Reflections on the World Water Vision by the ‘Next Generation of Water Leaders’

Edited by Naser Faruqui and Odeh Al-Jayyousi

Introduction

This report presents reflections on the World Water Vision by the next generation of water leaders (NGWLs). The NGWLs are 14 women and men, younger than 40 years old, who were selected by the Third World Centre for Water Management, the International Water Resources Association (IWRA), and the Stockholm International Water Institute (SIWI) as potential water leaders of the future.

The First World Water Forum, held in 1997, in Marrakech, Morocco, called for the development of a shared long-term vision on sustainable and equitable water resources management. Following the Forum, the World Water Council convened an independent commission to launch the Vision exercise. During a three-year participatory process, which included the preparation of several regional and sectoral visions, the World Water Commission prepared a Vision for Water, Life, and the Environment in the 21st Century, or World Water Vision for short. The Vision is collectively represented by two documents: the World Water Vision Unit Report (Cosgrove and Rijsberman, 2000) and the independent Commission report (World Water Commission, 2000). The Global Water Partnership also prepared a plan for implementing the Vision (Global Water Partnership, 2000). All three reports were presented and discussed at the Second World Water Forum, held in The Hague, in March 2000. Where this paper refers to the Vision or its implementation, it may refer to one, two, or all three of these reports.

The Second World Water Forum was also the first meeting for the NGWL. The reader is invited to visit the New Generation of Water Leader Website, currently under construction, at http://hydro.iis.u-tokyo.ac.jp/NGWL. In 1999, the Third World Centre for Water Management and the International Water Resources Association, with the support of the Stockholm International Water Institute, initiated a program to identify potential water leaders of the next generation. Over 250 nominations were received from all over the world, from which only 14 were selected by a group of international water experts. The potential water leaders are women and men, less than 40 years old, coming from different continents, with diverse backgrounds and experience. The World Water Vision provoked much debate by all participants at the Forum, including among the NGWL group. This paper, an outcome of the group’s first meeting, is intended to provoke debate as all stakeholders move from formulating the Vision to refining and implementing it. No attempt was made to develop a consensus position; rather, the group wishes to deepen the debate by exploring the complexities and contradictions inherent in water management issues raised by the Vision.

The following short essays highlight the perspectives of the NGWLs on the World Water Vision. Eight contributors, in pairs, offer differing perspectives on similar themes. The first two authors take a broad perspective: Dajun Shen cautions against discussing complex water issues in a simplistic, polarized manner, while Taikan Oki suggests extending the time-span of a future water vision. Christopher Scott and Karin Kemper address the principle of subsidiarity. The former identifies its shortcomings, and the latter stresses its importance. The next two authors discuss issues of donor aid: Zahir Uddin Ahmad stresses the need for donor agencies to harmonize their efforts, while Naser Faruqui argues that donors must help the South develop its own solutions. Odeh Al-Jayyousi and Cecilia Tortajada address approaches to economic growth. The former contrasts “good” and “bad” growth, and the latter argues for a balance between environment and development. The final six contributors offer individual reflections on distinct but related themes, including the importance of regional cooperation and integrated river basin management (Mohamed Abdel-Aty Sayed), “real” communication among stakeholders in the water sector (Caroline Figuérès), the affordability of water by the poor (Sanderson Medeiros-Leitão), multidisciplinary training in water (Aaron T. Wolf), reliable data for effective water management (Vimal Garg), and the distinction between the “blue” and “green” water (Johan Rockström).

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• Globalization Versus Decentralization: Globalization is both welcomed and feared. It is welcomed because it can generate new opportunities, but it is feared because it can cause instability and unwelcome changes. Globalization exposes the water sector to competition and shocks from outside. However, in general, fresh water is not a global resource. Decentralization can nourish responsive and efficient governance by allowing for more decision making at local levels. However, decentralization pushed too far can jeopardize sectoral stability and integrated water resources management.

• Private Versus Public Sector Management: Privatization was widely promoted at the Forum. Because most cases of privatization occurred only in the last decade, it is too early to draw hard conclusions. However, it is clear that private sector involvement in the water sector has not been universally successful. One obstacle is that water sector infrastructure requires large capital expenditures up front, and the investment has a long return period. Furthermore, integrated water resources management is far more complex than managing a typical private sector enterprise. And of course, while many public utilities are poorly managed, there are examples of successful utilities still managed by the public sector. In some countries, privatization will counteract institutional development.

• Modern Versus Traditional Approaches: We must look ahead, but at the same time, we must look into the past to avoid repeating our mistakes. Did we foresee such great advances in technology 25 years ago? Did we predict a water resource crisis so severe? If so, did we assume that the ingenuity of humankind would find a way to address our current water resources problems? While we must look into the past, we need not be constrained by it. Instead, we need to think “out of the box,” and be unafraid to propose completely different approaches and paradigms. It is clear, though, that we cannot rely completely on modern technology to solve our problems. Changes in human behavior will help address many problems, so technology-oriented management should be balanced with human-oriented management.

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Developing A Real, Long-term Vision by Taikan Oki

The World Water Vision, with its target year of 2025, is not really a vision of water in the future. Most water resources management systems require a few decades to be built and refined before they can effectively perform, so the Vision for 2025 is actually a plan on which we have to begin work immediately. The problems we consider in the Vision are the problems we now face, and the solutions we propose are those we can currently implement or imagine. Tackling this short-term Vision is obviously important, but as part of a group of potential “next” generation water leaders, I would like to look beyond 2025. It is true that if we look too far in the future, our prediction will not be realized and the vision based on it will fail. However, a vision is different from a prediction or a forecast. A vision should reflect the collective will of individuals for the future.

Therefore let us dream of a longer-term vision for our descendants, for which the target year could be 2100, or even 3000. No prediction for the year 3000 can be wholly accurate, but this is unimportant—in fact, it helps. For a longer-term vision, we are unrestricted by the accuracy of our predictions on the evolution of technology or social conditions, which limit our dreams in the short-term vision. For the 3000 Vision, we can focus on the vision bottom line — what shall be the advances related to water in future human society. Moreover, considering sustainability until 3000 is a good way of testing proposed solutions for 2025. While some solutions may be sustainable for a few decades, they may not be sustainable beyond that, let alone for 100, or even 1,000 years. I expect long-lasting technology, technology with millennial sustainability, will be widely applied in water resources management in the future, as others have been applied in the past few millennia.

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How “Participatory” is Integrated Water Resources Management by Christopher Scott

As the global water management community steps into the 21st century, we are faced with contrasting approaches to address very entrenched water management problems. The rural development movement of the 1970s and 1980s was geared toward local issues and emphasized that all stakeholders and water users need to be involved in all water management processes. On the other hand, there is growing awareness that water resources problems are linked, as indicated in the World Water Vision and the Framework for Action — quantity with quality, upstream with downstream uses, human uses with the environment. This is conceptualized by the integrated water resources management approach. While it is important that we have recognized both the vertical and horizontal links in the water management continuum, participatory approaches must be pared down to a manageable set of essential elements, and the top-down subsidiarity inherent in integrated approaches must be based on representation of local interests. Recent rapid increases in the quantity and quality of data available for water management in its various guises — social, technical, political, environmental — coupled with advanced analytical techniques to identify critical obstacles, will usher in a new paradigm of preventive water management.

While the principles behind integrated water resources management are laudable, the experience on the ground reflects either the model of very localized water user organizations coalescing around specific issues, or large-scale, top-down approaches. Localized, participatory efforts are inappropriate for integrated problem resolution because they tend to operate at the level of the lowest common denominator, resulting in unwieldy solutions that are often applied after the situation has already changed. Administrative solutions developed and applied without representation of local interests are inappropriate and inflexible. The rapid response essential for the effective management of complex problems requires identification of the key obstacles to resolution, as well as the stakeholders’ ability to significantly contribute to resolution. Clearly, a wide array of actors and interests is involved in a broader set of water management processes; nevertheless, the immediate stakeholders must deal with specific problems. Only when rapid and effective methods are in place will we be able to operationalize preventive approaches to water management. In the age of more widely available advanced information systems and analytical tools, there is no reason to doubt that future water management will indeed be participatory and integrated, perhaps for reasons different than those of a generation ago.

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Decentralizing Decision-Making by Karin Kemper

The World Water Commission makes reference to the principles espoused in the Dublin Statement and in Agenda 21. One of those principles is “management of water resources at the lowest appropriate level.” In the Commission Report it is rephrased as “the institutional principle,” which recognizes that “water management requires the involvement of government, civil society, and the private sector and that the principle of subsidiarity must be respected.” While this phrasing may be more elaborate than the original one, to many casual readers it also obscures one of the implications of the principle, namely the active management of water resources, as compared to mere involvement in the issues, by all the stakeholder groups.

When looking at the development with regard to decentralized water resources management over the past years, it seems that for current decision makers, it is relatively easy to give other stakeholders, including water users, a role of involvement, for example in basin committees, but far more difficult to decentralize decision making power to them. It is clear that people need incentives to give up their time and their money to participate in new endeavors such as water resources management. After all, they could be working on their farm, running their business, or taking care of their children instead. If real decentralization of decision making does not take place, then the new structures easily become “talking clubs” that will leave people without long-term interest in participating, and the expected improvement in water management will not take place. The best incentive one can give them is to actively participate and take responsibility for the resource is to transfer real decision making power over their water resources. This includes having a say about levying water resources fees, retaining the revenues, at least partly, at the basin level and deciding about investment and management plans.

A critical issue to go from vision (stakeholders should be involved) to action (stakeholders actually change their behavior) is therefore to recognize that the innocuous word “subsidiarity” implies real decentralization of decision making, including the transfer of power over financial resources.

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Harmonizing Sector-wide Donor Aid in Developing Countries by Zahir Uddin Ahmad

The World Water Vision indicates that while funds for the water sector will increasingly come from the private sector, official development assistance is still necessary, particularly for protecting public goods. However, it did not address the endemic lack of coordination and collaboration between different donors in the same country or region.

Most donors come to a developing country with their own, unique development agenda. Typically, each donor negotiates with the recipient government on which projects to fund. Some of these projects have less relevance to the national policy of the recipient country than to that of the aid-delivering country. Ultimately, this piecemeal approach results in projects or programs that are not sustainable beyond the project period. This is a generic problem in every sector in developing countries, including the water sector.

To overcome the shortcomings of the piecemeal approach, it will be necessary to adopt a new approach where:

- All the active donors of a developing country should join to formulate a common policy and strategy towards the development of the water sector. The overall picture of the sector must first be made clear, covering all the sub-sectors such as agriculture, fisheries, drinking water, and the environment.
- The donors may create a pool fund, instead of spending it bilaterally, that can be spent depending on the priority jointly set by the donors and the recipient country. This sector-wide approach requires good governance, both in recipient and donor countries.
- The active donors of a particular recipient country must effectively coordinate, in order to avoid “flag planting.” Harmonizing and synchronizing the resources of the donors and the need of the recipient country should be the ultimate objective.

Institutional capacity building of the recipient country to ensure long-term sustainability should be inherent in this proposed sector-wide approach. The chances of an aid-dependent country becoming self-reliant is far greater following a policy of harmonized donor aid with recipient priorities and capacity-building than under the current, piecemeal approach.

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Research and Innovation by the South, for the South by Naser Faruqui

The World Water Vision outlines two essential steps to address water problems – empowering communities to manage their own water and supporting research to generate knowledge for more productive water use. However, a crucial link between these two issues was neglected.

We now understand that less-centralized decision making results in more sustainable projects, but we have not yet grasped that the same concept applies to the generation of knowledge. Many international donors and even some officials in the South still believe that almost all of the innovative technology that beneficiaries can apply to more efficient water use will be developed by the North and “transferred” to the South. If a woman is hungry, feeding her will satisfy her hunger for one day. On the other hand, if we teach her how to fish, she will never be hungry again. Despite this, we are still trying to build her fishing rod, instead of empowering her to build it herself.

I am not proposing that the South can or should try to develop everything itself. Each country must focus on its competitive advantage. For example, in the long run, it may be far cheaper to import plastic pipes from elsewhere than to produce them domestically. The mistake lies in the implicit assumption that the North has a competitive advantage in brains. The most important technologies of the future, such as new seed varieties and information technology, depend more on cutting-edge science than on conventional technology, such as assembly-lines. While most developing countries have low capacity for conventional technology, many already have scientists with high capacity, for example, India’s computer engineers. Other scientists in the South also have high potential, whom, if supported with guidance, equipment such as good laboratories, and access to existing knowledge, can help solve some of their own water problems. For example, the International Development Research Centre has helped scientists in Chile develop innovative fog harvesting technology and scientists in Pakistan develop decision-support systems for managing the Indus River flows. In the long term, it will be more sustainable if most of the innovation required for increased water productivity in the South is developed by Southern scientists. One of the best uses of donor funds is to support the development of that research capacity.

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Reflections on the World Water Vision by the 'Next Generation of Water Leaders'

**Water Resources Development and Economic Growth by Odeh Al-Jayyousi**

The World Water Vision refers to “economic growth” as a measure or a criterion of water resources development. The Vision indicates that water plays a vital role for the attainment of economic growth, a worthy goal. However, the Vision makes no distinction between “good” growth and “bad” growth. Growth is only good when:

- it results in the production of goods and services that are inherently valuable and beneficial;
- these goods and services are widely distributed throughout society; and
- these benefits outweigh any other detrimental effects of the growth process on other parts of society.

Our measure of GNP makes no such distinctions. Indeed, a major portion of what shows up as growth in GNP is a result of:

- shifting activities from the non-monetary, social economy of household and community to the monetary economy, with the consequent erosion of social capital;
- depleting natural resource stocks, such as forests and fisheries; and
- counting as income the costs of defending ourselves against the consequence of growth, such as cleaning up toxic dumps and oil spills.

Globalization may be one of the salient trends that is likely to change (or create a paradigm shift in) the concept and practice of water management and development. Water management may be viewed as a balance between needs, institutions, and technologies. A clear distinction must be made between needs and wants. Water institutions may be informal organizations that utilize local knowledge and address the real needs of the poor. Our concept of technology should reflect the notion of “Small is Beautiful,” defined as “appropriate technology” or “blending of technology.” Our future challenge is to develop clear communication and dialogue between the global and local actors. In brief, we should develop guiding principles for localizing economies and globalizing consciousness.

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**Balancing Environment and Development by Cecilia Tortajada**

Irrespective of what is stated in the Vision, environmental and social issues are defended as long as the specific interests of international agencies and NGOs are not adversely affected, but not otherwise. Governments are blamed publicly for their lack of interest in the environment, but international organizations interested in the environment often ignore sensitive social and environmental issues that could compromise them. While environmental policies, including those related to water, should respond to the need and demand for conservation, they also must address the challenge imposed by globalization and the need for economic development and employment generation. Such policies should be linked to changes in lifestyles, and simultaneously to societal preferences and needs for environmental sustainability and economic growth. Economic and trade issues must be considered. In most cases, environmental protection strategies require both substantial investments and changes in the lifestyles of the people. Assuming both these factors can be handled simultaneously, they can contribute to improvements in both environmental quality and better living standards.

Development and the environment are part of an integrated process that is influenced by the extent and type of past economic and demographic growth, social and cultural conditions, and institutional and political regimes. They are also linked to future development patterns, population growth, and technological advances. Sustainable water development requires a clear understanding of the interactions between economic, social, and natural systems so that efficient and timely decisions can be taken that improve both long-term environmental and social welfare. Consideration of only efficient technologies and production and consumption processes will not contribute to the long-term process of sustainable development. Information, education, research, and sociocultural factors are equally important elements because they often contribute to the emergence of new attitudes and participatory behavior from the society as a whole. Isolated actions, with no clear policy framework, are unlikely to result in tangible environmental and social benefits over the medium to long term. However, government actions alone are not enough — society in general, and NGOs and the media in particular, need to be involved as well.

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Water and Development by Mohamed Abdel-Aty Sayed

The water sector has often been treated as an isolated issue from other development issues. Although water is often the main link that connects all major development activities, especially in arid climates, this was not well-enough developed in the Vision.

Planning for the development of shared basins on one hand, and planning for the whole globe on the other, is now more essential than at any other time before, due to globalization. Initiation of different types of water banks, for data, water storage, and financing, is one option for management of shared basins. Stopping resource deterioration and preserving the existing environment and ecological conditions are essential. Integrating social concerns and cultural values into the traditional political and economical concerns typically considered is necessary. A multi-disciplinary framework that embodies all the issues and concerns should be established.

The Nile basin is a real and applicable case. It is shared by ten states. Eight of these countries are ranked among the least developed of the world. Current economic decline and environmental degradation have underscored the need for coordinating development plans in the basin and linking this development to the management of the scarce water of the basin. Strengthening regional cooperation in all aspects of development will assure the proper utilization of the Nile resources and will help development in each country, for the betterment of the basin as a whole. Developing and applying a well-harmonized, basin-wide water policy, including a framework for dialogue, technical exchange, water banks, and basin-wide development plans for regional and national economic development, will link water resources to the overall basin development process.

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The Seeds of Action by Caroline Figuères

During the development of the World Water Vision, the World Water Commission consulted many different stakeholders, including governments, NGOs, the private sector, researchers, and labor and advocacy groups. But during the development of the Vision and its presentation and discussion at the World Water Forum, distrust between key stakeholders, such as trade unions and private utilities, and civil society and the World Bank, was evident.

The distrust is often the result of poor communication between these groups. On the other hand, something quite different happened in some of the sessions at the Forum. In these sessions, perhaps because the room and the audience was small, real communication between participants occurred. This communication went beyond the basic, and often polarized means of communicating at a conference – presentations by speakers and individual audience reaction, often challenging the speakers. Participants really listened to each other and tried to understand different positions. Some participants set aside their own narrow interests to focus on broader water issues and the interests of communities. It was a magical process that suggested the water sector could be on the edge of a huge change.

To move from Vision to Action, good will, energy, and real communication is essential between all interests. Through globalization we can improve our understanding of specific problems and challenges in particular areas. Using participatory mechanisms, different segments of society can work together to identify practical, tailor-made actions. But the effective implementation of these actions depends on the establishment of respect and trust between stakeholders. Real communication can help build respectful and trusting partnerships. During the Second World Water Forum, seeds for communication, partnership, and therefore, effective action were sown. Let us be caring gardeners!

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From Words to Reality by Sanderson Medeiros-Leifão

It is time for the hydro-elite to get their feet on solid ground and for them to put their heart and soul into helping make clean, safe, and sufficient water available to both humans and other life on the planet. Although words at fora are important — Dublin, Rio, Marrakech, and now, The Hague — how many more are needed to truly move from vision to action? It is time to act to attain and better the Vision presented at the Second World Water Forum.

What do the Tuaregs, a nomadic people living in the Sahel, the Xavantes, an indigenous people in Amazonia, and all other stakeholders have in common? Water! All of them are 70 percent water. All stakeholders and decision makers must remember this. As the world increas-
ingly follows a free-market model, how can we ensure that the poor, who do not have the means to pay, will have access to clean, sufficient and safe water? The Vision indicates that transparent, targeted subsidies are the answer. While this can be effective in some places, it is difficult to see the logic of the public sector subsidizing the Tuaregs and the Xavantes so that they can contribute to the profit of the private sector. We need to use modern technology to ensure that the poor may enjoy the basic, fundamental right of access to freshwater. The Vision is correct — political will is truly needed. But how can stakeholders and decision makers be convinced to truly work to implement the goals of the Vision instead for their own benefit? It is a challenge for all of us to make these two objectives compatible. Words are important, but let us now move from words to reality.

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The Need for Multi-disciplinary Training, Management, and Discourse by Aaron T. Wolf

My perspective is shaped by having one foot in the university setting and the other in the applied world of water management. One critically weak link, which is not addressed in the Vision, lies in the way we train our water professionals. Water is a powerfully unifying resource, so it is ironic to the point of absurdity that water education is so fragmented. To truly learn about water in its most holistic sense, one needs courses in many aspects of the hydrologic cycle, from meteorology to surface hydrology to soil sciences to groundwater to limnology to aquatic ecosystems — and that’s just the physical cycle. One should also have an integral sense of the human dimensions, from economics to law to ethics to aesthetics to sociology, anthropology, and geography. Universities simply are not organized to accommodate training along these lines. Moreover, our management institutions are equally fragmented, often dividing up surface water and groundwater, quality and quantity, as if they were not inextricably interrelated.

Given that our training and management has lost sight of the holistic and unifying forces of water, it is no wonder that our dialogue on the great hydro-issues of the day are likewise stilted, lacking the level of sophistication needed to do them justice. We often seem unable to remove our political or institutional blinders to address each issue’s complexity, each of which is invariably presented as an irreconcilable dichotomy: whether it is dams or the environment, development or sustainability, or privatization or a human right to water. We saw some of this fragmentation at the Forum, where protestors dangled from ropes and volubly refused to let speakers speak, and ministers espoused public participation while locking themselves in for closed-door drafting sessions.

In the meantime, the crisis, and its attendant human suffering, continues to mount. At some point soon, it might be worthwhile to harness some of the enthusiasm, energy, and resources that events like the Forum foster, and see if we can’t figure out how we might restructure our training, management, and, consequently, our very level of discourse, such that the importance of the topic is done some justice.

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The Use of GIS and Remote Sensing for More Effective Water Management by Vimal Garg

While the Vision Report does mention the need for reliable data for more effective water management, its importance is under emphasized. The documentation of reliable and authenticated data and the establishment of Geographic Information Systems (GIS) are essential for realistic planning, development, and management of water resources. Documentation and access to data can make decisions much more quick, effective, and rational. GIS provides fundamental elements such as geographic measurement, geoaccounting, and support for coordinated work flow, upon which analysis and integrated decision making depend. As the Vision recognizes that real solutions require an integrated approach to water resources management, GIS is crucial. Decision Support Systems (DSS) may be required to support decision-making processes. The decision-making process, which involves tradeoffs between policy priorities and uncertainties, can be aided by Multiple Criteria Decision Making (MCDM) methods. The integration of GIS and MCDM methods with the Internet can greatly increase the effectiveness of natural resource management.

GIS professionals use satellite images for feature extraction, spatial analysis, modeling, two-dimensional and three-dimensional stereo viewing, and map creation and presentation to solve global resource management and infrastructure problems. The greatest advantage of using remote sensing data in water resources management lies in the ability to generate information in spatial and temp-
poral domains. However, remote sensing involves a large amount of spatial data management and requires an efficient system to handle it. GIS technology provides suitable alternatives for efficient management of large and complex databases. Remote Sensing and GIS applications for specific elements of natural resources planning, such as land-use mapping, estimation of precipitation, command area studies, flood management, watershed prioritization, soil erosion studies, groundwater assessment, and rainfall-runoff modeling support the efficient development and management of water resources. The use of GIS and remote sensing in India is still confined to isolated cases, but is gradually being used more widely.

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The Importance of “Green Water” in Natural Resources Management by Johan Rockström

There is a persistent tendency among water professionals to consider only “blue” water resources, including river flow, lakes, and groundwater, as relevant for economic development. This leads to the conclusion that agriculture is the world’s largest water consuming sector, withdrawing some 70 percent of the annually renewable freshwater resource. In reality, we have no idea how much water is needed to sustain world food production.

Our management focus is on the estimated 5,000 km³ of blue water withdrawn annually, for irrigated agriculture, domestic use, and industrial use. The sustainable withdrawal has been estimated at 12,500 km³, and we are moving rapidly towards this ceiling. The resulting sense of urgency leads to an overemphasis on blue water resources management. Yet precipitation over land amounts to some 119,000 km³ annually, world-wide. This precipitation is used to sustain the world’s natural biomes, grazing and grass lands, and rainfed agriculture. “Green” water flow, or evapotranspiration, to sustain ecosystems is by far the largest water flow in the world. While the World Water Vision does distinguish between blue and green water, it, too, over emphasizes the former, at the expense of the latter.

It is useful to estimate the amount of green water flow needed to sustain ecosystems in the major biomes of the world. In a first attempt, green water flows to sustain croplands were estimated at 6,700 km³/yr, grasslands at 15,100 km³/yr, wetlands at 1,400 km³/yr, and woodlands/forests at 40,000 km³/yr. This gives a total average flow to sustain the world’s major biomes of some 63,000 km³/yr. This indicates a human dependency on water that is more than ten times higher than what is normally considered. It also highlights the important role of vapor flow in socio-economic development, and the high risk for vapor tradeoffs from ecosystems to agricultural land in order to sustain growing human populations. Moreover, this makes the need to increase the crop-per-drop ratio, so strongly advocated in the Vision report, even more important. It is essential that we focus on rainfed agriculture where the crop-per-drop ratio is generally lower than at research stations by a factor of two to three. This is explained by low soil infiltration capacity, poor crop water uptake capacity, and low capacity to cope with droughts and dry spells. Doubling crop growth per unit water would secure food for the next generation, underlining the importance of building capacity among field professionals and farmers to develop and apply affordable means of improved rainfall management.

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Conclusion

The development of the World Water Vision was a seminal event. We must now move beyond the Vision to its implementation. The Global Water Partnership identified follow-up steps in its framework for action, including the development of national actions plans by 2001 for implementation of the Vision by individual countries, with the support of international agencies. These plans will be presented at the Rio+10 conference, to be held in Bonn, in 2002. But as the Vision is implemented, it will evolve and be refined from what was presented in The Hague and probably from what will be presented in Bonn. This evolution will require further discussion for several reasons, including the challenge of implementing some of the concepts the Vision espouses, such as subsidiarity, and because different development approaches are favored in different countries. Thus, achieving the noble objectives behind the Vision will require deeper thinking. Given that the Vision is for 2025, thousands of young water professionals all over the world will have to contribute to this ongoing debate. The NGWL group hopes that it has contributed to this reflection process, which will continue over the next 25 years, and beyond.

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References