Economic considerations in water allocation

PROMOTING EQUITY, EFFICIENCY, SUSTAINABILITY
AND POVERTY ALLEVIATION

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Internal draft report as a contribution to the Toolkit for Water Allocation Planning project: Output 4

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October 2004

Preface

This document was prepared as part of the project titled *Toolkit for Water Allocation Planning* undertaken on behalf of the Department of Water Affairs and Forestry under the Water Resource Management Component of the DWAF Water and Forestry Support Programme

Contents

1 Introduction

A draft report which outlined economic principles related to water allocation was prepared by Palmer Development Group. This current revised document was prepared in response to comments received on the first draft and in response to other outputs of the Water Resource Management Component of the DWAF Water and Forestry Support Programme. In particular, the following two draft outputs provide the supporting policy material for this report:

- *Toolkit for Water Allocation Planning*, Output 4, draft 1 version b, subtitled "Investigate options to help build capacity to use water productively", prepared by Huggins, *et al*.; and,
- *Towards a Strategy for Water Allocation Reform for South Africa*, third internal draft, 28 July 2004, prepared by DWAF.

It is our understanding that this document on economic considerations in water allocation will provide a contribution to the former document, including making a contribution to the proposed section on the role of water trading and water markets.

The revised document has been prepared in the context of the comment on the previous draft conveyed from the lead author that the final consolidated report is not intended to be at a very detailed level but rather to assist in the establishment of a "business process design" for water allocation planning. In particular, insight is required into high level analysis of approaches to subsidies to the poor; water trading and the evaluation of the benefits of different water uses. It was suggested that some of this discussion could simply be at the level of a "pros and cons" debate.

This is supported by a comment from the team leader following the submission of the first version of the scoping report that the items identified i.e. public benefit analysis, water pricing, subsidies to the poor and allocation instruments should remain however these should be at a high level overview or scoping of the key issues in each case.

The key issues to be addressed are therefore:

1. The understanding of public benefit in the allocation of water between competing water users, such as commercial agricultural water use; emergent commercial farmers; and industrial, urban or manufacturing water uses
2. The relationship between water pricing, water subsidies and water allocation
3. The role of market approaches, primarily water trading, in assisting in water allocation decisions.

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In a project of this nature, where the team members have operated in a fairly dispersed manner, there are likely to be differences of approach amongst the team members. In some instances the approaches presented in this report may differ from approaches suggested in the current draft of the consolidated document. In the absence of team discussion the team leader will have to reconcile these approaches.

1.1 Context

Water allocations in South Africa are governed by national policy and legislation which are set out in the White Paper on National Water Policy (1997) and the National Water Act (1998). The institutions which allocate water in terms of these policies and legislation are the Department of Water Affairs and Forestry (DWAF), in the first instance, either at the national or regional offices. Where Catchment Management Agencies (CMAs) are established, and where the right to make water allocations has been delegated, then CMAs will also be involved in the water allocation process.

The **project** objectives in relation to the overall allocation process are shown in Figure 1.

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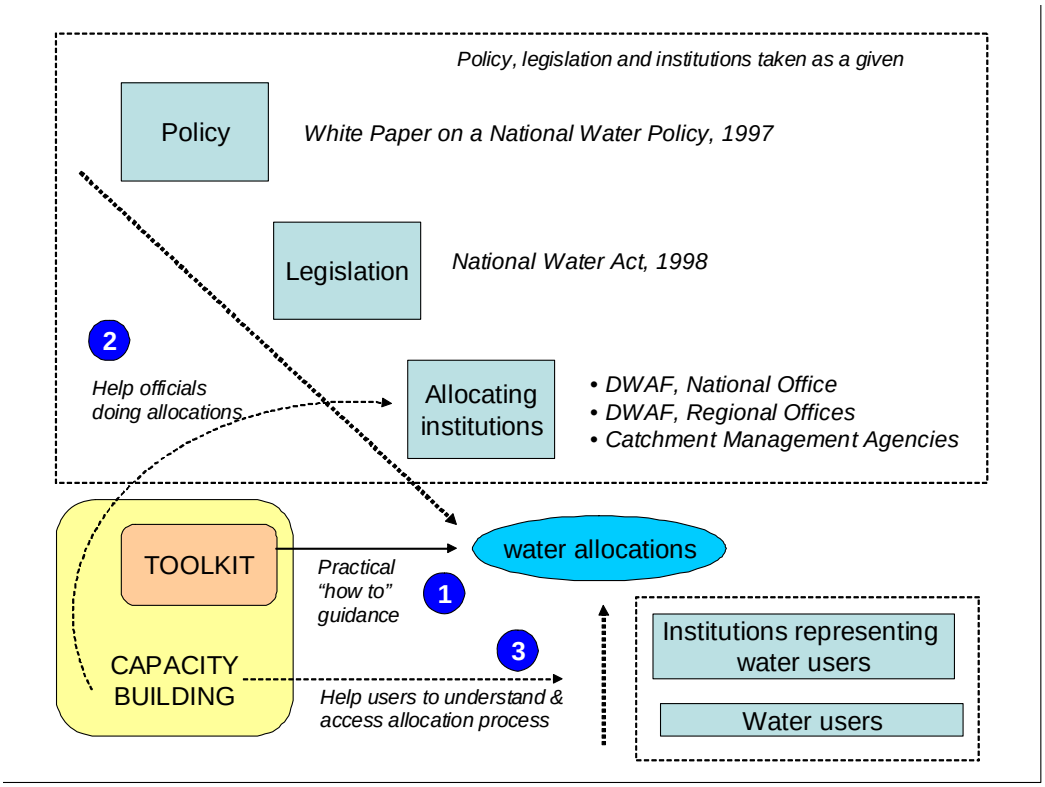

Figure 1: Project objectives

The objectives of this **report** are:

- to provide an **economic perspective** on the allocation of water, which includes:
  - The understanding of public benefit in the allocation of water between competing water users;
  - The relationship between water pricing, water subsidies and water allocation
  - The role of market approaches, primarily water trading, in assisting in water allocation decisions.
- to show how this perspective could be incorporated into a water allocation toolkit and influence water allocation approaches.

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1.2 Outline

Section 2 sets out a basic economic framework to understanding water allocations. This includes an outline of:

- Economic approaches to water allocation and how they are informed by notions of public and private benefit
- Financial considerations in water allocation, provision and use

Section 2 also discusses the role of market approaches, including water trading, in assisting in water allocation decisions.

In Section 3, the implications of these analyses and their potential role in the broader water allocation toolkit are discussed. Section 4 concludes the report.

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2 An economic approach to understanding water allocation

This section first outlines key elements of the policy context necessary to understand the role of economics in water allocation. This is followed by a discussion on the economics of water allocation itself.

2.1 The policy context

South African water policy seeks to promote and balance three fundamental objectives:

- **Equity** in access to, and benefits from, the use of water.
- Optimal **social and economic benefits**.
- Long term **sustainability** of the water resource.

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In the jargon of economics, these objectives are typically referred to in short hand as the three "e"'s of:

- Equity
- Efficiency, and
- Environmental sustainability

These objectives come across as being straight forward and uncontroversial. However, the concepts embodied within each objective are complex in their own right. Moreover, there exists no consensus in the literature on the appropriate or "optimal" means of balancing these typically competing objectives.[1]

The **equity** objective has a particular resonance in South Africa given the historically skewed access under apartheid to land in particular (and hence water in a riparian system) and to economic resources more generally (affecting users economic demand for water). At the heart of the equity objective is a political goal of reducing inequality in access to water resources and the benefits deriving from the use of water.

Although the goal of **environmental sustainability** would appear to be uncontroversial in its own right, the interpretation of what this means in practice is not straightforward. For example, there is an extensive debate in the literature on the meaning and definition of environmental sustainability. More importantly, measures to promote or ensure environmental sustainability, however defined, are likely to have a direct impact on the availability of water for other uses. In economic terms, this raises the scarcity (and hence costs) of water made available for other purposes. If narrowly conceived, and in the short term, there is a direct trade-off between the goal of environmental sustainability and the other two goals. However, when conceived more broadly and with a long term view in mind, the goals of equity and optimal benefits are underpinned by the environmental sustainability goal.

2.1.1 Policies with specific impact on water allocation

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There are some specific policies that affect or delimit the role of economics in water allocation in South Africa. These include:

- **Recognition of use**: All other water uses will be recognised "only if they are beneficial in the public interest". Water use may be recognized in the following ways:
  - Through general authorisations;
  - Through special time limited authorisations (licenses);
  - Existing use until such time as it is recognized (or not) in terms of the above two mechanisms.

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- **Pricing**: The allocation and use of this water for other uses will be subject to pricing and other economic tools and mechanisms (see pricing below).

[1] See Eberhard (2002).

- **End-user costs:** Water allocations will recognise private investments in infrastructure and hence, by implication, the costs borne by the end user for water use.
- **Phasing**: The new system of allocation will be implemented in a phased manner, beginning in water management areas which are already under stress. This system of allocation will use water pricing, limited term allocations and other administrative mechanisms to bring supply and demand into balance in a manner which is beneficial in the public interest.
- **Transitional arrangements:** These will, over time, ensure an orderly, efficient and gradual shift in water use allocations as and when necessary.
- **Trade:** There is scope for the Minister to enable the transfer or trade of these authorisations between users.

2.1.2 Pricing policies

Pricing policies[2] are set out in the White Paper, provided for in the National Water Act and elaborated in the cabinet approved national raw water pricing strategy. Specific pricing policies with respect to agricultural water use, including water charges to emergent farmers, are dealt with in DWAF (2000) which refers to decisions taken in a meeting between DWAF and organized agriculture.

In general, in terms of **raw water** use, there are three kinds of charge:

- **Resource development charge**. To promote the efficient use of water, the policy will be to charge users for the full financial costs of providing access to water, including infrastructure development.
- **Catchment management charge**. All water use, wherever in the water cycle it occurs, will be subject to a catchment management charge which will cover actual costs incurred related to catchment management activities.
- **Resource conservation charge**. All water use, wherever in the water cycle it occurs, will be subject to a resource conservation charge where there are competing beneficial uses or where such use significantly affects other users. In other words, this is a charge for achieving the efficient allocation of water

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These charges are being implemented on an equitable basis and according to a realistic reasonable programme. The policy provides for **exemptions** from charges in certain cases:

- **Basic human needs**. To promote equitable access to water for basic human needs, provision will also be made for some or all of these charges to be waived.
- **Equity in productive use**. To promote equitable access to water for disadvantaged groups for productive purposes such as agriculture, some or all of these charges may be waived for a determined period where this is necessary for them to be able to begin to use the resource.

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It is important to bear in mind that many water users will face prices and/or costs for water which are significantly in excess of the raw water and wastewater discharge prices as provided for above. These costs and/or prices arise from the costs of additional infrastructure required to use the water. In the case of urban water users, for example, these costs related to the costs of providing and operating all of the infrastructure downstream of the point of abstraction of the raw water from the river or dam. In the case of farmers, these costs related to the construction of private dams and/or the installation and operation of irrigation systems.

In the case of domestic water supply typically Water Services Authorities (WSAs) will be the responsible authority. In such cases, WSAs are responsible for developing policies and setting prices within the policy framework set out in the Strategic Framework for Water Services.

In the case of agricultural water use in many cases Water Users Associations (WUAs) will be the institutional structure managing prices. Policies related to the sharing of costs between users and implementation of prices are governed by WUAs provided these are compliant with the National Water Act.

[2] The pricing of water discharges is not addressed in this document

2.1.3 Available water authorisation options

In terms of the legislation the available water authorisation options comprise the following:

- **Schedule 1:** In terms of Section 22 (permissible use) and Schedule 1, reasonable water use for domestic purposes, small gardening for non-commercial purposes and for stock watering (with certain limitations) does not require licensing.
- **Existing lawful use:** a recognition of existing use; but not guaranteed in perpetuity;
- **General authorisations:** A general administrative authorisation which can be time limited and may be subject to being revoked. A general authorisation replaces the need for a licence, but does not limit or replace a pre-existing entitlement to water.
- **Compulsory licensing:** Compulsory licensing requires an allocation schedule to be developed. Not all available water need be allocated. Water for other use (after the Reserve and international treaty obligations have been met) may be subject to public auction or tender.

2.1.4 Institutional framework

Institutions relevant to the allocation and use of water can be categorised in terms of three key functions:

- **Regulation:** Regulatory institutions governing the allocation of water and regulating water use
- **Provision:** Institutions involved in providing water services
- **Consumption:** Institutions comprising or representing individual and groups of water users (or "consumers").

Ideally, the institutional framework should provide for a clear separation of these functions between institutions and avoid one institution being involved in multiple functions. The Strategic Framework for Water Services summarises the future roles of DWAF, CMAs and Water Services Authorities and Providers as follows:

The **Department of Water Affairs and Forestry** is the custodian of the water resource and overall leader of the water sector. It will not itself be involved in operating any water services infrastructure. DWAF will oversee the activities of all water sector institutions and will regulate water resources and water services. DWAF will be responsible for water resource planning at the national and international levels and for decisions related to inter-catchment transfers and international allocations. Most water licensing functions will ultimately be delegated to catchment management agencies. Only licensing with significant strategic or inter-water management area implications will be retained by DWAF. The efficacy of independent water services regulation will be assessed.

Catchment management agencies (CMAs) will be established in all water management areas. CMAs will be responsible for water resource planning at the catchment level and most water resources management activities in these areas, such as the licensing of water use and discharges where delegated by DWAF, monitoring abstractions and discharges, collecting abstraction and discharge fees, monitoring water quality, and overseeing land-use activities as this affects water management. DWAF will fulfil the role of the CMA where these are not yet established. In the short and medium term, DWAF national and regional offices will play a significant role in water allocations.

Water services authorities have the constitutional responsibility for planning, ensuring access to, and regulating provision of water services within their area of jurisdiction. They may provide water services themselves and/or contract external **water services providers** to undertake the provision function on their behalf. Water services authorities are responsible for securing from DWAF (or CMAs where they are established and where this function is delegated) licences to abstract water from, and to discharge wastewater to, the water resource. (**Regional water services providers** secure licences directly from DWAF or CMAs.) Water services authorities may regulate the provision of water services within their local area through by-laws and contracts. They may delegate the responsibility for obtaining licences through contracts" (DWAF, 2003).

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Water users have an entitlement to use water for certain restricted purposes, and may use water in terms of existing lawful use (which could be time limited), general authorisations (which are revocable) and time limited licenses.

Water user associations typically represent groups of water users and can apply for and hold water use licences on behalf of its users.

The separation of functions between institutions is reasonably clear in South Africa with the following exceptions:

- DWAF still plays an operational (provision) function in some instances which compromises its regulatory function;
- WSAs may be both water services providers and water consumers.
- The intention is for CMAs to be future regulators of water allocations. In this case, the temptation for CMAs to be involved in the provision function should be avoided.

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2.2 Economic framework

The Dublin Statement, adopted at the International Conference on Water and the Environment in January 1992, asserted that water is essentially an economic good. The fourth Principle of the Dublin Statement asserts that: "Water has an economic value in all its competing uses and should be recognized as an economic good". The Dublin Statement refers to the fact that water is a scarce resource with competing uses and therefore has value, either directly in household use, or as a valuable input used to grow irrigated vegetables or cash crops or for industrial production. Because of scarcity, allocating more water to one use, say food gardens, means less is available for other uses, say industry. Economic management is about the allocation and reallocation of limited water among the competing uses to increase economic efficiency and national well being, and it is about the selection of, and operation of, allocative mechanisms (Freebairn, 2003).

In discussing public policy towards water management and the issue of using prices and introducing markets as a major tool for water allocation and, therefore, for water management, it has to be understood that "controlling the use of water courses is a basic economic problem of resource allocation" (Freeman and Haveman, 1971, quoted in Lee and Jouravlev, 1998).

Despite the recognition that water is an economic good the current prevailing approach to water allocation in South Africa is strongly **administrative**. In other words, it is based predominantly on the relevant administration (the DWAF Regional Office or the CMA) applying its mind to a range of factors and on this basis deriving an allocation schedule. The policy underpinnings of this process is shown in the grey block below:

Part 8: Compulsory licences for water use in respect of specific resource

In determining the quantities of water to be allocated to users, **the responsible authority** must consider all applications received, and draw up a schedule detailing how the available water will be allocated among the applicants. In drawing up an **allocation schedule** the responsible authority must comply with the plans, strategies and criteria set out elsewhere in the Act and must give special consideration to certain categories of applicants. A responsible authority need not allocate all the available water in a water resource, **and may reserve some of the water** for future needs. Provision is also made for any water still available after the requirements of the Reserve, international obligations and corrective action have been met to be allocated on the basis of **public auction or tender**. A system of objections and appeals in relation to proposed and preliminary allocation schedules ensures that licences may be issued only after the allocation schedule has been finalised.

In terms of the overall objectives of the National Water Act, and given the prominence of the objective of equitable access to water use and its benefits, this approach is understandable.

However, it is clear from the extract that the Act also makes provision for a greater use of market forces, as opposed to administrative decisions, in the allocation of water. These include the reference to public auction and tender as well as the specific provision for water trading shown below:

Regulation and provision for water trading

(l) relating to ***transactions*** in respect of authorisations to use water, including but not limited to
- (i) the circumstances under which a transaction may be permitted;
(ii) the conditions subject to which a transaction may take place; and
(iii) the procedure to deal with a transaction;

(n) prescribing procedures for the allocation of water by means of public tender or auction; and

The ability to allocate some of the available water by public auction and the ability to establish conditions which will allow transacting in water authorisations provide the basis for two alternative or complementary approaches to water allocations, namely **water trading** and **market based water pricing**. These are discussed further below.

It is apparent that any future system is likely to be a blend of administrative and regulatory management of water allocation with a component of water allocation based on market forces constrained to some degree or the other. This section outlines some of the economic concepts and approaches that could contribute to this future mixed allocation approach.

The economic approaches and tools discussed therefore are viewed within a broader analytical framework which encompasses social, political and institutional factors (see diagram):

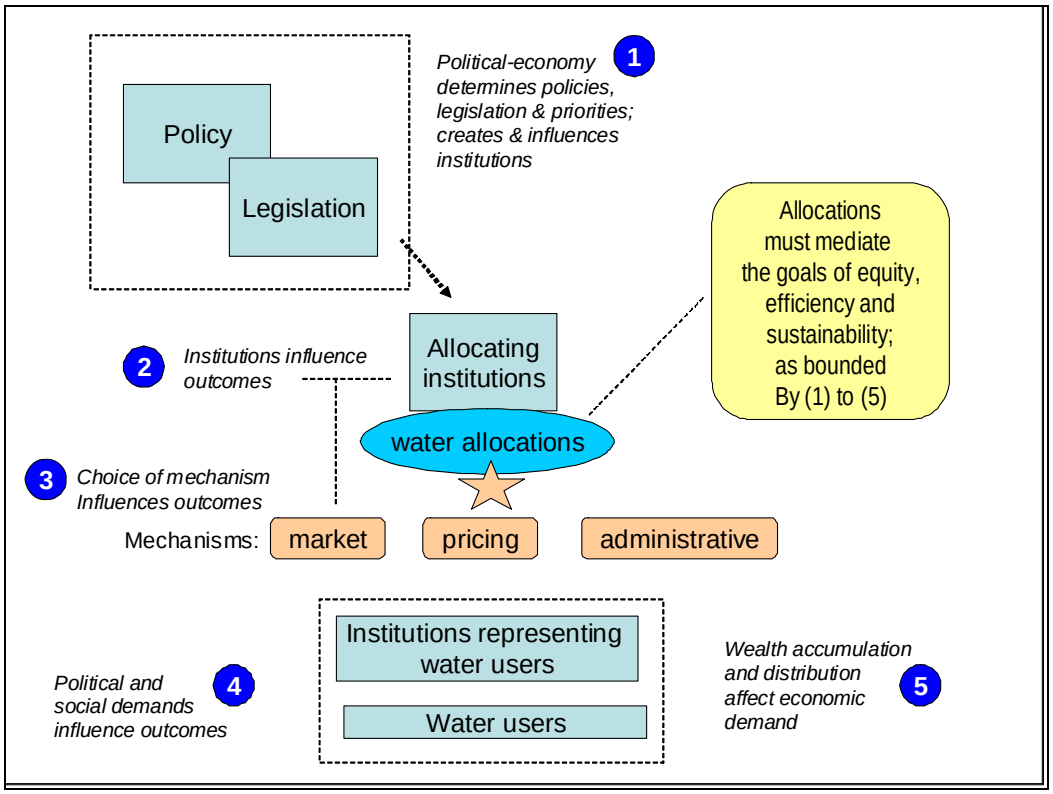

Figure 2: Analytical framework

National policies and legislation determine the overall policy and legislative framework for water allocations. These are determined politically and can be understood in terms of a political-economic analysis. The allocating institutions themselves (including any market) have an important influence over how the policies are applied and hence on the outcomes of allocations. These influences can be understood in terms of a institutional-economics analysis. The choice of allocation mechanism will affect allocation outcomes. Water users and water user associations will influence water allocations politically, socially and as a function of wealth distribution.

2.2.1 Concepts and tools

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The fundamental concepts and tools required for elaborating this economic framework for the analysis of water allocation are described below:

The neoclassical or "free market" approach

In neoclassical economics, the optimization of social and economic benefits is analyzed in terms of individual "utility". While this is a particularly narrow analytical framework, neoclassical thinking is very dominant within (and beyond) the world of economics. In terms of this framework, pricing which approximates (or simulates) a willing buyer – willing seller "free" market model is all important to achieving an "efficient" allocation of resources. Efficiency, in this framework, simply means a situation where the marginal price of each resource is equal to the marginal cost of provision.

An efficient allocation of resources will yield optimal economic (and by implication) social benefits. There is little doubt that this narrow analytical framework adds important insights concerning the impacts of resource allocation on economic and social benefits and economic mechanisms (for example, pricing and markets) for the allocation of resources. Nevertheless, it is reasonable to assume that the authors of the South African policy on water allocation deliberately conceptualized the "efficiency goal" in much broader terms as "long term optimal social and economic benefit of water use to society". This means that the economics of allocation, when applied in the South African context, needs to encompass a broader analytical framework than that provided by neoclassical economics.

Institutional economics

Institutional economics recognises that all economic transactions take place within an institutional context which is not neutral in its influence on the outcomes of these transactions. These institutions place bounds on the activities of economic transactions and their outcomes. For example, institutional capacity should be a key factor influencing the choice of allocative mechanism to be employed.

Political economy approach

A political-economy approach seeks to address two fundamental issues:

- **Wealth accumulation**. This analysis looks at the dynamic accumulation of wealth. The new allocation of water rights presents an opportunity to enable wealth accumulation by previously disadvantaged individuals in South Africa.
- **Wealth distribution.** The wealth accumulation process results in differential accumulation of wealth resulting in highly skewed income distributions. There is resistance to wealth redistribution. The recognition of existing lawful water use and the right to compensation provides some comfort to existing water users.

Water allocations processes in South Africa must at least be sensitive to these two key political-economic realities.

Postel's "ethical approach" to water recognises that the inequality in resource allocation and excessive luxurious resource use are primary contributors to resource constraints (particularly those affecting the poor). In this context, Postel criticises the trend towards the commodification of water as follows:

In principle, there is nothing wrong with properly valuing water's role as a commodity. … The risk, however, is that water's economic functions will be elevated over its life support functions, and that the three pillars of sustainability – efficiency, equity and ecosystem protection – will not be given equal weight. (Postel, 1997: xxviii)

In Postel's view, the pressure for the commoditisation of water has arisen out of the need to finance rising capital and operating and maintenance costs of water supply but she cautions that privatisation is inherently risky to both the poor and the environment.

Many economists would point out that, as the scarcity of a resource increases, price adjustments will automatically result in demand being balanced with available supplies.[3] Further, environmental economists would argue that the proper valuation of the environment

[3] Higher prices can potentially serve the dual function of reducing demand *and* increasing supplies.

would remove price distortions and create the right balance between development and conservation. In response, Postel argues that, at least as far as the environment and water are concerned, price responses are both too little and too late and furthermore, “getting the prices right” is not enough because a mere correction of prices does not address equity concerns in any real way, and without this sustainable development will be unachievable.

2.3 Water Trading

If water is an economic good then it should be possible to govern its allocation through the market. A much considered solution is to place as great a reliance as possible on prices and, therefore, on markets in the process of allocation of water and the related investments in productive services. Under such an approach the role of administrative allocation would be restricted to those few areas where markets cannot be developed and to the regulation of natural monopolies.

Lynne (1988) notes that "In light of the information problem, there seems to be little hope that administrative approaches can allocate water even with only minimal efficiency among the processes that result in marketable goods. It is not reasonable to expect a staff and a ... board to know what water is worth in every water use, which is necessary in order to know the economic efficiency of each board decision. The solution to the information problem will likely necessitate applying a market-like process for allocating water to produce market goods. The regulatory approach and the limited funds ... can then be focused on the areas where they are needed, which is in deciding water needs for the non market goods".

The notion of water trading is certainly not new internationally and water trading has occurred in other countries, such as Chile, for many years (see ECLA, 2004). More recently in South Africa a number of authors have noted that the National Water Act provides the framework for water markets (for example, Armitage, 1999; Farolfi and Perret, 2002). As shown above the water legislation makes provision for water rights trading as an option for water allocation. Farolfi and Perret (2002) note that even under past legislation, water-rights trading occurred and still exists between commercial irrigation farmers and has proved efficient in certain instances. They emphasise that DWAF has played an important role in the successful cases, assuring transparency, supervising and recording transactions.

2.3.1 Pre-conditions for effective water trading

The basic economic rationale for water trading is that efficient markets are the simplest way to allocate limited supplies of any good between different users to as to equate marginal social benefits across the different users.

Achievement of comprehensive and effective water requires attention to a range of issues without which water trading is likely to not occur, or to fail to deliver desired outcomes. These issues include (see Freebairn, 2003):

- **Specification of water rights:** Users of water can only make good decisions on the transaction of water rights if the water rights are explicitly, clearly and transparently defined. Workable water property rights should specify such things as the quantity and reliability of water supplied, any charges attached, the ability to buy and sell and any conditions on sale and purchase. The variability of water supply, including variability within a year, across years and longer term trends, should be built into water rights. What is at least as important as the structure and form of the water right specification is that whatever the specification that it be transparent, clear and enforceable.
- **Initial allocation of rights:** An important issue in setting up an effective water market is the initial allocation of the property rights. From the perspective of achieving an efficient allocation of water, competitive markets will in time achieve an efficient allocation from any starting point or initial allocation of rights (the famous Coase theorem). But, the initial allocation has important distributional implications. A common strategy in developed countries to achieve efficiency and at the same time to make no one worse off is to allocate water property rights to existing users, or the grandfather model. Other options used are for government to auction the rights, to offer them at random, or to allocate on a first-come-first-served basis. In South Africa, where the need to redress past inequalities and inequities is paramount, a very different approach

is required in which the initial allocation of water rights is explicitly premised on the redistribution of resources.

- **Recognition of external costs where relevant**: the associated costs attached to a water authorisation license (such as waste-water discharge costs) would have to be made clear and transparent. Adequate regulations to cover externalities, damage to third parties and the public interest, need to exist.
- **Low cost and transparent mechanism for transferring rights between buyers and sellers and for maintaining a public record of these transactions:** A single independent and transparent registry of water rights is needed to officially record ownership, and changes in ownership following sales and purchases. This would, by the prescriptions of the National Water Act, have to be DWAF or the CMAs. Typically information on prices and quantities of water rights traded would be available to the public.
- **A flexible mechanism for conflict resolution:** aligned with the above is a flexible and cheap mechanism to deal with conflicts and disagreements.

A review of the Chilean Water Code, which made water trading possible in Chile (ECLA, 2004) recently outlined some other 'fundamentals' for water trading to occur successfully. Many of these are addressed above but additional conditions of importance include:

- **A resource shortage:** in the absence of a resource shortage there is no scarcity price for the water and hence no incentive to trade
- **A social and cultural context that is in harmony with the economic system**: this is a particularly important issue in the South African context. If the social context is too far out of alignment with the economic system a trading system will fail. For example, if people in a particular area view water resources as a right rather than an economic good then they are unlikely to engage in a water trading system.

In summary, efficient construction of any market requires the existence of the necessary conditions for trading to occur:

- well-defined property rights;
- public information on the supply of and the demand for water rights; and,
- the physical and legal possibility for trading to take place (Curie, 1985).

Most authors tend to agree that of these three necessary conditions **by far the most important is the existence of well-defined property rights**. In the case of water, property rights define and limit the rights and duties of their holders relative to one another and to the rest of society to the use of a certain amount of water, which may be defined either volumetrically or in terms of shares of a stream or canal flow. If rights are poorly defined, market processes cannot be relied upon to allocate water resources efficiently. It is a basic responsibility of governments, as far as markets are concerned, to define, allocate and enforce property rights in water. Government policies play a critical role in defining the institutional setting for market operation and provide the basis for market activity by defining, allocating and enforcing water rights (Lee and Jouravlev, 1998).

2.3.2 Systems of trading in water rights or authorisations

There are a plethora of different water trading systems that are possible. Many different institutional and market design issues will need to be taken into account when finalising such a system. For example, some systems divide the tradable instrument into two parts – the water right or license itself (which can be seen as long term asset) and the annual volumes of water arising from that right (which can be traded on a much shorter time-frame). There have also been systems proposed that incorporate water quality considerations into the tradable license for ecological protection reasons. For example, the removal of a unit of water in an upper catchment may have more ecological impact than the removal of the same unit near the river mouth. In such cases an 'exchange rate' can be established between such units of water for the purposes of trading.

This document cannot address the complexities of water trading systems. It is sufficient to say that the design of the system is important in determining its eventual outcomes. There also exists the possibility that different catchments will require different types of trading systems.

Young (1997) provides a set of useful principles for evaluating any particular proposed economic instrument:

- **Economic efficiency:** having regard to implied and actual values, the chosen trade-off between objectives is achieved at least cost (productive efficiency) and so that no reassignment of property rights would improve objectives without making some-one worse off (allocative efficiency);
- **Dynamic and continuing incentives**: the mechanism used continues to encourage technical innovation, improved water efficiency beyond the official policy target; and automatically adapts to changing technology, prices and climatic conditions;
- **Equity**: no group of people, including future generations, is unfairly disadvantaged or favoured by the instrument's operation;
- **Dependability or certainty**: the instrument will deliver the desired target, even when knowledge about likely responses is uncertain;
- **Precaution**: the instrument avoids the chance of serious or irreversible consequences especially when there is scientific uncertainty about outcome;
- **Administrative feasibility and cost:** monitoring and information costs are minimal (low information cost)
- **Government enforcement is cost effective**: can be financed from available revenue and self enforcement is encouraged (low administrative cost), the instrument's requirements are simply explained (communicative simplicity), and the decision-making processes associated with the instrument can be understood by all parties (transparency);
- **Community and political acceptability**: the policy instruments motivate the community to ensure that the objectives are achieved, are perceived as being legitimately formulated and delivered, adds to social harmony, are consistent with government commitments and attracts widespread support.

2.3.3 Mechanisms to address market power and economic effects of trading

One of the possible concerns with water trading is the potential for some participants in the market to have so-called market power which allows them to dominate a market to their advantage. There are concerns that these kinds of problems may arise in South Africa. A model of potential water trading in the Olifants catchment (Farolofi and Perret, 2002) clearly reveals that there can be substantial difference in economic power between the sectors bidding for water – in this case mining and semi-commercial agriculture. This means that a direct negotiation of water rights transfer between mines and smallholders is likely to end up with an almost complete transfer of water rights to the mining sector. This would certainly have positive consequences in terms of strict economic efficiency, water productivity, and even formal employment in the area. On the other hand, such a transfer would challenge certain objectives of the government, which go beyond mere economic perspectives and include equity, sustainable rural development, environment protection, and the like.

Certain economic or regulatory policy tools may be implemented, as alternatives towards a more balanced allocation of water. Such systems have been used extensively elsewhere in the world. For example, if there is the fear that market power will lead to dominance there can be a taxation on license purchases (i.e. a tax on an authorisation trade) at an amount aimed at reducing the marginal return on water to the purchaser to a level which will curtail trades and which will have the additional benefit of revenue raising for catchment management. Other options are a "return to the community" system achieved by the periodic surrender of part, say 2.5%, of each share-holding to a tender pool with the revenue realized being returned to the local community; and hypothecation of revenue to a local council or catchment management committee.

Impacts of trading on areas-of-origin

The potential economic effects of water transfers are usually ignored in economic efficiency analysis on the grounds that they constitute "pecuniary" externalities and therefore resources that are affected (labour, land or capital) can easily move to other uses and because transferring water to a higher-value use should generally result in as larger or greater positive pecuniary externalities elsewhere in the economy. Empirical evidence supports the theory and suggests that typically negative economic effects of water transfers on the area-of-origin appear to be small and can be often compensated by benefits in importing areas (see Lee and Jouravlev, 1998 for many examples). They claim that in Chile, rural to urban transfers have rarely resulted in negative effects in the exporting areas, because farmers usually sell small portions of their water rights and are able to maintain agricultural production by adopting more efficient on-farm irrigation technology.

Because of structural problems in economies this is not always the case, and in some countries real economic losses may occur in the presence of long-term, structural unemployment of resources, immobility of resources, and the existence of economies of scale in related economic sectors. South Africa shares all these characteristics. Since rural and urban transfers often take place from depressed areas characterized by long-term unemployment of human and other mobile resources and there can be impediments to resource mobility, pecuniary externalities usually involve some real costs that should not be ignored. In addition, income redistribution from rural exporting to urban importing areas may be undesirable from a policy standpoint.

It is in part for these reasons that some countries have adopted strong policies to safeguard the needs of exporting communities. Many examples of such constraints can be found in the United States. For example, in Idaho, a statute provides that transfers from agricultural use should not be approved where such changes would significantly affect the agricultural base of the local area.

If the ultimate objective of a system of water trading is to ensure that water moves to its highest value use it is important, when considering any restrictions on water transfers, to avoid protectionist policies which lock water into historic uses or specific locations and perpetuate antiquated water use patterns that run contrary to efficient water allocation and modern demands, rather then encourage reallocation as economic and social conditions change. Asl Lee and Jouravlev (1998) note “this inertial inefficiency is inconsistent with the notion of maximizing water contribution to aggregate welfare and can result into substantial economic losses.” In other words, too many restrictions on water trading would undermine the very objectives sought by using such a system.

2.4 Water Auctions

The Water Act makes provision for the auctioning of water remaining after the requirements of the Reserve, international obligations and corrective action have been met. The rationale for auctioning is two-fold. The one reason is that it is likely to provide a more efficient means of allocation of water to productive users than an administrative allocation. A second reason is that auctions ensure that the wealth represented by water rights is transferred to the society as a whole and windfall profits are avoided.

Lee and Jouravlev (1998) note that the auction solution gives some concrete meaning to the vague proposition that national water resources belong to 'the public'. An auction enables the public to realise on this purported ownership in the form of receipts flowing into the state treasury.

The theory and practice of auctions has generated a substantial economics literature which cannot be addressed here. Suffice it to say that careful consideration needs to be taken of the manner in which water authorisations are auctioned, since different approaches can have very different financial outcomes for the state.

2.5 Tools for calculating the economic value of water

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In the absence of water markets a range of tools exist that can be used to approximate the kind of information that water markets would provide. In essence an administrator at a DWAF Regional Office or CMA would use these types of tools to make decisions on water allocations

that would simulate the functioning of an efficient water market. These tools include the following approaches outlined below.

2.5.1.1 *Catchment level economic and bio-physical models*

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There are a range of computer models that combine water resource planning and economic models of water use at a catchment or sub-catchment level. These typically work off a GIS platform and have an integrated economic model attached. Examples include Aquarius and WEAP. Typically the economic models attached have some form of optimisation programme which enables the user to determine an economically optimal allocation of resources given a set of bio-physical resource constraints. Some models may also include the use of input/output analysis to determine the indirect impacts of re-allocations of water away from current uses.

Typically, to be effective, these models are resource intensive both in the need for sound GIS and technical data and in the need for economic information on the current water uses in the catchment. It is likely that the latter data will be more difficult to come by in South Africa, with very limited research having been conducted on such key parameters as demand functions for water use and elasticities of demand amongst various water users.

2.5.1.2 *Micro-level estimations*

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At points it is sufficient to assess the economic demand for water from individual users or categories of users. In such cases simpler economic methods can be used such as net-back-analysis or other methods to determine the demand curve for water. In a net-back approach the information requirements are predominantly information on the economic of production of the user – generally the economics of agricultural production. This type of information, including farm-level budgets is fairly readily available in many areas of the country.

In analysing farm level budgets which are based on historical practice it is also important to understand the future technological options available to irrigators. Can they irrigate more efficiently? Can the switch to different crops? Can they switch to dry-land agriculture?

2.5.1.3 *Simulation by linear programming*

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Linear programming models are typically exclusively economic models used to determine "efficient" market clearing prices. Such models require information on the economic demand for water amongst various user categories and the long run marginal costs of water supply in a particular catchment. In some cases where this type of detailed economic information is lacking "quasi-linear programming" models using simple functions are sometime used (see Farolfi and Perret, 2002). These quasi-models are, of course, much cruder and provide indicative values rather which may help in understanding allocation decisions from an economic perspective, rather than providing definitive values that can be used to make allocation decisions.

2.6 Financial considerations

The financial considerations affecting water use are crucially important as well and there is limited value in only considering the economics of water allocations without some understanding of the financing of water supply and consumption.

Key components of the financial framework are financial costs, revenues and subsidies. The basic financial framework for water resources management and development is set out below:

- **Water resource management**. The costs of water resource management (including the allocation function) are recovered from water resource management charges.

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- **Water resource development**. The costs of water resource development are recovered from water resource development charges. These include a return on assets which creates a financial surplus (financial revenues exceed direct financial costs)
- **Waivers**. Water resource management and water resource development charges may be waived for emergent farmers. Emerging farmers are irrigators of historically disadvantaged groups, who will access existing or new government water schemes (GWS) through land reform programmes or will be registered or licensed under ex-homeland GWS, or become members of Water User Associations (WUAs).

- **Conservation charge**. Users may be charged a conservation charge. This charge is intended to reflect the scarcity or economic value of water in a catchment. This charge has not yet been implemented and could be implemented in a number of different ways.
- **Discharge**. A wastewater discharge charge system is being developed.

In addition to these water resources related charges, users are required to pay for the related water services infrastructure costs (including infrastructure on their own properties).

Because water users are expected to pay for the water they use (and the attendant water resource development and management costs) making allocations of water available to new users for productive use is a necessary but not sufficient condition to ensure that they actually will be able to access that water. In addition to having a right to use a volume of water new users will require:

- **Infrastructure**: to transport, store and use their authorised water use
- **Financial resources**: to pay for the costs of infrastructure and other water resource costs

2.6.1 Subsidy sources

The available subsidies for agricultural water use have been outlined in the documents prepared by DWAF (2000) and NDA (2002). These are also outlined in Section 5 of the main report (Irrigation and small scale farmer development).

The salient points outlined by DWAF (2000) are that for emerging farmers full recovery of operating and maintenance costs will be phased in over a five year period (20% in year one, 40% in year two, etc), commencing in the financial year following on the year in which the relevant water use has been registered or licensed. Under-recovery of costs will be subsidised from the DWAF budget. Catchment management and water resource management charges will also be phased in over a five year period, together with operating and maintenance charges.

Under special circumstances, where new farmers of historically disadvantaged groups who are the beneficiaries of land reform programmes will not be able to generate income within the first year after registration or licensing, the Minister can on request from such irrigators, consider and approve the waiving of GWS and WRM charges for a limited time period in terms of section 56 (3)(e) of the NWA. Such waiving will only be considered on an *ad hoc* basis and must be properly motivated.

The operating and maintenance charges for emerging farmers who will access GWS which are operated and maintained by WUAs can be subsidised to the same extent as the relevant charges for emerging farmers on GWS which are managed by the Department. This will be accomplished via an operational subsidy payable to the relevant WUA and phased out over a five year period.

Capital cost subsidies are also available from the Department for emerging farmers who are members of a WUA which intends developing a new irrigation scheme or wants to rehabilitate or upgrade an existing scheme (these are outlined in Section 5 of the main report).

Although the main report mentions the fact the business plan to be developed for new potential water users will be channelled to the appropriate department or agency for funding it is unlikely that subsidies for water use at any significant scale will be available for much longer than a five year period. It is also unlikely that any significant sources of subsidies for water will come from sources other than DWAF. Local government, despite some increasing focus on local economic development, is highly unlikely to be in a position to provide ongoing subsidies to any commercial activities. At present, most local authorities outside of the metropolitan areas, are struggling to even provide free basic water at the domestic level.

The current infrastructure and operating grants available to local government are not designed to support on-farm infrastructure nor to support any operating costs beyond basic needs. For this reason allocations of water must be realistic any must recognise the limited value of providing the right to someone to use water when that user will lack the financial means to give effect to that right.

3 The use of economic approaches in water allocation

3.1 Introduction

This sections illustrates how the economic framework and approach outlined in the previous section could be applied. It was beyond the brief of this paper to include empirical data relating to actual financial and economic costs, benefits and prices. At a later point, it would be desirable to strengthen and elaborate on this section will actual empirical data. Only once this has been done can firm conclusions be drawn.

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3.2 Scarcity at prevailing prices

Since market transactions are precipitated by the difference in the value of water in alternative uses and locations which must be large enough to outweigh the costs of obtaining water through the market process, water markets will be active only where and when water is sufficiently scare. Conversely, water markets won't be active where many water rights remain unallocated, where supply investments continue to be favoured over reallocation, where transportation and transaction costs are very high, or where there are other sources of low-cost water (Lee and Jouravlev, 1998).

To indicate in which catchments water trading is therefore likely to make some sense in the near future the following two tables show a reconciliation of "water requirements" (demand at current prices and with prevailing allocations) with availability by catchment. The data is sorted in order of decreasing scarcity which is defined as the volume of the available water (or absolute shortfall in water) expressed as a percentage of current water use (requirements).

Table 1: Reconciliation of water requirements and availability for year 2000 (million m³/a)

	Water Management Area	Reliable local yield	Transfers in (2)	Local requirement	Transfers out (2)	Balance (1)	Balance %use (3)
DEFICIT WATER MANAGEMENT AREAS							
11	Mvoti to Umzimkulu	527	34	828	0	(267)	-32%
7	Thukela	738	0	338	497	(97)	-29%
5	Inkomati	943	0	1 048	148	(253)	-24%
4	Olifants	611	172	971	8	(196)	-20%
2	Luvuvhu/Letaba	310	0	334	13	(37)	-11%
17	Olifants/Doring	335	3	373	0	(35)	-9%
16	Gouritz	277	0	342	1	(66)	-7%
1	Limpopo	282	19	325	0	(24)	-7%
19	Berg	501	203	738	0	(34)	-5%
WATER MANAGEMENT AREAS IN BALANCE							
14	Lower Orange	(1 007)	1 886	834	54	(9)	-1%
9	Middle Vaal	201	791	389	605	(2)	-1%
3	Crocodile West and Marico	693	656	1 328	10	11	1%
WATER MANAGEMENT AREAS WITH SURPLUS							
18	Breede	868	1	637	203	29	5%
10	Lower Vaal	50	651	653	0	48	7%
15	Fish to Tsitsikamma	437	571	902	0	106	12%
6	Usutu to Mhlatuze	1 010	32	693	114	235	34%
8	Upper Vaal	1 723	1 443	1 204	1 481	481	40%
13	Upper Orange	4 557	2	968	3 105	486	50%
12	Mzimvubu to Keiskamma	855	0	375	0	480	128%
	Total for Country	**13 911**	**0**	**13 280**	**124**	**504**	**4%**

Source: National Water Resource Strategy, 2003

Four water management areas show a "deficit" which as a proportion of local requirements exceeds 20%, namely: Mvoti to Umzimkulu, Thukela, Inkomati and Olifants.

The relative scarcity of water by water management area in 2025 is show in Table 2.

Table 2: Reconciliation of water use and availability for 2025 base scenario (million m³/a)

	Water Management Area	Reliable local yield (1)	Transfers in	Local use (2)	Transfers out	Potential for development (4)	Balance after development (3)
12	Mzimvubu to Keiskamma	872	0	413	0	1 500	1959
13	Upper Orange	4 799	2	1 022	3 496	900	1183
11	Mvoti to Umzimkulu	555	34	1 012	0	1 018	595
7	Thukela	742	0	347	497	598	496
6	Usutu to Mhlathuze	1 011	32	700	114	110	339
18	Breede	869	1	639	203	197	225
15	Fish to Tsitsikamma	452	595	979	0	85	153
17	Olifants/Doring	335	3	371	0	185	152
2	Luvuvhu/Letaba	403	0	349	13	102	143
14	Lower Orange	(1 001)	1 931	883	54	150	143
8	Upper Vaal	1 818	1 743	1 440	2 042	50	129
3	Crocodile West and Marico	805	901	1 594	10	0	102
19	Berg	506	203	829	0	210	90
10	Lower Vaal	48	648	645	0	0	51
16	Gouritz	278	0	353	1	110	34
9	Middle Vaal	205	775	400	580	0	0
4	Olifants	630	210	1 075	8	239	(4)
1	Limpopo	281	18	347	0	8	(40)
5	Inkomati	1 073	0	1 088	148	114	(49)
	Total for Country	**14 681**	**0**	**14 486**	**124**	**5 576**	**6 644**

1) Based on existing infrastructure and that under construction in the year 2000. Also includes return flows resulting from growth in requirements.
2) Based on assumptions as given in paragraph 2.4.2. Assumed growth in urban and rural water requirements as a result of high population growth and current ratios of domestic to public and business water use. Allowed for known development in other sectors only, with no general increase in irrigation.
3) Balance after potential development taken into account. Brackets around numbers indicate negative balance.
4) Shaded areas show catchments where scarcity would prevail without the additional water resource development shown in this column.
5) Three catchments will be in deficit in 2025 in the base scenario even with the water resource developments shown: Limpopo, Inkomati and Olifants.

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3.3 Proposed allocation approach on economic principles

For many years, it has been widely recognized in the literature that in the absence of markets it is difficult, if not impossible, to evaluate the real demand for water-related services because demand-functions cannot be estimated in such a situation. Instead of markets and the signals which they provide numerous a range of substitutes have been suggested (a number of these approaches have been described above). All these substitutes have in common that they provide fairly poor, and sometimes incorrect signals, and there is an argument that they provide no real solution to the problem of achieving an efficient allocation of water (Lee and Jouravlev, 1998).

On economic principles, therefore, the appropriate response is, where possible, to replace ineffective and inefficient administrative allocations of water with automatic and efficient market-based approaches and only to mediate or regulate such approaches where the market outcomes are clearly undesirable. To some degree this runs counter to most of the current suggestions for the implementation of the National Water Act. Most approaches to water allocation suggest that water allocation in South Africa is still largely conceived of as occurring via administration and not by pricing. For example, the raw water pricing strategy is designed to recover the costs of management of the water resource and water resource development and is not seen as a scarcity charge to allocate the resource. Similarly, the approaches to the design of the water allocation schedule are still strongly focused on stakeholder consultation and on the balancing of many criteria in making allocation decisions. Even in the current consolidated report (draft Output 4) the focus appears to be on a heavily administered system of the identification of water use opportunities and business plan development.

An alternative viewpoint is proposed here to provide guidance to water managers seeking to harness the potential for water trading in the allocation and management of water resources. It should be noted that the time and brief for this report has not allowed a full examination of the issues relating to water trading in South Africa, nor the options for the design of water trading systems. However, as outlined in the terms of reference, an approach to water allocation on economic principles is outlined as a component of a broader water allocations toolkit.

The key elements of the proposed use of economic principles in water allocation are outlined below. It should be noted that

3.3.1 Determine water hydrology and water availability

To decide whether a catchment is stressed the first requirement is to determine the river classification and hence the environmental Reserve. Also required is the determination of international obligations. The main role of economics in this process is an assessment of the economic impact of the reserve determination. This assessment should include:

What impact does the river classification and Reserve determination have on the availability of water in the catchment?

- In the case of a deficit, what is the full economic impact of this?
  - What is the economic impact of the allocation on other commodity prices (primarily agricultural commodities)?
  - Who bears the costs or benefits of these impacts?
  - What are the secondary impacts of the allocation on employment levels?
    - What is the economic impact on the beneficiaries?
    - How many beneficiaries will benefit?
    - By how much will individual beneficiaries benefit?
    - Should one place embargoes on the transfer of this benefit?
  - Are the economic impacts acceptable to society?

3.3.2 Water stressed catchments

The approach suggested applies to water stressed catchments. If a catchment is not water stressed then all an applicant needs to do is to demonstrate beneficial use (i.e. in the public interest). In the absence of water scarcity it is unlikely that a water trading system, or a quasi-market (such as an auction) will enhance water allocation decision-making. Therefore, a sound and consistent definition of water stressed catchments needs to be made.

3.3.3 Economic assessment

Following the fundamental hydrological and environmental determinations the water demand at current prices over time needs to be assessed. This is essentially a socio-economic evaluation which requires both a macro understanding of the economic development dynamics in the catchment (many of which will have been identified in local government IDPs in the areas) and

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a micro level consideration of water use. The micro level consideration requires an investigation into current water use practices, willingness-to-pay for water and technical options available to water users for demand reduction over time. On the basis of these investigations the economic surplus or deficit of water over time at current prices can be determined.

Where deficits exist, calculate or estimate the price of water that would cause the market to clear (demand equals available supply) over time.

3.3.4 Administrative allocations to redress past inequalities

Once a clear picture of the economics of the catchment has been developed it is now possible to make administrative allocations with adequate knowledge of the economic consequences of these actions. On this basis the catchment manager can then make new allocations to redress previous inequalities in access to water resources.

The recommendation (see further explanation below) is that these allocations are for historically disadvantaged users in the commercial forestry and irrigated agriculture sectors only. Water allocations for all other economic or productive purposes are done strictly on an economic basis.

In making these allocations on the basis of the redressing of previous inequalities it would be useful to have a national guidance on the appropriate national scale distribution of water resources that is sought (for example, what are the desired targets for the various user groups). In the light of these national objectives it will be easier to make the decisions as to what allocation should be made in this river basin?

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Care needs to be taken to protect the rights of historically disadvantaged groups, and the particularly vulnerable amongst them such as poor women farmers. There is a need to draw attention to the proposed approach for the allocation of water rights through campaigns of public information, as well as to offer legal and technical advice and to provide assistance to disadvantaged groups. In Chile, for example, the government has a programme to facilitate the legalization of the property titles to water rights; it has been spending more than US$ 0.32 million annually for this purpose (Lee and Jouravlev, 1998).

It is desirable to have a formal understanding of the economic impact of new allocations that are made to redress past inequalities in access. Therefore typically the water resource manager should be able to answer the following questions:

- What are the impacts of these allocations (and related price waivers) on resource use?
- What is the financial cost of these allocations (in revenue forgone)?
- What are the economic impacts of undertaking these allocations?
- Are the resource, financial, and economic impacts politically acceptable?

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A final decision to be made is whether this is a once-off long-term allocation or a periodic reallocation. Based on economic principles the former is strongly preferred.

3.3.5 Prevention of speculative water holding

Over time a catchment will become water stressed in which case the given water allocations will gain value. To ensure that current stakeholders in the catchment do not make windfall gains from holding water rights initial allocations to users should not be made if current beneficial use for the water is not intended since this will allow speculative holding of water allocations and will deny access to new entrants.

3.3.6 Market or price-based allocations

It is recommended that once the initial reallocation on equity grounds has been made that all other allocations are made on an economic basis. In this regards a number of options are possible, including:

- **Administrative pricing**: Under such a system the market clearing price would be determined administratively through the use of the various tools and approaches outlined above. This price would be reflected in the price of licenses and would hopefully give rise to a situation where all the water was taken up at the given price. The disadvantages of this approach are the large administrative effort required to

analyse the demand for water in the area and to derive a market clearing price. The other disadvantage is the significant chance that a mistake will be made and that either the price will be too high (in which case not all the water will be taken up) or the price will be too low (in which case there will be too much demand and a fall-back system will have to be used to apportion the water rights).

- **Water rights auction**: This would be a once-off auction to determine the market clearing price on a willing buyer basis. The advantages of an auction are that it raises immediate revenue for the state or CMA and that it reveals a market price. The disadvantages are that different auction designs can lead to different results and that it can be a fairly complicated instrument which may exclude potential new water users.
- **Tradable water rights**: The implementation of a tradable water rights system would address some of the problems of an auction, though not all. A water trading system would still require some mechanism to make the initial allocation of rights (which could be an auction process). This could give rise to some users making windfall profits (which may be desired if these users where previously disadvantaged and now had access to a natural resource with real value). Once the initial allocation had been made the relevant water management agency would need to become (or to appoint someone to be) the market maker in the catchment (or catchments if inter-basin trades were allowed). This function, of monitoring and managing trades would be crucial to the functioning of the system. Water trading should, in time, lead to a market clearing price but the benefits of the trade would accrue to the initial holders of the rights and not to the state.

Whilst these allocations are primarily motivated on the basis of economics, they also need to subject to the protection of the environment and third party interests. That is, economic allocations and trades must take into account any relevant externalities.

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3.4 An explanation of the proposed approach

The proposed approach is consistent with the intent of the policy and legislation on water allocations as outlined in the previous section and provides a practical *modus operandi* for the allocation of water which protects the environment, redresses past inequalities in access to water resources and promotes the efficient allocation and use of water.

Key features of the approach are highlighted below:

- **Preparatory analyses**: The methodology for allocation requires a logical sequence of analysis to be taken to ascertain the information necessary to make informed choices about the allocation of water. These steps are relatively well understood and are already widely practiced in South Africa with the exception the step to determine price at which demand would clear in a situation of deficit. The step is necessary to ascertain the economic value of water in a water scarce catchment.
- **Assessment of the economic impact of Reserve assessment**: The relationships between the classification of a river system, the determination of the Reserve and the related economic impacts are not widely appreciated in South Africa. This assessment explicitly recognizes these relationships and requires a quantitative assessment of the economic impact where a reserve determination (or rather a change in such a determination arising from implementing or changing the classification of a river system) will result in a significant increase in the economic value of water (the price at which demand in a catchment would clear). Whilst the water policy and the Act give an *a priori* "right" of the environment to a reserve, this right is clearly not absolute in the sense that different river classification will result in different reserve determinations. In general, there will be a direct trade-off between the classification of the river (a choice) and the economic impacts of this choice. This trade-off must be acceptable to society as a whole.
- **New allocations to redress inequalities:** The next step is to make new allocations to redress previous inequalities in access to water resources. This is essentially a political objective and it is wise to recognize it as such. All political objectives have costs and benefits. To make choices which are in the public benefit, it is good practice to explicitly

recognize the costs and benefits and to make informed choices. Economic tools can be used to estimate these costs and benefits. However, the final decision is a political one.

- **Once-off allocation versus a perpetual allocation (or periodic reallocation):** A key choice to be made here whether to make a once-off allocation or not. Once-off allocations are clean and neat. The analogy is the restitution of land. This is process that happens only once. Once water has been reallocated in a basin it could be considered that the past inequalities in access to resources have been addressed and hence it is not desirable to repeat this allocation on a continuous or periodic basis. The argument here is that abuses of licenses are prevented by the conditions imposed on the licenses and that transfers of licenses are controlled through a review process. On the other hand it may be argued that there will be a need for future reallocations of water to address the perpetuation of inequalities. Indeed, it is not inconceivable that people who received an allocation today could sell this allocation for short term gain resulting in long term disadvantage. Would it be fair to provide a second allocation to these people? Would it not be better to protect individuals who may be vulnerable to market power in the first place? If future re-allocations are made to new beneficiaries, on what basis are these new beneficiaries identified and targeted? On balance, it is recommended that reallocations are made once in each river basin (or water management area). In tandem with this approach measures should be put in place to protect the beneficiaries of these new allocations from negative impacts of market power and information and resource asymmetries.
- **Other allocations are made on an economic basis:** Once the reserve has been determined and water allocations have been made to redress past inequalities, then all other allocations of water are made on the basis of economic considerations.[4] The policy states this rather indirectly as follows: "All water use, wherever in the water cycle it occurs, will be subject to a resource conservation charge where there are competing beneficial uses or where such use significantly affects other users."
- **The conservation charge:** The conservation charge represents the economic value of water or water licenses when is it set at a value where the demand for water would clear (demand equals supply).
- **Determining the economic value of water:** These are various mechanisms for determining the economic value of water. The simplest to conceive is the price that the last user in a catchment which pay in an auction to use the last available volume of water. Other mechanisms include tradable licenses, virtual auctions and linear programming.
- **The value of a license:** A license will "hold" the economic value of water if the conservation charge is set to the economic value of water or, alternatively, if licenses are allowed to be traded on a willing buyer willing seller basis.

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3.4.1 Categorization of user groups as economic or entitled users

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Over and above domestic demand (which is an entitlement), "social and political demand" (as apposed to pure economic demand) for water is likely to arise from a number of use categories. The main ones are described below together with a proposed approach to water allocation for each category.

- **Sustainable livelihoods**. Water to support sustainable livelihoods (urban and rural), and made up of the following categories:

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  - **Home gardening**. Water for small home gardening is an entitlement and is therefore not subject to the allocation process.
  - **Cattle watering.** This is an entitlement (subject to certain restrictions) and is therefore not subject to the allocation process.

[4] Reasonable water use for domestic purposes, small gardening for non-commercial purposes and for stock watering (with certain limitations) does not require licensing and hence these uses are not subject to the water conservation charge and economic allocation considerations.

- **Home-based enterprises**. It could be argued that this should be an entitlement. However, water use for these purposes has not been defined as such. In view of the fact that total water costs are typically a small fraction of total enterprise input costs, it is recommended that water use for home-based enterprises be treated as an economic demand for the purpose of water allocations.

- **Emergent commercial farmers**
  - **Irrigation and forestry.** New allocations are made on a preferential basis subject to an assessment of affordability and acceptability of economic impacts.

- **Existing commercial farming**. In the past, water use for commercial farming has been heavily subsidised by the state. However, this practice is being done away with and commercial farmers are having to pay the full financial costs for water used. Where new allocations are made, or licenses granted, this should be based on a willing buyer model where the value of the licenses reflect their economic value and become tradable subject to certain constraints.

- **Economic development** (other economic activities)
  - **Enterprises**. A case could be made for preferential allocations of water to enterprises where these are owned by previously disadvantaged individuals. However, water input costs typically are a small fraction of total input costs of enterprises and free allocations and water subsidies would distort the incentives to use water efficiently. Therefore there should be no preferential allocation policy for water use for enterprises and allocations of water to enterprises should be based on economic demand and willingness to pay full economic costs.

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The conclusion to be stated here is that subsidised water allocations are not, in general, an effective means to redress past inequalities and to promote economic development. The only exceptions to this are the case of emergent farmers using water for irrigation and for commercial forestry. The key challenge presented by the above framework is the development of an appropriate definition of *emergent farmer* and *emergent forester*. The operational definitions outlined in Output 4 can be used as a basis for determining these categories.

The key policy objective is that water should not be the limiting factor in the emergence of new farmers – where farmers have access to all the other factors of production every effort should be made to provide water as the final factor.

This approach does not run counter to the main thrust of Output 4 which is to promote the beneficial use of water to support emergent farmers and other users. It simply notes that it is primarily for the category of emergent farmers alone that re-allocations should sensibly be made and that the economic costs of this allocation should be estimated.

It further notes that there are other constraints to these users enjoying the use of this allocated water. Within the water sector the primary constraint is the cost of water provision and, later, the costs of water resource development. There will be many constraints external to the water sector as well that should not aim to be addressed within the framework of water allocation as they are more appropriately addressed in other areas of government policy.

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3.5 Costs, value, willingness to pay and prices

In support of the proposed approach it is important to understand the economic demand for water from a user perspective. In order to do this it is necessary to understand the relationships between willingness to pay, financial costs, economic costs and prices with a view to explaining the economic and social impact of allocation policies on water users, water demand, third party impacts and social impacts.

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3.5.1 Urban systems

In these systems infrastructure costs dominate total costs. Infrastructure costs comprise the water resource development charge (typically levied by DWAF), bulk water costs (typically levied by water boards) and retail costs (typically levied by retail water services provider).

It is clear that the infrastructure costs are much more significant compared to the water resource costs. Hence, a policy of subsiding water resource costs or artificially lowering the water conservation charge for urban systems is a highly ineffectual means of achieving desirable social benefits. Therefore social benefits for urban water services (all water users dependant on networked urban water systems) should be provided through retail tariff subsidies and paid for from the national government equitable share and/or from cross-subsidies between users of the urban system.

3.5.2 Industrial Users

Figures on the value added through water use are given by Nieuwoudt *et al* as follows (from PDG, 2003).

Table 3: Value Added of Water Use per Sector in South Africa, 1998, R/m^3

1. Households	-
2. Industry	R157.44
3. Electricity	R 0.11
4. Mining	R 39.15
5. Agriculture	R 1.46
5.1.1 Irrigation: Field Crops	R 0.44
5.1.2 Irrigation: Orchards	R 1.32
5.1.3 Irrigation: Fodder Crops	R 0.42
5.2.1 Farming Livestock	R 10.51
5.2.2 Farming Game	R 15.48
6. Eco – Tourism And Recreation	R 44.37

Source: Conningarth Economists (2001), quoted in Niewoudt et al (2003)

The high numbers for value added in the case of industry and mining are notable and are associated with the fact that the input costs of water are not substantial in these cases. Due the great variety of circumstances there will be a wide range in the percentage of input costs represented by water supply and effluent treatment and return. However, estimates made by PDG for industry and by the Chamber of Mines for mining indicate that this is seldom more than 1 or 2 percent of production costs.

In the case of power generation Eskom estimate that the costs of water to their power station average 114.6 cents per kl in 2002. This amounts to 159.3 cents per kilowatt hour generated, of the order of 5 to 10% of the tariff paid for electricity by domestic consumers.

The implication of this is that the cost of water (including effluent treatment and disposal) is not substantial in the case of industries and mining and, therefore, is unlikely to be price sensitive in the majority of cases. This is less so in the case of power generation. There does not appear to be any merit for the application of water subsidies to these users.

3.5.3 Rural systems – potable water for domestic use

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The costs of rural water supply systems for domestic use are highly variable, but typically the infrastructure costs are very significant. The recommendation is therefore the same as that for urban systems.

3.5.4 Water for small scale non-commercial food gardening

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This water use is recognised as a right and is therefore not an allocation issue and should not be subject to a water conservation charge as the use is insignificant. Again, from a financial perspective the infrastructure costs dominate and this is therefore more a municipal service delivery issue than a water resource allocation issue. The implication is that if government at the local or national level wants to encourage small-scale non-commercial food gardening then it should find mechanisms outside of raw water pricing and allocation to do so.

3.5.5 Commercial irrigation and forestry

Input/output and multiplier analyses indicate that South African agriculture is an inefficient user of water in term of gross income generated per unit of water and also in terms of jobs created per unit of water. South African agriculture is, however, an important employer of labour as it is

labour intensive especially in the fruit and vegetable growing sectors. Evidence is provided that indicates that non-agriculture generally places a high value on sufficient water but little value on more than what it already uses. From this it is concluded that water may have to be transferred in future from agriculture to non-agriculture (PDG, 2003).

As discussed above, the category of emergent farmers is a crucial sub-category within commercial farmers. For these new farmers access to water rights allocations and access to sufficient capital will be crucial to allow them entry into the agricultural production section. There has also been an historical denial of access to water rights to rural black South Africans which needs to be remedied in the re-allocation of water resources. At the same time, beyond the DWAF subsidies for five years to such farmers it must be recognised that it is unlikely that many ongoing subsidies for on-farm input costs will be made available to such farmers. Beyond the initial allocation of water rights and support for capital infrastructure these farmers must demonstrate the long term financial sustainability of their operations.

4 Conclusions & recommendations

The economic consideration and approach outlined in this document is meant to assist in the development of a practical methodology for allocating water in the spirit of the National Water Policy and consistent with the National Water Act but also consistent with sound economic principles. The elaboration of many of the concepts outlined here will require considerable work, discussing and testing.

Some important remaining consideration are briefly outlined below:

Determining the reserve

- An important recommendation is that economic approaches should be brought to bear at the earliest stages in water resource allocation – that of determining the reserve. It is important, even at this stage, to recognise the economic and political trade-offs inherent in water allocation to all users, including the environment.

Redressing inequality in access and benefits

- There are a number of national policy and strategy level questions that should be addressed to aid in the catchment level water allocation process. These include:
  - How much water can/should reallocated to achieve equity goals?
  - Is a once-off allocation feasible and sufficient?
  - What are the detailed methods for conducting allocations (applications, criteria, process, conditions and so forth).
  - Targeting of allocations – should there be any means testing/targeting of allocations? How does one define an emergent farmer?

Economic allocations via water trading

- The design of a water trading system requires substantial work in the elaboration of the trading rules and institutional mechanisms required. Basic questions that need to be satisfied at the national level include:
  - What are the implications of allowing secondary trading in water rights?
  - Are their better alternatives to redress inequality?
  - Protection of beneficiaries against abuses of market power – how can beneficiaries be protected against abuses of market power but still retain the value of their allocation for trade?

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4.1 Administrative requirements

While this report suggests that there are many merits to expanding the role of water trading and other market instruments in the water allocation toolkit it is recognised that the introduction of water markets is by no means a universal solution to the problems facing water resources management.

As Lee and Jouravlev (1998) note, a water market is a management tool. It is a tool, however, which spreads the burden and difficulties of management among a larger population, permits greater participation in management decisions and can introduce greater flexibility into management systems. At the same time, however, the establishment of a water market demands new skills and new attitudes from the public administration, judicial systems and water users, as well as, investment in registration of rights, monitoring and measurement systems, and possibly in improving water distribution and transportation systems. Although they state that the prerequisites needed for a viable water market are the same as those needed for good water management it is apparent that the introduction of water trading, water auctions and other economic tools will demand new skills and expertise from water managers.

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4.2 Towards an allocation toolkit

The context in which this report has been prepared does not allow for specific and detailed recommendations to be made as to how to implement economic allocations of water resources. A tentative viewpoint, prior to the necessary wide discussion on this issue, is that the mechanisms and investigations needed to administratively determine market clearing prices are likely to be too costly and complex for the current catchment managers. The system in which the maximum data is revealed with minimum effort and cost will probably be an auction system.

An auction system is likely to assist in the initial allocation decision but will not introduce dynamic incentives nor automatic clearing of the water market over time. It is therefore likely that an initial auction will need to be followed by a subsequent move to a trading system which will allow for flexible adjustments to water allocations over time as the economy and water use technology evolves over time.

These systems can both be easily integrated into the approaches proposed in Output 4 to support new and emergent water users to identify and claim their rights to water. In effect, it is likely that most of such users, especially in the emergent agriculture sector, will be granted an initial allocation on a preferential basis. The allocation of the remaining water in the catchment and the future tradability and hence value of these entitlements will be the main focus of the market based approaches suggested here.

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