

# research evidence for policy



Farmers working without protective clothing on fields irrigated with wastewater from the Nhue River, Ha Nam province. Photo: Hung Nguyen Viet

## Safe use of wastewater in agriculture and aquaculture

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Case studies featured here were conducted in: Vietnam

### Policy message

- Wastewater is a valuable and sustainable resource in agriculture and aquaculture. But pathogens and chemicals in the water may harm farmers, and may contaminate vegetables and fish produced using it.
- A lack of knowledge about these health risks constrains the use of wastewater. Greater awareness and preventive measures are needed to avoid such risks.
- Wastewater can be treated in industrial locations, on farms, and by households to remove pathogens and chemicals while retaining valuable nutrients for use.

- Agriculture and aquaculture in Vietnam often use wastewater, particularly in urban or peri-urban areas. Wastewater provides both moisture and nutrients for crops and fish, and its use generates employment for poor communities.
- But using wastewater poses many health risks due to the pathogens (bacteria, viruses, and parasites) and chemicals it contains. These may harm people directly through contact or ingestion, or when they consume contaminated products. This issue of *evidence for policy* explores how wastewater can be used safely.

### Increasing water scarcity

- More than 2.8 billion people worldwide will face water stress or scarcity conditions by 2025. Forty of the 48 countries with this difficulty are in Asia and Africa, and by 2050, the number of countries could almost double. One of the targets of Millennium Development Goal (MDG) 7 (global environmental sustainability) is to halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation. Using wastewater to grow food can reduce the need for using surface and groundwater, so avoiding the depletion of drinking water. It will also partly contribute to MDG 1 (halving the proportion of people who suffer from hunger by 2015).

### Wastewater: a valuable nutrient source for food production

Wastewater includes domestic sewage and human excreta, and it is rich in nutrients that are valuable for agriculture and fish production. Wastewater has been used for agriculture and aquaculture in Vietnam for many decades. In Hanoi, for example, it has been used since the 1960s by farmers as a cheap and reliable source of water and nutrients for the culture of fish. Wastewater use has been growing: in 1995, in Thanh Tri district near Hanoi, a total of 1,121 ha of aquaculture ponds were fed with wastewater: a 120% increase of that ten years previously. Today's fish farmers around Hanoi have gained considerable experience in wastewater-fed aquaculture.

## Featured case studies

### Case study 1: environmental problems of wastewater from sanitation systems

Material flow analysis was used to evaluate nutrient levels in two rural communities in Ha Nam province (northern Vietnam) that use wastewater for irrigation. Results revealed that the sanitation system was a critical source of nutrients entering the Nhue River. Two neighbouring communes of 16,000 people discharge household effluent from septic tanks and latrines and other sources into the river. Every year, 69 tonnes of nitrogen and 23 tonnes of phosphorus are discharged. Simulations revealed that if nutrient management is not improved, levels of wastewater, faecal sludge, and organic solid waste will double from 2008 to 2020. Further simulations revealed possible strategies to significantly reduce the pollution and reuse the nutrients predicted to be available in 2020.

### Case study 2: diarrhoea, parasitic infections, and skin problems caused by wastewater use

Diarrhoeal infection risks caused by exposure to human excreta and wastewater were studied in the two communities in Ha Nam. Untreated wastewater, discharged into watercourses by households and urban settlements further upstream, is heavily contaminated by pathogens. The handling of excreta and the use of untreated wastewater for rice cultivation lead to high risks of infection among the exposed population. Community surveys and stool analysis, conducted during the rainy and dry seasons in this area, found high rates of helminth and protozoan infections. Wastewater and excreta were the main sources of such infections.

Skin problems (irritation and rashes), which may be due to heavy metals in wastewater, were more common among farmers in a community using wastewater (10% of farmers infected) than in a non-wastewater community in peri-urban Hanoi (2% infected). Farmers rarely used protective measures such as gloves and boots as they slowed down agricultural work.

- Farms and fish farms using wastewater from the city produce nutritious, affordable food for the growing population: 10–20% of the fish and a significant amount of vegetables consumed in Hanoi are from peri-urban production systems fed with wastewater.

### Yet wastewater use poses health risks

- Wastewater may consist of industrial, hospital, and domestic wastewater. It may contain pathogens and chemicals that pose health risks to farmers and their families as well as to consumers. Crops and fish may take up and accumulate heavy metals and other hazardous chemicals from industrial wastewater. Residues of agrochemicals (pesticides, nitrates) may also contaminate crops and fish. Common health risks include parasitic infections, diarrhoea, and skin rashes. Research shows helminth (parasitic worm) infections are high among farmers who have direct contact with untreated wastewater in many countries. Cases of diarrhoea are also common in communities practising wastewater irrigation in Vietnam, Pakistan, and Mexico. Research in Hanoi shows that farmers who work in vegetable fields or fish ponds fed with wastewater often report skin rashes and irritations, possibly because of chemicals in the water. Researchers also observed workers washing produce in wastewater or splashing it with contaminated water when bringing it to local markets. In the mar-

ket, vegetables and fish may become contaminated when stored or displayed in baskets close to drainage systems and if they are splashed with contaminated water.

There is a lack of awareness at different levels regarding the role and the risks of wastewater in food production. Farmers often fail to recognise the health risks to themselves and to consumers, and they do not know how to reduce such risks. Consumers, traders, and other actors in the value chain also have limited information about the health risks and how to prevent them. Policymakers may not fully recognise the important role of urban and peri-urban agriculture and the value of nutrients in wastewater, though they are often aware of health problems related to wastewater use.

### Ways to mitigate health risks of wastewater use

Given these risks, how can wastewater be used safely in agriculture and aquaculture?

**Treatment:** from a treatment perspective, it is necessary to enforce the treatment of wastewater contaminated with pathogens and chemicals before it is discharged into rivers and canals. In industrial zones, centralised wastewater treatment plants should be mandatory. For domestic wastewater, it is best to use low-cost treatment measures before it is discharged into the environment: possible solutions include a simple



Morning glory – a popular aquatic vegetable grown in wastewater. Consumption of such vegetables poses a health risk due to chemical and biological contamination. Photo: Hung Nguyen Viet



filtration system using sand, or a more elaborated system with a constructed wetland. For farms and communities that generate large amounts of wastewater from livestock and households, a series of stabilisation ponds to separate liquids and solids, integrated with aquatic production, can be a good treatment option. The investment and operating costs of such ponds can be as much as 80% lower than conventional activated-sludge or trickling-filtration systems, though they require a larger area.

**Protective measures:** many farmers who come into contact with wastewater consider skin ailments to be temporary problems that may disappear after treatment. They rarely wear gloves, boots, and protective clothing as they slow down their work. They receive little information and guidance on the risks or prevention. Better advice should be provided to farmers on how to best protect their health, such as promoting the use of convenient, cheap protective measures, and encouraging people to wash with clean water and soap after coming in contact with wastewater. It is important to educate farmers to reduce and avoid the contamination of foodstuffs.

**Awareness and regulation:** producers, traders, and authorities should be aware of the dangers of vegetables and fish being contaminated after they are harvested. Clean water and sanitation facilities should be provided in markets. Consumers should be made more aware of the importance of safe food and ways to disinfect food through washing and cooking. Product quality should be monitored and product certification schemes should be implemented. Products should be sampled and tested in the laboratory for contamination. Any product that is unsafe and that raises public health concerns must be announced in the public media.

### Featured case studies (continued)

#### Case study 3: farmers' perceptions of health risks related to wastewater use

A study on farmers' perceptions and awareness of wastewater use in the two communities in Ha Nam showed that people perceive wastewater as smelly and black, and thought that contact with the wastewater could cause skin problems (e.g. itching). Farmers felt that fish from the Nhue River and vegetables irrigated with wastewater were potential causes of diarrhoea.

### Definitions

#### Wastewater use

Wastewater consists of domestic effluent ("black" and "grey" water), industrial effluent, and storm water. In developing countries, wastewater is commonly not treated before discharge into common drainage channels, and flows to peri-urban areas where it is used in food production.

#### Pathogens in wastewater

Pathogens in wastewater are of faecal origin. They include bacteria (*E. coli* and *V. cholerae*), helminths (roundworm, hookworm), protozoa (*Cyclospora*, *Cryptosporidium*, *E. histolytica* and *Giardia*), and viruses (hepatitis A, rotavirus).



Vegetables may be contaminated after harvest due to unhygienic conditions during transport and marketing. Photo: Nguyen Thuy Tram



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### evidence for policy

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### Policy implications of NCCR North-South research

- Although there is clear evidence to show the link between wastewater use and health risks, more research is needed to assess the actual risk for particular groups such as farmers, consumers, and children. Such research would enable interventions to be focused better.
- It is important to treat wastewater to reduce the risks to health. Authorities need to monitor water quality from industrial zones regularly and to strengthen the regulation of wastewater treatment in factories and industrial zones that discharge wastewater into the sewerage system or the environment. Contamination levels of pathogens and chemicals from wastewater need to be monitored.
- Urban wastewater treatment plants should be built in order to eliminate chemicals and pathogens prior to discharge. Aquatic food production systems can significantly reduce the level of pathogens in wastewater while reusing the nutrients it carries. Natural wastewater treatment systems should be recognised by policymakers and urban planners and should be sustainable with the rapid urbanisation in Vietnam.
- Information, education, and communication activities are needed to change farmers' unsafe behaviours (such as not using protective clothing) and to promote hygiene practices by both farmers and consumers (such as washing hands after work with clean water and soap, and cooking vegetables and fish well).

### Further reading

- **Do-Thu N, Morel A, Nguyen-Viet H, Pham-Duc P, Nishida K, Kootattep T.** 2011. Assessing nutrient fluxes in a Vietnamese rural area despite limited and highly uncertain data. *Resources, Conservation and Recycling* 55(9-10):849-56.
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**WHO.** 2006. Guidelines for safe use of wastewater, excreta and greywater. Vols. 2-4. World Health Organization. Geneva.  
[http://www.who.int/water\\_sanitation\\_health/wastewater/gsuww/en/index.html](http://www.who.int/water_sanitation_health/wastewater/gsuww/en/index.html)

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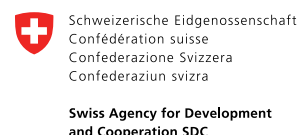
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