Effects of agriculture and vector-borne diseases

Topic F: Water use in agriculture

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Credit individual slides:

World Health Organization
F.23
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Eighty percent of freshwater use is for agriculture.

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Most agrarian societies in areas where water is a limiting factor have developed water lifting devices to irrigate their crops and boost production. In this way they can meet their needs in terms of food and fibres. Even the most primitive devices reveal human ingenuity. The introduction of animal power greatly enhanced the capacity. Motorized pumping requires major investments and operational costs. In areas where multi-purpose dams generate electricity, this source of energy may provide a cheap option for water lifting.

In terms of human health, water lifting devices preventing direct human-water contact in areas endemic for schistosomiasis are to be preferred, as are devices which remain without stagnant water when not in use, to avoid mosquito breeding. In those parts of the world where stagnant pools favour mosquito breeding, methods causing such pools are not appropriate. Where draught animal are introduced to lift water, they may become an important ecological factor in relation to human health - this is dealt with further in section H. Mechanized systems don’t carry any direct vector-borne disease risks.

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Canaletti are elevated, concrete water conveyance systems. They are constructed of prefabricated units and are particularly functional in areas where extensive irrigation is introduced in highly permeable soils. Examples can be found in Morocco and in Turkey. Little water is lost to seepage in canaletti systems, and as a result mosquito vector breeding in relation to the irrigation system as such as minimum. Schistosomiasis risks are associated with ancillary hydraulic structures such as weirs.

Unfortunately, a good system of afferent canals does not necessarily imply proper drainage. In the 1970s, an outbreak of malaria in Turkey’s Çukurova Plain near Adana was caused by insufficient drainage of canaletti-fed cotton production schemes.

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Flood irrigation involves a very low level of sophistication in water management and carries important vector-borne disease risks, both in terms of human-water contact and in terms of creating favourable mosquito breeding sites.

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Water contact is inevitable when farmers install their siphons for furrow irrigation, but flow rates are usually high and hence schistosomiasis risks low. Furrow irrigation can give rise to unequal water distribution in the fields, with pool formation in some parts. An improved version, called surge irrigation, applies water intermittently, to allow from a gradual adaptation of soil permeability.

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Sprinkler, central pivot and drip irrigation are sophisticated forms of water delivery with little or no health risks. They require, however, substantial investments and operate at a scale beyond the average smallholder schemes. Nevertheless, in some countries, such as Zimbabwe, smallholder cooperatives have successfully embarked on sprinkler schemes. Drip irrigation is almost exclusively used for very high value crops.

Well maintained canals and turnouts sustain a healthy environment. Local research in Pakistan on canal-lining technology aims to further improve the situation.

Lack of infrastructure and poor irrigation management create environmental degradation with health risks that need no further comment. Devolution of water management responsibilities, and operation and maintenance of irrigation schemes to farmer groups is expected to improve the situation.

While collaboration between different ministries to address the environmental and health issues pertaining to inadequate irrigation water management is often hard to achieve at the central level, it is at the district level, where all sectors meet, that efforts should be made to obtain maximum benefits from rehabilitation projects. Health workers and agricultural extension workers should be mobilized to educate communities about the health risks of situations such as depicted in these slides.

Waterlogging is a problem in both industrialized and non-industrialized countries. In many irrigated areas it becomes a permanent problem. A high water table in hot climates also leads to salination, to which annually substantial amounts of cultivable land are lost.

The Blue Nile Health Project in Sudan proposed an integrated approach with drinking water supply and sanitation, environmental modification and manipulation (including the periodic removal of aquatic weeds from canals), health education and the strengthening of health services.
From the air, the dramatic impact of irrigation development in an arid area is clearly visible. The adverse health implications of such an ecological change may take some time to develop. Schemes are seldom abandoned because of acute health problems, even though the impact of malaria may be fierce. Ill-health does, however, contribute to maintaining the cycle of poverty and underdevelopment, and as a result the social structure of a newly developed irrigation scheme may drastically change. Resettled smallholder farmers may be unable to produce sufficiently to pay back their debts and sell their land to speculators from urban centres. It is difficult to determine to what extent ill-health contributes to such developments.

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The growth of aquatic weeds, such as this tank with dense *Salvinia* growth in Sri Lanka, presents specific problems in South and South East Asia, where mosquitoes of the genus Mansonia breed. The larvae of these mosquitoes obtain their oxygen from the air roots of aquatic weeds. They transmit brugian filariasis. Weed control is the obvious solution, but may be hard to achieve on a sufficiently large scale once weeds have invaded a reservoir. In smaller reservoirs, community participation secures permanent weed clearing, provided there is an economic benefit (using the weeds as fodder or fertilizer, for example). Biological control methods have also been tested, using insect pests of weeds, or introducing fish or mammals that consume aquatic weeds.

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Tanks or reservoirs for drinking water supply and for cattle are often close enough to human settlements to pose a vector-borne disease risk.

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The supply of safe drinking water is crucial to community health in rural areas. Shallow or improved wells, or hand pumps all contribute to this, although the former carry more health risks in terms of contamination. For most rural communities, the daily collection of water for domestic use is a permanent chore, usually burdening the women. In many irrigation schemes, wells are not an option, because groundwater is brackish and polluted by residues of agrochemicals. Boreholes to greater depths may be a solution to this problem. While access to water in irrigation canals is obviously better than no water at all, and while it has been shown that water quantity rather than water quality is the crucial issue in diseases related to poor sanitation, the installation of a safe drinking water supply as part of irrigation development remains a very valid investment.

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The cultivation of fish in irrigated rice fields is an attractive option to reduce mosquito vector populations in this particular agro-ecosystem. In Indonesia, the method is referred to as *mina-padi*. There are a number of preconditions. In order to obtain farmers’ participation, the fish has to be marketable or at least attractive for consumption by farmers themselves. The fish species selected has to belong to the group of so-called larvivorous fish, i.e. fish that eat insect larvae. Great care has to be taken with chemical inputs into these rice fields, to avoid wiping out the fish stock. And during the periods when rice fields are drained, there should be refuges (ponds or a plot reserved for this purpose) to maintain a minimum fish population.