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Preparing for the future: water for a growing population

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ABSTRACT: This paper discusses the future implications of the global mismanagement of water and the explosive growth in the world's population. The globe is split into five types of population, each demonstrating different patterns in water consumption, climate and population growth. It is estimated that by the year 2025, 55% of the world's population will be living in countries that cannot be self sufficient in food production due to water constraints. Furthermore, the provision of safe water supply and sanitation to all urban inhabitants of developing countries will prove to be a Herculean task. The paper discusses the need to 'think' regionally and act 'locally' and concludes by presenting the required shifts in economic/social policies and the conceptual approaches to water in order to limit the calamities that have been forseen.

INTRODUCTION

The world is presently struggling with widespread symptoms of past mismanagement of land and water, and at the same time undergoing an almost explosive expansion of its population [1]. Widespread expectations for improved quality of life and generation of income puts further stress on limited water resources. Since water constraints may impose unforeseen and unwanted limitations to economic development, food self-reliance, health, industrial development etc. such constraints will influence social and economical development realities and will therefore have to be entered into national planning.

In the household supply sector massive efforts have been ongoing within the International Drinking Water Supply and Sanitation Decade. Early achievements have not been evaluated. Unfortunately, the effects of population growth have exceeded the water supply sector's efforts to date and future efforts to secure safe water and sanitation for all by 2025 is herculanean.

Urban growth is introducing a new sort of problem: finding raw water resources with a large enough capacity to supply an ever greater municipal area. Even if the household water in per capita terms is peanuts in comparison to other water needs, especially water for food production, the concentration of large populations to limited areas implies that fairly large water flows have to be directed to that area.

The challenge that is of interest to IWSA's constituency is basically the household needs and how they may be secured.

BASIC NEED FOR HOUSEHOLD WATER RAPIDLY EXPANDING

The urban scale and water supply crisis is linked to the fact that urban growth is proving impossible to control in many Developing World regions. The growth is exacerbated by the rural push, i.e. the exodus of poor population strata from marginal areas which is not considered possible to make a dignified living. Municipal authorities find it increasingly difficult to supply the infrastructure needed to provide safe water and sanitation. Water supply systems all over the world are leaking like sieves. Fifty percent leakage losses is nothing unusual. Many systems carry water only a few days per week. There exist exaggerated expectations on the government to supply the household water. The water supply systems are often in bad shape, highly cracked with large-scale leakages, so that pollutants from equally cracked sewage pipes can enter the pipes carrying household water and pollute that water.

In spite of massive efforts to remedy the public health situation during the International Drinking Water Supply and Sanitation Decade (1981–90), large deficiencies still remain in terms of supply of safe water and sanitation to the Developing World population [2]. The result is high mortality due to water-related diseases. The huge size of the remaining task makes several regions threatened by continued deficiencies—even in the medium term perspective. Sanitation development has turned out to be even more difficult to achieve. In fact it more or less came to a standstill during the 1990s. The challenge has more dimensions than just technique, public understanding, cultural habits, social dimensions etc. If the coverage is to be 100% by 2025, there will remain 5.4 bn people to serve. This corresponds to 450 000 additional individuals to be secured safe sanitation every day for 30 years.

When discussing household needs and how they will increase in response to population growth, it is useful to make a distinction between avoidable and unavoidable population growth (Fig. 1). The former is for the reproductive health authorities to address and try to avoid, whereas the unavoidable population growth should be planned for in view of the human rights of that population group. The mothers are already born and the challenge is to secure the health of this additional population which is fairly predictable.

The threat from rapidly growing urban areas can be illustrated by the situation in Bulawayo (Fig. 2), which was close to evacuation during a recent multiannual drought. The current

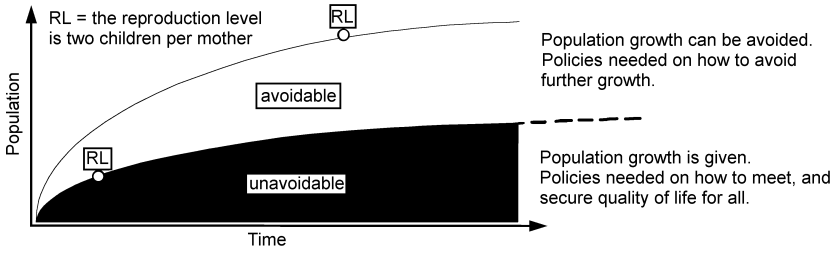

Fig. 1 Distinction between unavoidable and avoidable population growth. The former is related to mothers already born and an assessment of the time of achievement of reproduction level (RL), i.e. two children per woman.

planning involves water transfer all the way from the Zambesi river—supplying irrigation water along the way through Matabeleland—in a project of grand scale in terms of costs involved [3].

PREDICAMENT DIFFERENCES

Five main clusters

Recently a comprehensive overview of water availability and use was presented by Shiklomanov [4] regionalising the world into 26 internally homogeneous regions.

There are 26 principal regions which tend to concentrate into five clusters, each with distinct differences in terms of both water abundance/scarcity and per-capita withdrawals, the latter basically reflecting predominance of irrigation. The five clusters can be characterised as follows:

1 Dry climate region with high population pressure and high dispute proneness. Use-to-resource ratio is high in spite of moderate to low per capita withdrawals. Potential in terms of unused water is low (Northern Africa, Western and Southern Africa);

2 Temperate zone regions with low to moderate population pressure. Use-to-resource ratio is high due to highly wasteful water use. Potential in terms of unused water is low (USA, Middle Asia/Kazachstan, Caucasus);

3 A climatically mixed region with moderate levels in all respects: in population pressure, in per-capita water withdrawal, and in use-to-resource ratio. Good potential in terms of unused water (Central and Southern Europe, Southern Former Soviet Union, Southeast Asia and Northern China);

4 Water-rich regions with low water needs and therefore low use-to-resource ratio. High potential in terms of unused water (Southern America, Northern Europe, Northern America and Central Africa);

5 Dry climate regions with erratic precipitation and moderate

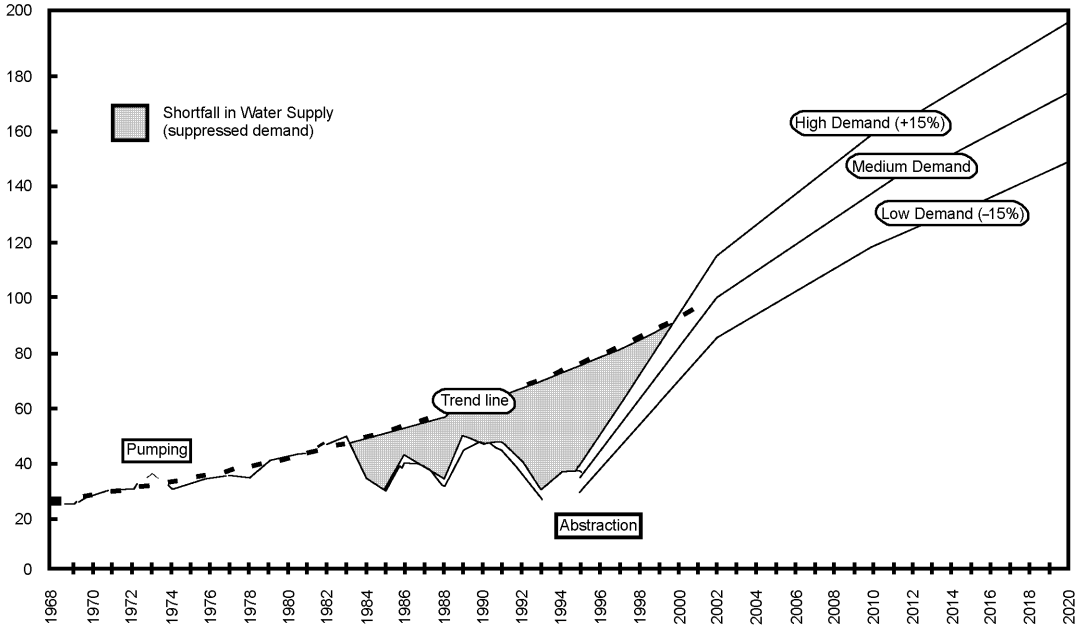

Fig. 2 Shortfall in water supply of the city of Bulawayo (Zimbabwe) during to the multi-year droughts during 1980s and '90s and water demand projections up to 2020AD. From [3].

population pressures. Use-to-resource ratio remains low due to lack of irrigation. Theoretically a high potential in terms of unused water but the water is difficult to mobilise, see below (dry parts of Subsaharan Africa).

Most limited in terms of degrees of freedom are regions with moderate to high technical scarcity, rapidly growing population pressure, and problems in terms of coping capability due to financing, administrative and manpower difficulties.

The amount of water needed for household water supply corresponds to only 30–70 m^3/person/year in the diagram, i.e. very little as compared to the 1000 m^3/person/year needed for food production in a self-sufficient semi-arid tropical country. In terms of per capita needs the problem is therefore not a quantity problem but an accessibility problem: how to secure large enough raw water sources on which water supply of large urban populations can be secured. The real quantity problem is the water needed for food self-sufficiency with which the urban planners will have to compete. The per capita amount needed is of the order of 15–30 times more than for household supply in dry climate regions where rainfed soil moisture is not enough to secure good yields but has to be complemented by irrigation. The competition induced by the needs to grow food for rapidly expanding populations will be rapidly expanding in several regions in Africa and Asia. It is estimated that by 2025, 55% of the world population will be living in countries that cannot be self-sufficient in food production due to water constraints [5]. Large competition for water can in other words be foreseen around the dry climate regions with rapid population growth.

The food sector therefore represents a serious competitor to urban areas. The present way of discussing the water needs based on economic criteria favours the urban sector since water can be priced. There is however a clear social dimension as well to bring into the picture: from where is the food going to come? Is the present way of irrigation investments the mental image to have in mind? Or could much simpler techniques for drought proofing to secure good yields introduce a completely different picture?

Increasingly polluted raw water

With increasing amounts of water being withdrawn from rivers and groundwater to supply domestic and industrial needs, the amount of polluted return water has tripled since 1950 [6]. Wastewater treatment expands only very slowly. The result is escalating wastewater flows, originating from a whole set of sources: urban wastewater, leaching dry waste deposits and storm waters, industrial wastewaters, and pollution stemming from agricultural practices and from fallout of atmospheric pollutants. Pollutants are of two main types: soft and biodegradable microbiological pollutants, and pollutants from hard chemical contaminants (toxic, carcinogenic, and genetically damaging). Although factual overviews are rather sporadic, it is evident from GEMS studies that surface water pollution is already widespread over the world [7]. Moreover, pollutant sources from land use and poorly managed agriculture is causing widespread pollution of subsurface water (i.e. acidification, salinisation, nitrate and pesticide pollution) [8].

If 30 L/s are needed to dilute the waste per 1000 persons—as sometimes assumed in coarse interviews—wastewater loads evidently cause problems. It is indeed quite normal that water withdrawals plus the dilution flow needed exceed the time stable flow. Judging from the regional overview by Shiklomanov, water quality problems might be particularly serious in the Northern Africa, Southern Asia, Western Asia, Middle Asia/Kazakstan and Caucasus regions, where already the withdrawals themselves exceed 30% of the availability.

Especially vulnerable regions in the 30-year perspective are those with increasing population, rapid industrialisation without treatment facilities, and therefore increasing pollution loads, financing, administrative and manpower problems and vulnerable ecosystems. In this perspective one might expect the quality problems to expand—beyond the regions just mentioned—to incorporate also Central Europe, Southern Europe, Southern part of Former Soviet Union, and USA.

PUTTING THE PICTURE TOGETHER

Think regionally—act locally

The paper has shown the gigantic scale of the problem of providing safe water supply and sanitation to all urban inhabitants in the developing countries by 2025 AD. The problem is a twin problem of, on the one hand, exploding point demands, particularly troublesome in areas where water is scarce for hydroclimatic reasons; on the other parallel explosions of waste production in urban areas with very large populations, creating particular problems on the urban fringe exposed to the threats from increasingly polluted water in traditional sources (local wells).

Due to the massive scale of the problem, business as usual is rapidly becoming outdated as a viable approach. At the same time the threats from failures in providing secure living environments in terms of disease explosions among the populations accumulating in urban areas—influencing their possibilities to find employment and income—will be growing at the same rate as the population.

It is worth stressing that the slogan in environmental circles 'Think globally, act locally' does not really make sense for water [9]. It was created with environmental problems related to the atmosphere in mind: climate change, ozone depletion. Instead the new thinking needed to support a less sustainable development to water resources than the one at present is to Think regionally, act locally.

Any local action has to fit well within the river basin action plan. Projects in that plan have however to be both implemented, operated and maintained locally. There are also two sorts of water sharing to pay attention to:

- the local allocation of water between all competing sectoral interests;
- the upstream/downstream sharing where the downstreamers are the victims of the upstreamers with principally no control over how much water comes down the river or aquifer.

The future we want

The overall conclusion to be drawn at this point is that major shifts in both policies and conceptual approaches to water are called for in order to limit the calamities that can otherwise be foreseen. Our present policies, technologies, and institutions are likely to lead to a future we will not like. An indication has been given of the herculaean effort involved in securing global food supply.

In order to find out a better way to develop future water resources strategies we have to look back at past achievements in order to visualise the future [10,11]. Our long-term vision is an environmentally sustainable society with the ability to endure and flourish. There is no undermining of the natural resource base, i.e. both land and water productivity are well protected from a long-term degradation. Upstream/downstream disputes regarding water sharing and water pollution are skilfully averted. International consensus has been achieved on a joint code of conduct based on a basic water ethics. Poverty eradication involves at least three components that are directly or indirectly water-related:

- morbidity reduction through health-protecting activities (safe water supply and sanitation);
- security in access to food either through achieving national self-reliance through water-consuming crop production, or through purchasing of food which depends on access to a secured family income;
- family income which depends on employment opportunities in sustainable industrial or cash crop production, both water-dependent.

Aversion of the different water-related threats hindering poverty eradication and sustainable economic development will demand a number of challenging management efforts:

- conflict aversion: water sharing strategies and regulations, based on a universally accepted water ethics;
- pollution aversion: proper management of waste (liquid and solid) and of water soluble agricultural chemicals;
- aversion of land fertility degradation: integrated soil/water/nutrient management;
- aversion of urban water supply collapses: development and maintenance of the urban water/sanitation infrastructure;
- aversion of crop failure: simple drought proofing technology based on rainwater harvesting or local run-off collection.

CONCLUSION

Water is not only a scarce resource but has many parallel functions and therefore enters into many societal sectors driven by non-coordinated political driving forces (Fig. 3). This makes it a major challenge to human ingenuity to find realistic ways of handling this complexity. Much of the current debate is based on the thinking 5 years ago at the time of UNCED with its stress on capability and willingness to pay. It does unfortunately not go very far towards the complexity-oriented goal. Rather it tends to conserve the either/or approach while water is in reality often sequentially reused down the river valley.

In reality the water that moves down the river basin has to be used for several purposes in parallel. The amount entered into piped delivery systems will return back to the landscape carrying a load of pollutants. It will move downstream and cause problems downstream. In extreme cases like the recent cholera event in Peru, large losses may even be caused to both trade and ecotourism.

Moreover an intensification of food production will be equivalent to consumptive use of more water, returning that water back to the atmosphere. This may in many countries with high evaporative demand reduce the runoff and thereby the water availability for downstream inhabitants in the same river basin. Such reductions have in fact been reported in several African rivers, but—not necessarily correctly—been blamed upon climate change.

Constraints will appear in the framework of social and economical development strategies and will have to be entered into national planning. These constraints may impose unforeseen and unwanted limitations to economic development, food self-reliance, health, industrial development, etc. The actions needed will be of a new type. Seeing the challenge as just a technical water management issue, taking the conventional fragmented approach would in fact aggravate the situation. Regional political involvement at the highest level of government will be needed to articulate a national water resources strategy, fully related to the national planning [12].

This new situation brings the water issue onto the political agenda as much as global climate change which has already attracted massive national and international interest, although it is indeed further away in the future [1] The water crisis calls for an even higher priority due to the shorter time horizon: the mothers are already borne and the population growth more or less unavoidable. This raises the question about what politicians need to know in order to act with similar decisiveness on the near future development crisis of world water resources.

Given the existential character for humanity of the issues raised in this paper global consensus is now needed to facilitate action in five main areas:

1 a 'water ethics' is needed, defining principles that help countries to maximise joint benefits from the water passing through a shared river basin

2 'interregional solidarity' is needed facilitating global food security through food trade from water surplus to water deficiency regions

3 an 'integrated approach to land and water' is needed encom-

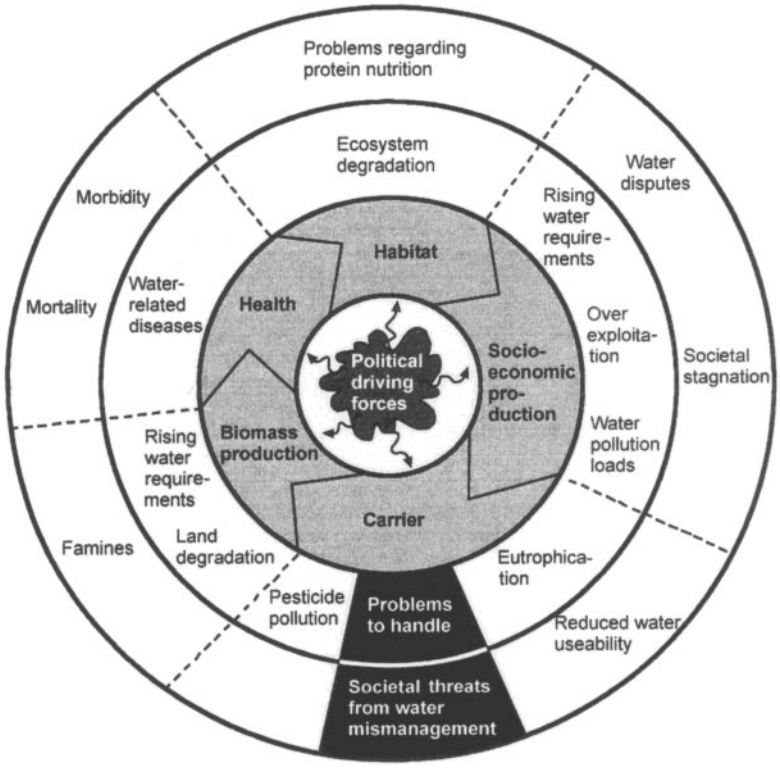

Fig. 3 Problems to handle and societal threats related to water mismanagement when political driving forces act on isolated water functions.

passing all water-dependent as well as water-impacting sectoral activities within a basin

4 realistic guidelines are needed on how to 'realise antipollution measures', especially in poor countries, before it is too late in terms of serious, widespread and—on a human time-scale—non-reversible groundwater pollution

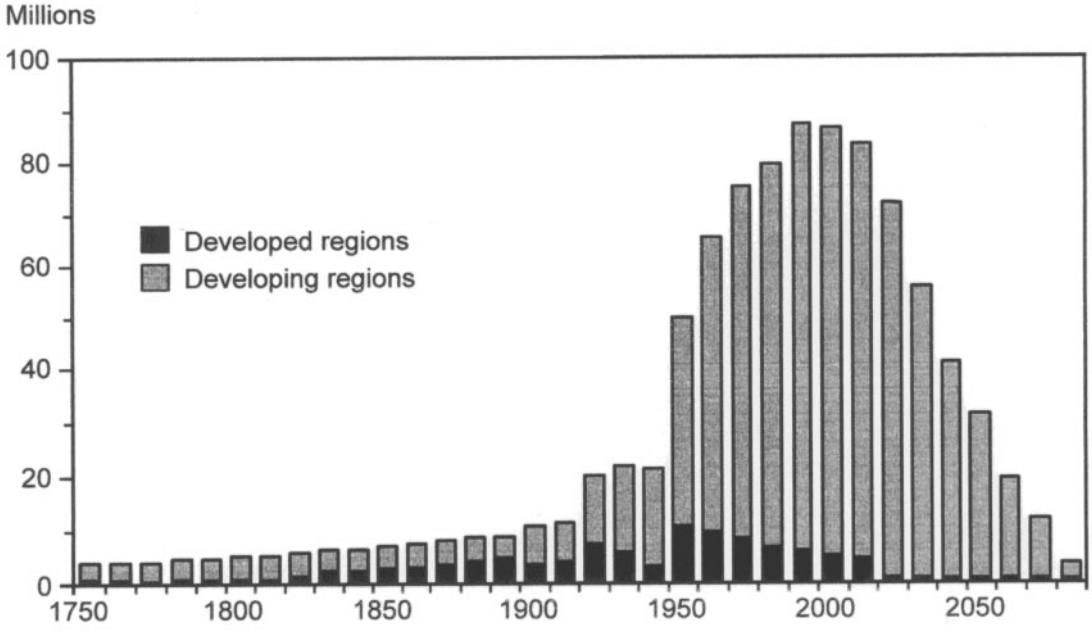

Fig. 4 Average annual increase in population numbers per decade.

5 guidelines are needed on how local scale 'participatory approaches' for water allocation can be incorporated within a framework of basin-wide upstream/downstream responsibilities.

It is up to governments to make the management revolution possible. Their particular responsibilities to society in general include:

- to make the desired management possible by adequate legal rules, capable administration, integrated regional planning, encouragement of local action;
- to secure the human capability development necessary for implementation;
- to agree on ethical rules and the general approach to hydrographic interdependencies.

Since the problem is generic in character, it is shared by all countries. What varies is the composition of the problem clusters due to differences in hydroclimate, soil vulnerability, level of socio-economic development, and multilateral dependence [1]. What is needed is no less than a Freshwater revolution as concluded by the Stockholm Water Symposium 1996 [13].

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