2020 VISION

SUSTAINABLE FOOD SECURITY FOR ALL BY 2020

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SUMMARY NOTE

Keynote Speaker: **Troubled Water, Water Troubles: Overcoming an Important Constraint to Food Security**

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A key ingredient of the Green Revolution was the investment of many billions of dollars in irrigation infrastructure. Development of reliable irrigation has been crucial to realising the benefits of high-yielding modern varieties.[1] The increased food production associated with the Green Revolution has come hand-in-hand with sharply increased water use in irrigated agriculture that has benefitted farmers[2] and the poor[3] variously, as well as damaged the environment.[4]

As populations rise, incomes rise, and countries industrialize — the demand for water in urban areas in developing countries will rise very strongly in the coming decades. At the same time increased environmental awareness will place more and more emphasis on maintaining a healthy environment for people as well as nature. Large-scale development of river and groundwater resources is less acceptable now than it was in the period 1960–1990, when the large majority of the world's 45 thousand large dams were built. Moreover, water infrastructure built in recent decades is getting obsolete — e.g., through silting up of reservoirs, and crumbling of irrigation networks — and there appears to be a decreasing willingness to fund rehabilitation and replacement of infrastructure. Groundwater levels are falling in key aquifers that have contributed substantially to food security in recent years through provision of water-on-demand to millions of farmers that tapped them directly through tubewells. In all these developments, as resources get scarcer, the poor and vulnerable are impacted first and suffer most.

Water for agriculture is getting squeezed as water is moved out of agriculture to be diverted to urban areas, groundwater sources dry up, and the willingness to develop new resources has declined for financial as well as environmental reasons. The consequences are visible in, for instance, Pakistan, home to the world's largest irrigation system and increasingly serious droughts. Agriculture has grown used to cheap and plentiful water in irrigated areas. As the human population tripled in the twentieth century, water use multiplied sixfold, mostly for agriculture. Agricultural productivity has risen sharply in recent decades due to higher yielding varieties and increased fertilizer use — but also due to major investments in water resources infrastructure and massive subsidies on energy for pumping groundwater that are less likely to be repeated in coming decades.

Crucial Questions: The Example of Gujarat

In Gujarat, an Indian state of 50 million people with an average eleven hundred cubic meter of water per person per year, there has been a very serious drought, both last year and this year. Groundwater is crucial for both agriculture and domestic supply, but groundwater levels have dropped tens of meters and wells have fallen dry across the state. Water tankers provide emergency rations to thousands of villages. Water has risen to the top of the political agenda and the Chief Minister has asked for advice on what he should do to alleviate the water crisis.

A number of water "vision" documents have been prepared for Gujarat. The state is heavily industrializing and a "White Paper on Water in Gujarat" states that industrial water demand is expected to jump eleven-fold to 5 cubic kilometers. Domestic water supply is expected to more than triple to 4 cubic

kilometers. Agricultural water use would grow by a relatively modest 68 percent — but that would still imply an increase of some 10 cubic kilometers — about as much as the expected industrial and domestic use in 2025 combined. The Gujarat Agrovision 2010 recommends, among many other things, to complete the megaproject Narmada/Sardar Sarovar as soon as possible. Also, it expects that over four hundred thousand more wells and six thousand tubewells would be needed to reach, what is calls, "the ultimate irrigation potential".

The Gujarat Whitepaper notes that if agriculture gave up only 8–10 percent, industrial and domestic demands could be supplied. But what is left unsaid is that Gujarat currently already uses over 40 percent of all renewable water resources for human purposes — the increases in use that the various visions contemplate would lift that percentage to something on the order of 70 percent in a highly variable monsoon-type climate. The current environmental problems of saline water intrusion and catchment degradation are not likely to be resolved. The groundwater levels that have fallen from 15 to a 150 meters deep in North Gujarat in one generation will not recover. Shallow wells for drinking water have fallen dry in many areas and deep tubewell water contains high levels of fluoride and/or arsenic. Manmade "droughts" are likely to become more rather than less frequent. How can all Gujaraties achieve water security?

What should the Chief Minister do? Unfortunately, Gujarat is far from alone in its dilemma. Moreover, as water resources get scarcer, the poor and vulnerable are impacted first and suffer most.

The question — in Gujarat and elsewhere — appears to be: How will we find sufficient water to provide food security, health, and livelihoods to a growing world population — in harmony with other water users and the environment? This is truly a global challenge, that perhaps should be re-formulated as follows: How can we grow the food we need with the water available?

To grow enough food and provide sustainable livelihoods to poor people with the available water will require a considerable overhaul of the way agriculture is practiced. The dominant agricultural philosophy that views land as the scarce resource and aims to maximize yields per unit of land through better varieties while removing nutrients and water as constraints[5] needs to be replaced. Replaced by a philosophy that views land, water, nutrients and genetic resources as an integrated set of scarce resources that need to be managed by the stakeholders.[6] For water and land resources management there are three priorities:

1. Implement better water and land resources management practices in agriculture, forestry and fisheries;
2. Increase understanding between agriculture and other water users, particularly environmental uses; and
3. Reduce agriculture's water use and dependence.

There are many ways in which water can be managed better, ranging from better technology such as laser-land leveling or drip irrigation[7] to better involvement of users in planning and management of resources. Collectively these are known as "integrated water resources management". Particularly in upper catchment areas and on hillsides, but not limited to these areas, better water management ought to be closely intertwined with better land management, e.g. through integrated watershed or catchment management approaches.

While it is clear that water and land resources management in currently cultivated systems can be improved, it is not clear how much irrigated areas should be expanded in the coming decades. Irrigated agriculture — "old style", understood as large-scale publicly funded irrigation systems — has gained an ambiguous reputation with parts of society. Willingness to invest in new systems has declined. Others, particularly in the irrigation and drainage community, hold it self-evident that considerable expansion of irrigated areas is necessary and unavoidable to achieve food-security and reduce hunger and poverty in rural areas.

Dialogue on Water, Food and Environment

Bridging the gaps in perception on the desirable directions in water management for agriculture will reduce conflicts among users and increase the resources available for broadly supported investments. To this end a broad consortium is being established — comprising farmer organizations, environmental organizations, UN agencies, water and irrigation organizations as well as the CGIAR represented by IWMI — that will catalyze a process of cross-sectoral dialogue on water for food and environmental security.[8] The Dialogue has been formally launched last month at the Stockholm Water Symposium. A sponsor group chaired by the Netherlands government has been established to support the exercise and has committed the first several million in US dollars to kick-off the program.[9] The Dialogue exercise will catalyze cross-sectoral debate at national and basin level, improve the knowledge base and link into many small-scale, local, formal and informal initiatives that often remain invisible. The Dialogue, as an exercise and as an alliance of key stakeholders, can both help shape the research agenda and disseminate research results if the CGIAR takes up the global challenge in water and agriculture.

The Global Challenge for Water and Agriculture

What is the challenge? Globally it will be to find ways and means to implement the call to arms of Mr. Kofi Annan to the Millennium Conference, when he said, "We need a Blue Revolution in agriculture that focuses on increasing productivity per unit of water — "more crop per drop." Recently, IWMI analyzed a scenario that would allow decreasing water to irrigated agriculture by 10 percent, rather the "business-as-usual" scenario which would require a 12–17 percent increase.[10]

Achieving this goal by 2025 would require both an increase in water productivity in irrigation by 60 percent and in rainfed agriculture by 35 percent.[11] This goal implies an increase in the rate of productivity increase per year that is two to three times higher than under business-as-usual. Increasing productivity globally will be necessary, but not sufficient. It will need to be done in a way that alleviates poverty and shares the benefits more widely among all people than in the past. And it will need to be done in a way that acknowledges the needs of other uses of water better. We will need to find ways, globally, to co-manage water for agriculture and nature, for industry and domestic use — exploiting complementarity rather than emphasizing adversity.

Locally it will mean finding ways for the Chief Minister of Gujarat to achieve all water-related objectives simultaneously, rather than separately, and be better prepared for the next drought.

It will require a considerable paradigm shift to think in terms of yield per unit of water as a major complement to yield per unit of land. Key areas can be grouped as follows:

1. increasing the drought stress tolerance of key irrigated and rainfed food and cash crops through breeding, biotechnology and functional genomics, thereby also adapting agriculture to increased climate variability due to anthropogenic climate change;[12]
2. similarly increasing the water productivity of key food and cash crops through breeding and biotechnology;
3. improving soil water and soil fertility management to sustainably increase yields in, particularly, rainfed agriculture — e.g., through integrated catchment management and rainwater harvesting;
4. improving integrated water resources management at the basin level to increase water productivity and (re-)allocate water resources to a sustainable mix of high value uses, from crops to forestry, to fisheries, the environment and domestic and industrial use and reduce conflicts among users; and
5. integrated natural resources management with full involvement of all stakeholders and explicit sustainability and poverty alleviation objectives using appropriate technologies — such as, for example, treadle pumps.

The quantified objective of the global challenge in water and agriculture is to sustainably increase global food production by 40 percent while reducing the renewable water resources used in agriculture by 10–20 percent in the next 25 years. This will imply a reduced use of water for agriculture over current projections by about 600–700 cubic kilometers — of the same order, as the additional water required for domestic and industrial purposes. If this can be achieved, and I see sufficient evidence that it can be, if an integrated approach is followed and resources are mobilized, then agriculture can once again be seen in a more positive light. As a source of food, as a source of poverty alleviation for people in rural areas, a source of pride for policymakers and researchers, and as an ally, not a threat, to the environment.

References

Batia, M. S. 1999. "Rural infrastructure and growth in agriculture." *Economic and Political Weekly* 34: A43–A68.

Cosgrove, W. J., and F. R. Rijsberman. 2000. *World water vision: Making water everybody's business.* London: Earthscan Publications.

FAO (Food and Agriculture Organization of the United Nations). 2000. *Crops and drops: Making the best use of land and water*. Rome: FAO.

Gallopin, G. C., and F. R. Rijsberman. 2000. "Three global water scenarios." *International Journal of Water* 1(1): 16–40.

Garcia, Y. T., A. G. Garcia, M. Oo, and M. Hossain. 2000. "Income distribution and poverty in irrigated and rainfed Ecosystems: The Myanmar case." *Economic and Political Weekly* (December 30): 4670–4676.

Hazel, P. B., and C. Ramasamy. 1991. *The green revolution reconsidered: The impact of high-yielding varieties in South India*. Baltimore: The Johns Hopkins University Press for IFPRI.

Janiah, A., M. L. Bose, and A. G. Agarwal. 2000. "Income distribution and poverty in irrigated and rainfed ecosystems: Village studies in Chhattishgarh." *Economic and Political Weekly* (December 30): 4664–4669.

Lemly, A. D., R. T. Kingsford, and J. R. Thompson. 2000. "Irrigated agriculture and wildlife conservation: Conflict on a global scale." *Environmental Management* 25 (5): 485–512.

Molden, D. J., and F. R. Rijsberman. 2001. "Assuring water for food and environmental security." Paper presented at the CGIAR Mid-Term meeting in Durban, May 2001.

Pingali, P. L., and M. Hossain, eds. 1999. *Impact of rice research in Asia*. Philippines: International Rice Research Institute.

Pingali, P. L., M. Hossain, and R. Garpacio. 1997. *Asian rice bowls: The returning crisis?* United Kingdom and the Philippines: CABI and IRRI.

Notes

1. While not a generally accepted fact, this is shown clearly in the literature, e.g. Hazell and Ramasamy (1991), Janaiah et al. (2000), Pingali et al. (1997), Pingali and Hossain (1999), and Batia (1999).
2. A review by the World Bank of 585 irrigation projects found an average economic internal rate of return (IRR) of 15 percent, substantially above the assumed opportunity costs of capital (World Bank 1994). Many irrigation projects, particularly in Africa, underperformed however, or had major social and environmental external costs. This has led to strongly held differences of opinion concerning the benefits and costs of irrigated agriculture.
3. There is no consensus on the poverty alleviation impacts of irrigation. Recent research led by IRRI, for instance, concluded for six villages in Madhya Pradesh, India, that incidence, depth, and severity of poverty were substantially lower in the villages where there was irrigation — compared to rainfed villages (Janaiah et al. 2000). Similar research in Myanmar concluded that recent

expansion of irrigation infrastructure in the 1990s has not increased household income, due to farmers' inability to cope with the economic and technical demands of the new rice-based technologies (Garcia et al. 2000). The acrimonious debate on dam development has convinced many that water resources development threatens livelihoods. A recent article on the Mekong in *Newsweek*, for instance, was titled "Strangling the Mekong: A spate of dam building," has stopped up Southeast Asia's mighty river and may threaten the livelihood of millions who lie along its banks (*Newsweek*, March 19, 2001).

4. A comprehensive review of the impacts of irrigated agriculture on wetlands and wildlife conservation (Lemly et al. 2000) concludes that the conflict between irrigated agriculture and wildlife conservation has reached a critical point on a global scale.
5. Achieved through higher yielding varieties, cheap fertilizer, and essentially free water.
6. This is, of course, nothing more or less than a plea for integrated natural resources management.
7. Both high-tech systems for large-scale agriculture as well as cheap, labor-intensive bucket-drip-kits adapted for resource-poor farmers on small plots.
8. Food and Agriculture Organization of the United Nations (FAO), Global Water Partnership (GWP), International Commission on Irrigation and Drainage (ICID), The International Federation of Agricultural Producers (IFAP), The World Conservation Union (IUCN), International Water Management Institute (IWMI) on behalf of the CGIAR, United Nations Environment Programme (UNEP), World Health Organization (WHO), World Water Council (WWC), and World-Wide Fund for Nature (WWF).
9. Support has been received or committed to date from the Netherlands, Japan, United Kingdom, Germany, and GEF. A Secretariat is being established at IWMI and will be headed by Hans Wolter from October 1, 2001 (dialogue@cgiar.org). Further information on the Dialogue is available at http://www.iwmi.org.
10. Focusing on irrigation efficiency, IWMI (1998) concluded that an additional 17 percent would be required in the period 1995–2025. FAO (2001) independently concluded it would be 12 percent for the period 2000–2030. Gallopin and Rijsberman (2000), in more normative scenarios developed for the World Water Vision (Cosgrove and Rijsberman), focused both on additional changes in lifestyle (diet) and on increased productivity in rainfed systems to arrive at a 6 percent increase.
11. Molden and Rijsberman (2001).
12. Drought-resistant corn (maize) varieties have been responsible for a major share of the yield increase seen in recent years, according to CIMMYT. IRRI has released salinity tolerant varieties (IRR51500-AC11-01), and is developing aerobic rice. ICRISAT is developing deeper, denser root systems for chickpea varieties.

Note: The views expressed in this summary note are those of the author and are not necessarily endorsed by or representative of IFPRI or of the cosponsoring or supporting organizations.