CHAPTER 12. MAIN MESSAGES

In the light of growing urbanization and associated challenges affecting our aquatic environment, the significance of agricultural water pollution appears to be sidelined. However, the increasing need to feed the growing global population has required agriculture to expand and intensify. The farm area equipped for irrigation has more than doubled since the 1960s; the total number of livestock has more than tripled since the 1970s; and aquaculture has grown more than twenty-fold since the 1980s, especially inland-fed aquaculture and particularly in Asia. Moreover, land, water and other agricultural inputs are used more intensively than ever before. In addition to population growth, changes in calorie intake and diets have increased the demand for a wider variety of foods, including more meat and dairy products, and led to an increased water footprint in terms of water quality. Where the resulting agricultural intensification is not well managed, its benefits for society are often accompanied by significant environmental and health costs, in particular through water pollution.

Historically, the analysis on water pollution has focused primarily on individual sources, their nature and impact. However, more attention is needed to understand linkages between these factors, as well as pollution drivers, types and loads, distribution dynamics and comparative risks for different aquatic ecosystems. Of major concern are:

- Excessive nutrient application: Intensified cropping systems with limited or no fallow periods can rapidly deplete agricultural soils of important plant nutrients unless fertilizers are applied. During the 20th century, the use of fertilizers rapidly increased as did the discharge of surplus nutrients to water from global agriculture.

- Pesticide overuse: Pesticides are another important requirement of many intensified farming systems. The overuse of pesticides is often associated with the accumulation of persistent organic pollutants in soil and water resources, potentially affecting the food chain. Although the risks of pesticides in the environment are better understood than in the past, regulations, as well as the monitoring of their use, often remain ineffective or inefficient.
- Salinity: Salinization of soils and freshwater bodies is still a leading concern for water quality and agricultural production, especially in arid and semi-arid regions. With an estimated global volume of 1,260 km^3 every year (which corresponds volume-wise with the minimum flow of the Congo river), drainage from irrigation mobilizes and transports billions of tonnes of salts to freshwater bodies.
- Increased erosion and sediments: Agricultural expansion on formerly uncultivated slopes, as well as changes in land use from forestry to agriculture, have accelerated runoff and erosion with increasing sediment loads affecting river quality and aquatic life, as well as the functionality of storage reservoirs. The average global erosion rate on cropland is estimated at 10.5 tonnes per ha per year, which can increase in hilly landscapes of the tropics and subtropics to 50–100 tonnes per ha. With eroded topsoil, soil organic matter, nutrients and, for example, pesticides also find their way into water bodies.
- Livestock: The trend towards increasing consumption of meat and dairy products has led to increasing investments in livestock production. Similar to fertilizer, livestock wastes also constitute major nutrient sources of global water pollution, leading to the potential contamination of drinking water and eutrophication of lakes, rivers and coastal areas. Moreover, animal manure and slurries also contain large amounts of pathogens, as well as veterinary medicines, such as antibiotics, which can affect aquatic life and the food chain. More than 85 percent of the world's faecal waste is from domestic animals, such as poultry, cattle, sheep and pigs.

Given the qualitative and quantitative complexity of possible pollutants, system-based modeling approaches are increasingly needed to support science-based policy responses. New models that are capable of simulating interactions between production systems, agricultural inputs (and livestock wastes), considering temporal, as well as spatial changes in aquatic ecosystems, would help establish a more solid understanding of the different water pollution pathways and potential remediation scenarios. These could also provide regulatory support by calculating, for example, maximum pollution loads (or caps). However, the results of water quality modeling can only be as good as the data used and, so far, many regions lack credible water quality data from farm to watershed. Increased data collection will help develop water quality models and translate their results into better water policies.

Water quality degradation has a variety of economic impacts, including human health, ecosystem health, agricultural and fisheries productivity and recreational and amenity uses. Although some of these effects are tangible, and costs appear significant, many impacts are difficult to value, especially given the paucity of data.

The most effective way to reduce water pollution from agriculture is to limit pollutants at the source or intercept them before they reach vulnerable ecosystems. Once in the system, the costs of remediation progressively increase. Despite significant progress on pesticide and fertilizer regulations, enforcement and actual monitoring of the final use of these inputs remains challenging. To adopt good agricultural practices (GAP) farmers also require more education, awareness and economic incentives, ideally leading to cooperative agreements and wide adoption across landscapes.

Policies that address water pollution from agriculture should therefore form (a) an integral part of overarching water policy frameworks at the national or river-basin scale, and (b) influence policies at a higher level of food security and nutrition to encourage people to adopt diets that are more sustainable in view of human and environmental health.