Environmental sustainability challenges of hunger alleviation

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Water - the bloodstream of the environment

Human livelihood is offered by the natural environment where plant production constitutes the main source of food. In order to grow food, humans have to manipulate the natural landscape in many different ways: clearing, draining, altering plant cover, fertilising, levelling, irrigating etc etc. Since water is the bloodstream of the biosphere and has numerous parallel functions in the environment, it will be active in generating different kinds of side effects of the necessary landscape manipulations which are the price for the food produced. For similar reasons, water also links many of the different MDG's: not only drinking water as such but water for income generation, water for food production, water as habitat, etc etc.

The largest challenge in terms of water implications of meeting the MDG's is linked to MDG 1 to eradicate poverty and hunger, especially Target 2, halving the number of hungry by 2015. It is easy to realise that halving the percentage of hungry from the situation by 1990 to 2015 will be a much more limited task than to produce full diet for the additional population added during that time. A study, just prepared as a contribution by Sweden on the occasion of the Millennium Summit +5 (SEI 2005), has analysed the problematique in terms of linkages between MDG 1 and MDG 7.

How much additional water will have to be consumed to produce more food?

Hunger alleviation will be equivalent to consumptive water use (evapotranspiration) of huge quantities of water. The reason is that water is one of the two key raw materials in the photosynthesis process, the other being carbon dioxide. When the leaves open to take in the latter huge amounts of water evaporates, in most climates of the order of 1500 m3 per ton biomass produced, but in poverty stricken dry climate countries often twice this amount due to large losses and low water productivity. To produce a balanced diet of 3000 kcal/p day (20 percent animal protein) involves a consumptive water use of 1300 m3/p day. This water is being picked up by the roots from the socalled green water in the soil consisting of infiltrated rainfall. Water may be added to the soil by irrigation with water withdrawn from the blue water available in rivers and aquifers. *This water requirement is an amount 70 times larger than the amount often assumed as the basic need for household supply (50 l/p day).*

The Swedish assessment suggests that to reach the MDG 2015 Target, an additional consumptive water use of 2 200 km3/yr will be required. This corresponds to a 50 percent increase from the situation today. If covered by irrigation only, it would involve more than a doubling of all the water withdrawals from rivers and aquifers today and would be absolutely unacceptable in view of the damage already caused by irrigation in terms of depleted rivers and degraded acquatic ecosystems. Looking beyond 2015 and accepting the FAO-projected average diet in the developing countries for 2030 of 3000 kcal/p day, an additional consumptive water use of 4 200 km3/yr would be required by 2030 assuming that hunger be altogether eradicated, increasing to an additional 5200 km3/yr by 2050 in order to feed also the additional population.

To meet the indicated water requirements must therefore be seen as a major environmental challenge: from where could such a huge amount of water be made available and what would be the environmental consequences? What will the MDG 7-goal in terms of environmental sustainability imply?

A major environmental challenge that will have to be met

First of all we know that much of today's agriculture in the developing world suffers from large water losses. This holds for both irrigated agriculture where water use efficiency tends to be of the order of only some 30 percent, and for rainfed agriculture where yields are often of the order of only 1 ton/ha or even below that. The losses tend to be largest in the savanna zone agriculture where in fact the majority of the poorest countries are located. There, rainfed agriculture typically involves of the order of 3000 m3/ton grain. In the savanna zone, the options are at the same time potentially good for halving this water requirement by soil and water management including protection of the plants from the dryspell damages to the roots, typical for the climate in that zone.

Turning next to what we might expect in terms of additional irrigation water, i.e. how much could be covered by blue water, we know that many rivers in the irrigation dependent regions are already over-appropriated beyond the requirements of the aquatic ecosystems. Our assessment, following the assumptions earlier made by IWMI, suggests that irrigation might not contribute more than maybe some 270 km3/yr by 2015 (520 by 2030, 725 by 2050). The remaining water requirements will have to be met in other ways.

The alternatives to consider are basically two: capturing more local rainwater, making it to infiltrate into the soil on the farmer's field, or expanding crop production into tropical forests and grasslands, appropriating water now consumed in the plant production of such natural ecosystems. This brings us to the issue of the water requirements of natural ecosystems.

Water for ecosystems

The huge amounts of additional water that has to evaporate to produce the food needed to eradicate hunger and feed the population added by population increase will evidently produce environmental impacts. Agriculture covers already some 25 percent of the land area of the continents and has according to the Millennium Ecosystem Assessment caused severe impact on natural ecosystems, terrestrial as well as aquatic. When now agriculture will have to consume more water and will have to expand into natural ecosystems, careful attention will have to be paid to ecosystems and their water relations: aquatic ecosystems and their blue water dependence and terrestrial ecosystems with their green water dependence.

Terrestrial ecosystems are interacting deeply with runoff production: the more of the infiltrated rain that is consumed by the plants the less remains to generate runoff or recharge groundwater. There is for instance considerable interest paid to how forestry interacts with runoff formation: whether forest plantations increase or decrease blue water availability, a debate often referred to in situations both of severe floods and of desertification phenomena. Trees interact with rainwater partitioning in two main ways; by influencing soil permeability and therefore rain infiltration, and by influencing root uptake of green water in the root zone.

The terrestrial ecosystems will be impacted by the horisontal expansion that will in the end turn out to be difficult to avoid. The more productive rainfed irrigation can be made, the less will be the expansion required, but the larger will be the impacts on aquatic ecosystems in stead.

Aquatic ecosystems dwell in blue water habitats and suffer when these change: either by the streamflow being depleted or its seasonality altered, for instance by vanishing flood flows, or by water quality deterioration. Great efforts have recently been made to define the socalled environmental flow requirements of aquatic ecosystems both in terms of percentage of the average flow that has to remain unappropriated and the floodflow events needed for proper functioning.

The aquatic ecosystems will be impacted in three ways: 1) by irrigation expansion, 2) by turning today's "losses" in terms of leakages from canals and percolation down to groundwater into consumptive water use by crops, and 3) by capturing more rainwater and getting it to infiltrate and turn into consumptive water use by crops.

Shift in thinking fundamental

These different effects indicates that in securing eradication of hunger and undernourishment, it will be unavoidable to *address a set of environmental trade offs* between water for producing more food, on the one hand, and on the other blue water now left in rivers and aquifers, and green water in the soil under terrestrial ecosystems.

The task will be to learn to wisely balance the water input from precipitation over land between water required by humans and water required by well functioning ecosystems. This balancing will have to be made in such a way that environmental sustainability can be secured. Such a sustainability means, as explained in the report from the Millennium Project Working Group for Target 9, in practical terms to avoid an undermining of the resource base for humans and vital ecosystems. The key must be protection of resilience against variability and chocks in order to secure long term functioning of these systems, so that they continue to produce for society vital ecological services.

It is evident that our present thinking in terms of environmental protection will be vastly insufficient if the presently projected population expansion will materialise. Guiding principles will have to be developed by proper attention to the necessity to secure resilience and the biodiversity necessary for that resilience. Water is the lifeblood of both nature and humanity.

Reference:
SEI 2005. Sustainable pathways to attain the Millennium Development Goals. Assessing the key role of water, energy and sanitation. Stockholm Environment Institute. Draft.