Increasing water productivity in agriculture
Contribution to Framework for actions leading to sustainable water use
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Increasing the use efficiency of water is the most effective path in fulfilling the increasing demand for food and non-food items through agricultural activities. Whereas reallocation of water may lead to more equitable sharing and distribution of resources and wealth, the bottom line in any effort to ensure that water will not become limiting in supporting the many functions is to produce more desired goods and services with less water. In this section various dimension for enhancing water productivity will be concisely described, based on chapter 7 "Pathways for increasing agricultural productivity" of the "Comprehensive Assessment of Water Management in Agriculture" in which Wageningen UR has made a major contribution (Molden et al., 2007).

Water productivity is defined as the ratio of the net benefits from crop, forestry, fishery, livestock, and mixed agricultural systems to the amount of water required to produce those benefits. It reflects the objective of producing most food, income, livelihoods and ecological benefits at least social and environmental cost per unit of water used.

All food items are derived from plants being the primary organisms in the chain to capture sunlight for converting inorganic molecules into organic compounds, such as sugar, fats, proteins etc. Animal, as secondary producers in the food chain, convert plant organic matter into animal compounds. Understanding water use in relation to plant production therefore is a basic requirement for identifying options for enhancing water productivity. Other important elements of water productivity are the interaction of water with other natural resources and the spatial dimension of water use.

Increase in food production will be achieved with a near proportionate increase in water use for transpiration.
Because of a fairly linear relation between plant transpiration and plant growth, higher growth means higher water use. There is little to no scope to improve the transpiration use efficiency by altering this linear relation, as it is related to basic physical and biochemical processes in the plants. Breeding however has (unintentionally) increased plant water productivity, by increasing the proportion of the crop that is edible. For the near future no large gains are expected in current major cereals, whereas there is much scope of improving the edible proportion of crops like sorghum and millet.

There is much scope to increase food production at the field scale with the same or even less water.
Apart from transpiration (known as "productive water") water in the field may be lost through evaporation from base soil surface or through seepage and percolation. Improvement of management practices can increase crop production by 200-400 percent in most regions in the world with low yield levels. This is achieved by using the synergy between water and other resources in plant growth (De Wit, 1992; Paganini et al., 2007) e.g. through fertilization and by more optimal tuning of water supply to the demand of the crop. As a result, water productivity is generally higher at higher yield levels as proper management enhances synergistic effects between production factors.

Increased water productivity at field scale contributes to higher value creation at the basin level.
Water saved at the field scale can be made available to other users in agriculture or in cities, industries and ecosystems. Many question however whether these are real savings when viewed from a basin perspective. Water lost due to poor management from fields or irrigation canals becomes available down streams through drainage and seepage for use by other farmers or for support of ecosystems and does not contribute to a loss at the basin level. As such improved management practices of fields and irrigation canals might suggest that we simply rob Peter to pay Paul. Also it is found that water saved by a farmer is not made available to others as he/she will expand his agricultural activities, resulting in higher water use. The benefits of improved management however are plenty. The farmer who expands its activities in the end produces more food or other agricultural products. Increased efficiency means that we can more effectively allocate water to the good and services we desire. Finally, water saved will also reach downstream areas but through its natural flow, e.g. through the river, and will be of good quality. Water flowing an unnatural course after drainage and seepage, e.g. through "groundwater flows" carry agrochemicals that may cause salinity and toxicity problems.

Further reading and References
Molden, D.J., T.Y. Oweis, P. Steduto, J.W. Kijne, M.A. Hanjra and P.S. Bindraban, 2007. Pathways for increasing agricultural productivity. In: Comprehensive Assessment of Water Management in Agriculture. Chapter 7. (in press)