

What Implications Does Economic Progress Have for Water?

Gross domestic products (GDPs) are expected to increase worldwide. This, coupled with growing populations, means that demand for food, energy and other goods and services will also increase. What are the implications for water and land resources? And what are the options for “de-coupling” – i.e. increasing GDP without increasing the pressure placed on land and water resources?

Food production: a heavy consumer of water

Food production is one of the most water-intensive sectors in society. So, we have to ask how we can meet the water requirements of greater food production when other sectors are also demanding more water. In food production, as in other sectors, water can be used either more or less efficiently; however, in biological production there is no substitute for it.

It is estimated that, on average, 0.5 m³ of water are used to produce 1,000 kcal of food derived from plants, and some 4 m³ to produce 1,000 kcal of animal products – though figures are uncertain and vary greatly between regions and products. Figures also vary between different production methods – for example, allowing livestock to graze as opposed to feeding them with cereals or other biomass produced elsewhere. Animal feed production is an important consumer

of water, however, as about a third of all the cereals grown are used for feed, and some of this involves irrigation. What is more, demand for milk and meat is rising faster than demand for foods from plants.

Thirsty crops for bio-energy

Thanks to new technologies, many of the crops used to produce food or animal feed can also be used to produce energy. Again, the exact amount of water used to produce a unit of energy from biomass varies significantly according to a range of factors, such as what kind of biomass is used, and whether heat or electricity are being produced.

Whatever the case, significant amounts of water will probably be needed to meet future demands for such bio-energy. In fact, many scenarios of energy-system development assume a huge growth in plantations, as these will be used to provide bio-energy crops after oil reserves begin to decline.

What happens to water demand when GDP grows?

Past experiences in a variety of countries show that increases in GDP are likely to lead to a greater demand for food. This, in turn, will mean that more water will be required to produce it. This trend is particularly striking in poorer countries. Among such countries, the amount of water used to produce food increases very quickly until a per capita GDP of around USD 10,000 is reached.

Based on the levels of growth in GDP that are predicted to occur until 2045, and assuming that water productivity doesn't change, the amount of water consumed to meet growing demands for food will increase from 7,100 to about 11,600 km³ per year. This is an increase of around 45%. The amount of water needed by energy crops by around the middle of this century is also expected to rise. Projections in this regard are difficult to make, but water for bio-energy could be in the same order of magnitude as water for food.

If current practices continue, we simply will not be able to meet future demands on the world's water resources. This means that, in the near future, we have to find ways to stimulate improvements in water use efficiency and better allocate the limited amounts of freshwater resources available to different sectors. These are major challenges.

How can we meet the demands of economic growth without increasing our water requirements?

Severe river depletion and groundwater over-draft are already part of the water crisis. So, it won't be possible to meet increased demand simply by using more water for irrigation. However, the water that we are already using for irrigation could be used much more efficiently to boost productivity.

We must make better use of rainfall. This is especially true in areas where production and productivity are currently low. The total



Photo: Mats Lannerstad

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rainfall during a season is often sufficient for a doubling of yields or more, but rainfall distribution implies high risk of crop failure or reduced yields. Use of agronomic advances, together with protective irrigation based on rainwater harvesting is crucial.

Considerable effort and large amounts of money have already been invested in the irrigation sector. If similar investments were to be made to improve our use of non-irrigated areas and to make better use of rainwater that soaks into the soil (“green water”), we should be able to greatly boost overall production. Such rainfed food-producing areas are very large, so improving production in them will make a significant difference.

Food chain

The pressure being placed on water could also be eased by addressing the huge losses that occur between the time that crops are harvested and the time at which food reaches consumers. These losses are caused by poor post-harvest technologies, and poor transport and storage.

Energy production

Regarding bio-energy, it is to recognise that the residues from both forestry and agriculture could be used. Residues can be used for energy production without using extra water. Though these “waste” materials only contribute a small amount of biomass, their use could be important at a regional or local level. However, using them for energy production means that they cannot rot down and return to the soil, which could affect soil fertility. In the long term, the production of

so-called second-generation liquid biofuels may change the picture significantly.

Consumption: a critical issue

Improving productivity and food transport and distribution are all important steps in combating the water crisis. However, addressing these issues without tackling consumer habits won't solve the problem. Consumers' increasing purchasing power, as well as their preferences and behaviours, have an enormous influence on production, demand and consumption, all of which are linked.

In fact, as consumers, we all influence the water cycle through our preferences for various goods and services. For example, some of the food we buy is simply wasted and thrown away. And, many people are buying and eating far more than they need – which also raises public health issues like obesity. Consuming less meat will also save water. Using feed from crops is a very wasteful process in terms of water use. In the search for ways of de-coupling GDP growth and pressure on water and land resources, adequate attention must be paid to this, the last link in the food chain.

What can be realistically achieved?

Improving water productivity by a realistic amount (about 25%) and halving the losses that occur between harvest and the table would result in water consumption in 2045 being at the same level as water consumption in 2000. However, the improvements will take time to realise, and will certainly not come about without systematic and concerted efforts.

Policy action needed

Thus, if the appropriate steps are taken, increases in GDP don't necessarily have to lead to increases in the amount of water used to produce food and biomass. To break the link between the two, policy makers need to address three key areas: production, wastage in the post-harvest supply chain, and consumers' habits and awareness.

To improve the efficiency with which rainfall is used, i.e. a green water strategy, policy makers need to ensure that poor producers can access credit at affordable rates. Support also needs to be provided for cultivation and marketing of crops with a growing demand. In irrigated systems, water productivity can be greatly enhanced by a combination of institutional reforms and technical improvements. Policy makers need to help producers to access post-harvest technologies and market their produce. Poor roads and other transport-related infrastructure need to be improved, so that food can be transported from the farm to the consumer efficiently, avoiding wastage. Building stronger links with the food-processing industry is important. Some processing can be done at farm level.

Policies need to target the consumers of food and a range of other goods and services – as their demands drive the way water is used. This is a complicated issue that will need to be addressed from a variety of angles. It is important to stimulate food habits that will make it possible to lead a “healthy, active and productive life.” Policies will need to include awareness raising (“water literacy”) efforts, price incentives and sanctions. Since a considerable part of total food demand and consumption takes place in schools, hospitals and other institutions, policies could be targeted at these establishments. They could play an important role in fostering smart and sound consumption patterns.

Better coordination of food, energy, agricultural and public health strategies in relation to water is the broader long-term policy challenge which must be faced.

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The article is based on the chapter “Scenarios on economic growth and resource demand. Background report to the Swedish Environmental Advisory Council, memorandum 2007:1.” Analyses of the anticipated demand for food and bio-fuels and the related water demand are included together with discussions about possible de-coupling. Contact the authors for more information.