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A METHOD OF EVALUATING AN IRRIGATION WATER USE IN TERMS OF "EFFICIENT, SUSTAINABLE AND BENEFICIAL USE OF WATER IN THE PUBLIC INTEREST"

F. P. J. VAN DER MERWE

A METHOD OF EVALUATING AN IRRIGATION WATER USE IN TERMS OF "EFFICIENT, SUSTAINABLE AND BENEFICIAL USE OF WATER IN THE PUBLIC INTEREST"

Francois Petrus Johannes van der Merwe

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'N METODE VAN BEOORDELING VAN 'N BESPROEIINGSWATERGEBRUIK IN TERME VAN "DOELTREFFENDE, VOLHOUBARE EN VOORDELIGE GEBRUIK VAN WATER IN DIE OPENBARE BELANG"

Francois Petrus Johannes van der Merwe

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DISSERTATION SUMMARY

A METHOD OF EVALUATING AN IRRIGATION WATER USE IN TERMS OF "EFFICIENT, SUSTAINABLE AND BENEFICIAL USE OF WATER IN THE PUBLIC INTEREST"

FPJ VAN DER MERWE

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Degree:	Master of Engineering (Water Resources Engineering)

SUMMARY

This dissertation endeavours to provide a practicable method to evaluate any existing or proposed irrigation water use against the purpose of the National Water Act (Act 36 of 1998) (NWA) as described in section 2. It firstly focuses on section 2(d) of the NWA, which requires the promotion of *efficient, sustainable and beneficial use of water in the public interest*. Although the evaluation of the degree to which this purpose is being achieved by a specific irrigation water use is the topic of this dissertation, it is further argued that by viewing this aspect comprehensively enough, it actually covers five other requirements of section 2, concerning irrigation water use.

The efficiency and effectiveness of the irrigation operation is evaluated. It includes irrigation technology aspects, the efficiency of the relevant irrigation systems and water supply infrastructure, irrigation management skills and the proper application of best management practices by the irrigator that determines the overall efficiency and effectiveness of the irrigation operation.

Aspects that determine sustainability of the particular water use that are included in the

evaluation, entail among others the protection of the water resource (surface and groundwater) and other natural resources, the riparian habitats and all relevant aquatic ecosystems. Other aspects concerning sustainability are the prevention and control of the chemical pollution of the water and soils resources through the irrigation process, as well as salination and water-logging of land through wrong agricultural and irrigation practices.

A further aspect is investigated here for a particular water use namely whether it really represents beneficial use in the public interest, by analysing the socio-economical and political considerations unique to every particular situation. This also requires the consideration of intangible benefits and costs, which are by nature subjective and for which the specific requirements will differ from the one situation to the other. In order to provide a procedure that is transparent and consistent enough to withstand any challenge from users or proposed users in this regard, it has been decided to utilise amongst others the BBBEE scorecard, which has been developed and is presently being implemented by government, also in terms of section 27(1)(b) of the NWA.

A practical and relatively simple procedure in the form of a computer spreadsheet is proposed, explained and demonstrated. The advantage of this procedure is that it allows for any particular irrigation situation to be analysed and prioritised through the awarding of weights to the different aspects that are considered. This process of awarding weights can even be done with the aid of a public consultation process, before the responsible authority finally decides on it. Once the weights have been awarded for a specific situation, different competing irrigation water uses could be compared transparently. This prioritisation of factors through the awarding of weights can also be used in the compulsory licensing process prescribed in the NWA. Different irrigation water uses could be evaluated through this procedure by scoring each competing use quantitatively on sixteen questions, which will then result in a final weighted score for a particular use or proposed use as a mark out of ten. This score can then be compared to that of the other competing uses.

The results of such an evaluation is an indication of the relative degree to which the purpose of the NWA is being achieved or will be achieved, giving the priorities awarded to the different aspects through the awarding of weights before the scoring of the competing irrigation water uses takes place according to the same set of criteria and priorities.

SAMEVATTING VAN VERHANDELING

'N METODE VAN BEOORDELING VAN 'N BESPROEIINGSWATERGEBRUIK IN TERME VAN "DOELTREFFENDE, VOLHOUBARE EN VOORDELIGE GEBRUIK VAN WATER IN DIE OPENBARE BELANG"

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SAMEVATTING:

Hierdie verhandeling is 'n poging om 'n prakties uitvoerbare metode te ontwikkel waarmee enige bestaande of voorgestelde gebruik van besproeiingswater gemeet kan word aan die doel van die Nasionale Waterwet (Wet 36 van 1998) (NW) soos vervat in artikel 2. Daar word eerstens op artikel 2(d) van die NW gefokus, wat die *doeltreffende, volhoubare en voordelige gebruik van water in die openbare belang* vereis. Alhoewel die mate waartoe hierdie doel in enige spesifieke geval bereik word, die onderwerp van hierdie verhandeling is, word daar verder geargumenteer dat deur hierdie aspek omvattend genoeg te benader, dek dit in werklikheid ook vyf verdere vereistes van artikel 2 van die NW aangaande watergebruik vir besproeiing.

Die doeltreffendheid en doelmatigheid van 'n besproeiingsoperasie word geëvalueer. Dit behels besproeiingstegnologie, die betrokke besproeiingstelsel, die watervoorsienings-

infrastruktuur, besproeiingsbestuursvaardighede en die behoorlike aanwending van beste bestuurspraktyke deur die besproeier, wat uiteindelik totale doeltreffendheid en doelmatigheid van die besproeiingsoperasie beskryf.

Aspekte wat die volhoubaarheid van 'n betrokke watergebruik wat beoordeel moet word bepaal, behels onder andere die beskerming van die waterbronne en ander natuurlike hulpbronne, die oewerhabitatte en alle verwante water-ekostelsels. Ander aspekte wat 'n rol in volhoubaarheid speel, is die voorkoming en beheer van die chemiese besoedeling van die water- en grondhulpbronne as gevolg van die besproeiingsproses, sowel as die verbrakking en versuiping van die grond deur die verkeerde landbou- en besproeiingspraktyke.

'n Verdere vraag wat hier ten opsigte van 'n besondere watergebruik ontstaan wanneer die sosio-ekonomiese en politieke oorwegings eie aan elke situasie ontleed word, is of dit werklik voordelig is in die openbare belang? So 'n ondersoek vereis ook die oorweging van nie-tasbare voordele en kostes, wat uiteraard subjektief is en waarvoor die spesifieke vereistes van die een situasie van die volgende sal verskil. Ten einde 'n prosedure daar te stel vir die evaluering van die voordeligheid in die openbare belang wat deursigtig en konsekwent genoeg is om die uitdaging van enige gebruiker of voornemende gebruiker in hierdie verband te kan weerstaan, is daar onder andere besluit om die BBBEE-telkaart, wat nou algemeen in gebruik en aanvaar is, te gebruik.

'n Praktiese en relatief eenvoudige prosedure in die vorm van 'n rekenaarwerkblad word voorgestel, verduidelik en gedemonstreer. Die nut van hierdie program is dat dit die gebruiker in staat stel om enige besondere besproeiingsituasie op 'n geprioritiseerde wyse te ontleed deur toepaslike gewigte aan die verskillende aspekte wat oorweeg word, toe te ken. Hierdie proses van toekenning van gewigte kan selfs met die hulp van 'n openbare konsultasieproses gedoen word, voordat die verantwoordelike owerheid finaal daaroor besluit. Sodra die gewigte vir 'n betrokke situasie toegeken is, kan verskillende mededingende besproeiingsituasies op 'n deursigtige wyse met mekaar vergelyk word. Hierdie prioritisering van aspekte deur die toekenning van gewigte kan ook in die verpligte lisensiëringsproses, wat deur die NW voorgeskryf word, gebruik word. Verskillende besproeiingswatergebruike kan met behulp van hierdie prosedure geëvalueer word deur puntetoekenning aan elkeen van gebruike op grond van sestien vrae, wat dan uitloop op 'n finale geweegde telling uit tien vir elke gebruik of voorgestelde gebruik. Hierdie telling kan dan vergelyk word met die van ander mededingende gebruike.

Die uitslag van so 'n evaluasie is 'n aanduiding van die relatiewe graad waartoe die doel van die NW bereik word of bereik sal word, gegewe die prioriteite wat aan die verskillende aspekte toegeken is deur middel van gewigte voordat die puntetoekenning van die mededingende besproeiingswatergebruike volgens dieselfde stel kriteria en prioriteite plaasgevind het.

ABSTRACT

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ABSTRACT

The purpose of the National Water Act (Act 36 of 1998) (NWA) as described in section 2 of this act, is amongst others *to promote the efficient, sustainable and beneficial use of water in the public interest*. The assessment of the degree to which this purpose is being achieved by a specific irrigation water use, is the topic of this dissertation. In this dissertation it is also argued that by viewing section 2(d) comprehensively enough, it actually includes the other requirements of section 2 as far as it concerns irrigation water uses. The different efficiency parameters, the aspects that determine sustainability as well as the beneficial use of water in the public interest in the irrigation process are explained. A practical procedure in the form of a computer spreadsheet is proposed, explained and demonstrated. This procedure allows for weights to be awarded to the different aspects that are considered in order to determine a quantitative score on the degree to which the purpose of the NWA is being achieved for every irrigation water use.

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LIST OF ACRONYMS

BBBEE	Broad-Based Black Economic Empowerment
BEE	Black Economic Empowerment
DWAF	Department of Water Affairs and Forestry
GWS	Government Water Scheme
NGO	Non-governmental organisation
NW	Nasionale Waterwet (Wet 36 van 1998)
NWA	National Water Act (Act 36 of 1998)
WUA	Water user association

CHAPTER 1: INTRODUCTION

South Africa's well-known relative water scarcity has a direct impact on every facet of its sustained economic development, and the judicious management of the country's water resources serves as an entry point for this study. The existing legislative framework will further provide guidelines along which the study should be developed, with the socio-economic, environmental, scientific, technical, political and commercial aspects that would be involved.

1.1 BACKGROUND

An adequate supply of water is vital for the development of healthy economies all over the world. It can be argued that a country's ability to adapt to a situation where water resources are limited, is essential in order to ensure its prospects with regard to economical, social and political welfare.

Although the provision of water for human consumption remains a first priority in water supply, other needs like food production, the environment, industries, mining, energy generation, etc., are also dependent on an adequate supply of water. From a social viewpoint, it can be argued that an overriding priority is the need to ensure that all people have access to adequately clean and healthy water.

The National Water Act (Act 36 of 1998) (NWA) was promulgated and took effect on 1 October 1998. According to the NWA, the use of water should be strictly controlled and monitored. One of the considerations prescribed in the NWA to evaluate the desirability and permissibility of water use in South Africa is: *"Efficient, sustainable and beneficial use of water in the public interest"* as stipulated as one of its objectives in section 2 (d). This is a consideration that has until now not been applied specifically in South Africa as far as irrigation is concerned, either formally or informally.

1.2 OBJECTIVES OF THE STUDY

The objectives identified for this study are:

1. To acquire and create a better understanding of the term "efficient, sustainable and beneficial use of water in the public interest" in the irrigation sector; and

2. To develop a method to evaluate the merits of any specific case of irrigation water use against the same consideration, namely the "efficient, sustainable and beneficial use of water in the public interest".

The study is therefore aimed at understanding the essential elements of the first requirement above and to develop a method by means of which to evaluate it and to enable one to compare different irrigation water uses so as to ensure that the country's water resources are used in ways that take this requirement into account. The evaluation of a single water use against the criteria will very often be used to compare it to other competing uses, in order to enable the Department of Water Affairs and Forestry (DWAF) to use this as a decision making tool in choosing between such competing proposed water users in the allocation of a limited amount of water.

The study consisted of a literature study to investigate the possible application of the same idea anywhere else in the world, and the meaning connected to any such application, an analysis of the possible common understandings connected to the idea and the development of a framework for evaluation of an irrigation water use against this consideration.

This method should be simple enough to be understandable and practicable for the interpretation of the NWA, while at the same time objective, consistent and transparent enough to be defendable.

The method must enable any interested party to verify whether the consideration contained in section 2(d) of the NWA has been satisfied over the wide range of practical situations currently prevailing in South Africa, or that will emerge in future.

1.3 SCOPE OF THE STUDY

The answers pursued in this study will inevitably be dependent on the different criteria to be considered. In order to narrow down the amount of possibilities, the scope of the study will be limited to the use of raw water from natural water resources like watercourses, dams, surface water or aquifers. The term *water use* will furthermore be limited to that described in section 21(a) (taking of water from a water resource) and the purpose of the use will be limited to the irrigation of agricultural crops for productive purposes. Around 60% of all available water in South Africa is today being used for this purpose and the intensification of competition for this limited resource will ask for clear answers in the criteria to be applied in this field.

1.4 PROBLEM STATEMENT

The topic of this dissertation can be summarised as the task of evaluating irrigation water uses in the process of water allocation in order to ensure that the country's water resources are used in ways that take into account the promotion of "efficient, sustainable and beneficial use of water in the public interest".

In order to first understand the full meaning of this consideration and secondly how to apply it to choose between competitive applications, a method is required through which a water use can be evaluated in an objective, consistent and transparent manner.

No documented method or even a framework exists for a consistent and transparent evaluation of the degree to which an irrigation water use satisfies the considerations in section 2 (d) of the NWA.

1.5 RESEARCH HYPOTHESIS

The research hypothesis for this study has been formulated as follows:

It is possible to develop a practicable method for the consistent and transparent evaluation of the degree to which any existing or proposed irrigation water use takes into account the promotion of "efficient, sustainable and beneficial use of water in the public interest", as stipulated in section 2 (d) of the National Water Act (Act 36 of 1998).

This study was undertaken with the purpose of investigating the above hypothesis.

1.6 ORGANISATION OF THE REPORT

The dissertation consists of the following chapters and appendices:

Chapter 1 serves as introduction to the dissertation.

Chapter 2 describes the background to the allocation of the limited water resources in South Africa in the context of the National Water Act (Act 36 of 1998) (NWA) and discussing the crucial terminology from an international literature perspective.

Chapter 3 discusses a new set of efficiency definitions which allows for the evaluation of the performance of those responsible for the different parts of the irrigation process.

Chapter 4 describes the suggested set of criteria according to which an irrigation operation can be evaluated.

Chapter 5 describes the suggested method of evaluating an irrigation water use and provides a step-by-step explanation of how it could be implemented.

Chapter 6 contains two appropriate case studies where the suggested assessment method has been applied.

Chapter 7 contains the final conclusion of the study.

Appendix A contains relevant references from the NWA.

Appendix B contains summaries of the different codes and scorecards for Broad Based Black Economic Empowerment (BBBEE)

CHAPTER 2: BACKGROUND TO WATER ALLOCATION IN SA AND LITERATURE STUDY

2.1 INTRODUCTION

In order to consider the development of a practicable method for the consistent and transparent evaluation of the degree to which an irrigation water use promotes the "efficient, sustainable and beneficial use of water in the public interest", the extent and availability of water in South Africa should be investigated. That will put the prescriptions contained in the NWA and the grounds on which the allocation of this water can be decided, into perspective.

2.2 EXTENT OF SOUTH AFRICA'S WATER RESOURCES

Besides the fact the average rainfall of South Africa is just over half of the world average, this rainfall is also strongly seasonal and highly irregular in occurrence. As a consequence of this uneven rainfall distribution and the country's topography, more than 60% of the river flow comes from only 20% of the area.

While the estimated average total annual surface run-off is 50 150 million m^3, a total storage capacity of about 27 000 million m^3 (or 54% of the total run-off) has been created over the years by the construction of large dams, mainly by the Department of Water Affairs and Forestry and its predecessors. Presently the annual water usage in South Africa is about 22 400 million m^3, and the percentage used for irrigation lies well above 50%.

Economical development and the distribution of the human population do not coincide geographically with the natural occurrence of these water resources, with the result that in several river basins the water requirements already by far exceed the natural availability of water. Numerous inter-basin transfer schemes have been constructed to cater for this anomaly.

Based on the trends in water use and population growth before HIV/Aids, South Africa is expected to reach the limits of its economically usable, fresh water resources around the year 2030.

2.3 WATER AVAILABILITY

It is acknowledged world-wide that the era of developing new water resources has mainly come to an end in most countries, and that the challenge has shifted to the development of the ability to use the existing water resources more effectively and efficiently. This is especially the case in South Africa.

However, the availability of water will always be of primary importance, before any decisions can be made on the best use to which it can be applied. The hydrological analysis of a water resource will always be the first step in developing it. This field – hydrology – is also extensively researched and analysed today and well described in literature.

For an authority to make allocations of irrigation water, it must be aware of the availability of water in that specific water resource at the specified assurance of supply. The availability of irrigation water is defined as the amount of irrigation water that a resource can supply at a specified level of assurance of supply.

2.4. WATER ALLOCATION FOR IRRIGATION

In the new political dispensation in South Africa the allocation of the water that is still available is a subject that is regarded as one that must comply with the new demands for political and social equity.

Three scenarios on the availability of water for irrigation in the future are identified.

Firstly the water presently utilised for the irrigation of agricultural crops for productive use, which may be acknowledged as *existing lawful water use* (section 22(1)(a)(ii) of the NWA). An existing mechanism available in the NWA is that of the trading of existing water allocations between willing sellers and willing buyers. Within certain definite practical and equitable limitations, this is a straight forward supply and demand process, which will remain a spontaneous and natural way of changing the existing water use pattern in South Africa.

Secondly the water available in presently undeveloped but also in the developed water resources that were never allocated before has roughly been estimated in 1998 to be only enough for 200 000 irrigated hectares (National Department of Agriculture, 1998). These resources are mainly located along the eastern coastal areas of South Africa, but in the meantime much of this available water has been allocated by way of licences.

Thirdly, water that complies with the conditions of existing lawful use (section 22(1)(a)(ii) of the NWA), that will become available for reallocation through the process of water allocation reform (WAR) that DWAF has embarked upon, as a further step in implementing the NWA which is the actual implementation of the process of compulsory licensing carried out according to sections 43 through 48 of the NWA.

2.5 CONSIDERATIONS FOR AUTHORISING WATER USE

Until recently, South Africa's national water affairs were managed and controlled by the previous Water Act (Act 54 of 1956), which was based mainly on European water legislative principles. Europe is generally a water-rich continent, which southern Africa is not, and over the years South Africa has gradually become more and more water stressed. The development of new measures according to which we should manage our diminishing and deteriorating water resources was welcomed over a wide front.

The NWA was promulgated on 1 October 1998. One of the measures applied in the NWA to evaluate the desirability and permissibility of a water use in South Africa, is the condition: *"Efficient, sustainable and beneficial use of water in the public interest".*

This is a condition that has until now not been applied formally in South Africa or, according to the literature study, anywhere else in the world.

This dissertation endeavours to create a better understanding of this concept in the irrigation sector, and to develop a method to evaluate any irrigation water use against this condition. It is trusted that this study will also be of practical use to the Department of Water Affairs and Forestry in the development of guidelines and procedures for the implementation of the NWA.

2.6 THE NATIONAL WATER ACT (ACT 36 OF 1998)

The urgency of introducing measures that will extend the period before the limits of South Africa's water resources are being met, has become obvious during recent years. The new NWA was developed and introduced on 1 October 1998. It created a framework to ensure that South Africa's water resources can be managed in a sustainable way to the benefit of all its citizens, to whom it belongs.

This dissertation focuses on section 2(d) as well as section 27(1)(c) of the NWA, and a short summarised explanation of the background to Section 27 of the NWA is supplied below.

<u>Chapter 1 (Sections 1 to 4)</u>: The fundamental principles of the NWA are set out. Sustainability and equity are identified as central guiding principles in the protection, use, development, conservation, management and control of water resources. These guiding principles recognise the basic human needs of present and future generations; the need to promote the efficient; sustainable and beneficial use of water; the need to protect water resources; the need to share some water resources with other countries; the need to promote social and economic development through the use of water; and the need to establish suitable institutions in order to achieve the purpose of the Act.

Since section 2 of the NWA is of central importance for this study, for the purpose of context, it is quoted in italics underneath:

> *"**Purpose of the Act***
>
> ***2.** The purpose of this Act is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors –*

(a) meeting the basic human needs of present and future generations;

(b) promoting equitable access to water;

(c) redressing the results of past racial and gender discrimination;

(d) promoting the efficient, sustainable and beneficial use of water in the public interest;

(e) facilitating social and economic development;

(f) providing for growing demand for water use;

(g) protecting aquatic and associated ecosystems and their biological diversity;

(h) reducing and preventing pollution and degradation of water resources;

(i) meeting international obligations;

(j) promoting dam safety;

(k) managing floods and droughts,

and for achieving this purpose, to establish suitable institutions and to ensure that they have appropriate community, racial and gender representation."

Chapter 2 (Sections 5 to 11): This chapter deals with the development of water management strategies that will facilitate the proper management of South Africa's water resources.

Chapter 3 (Sections 12 to 20): This deals with the protection of water resources, which is fundamentally related to their use, development, conservation, management and control.

Chapter 4 (Sections 21 to 31): This chapter of the NWA deals with the use of water. As the Act is founded on the principle of national government having the overall responsibility for and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest, a person can only be entitled to use water if such use is permissible under the Act. This chapter is of central significance to the Act, as it lays the basis for regulating water use. Chapter 4 is divided into two parts:

Part 1: (Sections 21 to 26): General Principles: This part sets out general principles for regulating water use. Water use is defined broadly and includes taking and storing water; activities that reduce stream flow; waste discharges and disposals; controlled activities (activities that impact detrimentally on a water resource); altering a watercourse; removing water found underground for certain purposes, and recreation. In general a water use must be licensed, unless it is listed in Schedule 1 as an existing lawful use, or is permissible under a general authorisation or if a responsible authority waives the need for a licence.

Part 2: (Sections 27 to 31): Considerations, conditions and essential requirements of general authorisations and licences: This part deals with matters relevant to all general authorisations and licences issued under the Act. It guides responsible authorities to exercise their discretion to issue general authorisations and licences, and to attach conditions to such licences and authorisations. It also explains the essential features of licences, such as effective periods, purposes and places for which they may be issued, and the nature of conditions that may be attached to them. The granting of a licence does not imply any guarantee regarding the availability or quality of water that it covers.
The section that is under the spotlight here is Section 27(1). It reads verbatim as follows:

> ***"Considerations for issue of general authorisations and licences***
>
> *27. (1) In issuing a general authorisation or licence a responsible authority must take into account all relevant factors, including -*
>
> *(a) existing lawful water uses;*
>
> *(b) the need to redress the results of past racial and gender discrimination;*
>
> ***(c) efficient and beneficial use of water in the public interest;***
>
> *(d) the socio-economic impact -*
>
> *(i) of the water use or uses if authorised; or*
>
> *(ii) of the failure to authorise the water use or uses;*
>
> *(e) any catchment management strategy applicable to the relevant water resource;*
>
> *(f) the likely effect of the water use to be authorised on the water resource and on other water users;*

(g) the class and the resource quality objectives of the water resource;

(h) investments already made and to be made by the water user in respect of the water use in question;

(i) the strategic importance of the water use to be authorised;

(j) the quality of water in the water resource which may be required for the Reserve and for meeting international obligations; and

(k) the probable duration of any undertaking for which a water use is to be authorised.

(2) A responsible authority may not issue a licence to itself without the written approval of the Minister."

It is also regarded desirable to include aspects such as the essential requirements of licences, as well as the possible conditions for the issuing of licences. Doing that, some light will be shed on what obligations and duties are attached to a licence once it has been issued. For that purpose, sections 28 and 29 are included in Appendix A.

The reasons for, and the manner in which the review and amendment of licences will be done, are discussed in section 49 – which is partly quoted below:

"Review and amendment of licences

*49 (3) An amendment ... may only be made if the conditions of other licences for similar water use from the same water resource in the same vicinity, all as determined by the responsible authority, have also been amended **in an equitable manner** through a general review process."*

A process by which the amendment of licence conditions can be done in an equitable manner therefore needs to be developed.

2.7 IRRIGATION IN THE CONTEXT OF THE NWA

The irrigation sector alone is presently responsible for more than 50 % of the total water consumption in South Africa, which is a much larger proportion than for any other sector. Hence it is imperative to target the irrigation sector first when an effort is made to increase the efficiency of water use in South Africa. A country-wide increase of only 10 % in the efficiency within the irrigation sector, for example, will annually save about a third of the capacity of the Vaal Dam (full capacity of Vaal Dam is 2 603 million cubic metres), South Africa’s most important storage dam. And if this amount of water can be used for the production of high-value crops, or be reallocated to other more beneficial or profitable uses, the advantages for the country are obvious.

The importance of efficient use of water is repeatedly stated in the NWA (sections 2 and 27). In the Water Conservation and Demand Management Strategy for the Agricultural Sector (Final Draft, August 2000), it is formulated as follows: “One of the key thrusts of the new approach to managing water in South Africa is the entrenchment of and insistence on efficient water management and use.” Efficiency is one of the key elements of water use, and should be valued separately.

The idea of an investigation into the meaning of “efficient, sustainable and beneficial use of water in the public interest” arose from the need for a better understanding of all irrigation-related ideas within the Department of Water Affairs and Forestry. A proper analysis will promote the development of a common understanding of this principle on the one hand, and on the other hand greater objectivity within this national department that is responsible for the execution of this specific requirement in the NWA.

2.8 TERMINOLOGY

The phrase *"efficient, sustainable and beneficial use of water in the public interest”* or more specific *"beneficial use of water in the public interest”* has prior to 1998 not been formally used as such in South Africa. This study will therefore help to define this condition.

2.8.1 Efficient use of water

Irrigation efficiency is an indication of how successful losses are prevented in the entire irrigation process.

The principles of "irrigation efficiency" in terms of water use are well documented all over the world. An investigation into the irrigation process from start to finish is necessary to determine the measure of the success of the operation, which is actually a combination of irrigation technology and irrigation management.

Following are some literature references that discuss the different components of *water use efficiency*.

Firstly, efficient use is defined as "marked by ability to choose and use the most effective and least wasteful means of doing a task or accomplishing a purpose".
(Webster's Third New International Dictionary, 1981)

Secondly, as "marked by qualities, characteristics or equipment that facilitate the serving of a purpose or the performance of a task in the best possible manner".
(Webster's Third New International Dictionary, 1981)

The definition of efficiency in the general sense is described by means of the following formula:

$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}} \quad \text{(a fraction or percentage)} \qquad (2.1)$$

(Smith, M., 2000)

or more specifically:

$$\text{Irrigation efficiency} = \frac{\text{Amount of irrigation water beneficially used}}{\text{Amount of irrigation water applied}} \qquad (2.2)$$

(Wong, A., Owens-Viani, L. & Gleick, P., 1999)

The word "beneficially" above is used according to the California definition, which refers to water directly used to produce agricultural crops (Wong, A. *et al.*, 1999) as further described in 2.8.3.

The following table has been compiled from available literature on the different aspects of efficient water use. It is sometimes difficult to compile such data as different authors use different terms for the same indicator. Wherever possible, the different names have been identified. Reference is made to the *Review of Selected Literature on Indicators of Irrigation Performance* (Rao, P.S., 1993), who provides a summary of literature on performance indicators.

Table 2.1: Bibliography of irrigation performance indicators.

Performance indicator	Definition	Variables involved	Units	Criteria	Used by	Remarks
Water delivery and utilization						
Conveyance efficiency	$\frac{\text{Volume of water delivered (to tertiary unit)}}{\text{Volume of water diverted/pumped from source}}$	Discharge Duration	h·m^3/s	Efficiency	**Bos and Nugteren** (1974, 1990) **Bos** (1980, 1985,1997)	Some refinement of definition between 1974 and 1997.
Distribution efficiency	$\frac{\text{Volume of water received at field}}{\text{Volume of water delivered (to tertiary unit)}}$	Discharge Duration	h·m^3/s	Efficiency	**Bos and Nugteren** (1974, 1990) **Bos** (1980, 1985)	
Field application efficiency	$\frac{\text{Volume of water needed by crop } (ET_p - P_e)}{\text{Volume of water received at field}}$	Crop ET_p Effective rainfall, P_e Discharge Duration	mm mm h·m^3/s	Efficiency	**Bos and Nugteren** (1974, 1990) **ICID** (1978) **Bos** (1980, 1985, 1997)	Some refinement of definition between 1974 and 1997.
Distribution uniformity	$\frac{\text{Average LQ depth irrigation water infiltrated}}{\text{Average depth infiltrated}}$	Infiltrated depth measured over an area	mm	Efficiency	**Merriam and Keller** (1978)	LQ ~ lower quartile.
Irrigation system efficiency	$\frac{\text{Volume of water received at field}}{\text{Volume of water diverted/pumped from source}}$	Discharge duration	h·m^3/s	Efficiency	**Bos and Nugteren** (1974, 1990) **ICID** (1978)	
Overall project efficiency	$\frac{\text{Volume of water needed by crop } (ET_p - P_e)}{\text{Volume of water diverted/pumped from source}}$	Crop ET_p Effective rainfall, P_e Discharge Duration	mm mm h·m^3/s	Efficiency	**Bos and Nugteren** (1974, 1990) **ICID** (1978)	

Performance indicator	Definition	Variables involved	Units	Criteria	Used by	Remarks
Delivery performance ratio/management performance ratio	$\frac{\text{Actual supplied discharge}}{\text{Target discharge}}$	Actual discharge Target discharge	m^3/s m^3/s	Adequacy Equity Reliability	**IIMI** (1987) **Murray-Rust and Snellen** (1993) **Molden and Gates** (1990) **Van der Velde** (1990)	Used by Van der Velde to identify canal maintenance problems.
Relative water supply (RWS)	$\frac{\text{Total water supply}}{\text{Crop water demand}}$ Levine (1982): $\frac{\text{Irrigation supply + rainfall}}{\text{Seepage + Percolation + }ET}$	Supply discharge Duration Crop *ET* Effective rainfall, P_e	 $h{\cdot}m^3/s$ mm mm	Adequacy Equity	**Levine** (1982) **Perry** (1996) **Molden *et al.*** (1998) **Kloezen and Garcés-Restrepo** (1998) **Keller** (1986) **Weller and Payawal** (1989) **Bos *et al*.** (1974, 1990)	Widely used, and variously defined.

In another approach, McIndoe (2002) has grouped the different aspects of irrigation efficiency into the following three main categories, namely *irrigation efficiency, application efficiency and distribution efficiency* and compiled the following summary of the terms:

In general, *irrigation efficiency (IE)* is related to the percentage of water delivered to the field that is used beneficially. Because the benefits of applying water are not immediately attained, definitions containing a measure of beneficial use are usually applied over a longer timeframe than for individual events. These definitions are more relevant when considering seasonal water allocation or seasonal water use.

The traditional definition of irrigation efficiency (IE) (from ASCE, 1978) is:

$$IE = \frac{\text{Volume of water beneficialy used}}{\text{Volume of water delivered to the field}} \qquad (2.3)$$

Burt *et al.* (1997) modified this definition to account for soil-water storage as:

$$IE = \frac{\text{Volume of irrigation water beneficially used}}{\text{Volume of irrigation water applied} - \text{change in storage of irrigation water}} \qquad (2.4)$$

This definition considers the overall water balance, area, hydrological boundaries, rainfall, soil moisture storage, and all uses over an appropriate timeframe. The approach developed by the International Commission on Irrigation and Drainage (ICID) by Bos *et al.* (1993) and adopted by the Australian Irrigation Association (IAA) provides the following overall definition of irrigation efficiency. They use the term overall project efficiency (OPE), which is suitable for all irrigation systems and is defined as follows:

$$OPE = \frac{\text{Crop water use}}{\text{Total inflow into supply system}} \qquad (2.5)$$

Bos *et al.* subdivided this definition into three sub-components – *conveyance efficiency*, *distribution efficiency* and *field application efficiency*, to track and account for water use from the point of supply through to the crop.

Because of the many factors that influence irrigation efficiency from the source to the crop (capital investment, labour availability and skills, energy use, weather, and the physical performance of irrigation systems), focusing on attaining a reasonable level of irrigation efficiency may be more realistic than trying to calculate irrigation efficiency rigorously. This takes the focus off trying to define all aspects of beneficial use. Burt & Styles (1994) have used an alternative definition that they have called irrigation sagacity (IS), which they consider to be a better measure of wise water use than irrigation efficiency, as follows:

$$\text{IS} = \frac{\text{Irrigation water beneficially or reasonably used}}{\text{Irrigation water applied}} \quad (2.6)$$

Although this definition is probably a better measure of good water use, it has not been widely adopted, primarily because of the difficulty of measuring beneficial or reasonable use.

One useful measure of irrigation efficiency that encompasses both water use and production is water use efficiency (WUE). It is commonly defined as:

$$\text{WUE (kg/m}^3\text{)} = \frac{\text{Production (kg/ha)}}{\text{Irrigation water used (m}^3\text{/ha)}} \quad (2.7)$$

This definition is commonly used in Australia and the USA.

Water use efficiency (WUE) was identified as one of the key water use indicators derived in a study of indicators of sustainable irrigated agriculture (LE, 1997), and is of most benefit to individual farmers. The definition focuses farmer’s attention on both water use and production, and provides an indication of whether the resource has been used effectively.

This definition has also used when conducting design audits for both Ida Valley – Central Otago (LE, 2005) and the Hawke's Bay regions (McIndoe, 2000).

An alternative definition of irrigation efficiency that takes into account the seasonal nature of irrigation is seasonal irrigation efficiency (SIE), which was developed as part of the development of indicators of sustainable irrigation (LE, 1997; Wells & Barber, 1998). It relates the depth of water applied in a season to consumptive use of the crop as follows:

$$\text{SIE} = \frac{\text{Seasonal depth of water applied to crop}}{\text{Seasonal evapotranspiration - seasonal rainfall}} \tag{2.8}$$

This definition typically gives values in the range of 1-2, with the more efficient systems resulting in values closer to 1.

Where the focus is on the performance of a single event, *application efficiency (AE)* is most commonly used. In broad terms, application efficiency is the percentage of water delivered to the field that is used by the crop. The typical definition (e.g. Bos & Nugteren, 1974; ASCE, 1978; Jensen *et al.*, 1983; Walker & Skogerboe, 1987) is known as water application efficiency (WAE) and is:

$$WAE = \frac{\text{Volume of water required to replace crop evapotranspiration}}{\text{Volume of water delivered to the field}} \tag{2.9}$$

Burt *et al.* (1997) define irrigation application efficiency (IAE) as follows:

$$IAE = \frac{\text{Average depth of irrigation water contributing to target}}{\text{Average depth of irrigation water applied}} \tag{2.10}$$

Burt's definition differs from the one typically used as it goes beyond simply replacing soil water deficits. It implies that water contributing to the target will eventually be beneficially used. In addition to meeting ET, it considers crop water needs such as germination, cooling, frost protection, leaching (limited requirement in New Zealand) and pest control. Partial replacement of the soil water deficit to allow more effective use of rainfall is also considered.

The definition proposed by Bos *et al.* (1993) for field application efficiency (FAE) is:

$$\text{FAE} = \frac{\text{Water applied that is used by crop}}{\text{Water delivered to irrigation field}} \qquad (2.11)$$

Another common definition relating to application efficiency is irrigation system efficiency (ISE), as defined by Painter & Carran (1978):

$$ISE = \frac{\text{Water applied that is stored in crop root zone}}{\text{Total amount of water delivered to the farm}} \qquad (2.12)$$

Commonly, in a variation to the above definition, application efficiency (AE) is used:

$$\text{AE} = \frac{\text{Water applied that is stored in crop root zone}}{\text{Average depth of water applied to crop}} \qquad (2.13)$$

This is identical to definition 2.10 for most piped sprinkler irrigation systems, where losses between the water delivery point and the field are negligible. It will differ on systems utilising non-piped delivery methods, as frequently found on border-strip irrigation systems.

This definition has been used when conducting design evaluations for both Ida Valley – Central Otago (LE, 2005) and the Hawke’s Bay regions (McIndoe, 2000). This definition was also adopted in the study prepared for the Ashburton Lyndhurst Irrigation Society “Field proven irrigation efficiency benchmarks” (Rout, *et al.*, 2002)

Distribution efficiency, which is a measure of uneven application, is usually defined in terms of distribution uniformity and has a significant effect on application efficiency. It is usually determined by measuring the depth of water falling into a grid of catch cans during an irrigation event and analysing the variation of water depths in the catch cans.

Distribution uniformity (DU) is an expression that describes the evenness of water application to a crop over a specified area, usually a field, a block or an irrigation district. It applies to all irrigation methods as all irrigation systems incur some non-uniformity.

It is defined as:

$$\mathrm{DU} = \frac{\text{Average lowest quartile depth of water applied to crop}}{\text{Average depth of water applied to crop}} \qquad (2.14)$$

The lower the value of DU, the poorer the uniformity of application and the lower the distribution efficiency.

Christiansen’s (1942) uniformity coefficient (CU) is commonly used for evaluating sprinkler system uniformity. It is defined as:

$$\mathrm{CU} = \frac{100[1 - (\sum |X - x|)]}{\sum X} \qquad (2.15)$$

Where: X = depth of water in individual catch cans

x = average depth of water in all catch cans

The definitions of DU and CU require that catch volumes are representative of the depth applied to equal areas, or, the catch volumes are weighted according to the area they represent.

If application depths are normally distributed and the mean depth of water applied is the same as the mean soil water deficit, Seginer (1987) showed that application efficiency can be approximated from CU as follows:

$$AE = 0,5\left(1 + \frac{CU}{100}\right) \quad (2.16)$$

This definition allows only for losses due to non-uniform applications under situations where depths applied equal soil water deficits.

In trickle irrigation, distribution efficiency is a measure of the variation of emitter flows down a lateral or throughout an irrigation block.

Measurement of applied depths in trickle irrigation is more difficult, so distribution efficiency is usually specified in terms of emission uniformity (EU), which is defined as follows:

$$EU = 100\left(1 - \frac{1,27 \times COV}{\sqrt{n}}\right) \times \frac{q_{min}}{q_{ave}} \quad (2.17)$$

Where: COV = coefficient of manufacturing variation for the emitters

$\sqrt{n}$ = square root of number of emitters per plant

q_{min} = minimum emitter flow in block

q_{ave} = average emitter flow in block

Application efficiency can be estimated from the distribution uniformity of the applied water. An empirical relationship has been derived to describe application efficiency based on distribution efficiency for trickle systems (Walker, 1979). However, significant design expertise is required to make this assessment, and it cannot be recommended for general use.

The value of a particular definition depends on the viewpoint of the author. Very “efficient” systems by some definitions can be very poor performers by other definitions, for example, if distribution uniformity and delivery amount are inadequate to fulfil crop need (Rogers *et al.*, 1997).

2.8.2 Sustainable use of water

Sustainability will be regarded from the viewpoint of the environment. A water use will therefore only be sustainable if it does not have a detrimental impact on the environment in the long term.

2.8.3 Beneficial use of water

Although the phrase *beneficial use of water* has been used relatively extensively internationally in the past, no reference could be found outside of the NWA of the phrase *beneficial use of water in the public interest.* The assumption is made in this dissertation that these two phrases do not mean exactly the same. This dissertation therefore goes to great lengths to give meaning to the interest of the public in any specific use of water as addressed in paragraph 4.3.

But as far as the *beneficial use of water* is concerned, the following references could be traced and the different components of the phrase could be analysed from existing literature:

Firstly, "...contributing to a good end".
(Webster's Third New International Dictionary, 1981)

Secondly, "...anything conducive to well-being, especially to personal health and feeling and to social welfare".
(Webster's Third New International Dictionary, 1981)

Thirdly, "...the use of such quantities of water when reasonable intelligence and reasonable diligence are exercised in its application for a lawful purpose"
(Webster's Online Dictionary, 2006, Parker, Philip M.)

In California, USA, **beneficial use of water** is defined by law, and refers to water directly used to produce agricultural crops (Wong, A. *et al.*, 1999).

Water in Colorado, USA, may be diverted for a purpose only if it is being used beneficially. **Beneficial use of water** is there defined as the use of a reasonable amount of water necessary to accomplish the purpose of the appropriation, without waste. Some common types of beneficial use are domestic, household use, irrigation, municipal, wildlife, recreation and mining.

CHAPTER 3: REDEFINING EFFICIENCY OF THE IRRIGATION PROCESS IN SOUTH AFRICA

3.1 INTRODUCTION

In this document, by definition, the entire irrigation process starts at the point where the water resource delivers the water into the supply system of the irrigation scheme (meaning a bigger area provided with water by bulk supply) and ends where the water is utilised by the crop. By expanding the irrigation process into its logical components, it becomes possible to isolate those areas where losses of a certain nature occur.

The reader is alerted to the fact that what follows here, is a new way of subdividing the entire irrigation process into its different components. The present study identifies a definite need for the authority responsible for the management of South Africa’s water resources to redefine the different components of irrigation efficiency in such a way that the person or body that has control over, and therefore bears the main responsibility of a specific operation, is identified. It is important to identify all the operations under the control of the individual water user, in this case the irrigation farmer, in order to evaluate the efficiency with which these operations are executed. With that in mind, the different components of the irrigation process have been grouped together in such a way that the efficiency of the irrigation operation that takes place on the farm, could be defined as *farm efficiency*. The different components of this on-farm process are the responsibilities of the individual irrigation farmer. Whenever a review or evaluation needs to be done, it would therefore be fair to give him/her the credit or blame for the efficiency of exactly those on-farm processes. The remaining part of the irrigation process, namely *conveyance efficiency* is normally under the control of the Water User Association (WUA) or Government Water Scheme (GWS). The water user only has limited control over this part of the process as an individual, but collectively all the users of a scheme have a say through their institutional arrangement. By identifying the different levels of responsibility, it becomes possible to effectively address the different aspects through training and improvement of the necessary support services. Ultimately this allows for the allocation of the water to where it is used beneficially in the public interest.

3.2 ENTIRE IRRIGATION PROCESS

The entire irrigation process is thus divided into two main components, namely *conveyance efficiency* and *farm efficiency*. Farm efficiency is in turn divided into three separately defined efficiencies, namely *farm storage efficiency*, *system efficiency* and *scheduling efficiency*. These components are described graphically in Figure 3.1:

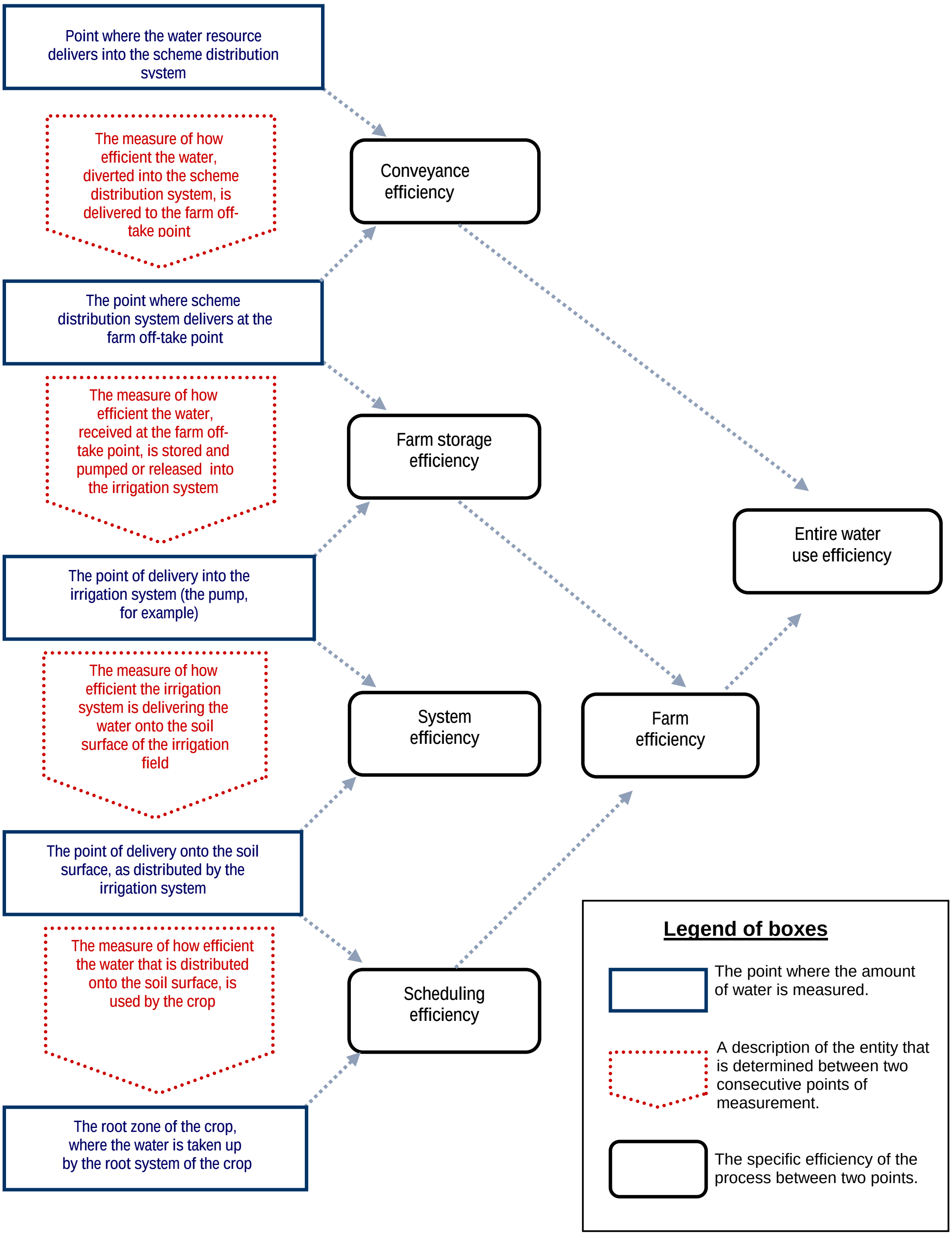

Figure 3.1: The relationship among the various efficiencies

3.2.1 Entire water use efficiency

The entire irrigation process can thus be defined as follows:

Entire water use efficiency = conveyance efficiency x farm efficiency (3.1)

And therefore:

$$\text{Entire water use efficiency} = \frac{\text{Crop water use}}{\text{Total inflow into the scheme distribution system}} \quad (3.2)$$

By dividing the *entire water use efficiency* into its two components, *conveyance* and *farm efficiency*, the responsible authority (e.g. the Department of Water Affairs and Forestry) will be enabled to evaluate the performance of the individual or institution in respect of the specific task for which he/she/it is responsible.

3.2.1.1 Farm efficiency

Farm efficiency is a measure of how efficiently the farmer manages his/her irrigation operations on the farm. The Department of Water Affairs and Forestry needs to measure the efficiency, effectiveness and sustainability of the irrigation farmer in order to assess the degree to which the water use of an individual farmer satisfies the condition stated in section 2(d) of the NWA.

$$\text{Farm efficiency} = \frac{\text{Water used by the crop}}{\text{Water received at farm off - take point}} \quad (3.3)$$

The entire irrigation process that takes place on the farm is under the spotlight, and for this purpose farm efficiency is divided into three distinct aspects:

- *Farm storage efficiency* on the farm (if necessary or applicable)
- *System efficiency*, through the use of an irrigation system
- *Scheduling efficiency* of the irrigation operation, which means the timely provision for crop water requirements and in the same time the prevention of any wastage. Rainfall should also be utilised optimally.

The following formula now holds:

Farm efficiency = *Farm storage efficiency* x *System efficiency* x *Scheduling efficiency* (3.4)

These three aspects are managed by the irrigation farmer. In many cases, geographical and practical circumstances, together with economic limitations or a lack of knowledge, hamper the farmer's efforts at improving the existing infrastructure. It is, however, possible to improve the efficiency of the processes mentioned through good management and innovation, and by introducing measures that do not necessarily cost a fortune.

3.2.1.1.1 Farm storage efficiency

Farm storage efficiency is the measure of how efficiently the water that is received at the farm boundary is stored on the farm and pumped or released into the irrigation system.

From where the water is received on the farm through a distribution system, it is sometimes stored in a storage dam until it is pumped or released into the irrigation system on the farm. The length of time that such storage takes place may vary from one day to a full season.

$$\text{Farm storage efficiency} = \frac{\text{Water delivered into the irrigation system}}{\text{Water received at farm off} - \text{take point}} \qquad (3.5)$$

Typical losses during this stage of the process include

- seepage into the floors and through the walls of storage dams;
- evaporation from the surfaces of dams, or from the banks and surroundings; and
- transpiration by trees and other vegetation (if any) on the dam wall and perimeter of storage dams.

The storage stage of the process may also be totally absent in certain cases, like when the farmer pumps directly from the source into the irrigation system. An example is where the water is pumped from a river, stream or borehole directly into the irrigation system. In such cases, the farm storage efficiency is equal to 1,0.

3.2.1.1.2 System efficiency

System efficiency is the measure of how efficiently the irrigation system delivers the pumped or diverted water onto the soil surface of the irrigation field.

This process involves the distribution of the water by the irrigation system onto the irrigation field, and its placement on the soil surface. For the purposes of this study, the system is defined as starting at the pump itself, instead of at the entrance of an irrigation block. This makes practical sense, since losses mainly occur between the emitter and the soil surface. This can be done either through a pressurised system (e.g. sprinkler, centre pivot, micro spray or drip) or by a flood irrigation system (e.g. furrow, border or basin).

$$\text{System efficiency} = \frac{\text{Water delivered onto the soil surface}}{\text{Water received into the irrigation system}} \tag{3.6}$$

Typical losses during this stage of the process are

- leakage from pumps, pipelines, valves, hydrants and pipe connections;
- seepage, evaporation and transpiration from canals and furrows in the case of flood irrigation;
- spray losses through evaporation and wind drift;
- evaporation from foliage and the soil surface;
- sub-standard distribution uniformity of the irrigation system; and
- run-off from soil surface.

3.2.1.1.3 Scheduling efficiency

Scheduling efficiency is the measure of how efficiently the water that is distributed onto the soil surface is used by the crop. This principle concerns the following two aspects of the real irrigation process:

- The timing of an irrigation event. The question is: "When does the crop need to be irrigated again?"
- The amount of irrigation water applied at such an event. The question is: "How much water should be applied?"

If these two questions are answered correctly all the time and the irrigation is executed accordingly, the crops' utilisation of the irrigated water will be maximised.

Due to the capital intensive nature of irrigation schemes and irrigation systems, the irrigator is often forced to compromise on this very aspect. Firstly, it is usually impossible to build the distribution system for an irrigation scheme in such a way that irrigators receive their full stream of water at any time they like. The farmer needs to await his/her turn on the scheme for the next irrigation event, which means that the correct timing of the next irrigation event is often impossible. Secondly, since the farmer is dependent on the size of the streams of water diverted to the irrigators, he/she normally needs on-farm storage, which is expensive and responsible for the partial loss of the water. An irrigation system that can irrigate all the blocks on the farm simultaneously, but also independently, is very costly – and can normally not be afforded by the farmer. Several further complications may hamper the farmer's ability and capacity to schedule irrigation sessions effectively.

Even if all relevant information, knowledge and skills were available to the irrigation farmer (which due to several practical reasons, is hardly ever the case), not nearly all irrigation farmers could succeed in scheduling irrigation events accurately.

$$\text{Scheduling efficiency} = \frac{\text{Water used by the crops}}{\text{Water delivered onto the soil surface}} \qquad (3.7)$$

Typical losses during this stage of the process are due to

- run-off from the soil surface; and
- deep percolation past the root system of the crop.

The irrigation process ends where the water is utilised by the crop.

3.2.1.2 Conveyance efficiency

Conveyance efficiency is the measure of how efficiently the water that is diverted into the irrigation scheme's distribution system is delivered at the farm off-take point.

$$\text{Conveyance efficiency} = \frac{\text{Water delivered at farm off-take point}}{\text{Total inflow into the scheme distibution system}} \quad (3.8)$$

This process starts where the water resource delivers the water into the supply system of the irrigation scheme. From there it is conveyed or transported to the farm or land under the jurisdiction of the farmer, and ends at the farm off-take point, normally at the farm boundary.

Conveyance efficiency may be measured either from a dam or a weir through a distribution canal or a pipeline, or from a dam into a river or stream, to be diverted or abstracted by a pump further downstream. Typical losses during this stage of the process are

- seepage from canals and furrows into the surrounding soil and rock formations;
- evaporation from the water surfaces of canals and furrows, and the surrounding soil surfaces;
- transpiration by vegetation surrounding canals and furrows;
- operational and management losses; and
- leakage from pipelines.

This stage may also be totally absent in certain cases, for instance when the farmer's allocation is measured at the point of delivery on the farm or at the farm boundary. An example is when the water is pumped directly from a river or stream, and the allocation is made right at the point of abstraction.

Conveyance efficiency is therefore a measure of the water-tightness of the distribution canals or pipelines, as well as of the optimal management of canals, in order to ensure that there is not an excessive amount of water diverted into the distribution canals, which will either be lost due to leaking canals or lost due to the fact that it is not taken by anybody and flows back to the river. Although the bigger part of it will still be available for use downstream in the river system, it is a loss for the specific branch of the canal and even for the entire irrigation scheme, especially when the water may have been released from storage.

This aspect is normally managed by the personnel of a WUA or GWS and is not under the direct control of an individual farmer. In the case of WUAs or private schemes, which together forms more than 75% of irrigation in South Africa, the farmers (as a group) however have final control over the management of the distribution system as well as over any improvements in the conveyance efficiency of the distribution system.

CHAPTER 4: ASSESSMENT CRITERIA: EFFICIENT, SUSTAINABLE AND BENEFICIAL USE OF WATER IN THE PUBLIC INTEREST

4.1 INTRODUCTION

The evaluation method that is suggested as a result of this study involves the development of 16 questions that represent (in the author's opinion) the full range of crucial criteria for the consistent and transparent evaluation of the degree to which an irrigation water use in fact promotes or will promote the "efficient, sustainable and beneficial use of water in the public interest". In this chapter, the 16 questions are stated and explained *in the same order* that they occur in the assessment method and in the subsequent spreadsheet developed for easier reference and practical evaluation. The method is explained step by step.

The condition "efficient, sustainable and beneficial use of water in the public interest" was broken down into two parts. Each will be broken down into two further parts for a second and a third time before the 16 crucial questions emerge after the fourth breakdown into two parts. It is important to consider the way in which this repetitive breakdown was done in order to judge whether the 16 questions are well balanced, whether no gaps are left and no critical overlaps occur. It should, however, be remembered that many of the concepts used here are in reality never totally isolated from each other. They are sometimes merely elements of an integrated process viewed from different angles, which would not be regarded as an overlap or that the same criteria are considered more than once. This study therefore concentrated on the careful definition of the different angles from which we look at this integrated process.

In the first analysis, the phrase "efficient, sustainable and beneficial use of water in the public interest" was broken down into two parts: "efficient and sustainable use" on the one hand and "sustainable use of irrigation water in terms of the environment" on the other.

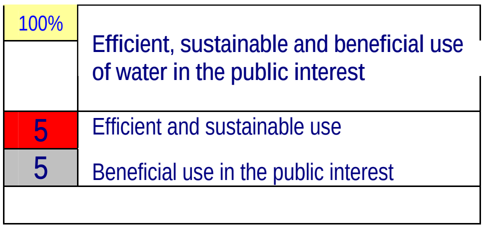

Figure 4.1: Efficient, sustainable and beneficial use of water in the public interest.

4.2 EFFICIENT AND SUSTAINABLE USE

The phrase "efficient and sustainable use of water" refers to the efficiency and effectiveness of the irrigation process, the general sustainability of the irrigation operation, which includes the question whether the aquatic ecosystems are being protected adequately.

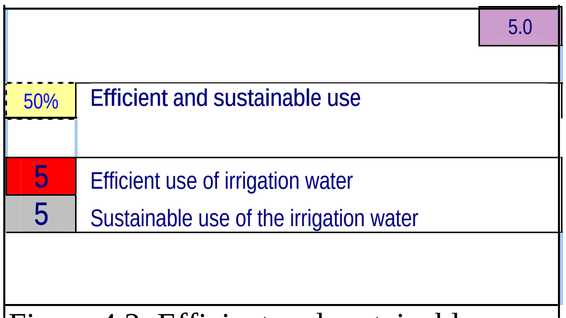

Figure 4.2: Efficient and sustainable use.

4.2.1 Efficient use of irrigation water

This aspect involves the irrigation efficiency on a scheme and system-wide scale, as well as the operator's capacity for and skills at managing the irrigation operation in the best possible way under the specific circumstances.

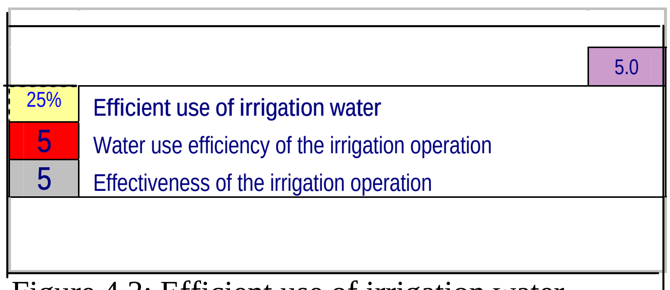

Figure 4.3: Efficient use of irrigation water.

4.2.1.1 Water use efficiency of the irrigation operation

In the discussion of irrigation efficiency in Chapter 3, this concept was divided into two components according to *who is responsible* for each of the two processes. This classification can now be applied here, and the efficiency of each of the two processes will be assessed separately:

- Use of irrigation systems with high efficiency (farm irrigation efficiency)
- Efficiency of off-farm water supply infrastructure (conveyance efficiency)

13%	Water use efficiency of the irrigation operation	5.0
5	1. Use of irrigation systems with high efficiency (high "Farm irrigation efficiency")	5
5	2. Off-farm water supply infrastructure with minimal water losses (high "Conveyance efficiency")	5

Figure 4.4: Water use efficiency of the irrigation operation.

4.2.1.2 Effectiveness of the irrigation operation

It is not only a matter of doing things right (efficiency), but also of doing the right things (effectiveness). The irrigation farmer has many decisions to make in this regard, which will eventually influence his/her degree of success as an irrigation farmer. The two decisions that will directly influence the effectiveness of the water use will be considered here, namely:

- The water user's proven irrigation management skills and ability to apply irrigation technology effectively.
- Effective implementation by the water user and the WUA of prescribed best management practices in terms of the Water Conservation and Demand Management Strategy for the Agricultural Sector (an official DWAF document).

13%	Effectiveness of the irrigation operation	5.0
5	3. Water user's proven irrigation management skills and ability to apply irrigation technology effectively	5
5	4. Effective implementation of applicable best management practices in terms of National Water Resources Strategy	5

Figure 4.5: Effectiveness of the irrigation operation.

4.2.2 Sustainable use of the irrigation water

The strongest test for sustainability is perhaps to evaluate "beneficial in the public interest" in the long term. The test is failed when irreversible damage is caused to the quality and/or usefulness of any natural resource.

An evaluation of irrigation surely needs to assess the influence it has and will have on the environment. While this is a vast topic, this study will only assess the direct and primary impact of the irrigation process, and only on immediate environmental aspects. It will therefore assess aspects like pollution of the soil and of the water resources by salination and water-logging, as well as the use of pesticides, herbicides and fertilisers. It will further examine the impact and the possible impact on aquatic ecosystems like the in-stream and riparian habitats, as well as the ecological importance and sensitivity of the resource that will be impacted upon. The two aspects below will be evaluated:

		5.0
25%	Sustainable use of the irrigation water	
5	Sustainability of the irrigation operation	
5	Protection of the aquatic ecosystems	

Figure 4.6: Sustainable use of the irrigation water.

4.2.2.1 Sustainability of the irrigation operation

This is where the immediate physical and chemical aspects are being assessed, namely:

- Soil, water, irrigation systems and irrigation practices compatible and not inclined to result in salination or water-logging of the surrounding land
- Avoidance of the use of herbicides, pesticides and inorganic fertilisers

13%	Sustainability of the irrigation operation	5.0
5	5. Soil, water, irrigation systems and irrigation practices compatible and not inclined to result in salination or water-logging of land	5
5	6. Avoidance of the use of herbicides, pesticides and inorganic fertilizers	5

Figure 4.7: Sustainability of the irrigation operation.

4.2.2.2 Protection of the aquatic ecosystems

This concerns the broader and more long-term aspects of protecting the aquatic ecosystems, namely:

- The ecological importance and sensitivity of the resource that will be impacted upon
- Protection of the riparian habitat of all relevant aquatic resources

13%	Protection of the aquatic ecosystems	5.0
5	7. The "Ecological Importance and Sensitivity" of the resource that will be impacted upon (high EI & S scores low point)	5
5	8. Protection of the riparian habitat of all relevant aquatic resources	5

Figure 4.8: Protection of the aquatic ecosystems.

4.3. BENEFICIAL USE OF WATER IN THE PUBLIC INTEREST

As indicated above, the meaning of the word *beneficial* is defined by Webster as "anything conducive to well-being, especially to personal health and feeling and to social welfare".

These benefits are subsequently divided into two main components, namely *economical* and *social* benefits. Before the economical and social benefits of a water use can be analysed, it is first necessary to consider who the possible beneficiaries are. The beneficiaries of the available water resources may be divided mainly into four groups:

- Individuals and communities that use water for reasonable domestic purposes, as well as family gardening (food production for family use) and watering of animals, which are regarded as subsistence water uses.
- Individuals and communities that use water for commercial irrigation purposes.
- Practitioners of any other permissible commercial use such as industries, mining, business, offices and shops, public gardens and parks, golf courses and other sports fields, schools, hospitals, theatres, etc.
- Nature.

The thousands of uses of water that fit (or may not fit) into the above-mentioned groupings are practised by people who always form part of the society or "public", or as a matter of fact, different "publics". As custodian of the water resources in South

Africa, the Department of Water Affairs and Forestry has the responsibility to ensure that these water resources are used beneficially and in the interest of all publics. It has the implied meaning that a water use that cannot be regarded as beneficial to the public should not be allowed a licence by the Department of Water Affairs and Forestry – which underlines the national importance of this study.

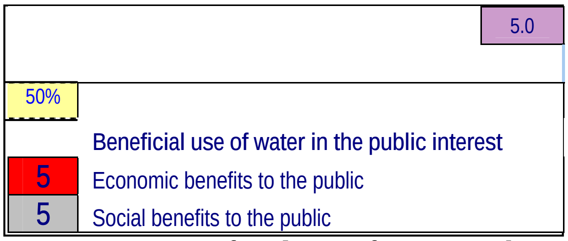

Figure 4.9: Beneficial use of water in the public interest.

4.3.1 Economic benefits to the public

No-one in South Africa needs to be reminded of the terrible reality of poverty and alarming unemployment rate that prevails in the country, and as if this is not enough, the associated appalling crime rate. The economic link between these problems is obvious, but their solution is neither simple nor easy.

Since this study is essentially not an economic one, a very practical approach will be followed. The economic objectives of all members of the public will be seen as a combination of different degrees of the need for *poverty alleviation* on the one hand, and the need for *financial prosperity* on the other.

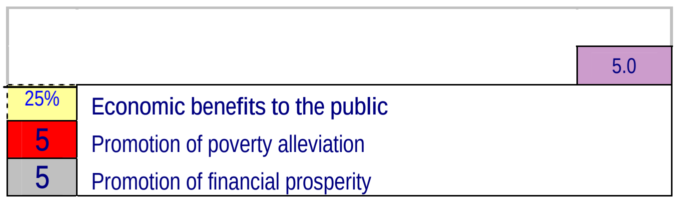

Figure 4.10: Economic benefits to the public.

4.3.1.1 Promotion of poverty alleviation

The supply of hand-outs for poverty relief is normally not feasible and would anyway not be sustainable. The poor should rather be provided with the proverbial fishing-rod than with fish, and thus the opportunity for self-sustainability would be created. Education and training, capacity building, the development of skills and job creation should therefore get the highest priority. The following aspects will be regarded as a measure of the beneficial use of water in this respect:

- Contribution to broad-based job creation as a result of the water use: Employment Equity, Code 300 on BBBEE scorecard (see Table B.4, Appendix B).
- Contribution to skills development as result of water use: Skills Development, Code 400 on BBBEE scorecard (see Table B.5, Appendix B).

13%	Promotion of poverty alleviation	5.0
5	9. Contribution to broad based job creation as a result of the water use: Employment Equity, Code 300 on BBBEE scorecard	5
5	10. Contribution to skills development as result of water use: Skills Development, Code 400 on BBBEE scorecard	5

Figure 4.11: Promotion of poverty alleviation.

4.3.1.2 The promotion of financial prosperity

The objective of financial prosperity is inherent in the principle of capitalism*. This free-market mechanism will be discussed from the viewpoint of producing maximum net returns within the limitations of sustainable development. The buyer (the public) dictates what the market demands. In order to ensure sustainability of irrigated production, the grower has to respond timely to market demands. The following aspects will be regarded as a measure of the beneficial use of water in this respect:

- Potential of the irrigation water use to ensure black ownership: Ownership, Code 100 on BBBEE scorecard (see Table B.2, Appendix B).
- Potential to secure profitable and financially stable enterprises: Preferential Procurement, Code 500 on BBBEE scorecard (see Table B.6, Appendix B).

13%	Promotion of financial prosperity	5.0
5	11. Potential of the irrigation water use to ensure black ownership: Ownership, Code 100 on BBBEE scorecard	5
5	12. Potential to secure profitable and financially stable enterprises: Preferential Procurement, Code 500 on BBBEE scorecard	5

Figure 4.12: Promotion of financial prosperity.

* Any person's aspirations to become financially prosperous are acceptable, but not if genuine care of one's neighbour or fellow citizen is neglected or absent.

4.3.2 Social benefits to the public

To identify the possible social benefits to the public that are a direct result of a specific irrigation water use is normally very subjective. These benefits are therefore also difficult to measure.

How do one define the well-being and the feeling of social welfare of a community? We may not underestimate the overriding effect of the lack of personal health, or the influence of culture, religion, politics or crime on the happiness of the individuals within a community.

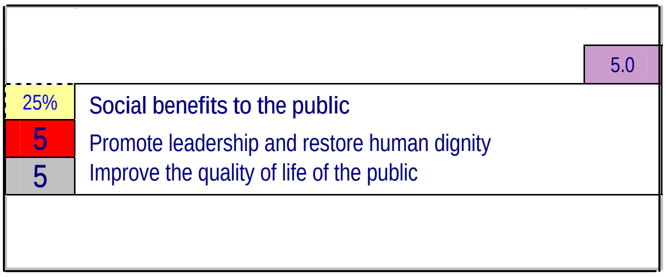

Figure 4.13: Social benefits to the public.

4.3.2.1 Promotion of leadership and restoration of human dignity

Since the establishment of the new democratic dispensation in South Africa, all policies – also those on water – include the need to redress the results of past racial and gender discrimination (section 2(c) of the NWA). Equity is a priority in every project that is considered. It requires that the needs of historically disadvantaged population groups must receive priority over the needs of the established population. Against the background of the fact that the public has to be consulted properly and the public opinion should be considered in decisions, as one of the underlying principles of democracy, the question of whether any use of water is beneficial and in the public interest will also in a sense be subject to this principle.

The simplified criteria on this aspect are as follows:

- Establish equity by empowering historically disadvantaged people and giving them access to irrigation farming: Management Control, Code 200 on BBBEE scorecard (see Table B.3, Appendix B).

- Develop know-how in business management and entrepreneurship within historically disadvantaged communities: Enterprise Development and Residual, Code 600 and 700 respectively on BBBEE scorecard (see Tables B.7 and B.8 respectively, Appendix B).

13%	Promotion of leadership and restoration of human dignity	5.0
5	13. The promotion of top and executive management skills: Management Control, Code 200 on BBBEE scorecard	5
5	14. Enterprise and rural community development: Enterprise Development and Residual scorecard, Codes 600 and 700 of BBBEE	5

Figure 4.14: Promotion of leadership and restoration of human dignity.

4.3.2.2 Improvement of the quality of life of the public

In South Africa's poverty-stricken societies, even more so in the deep rural areas, many people's daily struggle is focused on the one simple question: *"Where will our next meal come from?"* This includes families with children, elderly persons and adults stripped of their human dignity by circumstances beyond their control, through the lack of proper education and training, low self-esteem, lack of leadership within the community and the absence of adequate economic activity within reach of the transport systems.

It is for that reason that a family food supply with good nutritional value is earning its place among the criteria for quality of life. Many other factors are constantly influencing the quality of life within every community and are using as indicators the social stability within the community and a good effort to judge the cumulative well-being of the individual members of such a community.

The two relevant criteria are as follows:

- Direct contribution of the water use to a basic family food supply with high nutritional value
- Direct contribution of the water use to the social stability of the communities and the well-being of the individuals

13%	Improvement of the quality of life of the public	5.0
5	15. Direct contribution of the water use to supply in the basic human needs of the poorest of the poor in the broader community	5
5	16. Direct contribution of the water use to the social stability within communities and the happiness and well-being of individuals	5

Figure 4.15: Improvement of the quality of life of the public.

CHAPTER 5: ASSESSMENT METHOD

5.1 INTRODUCTION

The method of evaluating the desirability of a proposed water use is a combined approach in terms of both quality and quantity. The evaluation method will consist of the following elements:

5.1.1 Set priorities

Establishing the priorities that will be applied for the approval of a licence within a specific area of the irrigation sector by the concerned authorities.

5.1.2 Scoring

Assessing all concerned applications or cases for review by scoring points against the priorities set in 5.1.1

5.1.3 Final evaluation

The final step is to study the outcome and to take a decision when necessary.

5.2 THE METHOD

The method is contained in a computer spreadsheet that can be run on Excel on any PC on which Microsoft XP has been installed. The file to run is named “ESB.xls” and is contained on the CD in the pocket on the inside of the back of this dissertation. It is protected, except for those cells where either the relevant weights or scores should be entered. The formulae, however, can be viewed one by one in the formula bar of the spreadsheet. See Figure 5.1 for the spreadsheet and Figure 5.2 for the formulae (next page):

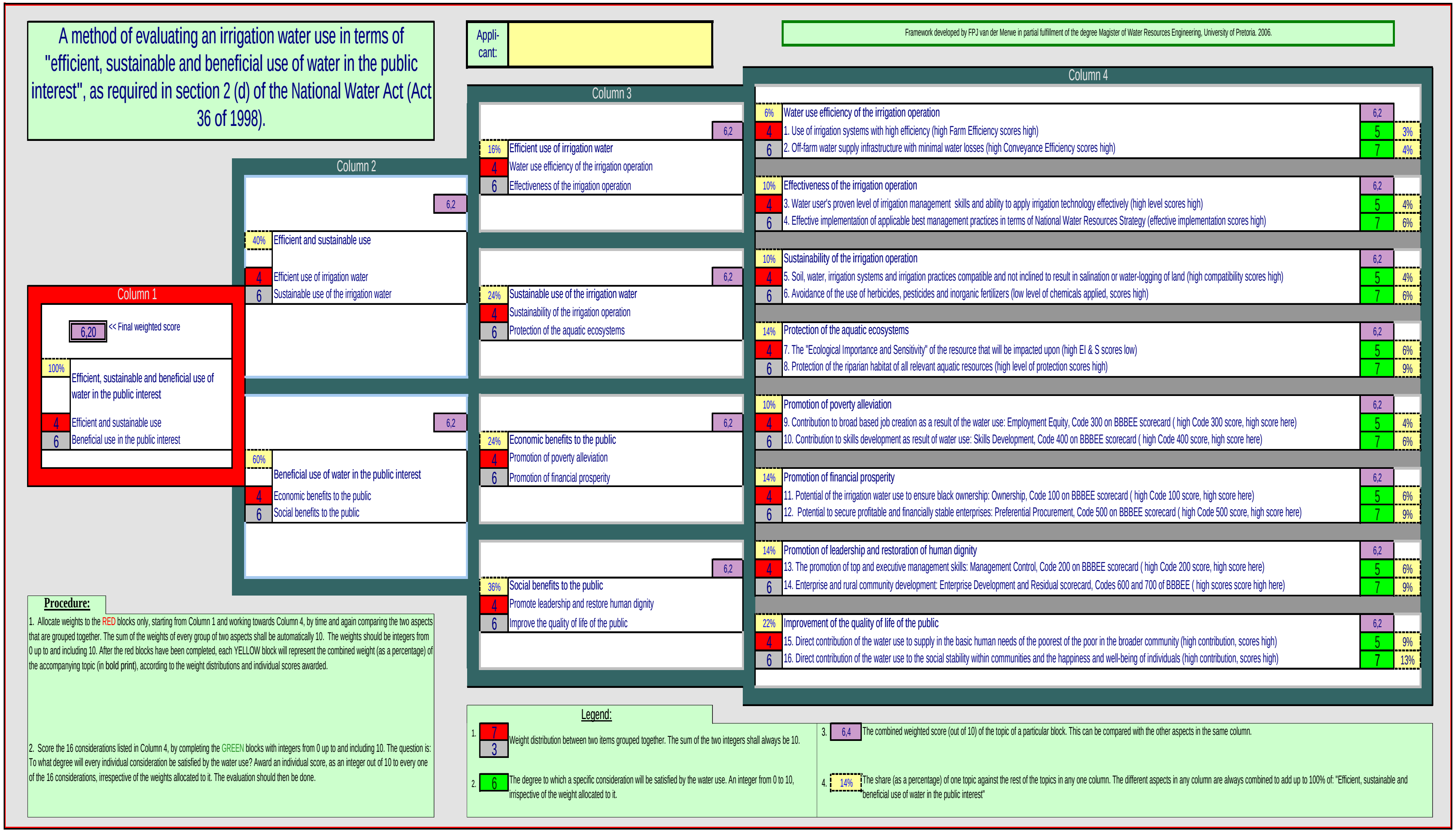

Figure 5.1: The MSExcel spreadsheet for the evaluation method suggested in this study.

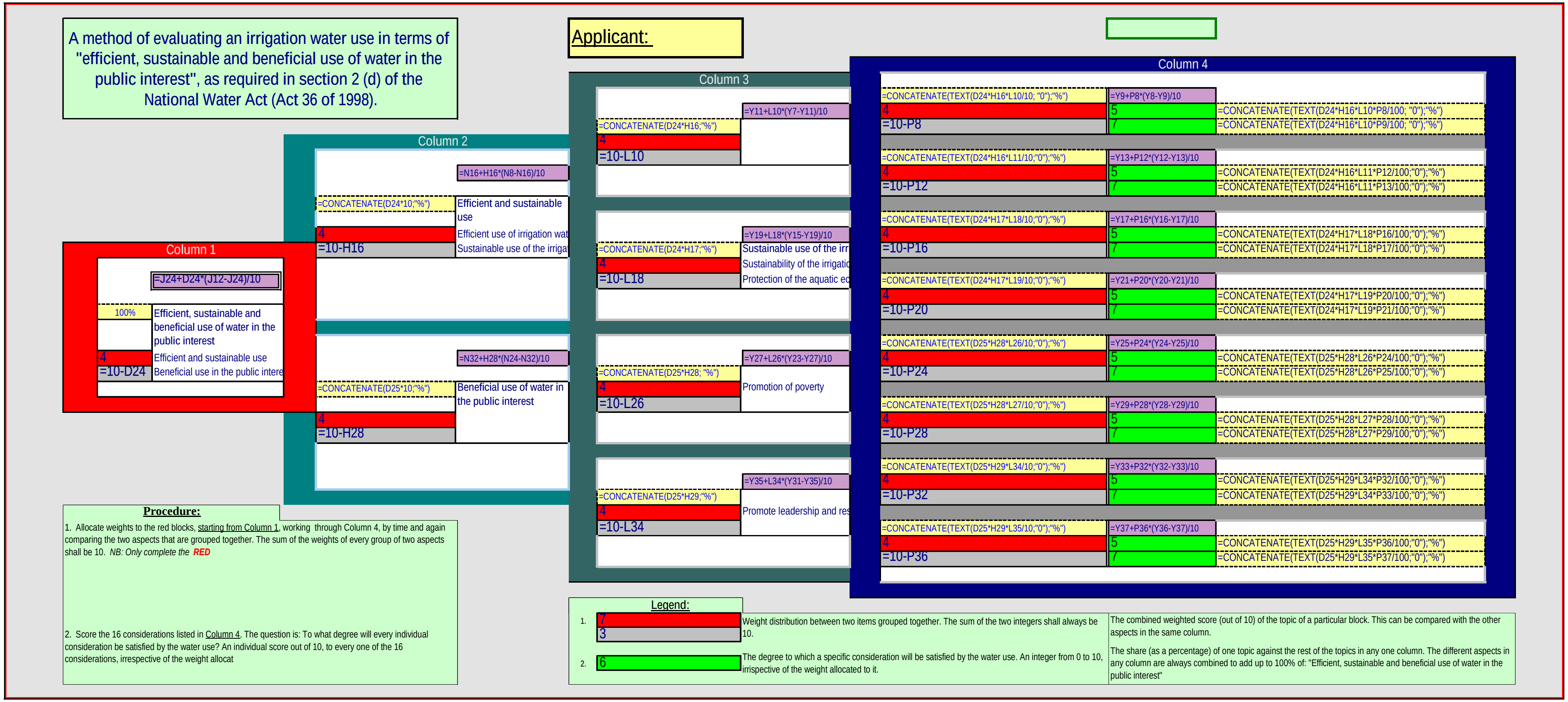

Figure 5.2: The formulae contained in the spreadsheet.

What is suggested here is that priorities, by means of weights, be appointed to the different criteria for a specific homogeneous area. The area may be an irrigation scheme or other geographical area within a catchment area for which the criteria will be fixed. Once the priorities for an area have been determined, all the different users in this specific area should be treated alike, in other words under the same set of priorities. This means that once the weights – the RED blocks on the spreadsheet – are adjusted to the satisfaction of the authorities, they will stay constant for a specific area, and the different applications can be assessed or valued against this set of priorities by completing the GREEN blocks on the spreadsheet. In the case of the five-yearly review of existing licences in a specific area, the scores in the green blocks will be changed for every single case, without changing the weights in the red blocks.

The steps to be taken are discussed in the sections below.

5.2.1 Steps

The following steps should be taken:

5.2.1.1 Insight

One should first of all study the circumstances in the area where the water is going to be used. What is the best to do in the interest of the relevant communities, the public in general, as well as in the regional and national interest?

5.2.1.2 Judging priorities for water allocation

Every situation should be judged on own merit before any decisions are taken on priorities in the specific case. All relevant factors should be taken into account in the correct way in order to be fair to all interested and affected parties, while careful consideration should be given to promoting the regional and national interest.

5.2.1.3 Awarding weights to the criteria

Consider and allocate weight distributions in the red blocks, starting from Column 1 to Column 4, by time and again comparing the two aspects that are grouped together. The total of 10 points shall always be distributed between every two aspects, and therefore the sum of the weights of every group of two aspects shall be 10.

NB: Complete only the RED blocks, *with integers from 0 up to and including 10*. After the red blocks have been completed, each YELLOW block will represent the combined weight (out of 10) of the accompanying topic (in bold), according to the weight distributions and individual scores awarded.

5.2.1.4 Scoring the specific irrigation water use according to the 16 questions

Assess the specific water use according to the 16 considerations listed in Column 4. The question is: To what degree will every individual consideration be satisfied by the water use? An individual score *out of 10* must be awarded to every one of the 16 considerations, irrespective of the weight allocated to it.

NB: Complete only the GREEN blocks, with integers from 0 up to and including 10.

Additional notes:

- The weight distribution between two items grouped together will be such that the sum of the two integers shall always be 10.
- The purple block supplies the combined weighted score (out of 10) of the topic of a particular block. This can be compared with the other aspects in the same column. The "Final weighted score" in the leftmost purple block of the diagram should be weighted up against the other applications that compete for the same water resource.
- The yellow block represents the share (as a percentage) of one topic against the rest of the topics in any one column. The different aspects in any column are always combined to add up to represent 100% of the notion: "Efficient and beneficial use of water in the public interest".

5.2.1.5 Evaluating the results

In order to evaluate the results, it is extremely important for those who do this evaluation, to stay personally detached from the final result. This ability and habit is anyway indispensable and is a prerequisite for anybody involved in this process.

The whole approach behind the development of this method is to have a breakdown of all aspects of the water use into its elements and to deal with the elements separately while staying blind for the final outcome. That simply entails the allocation of weights to the different aspects and thereafter to score every aspect individually. After that, it is a matter of simple arithmetic.

In order to ensure that no errors occur, it is always a good habit to finally check the score-sheet for any omissions or other obvious errors. The final score can also be double-checked arithmetically by doing your own quick mental calculations.

Then look at the final outcome. If there is any doubt about the validity of the final score, you may only recheck the relative weights and the scores allocated to the separate aspects while being wary of the importance to stay absolutely objective.

CHAPTER 6: CASE STUDIES

6.1 INTRODUCTION

This method has been developed by the author based on experience of the following:

- Irrigation technology
- The process of developing irrigation policy for the Department of Water Affairs and Forestry
- Involvement in the very complex process of numerous efforts to develop irrigation schemes for historically disadvantaged people
- The requirements of the NWA regarding the objective and fair allocation of water to a wide variety of users applying for water use licences (mainly irrigation)
- The requirements of the NWA concerning the compulsory licensing process, which is now under development by the Department of Water Affairs and Forestry

The three case studies chosen and discussed below provide a variety of situations with different approaches that need to be applied:

6.2 MANGONDI VILLAGE

Mangondi is a rural village 27 km east of Thohoyando in the province of Limpopo. It has about 1 300 inhabitants, of whom the majority are unemployed, untrained and without job skills, and therefore very poor. The Mangondi community therefore finds itself on the sub-subsistence level, resulting in a high level of hunger and malnutrition leading to a huge problem of theft in the village. Although DWAF recently supplied street taps and toilets in the village, fresh vegetables and other food still constitute the biggest need of the community.

It is a semi-arid area with almost no frost in winter. About 23 ha of land is available for irrigation on the outskirts of the village, about 800 m from the Levubu River (a river with very high ecological importance and sensitivity), from where they should pump the water. The flow in the river will soon become consistent throughout the year. The Nandoni Dam, which has recently been completed a few kilometres upstream from the pumping station, is currently being filled and water will soon be released for consistent use by downstream users. The inhabitants only have a basic knowledge of irrigation. In the land chosen to be cultivated, the soil is suitable for flood irrigation, but in the higher parts it is somewhat shallow (only 450 mm to a virtually impenetrable layer) and therefore prone to water-logging. The community have not yet formed a WUA, mainly because they do not know how to, and consequently they have not learned anything about Best Management Practices.

With financial help from a non-governmental organisation (NGO), they intended to install a pump at the river and a pipeline to the field, and to build a small concrete dam at the highest point next to the field. From the dam, 48 women and 15 men, each with a plot of between 200 and 500 square meters of this field, intend to grow maize, mixed vegetables and even some higher value sub-tropical crops like ginger. For a start they will use the so-called “short furrow” method of irrigation, which is not highly efficient, but suitable because it is inexpensive and the technique is easy to learn. The method is, however, labour intensive and they would need to employ labour from the village. Since an abundant amount of kraal manure is available in the area, they want to use that and simultaneously save on fertilisers. Instead of pesticides and herbicides, they will use indigenous methods to prevent pests and do weeding by hand. With the financial assistance as promised and the help of the local extension officer, the 63 farmers could learn how to grow enough food for at least one balanced meal a day for their own families.

The Village Committee applied for a licence with the Department of Water Affairs and Forestry for the use of 640 000 cubic metres of raw water from the Levubu River per year for irrigation. The Committee indicated that they would like to become a water user association and improve the management of the scheme by switching the irrigation system from flood to sprinkler and training the farmers in effective farming and efficient irrigation practices. Their intention is to increase their yields so as to market part of their harvest in order to earn extra money some day.

The question: Will the intended use of water for Mangondi be regarded as “efficient, sustainable and beneficial in the public interest”, can now be assessed.

6.2.1 Assessment of the Mangondi Village case

Run the spreadsheet “ESB.xls” and follow steps 5.1.1 and 5.1.2.

The result is shown in Figure 6.1 below.

6.2.2 Discussion of the Mangondi Village case

According to the weight distribution performed in Step 1, the factor entitled “Social benefits to the public” carries 42% of the total weight, and that entitled “Economic benefits to the public” carries 28% of the weight.

The two most important individual considerations are “Direct contribution of the water use to basic family food supply with high nutritional value”, which counts for 24%, and “Creation of multiple jobs for local communities (primary and secondary jobs created)”, which counts for 18% of the total.

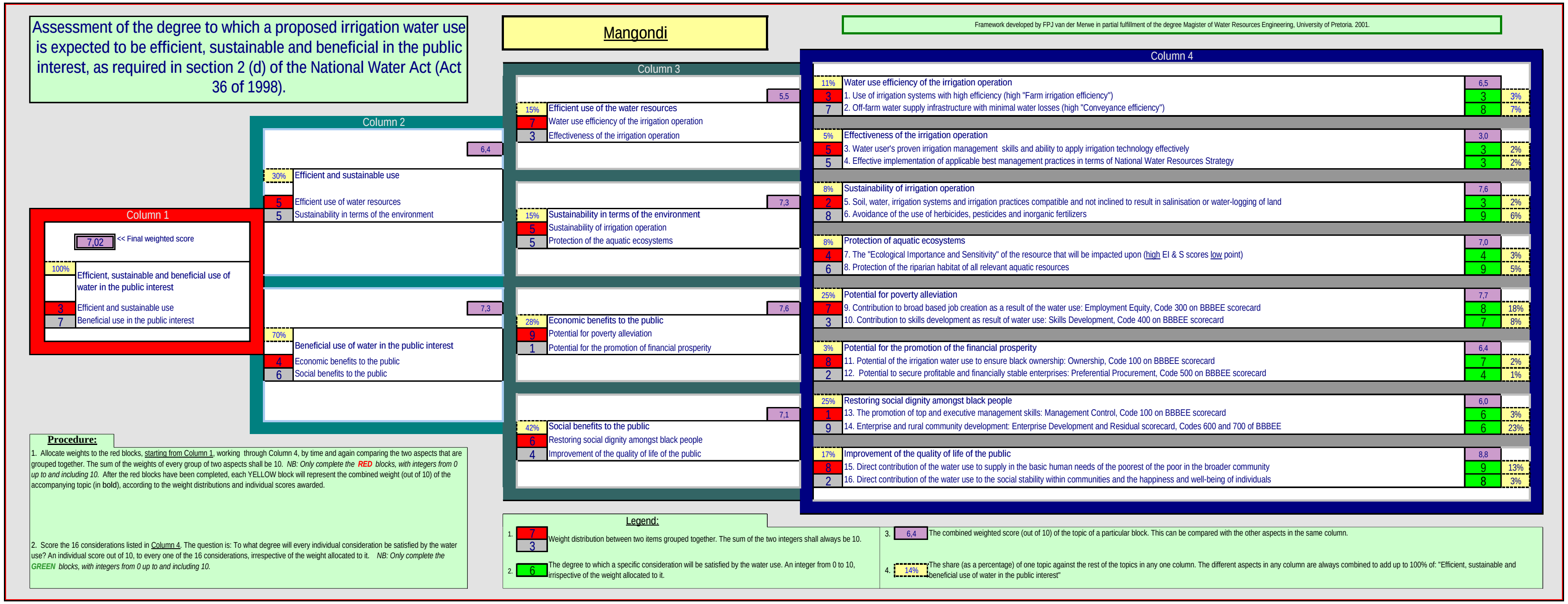

Figure 6.1: Evaluation scorecard for Mangondi Village, Limpopo Province.

The intended water use by the Mangondi village food growers fits well into these two considerations. The final outcome for the total evaluation of the Mangondi application is rated **7,02 out of 10**.

6.3 MAKHATHINI FLATS SUGAR PROJECT

The Pongolapoort Dam dam was constructed between 1966 and 1970 by the then Department of Water Affairs with a view to placing some 30 000 ha of sugar cane under irrigation on the Makhathini Flats.

However, as a result of the drop in the world sugar price in the early seventies, the irrigation project never materialised. What remained was a vast 2 500 million m^3 impoundment which significantly affected the flow regime of the lower Phongolo River downstream of the Lebombo Mountains.

To make matters worse, the dam could not be filled for the first 13 years of its life, as no agreement had been reached with Swaziland, a portion of which would be inundated if the dam level rose above one third of its full supply capacity. Agreement with Swaziland was reached in 1983 only, in return for a proposed pumping scheme to supply 142 litres per second (5 cusecs) of water to Lavumisa in Swaziland. During Cyclone Domoina in 1984, the Pongolapoort Dam played a major role in attenuating the flood, saving many thousands of lives downstream.

The floodplain, comprising some 70 pans and a home to a population of about 70 000 people, is a complex ecosystem that requires periodic flooding in order to function. There is also a volume of 60 million m^3 of water available for allocation from the Pongolapoort Dam, for which the Department has received a large number of applications. A task team comprising officials from all the relevant government departments as well as councillors and officials from the relevant local municipalities was set up to assist with the evaluation of applications.

Following a screening of applicants and apart from a number of smaller applications that could be accommodated in a separate way, DWAF was essentially left with applications from two sugar mill developers (referred to as Company A and Company B). They both claimed support from the community and the relevant interest groups, and maintained that they were supporting the government's Black Economic Empowerment (BEE) programme and had met DWAF's allocation criteria. Both applicants were impatient to develop and had already written to the Minister of Water Affairs and Forestry to complain about the allocation process being too slow.

The problem was that the applications were both extremely sound. The evaluation process would thus be very difficult and greatly sensitive to subjective and selective judgement.

Table 6.1: A comparison of the assessment attributes of Companies A and B

	Company A	Company B
Project support	Department X supports A's application (for debatable reasons) - Project led by community forum - Against importation of second-hand machinery - Renowned sugar technology leader - South African company - Sugar juice not economically viable Project initiated by Local Committee Support from Bank C (respectable South African commercial bank)	Local municipality supports B's application (for debatable reasons) - Project to be owned by the community Land Trust promises 40-year lease once the land is under its jurisdiction Department B to assist with relocation of communities
Project Description	Farming of sugar cane to be undertaken by local Makhathini farmers Processing of raw sugar in factory Two components: raw sugar mill and electricity co-generation plant Supply power to sugar mill and as well as into the local and national grid	Farming of sugar cane to be undertaken by local Makhathini farmers Processing of raw sugar in sugar mill Considering other alternatives, e.g. sugar juice
Ownership	Not yet finalised - but envisages at least 50% BBBEE participation in factory Probably 100% BBBEE ownership of co-generation plant and shared ownership of mill between Company A and BBBEE entity	Currently 63% of proceeds to grower and 37% to miller Eventually 100% to community
Community support and land access	Makhathini Consultative Forum have letters of commitment from Amakhosi specifying hectares available	Councillor Z indicated that 3 000-4 000 ha are available
Investment	Mill to the value of R 500 million R400 million infrastructure	R750 million (including infrastructure)
	As a result of the sophisticated and competitive nature of sugar mill technology world-wide, it is doubted whether there will eventually be a meaningful difference in investment between the two companies.	
Feasibility of 60 million m^3 water allocation	9 000 ha cane (including existing cane)	10 000 ha ideally
	900 000 tonnes cane per annum processed by the sugar mill Farming component - commercial return of 25% IRR - acceptable Factory component not viable - requires 1.5 million tonnes cane to make viable - 110 million m^3 - 15 000 ha cane	However, viable with 6 000-8 000 ha (not including other growers) 1 million tonnes cane to sugar mill 6 800 ha No information available regarding viability of subsidiary projects

	Company A (continued)	**Company B (continued)**
Irrigation	65 ha centre pivots Minimum 1 grower per pivot	75 ha centre pivots
Cane yield	100 tonnes/ha/annum	90-110 tonnes/ha/annum (reduced estimate)
		approx 147 tonnes/ha/annum
Alternatives	Co-generation Fermentation - yeast, alcohol, ethanol Downscaling mill - Syrup mill only - then ship to Felixton	Sugar juice concentrate Canning Cattle feed
	Delay/Downscale mill construction – smaller water allocation required Operate as structural under-seller to reduce refining costs Company A's technology for on-site refining	Ethanol
Job creation	Mill - 215 permanent jobs Farms – 4 200 jobs Salaries estimated at R78 million per annum	8 000 jobs estimated Salaries estimated R64 million per annum
Transfor-mation	Compliance with Agri-BEE Transformational Charter, BBBEE Training of local staff	BBBEE Training of local staff
Race & gender redress	90-100% black labour >60 % BBBEE ownership 50-59% BBBEE management 40-49% female employees 30-39% female ownership 20-29% female management 41-50 permanent jobs per million m^3 51-100 seasonal jobs per million m^3 2 to 2.5 million R/million m^3 of water use	90-100% black labour >60% BBBEE ownership 25-49% BBBEE management 40-49% women employed 30-39% female ownership 20-29% female management 81-120 permanent jobs per million m^3 <10 seasonal jobs per million m^3 2 to 2.5 million R/million m^3 of water us

6.3.1 The assessment of the Makhathini Sugar Project case

Run the spreadsheet "ESB.xls" and follow steps 5.2.1.1 to 5.2.1.5 on pages 48 to 50.

The resultant assessments of the two companies are shown in Figures 6.2 and 6.3 below respectively.

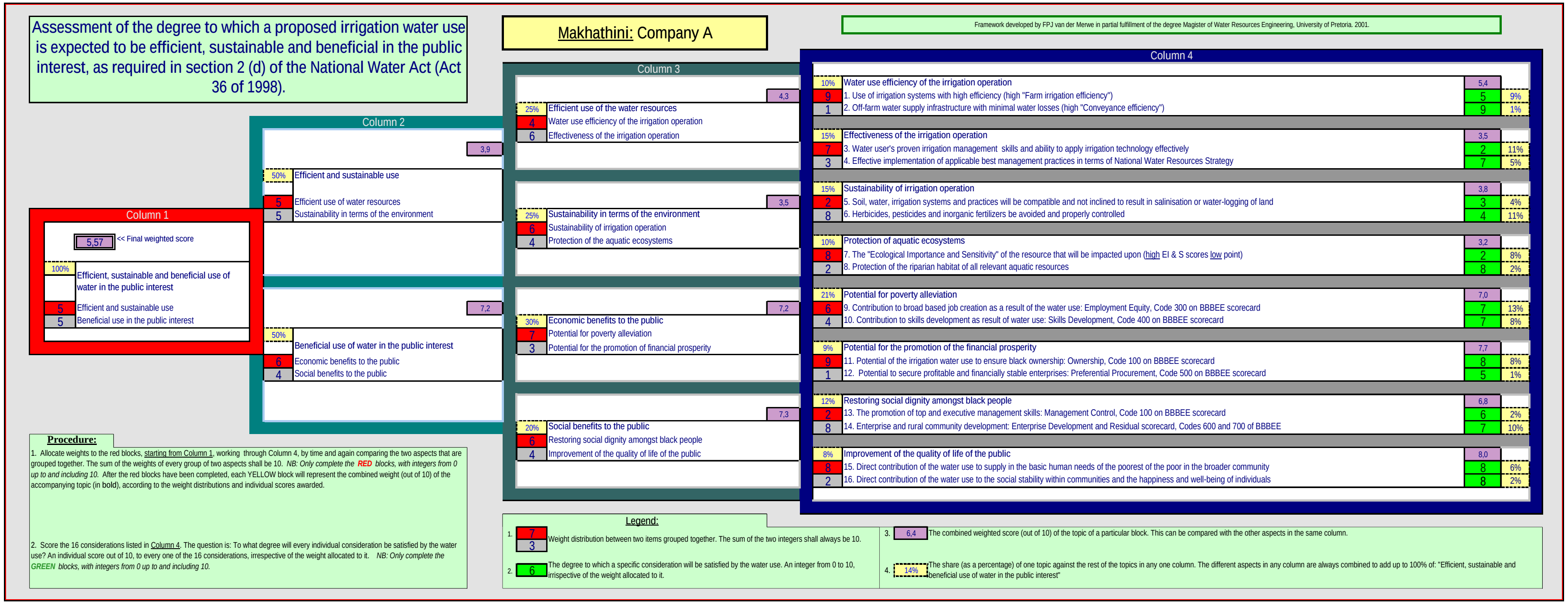

Figure 6.2: Evaluation scorecard for Company A, Makhathini Flats Sugar Project, KwaZulu-Natal.

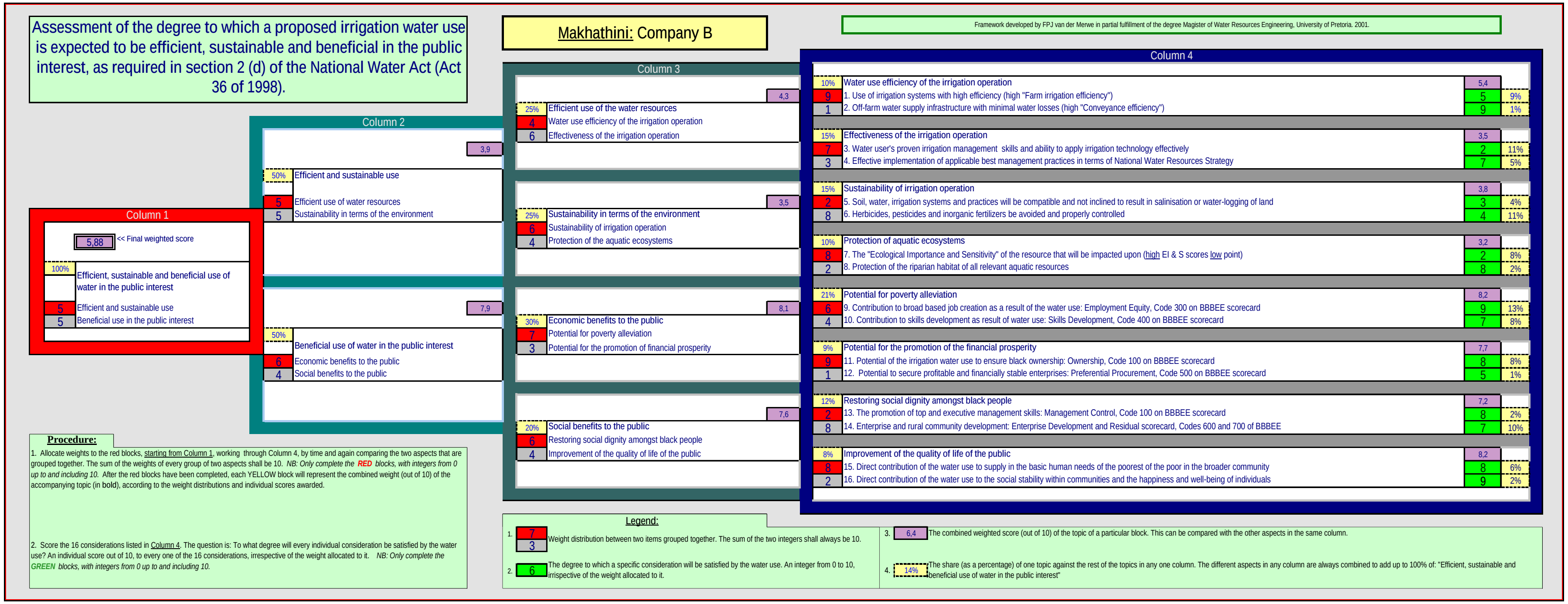

Figure 6.3: Evaluation scorecard for Company B, Makhathini Flats Sugar Project, KwaZulu-Natal.

6.3.2 Discussion of the Makhathini Flats Sugar Project case

Although the total scores of the two companies (5,57 for company A against 5,88 for company B) do not differ significantly, the difference becomes more significant once the assessments of the two companies are analysed. The third level of comparison (column 3) reveals a more prominent difference. The scores given in column 3 of the assessment method are as follows:

Table 6.2: A comparison of the third level of assessment for Companies A and B

Assessment criteria	Score of Company A	Score of Company B
Efficient use of the water resources	4,3	4,3
Sustainability in terms of the environment	3,5	3,5
Economic benefits to the public	***7,2***	***8,1***
Social benefits to the public	7,3	7,6

In the area of "economic benefits to the public", Company B shows a significantly better score than Company A (8,1 for Company B against 7,2 for Company A). By looking into the fourth level, it will be further revealed that especially the "potential for poverty alleviation" of Company B beats that of Company A significantly. According to the weights allocated to the different attributes (the red blocks in the spreadsheet) before the scores are allocated, this is a factor which in the case of this assessment makes a significant difference between the two companies, and which indicates that Company B is the better candidate from the overall viewpoint of "efficient, sustainable and beneficial use of water in the public interest".

6.4 CHANGE IN THE PRIORITIES FOR WATER ALLOCATION

Since water allocation is a dynamic process, the Department of Water Affairs and Forestry needs to be able to cope with changing situations. From time to time it has to rethink the weights of the different criteria that are applied in the consideration of licences. By using the proposed assessment method, any new set of weights can be decided upon and applied instantaneously, with a subsequent immediate change in the outcome of assessments.

CHAPTER 7: CONCLUSION

The study of developing a practicable method for the consistent and transparent evaluation of the degree to which an irrigation water use complies with the requirement of “efficient, sustainable and beneficial use of water in the public interest” for authorising an irrigation water use as specified in section 2(d) of the NWA of South Africa, has enabled the author to acquire adequate insight into the evaluation process and to successfully develop such a method.

The experience that the author has gained within the Department of Water Affairs and Forestry on the assessment of water uses, enabled the author to develop, test and refine this method until its final form.

Finally, it is necessary to consider the question whether the objectives of this study have been met. There were two main objectives.

Firstly to acquire and create a better understanding of the term “efficient, sustainable and beneficial use of water in the public interest” in the irrigation sector.

Secondly to develop a method to assess the merits of any specific case of irrigation water use against the consideration of “efficient, sustainable and beneficial use of water in the public interest”.

During the course of analysing this requirement, the literature study has revealed the following:

7.1 DIFFERENT COMPONENTS OF "EFFICIENCY" DEFINED

The term “efficiency” has been studied extensively world-wide in terms of the basic definitions and interpretations of the term in the irrigation field. However, the relationship between the different components of efficiency has been rearranged to be more practical and useful in the South African context. Six different efficiencies have been defined, namely conveyance efficiency; farm storage efficiency; system efficiency (which corresponds with classic definition); scheduling efficiency; farm efficiency; and the entire water use efficiency.

The relative linking of these efficiencies and the way they are grouped together deviate somewhat from literature. The following relationships have been used in this study:

Table 7.1: Linkages between the different efficiencies

<table>
<tr><th>Efficiency</th><th>Description</th><th>Efficiency</th><th>Description</th><th>Efficiency</th><th>Description</th></tr>
<tr><td>Conveyance efficiency</td><td colspan="3">How efficiently does the scheme manager deliver water at the farm off-take point?</td><td rowspan="4">Entire water use efficiency</td><td rowspan="4">How efficiently is the whole irrigation operation managed on a scheme-wide scale?</td></tr>
<tr><td>Farm storage efficiency</td><td>How efficiently is the water stored on the farm?</td><td rowspan="3">Farm efficiency</td><td rowspan="3">How efficiently does the farmer manage his/her irrigation operation on the farm?</td></tr>
<tr><td>System efficiency</td><td>How efficiently is the irrigation system delivering water onto the soil surface?</td></tr>
<tr><td>Scheduling efficiency</td><td>How efficiently is the water utilised by the crops?</td></tr>
</table>

Entire water use efficiency therefore contains the following three factors:

7.1.1 Conveyance efficiency

Conveyance efficiency is determined firstly by the technical properties of the distribution infrastructure and secondly by the skills and dedication of those responsible for the management and maintenance of the distribution system.

7.1.2 Farm efficiency

Farm efficiency is mainly determined by the type, technical properties of the irrigation system on farm level and how well it is managed and maintained by the farmer/manager.

7.1.3 Scheduling efficiency

Scheduling efficiency is mainly determined by the ability of the farmer/manager to utilise the irrigation system optimally in order to provide the right amount of water at the right time to the crops. It is the water user's irrigation management skills and ability to apply irrigation technology effectively, as well the effective implementation of applicable best management practices that should be evaluated here.

7.2 SUSTAINABILITY

The term "sustainable" has taken the same meaning as the internationally accepted definition. The following three criteria were developed to measure overall sustainability:

7.2.1 Suitability of resources and compatibility of actions

Suitability of soil, water, irrigation systems and irrigation practices, but also the compatibility of the different elements so that they are not inclined to result in salination or water-logging of land.

7.2.2 Prevention of pollution

Avoidance of the use of herbicides, pesticides and inorganic fertilisers.

7.2.3 Sensitivity to the ecology

The “Ecological Importance and Sensitivity” of the resource that will be impacted upon (high 'Ecological Importance and Sensitivity' scores low point) and the protection of the riparian habitat of all relevant aquatic resources.

7.3 BENEFICIAL USE OF WATER IN THE PUBLIC INTEREST

The term “beneficial use of water in the public interest“ has not been used in the South African context before. Although it is contained in section 2 (d) of the NWA, due to the interwoven nature of these aspects, it should amongst others also be evaluated against the background of other factors given in section 2, namely sections 2 (b), promoting equitable access to water; section 2 (c), redressing the results of past racial and gender discrimination; section 2 (e), facilitating social and economic development; section 2 (g), protecting aquatic and associated ecosystems and their biological diversity; and section 2 (h), reducing and preventing pollution and degradation of water resources. In order to achieve this goal, the following eight criteria are adopted to measure beneficial use of water in the public interest:

- Contribution to broad-based job creation as a result of the water use: Employment Equity, Code 300 on BBBEE scorecard (see Table B.4, Appendix B)
- Contribution to skills development as result of water use: Skills Development, Code 400 on BBBEE scorecard (see Table B.5, Appendix B)
- Potential of irrigation water use to ensure black ownership: Ownership, Code 100 on BBBEE scorecard (see Table B.2, Appendix B)
- Potential to secure profitable and financially stable enterprises: Preferential Procurement, Code 500 on BBBEE scorecard (see Table B.6, Appendix B)
- The promotion of top and executive management skills: Management Control, Code 200 on BBBEE scorecard (see Table B.3, Appendix B)
- Enterprise and rural community development: Enterprise Development and

Residual scorecard, Codes 600 and 700 of BBBEE (see Tables B.7 and B.8 respectively, Appendix B)

- Direct contribution of the water use to meet the basic human needs of the poorest of the poor in the broader community
- Direct contribution of the water use to the social stability within communities and the happiness and well-being of individuals

7.4 EFFICIENT, SUSTAINABLE AND BENEFICIAL USE OF WATER IN THE PUBLIC INTEREST

In practice, and in the author's opinion, the 16 criteria mentioned above were found to adequately cover all aspects of the study field. This indicates that proper insight into and therefore a better understanding of the term "efficient, sustainable and beneficial use of water in the public interest" in the irrigation sector has been acquired and introduced through this study.

A method has been developed to assess the merits of any specific case of irrigation water use against the consideration of "efficient, sustainable and beneficial use of water in the public interest". The method makes use of the 16 questions referred to above which should be weighted, scored and evaluated. The study revealed the following characteristics of the proposed method:

- It reduces subjectivity in a relatively complex and integrated matter, is straightforward and relatively simple to use.
- It is flexible enough to make provision for the wide variety of different scenarios that one may come across in practice.
- It allows the user to decide on the weights to be applied in every case. It therefore has the flexibility to increase or reduce the relative importance of any aspect in a transparent manner and even to eliminate it completely if necessary.
- It allows that the calculations are performed automatically, with the result that if any weight or any score is changed, it automatically updates all

scores, which enables the user to easily use it as a “What if?” tool.

- It is ideally suited to be used in cases where tenders are invited for a specific water allocation, because the weights that will eventually be applied by the responsible authority to evaluate such tenders can be made public up-front with the invitation for tenders. This will enable interested parties to be well informed on the criteria for the eventual adjudication, ensuring a transparent and fair process.
- In any other case the priorities of the different criteria that are used by the responsible authority may be adjusted if needed by simply adjusting the weights, in order to cope with changing situations in the consideration of licences. By using this assessment method, any new set of weights can be decided upon and applied instantaneously, causing an immediate change in the outcome of assessments. This tool may be useful with the process of compulsory licensing that the Department of Water Affairs and Forestry is developing at the moment – and is *recommended for further research*, in order to cope with refinements in the roll-out of the water allocation policy.
- The questions can be adapted when necessary and the scope widened beyond irrigation to also include other water use sectors. As *a recommendation for further research,* this can be investigated further.

7.5 A FINAL ASSESSMENT OF THE RESEARCH HYPOTHESIS

As a final conclusion to the study, it should be reflected whether the objective of the study has been met.

The evaluation method that was developed in this study and tested in the real world, does actually provide both qualitative and quantitative answers to those who have to apply their minds and consider the possible benefits of the different applications. It also provides a framework for a better understanding. The well-informed user involved in the decision-making process of water allocation has with this study acquired a flexible and versatile evaluation method.

The author thus postulates that the hypothesis has been proven and that the study has been completed successfully.

CHAPTER 8: REFERENCES

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APPENDIX A

APPENDIX A: RELEVANT SECTIONS OF THE NATIONAL WATER ACT (ACT 36 OF 1998)

A.1 INTRODUCTION

In order to acquire a full picture of the stipulations of the NWA that are referred to in this study, those sections are quoted *verbatim* underneath.

A.2 SECTIONS 2, 21, 27, 28, 29 AND PART OF 49 OF THE NATIONAL WATER ACT (ACT 36 OF 1998)

“**Purpose of the Act**

2. The purpose of this Act is to ensure that the nation’s water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors –

(a) meeting the basic human needs of present and future generations;

(b) promoting equitable access to water;

(c) redressing the results of past racial and gender discrimination;

(d) promoting the efficient, sustainable and beneficial use of water in the public interest; (author's italics)

(e) facilitating social and economic development;

(f) providing for growing demand for water use;

(g) protecting aquatic and associated ecosystems and their biological diversity;

(h) reducing and preventing pollution and degradation of water resources;

(i) meeting international obligations;

(j) promoting dam safety;

(k) managing floods and droughts,

and for achieving this purpose, to establish suitable institutions and to ensure that they have appropriate community, racial and gender representation.”

"Water use

21. For the purposes of this Act, water use includes -

(a) taking water from a water resource;

(b) storing water;

(c) impeding or diverting the flow of water in a watercourse;

(d) engaging in a stream flow reduction activity contemplated in section 36;

(e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);

(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;

(g) disposing of waste in a manner which may detrimentally impact on a water resource;

(h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;

(i) altering the bed, banks, course or characteristics of a watercourse;

(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and

(k) using water for recreational purposes.

“**Considerations for issue of general authorisations and licences**

27. (1) In issuing a general authorisation or licence a responsible authority must take into account all relevant factors, including -

(a) existing lawful water uses;

(b) the need to redress the results of past racial and gender discrimination;

(c) efficient and beneficial use of water in the public interest; (author's italics)

(d) the socio-economic impact -

(i) of the water use or uses if authorised; or

(ii) of the failure to authorise the water use or uses;

(e) any catchment management strategy applicable to the relevant water resource;

(f) the likely effect of the water use to be authorised on the water resource and on other water users;

(g) the class and the resource quality objectives of the water resource;

(h) investments already made and to be made by the water user in respect of the water use in question;

(i) the strategic importance of the water use to be authorised;

(j) the quality of water in the water resource which may be required for the Reserve and for meeting international obligations; and

(k) the probable duration of any undertaking for which a water use is to be authorised.

(2) A responsible authority may not issue a licence to itself without the written approval of the Minister."

"Essential requirements of licences

28. (1) A licence contemplated in this Chapter must specify -

(a) the water use or uses for which it is issued;

(b) the property or area in respect of which it is issued;

(c) the person to whom it is issued;

(d) the conditions subject to which it is issued;

(e) the licence period, which may not exceed forty years; and

(f) the review periods during which the licence may be reviewed under section 49, which must be at intervals of not more than five years. (author's italics)

(2) Subject to subsection (3), restriction, suspension or termination in terms of this Act and review under section 49, a licence remains in force until the end of the licence period, when it expires.

(3) Subject to subsection (4) and notwithstanding section 49(2), a responsible authority may extend the licence period of a licence if this is done as part of a general review of licences carried out in terms of section 49.

(4) An extension of a licence period contemplated in subsection (3) may only be made after the responsible authority has considered the factors specified in section 49(2) and all other relevant factors, including new applications for water use and has concluded that there are no substantial grounds not to grant an extension.

(5) An extension of a licence period in terms of subsection (3) may only be given for a single review period at a time as stipulated in subsection (1)(f).

(6) If the licence period of a licence is extended in terms of subsection (3), the licence

may, in respect of the period for which it is extended, be issued subject to different conditions which may include a lesser permitted water use.

Conditions for issue of general authorisations and licences

29. (1) A responsible authority may attach conditions to every general authorisation or licence -

(a) relating to the protection of -

(i) the water resource in question;

(ii) the stream flow regime; and

(iii) other existing and potential water users;

(b) relating to water management by -

(i) specifying management practices and general requirements for any water use, including water conservation measures; (author's italics)

(ii) requiring the monitoring and analysis of and reporting on every water use and imposing a duty to measure and record aspects of water use, specifying measuring and recording devices to be used;

(iii) requiring the preparation and approval of and adherence to, a water management plan;

(iv) requiring the payment of charges for water use as provided for in Chapter 5;

(v) requiring the licensee to provide or make water available to a person specified in the licence; and

(vi) in the case of a general authorisation, requiring the registration of the water use with the responsible

authority and the payment of a registration fee as a pre-condition of that use;

(c) relating to return flow and discharge or disposal of waste, by -

(i) specifying a water resource to which it must be returned or other manner in which it must be disposed of;

(ii) specifying permissible levels for some or all of its chemical and physical components;

(iii) specifying treatment to which it must be subjected, before it is discharged; and

(iv) specifying the volume which may be returned;

(d) in the case of a controlled activity -

(i) specifying the waste treatment, pollution control and monitoring equipment to be installed, maintained and operated; and

(ii) specifying the management practices to be followed to prevent the pollution of any water resource;

(e) in the case of taking or storage of water -

(i) setting out the specific quantity of water or percentage of flow which may be taken;

(ii) setting out the rate of abstraction;

(iii) specifying the method of construction of a borehole and the method of abstraction from the borehole;

(iv) specifying the place from where water may be taken;

(v) specifying the times when water may be taken;

(vi) identifying or limiting the area of land on which any water taken from a resource may be used;

(vii) limiting the quantity of water which may be stored;

(viii) specifying locations where water may be stored; and

(ix) requiring the licensee to become a member of a water user association before water may be taken;

(f) in the case of a stream flow reduction activity -

(i) specifying practices to be followed to limit stream flow reduction and other detrimental impacts on the water resource; and

(ii) setting or prescribing a method for determining the extent of the stream flow reduction caused by the authorised activity;

(g) which are necessary or desirable to achieve the purpose for which the licence was issued;

(h) which are necessary or desirable to ensure compliance with the provisions of this Act; and in the case of a licence -

(i) specifying times when water may or may not be used;

(ii) containing provisions for its termination if an authorised use of water is not implemented or not fully implemented;

(iii) designating water for future or contingent use; or

(iv) which have been agreed to by the licensee.

(2) If a licensee has agreed to pay compensation to another person in terms of any arrangement to use water, the responsible authority may make the obligation to pay compensation a condition of the licence."

"Review and amendment of licences

49. (1) A responsible authority may review a licence only at the time periods stipulated for that purpose in the licence.

(2) On reviewing a licence, a responsible authority may amend any condition of the licence, other than the period thereof, if -

(a) it is necessary or desirable to prevent deterioration or further deterioration of the quality of the water resource;

(b) there is insufficient water in the water resource to accommodate all authorised water uses after allowing for the Reserve and international obligations; or

(c) it is necessary or desirable to accommodate demands brought about by changes in socio-economic circumstances, and it is in the public interest to meet those demands.

(3) *An amendment contemplated in subsection (2) may only be made if the conditions of other licences for similar water use from the same water resource in the same vicinity, all as determined by the responsible authority, have also been amended in an equitable manner through a general review process. (author's italics)*

(4) If an amendment of a licence condition on review severely prejudices the economic viability of any undertaking in respect of which the licence was issued, the provisions of section 22(6) to (10) apply.

(5) A responsible authority must afford the licensee an opportunity to be heard before amending any licence condition on review.

APPENDIX B

APPENDIX B: BBBEE CODES AND SCORECARDS

B.1 INTRODUCTION

The codes for Broad Based Black Economic Empowerment (BBBEE) has been developed since the promulgation of the Black Economic Empowerment Act (Act 53 of 2003), and has been published in the Government Gazette on 9 February 2007.

The system has since been developed with the objective of giving black entrepeneurs a headstart in procurement matters like tenders. It is therefore a system for preferential procurement, with sets of criteria taken up in generic scorecards in seven different relevant equity fields. Because it has been widely tested and is generally accepted as a way to evaluate the degree of BBBEE participation of the business or individual, the author decided to use these scorecards unchanged in the evaluation method suggested in the study.

Table B.1: Summary of the seven different BBBEE scorecards

Element	**Weighting**	**Primary Codes Reference**
Ownership	20 points	Code 100
Management Control	10 points	Code 200
Employment equity	10 points	Code 300
Skills development	20 points	Code 400
Preferential procurement	20 points	Code 500
Enterprise development	10 points	Code 600
Residual	10 points	Code 700

The way the system has been developed for procurement purposes, a tender has to score a mark out of 80 for price and one out of 20 for preference where the tender is below a certain amount (currently R500 000). Where the tender is above the threshold amount, you need to score a mark out of 90 for price and a mark out of 10 for preference. Although the preferential procurement regulations still have to be amended, it seems as if the score out of 20 or 10 will be calculated by converting the score on the generic scorecard to a score out of 20 or 10.

Very important is the fact that since price is obviously not relevant as far as straight forward water allocation is concerned, the preferential part of the scorecards will be used for the full 100 points in every case.

Although it is a system intended for economic empowerment, the different sets of criteria do nicely follow the topics involved in the evaluation criteria adopted in this study.

Utilising these scorecards will have the advantage that it is a widely accepted and fully transparent process, which will leave very limited danger of either uncertainty or debate by applicants for water allocations.

It is expected that this Bill will soon be passed through Parliament.

B.2 CODE 100: OWNERSHIP SCORECARD

The Ownership Scorecard entails the following criteria, weighting points and compliance targets:

Table B.2: Ownership scorecard.

CATEGORY	OWNERSHIP CRITERIA	WEIGHT-ING POINTS	COMPLIANCE TARGET
Voting Rights			
	1.1 In the hands of black people	3	25% + 1 vote
	1.2 In the hands of black women	2	10%
Economic Interest			
	2.1 In the hands of black people	4	25%
	2.2 In the hands of black women	2	10%
	2.3 To which Black designated groups, Deemed participants in Distribution- or employee schemes or black participants in co-operatives are entitled.	1	2.5%
Realisation points			
	3.1 Net Equity Interest	7	-
	3.2 Ownership Fulfillment	1	-
Bonus Points			
	4.1 Involvement in ownership by black new entrants, black deemed participants of BBOS or black participants in co-operatives	3	-
	Total available Ownership Points	**23**	

B.3 CODE 200: MANAGEMENT CONTROL SCORECARD

The Management Control Scorecard contains the following criteria, weighting points and compliance targets:

Table B.3: Management Control Scorecard.

CATEGORY	MANAGEMENT CONTROL CRITERIA	WEIGHTING POINTS	COMPLIANCE TARGET
Board Participation			
	1.1 Exercisable voting rights held by black board members;	3	50%
	1.2 Black executive board members;	1	50%
	1.3 Black female executive board members;	1	25%
Top management participation			
	2.1 Black members of Senior Top Management	2	40%
	2.2 Black female members of Senior Top Management	1	20%
	2.3 Black members of Other Top Management	1	40%
	2.4 Black female members of Other Top Management	1	20%
Bonus points			
	Black Independent Non-Executive Board Members	1	40%
	Total available Management Control Points	**11**	

B.4 CODE 300: EMPLOYMENT EQUITY SCORECARD

The Employment Equity Scorecard contains the following criteria, weighting points and compliance targets:

Table B.4: Employment Equity Scorecard.

EMPLOYMENT EQUITY CRITERIA	WEIGHTING POINTS	COMPLIANCE TARGET
1.1 Black people with disabilities	2	4%
1.2 Black Senior Management	2	60%
1.3 Black female Senior Management	2	30%
1.4 Black Professionally Qualified employees	2	75%
1.5 Black female Professionally Qualified employees	1	40%
1.6 Black Academically Qualified employees	1	80%
Total Available Employment Equity points	**10**	

B.5 CODE 400: SKILLS DEVELOPMENT SCORECARD

The Skills Development Scorecard contains the following criteria, weighting points and compliance targets:

Table B.5: Skills Development Scorecard.

CATEGORY (Element)	**SKILLS DEVELOPMENT CRITERIA**	**WEIGHTING POINTS**	**COMPLIANCE TARGET**
SKILLS DEVELOPMENT			
	1.1 Skills Development Spend on black employees	4	3%
	1.2 Skills Development Spend on Critical/Core skills of black employees	2	2.6%
	1.3 Skills Development Spend on Critical/Core skills of black female employees	2	1.4%
	1.4 Skills Development Spend on disabled black employees	1	0.3%
LEARNERSHIPS			
	2.1 Black employees on SETA accredited learnerships	2	5%
	2.2 Female black employees on SETA accredited learnerships	2	2.5%
	2.3 Formerly black unemployed people or black people formerly residing in rural areas on SETA accredited learnerships	1	1%
Organisational Transformation			
	3.1 Existence of comprehensive BEE strategy as prescribed?	1	

	If 'Yes'		
	3.2 Employment of Skills Development Facilitator? If 'Yes'	1	
	3.3 Existence of policy on non-discrimination as prescribed? If 'Yes'	1	
	3.4 Compliance with all relevant employment related legislation? If 'Yes'	1	
	3.5 Effective human resource management plan implemented, as prescribed? If 'Yes'	1	
	3.6 Existence of a program designed to give practical effect to items 3.1 – 3.5 above, as prescribed? If 'Yes'	1	
	Total available Skills Development points	**20**	

B.6 CODE 500: PREFERENTIAL PROCUREMENT SCORECARD

The Preferential Procurement Scorecard contains the following criteria, weighting points and compliance targets:

Table B.6: Preferential Procurement Scorecard.

PREFERENTIAL PROCUREMENT CRITERIA	WEIGHTING POINTS	COMPLIANCE TARGET
1.1 BEE Procurement Spend from all Suppliers	15	70%
1.2 BEE Procurement Spend from QSE's	4	15%
1.3 BEE Procurement Spend from Exempted Micro Enterprises	1	5%
Total Available Preferential Procurement points	**20**	

B.7 CODE 600: ENTERPRISE DEVELOPMENT SCORECARD

The Enterprise Development Scorecard provides for the following criteria, weighting points and compliance targets:

Table B.7: Enterprise Development Scorecard.

ENTERPRISE DEVELOPMENT CRITERIA	WEIGHTING POINTS	COMPLIANCE TARGET
1.1 Cumulative Non-recoverable contributions as a percentage of cumulative EBITDA	6	2%
1.2 Cumulative Recoverable contributions as a percentage of cumulative EBITDA	4	3%
1.3 Bonus point	1	-
Total Available Enterprise Development points	**11**	

B.8 CODE 700: RESIDUAL SCORECARD

The Residual Scorecard provides for the following criteria, weighting points and compliance targets:

Table B.8: Residual Scorecard.

RESIDUAL CONTRIBUTION CRITERIA	WEIGHTING POINTS	COMPLIANCE TARGET
1.1 Cumulative Non-recoverable qualifying CSI contributions as a percentage of cumulative net profit after tax	5	1.5%
1.2 Cumulative Industry Specific contributions as a percentage of cumulative net profit after tax	5	1.5%
1.3 Bonus point	1	-
Total Available Residual Contribution points	**11**	
