3	10	10	34
TOTAL	**290**	**75**	**64**	**17**	**13**	**3**	**20**	**5**

The majority of frontline extension workers (75%) have obtained an agricultural diploma, which qualifies them as agricultural technicians but does not place them in the professional category of the scientist. What is positive is the significantly higher qualification of the supervisors and extension managers where 67% of them have an Advanced Diploma or higher qualification, while only 15.2% of the agricultural technicians have this qualification. The significantly higher qualifications of the officers in the support service are to be expected, but the consequence of this is that they should be involved much more effectively in the extension process, particularly for knowledge support purposes.

3.5.2 Field of subject matter specialisation

It is expected of extensionists not to have only an adequate level of tertiary training in agriculture that will satisfy the requirements of their clients, but that subject matter specialisation in an appropriate field is often needed. The distribution of the fields of specialisation of extensionists responsible for the support of small-scale irrigation farmers is shown in Table 3.3.

TABLE 3.3 FREQUENCY DISTRIBUTION OF FRONTLINE EXTENSION WORKERS ACCORDING TO THEIR FIELD OF SPECIALISATION IN AGRICULTURE (N=387)

Field of specialisation	n	%
Extension	184	47
General agriculture	75	19
Animal healthcare	26	7
Crop production	22	6
Home economics	19	5
Animal production	16	4
Rural development	15	4
Horticulture	6	1.5
Agricultural management	5	1.3
Agricultural economics	4	1
Communication	3	0.8
Land use planning	3	0.8
Soil conservation	2	0.8
Irrigation	*2*	*0.8*
Game /wildlife production	1	0.2
Public administration	1	0.2
Soil science	1	0.2
Aquaculture	1	0.2
Crop protection	1	0.2
Total	**387**	**100**

The majority of extensionists (47%) have specialised in the field of extension, while only 0.8% indicated qualifications directly related to irrigation. Six percent of the extensionist is qualified in crop production, while two percent respectively is qualified in horticulture production. These findings clearly illustrate that the majority of extensionists working on small-scale irrigation schemes are not technically competent to render the necessary support expected by small-scale irrigation farmers with regard to irrigation management.

3.5.3 Non- formal training of extension workers in irrigation management

Training applicable to irrigation management either is formal, in formal or non-formal. Non-formal education can contribute significantly to the development of quality staff, as it can train extension workers in a short time, is usually relative cheap and can be aimed at the needs of the specific group, e.g. irrigation extension workers.

Respondents were asked to indicate their attendance of short courses in irrigation management, the training providers of short courses and time lapse since the last training completed (Table 3.4). Only 29% of the respondents have attended short courses in irrigation management.

TABLE 3.4 PERCENTAGE DISTRIBUTION OF EXTENSION WORKERS THAT ATTENDED SHORT COURSES IN IRRIGATION MANAGEMENT (N=83)

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Short courses as source of knowledge support	n	%
Yes	24	29
No	58	70
No response	1	1
Total	**83**	**100**

Thirty three percent of the extension supervisors/managers interviewed also attended some of the short courses that were offered. There is also a tendency that extension officers involved with more sophisticated irrigation systems (36%) like sprinkler, centre pivot and floppy irrigation systems are more exposed to short courses in irrigation management than those involved in furrow irrigation (16%).

As illustrated in figure 3.5, short courses in irrigation management are mainly offered to extension workers by private organisations (50%) and agricultural colleges (31%) in the various provinces.

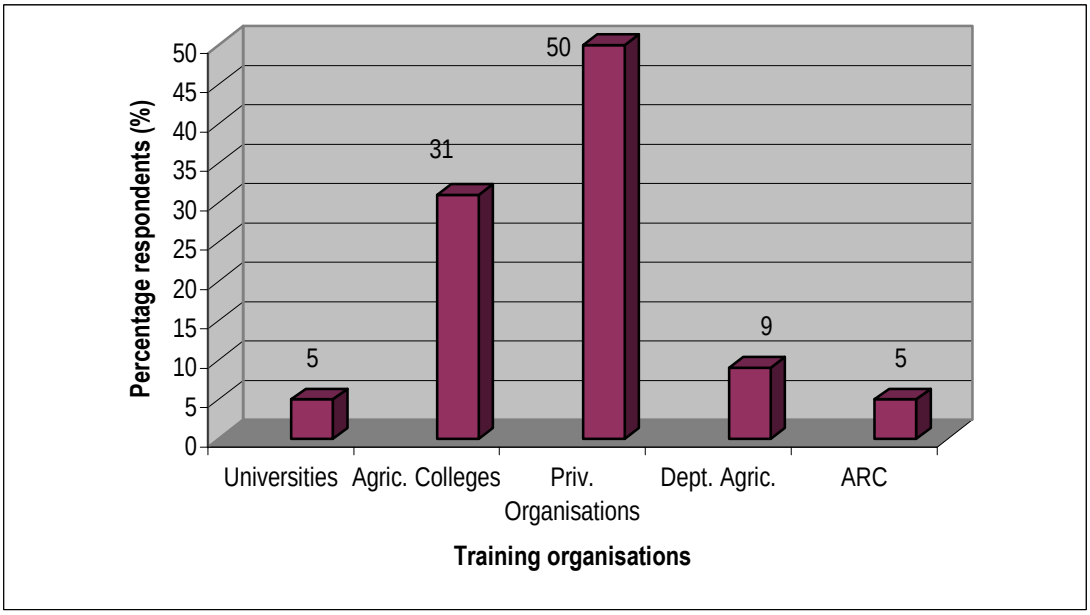

FIGURE 3.5 PERCENTAGE DISTRIBUTION OF THE ORGANISATIONS THAT OFFERED SHORT COURSES IN IRRIGATION MANAGEMENT (N=24)

The relationship between the field of specialisation as indicated by the respondents and their attendance of short courses in irrigation management is illustrated in Figure 3.6.

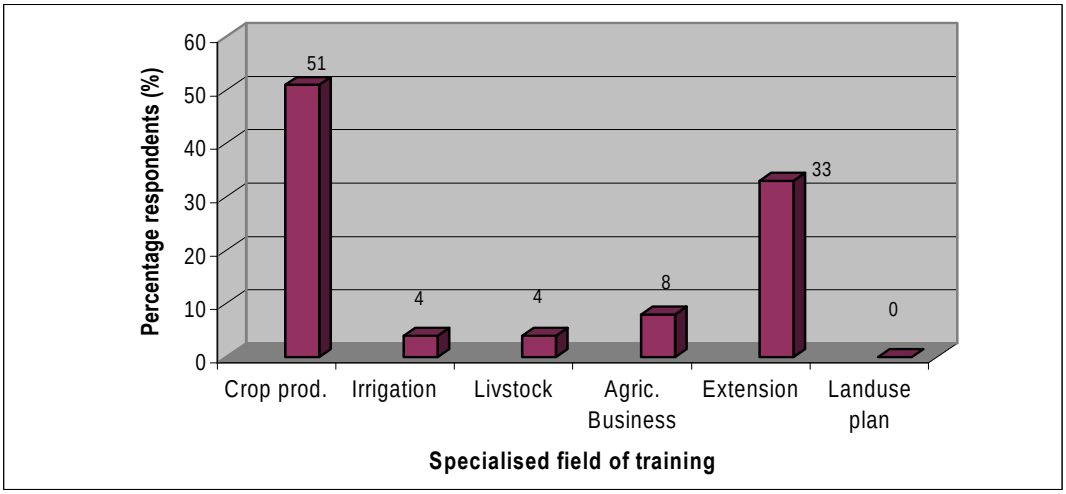

FIGURE 3.6 THE PERCENTAGE DISTRIBUTION OF RESPONDENTS THAT ATTEND SHORT COURSES ACCORDING TO THEIR FIELD OF SPECIALISATION (N=24)

A significant relationship (r=0.266; p=0.025) exists between extension officers with a qualification in crop production and the attendance of short courses in

irrigation management. The content of the short courses offered focussed mainly on aspects and principles of irrigation management.

3.6 PERCEIVED COMPETENCE IN IRRIGATION MANAGEMENT BY FRONTLINE IRRIGATION EXTENSION WORKERS

Because of the impracticability of obtaining reasonably objective indications of extensionists' competence within the limited timeframe allocated for the study as well as the funding, the only alternative way was to make use of subjective or perceived assessments.

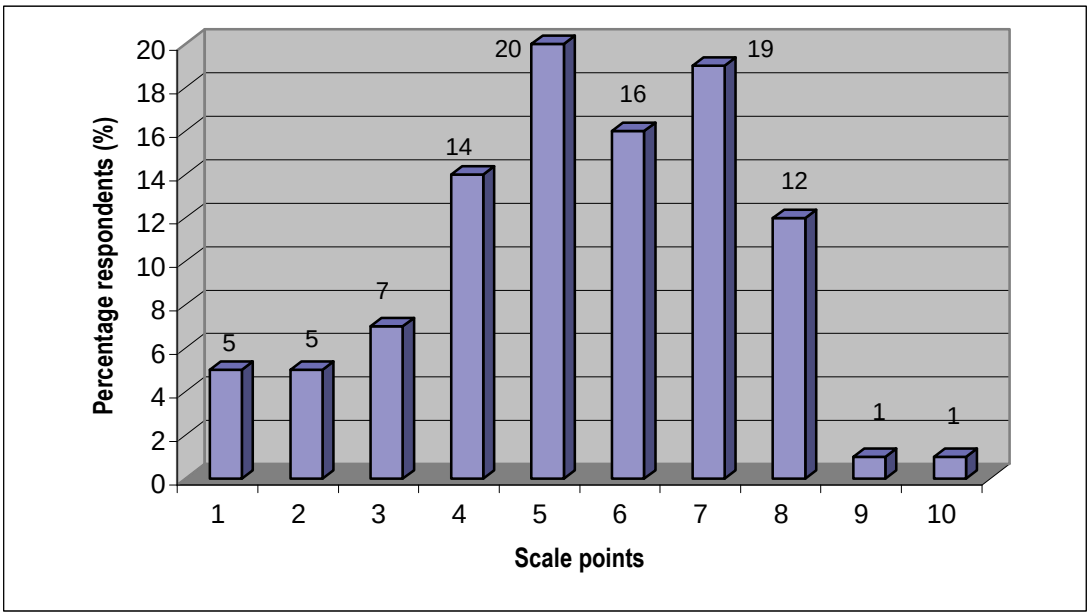

FIGURE 3.7 PERCENTAGE DISTRIBUTION OF EXTENSIONIST ACCORDING TO THEIR ASSESSMENT OF COMPETENCY WITH REGARD TO IRRIGATION MANAGEMENT (N=83)

Figure 3.7 shows the percentage distribution of respondents on selected small-scale irrigation schemes according to their own assessment. The assessment of competency in irrigation management by extensionists clearly indicates that 69 % of the respondents perceive themselves to be competent in terms of skills and knowledge regarding irrigation management.

This confirms the experience by some project team members in the field, namely that many extensionists responsible for serving small-scale irrigation farmers are overrating their own knowledge and competency in irrigation management.

3.6.1. Assessment of irrigation knowledge profile by irrigation extensionists themselves

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The mean knowledge assessment of extension workers by themselves using a 10-point semantic scale (where 1 = extremely low knowledge level and 10= extremely high knowledge level) was used with regard to the following learning areas in irrigation management:

- Crop production or agronomy aspects.
- Soil (cultivation practices, physical and chemical characteristics of soil, irrigation potential, water holding capacity, etc.).
- Use of climate data (ETo, evaporation figures, rainfall, temperature, humidity, etc.).
- Irrigation economics (drafting and interpretation of enterprise budgets, compiling and preparing of business plan for irrigation farming, calculating and interpreting of irrigation operational costs, etc.).
- Irrigation engineering (maintenance of irrigation systems, delivery rate of water sources, monitoring of system efficiency, etc.).

The results of this assessment by extension officers of their knowledge profile on irrigation management are illustrated in Figure 3.8.

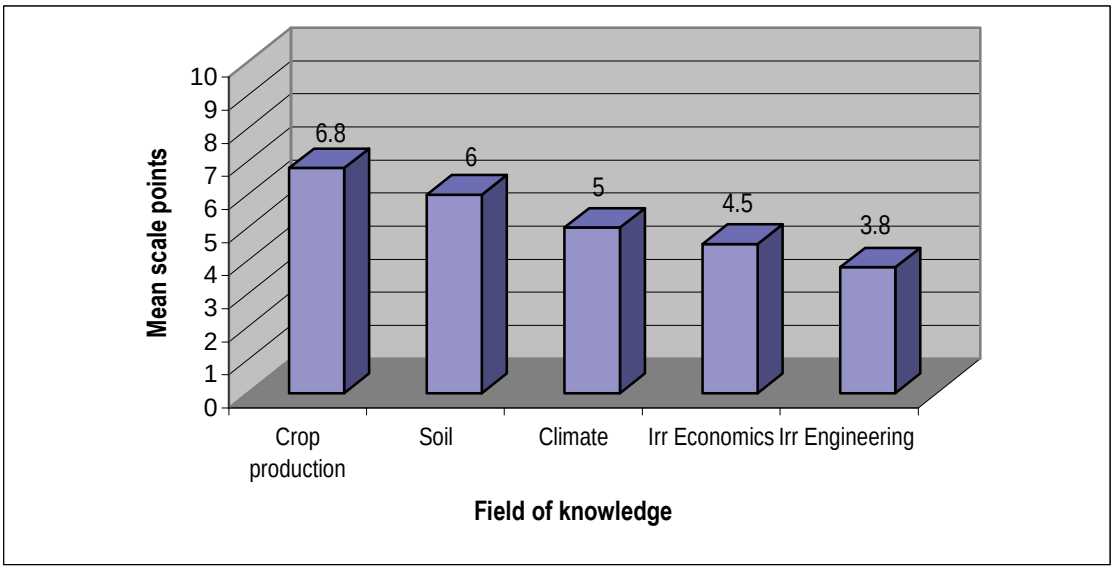

FIGURE 3.8 THE MEAN KNOWLEDGE ASSESSMENT OF EXTENSION WORKERS BY THEMSELVES OF THE DIFFERENT FIELDS OF IMPORTANCE IN IRRIGATION MANAGEMENT USING A 10-POINT SCALE (N=83)

Extension officers perceive their knowledge levels with regard to crop production, soil science and the use of climatic data as adequate (with a mean score of 5 points and above). However, it is clear that they perceive their knowledge levels with regard to irrigation economics and irrigation engineering to less adequate. Perhaps this is a modest indication and not necessarily a realistic indication of the shortfall of the knowledge required, and emphasise the need for an appropriate knowledge support system.

The need for this knowledge support lies first of all in an understanding that the educational curricula offered to the majority of extensionists at agricultural colleges mainly focus to train students on general agricultural aspects like crop and soil production principles. However, with regard to irrigation engineering, irrigation economics and climate, more specialised training and knowledge is often required. Therefore the need for maximum knowledge support by specialists with regard to these three learning areas lies in the impossibility of the individual dealing on a specialist level with a wide variety of commodities or enterprises in a unique agro-ecological environment and socio-economic situation.

3.7 PERCEIVED PREFERENCES WITH REGARD TO APPROPRIATE TRAINING METHODS

A closer analysis of the perceived preferences with regard to learning by extension officers revealed clearly that 85% extension workers prefer non-formal and self-directed training methods and approaches.

TABLE 3.5 THE PERCENTAGE DISTRIBUTION OF EXTENSIONISTS REGARDING THEIR PREFERENCE OF DIFFERENT TRAINING METHODS APPLICABLE FOR TRAINING IN IRRIGATION MANAGEMENT (N=83)

Training method	Mean weighted percentage (%)
Formal training	14.6
In-formal/self directed training	85.4

The preferred training approaches indicated by the respondents show highly significant preferences for self-directed or informal training for the learning areas crop production (r=0.311; p= 0.009), soil science (r=0.427; p=0.049) and irrigation economics (r=0.424; p=0.050). The preference by extensionists for informal training or self-directed study with regard to irrigation economics and soil is further highlighted by negative correlations been indicated for formal training for these specific fields. Significant preferences for both formal and self-directed training in irrigation engineering and irrigation management exist.

Training regarding meteorology (climate) is the only learning area where the respondents did not indicate a clear preference for a specific training method. A possible explanation could be the fact that many extensionists seem to be unsure what to expect from such a training curriculum to be offered.

4. OVERVIEW OF TRAINING CURRICULA PRESENTED BY TERTIARY ORGANISATIONS

An assessment of current training curricula in irrigation management, which are presented to agricultural students by tertiary organisations, revealed that the majority of tertiary organisations allocate fairly small percentage training to irrigation management.

At NQF6-level the University of the Free State seems to provide the most comprehensive irrigation training that could lead to either a BSc Agric or a B Agric qualification. This qualification includes courses in soil science, agronomy, agro-meteorology and irrigation engineering. The University of Fort Hare also presents what seem to be fairly comprehensive B Agric and B Sc Agric courses in irrigation. The Universities of Pretoria and Stellenbosch have irrigation-related content included in either their Soil Science or Plant Production courses. The Universities of KwaZulu-Natal and Zululand has several trans-disciplinary programmes in agriculture with focus on a systems approach to sustainable agriculture and rural development. To what level irrigation planning and management is included, could not be ascertained.

The Central University of Technology (Free State Province) includes a course in irrigation design based on the content of the South African Irrigation Institute (SABI) design manual as part of their B Tech course, while Tshwane University of Technology includes irrigation management as a module in the training provided to students in crop production (B Tech level).

At the NQF5-level the majority of agricultural colleges offer training in irrigation management mainly as one or two modules, which usually forms part of the fundamental training provided in crop production. However, the Lowveld Agricultural College is the exception to the rule, where a student could specialise in irrigation management with regard to either agronomy or horticulture. At this agricultural college, it was found that a student must

successfully complete irrigation management as one of the core courses, before he/she will be promoted to the final year of study. At Elsenburg Agricultural College, students receive basic training in the management and design of irrigation systems, where the curriculum content is based on the SABI Irrigation Design Manual. This training provides the students with basic knowledge and skills to operate and manage irrigation systems on a farm-level, but not to design an irrigation system.

5. PERCEIVED KNOWLEDGE PROFILE OF IRRIGATION EXTENSION WORKERS

As part of the participatory approach adopted with this study, the sample of 83 extension officers as well as 32 subject matter specialists, progressive commercial irrigation farmers and experienced irrigation consultants/advisors were involved in the assessment on the perceived technical competency in irrigation management and extension of irrigation extensionists serving the irrigation farmer.

After extensive consultation and discussions with experts in the irrigation fraternity, the following seven technical learning areas in irrigation management were identified to be included in a training curriculum in irrigation management offered to extensionists:

- Soil and topography of the farm (irrigation potential of different soil types; soil compaction and related problems, etc.).
- Crop production (crop growth and water requirements, sensitivity of different crops, general crop management requirements).
- Climate (influence of climate on crop growth, crop choice, irrigation requirements).
- Irrigation economics (capital investments operational costs of different irrigation systems, etc.).

- Irrigation engineering (soil-plant-atmosphere requirements and hydraulic principles of importance with designing and planning of an irrigation system).
- Water use efficiency on-farm (water budgets, etc.).
- Extension and institutional arrangements (group mobilisation, leadership development).

5.1 PERCEIVED LEVEL OF SUPPORT RENDERED BY IRRIGATION EXTENSIONISTS

The objective with this part of the study was to determine the perceived status of technical training in irrigation management and extension delivery of irrigation extensionists. This was done through the stratified selection of 32 commercial farmers, subject matter specialists from the irrigation and extension fraternity as well as senior advisors and extensionists (advisor/EO) operating in the irrigation environment. The findings of this assessment helped to determine the current level of formal technical training in irrigation management and extension offered at tertiary organisations. It also helped to provide insight into possible critical shortcomings with regard to the occupational profile of extensionists as perceived by their clientele (farmers) and colleagues (subject matter specialists and senior extensionists and advisors).

5.1.1 Perceived extension support on aspects of soil science

The competency and knowledge level of extensionists with regard to the evaluating of the irrigability of soils for irrigation, calculation of the water holding capacity of soils and identification and support with the rectifying of sodicity, salinity and pH problems was assessed by commercial irrigation farmers, subject matter specialists and senior irrigation extensionists using a five–point Likert scale and are illustrated in Figure 5.1.

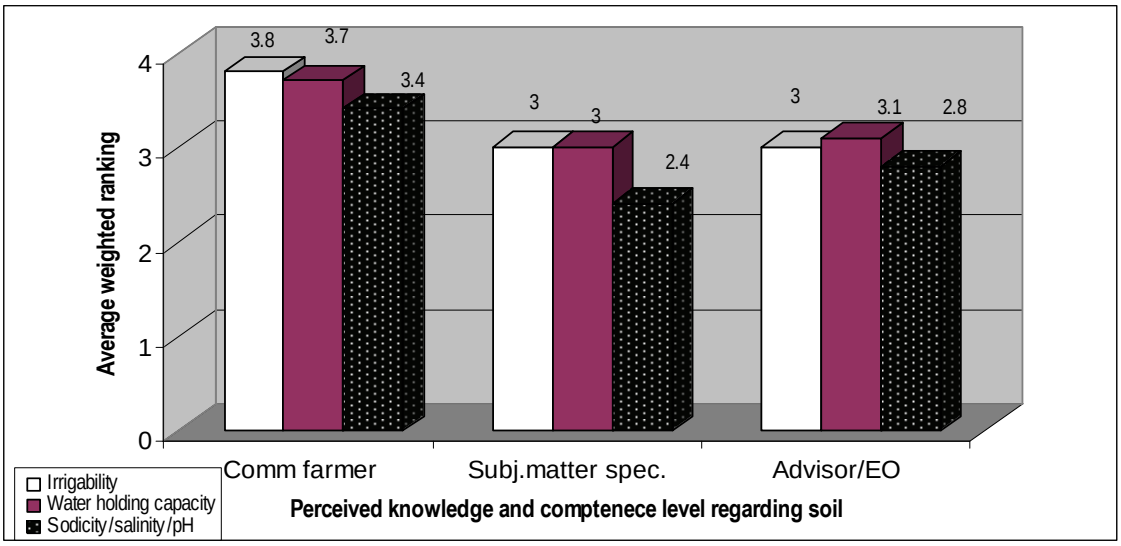

FIGURE 5.1 PERCEIVED COMPETENCE AND KNOWLEDGE LEVEL OF IRRIGATION EXTENSIONISTS ON ASPECTS OF SOIL EXPRESSED AS MEAN SCALE POINT (N=32)

General satisfaction with regard to the knowledge and skills of extensionists on aspects of soil science exists. The findings illustrate that the commercial farmers are in general more satisfied with the competency level of extensionists with regard to soil potential aspects than subject matter specialists and the advisor/EO group. Respondents are however concerned about the technical knowledge and skills of extensionists when they are faced with problems that concern salinity, sodicity and pH problems experienced in the field. The biggest shortcoming identified with regard to current training programmes offered is the lack of opportunities to improve the practical skills of extensionists on the evaluation of soil properties (texture, structure, soil water holding capacity, etc.).

5.1.2 Perceived extension support on crop production

Irrigated crop production challenges the capacity of farmers as decision makers with regard to their ability to manage an intensive enterprise under environmental conditions that could be selectively controlled by the manager. However, this necessitates a good working knowledge and skills on several issues with regard to the specific enterprise that will be selected. With this in

mind, the support that an extensionist should offer must be based on comprehensive knowledge and practical skills of crop production.

Commercial irrigation farmers, subject matter specialists and the advisor/EO group assessed the competency level of extensionists with regard to the following aspects of crop production:

- Adaptability of various irrigated crops to different soil, water and climate conditions.
- The principles that apply to the implementation of crop rotation for sustainable crop production.
- The influence of irrigation management on the practising of weed management on irrigated crops.
- The implementation of sound pest and disease control under conditions of irrigation.
- Principles with regard to fertilisation and fertigation under conditions of irrigation.
- The necessary knowledge to calculate the crop water requirements based on climate, soil and irrigation system capacity.
- Crop growth stages: Can you deliver enough water to meet the peak crop water requirements?

Respondents are relatively satisfied with the competence and knowledge displayed by extensionists with regard to crop production (Figure 5.2). However the general ability of extensionists to help farmers with the calculating of crop water requirements was found to be inadequate. The most important shortcomings with regard to the training curriculum identified are: practical skills with the application of on farm irrigation scheduling, knowledge and skills with regard to the planning of weed, pest and disease management under conditions of irrigation.

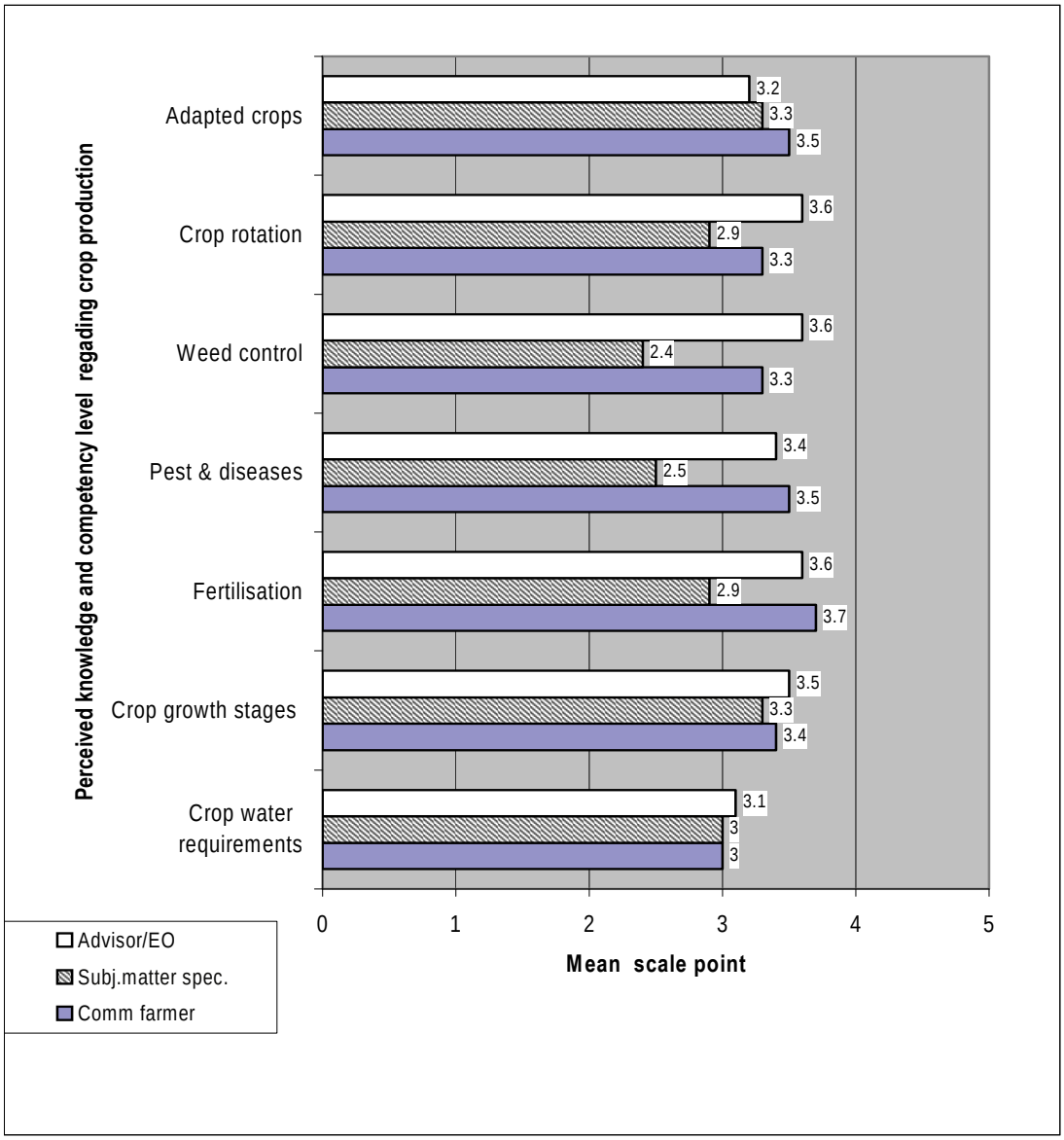

FIGURE 5.2 PERCEIVED COMPETENCE AND KNOWLEDGE LEVEL OF IRRIGATION EXTENSIONISTS ON ASPECTS OF CROP PRODUCTION EXPRESSED AS MEAN SCALE POINT (N=32)

Subject matter specialist were more critical in their assessment, and indicated significant shortcomings with regard to competency required for the planning of sustainable crop rotation programs, advice on weed, pest and disease management under irrigation conditions, the general planning of fertilisation programmes and also the calculation of crop water requirements for implementation into an irrigation management strategy.

5.1.3. Perceived extension support on aspects relating to the role of climate

The technical knowledge and insight of extensionists with regard to the role of climate within the plant-soil-atmosphere interaction is fundamental for supporting farmers with the planning of sustainable and easy to implement on-farm irrigation strategies. The assessment of the competency of extensionists was done on a five –point semantic scale (Figure 5.3) with regard to:

- Ability to collect data on the climate (meteorological data) of a specific area and to interpret that for the use in decisions to be taken on adapted crops for the specific conditions.
- Ability to help farmers to understand the effect of climate conditions on the calculation of crop water requirements.

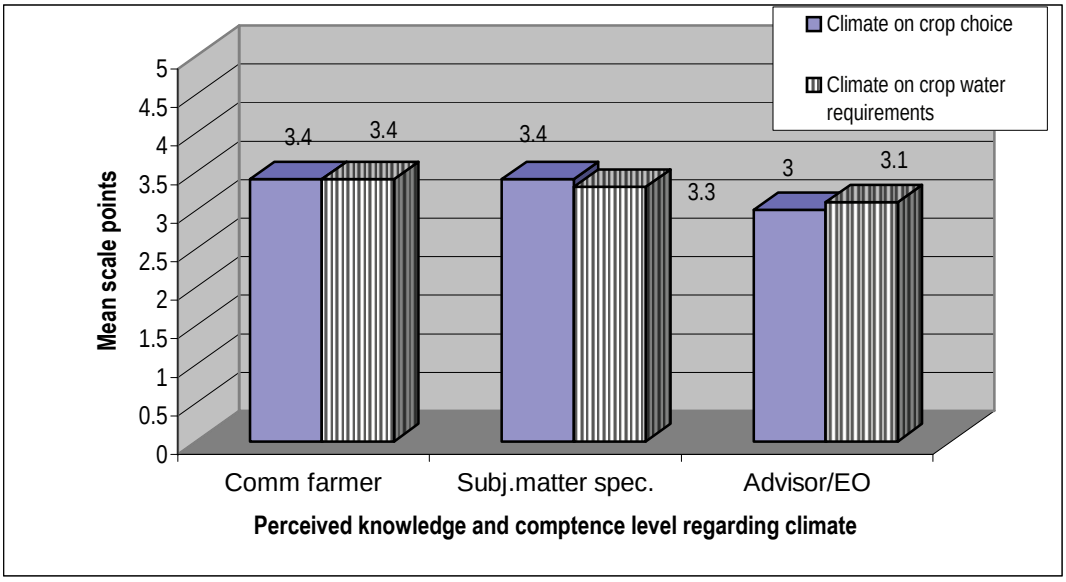

FIGURE 5.3 PERCEIVED COMPETENCE AND KNOWLEDGE LEVEL OF IRRIGATION EXTENSIONISTS ON ASPECTS OF CLIMATE EXPRESSED AS MEAN SCALE POINT (N=32)

The major shortcoming identified with regard to the current training programmes provided to extensionists is the lack of capacity required to

interpret climate data for inclusion into on-farm irrigation management strategies.

5.1.4 Perceived extension support on aspects relating to irrigation economics

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The competency level of extensionists on irrigation economics were assessed on a five-point semantic scale using the following aspects:

- Knowledge with regard to capital costs relating to on-farm storage, supply and filtration systems; pumps; irrigation application system and competency to help with the calculation of the risk involved with these decisions.
- Support to help farmers with the drafting of enterprise budget that could be used in a business plan. This business plan of the farm will be based on a proper irrigation management plan where also marketing strategies are displayed.

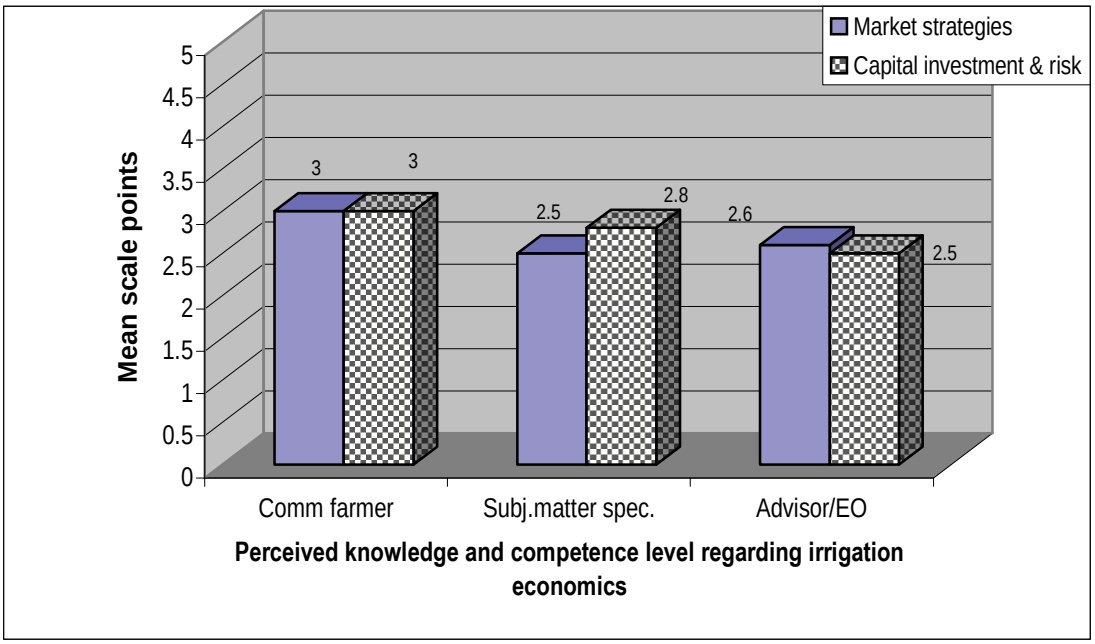

FIGURE 5.4 PERCEIVED COMPETENCE AND KNOWLEDGE LEVEL OF IRRIGATION EXTENSIONISTS ON ASPECTS OF IRRIGATION ECONOMICS EXPRESSED AS MEAN SCALE POINT (N=32)

The assessment of the respondents (Figure 5.4) showed concern about the general competency of extensionists with regard to irrigation economics. The major shortcoming identified in current training programmes offered is the relative poor training of skills with regard to the drafting of a business plan for the irrigation farmer, especially within an environment of increasing water tariffs.

5.1.5 Perceived extension support on aspects relating to irrigation engineering

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The irrigation infrastructure associated with irrigation commonly represents one of the largest on-farm capital investments by the irrigation farmer. However in many cases, irrigation infrastructure is selected with little reference to future irrigation requirements or specification of minimum levels of performance and maintenance. Basic knowledge and understanding of the principles that apply with regard to the selection of appropriate irrigation infrastructure is required by the extensionists for effective support of the irrigation farmer.

The competencies of extensionists with regard to the following aspects of irrigation engineering were assessed (Figure 5.5):

- Assessment of the volume of water available, reliability of water sources on the farm, access limitations applicable.
- Basic hydraulic principles and other factors to be taken into account with the design and planning of irrigation systems to assure that enough water can deliver to meet the crop water requirements.
- On farm conveyance and distribution system: on-farm pumping, planning of distribution system, water losses and leaks, maintenance, etc.
- Principles that apply with the selection of appropriate irrigation systems (personal preferences and factors like soil suitability, crop, climate, economy, etc.).
- Evaluation and routine maintenance requirements of selected irrigation system (application rate, distribution uniformity).

- Satisfaction of required capacity, where the farmer must be supported to manage irrigation and soil in a manner that soil water storage is maximised and evaporation losses minimise.

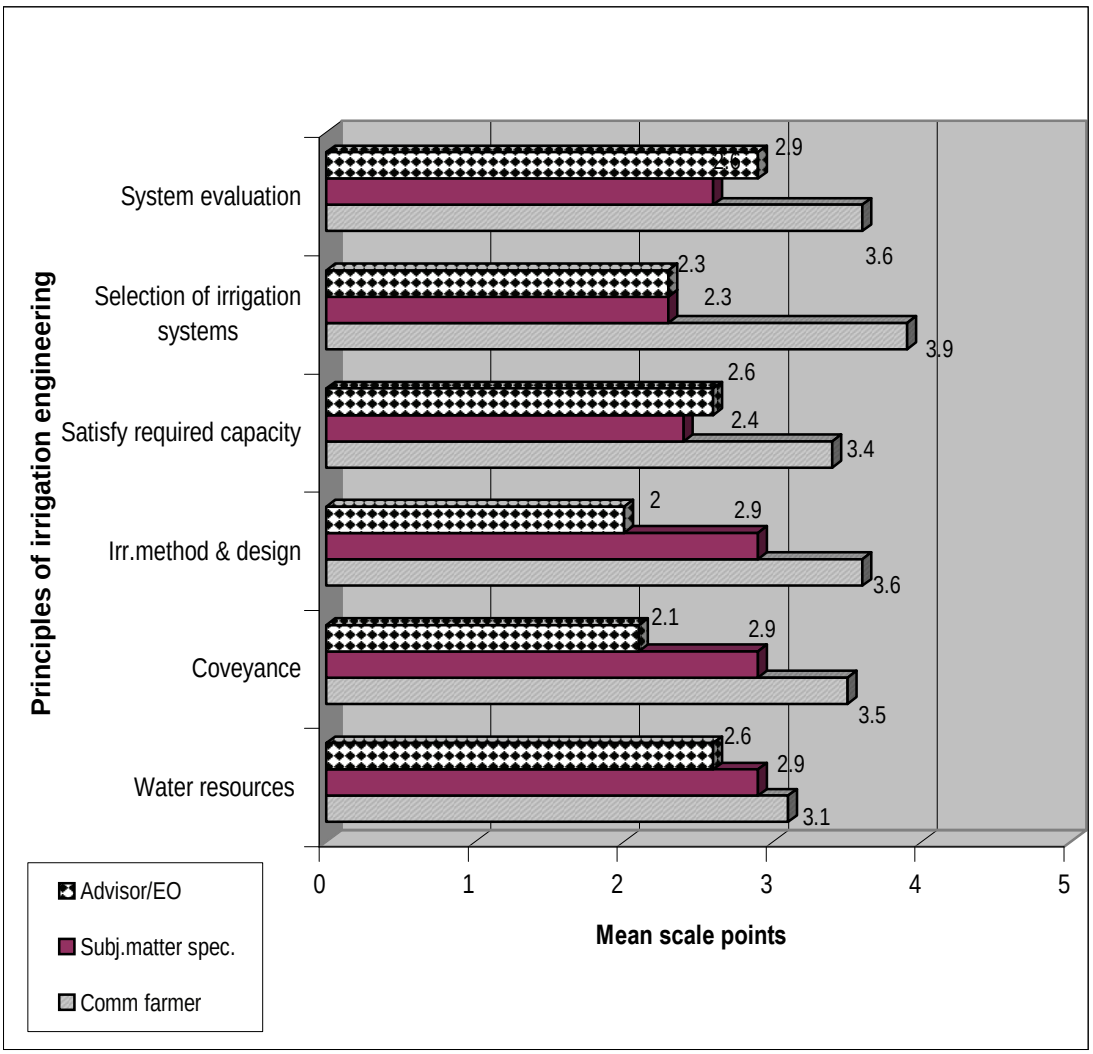

FIGURE 5.5 PERCEIVED COMPETENCE AND KNOWLEDGE LEVEL OF IRRIGATION EXTENSIONISTS ON ASPECTS OF IRRIGATION ENGINEERING EXPRESSED AS MEAN SCALE POINT (N=32)

It appears that the commercial irrigation farmers in general are satisfied with the support they receive from irrigation advisors and extensionists with regard to selection and designing of irrigation infrastructure and irrigation systems. It is however important to keep in mind that these respondents are usually served by advisors from private irrigation companies, which are supposed to have more specialised knowledge and skills than the general extension worker.

Therefore this assessment may be a little bit clouded, in that it does not reflect the status of the general extensionists found on the farm.

It is however clear from the findings that both the subject matter specialists and the advisor/EO group of respondents perceive the competency and knowledge level of extensionists with regard to irrigation engineering aspects to be inadequate (below 3 mean scale points).

5.1.6 Perceived extension support on aspects of water use efficiency

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Water use efficiency is a generic label that describes a ‘toolbox” of performance indicators of water use on the farm. In general it represent a relationship between water (input) and agricultural product (output) and efficiency relate to an output (e.g. water arriving at the destination) to an input (e.g. water diverted from the source). The main aim with extension support to irrigation farmers is to increase the general on-farm water use efficiency by increasing the output per unit water and to reduce water losses that may occur. This implies that farmers must be equipped with the necessary skills and knowledge to become more effective in the managing of their irrigation systems.

The respondents assessed the following aspects with regard to on-farm water use efficiency:

1. Seasonal influences of water use at farm level as determined by the specific crop planted, planting dates, area under a specific crop, crop growth stage and length of the growing season of crops.
2. Irrigation scheduling strategy in order to supply enough water at the right time to address the peak crop growth periods sufficiently. Here aspects like the selection of appropriate irrigation scheduling tools; irrigation system capacity and labour requirements are taken into consideration. Contingency plans should be prepared for possible breakdowns.

3. The use of benchmarking to identify yield per unit water and profit per unit water. Adequate knowledge and skills with regard to appropriate measuring of irrigation efficiency and keeping records is a prerequisite. Help to farmers with the planning and implementation of simple benchmarking practices.

The mean ratings of the knowledge and competency level of extension support as expressed on a five-point semantic-scale are summarised in Figure 5.6.

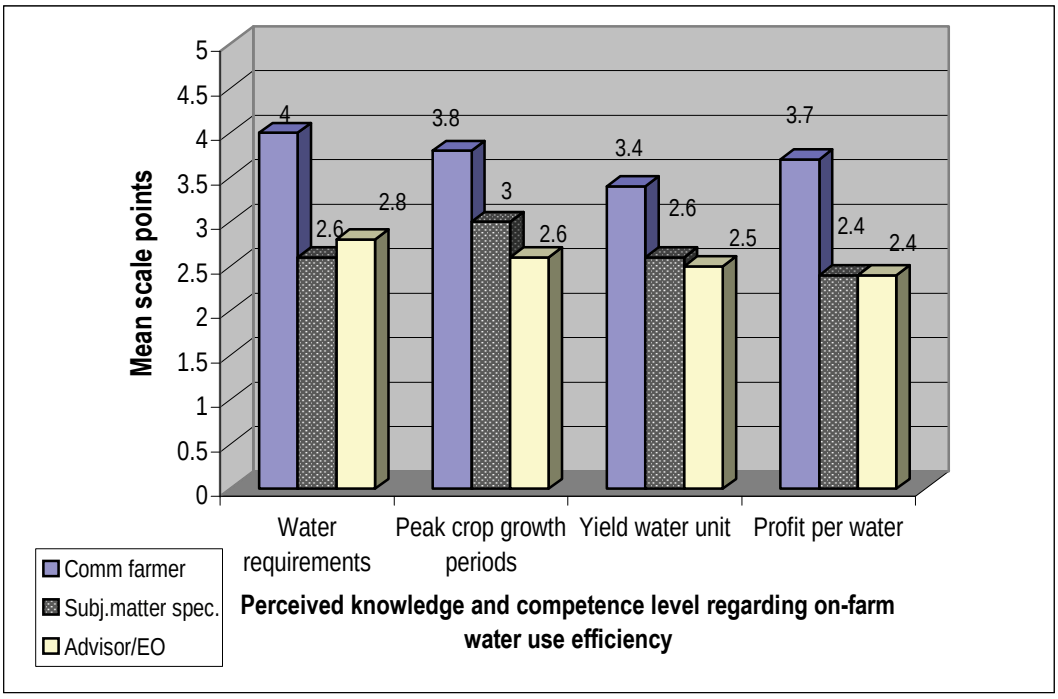

FIGURE 5.6 PERCEIVED COMPETENCE AND KNOWLEDGE LEVEL OF IRRIGATION EXTENSIONISTS ON ASPECTS OF CROP PRODUCTION EXPRESSED AS MEAN SCALE POINT (N=32)

The above findings indicate that commercial farmers perceive the competency and knowledge of the extensionists serving them to be highly satisfactory. It is however clear from these findings that the advisor/EO group as well as subject matter specialists are concerned about the general competency with regard to aspects of water use efficiency.

5.1.7 Perceived extension support on aspects of extension and institutional arrangements

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The methods and strategies used in the delivering of extension are dependent on the understanding of extension and its underlying goals. Extension for some is a form of education being primarily pro-active in nature and focusing on future problems that the client may encounter, while for others extension is similar to that of an advice-giving nature. In its extreme form only the advice requested is given and consequently is usually of a recipe nature.

The irrigation extensionists that are responsible for agricultural development among small-scale farmers are fitting the educational approach of extension where the mobilisation of farmer groups, leadership development, needs assessment among clients and planning of communication strategies are some of the important functions and activities to be undertaken. The respondents assessed the irrigation competency with regard to the following aspects of institutionalising and agricultural development:

- Group mobilisation: the mobilisation of farmers to organise themselves into farmer organisations and study groups was found to have positive effects on the adoption of new practices, since farmers do not operate in a vacuum but are influenced by values and perceptions of fellow farmers (Stevens & Terblanche, 2004).
- Need assessment: The needs of farmers include concepts like drives, motives, incentives and goals. It is important to determine the needs of irrigation farmers as this helps to explain the adoption-behaviour of farmers and to make sure those new recommended practices fits the farming style of the individual farmer.
- Leadership development: the desirables expected by a group rarely occur spontaneously and need to be encouraged through sensitive and responsible leadership, which often need to be developed.
- Planning of communication strategy: the extensionists play an important role in the planning of effective communication strategies between the

farmer, research and extension. They play an important role in helping farmers to develop farmer networks as means for accessing information that is perhaps not readily available.

- Monitoring and evaluation of farmer group efficiency and the role that extension plays in the development of agricultural in the specific area. Periodically a farmer group needs to stop to examine how well it is functioning and how the effectiveness can be improved. Extensionist should have the necessary competency to play an important role with regard to these exercises.

The mean rating of the competency and knowledge level of extensionists on institutionalising and extension aspects are summarised in Figure 5.7.

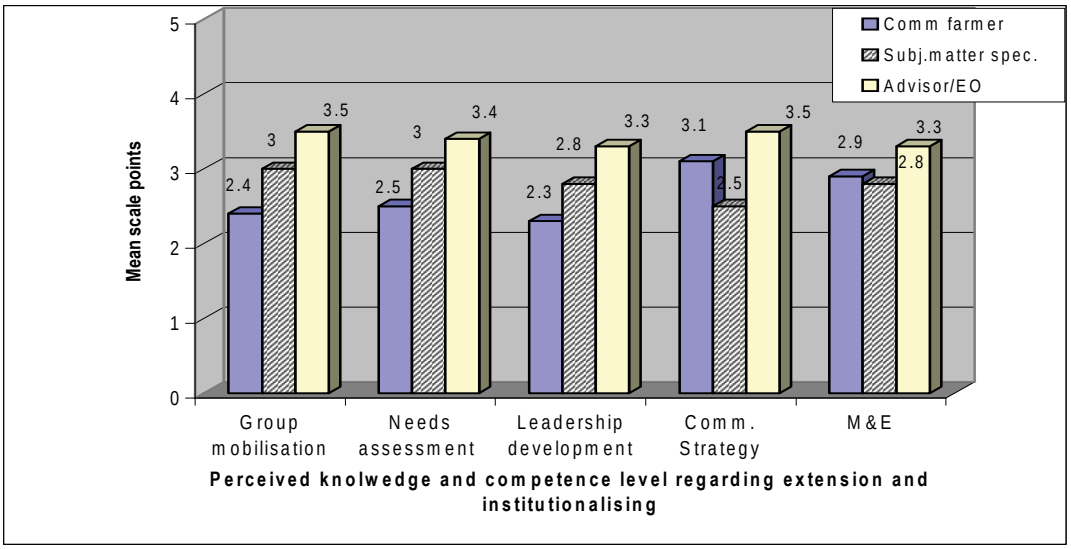

FIGURE 5.7 PERCEIVED COMPETENCE AND KNOWLEDGE LEVEL OF IRRIGATION EXTENSIONISTS ON ASPECTS OF EXTENSION AND INSTITUTIONAL ARRANGEMENTS EXPRESSED AS MEAN SCALE POINT (N=32)

The above findings indicate that the advisor/EO group is in general satisfied with their knowledge and competency with regard to extension and institutional arrangements. However the subject matter specialists and the commercial farmers did not share the same perceptions, where relatively low mean scores (below 3 mean scale points) were recorded. Some explanation for these findings could be that although extensionists perceive to have adequate

knowledge with regard to aspects like group mobilisation and institutionalising, many of them often lack the necessary practical skills to apply it.

Commercial farmers in general rate the competency of the support of extensionists with regard to institutional arrangements and aspects of extension very low. This could however be expected where these farmers are usually served on technical issues with regard to irrigation management by advisors and professionals from the private industry, where the emphasis is most of the time on profit rather than the capacity building of farmers (human development).

6. KEY STAKEHOLDER WORKSHOP

The findings of the two surveys illustrated clearly that some knowledge and competency gaps exist in the training of irrigation extensionists. Based on the training needs assessment and the evaluation of the occupational profile by subject matter specialists, commercial irrigation farmers and irrigation advisors a discussion document was prepared for deliberation at a key stakeholder workshop that took place during June 2006 at the University of Pretoria.

From the outset of the workshop, delegates (*Appendix B*) emphasized the pivotal role that agricultural extension should play in the capacity development of irrigated agriculture. Although farmers are encouraged to take responsibility for the on- farm irrigation management decisions, the demand for informed support services with regard to new irrigation technologies, technical advice, finance, water management regulations and management information needed for sound water management increase daily. The role of extension is to supply farmers with the necessary support where needed as well as to deliver this information for decision-making in an understandable and effective way, taking into consideration the various learning styles of farmers. Extension also plays a fundamental role in the feedback mechanism of research problems as faced by farmers on the farm. However, it was in general accepted that only a few

farmers benefit from new irrigation technology, since current agricultural knowledge systems often failed to be responsive enough in addressing farmers' problems and opportunities.

The Agricultural Knowledge Triangle (Figure 6.1) was accepted as a conceptual model during the workshop where farmers and extensionists through the development of appropriate linkages learn mutually and build capacity. This agricultural knowledge system integrates irrigation farmers, educators, researchers and extensionists to harness knowledge and information from various sources for better irrigation farming and improved livelihoods. Although capacity development is not solely about individuals, it is indeed people centred with the irrigation farmer at the centre of the attention with regard to the development of the necessary capacity needed for on-farm irrigation management.

The Agricultural Knowledge Triangle model describes a two-way flow of information and knowledge among the research, extension organisations and farmers. In this sense, this model goes against the existing linear information dissemination systems, which were developed in most national agricultural research systems under the Transfer of Technology model. The Agricultural Knowledge Triangle perceives two-way exchange of information as crucial for effective generation and transfer of relevant irrigation technology. As a consequence, the role of extension has been reformulated from a one-way TOT persuasive channel, into a two-way channel for requests and answers, which facilitates the learning process for farmers, extension staff and researchers. But the change from disseminating to facilitating requires staff with fundamentally different attitudes, skills and knowledge.

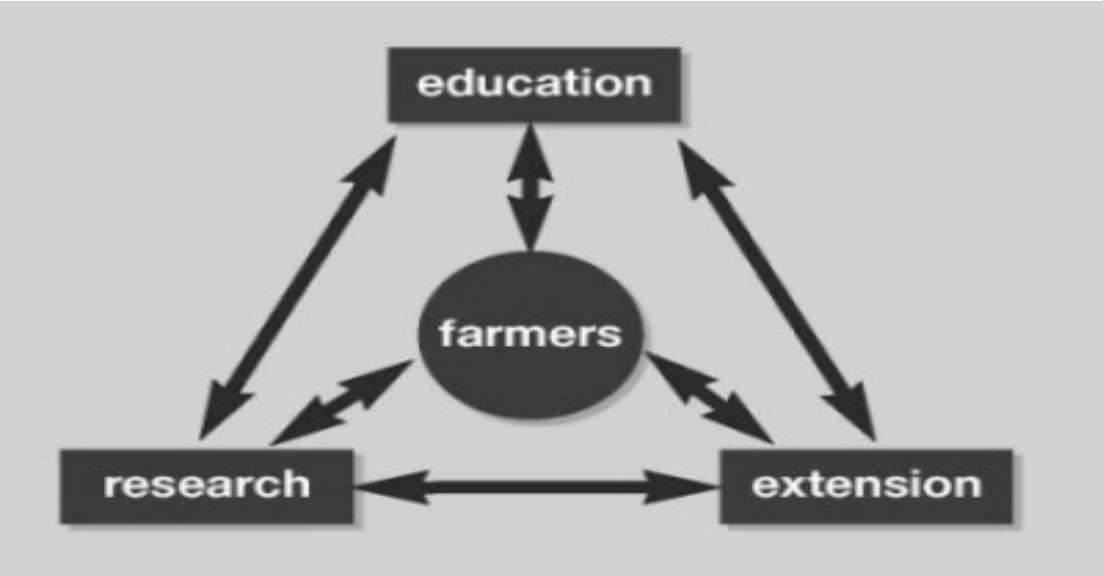

FIGURE 6.1 AGRICULTURAL KNOWLEDGE TRIANGLE MODEL

This model requires extension staff that understands that the development of capacity of the irrigation farmer comprises of four levels of capacity, namely the individual level, organisational level, irrigation sector level and the broad national and international context within which irrigated agriculture functions. It also necessitates that extensionists understand the linkages between these different levels, for example, the irrigation performance of the Water User Association is shaped as much by the society (laws and regulations) as it is by the individuals (skills, leadership and group functioning). In the third place, it requires extensionists with a specific level of technical knowledge and skills in irrigation management.

6.1 KNOWLEDGE PROFILE OF THE IRRIGATION EXTENSIONIST

The focussed group discussion during the workshop identified the following "knowledge and skills profile" as prerequisites for irrigation extensionists before they could become effective communicators with irrigation farmers, researchers or subject matter specialists and educators.

6.1.1 Conceptual understanding of the "knowledge profile" of an irrigation extensionists

Based on the research findings and the deliberations at the workshop, a conceptual understanding of the required knowledge and skills profile needed for efficient extension delivery to irrigation farmers (commercial and small-scale) was developed. This conceptual framework of the "knowledge profile" of an irrigation extensionist identified three important aspects for the development of capacity (Figure 6.2):

- Appropriate training of extensionists with regard to knowledge and skills in the *extension discipline* must form the core of any proposed curriculum framework for the training of irrigation extensionists. This knowledge capacity together with an appropriate attitude is crucial to simplify the often complex and high-level irrigation technology that farmers need to implement on the farm. The task of an extensionist is to ensure that a common understanding is developed and maintained between the farmer, researcher and the extensionists with regard to concepts used in irrigation management.
- The second important aspect that was identified is that a healthy balance between theory and practical skills should prevail with the offering of training in irrigation management to extensionists. The importance of '*experiential learning'* where irrigation extensionists learn through integrating new ideas with their knowledge and experience rather than only gaining new academic knowledge was emphasized. Unfortunately, the lack of capacity among lecturers with regard to practical experience that prevails at both college and university level, often jeopardise such a learning journey that students need to undertake.
- The importance of guidance and the *role of mentorship* with the offering of training and support in irrigation management by experienced irrigators were identified as a need in current training programmes. The role of the mentor was identified with specific reference to the articulation of complex irrigation terminology often used in "scientific language', which is not well understood by both extensionists and farmers.

According to Rogers (1961), personal experience as gained through experiential learning, is of the highest authority or touchstones of validity. No other person's ideas and none of a person's ideas are as authoritative as one's own experience. He is of the opinion that experiential learning is equivalent to personal change and growth.

The "knowledge profile "of an irrigation extensionist as illustrated in Figure 6.2, was identified as a basic component of the occupational profile of extensionists to overcome "hekvrees" and to communicate effectively with irrigation farmers on various aspects of irrigation management. It also illustrates that extensionists should be equipped with the necessary knowledge and skills to communicate effectively with researchers and subject matter specialist on irrigation management aspects when needed.

This conceptual "knowledge profile" of the irrigation extensionists does not imply that extensionists should become experts in each of the five identified technical disciplines, but rather that adequate technical knowledge and competence in each of these disciplines is a prerequisite for credible extension service delivery to irrigation farmers. Although the role of the irrigation extensionists is to facilitate the learning process that the farmer needs to undergo with regard to irrigation management, it was emphasised that a healthy balance between application of facilitation skills and provision of basic scientific knowledge in irrigation management are essential for effective irrigation extension service delivery.

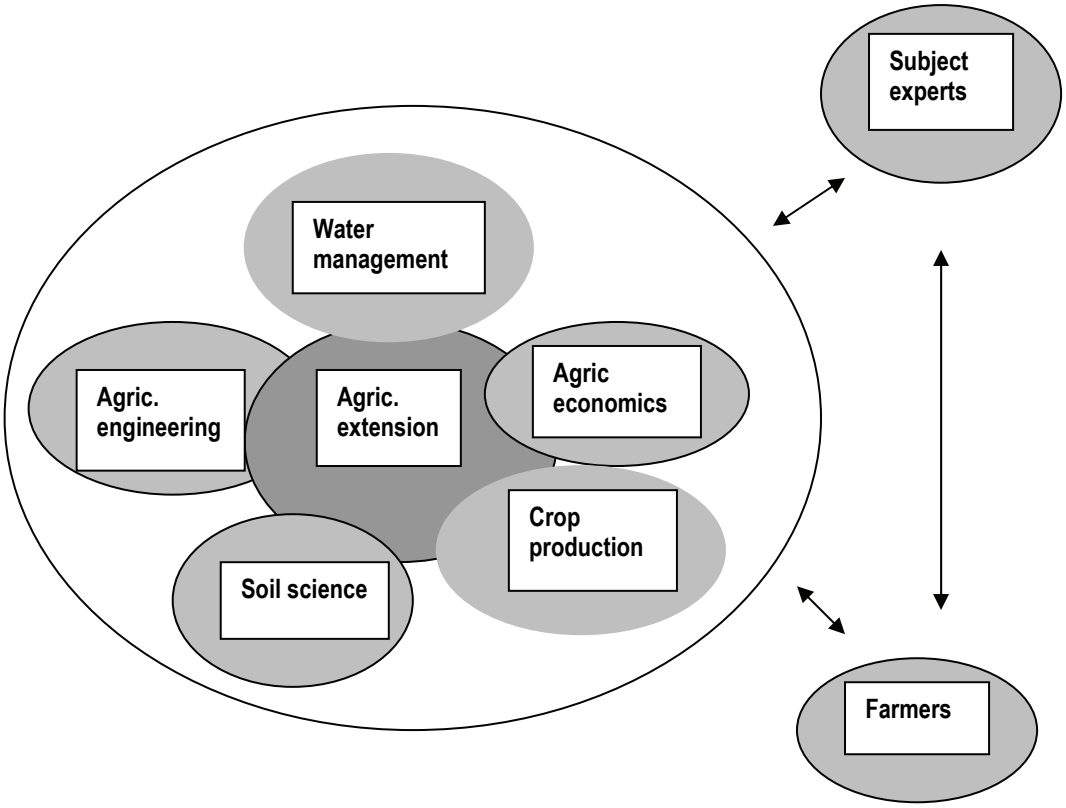

FIGURE 6.2 CONCEPTUAL FRAMEWORK OF THE "KNOWLEDGE PROFILE" OF AN IRRIGATION EXTENSIONIST

The key stakeholders that attended the workshop comprise of "insiders" who have an intimate knowledge of the educational system as experienced in tertiary training at agricultural colleges and universities, as well as "outsiders" from the irrigation industry, for example extensionists, irrigation consultants and employers of irrigation extensionists (*Appendix B*).

6.2 BASIC TECHNICAL KNOWLEDGE LEVEL REQUIREMENTS

Based on the discussion document (*Appendix A)* that served as the baseline document for the deliberations during the workshop, the following technical learning areas in irrigation management were identified for inclusion in the conceptual framework for the development of training material for irrigation extensionists:

- Crop production or agronomy aspects.

- Soil (cultivation practices, physical and chemical characteristics of soil, irrigation potential, water holding capacity, etc.).
- Use of climate data (ETo, evaporation figures, rainfall, temperature, humidity, etc.).
- Irrigation economics (drafting and interpretation of enterprise budgets, compiling and preparing of business plans for irrigation farming, calculating and interpreting of irrigation operational costs, etc.).
- Irrigation engineering (maintenance of irrigation systems, delivery rate of water sources, monitoring of system efficiency, etc.).
- Water management (interpretation of water rights and legislation, basic understanding of irrigation scheduling practices and soil-water balances, etc.).

TABLE 6.1 LEARNING AREAS IDENTIFIED FOR INCLUSION IN PROPOSED FRAMEWORK OF CURRICULA FOR TRAINING OF EXTENSIONISTS IN IRRIGATION MANAGEMENT.

Technical learning areas	**Minimum required knowledge and practical skills**
Soil	Soil genesis: interpretation in terms of topography
	Interpret soil profile for irrigability by using relevant parameters
	Interpret texture in terms of water holding capacities
	Observe visible signs of problems (water logging, salinity, crusting, restrictive layers)
	Identification of potential water-logging problems and drainage potential
	Basic interpretation of chemical and physical parameters
	Basic soil mapping/profile interpretations/soil sampling
	Interpretation of soil topography
	Interpretation of Landsat/ aerial maps
	Maintenance of soil fertility
	Basic skills in soil preparation/cultivation

Water	Interpretation and understanding of water use right and allocation for irrigation
	Basic understanding of water availability and licensing for water use right
	Determination of water reliability
	Basic understanding of water quality and its influence on crop production and quality maintenance
Crop	Insight and knowledge with regard to the selection of adapted crops
	Ability to help with appropriate cultivars selection
	Determining of crop water requirements
	Interpretation of satellite/Landsat/infra-red photos or maps
	Calculation of production potential or the production level of crops
	Basic understanding of principles applicable with the implementation of integrated crop/pest/diseases management
	Basic understanding of fertigation
	Basic understanding of principles applicable with sustainable crop production practices
	Basic understanding of principles applicable with the implementation of crop rotation
Climate	Basic understanding to select crops appropriate to specific climate-soil-market environment
	Basic understanding of the influence of climate on irrigation requirement
Agric. economics	Basic understanding of cost analyses (long-term and short term)
	Basic understanding and skills to prepare enterprise budgets
	Basic understanding and skills to prepare whole farm/partial budget
	Basic understanding and skills to prepare an appropriate marketing strategy for specific farm
	Basic understanding and skills to help with the selection of appropriate financing alternatives
	Basic understanding and skills to prepare a risk analysis
	Basic understanding of cost saving options (e.g. Ruraflex)

Agric. engineering	Basic understanding and ability to determine area, peak demand and water availability
	Basic understanding to provide appropriate advice on the location in terms of distance/height/cost
	Appropriate knowledge and skills to help with the selection of adapted irrigation systems
	Basic understanding of the principles applicable with the evaluation and maintenance requirements of the selected irrigation system
	Basic understanding and skills needed to determine the application and distribution efficiency of an irrigation system
	Basic understanding with regard to different irrigation systems and irrigation in general
	Basic understanding of the principles applicable with the implementation of small scale water harvesting
	Basic understanding of the principles applicable with the implementation of on-farm conservation practices
Agric. extension	Basic understanding and skills required for socio-economic analysis
	Basic understanding and skills required for institutional organisation and capacity building (WUA, FO, etc.)
	Basic understanding and skills required for leadership development
	Basic understanding of principles applicable for effective communication
	Basic understanding and skills required for effective mobilising of groups
	Basic understanding of the principles applicable for gaining the necessary credibility for efficient extension delivery
	Basic understanding of the concept holistic/whole farm approach

Water management	Basic understanding of the different tools and approaches to select from with regard to irrigation scheduling
	Basic understanding of principles applicable with regard soil-crop-atmosphere interaction
	Basic understanding of the soil water balance principles
	Basic understanding of the consequences of over- and under irrigation
	Basic knowledge and skills to help a farmer to calculate on-farm water use efficiencies
	Basic understanding of the principles that apply with scheme management

It was accepted that education is essential to develop the future cadres of extension professionals, but to achieve this development of capacity within agricultural colleges, universities and to some extend in schools will need to be considered. The range of basic learning areas identified in Table 6.1 serves as a guideline that could be incorporated by tertiary organisations in future curricula if it so wished. These identified learning areas will form the basis for defining the learning outcomes required to satisfy training unit standards for NQF 5 and NQF 6 levels as prescribed by SAQA.

Because of the multi-disciplinary nature of irrigation, the young graduate cannot be proficient in all the identified subject matter fields and/or content. The extensionist in an irrigation area should however have the opportunity to attain proficiency in the identified knowledge fields through attending short courses and through self-study. It is expected that a mentor should guide the young extension officer for the first few years of his professional life so that he/she can gain practical experience and confidence in the conversion of theoretical knowledge to practical application. Continuous monitoring of the efficiency of the extension officer is required to ensure that he/she/it stays up to date with newest developments.

7. CONCLUSIONS

It is generally accepted that extension provides an essential link between research output and solving the perceived problem which farmers experience. The small-scale farmers are very much depending on efficient extension services as a source of knowledge and information. Since the science of irrigation management is complex and comprehensive, irrigation extensionists also need comprehensive technical knowledge and skills in irrigation management.

This consulting project served to identify the training needs of irrigation extension workers as well as to evaluate the occupational status of irrigation extensionists. The findings clearly indicate some knowledge and competency gaps that exist in the formal training of irrigation extensionists. An assessment of the current education curricula in irrigation management offered to agricultural students by tertiary organisations revealed that the majority of them allocate fairly small percentage training to irrigation management.

Based on the research findings and deliberations during the key stakeholder workshop, a conceptual understanding of the “knowledge profile” of an irrigation extensionist was developed. It was emphasized that irrigation extensionists are not expected to become experts in each of the technical learning areas identified, but rather to have adequate ‘working knowledge” required to support irrigation farmers with decision-making in irrigation management to overcome the “fear” of engaging with farmers or lack of self-esteem. Imbalances found between the presentation of classroom training and practical hands-on skills within many irrigation management training programmes impedes students from learning what is required to improve on-farm irrigation water management decisions.

The framework of curricula for the training of extensionists in irrigation management developed through this project will serve as a baseline document for the development of more detail training material required for the building of the capacity of irrigation extensionists.

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Appendix A

Workshop

Participatory curriculum development for the training of extensionists in irrigation management

Venue: FABI Seminar room

University of Pretoria

Natural and Agricultural Science Building

(*See attached map of UP: we will meet at Building 54)*

Date: 1 June 2006

Programme

10:00-10:30 Arrival and coffee

10:30-0:45	Welcome	Dr Backeberg
10:45-1:05	Objectives and purpose of the workshop	Joe Stevens
11:05-1:40	Presentation of research findings	Pieter van Heerden
11:40-12:45	General discussions	
12:45-13:30	Lunch	
13:30-14:45	Group discussions	
14:45-15:45	Feedback	
15:45-16:00	Conclusion and way forward	Dr Backeberg

WRC Project No K8/597/4: Conceptualised framework of a possible curriculum for the training of extensionists and advisors in irrigation management

Participatory curriculum development for the training of extensionists in irrigation management – a discussion document for the 2006 Project Workshop

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May 2006

TABLE OF CONTENT

1. RATIONALE FOR THE DEVELOPMENT OF CONCEPTUALISED FRAMEWORK FOR TRAINING

This discussion document is prepared for those attending the WRC Project Workshop scheduled for 1 June 2006. This document is a summary of a more detailed progress report submitted to the WRC intended to identify the current state of training of extensionists and advisors in irrigation management and to identify shortcomings in the current training programmes offered to agricultural students.

The challenge for the adoption of irrigation management plans is for research to develop economical, social and technological adapted management plans that are disseminated to farmers in an effort for the successful utilisation by the farm clients. The role of the extensionist in irrigated agriculture is amongst other, to support the farmer in the learning and adoption of efficient irrigation management practices. Although efficient irrigation management practices can improve the on-farm water use, farmers must be convinced of its profitability and applicability. Further, farmers should have sufficient resources and proper knowledge before they will change their current perceptions and adoption behaviour on the new technology. Since the science of irrigation management is complex and comprehensive, the irrigation extensionists must have comprehensive technical expertise and skills in irrigation management as well as appropriate knowledge and understanding with regard to human behaviour (Stevens & van Heerden, 2006). Commercial and innovative farmers often seek advisory help on their own initiative. Unfortunately, this is not the case with less skilled farmers and small-scale farmers badly need regular and prompt extension help (Stevens *et al*., 2005).

The purpose of the Project Workshop of 1 June 2006 is to gather input and critique on the development of a conceptualised framework of a curriculum for introductory and specialised training of extensionists in irrigation aspects.

2. OBJECTIVES AND METHODOLOGY

The baseline study by Düvel (2002) was used to provide a brief overview of the current status of training and qualifications of the extension workers regarding agriculture and extension, but it was found to be insufficient to make any profound conclusions with regard to their status of irrigation management training and competency.

This was followed with a study that was done where a stratified sample of extension workers from KwaZulu-Natal, Eastern Cape, Limpopo, Northwest and Mpumalanga were interviewed by using a structured questionnaire. Stratified sampling was used to obtain a greater degree of representative ness of the current status of training and competency amongst extension workers serving the small-scale farmer. Of the 202 small-scale irrigation schemes that could be ascertained in South Africa (Backeberg *et al.* (1996), 79% are in the Eastern Cape, KwaZulu Natal and the Limpopo Province. With this figure taken into account it was decided to interview extension workers face–to-face from some of the bigger small-scale irrigation schemes in the Limpopo (Tshiombo, Palmaryville, Mutale, Khumbe), KwaZulu-Natal (Tugela Ferry), Northwest (Taung), Mpumalanga (Nkomazi) and Eastern Cape (Zanyokwe, Keiskammahoek, Qamata).

These structured personal interviews with extension workers from the various provinces were followed by personal discussions and interviews of stratified commercial farmers, subject matter specialists from the irrigation and extension fraternity as well as irrigation consultants and extensionists active in the irrigation industry. These respondents (commercial farmers, subject matter specialists and irrigation consultants and advisors) are regarded as opinion leaders in the industry and therefore acted as a soundboard to identify the perceived satisfaction regarding the current irrigation management curricula offered to students and to identify possible shortcomings in the training and education of extensionists in irrigation management**.**

Guided by the terms of reference the following objectives were set for this project:

- Determine the current status of irrigation management training, knowledge and competency of extensionists responsible for the serving of small-scale irrigation farmers.
- Identification of extension workers' perceived preferences of learning about irrigation management (self directed, formal training or informal training viz. experiential learning, short courses, etc.).
- Identification of specific training needs with regard to irrigation management.
- Determine the perceived satisfaction of professionals, irrigation extensionists and advisors as well as commercial irrigation farmers on the current training curricula offered to extension workers.
- Identify shortcomings in the current training curricula offered at various training institutions.
- Conceptualisation and initial steps in the drafting of a possible curriculum for training of extensionists in irrigation management.

This information will be used to obtain an indication on the current training and competency status of irrigation extensionists serving small-scale irrigation farmers as well as for the drafting of a conceptualised curriculum on irrigation management training for extension workers.

3. EXTENSIONISTS RESPONSIBLE FOR SERVING THE SMALL-SCALE IRRIGATION FARMERS

The database of 1199 extensionists was used to identify the 387 extensionists responsible for serving farmers on irrigation schemes. The frequency distribution of extensionists on the irrigation schemes is indicated in Table 1.

TABLE 1: THE DISTRIBUTION OF EXTENSIONISTS INVOLVED IN SUPPORTING SMALL-SCALE AND COMMERCIAL IRRIGATION FARMERS (N=387).

Province	**Sample size**
Eastern Cape	65
Free State	3
Gauteng	2
KwaZulu-Natal	67
Limpopo	192
Mpumalanga	36
Northern Cape	3
North West	8
Western Cape	11
TOTAL	**387**

4. QUALIFICATIONS OF EXTENSION WORKERS

Agricultural extension requires of extension workers to be qualified and competent in both the disciplines of agriculture and extension. The highest formal qualifications of extension staff, consisting of frontline extension workers and those associated to support services on small-scale irrigation schemes, are summarised in Table 2.

TABLE 2: FREQUENCY DISTRIBUTION OF EXTENSIONISTS ACCORDING TO THEIR EXTENSION POSITION AND THEIR HIGHEST TERTIARY QUALIFICATION (N=387)

Position	**National Certificate/Diploma in Agriculture**		**Advanced Dipl/BTech/D-degree**		**BSc/BSc (Hons)**		**Masters/MSc/ PhD**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Agricultural Technicians	274	84.8	47	14.6	0	0	2	0.6
Scientist	2	10	6	30	7	35	5	25
Supervisors & Managers	5	33	4	27	3	20	3	20
Other support services	9	32	7	24	3	10	10	34
TOTAL	**290**	**75**	**64**	**17**	**13**	**3**	**20**	**5**

The majority of frontline extension workers (75%) have obtained an agricultural diploma, which qualifies them as agricultural technicians but does not place

them in the professional category of the scientist. What is positive is the significantly higher qualification of the supervisors and extension managers, where 40% of them have a BSc (Hons) or higher qualification. The significantly higher qualifications of the officers in support service are to be expected, but the consequence of this is that they should be involved much more effectively in the extension process, particularly for knowledge support purposes.

5. FIELD OF SUBJECT MATTER SPECIALISATION

The distribution of the field of specialisation of extensionists responsible for the support of small-scale irrigation farmers is illustrated in Table 3.

TABLE 3: FREQUENCY DISTRIBUTON OF FRONTLINE EXTENSION WORKERS ACCORDING TO THEIR FIELD OF SPECIALISATION IN AGRICULTURE (N=387)

Field of specialisation	**n**	**%**
Extension	184	47
General agriculture	75	19
Animal healthcare	26	7
Crop production	22	6
Home economics	19	5
Animal production	16	4
Rural development	15	4
Horticulture	6	1.5
Agricultural management	5	1.3
Agricultural economics	4	1
Communication	3	0.8
Land use planning	3	0.8
Soil conservation	2	0.8
Irrigation	*2*	*0.8*
Game /wildlife production	1	0.2
Public administration	1	0.2
Soil science	1	0.2
Aquaculture	1	0.2
Crop protection	1	0.2
Total	**387**	**100**

The majority of extensionists (47%) have specialised in the field of extension, while only 0.8% indicated their specialisation in irrigation. Six percent of the extensionist indicated specialisation in crop production while 1.5 percent respectively indicated specialisation in horticulture production. These findings

clearly illustrate that the majority of extensionists working on small-scale irrigation schemes are not technically competent to render the necessary knowledge support expected by small-scale irrigation farmers with regard to irrigation management.

6. CURRENT TRAINING CURRICULA PRESENTED BY TERTIARY TRAINING INSTITUTIONS

An assessment of current training curricula in irrigation management that are presented to agricultural students by tertiary organisations revealed that the majority of tertiary organisations allocate a fairly small percentage training within a specific course to irrigation management.

At NQF6-level the University of the Free State seems to provide the most comprehensive irrigation training that could lead to either a BSc Agric or a B Agric qualification. This qualification includes courses in soil science, agronomy, agro-meteorology and irrigation engineering. The University of Fort Hare also presents what seem to be fairly comprehensive B Agric and B Sc Agric courses in irrigation. The universities of Pretoria and Stellenbosch have irrigation-related content included in either their soil science or plant production courses. The Universities of KwaZulu-Natal and Zululand has several trans-disciplinary programmes in agriculture with focus on a systems approach to sustainable agriculture and rural development. To what level irrigation planning and management is included, could not be ascertained.

The Central University of Technology (Free State Province) includes a course in irrigation design based on the content of the South African Irrigation Institute (SABI) design manual as part of their B Tech course while Tshwane University of Technology includes irrigation management as a module in the training provided to students in crop production (B.Tech level).

At the NQF5-level the majority of agricultural colleges offer training in irrigation management mainly as one or two modules, which usually forms part of the fundamental training provided in crop production. However, the Lowveld Agricultural College is the exception to the rule, where a student could specialise in irrigation management with regard to either agronomy or horticulture. At this agricultural college, a student must successfully complete irrigation management as one of the core courses, before he/she will be promoted to the final year of study.

At Elsenburg Agricultural College, students receive basic training in the management and design of irrigation systems, where the curriculum content is based on the SABI Irrigation Design Manual. This training provides the students with adequate knowledge and skills to operate and manage irrigation systems on a farm-level.

7. PERCEIVED SHORTCOMINGS IN THE IRRIGATION MANAGEMENT TRAINING CURRICULA

As part of the participatory curriculum development approach that was adopted for this study, 32 subject matter specialists, progressive commercial irrigation farmers and experienced irrigation consultants/advisors were involved in the assessment on the perceived competency of irrigation extensionists. These structured and semi-structured interviews with regard to the current training status of extensionists in irrigation management revealed certain shortcomings that need to be addressed.

Seven spheres of study, which should be included in the training curricula in irrigation management offered to extensionists, were identified after extensive consultation and discussions with experts in the irrigation fraternity. This consultation process identified topics and spheres of study that need to be addressed in the training curricula offered to extensionists, without prescribing

the content and objectives of the training. Content and objectives will rest with the institutional structures responsible for training.

The seven learning domains are as follow:

- Soil and topography of the farm (irrigation potential of different soil types; soil compaction and related problems, etc)
- Crop production (crop growth and water requirements, sensitivity of different crops, general crop management requirements)
- Climate (influence of climate on crop growth, crop choice, irrigation requirements)
- Irrigation economics (capital investments operational costs of different irrigation systems, etc.)
- Irrigation engineering (soil-plant-atmosphere requirements and hydraulic principles of importance with designing and planning of an irrigation system)
- Water use efficiency on-farm (water budgets, etc)
- Extension and institutional arrangements (group mobilisation, leadership development)

The following shortcomings were identified within the current training curricula offered to irrigation extensionists:

- *Soil:* General satisfaction with regard to the knowledge and skills of extensionists on aspects of soil science. Respondents are however concerned about the technical knowledge and skills of extensionists when they are faced with problems that concern salinity, sodicity and pH problems experienced in the field. The biggest shortcoming identified with regard to current training programmes offered is the lack of opportunities to improve the practical skills of extensionists on the evaluation of soil properties (texture, structure, soil water holding capacity, etc.).
- *Crop production:* Respondents are relatively satisfied with the competence and knowledge displayed by extensionists with regard to crop production. However the general ability to help farmers with the calculating of crop water requirements was found to be inadequate. The most important

shortcomings with regard to the training curriculum identified are: practical skills with the application of irrigation scheduling on farm, and more appropriate training with regard to the planning of weed, pest and disease control programmes under conditions of irrigation.

- *Climate:* The major shortcoming with regard to the current training provided to extensionists is the fact that they lack the capacity to interpret climate data to be included into the irrigation management strategy of the irrigation farmer.
- *Water Use Efficiency on-farm:* The major shortcoming identified in the current training programmes is the lack of practical skills and knowledge to guide a farmer on the implementation of adapted water use strategies.
- *Irrigation engineering:* The findings on the assessment of the three groups of assessors indicated that irrigation extensionists in general are incompetent to help irrigation farmers with regard to aspects on irrigation engineering. The basic knowledge and understanding with regard to the appropriateness of infrastructure components given the crop requirements and the operating performance of the system components is often lacking among extensionists.
- *Irrigation economics:* The assessment of all the respondents showed concern about the competency level of extensionists with regard to irrigation economics. The major shortcoming with regard to current training programmes identified is the training of students in drafting of a business plan for the irrigation farmer, especially within an environment of increasing water tariffs.
- *Extension and institutional arrangements:* The general lack of knowledge and practical skills of extension workers on small-scale irrigation schemes with regard to the mobilisation of farmer groups and guidance on leadership development in a farmer group were identified as the major shortcomings.

8. CONCEPTUALISATION AND INITIAL STEPS IN THE DRAFTING OF A POSSIBLE CURRICULUM FOR TRAINING OF EXTENSIONISTS IN IRRIGATION MANAGEMENT

The surveys that were discussed in these reports have clearly indicated some knowledge and competency gaps that exist in the training of extensionists working in the irrigation field. These assessments are based on the perceptions of irrigation extension workers themselves as well as the assessment of competency levels by senior extensionist /advisors, progressive commercial farmers that also act as opinion leaders in their farming community as well as subject matter specialists in the irrigation field.

The proposed content of the training curricula as perceived for the training of extensionists on a NQF 5 level and the NQF 6 level will show huge overlaps, with clear differentiation to be found with regard to the level of competence and autonomy to learn that is expected.

It is expected of a student on a **NQF level 5** to have the following competencies with regard to the studying of irrigation management and crop production:

- a fundamental knowledge base of the main areas of irrigation and crop production,
- a broad overview of the place of irrigation farming within the bigger farming environment,
- the ability to apply essential methods, procedures and techniques of irrigation management and crop production required
- an ability to use their acquainted knowledge to solve defined-problems that exist in irrigation environment
- ability to adjust the application of a propose solution within the relevant parameters of the context of irrigation environment

The student that is qualified with a NQF 5 qualification in irrigation management or crop production will therefore display the ability to operate in a simple work settings, where basic knowledge of crop production and irrigation management

aspects are needed to synthesise different components of the irrigation farm to form a whole picture.

The student that obtain a degree in agriculture **(NQF 6 level)** must however display the following competencies:

- a solid knowledge base in at least crop production or irrigation management
- a sound understanding of either crop production, soil science, irrigation economies, irrigation engineering, climate, water use efficiency on the farm, institutional building and extension
- effective selection and application of the central procedures , operations and techniques of one of above mentioned fields
- ability to solve well-defined but unfamiliar problems found among irrigation farmers by using the correct procedures and appropriate evidence
- a critical analysis and synthesis of information, presentation of the collected information and skills in using of basic information technology
- ability to present and communicate information effectively

Therefore, the student qualified on a NQF 6 level must be acquainted with the necessary knowledge, skills and competency to operate in a relative complex work setting among irrigation farmer where it is expected of the learner to make certain judgements and evaluate ideas and information needed for decision-making.

The following learning outcomes were identified to be in place to ensure competent and efficient extensionists, which could serve their irrigation farmers with the necessary credibility.

Field	Learning outcome:
Crop science	
Crop irrigation requirements	Analyse and explain the influence of the variables that determine the climate and soil environments on crop irrigation requirements. Analyse and explain the effect that different irrigation strategies have on irrigation requirements. Must be able to select best options and explain why. Analyse and explain the effects of stress situations on irrigation requirements and strategies to manage stress situations, such as water shortages, temperature extremes, desiccating conditions, saline, sodic and acidic soils and/or use of low quality water. Must be able to select best options for specific situations. Be able to determine/measure plant stress situations due to water stress.
Choice of options	Must be able to advise on a wide range of crops, including pastures and the related animal production possibilities
Adaptation to climate zones	Analyse and explain plant adaptation to different climate zones and the effect of differences in humidity and temperature on crop growth, productivity and irrigation requirements.
Crop rotation	Plan crop rotation systems that will be suitable for water-soil-climate situations and are compatible with the farming system. Adapt these to make best use of available irrigation water. This includes cover crops in orchards
Soil science	
Soil water storage capacity	Analyse and explain the effect of impervious or semi-impervious layers, soil texture and soil structure on plant root development and soil water-holding capacity. Must be able to relate this to irrigation scheduling planning and to irrigation systems.
Soil water content	Be able to advise on and determine soil water content by various means of measurement.
Hydraulic conductivity	Analyse and explain the concept of hydraulic conductivity and its effect on infiltration rates and water movement through soils and its effect on crop irrigation requirements
Soil water content and root development	Analyse and explain the effect that water content has on root development. This includes situations of low and excessive water content. Include water logging situations.

Soil classification	Must be able to identify, describe and interpret soil profiles and their suitability for irrigation.
Soil chemistry	Must be able to analyse major and explain all chemical conditions/ content/ reactions that affect plant growth and production and their effect on irrigation requirements. This includes toxicity.
Soil treatment	Must be able to determine and recommend corrective treatments for sodic, saline and acidic soils.
Water	Must be able to interpret water analysis results in terms of suitability for irrigation and recommend management practices suitable for low quality water
Land use planning	Must be able to use water, soil, climate, crop and management variables for irrigation land use planning. These include the classification of soil and water into suitability classes for irrigation and special treatments if required.
Weed-, disease- and pest control	
Weed control	Identify the more common weeds of crops in a specific area and recommend suitable control measures
Disease control	Identify the more common diseases affecting crops in a specific area and recommend suitable control measures
Pest control	Identify the more common pests affecting crops in a specific area and recommend suitable control measures
Agro-meteorology	
Weather data	Must be able to interpret weather data and the implication of weather data on crop production. Sources of weather data must be identified.
Weather stations	Know the instruments and principles on which they work. Be able to take readings and do normal upkeep of stations.
Reference evapotranspiration	Must be able to calculate reference evapotranspiration by means of internationally accepted methodologies and apply that in the estimation of crop irrigation requirements
Engineering	
Design of systems	Know the principles of the design of different irrigation systems and their application for different soil-crop combinations. Must be able to identify factors that affect efficiency and recommend solutions. Include the use of irrigation systems for their cooling effect and for frost control.

Water conveyance	Know the principles of the design of conveyance systems and their application.
Flow measurement	Know the principle and application of various flow measuring devices.
Motors and pumps	Know the principles of the use of engines/motors and pumps and their application.
Irrigation system efficiency	Be able to determine the efficiencies of different facets of the irrigation system and its water supply. Must be able to recommend corrective measures.
Irrigation systems and chemspray applications	Be able to recommend on the application of applicable agro-chemicals through irrigation systems.
Maintenance of systems	Must be able to demonstrate and advise on the maintenance of irrigation systems.
Drainage	Have a working knowledge of water logging and salinity situations, subsurface water table surveys; know the principles of the design of drainage systems, their application and effectiveness.
Effective water use	
Water use management	Must know what tools are available to improve water use efficiency at farm and irrigation scheme level and be able to demonstrate the use of these to enhance water use efficiency form planning of crop irrigation requirements to implementation during a growing season.
Agricultural economics	
Enterprise budgets	Be able to interpret enterprise budgets and advise on their use.
Farm budget	Be able to draw up a simple farm budget. Be able to do partial budgets
Marketing	Interpret and choose best options based on market information
Risk	Must know the basic approaches to risk analysis and the use of it in farm production planning
Savings	Must be able to plan irrigation strategies that make best use of savings; e.g. the ESCOM Ruraflex approach.
Legal	
Legal aspects of irrigation	What does the law allow the irrigator and require of him/her.

Agricultural extension	
Working with groups	Be able to analyse and apply group dynamic principles in order to improve group interaction
Leadership development	Be able to identify different leadership styles, know their place in the social structure and the application of this knowledge to improve group interaction. Be able to improve leadership qualities.
Managing farmer organisations	Be able to guide farmer organisations to improve their productivity
Barriers to change	Be able to identify barriers to change in individuals and communities and be able to overcome these.
Motivation	Know and understand the principles of motivation. Be able to analyse local situations and be able to exploit this knowledge
Extension planning	Be able to survey a target area, analyse a situation, plan an extension programme, execute the programme and evaluate the results. Must be able to apply suitable tools for specific situations.

9. CONCLUSION

9.1 WORKSHOP OBJECTIVES

The objectives of the workshop are to:

- Critically assess the shortcomings identified in the training of knowledge support rendered by extensionists and advisors as reflected in the discussion paper.
- Comment on how these shortcomings could be addressed through appropriate training (formal and non-formal) with regard to NQF levels 5 and 6.
- Review and assess the current training curricula offered by tertiary training institutions (NQF 5 and 6 levels).
- Critically discuss and provide input to the development of a conceptual framework for training of extensionists and advisors in irrigation management.

9.2 KEY ISSUES TO BE EXPLORED AT THE WORKSHOP

The workshop has been structured to stimulate dialogue between stakeholders as part of the participatory curriculum development process that is envisaged within this project. It is expected that the resultant discussions will revolve around many of the issues outlined in the discussion paper, summarised below:

- Training status of extensionists and advisors in irrigation management and the impact on knowledge support to irrigation farmers.
- Shortcomings identified in the training curricula offered to agricultural students at tertiary training institutions on NQF 5 and NQF 6 levels.
- The role of participatory curriculum development with regard to the development of appropriate training curricula for agricultural students with specific reference to agricultural extensionists and advisors.
- Opinion and comments on the conceptual framework of training curricula in irrigation management.

It is envisaged that the discussions from this workshop will make a substantial contribution to ensure that an appropriate training curricula framework is developed taking into consideration the diversity and complexity of the irrigation environment in South Africa.

Appendix B

Workshop: Participatory curriculum development training of extensionists in irrigation management

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