WATER SCARCITY AND SOCIAL STABILITY: TOWARDS A DEEPER UNDERSTANDING OF THE KEY CONCEPTS NEEDED TO MANAGE WATER SCARCITY IN DEVELOPING COUNTRIES

A.R. Turton, SOAS Water Issues Study Group (University of London) & African Water Issues Research Unit (AWIRU) (Pretoria University Department of Political Sciences), Pretoria, 0002, Republic of South Africa.
E-mail: art@icon.co.za & at31@soas.ac.uk
Telephone: +27-11-665-3645 or +27-12-420-2464

L. Ohlsson, Department of Peace and Development Research, University of Goteborg, Sweden.
E-mail: L.Ohlsson@padrigu.gu.se
Telephone: +46-31-773-1408

Introduction

There is generally a paucity of theory within the water sector that is capable of explaining and predicting what the critical elements of social stability are. It is known, for example, that there is an increase in water scarcity in general at the global level (Falkenmark, 1989), and that this is affecting the developing world. It can therefore be anticipated that this increased water scarcity will impact in some form or other on social stability within these developing states, but it is not known exactly where or how this will manifest itself. Existing research tends to have focussed on water as a scarce natural resource. This can be understood as being a first-order analysis of water as a resource, which can be misleading however, as it tends to take researchers in the wrong direction. A more fruitful area of research is that which focuses on the ability (or inability) of a social entity to cope with the increasing demands caused by water scarcity. This can be called a second-order scarcity (Ohlsson, 1998; 1999) of social resources, which gives a far better insight into the dynamics at work within the context of social stability in developing countries. This paper will attempt to contribute to a deeper understanding of the social dimension of water scarcity and social stability by developing some key concepts further, and then by suggesting a tentative model that can be considered for empirical testing in various social settings.

Conceptual Origins

The whole aspect of the social side of water is a relatively new field of study. This owes its existence, at least in part, to the pioneering work that was done by Falkenmark (1987), who suggested that water scarcity is on the increase, largely being driven by population pressure. Falkenmark (1993;1994;1997) and Falkenmark *et al.*, (1990) then made an extremely valuable contribution to the debate by suggesting the idea of a 'water barrier' and 'water scarcity' as being a limitation of sorts to the economic growth potential of developing countries - and thus a potential source of conflict and social instability. In this it was implied, but not clearly stated, that a direct relationship exists between increased water scarcity and some form of potential social instability.

In the same vein, Allan and Karshenas (1996) showed that a developing country tends to over-use its environmental capital. They showed that under certain conditions however, a developing country could make a series of incremental adjustments to their development policy. These adjustments, coupled with the precautionary approach of conservative environmental economics, could thus allow a developing country to ultimately engage in 'natural resource reconstruction'. Israel is a case in question, where recycled wastewater is now being used to revitalize aquatic ecosystems. South Africa provides another example where the new Water Law has made the needs of aquatic ecosystems equal in status to that of basic human consumption, calling this the 'reserve' and thus protecting it as a legal right. Other Southern African countries such as Botswana and Namibia are now following suite.

Homer-Dixon & Percival (1996:53) suggested that adaptation to resource scarcity by means of mechanisms such as economic pricing reduces the risk of conflict within a social entity. To this end, 'resource capture' is a significant contributing factor to social instability (Homer-Dixon & Percival, 1996:6). Ohlsson (1998;1999) then made a quantum leap by showing for the first time, that a distinction exists between what he called a 'first-order scarcity of natural resources' and a 'second-order scarcity of social resources'. With these concepts in hand, a researcher can now explain how a social entity might not cope with the first-order scarcity of water, due to the existence of a second-order scarcity of social resources. This enabled other workers such as Turton (1999a) to link Allan and Karshenas' concept of 'natural resource reconstruction' to Ohlsson's concept of 'adaptive capacity' via the mechanism of 'water demand management'. Using this newly developed set of conceptual tools, it is then possible to tentatively show how some communities facing extreme levels of water scarcity (first-order level of analysis) seem to be able to adapt (second-order level of analysis) if traditional value systems are still functioning (Lichtenthäler & Turton, 1999). Adaptive behavior can also be found in the legal transformations currently taking place in the Southern African water sector and in Israel for example.

A concept that is potentially useful to the overall understanding of social adaptive behavior in the face of water scarcity is that of 'water rich', which seems first to have been coined by Falkenmark (1990:178). Linked to this is the terminology that was used by Feitelson (1999), in a recent presentation at Oxford University, in a context suggesting that 'water scarcity' and 'water poverty' are not the same thing. This suggests that this concept is useful, as it implicitly embraces notions of 'adaptive capacity', but that in its current form it remains too fuzzy to be of any real value in its own right.

This has inspired the authors to present a paper, in an effort to gain conceptual clarity, and thus take the debate forward in the context of water as an element of social stability. It is to this effort that we now turn our attention.

Refining the Concepts Further

As a point of departure, it is necessary to develop a basic hypothesis.

Basic Hypothesis

In the context of water as an element of social stability, it is hypothesized that increasing levels of water deficit are likely to result in a series of measures or coping strategies being generated by decision-makers. It is these measures that are likely to become the source of conflict and potential instability within developing countries, because such measures are going to be largely allocative in nature, thereby changing the balance of privilege in society.

Thus we can start to construct a simple model, using basic concepts as primary building blocks. The initial model thus has increasing levels of 'water scarcity' resulting in a range of social responses or 'adaptive behaviors' that are likely to result in a series of 'coping strategies' that are 'allocative' in nature. This is represented schematically in Figure 1.

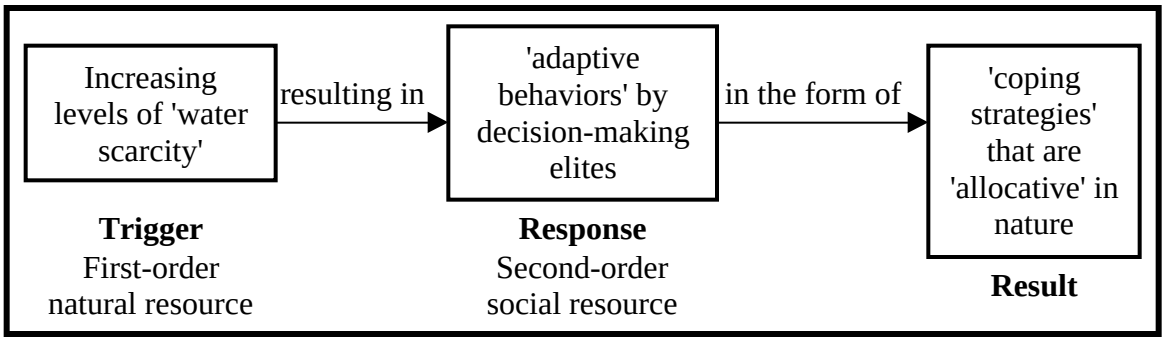

Figure 1. Schematic representation of the basic hypothesis showing how 'water scarcity' generates an adaptive response that results in some form of allocative measure being introduced.

In order to develop conceptual clarity, let us now define exactly what is meant by each concept. For the purposes of this paper, the following definitions will apply:

'Water scarcity' is a decrease in the volume of water available per capita over time.
'First-order resource' is the natural resource that is becoming either scarcer (or more abundant) relevant to population over time.
'Second-order resource' is the set of potential 'adaptive behaviors' that are drawn upon from the broader social context that can be used by decision-making elites, either legitimately or illegitimately.
'Adaptive behavior' is a clearly manifest response to the changing level of water scarcity that can be in any one of a number of forms, such as voluntary rationing schemes, changes in cropping cycles, rainwater harvesting, groundwater mining, formal policies etc.
'Coping strategy' is the output of the decision-making elite, usually in the form of some coherent policy or set of strategies such as water demand management, that seeks to manage the water scarcity in some form or another.

'Allocative' mechanisms or procedures are a component of the coping strategy that seek to take water from one area or sector of utilization and re-allocate it to another.

With this point of departure, one can now start to develop some key concepts a little further. Let us focus our attention now on the notions of a first and second-order scarcity, and then seek to weave these into useful concepts, which can in turn serve as building blocks for a more complex model. Ideally, such concepts should be empirically testable. Let us try to understand the subtle nuances that result from different combinations of a first and second-order resource relative to quantity of that specific resource. This can be derived from a simple matrix, presented as Figure 2.

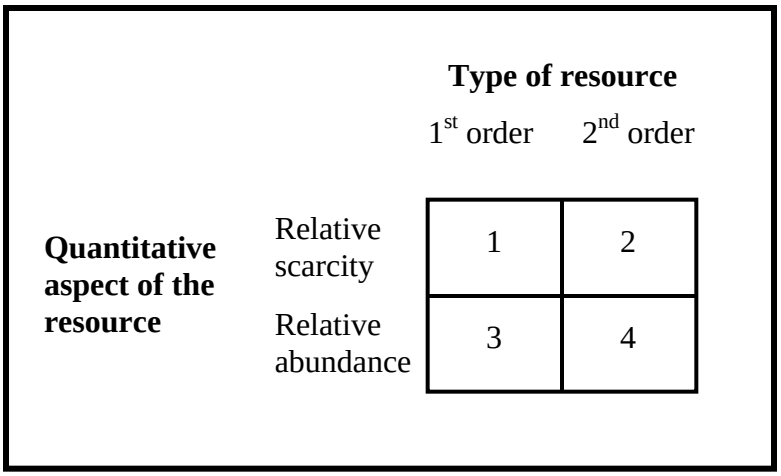

Figure 2. Matrix showing possible variations of type of resource and quantitative aspects of the resource.

We can now start to define key concepts with respect to this matrix, simply by assigning labels to different combinations. From these the following definitions can be derived:

'Water poverty' can be defined as the existence of both a first-order resource scarcity (block 1) and a second-order resource scarcity (block 2) simultaneously. This enables us to theorize that a social entity is in a condition of 'water poverty' if it is confronted by a prevailing condition of 'water scarcity' in conjunction with a low level of 'adaptive capacity'.

'Structurally-induced water abundance' can be defined as the condition that exists when a social entity has both a first-order resource scarcity (block 1) and a second-order resource abundance (block 4) simultaneously. This enables us to theorize that such a social entity has managed to adapt to 'water scarcity' by means of generating a suitable set of 'coping strategies' if it has sufficient 'adaptive capacity' that is empirically manifest as a set of 'adaptive behaviors'. Such an entity has induced relative water abundance by being socially adaptive and technically innovative in the face of endemic water scarcity.

'Structurally-induced social scarcity' can be defined as the condition that exists when a social entity has both a first-order resource abundance (block 3) and a second-order

resource scarcity (block 2) simultaneously. This enables us to theorize that under certain conditions of social resource scarcity, relative water abundance may still result in social instability.

'Water abundance' can be defined as the condition that exists when a social entity has both a first-order resource abundance (block 3) and a second-order resource abundance (block 4) simultaneously. This enables us to theorize that under such conditions, social stability is likely to be the prevailing situation.

From this we can now move forward with the construction of our model. Let us start off by focussing on the trigger identified in Figure 1, as this is the logical origin for a series of subsequent events or responses. If one is trying to understand what social instability may result from a change in the availability of water, one first needs to understand what is actually meant by 'water scarcity' in a more profound manner. Again this can be illustrated schematically as in Figure 3.

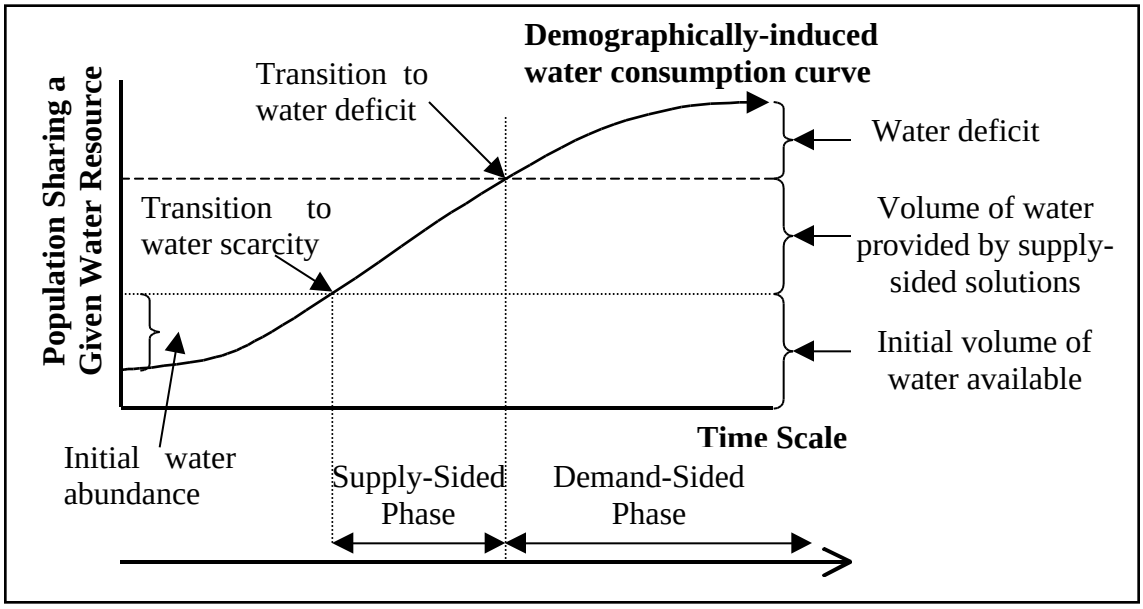

Figure 3. Simplistic model showing transition from Supply-Sided Phase to Demand Management Phase in a political economy (Turton, 1999a:13).

From Figure 3 it becomes clear that as a given population grows, it uses more water. Thus what starts out as an initial abundance of water changes into a condition of 'water scarcity' at the point where demographically-induced demand overtakes the prevailing level of supply. This transition to 'water scarcity' acts as the initial trigger to the authorities who are in government, to deliver more water. Thus the Supply-Sided Phase is dominated by the desire to mobilize more water. This has been called the period of "heroic engineering" by Platt (1999) in the case of large metropolitan areas such as Boston and New York. Reisner (1993) refers to this as the birth of the "hydraulic mission" in the case of the American West. Swyngedouw (1999) notes that Spain "launched itself on a path of accelerating modernization" from the late 19th century

onwards that has seen the "production of nature" in a hybrid form where social practices, cultural meanings and engineering principles become infused with hydrological characteristics. To this end, the "hydraulic engineering mission consisted primarily in 'restoring' the 'perturbed' equilibrium of the erratic hydrological cycles in Spain". It is thus reasonably safe to say that the Supply-Sided Phase is about getting more water, usually from ever more distant sources, to satisfy the growing demand in the urban areas. Significantly, the 'adaptive behaviors' by the decision-making elites are manifest as a set of 'coping strategies' that are based largely on major feats of hydraulic engineering.

Taking this demographically-induced consumption curve further along its trajectory, one notices that a second transition point is reached where 'water deficit' occurs. This is an extremely important transition to understand within the context of social stability, as it is at this point where a previously stable social system can become unstable. What triggers this transition seems at this stage to be the coincidence of at least two significant events in the context of 'adaptive behavior'. Firstly, the increasing cost caused by the escalating levels of complexity of these supply-sided solutions becomes a form of social trigger. Either local authorities can no longer pay for the hydraulic engineering works to continue, or else there is simply no alternative source of water left to exploit. Secondly, there is the birth of a social conscience, often in the form of environmentalism and manifest in the concern for the escalating levels of environmental degradation that result from the supply-sided hydraulic engineering. Platt (1999) refers to the case of the Connecticut River where strong resistance was mobilized by the local residents on environmental grounds. Reisner (1993:284) notes that the damming of Glen Canyon in the American West unleashed a powerful social response that projected the Sierra Club into the forefront of the anti-dam lobby. Significantly, the birth of this social conscience can be regarded as a form of adaptive behavior, being a response from a social entity to a trigger event and ultimately acting as a form of check or balance to the prevailing governmental policy, that is usually protected by a dominant sanctioned discourse.

Given the major significance of the transition to a prevailing condition of 'water deficit', it becomes increasingly important to understand this concept more fully. What can be understood by the term 'water deficit'? According to Warner (1999), the terminology that is selected should denote a problematic situation vis-à-vis both quantity and quality. In other words, the definition should embrace a change, either as a deterioration or improvement, in the quantitative aspects of both volume and water quality. Warner (1999) suggests the inclusion of an aspect akin to the notion of an IQ test. In this regard, he notes that the perception of the issue by the public with all the resultant social, cultural and political overtones turns this into a qualitative problem. To this end, he suggests that one considers a form of "water IQ" indicator as it embraces available "water capital" in conjunction with available "social capital" seen as a form of adaptive response. In this context, social adaptivity can thus be understood to be a necessary but not a sufficient condition to cope with less than desired quantities or qualities of available water. For example, Char dwellers in Bangladesh are extraordinarily adaptive, but are likely to be drowned by the next cyclonic thunderstorm because the political economic context in which they find themselves makes too few resources available for survival. Therefore floods, as well as drought, should be understood with respect to the adaptive capacity to

water-related risks. Israel is well adapted to drought conditions but not so to flooding. This is inverted for Holland. Significantly, Warner (1999) concludes that "the better governments provide the structural cushions against supply shocks, the more society will lose touch with the variability of the resource. Society will become technically, but not socially adaptive as a result".

Baer (1999) also makes a very valid point, which needs to be considered when trying to understand the concept of 'water deficit'. She suggests that the concept 'water deficit' should be understood in terms of the consumption aspects of water. In this regard, 'water deficit' is the situation where non-renewable consumption exceeds the availability of renewable freshwater resources. This enables the researcher to now focus on 'coping strategies' by asking how a social entity covers its 'water deficit'? Such strategies could be by groundwater mining (an unsustainable practice), by the importation of Virtual Water, by developing more elaborate water supply schemes or by desalination etc. Baer (1999) concludes that by using the concept in this way, it would enable the researcher to gain an insight into the way that social stability results from water scarcity, because it relates back to the traditional understanding of the term as derived from the discipline of economics.

The authors consequently believe that the concept of 'water deficit' is extremely important to clarify, as it becomes the trigger point for the transition into a new phase of water management and thus a period of potential social instability. For this reason, the following definition is offered:

'Water deficit' is the prevailing condition that exists when the consumption of freshwater within a social entity exceeds the level of sustainable supply.
'Water surplus' is the prevailing condition that exists when the consumption of freshwater within a given social entity is within the level of sustainable supply.

From this it becomes evident that a continuum exists between 'water scarcity' and 'water deficit'. In this context, 'water scarcity' is the first trigger that results in the supply-sided hydraulic mission within a given social entity. Over time this gives rise to the birth of some form of social conscience that is triggered when the economic and environmental cost of increasingly complex supply-sided solutions become interpreted within the specific cultural context as being inappropriate. The transition to 'water deficit' is then understood as being a critically important step as this can trigger various forms of social instability which, if incorrectly dealt with by government, can result in a wide range of responses such as migration, political opposition, civil disobedience etc.

By using this terminology, both the social component and the emphasis of the prevailing discursive elites is brought into the equation. For example, 'water scarcity' is really a quantitative concept, triggering a quantitative response - mobilizing more water as part of an overall hydraulic mission. 'Water deficit' on the other hand is more of a qualitative concept, embracing social responses to the purely quantitative issues. The transition from one to the next also becomes significant in the context of social stability. The first transition from 'water abundance' to 'water scarcity' serves to alienate people from an

intimate contact with the natural resource. One can say that the first transition is largely dominated by first-order scarcities which causes the disempowerment of the individual in the form of an "alienation from nature" (Atkinson, 1991:88), to use a term that is now part of the modern political ecology discourse (Turton, 1999b). In so doing, the individual surrenders the responsibility for mobilizing water to a centralized authority of sorts, in much the same way as classic contract theorists such as Hobbes and Locke envisaged. For purposes of this paper, let us call this the hydro-social contract. Thus the first level of potential social instability arises when the central authority fails to uphold their side of the hydro-social contract by delivering adequate quantities of safe water to places where it is needed. In similar vein, the second transition from 'water scarcity' to 'water deficit' serves to trigger another set of social responses, such as the birth of some form of heightened social conscience. At this point in time, special interest groups start to mobilize support and begin to question governments' interpretation of the hydro-social contract. This may coincide with increased demands for democracy and fundamental political transformation of sorts. Therefore the second transition also becomes a point of potential social instability, because at that moment in time, the prevailing governmental policies are out of touch with the rapidly changing social norms and perceptions on water and water delivery. Unless a degree of adaptability exists within society in general, and specifically within government, then the resultant 'coping strategies' will be out of touch with society and hence increasingly be perceived by the individual as being illegitimate. This is illustrated schematically in Figure 4.

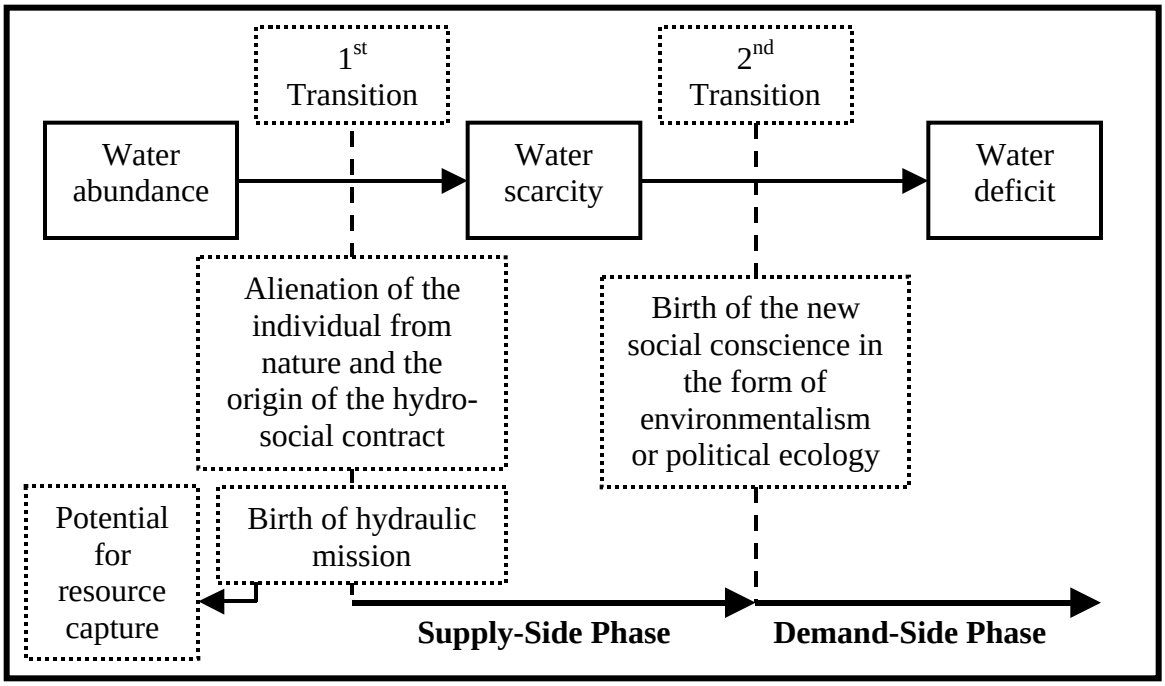

Figure 4. Schematic representation of the two transition periods that can result in social instability.

It is apparent from Figure 4 that the first transition from water abundance is largely in response to a change in availability of the first-order natural resource (water) to the

individual. It is thus appropriate that the chosen definition of 'water scarcity' should reflect this. Significantly, from a social stability perspective, the immediate result of this first transition is the alienation of the individual from the resource and the birth of a hydro-social contract. In this contract the individual surrenders their responsibility for providing water for themselves, to a central authority. The hydraulic engineer becomes the dominant 'discursive elite' and the 'sanctioned discourse' is the result. Three forms of social instability are then likely to result. Firstly, the resource starts to be degraded because the individual is now alienated from nature (in a philosophical sense) whereas the new custodian of nature - the government - has insufficient social conscience to effectively discharge this responsibility, as it is motivated largely by a desire to match the supply to the demand. Secondly, as social and political pressures increase, the government responds by developing more sophisticated supply-sided solutions. Typically the government performs a series of hydraulic miracles (heroic engineering) involving the radical reconstruction of nature in some form or another. These simply serve to increasingly alienate the individual from the resource over time and further entrench the prevailing 'sanctioned discourse'. Thirdly, a tension develops between this alienation of the individual and the increased difficulty of the government to comply with its side of the hydro-social contract in a sustainable manner, until a new social conscience is born in the form of environmentalism or increased political demands for sustainability. This new social conscience, championed by a special interest group such as environmentalists, challenge the now dominant 'sanctioned discourse' and demand an alternative response to dam building. Environmentalists thus become a new member of the 'discursive elite' and the 'sanctioned discourse' changes to embrace sustainability as a fundamental principle. As each new discursive elite coalesces and emerges, conflict results as they challenge the dominant 'sanctioned discourse' and seek to traverse the ego barrier into a new form of multidisciplinarity. Thus the second transition is likely to be dominated by the desire of the public to realign the water policies with the broader social consciousness, giving rise to the roots of 'natural resource reconstruction'. The hydraulic engineers lose their hegemonic position within the discursive elite, public participation in decision-making processes becomes broader and ecologists become an important source of input into the policy-making process. Stated simplistically, at this point the perceptions of water change, and what Falkenmark and Lundqvist (1995:185) refer to as the psychological and habitat functions of water enter the overall supply-demand equation. In short, the dominant desire at this time is to address the alienation from nature resulting from the mismanagement of the hydro-social contract by over-zealous authorities.

Another potential for structural instability also theoretically arises at this first transition. Under conditions of increasing 'water scarcity', access to water becomes a primary source of advantage. This triggers off the process of 'resource capture', which under advanced forms can institutionalize privilege and thus serve to de-legitimize the regime (Turton, 1999a). Thus one could see a direct relationship between the prevailing level of 'resource capture' and social stability. This drives social instability over time, in direct relationship to the degree of marginalization caused by this capture, until the tensions become acute, resulting in a form of internal revolution or major realignment of social groupings and political cleavage lines. Under conditions of resource capture, this is likely to coincide with the second transition. This is what happened in the case of South Africa, where the

process of democratization altered the balance of privilege in society in a fundamental way, with water supply becoming one of the major focal points of social change.

From this it becomes necessary to make three more definitions:

'Sanctioned discourse' is the discourse regarding what is good and acceptable practice that prevails within an institutional or political setting at any given moment in time. Significantly this 'sanctioned discourse' forms a type of paradigm, defining the problem on hand and the type of solutions that are acceptable. This is what Waterbury (1979:116) refers to as the "High Dam Covenant" in the case of the Nile and the construction of the Aswan High Dam. Of even greater importance, the 'sanctioned discourse' defines the relationship of the individual technocratic elite within an institutional hierarchy as it is logical to assume that an individual who challenges the prevailing conventional wisdom would find themselves running out of career advancement opportunities. For example, if the 'sanctioned discourse' is based on irrigation, then the discursive elites would be from an irrigation background and the dominant jargon in use would reflect this. The American hydraulic mission was based on the Land Reclamation Act, which gave rise in turn to the Bureau for Reclamation as the dominant bureaucratic entity. Within this bureaucracy, the jargon used was based on a notion of "conserving" the freshwater that flowed to the sea (which was regarded as being wasted), by building dams and piping it to "reclaim" the desert from nature. In terms of this 'sanctioned discourse' wild rivers were thus in need of being tamed, and they had little intrinsic value by just being wild. This in turn gave rise to a technocratic elite with a specific profile. Reisner (1993:114) notes that, "the engineers who staffed the Reclamation Service [at that time] tended to view themselves as a Godlike class performing hydraulic miracles for grateful simpletons who were content to sit in the desert and raise fruit". In Spain, the Corps of Engineers is highly elitist, intellectualist, 'high cultured', male dominated, socially homogenous and an exclusive organization that has taken a leading role in Spanish politics and development over the centuries (Mateu Belles, 1995). Waterbury (1979:101) eloquently describes the 'sanctioned discourse' at the time that the decision was made to construct the Aswan High Dam by quoting from the *Rubayyat of Omar Khayyam*: "When the King says it is midnight at noon, the wise man says behold the moon". The 'sanctioned discourse' is thus a critically important concept to grasp when seeking to understand the social stability aspects of water, as it in effect provides the key to the code with which the researcher can decipher what is actually happening in society.

'Discursive elites' are those persons, usually defined in terms of membership to a given political, scientific or professional grouping, who dictate the form and content of the dominant discourse. In other words the 'discursive elites' act as gatekeepers, by defining how knowledge is constructed within a given bureaucratic or institutional setting, and by sanctioning who may say what about a given subject at a given moment in time. 'Discursive elites' are thus extremely important to understand as their impact on the 'sanctioned discourse' can have direct results in terms of social responses to 'coping strategies'. Stated differently, 'discursive elites' impact fundamentally on the way that the hydro-social contract is perceived and dealt with by government. It therefore becomes logical to conclude that when looking for 'adaptive behaviors' in the context of an

understanding of social stability, then the responses of these 'discursive elites' to a new problem become highly illuminating.

'Resource capture' is the process by which powerful social groups shift resource distribution in their favour (Homer-Dixon & Percival, 1996:6) over time. This is particularly relevant under conditions of 'water deficit' where access to a critical natural resource like water gives considerable advantage to those who control the access and allocation of that resource. This serves to politicize water further by decreasing the level of legitimacy, introducing elements of mistrust which undermine the water demand management strategies being introduced by technocratic elites (Turton, 1999a) (Lichtenthaler & Turton, 1999). 'Resource capture' can thus institutionalize privilege, which in turn can become a source of structural scarcity and endemic social instability.

This brings a new variable into the equation, and allows a refined hypothesis to be made in response to a refined problem statement.

Problem Statement

How can an effective 'coping strategy' be developed by technocratic elites to enable increasing levels of first-order resource scarcity to be managed without dangerous levels of social instability occurring?

Within the context of social stability and water, the 'adaptive capacity' of society becomes a critical interceding variable between 'water scarcity' and 'water deficit'. Because 'adaptive capacity' is a rather nebulous concept in its generic sense, it is difficult to operationalize and measure in a scientific context. However, in terms of the initial definitions of 'adaptive behavior' and 'coping strategy', water demand management can become one of the empirically testable concepts. This gives rise to a secondary hypothesis that can guide future research into water and social stability.

Secondary Hypothesis

Water demand management (WDM) is an empirically testable manifestation of the 'adaptive capacity' of a given social entity in the context of coping with the transition from 'water scarcity' to 'water deficit'.

This enables one to now shift attention to an empirically verifiable manifestation of 'adaptive capacity', with WDM becoming a key indicator. To this end, the authors have developed a tentative model showing how 'adaptive capacity' can lead to 'natural resource reconstruction' via 'water demand management'. By building a model around these three concepts, it allows for empirical verification of each. For example, 'adaptive capacity' is manifest in the form of WDM. If the WDM strategies are successful, then 'natural resource reconstruction' will be the end result. This can be empirically verified. Conversely, if the coping strategies that are being developed do not reflect the social value systems and changing public perceptions of water, these WDM efforts will be regarded as being illegitimate by the public and will thus be resisted. This is illustrated schematically in Figure 5.

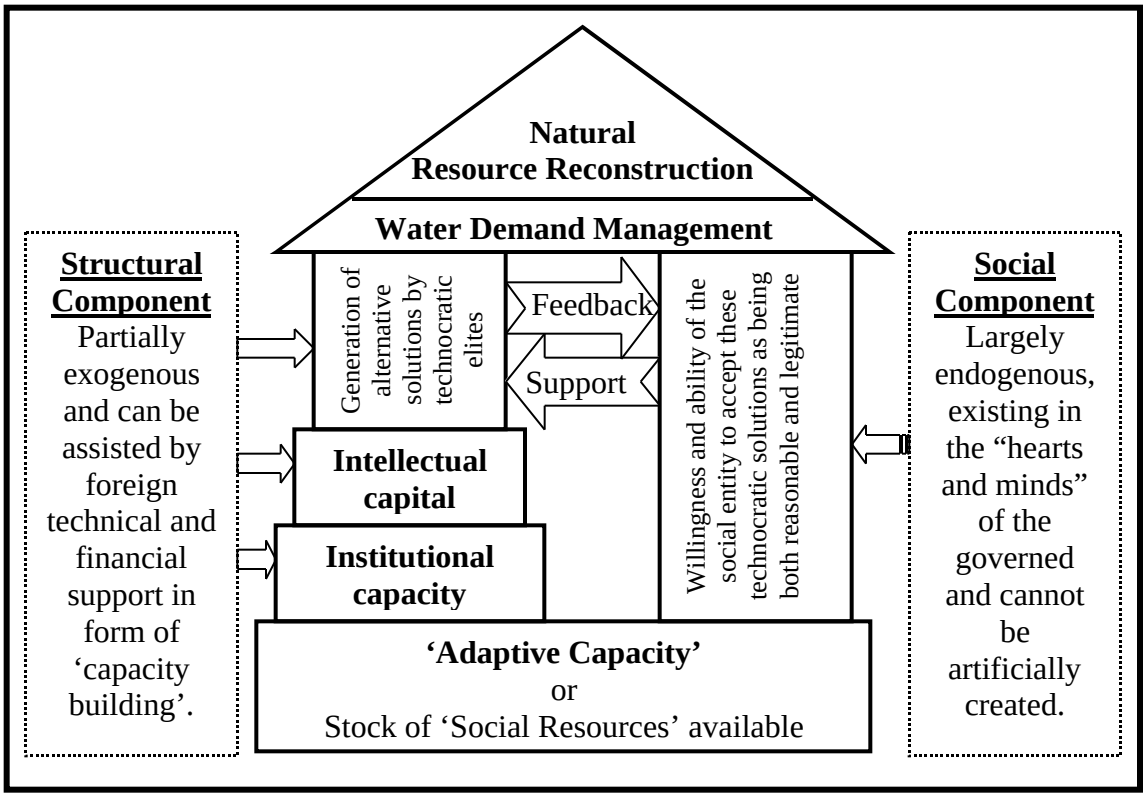

Figure 5. Model linking 'natural resource reconstruction' via 'water demand management' to the 'adaptive capacity' of a social entity.

From Figure 5, we can see that in a theoretical context, a social entity facing 'water scarcity' and approaching a condition of 'water deficit' (second transition), can potentially manage itself out of the problem. If the problem is effectively managed, then a coping strategy in the form of WDM is needed. If effectively developed and introduced, then 'natural resource reconstruction' will be the empirically verifiable end condition. At that point in time, the social entity concerned will theoretically be in a stable condition, as it will be living within the constraints of its first-order resource availability. This leads us to our tertiary hypothesis.

Tertiary Hypothesis

In highly adaptive societies, 'structurally-induced water abundance' is possible to achieve, whereby natural resource reconstruction occurs in the face of a chronic first-order resource scarcity.

Let us examine the critical components of the model in more detail. Moving from the bottom to the top, we have the 'adaptive capacity' of a social entity, developing a 'coping strategy' in the form of WDM, with the end result being 'natural resource reconstruction'. It therefore becomes important to examine the critical components of 'adaptive capacity' in more detail. Essentially there are three components. Moving from left to right, we first

find the 'structural component'. The basis of this structural component is an institutional setting of sorts. It is imperative that this institution is effective, so rationality is assumed with respect to finances, information generation, data flow and availability (Turton 1999a:26). Resting on this institutional capacity, is the intellectual capital that is available. Given the complexity of managing the second transition, this intellectual capital will ideally have to be multidisciplinary in makeup. This can be created or engineered from without in the form of capacity building, so this component is partially exogenous in origin. The empirically verifiable output of this 'structural component' is a set of alternative solutions or 'coping strategies' by the technocratic elite.

Moving now from the right to the left, we find the second 'social component'. This exists within society and is thus endogenous. It can be loosely defined as being in the hearts and minds of the individual members of society. This component embodies the social conscience and perceptions of water that change over time.

Sandwiched in between the 'structural component' and the 'social component' we find the third component, comprising 'feedback' and 'support'. By feedback, we mean the way in which the technocratic elites communicate their coping strategies with the public at large. If this feedback is done in an effective manner, and the coping strategies are socially acceptable and accurately reflect the changing perceptions of water in the public domain, then 'support' will be given. If the feedback is ineffective, then support will be withheld. From this we can derive an understanding of a critical aspect in terms of water and social stability. This leads to the following definition:

The 'legitimacy' of the central authority in terms of the hydro-social contract is manifest as the willingness and ability of the social entity to accept the coping strategies that are developed by the technocratic elite as being reasonable and worthy of public support. From this it is possible to theorize that a technocratic elite which is removed from the changing perceptions of water and the water landscape, will be regarded as being illegitimate and the resultant coping strategy will be resisted by the public. In similar vein, if the technocratic elite are simply trying to institutionalize privilege by actively promoting policies of 'resource capture', then these coping strategies will also be regarded as being illegitimate and can become the rallying point for civil disobedience and social instability. Conversely, if the base of the discursive elites is broadened, the prevailing sanctioned discourse will change in a manner that is reflective of the transitions in public opinion, which will result in public support and more social harmony.

This legitimacy is extremely important if social stability is to be achieved in the face of 'water deficit', as it is logical to assume that under such conditions, unsustainable policies are being practiced. Unsustainability can be translated into social instability as ecosystem collapse approaches. Therefore, the optimal coping strategy is one that involves managing the 'water deficit' and reducing levels of consumption down to sustainable levels of supply. It is in this context that the concept of 'water poverty' becomes important. Social entities facing 'water poverty' are likely to be incapable of managing the second transition, and are thus likely to become highly unstable. This serves as the cue to introduce the reasoning why conditions of 'water poverty' are likely to be so socially

unstable. Up to now it has been assumed that there are two phases of water management. The first phase is about getting more water and is called the Supply-Sided Phase. The second phase is about doing better things with available water and is called the Demand-Sided Phase. This is misleading however. The authors are of the view that there is in fact a third phase that is critically important in the context of social stability. This phase is called the 'Adaptive Phase' as it involves coping with absolute scarcity. This is presented schematically in Figure 6.

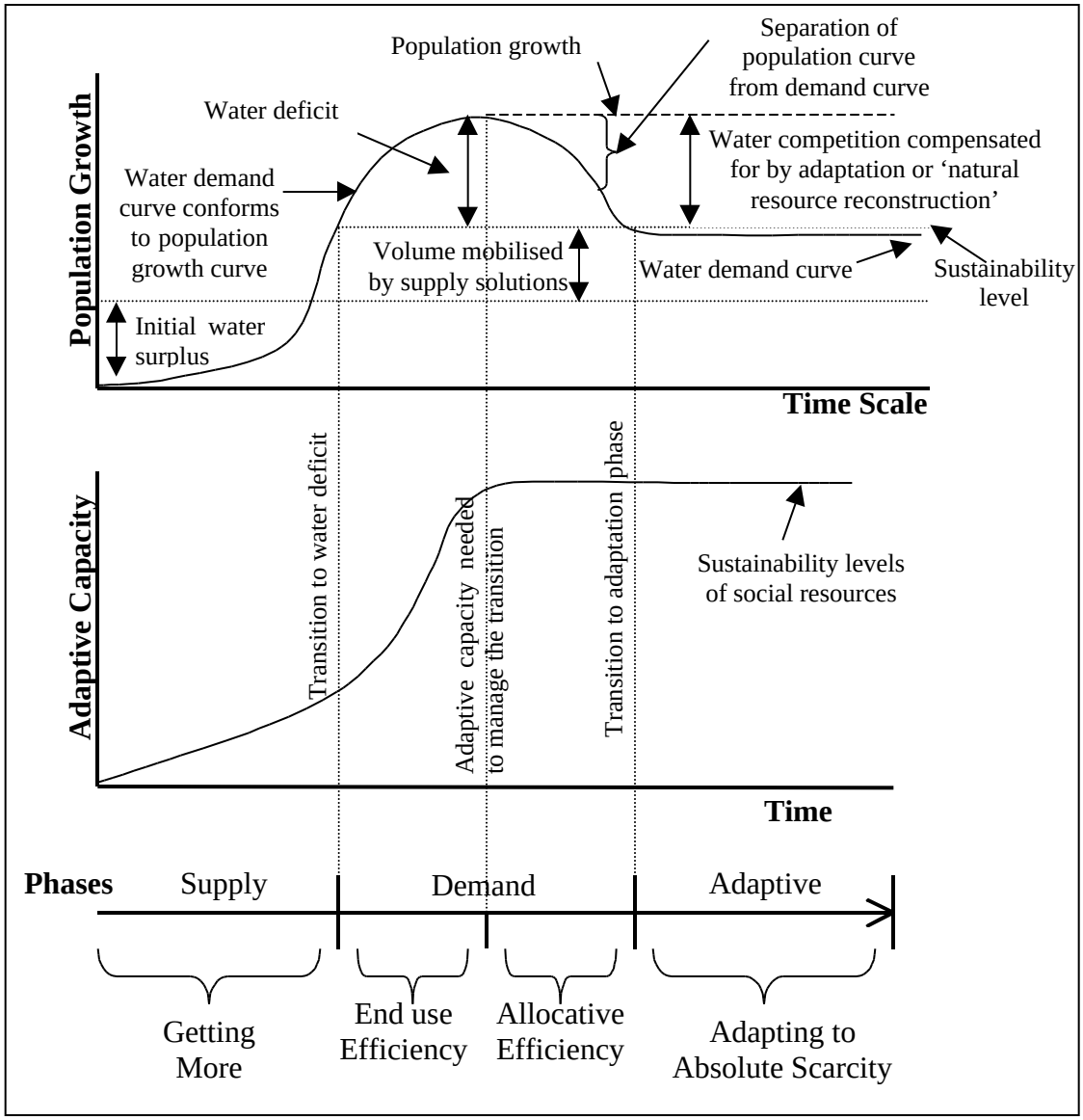

Figure 6. Schematic representation indicating how 'adaptive capacity' is needed to realign population-induced demand with maximum level of sustainable supply.

In keeping with the definitions already developed, there are two possible outcomes of the 'Adaptive Phase'. Firstly, there is the possibility of acute social instability. This is likely

to occur under conditions of 'water poverty'. Under these conditions the social entity has a severe scarcity of social resources and is thus simply unable to make the adaptation smoothly. Anarchy is the likely result. Secondly, there is the possibility of social stability. This is likely to occur under conditions of 'structurally-induced water abundance'. Under these conditions, the social entity has sufficient stock of social resources, and thus manages to live within the constraints of the first-order scarcity. The prognosis is thus relative social harmony under these conditions.

Therefore, it becomes abundantly clear that a vitally important water resources management goal has to be the re-alignment of the demographically-induced water consumption curve with the sustainable level of first-order resources available. Stated simplistically, the 'water deficit' has to be managed in such a way as to harmonize it with the sustainable levels of water supply. At the social level, this reduces the level of water competition by means of 'natural resource reconstruction' or by creating 'structurally-induced water abundance' in a relative sense. This is illustrated schematically in Figure 6.

From this illustration, it becomes clear that three important new concepts come into the picture. Both of these are derived from the type of 'coping strategy' that is generated by the technocratic elite. Referring back to Figure 1, it can be seen that these strategies are 'allocative' in nature. By allocating scarce water from one social or economic activity (or sector) to another, relative efficiencies can be harnessed which in turn can improve the 'water deficit' albeit at a social price. The social cost is derived from relative privilege that is lost or gained in the process, as well as the structural adjustments that are needed.

We can thus develop a matrix for use in our definitions. Figure 7 shows 'return to water' on the horizontal axis. The 'return to water' (Allan, 1998:3), or relative water efficiency, can be understood as being the ratio that is derived from the consumption of water within a given sector expressed in relation to the contribution of that activity to the overall economy. Typically, agriculture consumes a large portion of the total water budget but only contributes a small amount to the overall Gross Domestic Product (GDP). Conversely, industry consumes a smaller portion of the total water budget while contributing a relatively larger amount to the GDP. For purposes of conceptual clarity, 'return to water' will be assumed to be based on some form of rational choice. This raises all sorts of social issues such as perceptions of rationality, which are beyond the scope of this paper however. On the vertical axis the level of social stress is plotted. This social stress is derived from the structural changes that are made when a policy choice redirects water away from one economic sector to another. For example, by allocating water away from agriculture, social mobility is induced in one form or another. This can be in the form of urbanization, which in turn can create bottlenecks elsewhere, creating a knock-on effect throughout society.

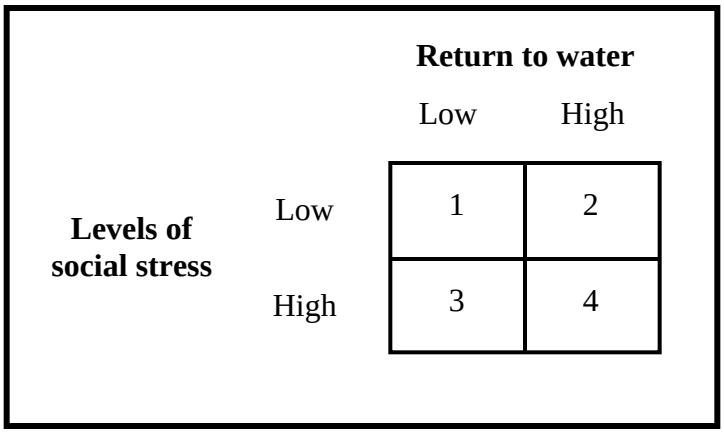

Figure 7. Matrix showing possible variations of 'return to water' and 'levels of social stress'

We can now develop some more definitions by means of this matrix, in order to maintain the conceptual clarity for which we are striving. The following definitions are derived:

'Allocative efficiency' is the productive activity involving water that would yield the best return to water, within the bounds of acceptable political risk, under conditions of increasing first-order resource scarcity. There are at least two distinct types of 'allocative efficiency', each with a different level of political stress and a different relative water efficiency or 'return to water' as illustrated in Figure 7.

'Inter-sectoral allocative efficiency' is achieved by allocating water away from an economic sector or activity that has a 'low return to water', usually agriculture, to another economic sector or activity that has a higher 'return to water', usually industry. The significance of this 'coping strategy' is that it has a high level of social stress inherent within the policy choice coupled with a high 'return to water' (block 4). This means that it is socially the most stressful policy option available and is thus avoided by politicians. It also means that it is the economically and hydrologically rational choice to make, being almost inevitable if 'natural resource reconstruction' and ultimate social stability is to be achieved in the long-term. Logically, this also means that in order for long-term social stability to be achieved, then a short-term period of acute social stress has to be endured. This in turn means that a high level of 'adaptive capacity' is needed during the Demand Management Phase if the transition to the Adaptive Phase is to be made without the risk of social instability. Let us refer to the transition between the Demand Management Phase and the Adaptive Phase as the 'third transition', in keeping with the nomenclature already in use.

'Intra-sectoral allocative efficiency' is achieved by allocating water within a given economic sector, usually at the level of the production unit (farm of factory), away from a productive activity with a low 'return to water', to production with a higher 'return to water'. The significance of this 'coping strategy' is that it has a low level of social stress coupled with a low 'return to water' (block 1). This means that it is socially the least

stressful option and is thus favoured by politicians. It also means that politically it is the rational choice to make, but economically and hydrologically it is irrational, as the long-term effects are less profound than 'inter-sectoral allocative efficiency'. Logically, this means that 'intra-sectoral allocative efficiency' is the favoured approach for the early stages of the Demand Management Phase, but that this 'coping strategy' on its own is unlikely to realign the demographically-induced consumption curve with sustainable supply. For this reason, it is theorized that 'adaptive capacity' needs to peak out roughly in the middle of the Demand Management Phase as illustrated in Figure 6.

'Productive efficiency' is a component of the 'coping strategy' that is aimed at improving the 'return to water' that involves improvements to the efficiency of water delivery (block 1). This is also known as 'end-user efficiency' in some of the literature. The significance of this 'coping strategy' is that it has a low level of social stress in conjunction with a relatively low 'return to water'. The latter is true inasmuch as it is logical to assume that by improving the delivery efficiency of irrigation systems for example, the overall rationale of irrigation still remains untouched. Therefore if irrigation is a cornerstone of the 'sanctioned discourse', then long-term economic rationality and 'natural resource reconstruction' will not be achieved because agriculture will always be less efficient than industry, even if the deliver systems become more efficient. This does not mean that irrigated agriculture is undesirable. This is a strategic choice that the decision-making elite has to exercise. It is obviously desirable to make irrigation as efficient as possible, given the fact that it is a large consumer of water and that it may be strategically significant if political rationality is to prevail in the form of food self-sufficiency.

From this we can see that it is theoretically necessary for a social entity that is facing chronic 'water deficit' to manage three distinct transition periods. This is presented schematically as an appendix. The first transition occurs when water abundance gives way to 'water scarcity'. At this time the individual is alienated from the resource and the hydro-social contract is born. This can result in long-term 'resource capture' and ecologically unsustainable supply-sided solutions. The second transition occurs when the 'water scarcity' becomes 'water deficit'. At this time there is the emergence of a new social conscience that challenges the government in its handling of the hydro-social contract. One form of challenge is on ecological grounds. Another form of challenge can emerge from those people who have been marginalized as the result of 'resource capture'. An internal revolution can thus occur at this time in the sense that the fundamental structure of privilege in society is challenged and altered. The third transition then occurs when 'water deficit' is managed by means of 'coping strategies' that are 'allocative' in nature. In this sense the social stability is impacted on by the structural adjustments that need to be made. For this reason, policies involving 'intra-sectoral allocative efficiency' and 'productive efficiency' are initially favoured by the technocratic elites, but these fail to ultimately balance the water budget sufficiently. This means that inevitably policies based on 'inter-sectoral allocative efficiencies' need to be implemented. These give the best 'return to water' and thus address the 'water deficit' in the most dramatic manner, but they are also the most socially disruptive. Clearly, under such conditions, regime legitimacy will become a key factor, as an illegitimate regime is simply unlikely to be able to withstand the rigors of adaptation.

Elements of an Adaptive WDM Coping Strategy

One can now ask how we will know when social stability has been reached? To this it can be theorized that the natural end result of an effective WDM strategy is 'natural resource reconstruction'. When this is taking place, one can say that the social entity concerned has managed the 'water deficit' to such an extent that 'water poverty' has been averted and a condition of 'structurally-induced water abundance' has resulted. It thus becomes productive to dwell for a few moments on how an effective WDM coping strategy would ideally be structured.

It is logically evident that a coping strategy that is truly adaptive in nature would contain a mix of key elements. While the overall combination of these elements is best developed to suit prevailing local conditions, it is reasonable to speculate that for a coping strategy to be effective, it would have to contain a number of generic elements. These are likely to be the following:

Firstly, a WDM strategy would have to embrace elements of supply-side management. The role of the engineer is thus likely to change from the design and management of major water transfer schemes, to the design and management of water augmentation facilities such as recycling and desalination plant. The engineer would also be called on to be highly creative in ensuring optimal efficiency in terms of water delivery systems. This could be regarded as being an element of 'productive' or 'end-use efficiency'. The thrust of this element of the overall strategy would be to make every drop of water count. This is unlikely to cause social disruption however if effectively implemented.

Secondly, a WDM strategy would have to embrace a number of allocative mechanisms, of which three are likely to be of critical importance.

(a) A mechanism embracing the concept of 'intra-sectoral allocative efficiency' is going to be needed in order to optimize the allocation of water within economic sectors that are known heavy consumers of water such as agriculture. The defining factor here is likely to be the strategic significance of food self-sufficiency. To this end a balance would have to be struck between national self-sufficiency and food security. This is likely to become a vigorous debate in certain developing countries, as public perception could be that a new form of political (neo-colonial) dependence is developing. In social entities with a strong nationalistic sentiment, this could become a cause of social instability.

(b) A mechanism embracing the concept of 'inter-sectoral allocative efficiency' is going to be needed in order to take advantage of the sectoral water efficiency aspects previously noted. This is likely to be socially disruptive however, as it involves a fundamental adjustment to the very structure of society. One aspect that is likely to become a locus of conflict is associated with changing from an agrarian based to an industrial based social structure. This is likely to unleash sentiments, fuelled by perceptions of the land and the relationship between land and people. In certain social entities, this can be a passionate issue with a high potential for violence.

(c) Given the propensity for violence that 'inter-sectoral allocative efficiency' is likely to unleash, the concept of 'virtual water' will have to be incorporated as a mechanism within the overall 'coping strategy'. 'Virtual water' is the amount of water that it takes to produce a commodity, therefore to import something such as wheat, is the same as importing water. It is like mobilizing water in a virtual sense of the word. The advantage of this strategy is that it is politically silent. It can thus enable the politicians to downplay the fact that there is a looming crisis. In short, it provides a political life raft at a time when the seas of transformation become storm-lashed. It is thus a strategic issue of great significance with the potential to act in mitigation of social instability. By mobilizing 'virtual water', the government concerned can maintain the essential lie that everything is under control and that there is no need for panic on the streets. Thus it can be seen that 'virtual water' should not become front-page news, but should rather become a silent option to consider within a broader strategic context.

Thirdly, an effective WDM strategy would need to embrace at least three elements of a broader national or regional policy if it is to effectively minimize the possibility of social instability.

(a) One of the major driving forces of water scarcity is population growth. For this reason, there will have to be a coherent population policy in place if the WDM strategy is to avoid social instability in the long-term.

(b) Due to the fact that allocative strategies are going to have to be implemented, these will impact on the economic growth potential of a country. For this reason, there will have to be a coherent and rational economic policy in place if the WDM strategy is to avoid social instability in the long-term.

(c) Because the agricultural sector is one of the heaviest consumers of water, coupled with the emotional response that national food self-sufficiency invokes, it will have to be managed in a rational manner. In fact, if one discounts water used by irrigation, one can even conclude that certain countries that are currently facing 'water deficit' can be regarded as merely being 'water scarce'. For this reason, a critical balance will have to be struck between national self-sufficiency and food security. Due to the propensity of this debate to cause social instability, a carefully crafted strategic agricultural policy will have to be formulated, with a 'virtual water' component to that strategy.

From the above - which is simply logical speculation at this juncture and therefore likely to be an oversimplification - it becomes abundantly clear that the problem is in fact highly complex. The two variables of the problem can thus be understood as being the need to manage extreme complexity on the one hand (a form of risk society), with a limited range of resources on the other. Regime legitimacy is therefore a critical variable to monitor and understand within the context of water and social stability. For this reason, social adaptive capacity will have to be developed, and the second-order scarcity of social resources can thus be rightly regarded as being the potential source of social instability under conditions of 'water deficit'.

A broad conclusion can thus be drawn. The highest levels of social stability are therefore likely to be found within entities that are functioning under conditions of 'structurally-induced water abundance'. Conversely, the highest levels of social instability are likely to be found within entities that are functioning under conditions of 'water poverty'. These can be regarded as being potential research hypotheses. The goal of development agencies should thus be to transform 'water poverty' into 'structurally-induced water abundance'. This is no easy task, so high levels of cooperation and a concerted multidisciplinary research effort are going to have to be mobilized.

Conclusion

The development of a tentative WDM model has meant that a theory can now be developed that is capable of explaining and predicting how and why developing countries are likely to face future threats of social instability in the face of increasing 'water deficit'. In other words, it links the first-order scarcity of natural resources to the second-order scarcity of social resources. From this interaction, a number of distinct concepts have been derived and defined to the best of our ability. It shows that a critical aspect of water and social stability is the way in which a social entity responds to attempts that are being made by the government to manage water scarcity. It is these socially-induced conflicts that are likely to result from attempts to adjust to 'water deficit', rather than conflict over access to freshwater, that need to be better understood in the opinion of the authors. This tentative model will now be tested in a number of social settings in order to develop a coherent database of case studies sufficient to fill the gaps in existing knowledge. Initial use of the model in the Yemen (Lichtenthaler and Turton, 1999) has proved encouraging. A Southern African research project is about to be launched. The tentative model remains just that - tentative! It represents the state of the art at this moment in time with respect to the ramifications of an interaction between first and second-order scarcities, but in essence we are still groping in the dark. It is sincerely hoped that the introduction of conceptual clarity will contribute to a significant advancement in the study of water and social stability. The model is not being offered as a form of concrete finality, but rather in a sincere effort to catalyze debate and to stimulate discussion.

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